December 22, 2008

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of: U.S. DEPARTMENT OF ENERGY (High Level Waste Repository)	Docket No. 63-001

CLARK COUNTY, NEVADA'S REQUEST FOR HEARING, PETITION TO INTERVENE AND FILING OF CONTENTIONS

Pursuant to 10 CFR § 2.309 and the notice published by the Nuclear Regulatory Commission ("NRC" or "Commission") at 73 Fed. Reg. 63,029 (October 22, 2008), Clark County, Nevada ("Clark County") hereby submits this Request for Hearing, Petition to Intervene and Filing of Contentions in the captioned proceeding. This proceeding involves the Department of Energy's ("the DOE's") application before the Nuclear Regulatory Commission ("the NRC") for a license to construct a high level radioactive waste and spent fuel repository at Yucca Mountain in Nye County, Nevada.

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ATTACHMENTS

Attachment 1: Affidavit of Dr. Alvin Mushkatel

Attachment 2: Affidavit of Dr. Sheila Conway

Attachment 3: Affidavit of Eugene I. Smith

Attachment 4: Affidavit of Dennis Bley

Attachment 5: NTS, "Stockpile Stewardship Program" (2004)

Attachment 6: "National Security and Nuclear Weapons: Maintaining Deterrence in the 21st Century" (July 2008)

Attachment 7: United States Government Accountability Office, "Nuclear Waste: Action Needed to Improve Accountability and Management of DOE's Major Clean-up Projects," GAO-08-1081 (September 2008)

Attachment 8: United States Department of Energy, Office of Inspector General, "Memorandum for the Secretary" (April 23, 2001)

Attachment 9: "Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States." Committee on Transportation of Radioactive Waste. National Research Council of the National Academies: The National Academies Press; Washington, D.C. (2006)

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Attachment 11: UER, "Sustainable Indicators Report." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Jan 2001)

Attachment 12: UER, "Community visioning report on behalf of the town of Indian Springs, Clark County, Nevada." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division (Feb 2004)

Attachment 13: UER, "Clark County Monitoring Program: Community Survey." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division (Apr 2008)

Attachment 14: UER, "Clark County Monitoring Program: Community Survey." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division (May 2007)

Attachment 15: UER, "Clark County Monitoring Program: Community Survey." Prepare for the Clark County Department of Comprehensive Planning Nuclear Waste Division (Feb 2006)

Attachment 16: UER, "Clark County Monitoring Program: Community Survey." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division (Jul 2006)

Attachment 17: Schweer, K. UNLV Center for Business and Economic Research (2001)

I. INTRODUCTION

A. Name of Party

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C. Standing

Clark County enjoys standing as a matter of right as an Affected Unit of Local Government,[1] and is therefore deemed to have demonstrated the standing elements of 10 CFR 2.309 of the Commission's regulations.[2] Clark County herein submits 15 contentions, thus satisfying the requirements of § 2.309(d)(2).[3]

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[1] The Secretary of Energy granted Clark County's request for AULG status on April 21, 1988.

[2] 73 Fed. Reg. 63,029 at 63030 (October 22, 2008) ("Any AULG seeking party status shall be considered a party to this proceeding, provided that it files at least one admissible contention in accordance with 10 CFR 2.309. An AULG need not address the standing requirements under that section.")

[3] In the event Presiding Officer does not admit any of Clark County's contentions, Clark County respectfully requests leave to participate as an Interested Governmental Participant pursuant to 10 CFR Section 2.315(c). The County's representative for the purposes of said hearing is the Clark County Commission. The County will identify those contentions on which it wishes to participate within the time frame established by the Commission.

D. Joint Contentions

Clark County is not submitting any joint contentions at this time. However, Clark County will review the contentions raised by other parties and will evaluate whether to pursue any such contentions jointly.

II. CONTENTIONS

Clark County's contentions are as follows:

1. A brief statement of the contention

Treatment of uncertainty in the Safety Analysis Report[4] ("SAR") is neither complete, integrated, nor unbiased. Three important sources of uncertainty that impact the SAR results – data assumptions, model assumptions, and methods assumptions – appear in the SAR primarily as assumptions, screening "analyses," and claims of conservatism, presented without associated technical bases. As a result, risk could be much higher than calculated. The DOE's evaluation of risk is therefore unreliable and fails to comply with the safety requirements of 10 CFR Part 63.

2. A summary of the basis for the contention

There are many potential sources for uncertainty in the results of the SAR. Some sources are due to aleatory effects (randomness) and some are epistemic (the result of lack of knowledge). Both kinds of uncertainty must be treated properly if the results of the analysis are to be meaningful. The pre-closure safety analysis (Chapter 1 of the SAR, LSN# DEN001592183) omits justifications for many assumptions, screening analyses, and claims of conservatism, rendering the results of the analysis unreliable. Examples of improper treatment of uncertainty are provided in Section 5 of this contention, but the

[4] United States Department of Energy, Office of Civilian Radioactive Waste Management, "Yucca Mountain Repository License Application Safety Analysis Report," DOE/RW-0573, Rev.0, June 2008. LSN# DEN001592183.

omissions are so pervasive that the examples provided are merely illustrative of a systemic problem.

The Total System Performance Assessment[5] ("TSPA"), which is the basis of the post-closure safety analysis in Chapter 2 of the SAR, (LSN# DEN001592183) is a detailed and complex analysis that links together physical, chemical, and biological models of processes that could lead to eventual release and transport of radionuclides from buried wastes. The complexity and long time period of the analysis require that the uncertainties be clearly identified and more carefully executed and documented than is the case in DOE's SAR.

There are three primary ways in which these sources of uncertainty enter the SAR:

1) Data assumptions – the database, including accuracy of the data and its applicability to the problem at hand, as well as the results of expert elicitation; both should properly reflect the kind and extent of uncertainty in the data.
2) Model assumptions – models are abstractions of reality; the results of the model may diverge from reality because of randomness or because the models do not reflect the true state of the world over time. Alternative models should be considered in the uncertainty treatment.
3) Methods assumptions – methods used for developing expressions of uncertainty and for combining models and uncertainties must be theoretically correct and must be implemented appropriately.

As required by 10 CFR Part 63 paragraphs 10, 21, 101, 114, and 311, uncertainty must be thoroughly addressed qualitatively and quantitatively if the results are to be adequate to support licensing of the facility. Qualitatively, the analysis must properly characterize all

[5] Sandia National Laboratories, "Total System Performance Assessment Model/Analysis for the License Application Volume III." Prepared for: U.S. Department of Energy Office of Civilian Radioactive Waste Management Office of Repository Development, LSN# DEN001579005.

uncertainties in all aspects of the model. Quantitatively, the uncertainty must be treated in an integrated and justified way; dependencies must be addressed.

As outlined above, assumptions at every stage of the analysis are directly related to the uncertainty in the results. There are many ways in which the assumptions used in developing the analysis could be upset. Examples of the types of assumptions that often cause problems that Clark County has identified in the SAR are detailed in Section 5 of this contention, and include:

- Conservative assumptions in one area, which, while seemingly benign, can mask real problems elsewhere;
- Assumed applicability of data -- lack of thorough review of databases for accuracy, applicability, and their representation of uncertainty can introduce untracked errors;
- Errors and damage that might occur during pre-closure activities can negate assumptions about placement and condition of casks that are essential to the TSPA; and,
- Failure to evaluate alternative assumptions can mask key problems and does not allow complete treatment of uncertainty.

When uncertainty is broad, extreme high values control the mean; i.e., if some low probability, high consequence possibilities are screened, then the mean value will underestimate the risk.

3. A demonstration that the contention is within the scope of the hearing

This contention raises an issue whether the DOE has complied with the NRC requirements applicable to Yucca Mountain, and falls within the scope of the hearing as specified in section II, paragraph 1 of the Notice of Hearing. Incomplete or poorly integrated treatment of the uncertainty associated with the analysis of the Yucca

Mountain Repository, including errors in the assumptions and screening activities in the TSPA and SAR, could mean that the risk is greater than reported in the TSPA and SAR. 10 CFR Part 63 is risk-informed and performance-based. Risk of health effects to the reasonably maximally exposed individual is the basis for its performance objectives.[6] The issue of inadequate treatment of uncertainty thus lies within the scope of the proceeding, as described in the NRC's Notice of Hearing.[7]

4. A demonstration that the contention is material to the findings the NRC must make to license Yucca Mountain

Under 10 CFR § 63.31(a)(2), the NRC may authorize construction of the repository at Yucca Mountain if it determines that there is a reasonable assurance or expectation the materials described in the Application can be disposed of without unreasonable risk to the health and safety of the public. In reaching this determination, 10 CFR § 63.31(a)(3) requires that the site and design comply with Subpart E, Technical Criteria, of 10 CFR Part 63, and that the DOE's proposed operating procedures to protect health and to minimize danger to life or property are adequate.

Subpart E, 10 CFR § 63.111 requires a pre-closure safety analysis that meets the requirements of § 63.112: That the safety analysis include the technical basis for either inclusion or exclusion of specific, naturally occurring and human-induced hazards in the safety analysis; an analysis of the performance of the structures, systems, and

[6] USNRC, "Yucca Mountain Review Plan: Final Report" NUREG-1804, Rev. 2, Washington, July 2003. LSN# DEN001414954.

[7] 73 Fed. Reg. 63029 (October 22, 2008).

components to identify those that are important to safety and their performance; and evaluation of possible mitigation measures.

Subpart E, 10 CFR §§ 63.113 and 63.114 requires a post-closure performance assessment that accounts for uncertainties and variabilities in parameter values, accounts for alternative conceptual models, and provides the technical bases for all aspects of the analysis. Furthermore, 10 CFR § 63.10 requires that the information required by the Commission's regulations is complete and accurate in all material respects. Failure to properly consider uncertainty or to document the basis for its treatment can render this information materially incomplete and inaccurate.

5. A concise statement of facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

10 CFR Part 63 establishes risk-informed and performance-based requirements for licensing that underscore the importance of proper and complete consideration of uncertainty. The report of the Independent Performance Assessment Review ("IPAR") Panel[8] states that:

> An overarching requirement is that the uncertainties associated with the future performance of the repository be understood and quantified. . .This focus on uncertainties is driven by the complexities of the processes that may lead to the release of radionuclides from the repository and the extremely long periods of time over which the repository performance is to be evaluated (10,000 and 1,000,000 years after closure).

[8] George E. Apostolakis, G.E., Chair, R.G. Ballinger, C. Fairhurst, M. Gascoyne, L. Smith, and C.G. Whipple, "Report of the Independent Performance Assessment Review (IPAR) Panel" prepared for Sandia National Laboratories Yucca Mountain Project, March 21, 2008. LSN #: DEN001598189.

Therefore, treatment of uncertainty must be held to a high standard. In an analysis that seeks to quantify all events with probabilities greater than 1 chance in 10,000 over 10,000 years (1×10^{-8} per year), uncertainty is the key to an adequate analysis; it must be thoroughly treated, allowing for the wide variety of possible futures as well as uncertainty in underlying assumptions, models, and data. This is a very high standard, and the DOE's failure to adhere to it renders the long-term results of the TSPA and SAR unreliable, which in turn fails to provide reasonable assurances of safety.

Clark County's review of the SAR and existing formal reviews identify a number of cases where the treatment of uncertainty, including the assumptions and screening criteria, are not fully justified.[9] Supporting facts for this contention are detailed in the Table below, and include a number of examples that demonstrate a systematic problem in the Application--a problem that is pervasive in the documentation and appears to be widespread in the actual analysis.

The difficulty in evaluating the DOE's assessment of risk can be demonstrated as follows: The risk assessment is made of many analyses that interact. One such analysis is the human reliability analysis ("HRA") in the pre-closure PRA. Only five pages of the entire SAR are devoted to an explanation of the HRA (SAR Section 1.7.2.5 pp 1.7-35 to 1.7-39). These pages simply describe the approach and outline two examples. There is no roadmap showing how details of the HRA are incorporated. The reference list of SAR 1.7.6 General References simply points to 14 Bechtel SAIC Company technical reports on specific aspects of the pre-closure PRA event sequence analysis. To unravel the

[9] Clark County considered whether each of the examples provided in the Table included in this contention should be entered as separate contentions and concluded that the examples illustrate a systematic problem.

analysis one must turn to one of the reports referenced in the DOE's summary; for example, the report on reliability and event sequence analysis of the canister receipt and closure facility.[10] However, in that report the DOE simply provides another brief summary and reference to another document. Following the thread to Appendix E of that document, there is a 231 page HRA report. Similar lengthy reports are associated with each aspect of the facility. There are literally thousands of pages of detailed HRA and that is only one element of the complete analysis. Thus, although this is one example, it is representative of the difficulty in unraveling the analysis throughout the Application.

The NWTRB, TSPA IPAR review, and the NRC staff apparently agree that the issue identified in this contention is relevant, legitimate and pervasive:

- In a letter to the DOE, the NWTRB observed[11] that in the area of integration of waste acceptance/transportation with repository operations, "DOE has analyzed a single scenario based on certain optimistic assumptions" and noted that different conditions than assumed could be very important. (An example of not examining alternative models.) They also suggested that there seems to be a lack of understanding of the surface facility design's technical basis and that integrated throughput analysis that considers possible off-normal events is necessary to understand uncertainty in actual performance. (Once again, lack of complete treatment of uncertainty can provide misleading or incomplete results.) Finally, they pointed out that the feasibility of unique components and operations has not been confirmed, which also portends uncertainty in actual operations. (An example of failure to consider uncertainties in model assumptions and data applicability.)
- IPAR's identification of the unsupported "conservative" treatment of SCC allowed an inappropriate screening of alternative corrosion models.
- NRC staff have identified, in a growing number of Requests for Additional Information ("RAIs"), issues where DOE has not provided a technical basis for assumptions in the analyses, alteration of methods for calculations, claims of conservatism, and apparently the use of inappropriate data. Several of these are

[10] "Design Calculation or Analysis: Canister Receipt and Closure Facility Reliability and Event Sequence Categorization Analysis," BSC 2008b. LSN#DEN001578955.

[11] Garrick, B.J, letter from US Nuclear Waste Technical Review Board to E.F. Sproat, DOE, November 5, 2008. LSN # NEN000000780.

actually included in the Table below, e.g., items in the table associated with DOE's aircraft crash analysis (1.1.2, 1.1.3, 1.1.4, 1.2.1, 1.3.2, 2.1.7, 3.2.1, and 3.2.2) are also raised in NRC RAIs[12].

The NRC staff have already begun the process of identifying specific cases in their RAIs, and from the examples cited above, there appear to be an unprecedented number of them. The NRC staff should not be forced to identify, essentially by audit, such a pervasive list of items lacking adequate analysis and documentation -- these are items that the DOE was obliged under Part 63 to present in the Application. In fact, the DOE failed to provide these items. The licensing process would be better served by directing the DOE to provide at the outset all requisite documentation and technical bases for its data, modeling, and methods assumptions which are required by 10 CFR Part 63. An analogy from quality assurance ("QA") makes the point. In *Quality is Free*[13], Philip Crosby notes that the purpose of QA is to confirm that quality is present in a product. QA cannot build quality into a defective product. The place to do it right is in the design (when it is "free" if the design process is working properly), not in the review.

Finally, the lack of transparency in the DOE's SAR makes it more difficult for interested parties to perform independent verifications and analyses, particularly when resources are thin. It is not possible for Clark County to identify all of the DOE's cases of insufficient treatment of uncertainty due to the limited resources and time to submit this contention, and because they are spread throughout the thousands of pages of

[12] USNRC, Request for Additional Information (RAI), Volume 3—Postclosure Chapter 2.2.1.2.2—Event Probabilities (Department of Energy's Safety Analysis Report Sections 2.3.6.6, 2.3.6.8.4, 2.2.2.3) LSN# NRC000029843.

[13] Crosby, P.E., *Quality is Free*, New American Library, Penguin Putnam, New York 1980.

supporting documents to the Application. However, the examples are sufficient to demonstrate the DOE's errors.

CLK-SAFETY-001, Table 1. POTENTIAL IMPACTS OF UNCERTAINTY [aleatory (randomness) & epistemic (incomplete knowledge)]

UNCERTAINTY Due to:	PROBLEMS Found in SAR[14]		
	Unjustified Assumptions	**Inappropriate Screening "Analyses"**	**Unsubstantiated Claims of Conservatism**
Data Assumptions	Generic Implications: Data collected from events that differ from the case being modeled and extrapolating data to new conditions can lead to underestimating risk. 1.1.1 Database Not Reviewed. IPAR pointed out that they had not reviewed the database used in the analysis. It is not clear that any thorough outside review of the databases used in the SAR was performed.	Generic Implications: Improper screening of data can badly distort analysis results. Censored data requires a physical and statistical basis. Both can lead to overly optimistic results. 1.2.1 Screening of Real Events. Analysis supporting SAR 1.6.3.4.1 in BSC 20007c LSN#DN2002406192 censors data for mishaps with unknown distances to crash and unknown glide ratios, without developing a suitable uncertainty approach to account for them.	Generic Implications: Even if conservative under considered condition, it is often used under other conditions elsewhere in the model, where it can underestimate risks. 1.3.1 IPAR review on SCC and Wedging. The 2008 IPAR review[15] identified a case where an improper assumption of conservatism hid important information that could mean the results do not reflect a real, physical form of corrosion. "Conservative" modeling of stress corrosion cracking (SCC) led to the assumption that SCC would occur and therefore an alternative mechanism, oxide wedging, would not have a chance to occur and need not be modeled (i.e., it could be screened from further consideration). IPAR pointed out that SCC is almost certainly precluded by conditions at the burial vault. Therefore it is improper to

[14] Numbering for reference only; represents items in each cell of the 3x3 matrix:

	Unjustified Assumptions	Inappropriate Screening	Unsubstantiated Conservatism
Data Assumptions	1.1.x	1.2.x	1.3.x
Model Assumptions	2.1.x	2.2.x	2.3.x
Methods Assumptions	3.1.x	3.2.x	3.3.x

[15] George E. Apostolakis, G.E., Chair, R.G. Ballinger, C. Fairhurst, M. Gascoyne, L. Smith, and C.G. Whipple, "Report of the Independent Performance Assessment Review (IPAR) Panel" prepared for Sandia National Laboratories Yucca Mountain Project, March 21, 2008. LSN # DEN001598189.

CLK-SAFETY-001, Table 1. POTENTIAL IMPACTS OF UNCERTAINTY [aleatory (randomness) & epistemic (incomplete knowledge)]

UNCERTAINTY Due to:	PROBLEMS Found in SAR[14]		
	Unjustified Assumptions	**Inappropriate Screening "Analyses"**	**Unsubstantiated Claims of Conservatism**
			screen out oxide wedging. The impact on risk must be determined.
Data Assumptions	1.1.2 Incomplete Basis. Analysis supporting SAR 1.6.3.4.1 (LSN # DEN001592183) in BSC 2007c (LSN#DN2002406192) cites unavailable references for an assumed exponential decay factor in the Solomon model for flights through the Beatty Corridor and fails to justify truncated range for the factor. Does data or a model support this? 1.1.3 Incomplete Basis. Analysis supporting SAR 1.6.3.4.1 (LSN # DEN001592183) in BSC 2007c (LSN#DN2002406192) provides no basis for the claim that all midair collisions and flights into terrain occur during maneuvering. No uncertainty analysis is provided. Does data or a model support this? 1.1.4 Incomplete Basis. Analysis supporting SAR 1.6.3.4.1 (LSN # DEN001592183) in BSC 2007c (LSN#DN2002406192) uses its Table 10 to support the analysis of aircraft crash, without providing a technical basis for the table. Does data or a model support this?		1.3.2 No Supporting Data. Analysis supporting SAR 1.6.3.4.1 (LSN # DEN001592183) in BSC 2007c (LSN#DN2002406192) claims that it is conservative to assume that overflights of the restricted area occur at an altitude of 14,000 feet, without providing the technical basis analysis.

CLK-SAFETY-001, Table 1. POTENTIAL IMPACTS OF UNCERTAINTY [aleatory (randomness) & epistemic (incomplete knowledge)]

UNCERTAINTY Due to:	PROBLEMS Found in SAR[14]		
	Unjustified Assumptions	**Inappropriate Screening "Analyses"**	**Unsubstantiated Claims of Conservatism**
Model Assumptions	Generic Implications: Wrong model can completely miss important phenomena that govern a physical process, potentially underestimating risk. Using one model, when epistemic uncertainty requires weighting the results from several possible models can underestimate risk.	Generic Implications: Screening of models ignores the possibility of other models being appropriate under specific conditions, which can have high risk significance	Generic Implications: The most common misuse of conservatism is in cases where an assumption that is conservative under one condition can be overly optimistic in another. Failing to consider other conditions can grossly underestimate risk. "Conservatively" assuming one mechanism occurs can mask other important mechanisms. Some claims are not conservatisms at all, but simply crude estimates of possible uncertainty; e.g., attempting to account for possible future growth.
	2.1.1 No Deliquesance. The DOE analysis assumed deliquesance would not occur. While IPAR agreed that later work made this assumption likely true, the NWTRB disagreed very strongly[16]. Furthermore, nitrate concentration is important on its own, but takes on a much greater importance if the issue of corrosion by deliquescent salts is not rejected. If one accepts the possibility of localized corrosion by deliquescent salts the importance of the drip shields is greatly diminished, as there is no need for the shields to fail before localized corrosion can be initiated. Nitrate ion concentration in the dust and or the water influences the rate of	2.2.1 See 1.3.1 IPAR review on SCC and Wedging. Wedging effectively screened from analysis.	2.3.1 See 1.3.1 IPAR review on SCC and Wedging. Claim that assuming SCC is conservative, essentially masked other effects.

[16] Minutes of the May 29, 2008 NWTRB meeting. LSN #: NEN000000714.

CLK-SAFETY-001, Table 1. POTENTIAL IMPACTS OF UNCERTAINTY [aleatory (randomness) & epistemic (incomplete knowledge)]

UNCERTAINTY Due to:	PROBLEMS Found in SAR[14]		
	Unjustified Assumptions	**Inappropriate Screening "Analyses"**	**Unsubstantiated Claims of Conservatism**
	corrosion, as the nitrate ion acts as a corrosion inhibiter. Uncertainty in the amount of nitrate present therefore adds to the overall uncertainty in localized corrosion. DOE under Section 6.3.5.2 of the TSPA states that "The temperature, pH, chloride-ion concentration, and nitrate-ion concentrations in aqueous solutions on the WP outer surface are the primary factors that determine the potential for initiating localized corrosion." In the TSPA-LA Model, only crown seepage water chemistry has the potential to fail WPs due to localized corrosion (SNL 2007 [DIRS 181267], Section 7.1.5). This stand-alone analysis is documented in Section 6.3.5.2. The temperature, pH, chloride-ion concentration, and nitrate-ion concentration in aqueous solutions on the WP outer surface are the primary factors that determine the potential for initiating localized corrosion. DOE continues to take credit for the inhibitive effects of nitrate ion concentration even though it has been known for same time that the nitrate ion concentration is decreased when exposed to elevated temperatures (Goldschmitt Conference Cologne, Germany and presentation to the NWTRB, January 2008). This would have a direct effect on the initiation of localized corrosion and makes the issue of deliquescent salt		

CLK-SAFETY-001, Table 1. POTENTIAL IMPACTS OF UNCERTAINTY [aleatory (randomness) & epistemic (incomplete knowledge)]

UNCERTAINTY Due to:	PROBLEMS Found in SAR[14]		
	Unjustified Assumptions	**Inappropriate Screening "Analyses"**	**Unsubstantiated Claims of Conservatism**
	mixtures that much more important. The possibility that corrosive salt mixtures can cause early waste package failures would be damaging to the project, but a sound basis is required to support the DOE position and an objective treatment of the uncertainty is needed.		
Model Assumptions	2.1.2 Infiltration. DOE has paid for the development of two models for the amount of infiltration to be considered in the calculation for the amount of water that would fall on the drip shields. The original one developed by the USGS (INFIL) was rejected due to some inappropriate e-mails sent by some of the investigators working on the model. (There was never any proof that the data were compromised.) The next model, developed by SADIA (MASSIF) calculated higher infiltration rates than the one developed by the USGS. DOE then used temperature data and Chlorine mass balance data to degrade the results from SANDIA to match those that were originally developed by the USGS. The report does not explain the data and model uncertainty accounted for in the final numbers for infiltration or provide a technical basis abandoning the original analysis and adjusting the second.	2.2.2 Canister Damage. Surface damage to the disposal canisters can occur during handling and the final disposal operation, which could affect corrosion. We have not found that the effects of stresses introduced during handling mishaps are considered in the SAR. It would seem that the introduction of stresses from accidental collisions would add to the uncertainty and have a possible effect on localized corrosion. All of the corrosion investigations we know about have used carefully prepared specimens.	2.3.2 Limited Range of Conservatism. SAR p. 2.1-40 states that naval SNF are conservatively modeled as commercial SNF, without demonstrating that this is always conservative.

CLK-SAFETY-001, Table 1. POTENTIAL IMPACTS OF UNCERTAINTY [aleatory (randomness) & epistemic (incomplete knowledge)]

UNCERTAINTY Due to:	PROBLEMS Found in SAR[14]		
	Unjustified Assumptions	**Inappropriate Screening "Analyses"**	**Unsubstantiated Claims of Conservatism**
	2.1.3 Operational Uncertainties. NWTRB points out additionally that other uncertainties in integrated systems operations (which affect the duration of the preclosure period and risk during that time) are not considered by DOE, when it modeled a single scenario with additional optimistic assumptions, such as an optimal waste receipt schedule and the absence of any upset conditions. They pointed out that at least the following scenarios should be addressed: • Less than 90 percent of CSNF arriving in TADs. • Seasonal variation in the receipt rate of CSNF. • Delay in receipt of DOE waste, or DOE waste not received in the order needed. • Less than 75 percent availability of the surface facilities. • Occurrence of upset conditions in any part of the system. • Provisions DOE is making to ship spent fuel that is in storage casks at utility sites. • Provisions DOE is making regarding dual-purpose spent fuel storage	2.2.3 TAD 90/10 Split. DOE has analyzed a single scenario assuming that the repository will receive 90 percent of commercial spent nuclear fuel in transportation-aging-disposal (TAD) canisters. Many factors not included in the analysis and its uncertainty could dramatically change the ratio of TAD to other shipments, e.g., delay in construction or inability to construct the Nevada rail line, delay in deployment of TADs beyond 2013, the number of utility sites without usable short-line rail connection to a main rail line, and other ways in which DOE may have underestimated shipments not in TADs[17]. If this figure is not attained then worker exposure at the surface facilities is likely to be increased.	2.3.3 Limited Range of Conservatism. SAR 2.4.2.2.1 claims that drip shield and waste package early failure mechanisms are represented by conservative assumptions, without demonstrating that specific assumptions are always conservative.

[17] For example, while the DOE's base case is 307 non-TAD containers, EPRI estimates 2,375 non-TAD containers by 2020. "Occupational Risk Consequences of the Department of Energy's Approach to Repository Design, Performance Assessment and Operation in the Yucca Mountain License Application," EPRI 1018058, Aug. 2008. LSN #: NEN000000720.

CLK-SAFETY-001, Table 1. POTENTIAL IMPACTS OF UNCERTAINTY [aleatory (randomness) & epistemic (incomplete knowledge)]

UNCERTAINTY Due to:	PROBLEMS Found in SAR[14]		
	Unjustified Assumptions	**Inappropriate Screening "Analyses"**	**Unsubstantiated Claims of Conservatism**
	systems to avoid repackaging into TADs at Yucca Mountain.		
Model Assumptions	2.1.4 Incomplete Basis. Same as 1.1.2. Analysis supporting SAR 1.6.3.4.1 (LSN # DEN001592183) in BSC 2007c (LSN#DN2002406192) cites unavailable references for an assumed exponential decay factor in the Solomon model for flights through the Beatty Corridor and fails to justify truncated range for the factor. Does data or a model support this?	2.2.4 Operational Uncertainties. Same as 2.1.3. Single point assumptions effectively screens out other real possibilities.	
	2.1.5 Incomplete Basis. Same as 1.1.3. Analysis supporting SAR 1.6.3.4.1 (LSN # DEN001592183) in BSC 2007c (LSN#DN2002406192) provides no basis for the claim that all midair collisions and flights into terrain occur during maneuvering. No uncertainty analysis is provided. Does data or a model support this?	2.2.5 Incomplete Basis. Same as 1.1.3 and 2.1.5. Lack of consideration of other cases of midair collisions effectively screens out other possibilities.	
	2.1.6 Incomplete Basis. Same as 1.1.4. Analysis supporting SAR 1.6.3.4.1 (LSN # DEN001592183) in BSC 2007c (LSN#DN2002406192) uses its Table 10 to support the analysis of aircraft crash, without providing a technical basis for the table. Does data or a model support this?		
	2.1.7 Incomplete Basis. Analysis supporting SAR 1.6.3.4.1 in BSC 20007c LSN#DN2002406192 uses an		

CLK-SAFETY-001, Table 1. POTENTIAL IMPACTS OF UNCERTAINTY [aleatory (randomness) & epistemic (incomplete knowledge)]

UNCERTAINTY Due to:	PROBLEMS Found in SAR[14]		
	Unjustified Assumptions	**Inappropriate Screening "Analyses"**	**Unsubstantiated Claims of Conservatism**
Model Assumptions	unsupported factor to reduce the chance of crash affecting the facility. NRC RAI #7 points out that glide could occur in any direction. 2.1.8 Conflicting Assumptions. Analysis supporting SAR 1.6.3.4.1 in BSC 20007c LSN#DN2002406192 appears to have conflicting assumptions with respect to independence of crashes and over-flights on number of sorties flown.		
Methods Assumptions	Generic Implications: Assumptions about the appropriate method to apply can artificially restrict the range of epistemic uncertainty, as can ignoring steps in a method that search for sources of uncertainty. This effect is all in one direction: risk will be underestimated. 3.1.1 No Uncertainty in FEP Analysis. Appendix I of TSPA Vol. 3 (LSN#: DEN001579005), which lists all of the FEPs and the reasons for their inclusion or rejection, does not consider uncertainties as promised in Chapter 1 of the SAR.	Generic Implications: Use of frequency cut-offs in logic models (e.g., event trees and fault trees) can hide important common mode failures and, in complex models, can ignore the fact that the sum of a large number of low frequency events can far exceed the cut-off frequency. Without checks, such as summing the frequencies of all cut-off scenarios, the degree of underestimating risk is unknown. 3.2.1 Optimistic Assumption. Analysis supporting SAR 1.6.3.4.1 (LSN # DEN001592183) in BSC 2007c (LSN#DN2002406192) assumes that, for flights outside the restricted zone, pilots will eject outside the zone. There is no allowance for entry into the zone as the pilot tries to control or uncertainty and no convincing technical basis.	Generic Implications: Analyses that use "conservative" screening values treat multiple events as independent; when they are dependent risk can be grossly underestimated 3.3.1. Same as 3.1.5. SAR 1.7.2.5 human reliability analysis does not discuss dependencies among human failure events that are incorporated into fault trees. Failure to identify and model dependencies among events can substantially underestimate risk from human-involved event sequences. Review of referenced detailed analysis reports, e.g., LSN# DEN001578955, do not appear to address this issue. When HRA screening values are used, as described in SAR 1.7.2.5 Step 4, this is an especially important point.

CLK-SAFETY-001, Table 1. POTENTIAL IMPACTS OF UNCERTAINTY [aleatory (randomness) & epistemic (incomplete knowledge)]

UNCERTAINTY Due to:	PROBLEMS Found in SAR[14]		
	Unjustified Assumptions	**Inappropriate Screening "Analyses"**	**Unsubstantiated Claims of Conservatism**
Methods Assumptions	3.1.2 Long Term Corrosion Testing. DOE has used saturated zone water to conduct most, if not all of their long term corrosion testing. Experiments at LLNL have found that there is a distinct difference in the composition of unsaturated zone water that is found at the level of the repository and the water that is found in the saturated zone. The effect of the uncertainty in the water composition on the long-term corrosion effects of the drip shield and the waste package is not included in the analysis. This also interfaces with the effects of the condition of the surface of the as emplaced waste packages. 3.1.3 Infiltration. See 2.1.2 New method had to be "adjusted" to fit problem. 3.1.4 Canister Testing. The environment and handling of the disposal canisters is a critical issue when looking at long-term performance. All of the testing that has been done on coupons has been performed on carefully prepared surfaces. The effects of surface damage due to mishandling and the subsequent stress fields and their effect on corrosion have not been considered in the uncertainty analysis. This is one area where stress corrosion could be an important issue.	3.2.2 No Technical Basis Provided. SAR 1.6.3.4.1 (LSN # DEN001592183) in BSC 2007c (LSN#DN2002406192) lacks justification for the technical basis for screening analysis of ordnance.	

CLK-SAFETY-001, Table 1. POTENTIAL IMPACTS OF UNCERTAINTY [aleatory (randomness) & epistemic (incomplete knowledge)]

UNCERTAINTY Due to:	PROBLEMS Found in SAR[14]		
	Unjustified Assumptions	**Inappropriate Screening "Analyses"**	**Unsubstantiated Claims of Conservatism**
Methods Assumptions	3.1.5 SAR 1.7.2.5 human reliability analysis does not discuss dependencies among human failure events that are incorporated into fault trees. Failure to identify and model dependencies among events can substantially underestimate risk from human-involved event sequences. Review of referenced detailed analysis reports, e.g., LSN#DEN001578955, do not appear to address this issue.		

6. Sufficient information to show a genuine dispute with the DOE, along with specific references to the portions of the Application being controverted

The DOE's transmittal letter alleges that the DOE prepared the Application in accordance with the requirements set forth in 10 CFR § 63.21, "Content of Application," and the guidance contained in the "Yucca Mountain Review Plan," NUREG- 1804, Revision 2, Final Report (July 2003) ("YMRP").[18] However, the Application does not comply with §§ 63.111 and 63.113, which also require compliance with § 63.114, as explained in section 5 of this contention.

Failure to adequately address uncertainty means that risks to the public and workers could exceed those calculated in the pre-closure safety analysis, an issue that will directly affect the health and safety of workers, many of whom are residents of Clark County. Likewise the post-closure TSPA could underestimate the consequences and likelihood of post-closure radioactive releases, which could have devastating economic and social impacts on Clark County and its residents.

[18] Letter from E.F. Sproat, III, Director, Office of Civilian Radioactive Waste Management, DOE, to M.F. Weber, Director Office of Nuclear Material Safety and Safeguards, USNRC, "Yucca Mountain Repository License Application (LA) for Construction Authorization," dated June 3, 2008.

1. A brief statement of the contention

The SAR improperly failed to analyze the risks to the proposed repository at Yucca Mountain associated with ground-to-ground missile testing at the Nevada Test Site ("the NTS").

2. A summary of the basis for the contention

SAR Section 1.6.3.4.1 improperly eliminated analysis of ground-to-ground missile testing at the NTS. The SAR indicates that the DOE decided to exclude such analysis solely because of a single email from M.J. Childers to R. Morissette, dated January 31, 2002, in which Childers states that "no future launches are anticipated in the near future" (BSC 2007b, as referred to in SAR Section 1.6.5 General References, LSN# DEN000328287). Although the last Army Tactical Missile System launch was conducted at Area 26 of the NTS in June of 2000, in June of 2006, the Defense Threat Reduction Agency ("DTRA") proposed a non-nuclear 700-ton fuel oil and fertilizer bomb test, known as Divine Strake, to gather data about penetrating underground bunkers that produce and store weapons of mass destruction. While the DTRA withdrew its proposal in February 2007, it is clear that future ground-to-ground missile testing at the NTS is reasonable and likely within the entire pre-closure period. Stated differently, there are no final and definitive assurances or evidence that ground-to-ground missile testing at the NTS will never again be conducted and never again pose a threat during the pre- or post-closure periods.

The DOE incorrectly extrapolates a conclusion that no missile testing will be conducted during the pre-closure phase of the proposed facility based solely on a single email that says that "no future launches are anticipated in the near future…" This is blatantly in error, and ignores, among other things, the DTRA's 2006 and 2007 proposed Divine Strake test. More recently, Secretary of Defense Robert Gates indicated the need to resume nuclear testing to ensure the safety of the United States nuclear stockpile.

Noteworthy is the fact that the DOE does not here contend that ground-to-ground missile testing would not pose a threat to the facility. Rather, the DOE failed to even analyze the threat by presuming, with virtually no basis, that missile testing will never again be conducted and that therefore there is no threat or risk to study.

3. A demonstration that the contention is within the scope of the hearing

This contention raises an issue whether the DOE has complied with the NRC requirements applicable to Yucca Mountain, and falls within the scope of the hearing as specified in the Notice of Hearing. The potential effects of a strike by an errant missile raise self-evident safety issues.

4. A demonstration that the contention is material to the findings the NRC must make to license Yucca Mountain

10 CFR § 63.31(a)(2) states that the NRC may authorize issuance of a construction authorization for Yucca Mountain if it determines that there is reasonable assurance or expectation that the materials described in the Application can be disposed of without unreasonable risk to the health and safety of the public. In reaching this determination, 10 CFR § 63.31(a)(3) requires that the Application satisfy the

requirements in 10 CFR § 63.21, and the site and design to comply with Subpart E of 10 CFR Part 63. 10 CFR § 63.21(c)(9) requires an assessment to determine the degree to which features, events and processes of the site that are expected to materially affect compliance with § 63.113 have been characterized, and paragraph (c)(15) requires adequate support for the models used to provide the information required in paragraph (c)(9). 10 CFR § 63.114 (part of Subpart E) requires a performance assessment to evaluate the ability of the engineered barrier system along with natural barriers to meet the performance objectives of § 63.113, and this performance assessment must include consideration of the probability and consequences of events and processes identified under 10 CFR § 63.21(c)(9). This contention alleges non-compliance with these regulatory provisions and therefore raises a material issue within the scope of the licensing proceeding.

The DOE recognizes that air operations pose risks requiring analysis -- section 1.6.3.4.1 of the SAR reviews Aircraft Impact and risks associated with potential aircraft hazards. The DOE nevertheless failed to address such hazards in connection with ground-to-ground missile testing, and this failure was based merely on one email that does not even itself state that there will be no more missile testing in the area.

5. Concise statement of the facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

The NTS was established in 1951 to provide a proving ground for the nation's burgeoning nuclear weapons program. Between 1951 and 1962, over one hundred atmospheric nuclear tests were conducted at the NTS. Subsequently, the United States Government initiated a moratorium on above-ground testing, moving all testing

underground. In 1992, President Clinton commenced a moratorium on all nuclear testing, while directing the United States Department of Energy National Nuclear Security Administration ("USDOE/NNSA") to maintain the safety and reliability over the United States' nuclear arsenal. In recent years, the DOE has developed a number of programs to meet these objectives. Subcritical experiments are conducted to obtain information about nuclear weapons in the absence of nuclear testing. As part of the moratorium, President Clinton charged the USDOE/NNSA with the responsibility "to maintain a test readiness program in the event that resumption of nuclear weapons testing becomes necessary."[19]

In July of 2007, the Secretary of Energy, Secretary of Defense, and Secretary of State issued a joint statement titled "National Security and Nuclear Weapons: Maintaining Deterrence in the 21st Century." The statement notes that delays in modernizing the nuclear weapons stockpile raise "the prospect of having to return to underground nuclear testing to certify existing weapons."[20]

Further evidence is the sole email upon which the SAR relies for its failure to study missile testing. That email poses the question: "Is ground-to-ground missile testing still ongoing at the NTS?" That email then answers that question, stating in part that "no future launches are anticipated in the near future…." (LSN# DEN000328287). The statement does not say that missile testing has been permanently terminated or prohibited, nor that the NTS has been or will be shut down. Rather, it merely states that no launches are "anticipated" in the "near future." The DOE takes an unwarranted and unsupported leap of faith in using that vague and somewhat qualified phrase to be

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[19] See NTS, "Stockpile Stewardship Program," Attachment 5 hereto.

[20] Attachment 6 hereto.

tantamount to evidence that missile testing will not remain active and that study of its risks and affects on its proposed facility is unnecessary.

6. Sufficient information to show a genuine dispute with the DOE, along with specific references to the portions of the Application being controverted

This contention and the evidence summarized herein establish a genuine dispute with the DOE's claims that the proposed facility will not endanger the public health and safety, and its claim that it need not analyze the risks associated with constructing such a facility in the proximity of a missile testing site. One informal email does not alone provide sufficient basis for presuming that missile testing will not occur during the pre-closure period, even if the email actually said such a thing. Here, the sole basis for the DOE's assumption that there will be no more missile testing is an email that does not even state there will be no more testing, only that no launches are "anticipated" in the "near future."

1. A brief statement of the contention

SAR Subsections 2.2.2.2.3.1, 2.3.11.2.2 and related sections, which indicate the probability of igneous activity disrupting a repository drift, underestimates that probability, likely by two or more orders of magnitude, because it assumed incorrectly that melting to produce basaltic magma will be in the shallow lithospheric mantle and not in the deeper asthenosphere.

2. A summary of the basis for the contention

The DOE's assumption that the source of the basaltic magma is in the shallow lithosphere infers a dwindling supply of new basalt and little chance of future events. The DOE does not account for published data and interpretations that indicate that melting to produce basalt is in the asthenosphere and not in the lithosphere. Melting of asthenosphere implies a more active igneous future for Yucca Mountain and a higher probability of igneous activity disrupting repository drifts.

3. A demonstration that the contention is within the scope of the hearing

This contention raises an issue whether the DOE has complied with the NRC requirements applicable to Yucca Mountain, and falls within the scope of the hearing as specified in section II, paragraph 1 of the Notice of Hearing.

4. A demonstration that the contention is material to the findings the NRC must make to license Yucca Mountain

10 CFR § 63.31(a)(2) states that the NRC may authorize issuance of a construction authorization for Yucca Mountain if it determines that there is reasonable assurance or expectation the materials described in the Application can be disposed of without unreasonable risk to the health and safety of the public. In reaching this determination, 10 CFR § 63.31(a)(3) requires that the Application satisfy the requirements in 10 CFR § 63.21, and the site and design to comply with Subpart E of 10 CFR Part 63. 10 CFR § 63.21(c)(9) requires an assessment to determine the degree to which features, events and processes of the site that are expected to materially affect compliance with § 63.113 have been characterized, and paragraph (c)(15) requires adequate support for the models used to provide the information required in paragraph (c)(9). 10 CFR § 63.114 (part of Subpart E) requires a performance assessment to be completed to evaluate the ability of the engineered barrier system along with natural barriers to meet the performance objectives of § 63.113, and this performance assessment must include consideration of the probability and consequences of events and processes identified under 10 CFR § 63.21(c)(9). This contention alleges non-compliance with these regulatory provisions and therefore raises a material issue within the scope of the licensing proceeding.

5. A concise statement of the facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

The SAR discusses the assumption that basaltic magmas were generated in the shallow lithospheric mantle mainly in Subsections 2.2.2.2.3.1 and 2.3.11.2.2. In SAR

Subsection 2.2.2.2.3.1 at 2.2-97, and repeated in Subsection 2.3.11.2.2.5 at 2.3.11-23, it states:

> The PVHA experts generally view volcanism in the Yucca Mountain region as a regional-scale phenomenon resulting from melting processes in the upper lithospheric mantle. . . .
>
> Analyses of magmatic processes in the Yucca Mountain region generally indicate that the magnitude of mantle melting has significantly decreased since the middle Miocene. The analyses also suggest that melts in the past few million years were generated within relatively cool ancient lithospheric mantle (compared to asthenospheric mantle), which is a factor that may contribute to the relatively small and decreasing volume of basaltic melt erupted in the Yucca Mountain region since the Miocene period (BSC 2004k, Section (6.3.3)).

These statements are contrary to published research that clearly explains that melting of lithospheric mantle to produce basalt late in an extensional event, as the DOE assumes, is difficult if not impossible. In several papers it was demonstrated that lithospheric mantle does not melt to produce basalt around Yucca Mountain.[21] Peridotite of the mantle lithosphere is too cold to melt. The only components that could melt are those with a lower solidus temperature than dry peridotite. These components were probably totally melted during previous events that produced the voluminous rhyolite ash-flow tuffs that now form Yucca Mountain.

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[21] See "Episodic Volcanism and Hot Mantle: Implications for Volcanic Hazard Studies at the Proposed Nuclear Waste Repository at Yucca Mountain, Nevada," (04/01/2002), LSN# NEV000002718 at 4-10; Smith, E.I. and Keenan, D.L. "Yucca Mountain Could Face Greater Volcanic Threat,", EOS, TRANSACTIONS OF THE AMERICAN GEOPHYSICAL UNION, Vol. 86, No. 35 (2005) at 317; and Smith, E.I., Conrad, C.P., Plank, T., Tibbetts, A., Keenan, D., "Testing Models for Basaltic Volcanism: Implications for Yucca Mountain, Nevada," AMERICAN NUCLEAR SOCIETY, PROCEEDINGS OF THE 12TH INTERNATIONAL HIGH-LEVEL RADIOACTIVE WASTE MANAGEMENT CONFERENCE (2008) at 157-164.

Calculations of melting depths indicate that basalts at Yucca Mountain were produced by melting at depths of 115-133 km within the asthenospheric mantle.[22] These calculations were done assuming a dry mantle, but even if water contents of 1-4.5 wt.% are considered, melting is still deep in the asthenosphere.[23] Depth of melting calculations used the Fe-Na[24] and Silica geobarometers[25] and were calibrated using basalt samples from the Big Pine Volcanic Field in eastern California. In the Big Pine example, both geobarometers placed melting in a zone of low-velocity (high temperature) asthenosphere at depths of 50 to 75 km.[26] These calculations place high confidence in melting depths calculated using both the Fe-Na and Silicon barometers and strongly indicate that melting to produce basaltic magma is in the deep asthenosphere and not in the lithospheric mantle.

Prior to ten million years ago, shallow melting did occur in the Great Basin area, including in the Crater Flat Volcanic Field immediately adjacent to Yucca Mountain. Harry, D.L., Sawyer, D.S., and Leeman, W.P.,[27] and Harry, D.L. and Leeman, W.P.,[28] examined the effects of extension in the Great Basin in relation to melting of lithospheric mantle (shallow melting). They determined that certain components commonly found in

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[22] See "A Mantle Melting Profile Across the Basin and Range, SW USA," (01/22/2002), LSN# NEV000004173 at ECV 5- 1 – ECV 5-21; NEV000002718 at 4-10; Smith, et al. (2008) at 157-164; and "Yucca Mountain Project Terry Plank Lamont-Doherty Earth Observatory Report on Activities from January 26, 2008 - February 26, 2008," (02/26/2008), LSN# NEV000005026 at 1-4.

[23] See NEV000005026 at 1-4; and Smith, et al. (2008) at 157-164.

[24] See NEV000004173 at ECV 5-1 through ECV 5- 21.

[25] See NEV000005026 at 1-4.

[26] See NEV000005026 at 1-4.

[27] "The Mechanics of Continental Extension in Western North America: Implications for the Magmatic and Structural Evolution of the Great Basin," EARTH AND PLANETARY SCIENCE LETTERS, Vol. 117 (1993) at 59-71.

[28] "Partial Melting of Melt Metasomatized Subcontinental Mantle and the Magma Source Potential of the Lower Lithosphere," JOURNAL OF GEOPHYSICAL RESEARCH, Vol. 100 (1995) at 10255-10269.

the lithospheric mantle (mafic veins or water rich minerals) could be melted during the initial phases of extension. This would explain the widespread silica-rich volcanism during Oligocene time (33.7-23.8 million years ago). These studies also determined that the early melting events exhausted the lower melting temperature components in the lithospheric mantle. Consequently, any volcanism after about 10 million years ago could not be from this source and must be from asthenospheric (deep) melting. Gallagher, K., and Hawkesworth, C.J., did a regional study of the Great Basin to determine the effects of the presence of water on subsurface melting.[29] Their study concluded that lithospheric mantle will only melt with the presence of water (0.5 wt. %) and that lithospheric mantle will melt before asthenospheric mantle. They also concluded that the early voluminous volcanic activity likely depleted the water component that made lithospheric mantle melting possible. In addition, the large scale extension throughout the region caused thinning of the lithospheric mantle. This allowed upwelling of the asthenospheric mantle. The resulting decrease in pressure in the asthenosphere created conditions favorable to melting of this material. The depletion of water and resulting thinning of the lithosphere due to extension led the authors to the conclusion that little if any lithospheric mantle melting could have occurred more recent than 10 million years ago. Deep melting models are a more accurate way to explain the volcanism that occurred during the last 10 million years.

The DOE uses an isotopic data set that shows that basalt near Crater Flat has higher Strontium ("Sr") and lower neodymium ("Nd") isotopic signatures than expected

[29] Gallagher, K., and Hawkesworth, C.J., "Dehydration Melting and the Generation of Continental Flood Basalts," NATURE, Vol. 358 (1992) at 57-59; See also Hawkesworth, C., Turner, S., Gallagher, K., Bradshaw, T., and Rogers, N., "Calc-Alkaline Magmatism, Lithospheric Thinning, and Extension in the Basis and Range," JOURNAL OF GEOPHYSICAL RESEARCH, Vol. 100 (1995) at 10271-10286.

for asthenospheric sources. They use this data to support the shallow melting model. This isotopic data does not establish shallow melting because it is not inconsistent with deep melting. Lee, C.T., Yin, Q., Rudnick, R.L., Chesley, H.T., and Jacobsen, S.B., "Osmium Isotopic Evidence for Mesozoic Removal of Lithospheric Mantle Beneath the Sierra Nevada, California," SCIENCE, Vol. 289 (2000) at 1912-1916 suggested that basalts with the isotopic signatures found in the Crater Flat volcanic field could be related to contamination either by lithospheric mantle or by subducted crustal material. A later study determined that Archean (>2.7 billion years old) crust may be present beneath the southern Great Basin area.[30] Melting of Archean crust or contamination from it could account for the isotopic signatures.

In recent years there have been numerous studies based on a variety of data, all of which point to the presence of deep melting in the Yucca Mountain area and throughout most of the central Great Basin.[31] Indeed, the DOE originally suggested melting of the asthenosphere to produce basalt. Perry and Crowe noticed steep rare earth element patterns, which indicate deep melting.[32] Furthermore, several geophysical studies all support hotter than normal mantle at depth in the central Nevada region and thus deep melting.[33]

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[30] See Lee, C.T., Yin, Q., Rudnick, R.L., and Jacobson, S.B., "Preservation of Ancient and Fertile Lithospheric Mantle Beneath the Western United States," NATURE, Vol. 111 (2001) at 69-73.

[31] Reported in Wang, et al. (2002) at 10 ECV 5-1 through ECV 5-21, and Smith, et al. (2008) at 157-164.

[32] "Geochemical Evidence for Waning Magmatism and Polycyclic Volcanism at Crater Flat, Nevada," (04/20/1992), LSN# DN2001597248 at 1-10,

[33] See Van der Lee, S. and Nolet, G., "Upper Mantle S Velocity Structure of North America," JOURNAL OF GEOPHYSICAL RESEARCH, Vol. 102 (1997) at 22815-22838; Savage, M.K., Lowry, A.R., Ribe, N.M., and Smith, R.B., "Dynamic Elevation of the Cordillera, Western United States," JOURNAL OF GEOPHYSICAL RESEARCH, Vol. 105 (2000) at 23371-23390; Sheehan, A.F., "Seismic Anisotrophy and Mantle Flow from the Great Basin to the Great Plains, Western United States," JOURNAL OF GEOPHYSICAL RESEARCH, Vol. 105S (2000) at 13725- 13734.

6. Sufficient information to show a genuine dispute with the DOE, along with specific references to the portions of the Application being controverted

This contention challenges SAR Subsections 2.2.2.2.3.1 and 2.3.11.2.2 and related sections, which state a major assumption that the DOE uses to derive its probability estimate for igneous events, namely that melting to produce basalt near Yucca Mountain will occur in the shallow lithospheric mantle. If the DOE were to make the correct assumption, SAR Subsections 2.2.2.2.3.1, 2.3.11.2.2 and related sections, which indicate that the probability of igneous activity disrupting a repository drift is 1.7 x 10-8 events/year, would underestimate that probability, likely by two or more orders of magnitude. The supporting reasons are given in Section 5 above and may be summarized as follows: The DOE's assumption that the source of the basaltic magma is in the shallow lithosphere infers a dwindling supply of new basalt and little chance of future events. The DOE does not account for published data and interpretations that indicate that melting to produce basalt is in the asthenosphere and not in the lithosphere. Melting of asthenosphere implies a more active igneous future for Yucca Mountain and a higher probability of igneous activity disrupting repository drifts.

1. A brief statement of the contention

SAR Subsections 2.2.2.2.3.1, 2.3.11.2.2 and related sections, which indicate the probability of igneous activity disrupting a repository drift, underestimates that probability, likely by two or more orders of magnitude, because the DOE ignored the entire 11 million year span of basaltic volcanism near Yucca Mountain.

2. A brief summary of the basis for the contention

Despite the 11 million year long record of basaltic volcanism near Yucca Mountain, the DOE considered only the past 5 million years of the geologic record and concluded both that volcanism near Yucca Mountain is decreasing in volume and number of events and that future eruptions are very unlikely. These observations fail to consider the entire history of volcanism as recorded in surface outcrops and core from borings about Yucca Mountain that define two super-episodes of volcanism. Rather than a single slowly dying igneous system, volcanism near Yucca Mountain occurred in *two* periods over the last 11 million years, each lasting 3 to 4 million years. Both super-episodes show chemical signs of a waning volcanic system toward the end of their history. The implication is that volcanism near Yucca Mountain does not record a single waning system but represents igneous activity that periodically starts and stops. Two periods of volcanic activity have already occurred at Yucca Mountain. Consideration of the complete record would support the proposition that the eruption at Lathrop Wells 78,000 years ago represents the beginning of a third super-episode.

3. A demonstration that the contention is within the scope of the hearing

This contention raises the issue of whether the DOE has complied with the NRC requirements applicable to Yucca Mountain, and falls within the scope of the hearing as specified in section II, paragraph 1 of the Notice of Hearing.

4. A demonstration that the contention is material to the findings the NRC must make to license Yucca Mountain

10 CFR § 63.31(a)(2) states that the NRC may authorize issuance of a construction authorization for Yucca Mountain if it determines that there is reasonable assurance or expectation the materials described in the Application can be disposed of without unreasonable risk to the health and safety of the public. In reaching this determination, 10 CFR § 63.31(a)(3) requires the Application to satisfy the requirements in 10 CFR § 63.21, and the site and design to comply with Subpart E of 10 CFR Part 63. 10 CFR § 63.21(c)(9) requires an assessment to determine the degree to which features, events and processes of the site that are expected to materially affect compliance with § 63.113 have been characterized, and paragraph (c)(15) requires adequate support for the models used to provide the information required in paragraph (c)(9). 10 CFR § 63.114 (part of Subpart E) requires a performance assessment to be completed to evaluate the ability of the engineered barrier system along with natural barriers to meet the performance objectives of § 63.113, and this performance assessment must include consideration of the probability and consequences of events and processes identified under 10 CFR § 63.21(c)(9). This contention alleges non-compliance with these regulatory provisions and therefore raises a material issue within the scope of the licensing proceeding.

5. A concise statement of the facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

SAR Subsection 2.3.11.2.1.1 at 2.3.11-16, states:

> [T]he decreased eruptive volume through time, together with geochemical evidence (Perry, Crowe, et al., 1998, P. 4-8) indicates that the intensity of mantle-melting processes beneath the Yucca Mountain region has waned over the past 5 million years (Perry and Crowe 1992, p. 2359; Perry, Crowe, et al., 1998, p- 4-1). Considered in terms of total eruption volume, recurrence intervals, and duration of volcanism during the past 5 million years, the Crater Flat volcanic field, adjacent on the west to Yucca Mountain, is one of the least active basaltic volcanic fields in the western United States (BSC 2004a Section 6.1.1.1).

Although volcanism over the past 11 million years is mentioned in SAR Subsection 2.3.11.2.1.1 at 2.3.11-16, ("Small-volume basaltic volcanism has continued into the Quaternary as part of the general decline in eruption volume over the past 11 million years in the Yucca Mountain region Perry, Crowe, et al., 1998, Chapter 2)"), emphasis is placed only on activity over the past 5 million years. The study of the entire 11 million year old record tells a different story.

Yucca Mountain core provides a unique opportunity to view the volcanic history of the Yucca Mountain area back to 11 million years ago. Unlike previous work that limits analysis to post-5 million-year basalts,[34] the core provides a record from the beginning of basalt volcanism 11 million years ago. Rather than a pattern of decreasing volume and waning activity, the record from the core combined with data from surface exposures reveals two episodes of activity separated by a several million year period of relative quiet. Within each episode, volcanism occurred periodically with individual peaks of activity lasting from 500,000 to 1 million years. Each super-episode shows

[34] See Valentine, G.A. and Perry, F.V., "Tectonically Controlled, Time- Predictable Basaltic Volcanism from a Lithospheric Source," (2007), LSN# DN2002382703 at 201-216.

chemical evidence of early larger degrees of melt formation followed by a pattern of waning volcanism as revealed by higher Ce/Yb and increasing epsilon Nd values. An important question is whether the Lathrop Wells cone (ca. 78,000 years old) represents the start of a new episode of eruption or whether it represents the end of an episode. Valentine and Perry suggest that it is the lone event in its episode because of the amount of time passed since the event without another eruption.[35] However, because there was a 1 million year period of little to no activity following the eruption of the Crater Flat cones and nearly 2.5 million years of quiet between the eruption of basalt in SE Crater Flat and the 1 million year ago Crater Flat volcanoes, there is a strong possibility that the Lathrop Wells cone may herald the beginning of a new eruptive episode.

6. Sufficient information to show a genuine dispute with the DOE, along with specific references to the portions of the Application being controverted

This contention challenges SAR Subsection 2.3.11.2.1, which advocates that the volcanic system near Yucca Mountain represents a simple system that began with high volume activity and is now in a waning period. The implication of using the entire 11 million year record is that another super-episode of activity could occur, that the Lathrop Wells eruption may represent the beginning of a third super-episode, and that SAR Subsections 2.2.2.2.3.1, 2.3.11.2.2 and related sections, which indicate that the probability of igneous activity disrupting a repository drift is 1.7×10^{-8} events/year, underestimates that probability, likely by two or more orders of magnitude. Supporting reasons are given in Section 5 above and may be summarized as follows: Despite the 11 million year long record of basaltic volcanism near Yucca Mountain, the DOE uses the

[35] LSN# DN2002382703 at 214.

past 5 million years of the record to conclude both that volcanism near Yucca Mountain is decreasing in volume and number of events and that future eruptions are very unlikely. These observations do not consider the entire history of volcanism as recorded in surface outcrops and core from borings about Yucca Mountain that define two super-episodes of volcanism. Rather than a single slowly dying igneous system, volcanism near Yucca Mountain occurred in two periods over the last 11 million years, each lasting 3 to 4 million years. Both super-episodes show chemical signs of a waning volcanic system toward the end of their history. The implication is that volcanism near Yucca Mountain does not record a single waning system but represents igneous activity that periodically starts and stops. Two periods of volcanic activity have already occurred at Yucca Mountain. Consideration of the complete record would support the proposition that the eruption at Lathrop Wells at 78,000 years ago represents the beginning of a third super-episode.

1. A brief statement of the contention

SAR Subsections 2.2.2.2.3.1, 2.3.11.2.2 and related sections, which indicate the probability of igneous activity disrupting a repository drift, underestimate that probability, likely by two or more orders of magnitude, because the DOE focuses improperly on upper crustal extension patterns to explain volcano location and the timing of volcanic events.

2. A summary of the basis for the contention

Understanding the process of volcanism is critical for calculating the probability of future events. The DOE clearly lacks this understanding and instead focuses on upper crustal extension patterns to explain volcano location and the timing of volcanic events. Contrary to the DOE's arguments, the primary controls of the location of a volcanic field lie in the earth's mantle. The location of thermal anomalies, the topography at the base of the lithosphere, and patterns of mantle flow together control the location and timing of volcanism. Upper crustal structures and extension rates may be important for controlling the location of volcanoes whose magma resides for periods of time in the crust, but have less of an effect for basaltic magmas that rise quickly from their mantle source without stalling for long periods of time in the crust.

3. A demonstration that the contention is within the scope of the hearing

This contention raises an issue whether the DOE has complied with the NRC requirements applicable to Yucca Mountain, and falls within the scope of the hearing as specified in section II, paragraph 1of the Notice of Hearing.

4. A demonstration that the contention is material to the findings the NRC must make to license Yucca Mountain

10 CFR § 63.31(a)(2) states that the NRC may authorize issuance of a construction authorization for Yucca Mountain if it determines that there is reasonable assurance or expectation that the materials described in the Application can be disposed of without unreasonable risk to the health and safety of the public. In reaching this determination, 10 CFR § 63.31(a)(3) requires the Application to satisfy the requirements in 10 CFR § 63.21, and the site and design to comply with Subpart E of 10 CFR Part 63. 10 CFR § 63.21(c)(9) requires an assessment to determine the degree to which features, events and processes of the site that are expected to materially affect compliance with § 63.113 have been characterized, and paragraph (c)(15) requires adequate support for the models used to provide the information required in paragraph (c)(9). 10 CFR § 63.114 (part of Subpart E) requires a performance assessment to be completed to evaluate the ability of the engineered barrier system along with natural barriers to meet the performance objectives of § 63.113, and this performance assessment must include consideration of the probability and consequences of events and processes identified under 10 CFR § 63.21(c)(9). This contention alleges non-compliance with these regulatory provisions and therefore raises a material issue within the scope of the licensing proceeding.

5. A concise statement of the facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

SAR Subsection 2.3.11.2.2.5 at 2.3.11-23 states that "[f]or regional volcanism, no single base-case conceptual model is appropriate because the underlying physical processes that control the precise timing and location of volcanic events within a particular region remain uncertain"[36] The DOE clearly does not understand the processes that control volcanism. Nevertheless, the DOE in SAR Subsections 2.2.2.2.3.1 at 2.2-96 through 98, 2.3.11.2.1.1 at 2.3.11-15 through 18, and 2.3.11.2.2.5 at 2.3.11-23 through 24 and related sections calls upon crustal structures and extension rates to explain the location and timing of volcanism. There is, however, considerable literature that contradicts this conclusion for basaltic volcanism and suggests that thermal anomalies, mantle flow patterns, and topography at the base of the lithosphere explain the location and timing of volcanism. The DOE ignores the role of the mantle and published geochemical and geophysical work that suggests that deep melting of asthenospheric mantle caused by upwelling associated with low-viscosity "pockets" and a step in lithospheric thickness explain the occurrence of volcanic activity near Yucca Mountain, and the episodic nature of volcanism.[37] Smith and Keenan (2005) at 317, and Smith, et al. (2008) at 157-164 cite articles that document a sharp change in the thickness of the

[36] BSC 2004a, Section 6.3.1.6.

[37] See Smith, E.I. and Keenan, D.L., "Yucca Mountain Could Face Greater Volcanic Threat," EOS, TRANSACTIONS OF THE AMERICAN GEOPHYSICAL UNION, Vol. 86, No. 35 (2005) at 317; and Smith, E.I., Conrad, C.P., Plank, T., Tibbetts, A., and Keenan, D., "Testing Models for Basaltic Volcanism: Implications for Yucca Mountain, Nevada," AMERICAN NUCLEAR SOCIETY, PROCEEDINGS OF THE 12TH INTERNATIONAL HIGH-LEVEL RADIOACTIVE WASTE MANAGEMENT CONFERENCE (2008) at 157-164). Smith, et al., "Episodic Volcanism and Hot Mantle: Implications for Volcanic Hazard Studies at the Proposed Nuclear Waste Repository at Yucca Mountain, Nevada," (04/01/2002), LSN# NEV000002718 at 4-10.

North American plate producing a west facing buttress or keel in the lithosphere. Formed by Paleozoic and Mesozoic orogeny, a lithospheric boundary (the western margin of the North American Craton) and lithospheric thinning beneath the Sierra Nevada, the buttress lies either to the west or east of the Crater Flat area. Mantle flow caused by the buttress results in eddies or rolls that stir up areas of mantle close to the melting temperature. Mantle caught in upward flow melts due to pressure reduction and produces basaltic magma. A mantle eddy travels with the lithosphere and results in long-lived, geographically restricted magmatism. The shape and spacing of areas of hot mantle control the geographic extent and episodic nature of volcanism.

Numerical modeling of mantle flow provides information about the geometry of areas of upwelling, the effects of lithospheric steps, and the role of "hot-pockets" of mantle.[38] Mantle flow beneath North America is thought to be dominated by the descent of a region of dense mantle rocks that lie about 1500 km below the Midwest and Eastern portion of the continent. This region, known as the "Farallon Slab" can be imaged seismically and was produced by subduction of dense oceanic lithosphere in the mantle interior off the western coast of North America prior to about 30 million years ago. Several studies have shown that descent of this slab produces a broad region of mantle down welling beneath the eastern portion of North America that depresses the Earth's surface and influences the westward motion of the North American plate. Numerical models of global-scale mantle flow confirm this flow pattern. Within the asthenosphere beneath the southwestern United States, these models show eastward directed flow

[38] See Smith and Keenan (2005) at 317, and Smith, et al. (2008) at 157-164.

toward the region of down welling. The rate of eastward flow at the base of the asthenosphere is up to 3 cm/yr.

Because the overlying North American plate is moving westward at rates of about 2 cm/yr, the asthenosphere beneath the southwestern United States is shearing at rates of up to about 5 cm/yr. The vigorous shear flow occurring beneath the southwestern United States occurs within a region of asthenosphere that exhibits large lateral variations in material properties; these variations can be observed seismically. In particular, variations in seismic velocity observed by van der Lee and Frederiksen,[39] at about 110 km show several trends that will influence the flow field of the asthenosphere beneath the southwestern United States. First, there is a general increase in seismic velocity moving from the southwest toward the continental interior. In general, faster seismic velocities are thought to represent denser and colder material, with lithospheric rocks featuring both. Thus, the eastward increase in seismic velocity is consistent with an increase in continental thickness moving from the Basin and Range province (with lithosphere shallower than 110 km) to the stable craton of the Midwest (with lithosphere thicker than 110 km). This increase in thickness has been observed by some authors to occur as a sharp increase in lithospheric thickness beneath the Nevada region. Second, several "pockets" of low-velocity anomalies are evident within the asthenosphere of the southwestern United States at a depth of 110 km. These "pockets" are consistent with portions of the asthenosphere that are unusually low-density, and therefore presumably hotter than the surrounding asthenosphere. These low velocity "pockets" of asthenosphere have also been observed in other tomographic studies of the western

[39] See Van der Lee, S. and A. Frederiksen, "Seismic Earth: Array Analysis of Broadband Seismograms," G. Nolet and A Levander, Eds, GEOPHYSICAL MONOGRAPH SERIES, 157 (2005) at 67-80.

United States. Thus, the flow field within asthenosphere of the southwestern United States likely encounters both a sharp increase in the thickness of the cold lithosphere, as well as several "pockets" of unusually hot asthenosphere. Because the viscosity of mantle rocks is thought to vary strongly with temperature, the cold lithosphere and hot "pockets" can be thought of as high-viscosity and low-viscosity features, respectively. Both types of lateral viscosity variations may interact with the background mantle flow field to produce asthenospheric upwelling flow.

Numerical models examine how asthenospheric shear flow interacts with the lateral viscosity variations described above. To do this, Smith and Keenan, and Smith, et al. examined flow within a two-dimensional layered structure that features a high-viscosity lithosphere and a low-viscosity asthenosphere.[40] By pinning the surface lithosphere and imposing a velocity boundary condition on the base of the asthenosphere, Smith and Keenan, and Smith, et al. generated a shear flow within asthenospheric layer that models the one occurring beneath the western United States.[41] To test the effect of varying lithospheric thickness on the flow field, Smith and Keenan, and Smith, et al. imposed lateral variations in the thickness of the lithospheric layer. To do this, Smith and Keenan, and Smith, et al. inserted a "cavity" of asthenospheric fluid into the lithospheric layer.[42] Within the "cavity" region, the lithosphere is thin; outside of it the lithosphere is thicker. Shear flow in the asthenosphere generates circulation within the lithospheric "cavity." For a relatively narrow cavity, circulation develops within the cavity with an upwelling arm on the upstream side of the shear flow. For a wider cavity (or a step

[40] Smith and Keenan ((2005) at 317), and Smith, et al. ((2008) at 157-164).

[41] Id.

[42] Id.

function increase in lithospheric thickness as expected for the southwestern United States), a small "vortex" develops in the corner of the cavity, with upwelling flow along the vertical face of the lithospheric step.

For the geometries of lithospheric variations that are expected for the southwestern United States, Smith and Keenan, and Smith, et al. found that the amplitude of upwelling may be up to about 5% of the shear flow magnitude, or about 0.25 cm/yr for the 5 cm/yr of shear flow expected for the southwestern United States.[43] Lower viscosities of the upwelling fluid, which would be expected to accompany adiabatic melting, tend to amplify this effect. In a second test, Smith and Keenan, and Smith, et al. embedded a "pocket" of low-viscosity fluid within the asthenospheric layer.[44]

If this pocket is positioned immediately below the lithospheric layer, the faster velocities that the shear flow exerts on the base of the pocket generate a circulation within the low-viscosity pocket itself. Smith and Keenan, and Smith, et al. found that this circulation develops if the viscosity of the pocket is more than about 10 times less than the viscosity of the surrounding asthenosphere.[45] If the pocket viscosity is 100 times smaller than the viscosity of the asthenosphere (which would be expected if the temperature of the pocket were about 200 degrees Celsius hotter than the asthenosphere), then Smith and Keenan, and Smith, et al. found that upwelling portion of the circulatory flow may feature upward velocities that are up to ~20% of the magnitude of asthenospheric shear.[46] Thus, for the 5 cm/yr of shear flow, up to 1 cm/yr of upwelling is

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[43] Smith and Keenan (2005) at 317, and Smith, et al. (2008) at 157-164.

[44] Id.

[45] Id.

[46] Id.

predicted within a low-viscosity "pocket" of asthenosphere. The low-densities of the hot fluid should augment this upwelling.

In summary, the vigorous shear flow that occurs beneath the western US can interact with lateral viscosity variations in both the lithospheric and asthenospheric layers to produce upwelling flow. At least two viable mechanisms associated with heterogeneity in lithospheric thickness and asthenospheric viscosity produce upwelling flow at maximum rates estimated to be ~1 cm/yr. Since both types of heterogeneity are present beneath the southwestern United States, either mechanism may produce the upwelling responsible for adiabatic melting in the asthenosphere. It is also possible that both mechanisms may be interacting to produce even more vigorous upwelling flow. These observations highlight the role of the mantle in controlling the location and timing of volcanism.

6. Sufficient information to show a genuine dispute with the DOE, along with specific references to the portions of the Application being controverted

This contention takes issue with SAR Subsections 2.2.2.2.3.1, 2.3.11.2.1.1, 2.3.11.2.2.5, and related sections, which indicate wrongly that upper crustal extension is the main control of volcano location.

Geophysical and geochemical studies indicate that the mantle strongly controls the location and timing of volcanism near Yucca Mountain, and demonstrate that the DOE does not understand the process of volcanism at Yucca Mountain. A proper understanding would indicate that SAR Subsections 2.2.2.2.3.1, 2.3.11.2.2 and related sections, which indicate that the probability of igneous activity disrupting a repository drift is 1.7×10^{-8} events/year, underestimate that probability, likely by two or more orders

of magnitude. Supporting reasons are given in Section 5 above and may be summarized as follows: Understanding the process of volcanism is critical for calculating the probability of future events. The DOE clearly lacks this understanding and instead focuses on upper crustal extension patterns to explain volcano location and the timing of volcanic events. Contrary to the DOE's arguments, the primary controls of the location of a volcanic field lie in the earth's mantle. The location of thermal anomalies, the topography at the base of the lithosphere, and patterns of mantle flow together control the location and timing of volcanism. Upper crustal structures and extension rates may be important for controlling the location of volcanoes within which magma resides for periods of time in the crust, but have less of an effect for basaltic magmas that rise quickly from their mantle source without stalling for long periods of time in the crust.

CLK-SAFETY-006
THE DOE IMPROPERLY EXCLUDES THE DEATH VALLEY VOLCANIC FIELD AND GREENWATER RANGE FROM VOLCANISM CALCULATIONS

1. A brief statement of the contention

SAR Subsections 2.2.2.2.3.1, 2.3.11.2.2 and related sections, which indicate the probability of igneous activity disrupting a repository drift, underestimate that probability, likely by two or more orders of magnitude, because the DOE does not include the Death Valley volcanic field in the Greenwater Range as part of the area to be considered for hazard calculations.

2. A summary of the basis for the contention

SAR Subsections 2.2.2.2, 2.2.2.2.3.1, 2.3.11.2.1.1, and 2.3.11.2.2.5 claim that the essential characteristics of the age and location of basaltic volcanism near Yucca Mountain were fundamentally understood when the Probabilistic Volcanic Hazard Assessment ("PVHA") was completed in 1996; however, this statement ignores volcanic activity in the Greenwater Range just 20 km south of buried basalt in Amargosa Valley. Volcanic rocks in the Greenwater Range have chemical, mineralogical and age similarities to those near Yucca Mountain and clearly represent the southern extension of the field of volcanoes about Yucca Mountain. This larger volcanic field, therefore, should be considered in any calculation of repository disruption by volcanic activity.

3. A demonstration that the contention is within the scope of the hearing

This contention raises an issue whether the DOE has complied with the NRC requirements applicable to Yucca Mountain, and falls within the scope of the hearing as specified in section II, paragraph 1 of the Notice of Hearing.

4. A demonstration that the contention is material to the findings the NRC must make to license Yucca Mountain

10 CFR § 63.31(a)(2) states that the NRC may authorize issuance of a construction authorization for Yucca Mountain if it determines that there is reasonable assurance or expectation that the materials described in the Application can be disposed of without unreasonable risk to the health and safety of the public. In reaching this determination, 10 CFR § 63.31(a)(3) requires the Application to satisfy the requirements in 10 CFR § 63.21, and the site and design to comply with Subpart E of 10 CFR Part 63. 10 CFR § 63.21(c)(9) requires an assessment to determine the degree to which features, events and processes of the site that are expected to materially affect compliance with § 63.113 have been characterized, and paragraph (c)(15) requires adequate support for the models used to provide the information required in paragraph (c)(9). 10 CFR § 63.114 (part of Subpart E) requires a performance assessment to be completed to evaluate the ability of the engineered barrier system along with natural barriers to meet the performance objectives of § 63.113, and this performance assessment must include consideration of the probability and consequences of events and processes identified under 10 CFR § 63.21(c)(9). This contention alleges non-compliance with these regulatory provisions and therefore raises a material issue within the scope of the licensing proceeding.

5. A concise statement of the facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

The DOE asserts that the size and shape of the volcanic field about Yucca Mountain is well known and that the hazard estimates made by experts of the PVHA panel in 1996 are still valid. Even after considering buried volcanic centers discovered after 1996, the DOE claims in SAR Subsection 2.2.2.2 at 2.2-91 that "[t]he results also show that the effects of buried volcanic centers on the hazard estimate are modest (Section 2.3.11.2.2.6)**,** and the updated hazard estimate is robust and suitable for use in the license application and supporting TSPA calculations." However, the volcanic field about Yucca Mountain should be expanded to include the volcanoes of the Greenwater Range near Death Valley. The following evidence supports this contention.

First, volcanic activity in the Greenwater Range is associated with at least 17 volcanic centers and occurred after about 5 million years ago, contemporaneous with activity near Yucca Mountain.[47]

Second, basalt from Death Valley is very similar in major and trace element chemistry to basalt from Crater Flat. Trace-elements usually better characterize volcanic rocks than do major elements and are considered as fingerprints that are commonly used to correlate volcanic rocks from area to area. For comparison purposes, volcanic rocks are usually normalized to a standard rock like average ocean island basalt. Plots of trace elements versus normalized concentration show characteristic patterns that can be used to fingerprint and compare rocks from different volcanic fields. Comparing Death Valley and Crater Flat basalt on such a plot shows that they share a similar pattern. Especially

[47] See "Geologic Map of California -- Death Valley Sheet, with Index and Stratigraphic Nomenclature" (01/01/1974), LSN# DN2001741565.

characteristic is low Niobium ("Nb") and high rubidium ("Rb"), thorium ("Th") and uranium ("U").[48]

Third, Strontium ("Sr") and neodymium ("Nd") isotopes for Greenwater Range basalts[49] are identical to isotopic analyses from Crater Flat. Basalts in both areas have low epsilon Nd values (between -9.95 and -12), and high $^{87}Sr/^{86}Sr$ (0.7069-0.7073).[50]

Fourth, basalts in both the Crater Flat and Death Valley areas are similar in mineralogy and contain olivine as the major phenocrysts phase. Plagioclase is rare and usually occurs as microlites in the matrix.

In summary, the close geographic proximity to Crater Flat, similar age of eruption, similar mineralogy and major element chemistry, distinctive trace element patterns and distributions, and identical isotopic ratios demonstrate that Death Valley basalt in the Greenwater Range is closely associated with Yucca Mountain basalt. Hazard assessment for Yucca Mountain should consider the Greenwater volcanoes near Death Valley as a part of a field of volcanoes about Yucca Mountain. Calculations of repository disruption that ignore the Death Valley field underestimate the probability of repository disruption by igneous activity.

6. Sufficient information to show a genuine dispute with the DOE, along with specific references to the portions of the Application being controverted

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[48] See "Report of Research Activities in 2007 Prepared to Satisfy the Requirements of a Clark County Contract for Volcanic Hazard Assessment of the Proposed Nuclear Waste Repository at Yucca Mountain, Nevada" (07/08/2008), LSN# CLK000000071, at 10-13.

[49] See Asmerom, Y., Jacobsen, S.B., and Wernicke, B.P., "Variations in Magma Source Regions During Large Scale Continental Extension, Death Valley Region, Western United States," EARTH AND PLANETARY SCIENCE LETTERS, Vol. 125 (1994) at 235-254)

[50] See CLK000000071, at 10-13.

This contention takes issue with SAR Subsections 2.2.2.2, 2.2.2.2.3.1, 2.3.11.2.1.1, 2.3.11.2.2.5, which claim that the essential characteristics of the age and location of basaltic volcanism near Yucca Mountain were fundamentally understood when the PVHA was completed in 1996, ignoring volcanic activity in the Greenwater Range just 20 km south of buried basalt in Amargosa Valley. Had this activity been considered, then SAR Subsections 2.2.2.2.3.1, 2.3.11.2.2 and related sections, which indicate that the probability of igneous activity disrupting a repository drift is 1.7×10^{-8} events/year, would have had to be revised, as they underestimate that probability, likely by two or more orders of magnitude.

Supporting reasons are given in Section 5 above and may be summarized as follows: SAR Subsections 2.2.2.2, 2.2.2.2.3.1, 2.3.11.2.1.1, 2.3.11.2.2.5 claim that the essential characteristics of the age and location of basaltic volcanism near Yucca Mountain were fundamentally understood when the PVHA was completed in 1996. This statement ignores volcanic activity in the Greenwater Range just 20 km south of buried basalt in Amargosa Valley. Volcanic rocks in the Greenwater Range have chemical, mineralogical and age similarities to those near Yucca Mountain and clearly represent the southern extension of the field of volcanoes about Yucca Mountain. This larger volcanic field, therefore, should be considered in any calculation of repository disruption by volcanic activity.

1. A brief statement of the contention

DOE wrongly assumes in SAR Subsections 2.3.11 and 2.3.11.1 and related subsections that its approach to estimating the probability of igneous events for the first 10,000 years is applicable to the probability estimate for 1,000,000 years as well, because its approach fails to consider deep melting models or the entire period of volcanism from 11 million years to the present.

2. A summary of the basis for the contention

Despite the requirement to consider compliance periods greater than 10,000 years, DOE essentially ignores this requirement in the Application. Compliance periods greater than 10,000 years are only briefly mentioned and the DOE claims in SAR Subsections 2.3.11 that because of the overall volcanic stability of the region (in terms of recurrence rate, eruptive style, volume, and location relative to the repository) over the last 2 million years, this same estimated annual frequency of intersection is also valid for evaluations over time periods that extend beyond 10,000 years. This statement does not consider deep melting models or the entire period of volcanism from 11 million years ago to the present.

3. A demonstration that the contention is within the scope of the hearing

This contention raises an issue whether the DOE has complied with the NRC requirements applicable to Yucca Mountain, and falls within the scope of the hearing as specified in section II, paragraph 1 of the Notice of Hearing.

4. A demonstration that the contention is material to the findings the NRC must make to license Yucca Mountain

10 CFR § 63.31(a)(2) states that the NRC may authorize issuance of a construction authorization for Yucca Mountain if it determines that there is reasonable assurance or expectation that the materials described in the Application can be disposed of without unreasonable risk to the health and safety of the public. In reaching this determination, 10 CFR §63.31(a)(3) requires the Application to satisfy the requirements in 10 CFR § 63.21, and the site and design to comply with Subpart E of 10 CFR Part 63. 10 CFR § 63.21(c)(9) requires an assessment to determine the degree to which features, events and processes of the site that are expected to materially affect compliance with § 63.113 have been characterized, and paragraph (c)(15) requires adequate support for the models used to provide the information required in paragraph (c)(9). 10 CFR § 63.114 (part of Subpart E) requires a performance assessment to be completed to evaluate the ability of the engineered barrier system along with natural barriers to meet the performance objectives of § 63.113, and this performance assessment must include consideration of the probability and consequences of events and processes identified under 10 CFR § 63.21(c)(9). This contention alleges non-compliance with these regulatory provisions and therefore raises a material issue within the scope of the licensing proceeding.

5. A concise statement of the facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

Compliance periods as long as 1,000,000 years must be considered for volcanic probability calculations. However, DOE essentially ignores this requirement. In SAR 2.3.11 and similar sections, DOE claims that calculations for the 10,000 year period also apply for longer compliance post-closure periods, but bases this conclusion on a model of shallow melting in the lithospheric mantle and observations of volcanism over the past 5 million years. This is explained in detail in contentions CLK-SAFETY-003 and CLK-SAFETY-004. In brief, a shallow melting model infers that volcanic activity will be less vigorous in the future and that the number of future events will be small and infrequent, but work by Smith, et al., and references therein, show persuasively that deep melting models are more relevant to the Yucca Mountain area.[51] Deep melting models predict a more active volcanic future with a higher probability that volcanism will become more vigorous. The deep melting model is especially important for the 1 million year compliance period because peaks of activity recorded for the Yucca Mountain area have occurred every 1-2 million years. Therefore, a new episode of activity is likely to occur during the longer post-closure compliance period. Also, considering the entire record of volcanism from 11 million years to the present demonstrates that in the Yucca Mountain

[51] "Episodic Volcanism and Hot Mantle: Implications for Volcanic Hazard Studies at the Proposed Nuclear Waste Repository at Yucca Mountain" (04/01/2002), LSN# NEV000002718 at 4-10, Smith, E.I. and Keenan, D.L., "Yucca Mountain Could Face Greater Volcanic Threat," EOS, TRANSACTIONS OF THE AMERICAN GEOPHYSICAL UNION, Vol. 86, No. 35 (2005), at 317, Smith, E.I., Conrad, C.P., Plank, T., Tibbetts, A., and Keenan, D., "Testing Models for Basaltic Volcanism: Implications for Yucca Mountain, Nevada," AMERICAN NUCLEAR SOCIETY, PROCEEDINGS OF THE 12TH INTERNATIONAL HIGH-LEVEL RADIOACTIVE WASTE MANAGEMENT CONFERENCE (2008) at 157-164.

area two super-episodes of activity occurred each lasting 3-4 million years.[52] Moreover, when considering the last 11 million years the Yucca Mountain area is far from being volcanically stable as claimed in SAR 2.3.11. The implications of using deep melting models and the entire volcanic record are that future volcanic activity could be just as intense as past activity and that a third super-episode may occur. In fact, data and analyses are consistent with the proposition that the Lathrop Wells cone that erupted 78,000 years ago after nearly 1 million years of quiescence may represent the beginning of the third super-episode.

6. Sufficient information to show a genuine dispute with the DOE, along with specific references to the portions of the Application being controverted

This contention takes issue with SAR subsections 2.3.11 and 2.3.11.1 and related sections, which wrongly assume that the DOE's approach to estimating the probability of igneous events for the first 10,000 years is applicable to the probability estimate for 1,000,000 years as well. Had the DOE not made this assumption, and considered the factors discussed above, SAR Subsections 2.2.2.2.3.1, 2.3.11.2.2 and related sections, which indicate that the probability of igneous activity disrupting a repository drift is 1.7 x 10-8 events/year, would have had to be revised, as they underestimate that probability, likely by two or more orders of magnitude.

Supporting reasons are given in Section 5 above and may be summarized as follows: The DOE essentially ignores the legal requirements to consider compliance periods greater than 10,000 years in the Application. Compliance periods greater than

[52] See "Report of Research Activities in 2007 Prepared to Satisfy the Requirements of a Clark County Contract for Volcanic Hazard Assessment of the Proposed Nuclear Waste Repository at Yucca Mountain, Nevada" (07/08/2008), LSN# CLK000000071 at 14-17.

10,000 years are only briefly mentioned and DOE claims in SAR subsections 2.3.11 at 2.3.11-1 and 2.3.11.1 at 2.3.11-9 that because of the overall volcanic stability of the region (in terms of recurrence rate, eruptive style, volume, and location relative to the repository) over the last 2 million years, this same estimated annual frequency of intersection is also valid for evaluations over time periods that extend beyond 10,000 years. This statement does not consider deep melting models or the entire period of volcanism from 11 million years to the present.

1. A brief statement of the contention

The DOE's approach to determining the frequency of future igneous events wrongly ignores the data set obtained from core, which along with surface data provides a record of volcanism back to 11 million years that requires consideration, and wrongly relies instead on the chemistry of surface basalt erupted over the past 5 million years. This approach obscures long-term trends and provides an inaccurate prediction of future events.

2. A summary of the basis for the contention

Contrary to the claim in SAR subsection 2.3.11.2.1.1 that the chemistry of buried basalt bodies is essentially the same as basalt exposed on the surface, buried basalt contains rock types not found or that are rare at the surface. Buried basalt observed in core from borings in Crater Flat, Amargosa Valley and Jackass Flat reveal compositions not found or that are rare at the surface.

Combining core with surface data reveals a geologic history back to 11 million years characterized by two super-episodes of volcanism each independently showing major and trace element signs of a developing and then dying system that may be replicated in the future. The DOE ignores the rich data set obtained from core and relies on the chemistry of surface basalt erupted over the past 5 million years to make assumptions about the frequency of future events. This approach obscures long-term trends and provides an inaccurate prediction of future events.

3. A demonstration that the contention is within the scope of the hearing

This contention raises the issue of whether the DOE has complied with the NRC requirements applicable to Yucca Mountain, and falls within the scope of the hearing as specified in section II, paragraph 1 of the Notice of Hearing.

4. A demonstration that the contention is material to the findings the NRC must make to license Yucca Mountain

10 CFR § 63.31(a)(2) states that the NRC may authorize issuance of a construction authorization for Yucca Mountain if it determines that there is reasonable assurance or expectation that the materials described in the Application can be disposed of without unreasonable risk to the health and safety of the public. In reaching this determination, 10 CFR § 63.31(a)(3) requires the Application to satisfy the requirements in 10 CFR § 63.21, and the site and design to comply with Subpart E of 10 CFR Part 63. 10 CFR § 63.21(c)(9) requires an assessment to determine the degree to which features, events and processes of the site that are expected to materially affect compliance with § 63.113 have been characterized, and paragraph (c)(15) requires adequate support for the models used to provide the information required in paragraph (c)(9). 10 CFR § 63.114 (part of Subpart E) requires a performance assessment to be completed to evaluate the ability of the engineered barrier system along with natural barriers to meet the performance objectives of § 63.113, and this performance assessment must include consideration of the probability and consequences of events and processes identified under 10 CFR § 63.21(c)(9). This contention alleges non-compliance with these regulatory provisions and therefore raises a material issue within the scope of the licensing proceeding.

5. A concise statement of the facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

SAR Subsection 2.3.11.2.1.1 at 2.3.11-17 states: "Major-element, trace-element and isotopic data were obtained from the buried basalt bodies and indicate that all are broadly basaltic in composition with typical SiO_2 contents of 42-50%. These geochemical results are consistent with geochemical analyses of basalt samples from surface exposures near Yucca Mountain [(Perry and Bowker 1998)]." However, work by "Report of Research Activities in 2007 Prepared to Satisfy the Requirements of a Clark County Contract for Volcanic Hazard Assessment of the Proposed Nuclear Waste Repository at Yucca Mountain, Nevada," (07/08/2008), (LSN# CLK000000071) at 9-10 indicates that:

1. Basalt collected from borings in Crater Flat and the Amargosa Valley is quite different in chemistry when compared to basalt in the 1.0 million year old cinder cones in Crater Flat;

2. Basalt in core has a larger range of SiO_2 contents (43 to 52 wt. %), compared with Crater Flat (47-50 wt. %), and lower light rare-earth element concentrations; and,

3. Three rock types were observed in core but are not found at the surface:

    a. Lower silica basanites in USW-VA-1;
    b. Coarse-grained quartz diorite dikes in boring USW-VA-1 at a depth of 556.7 feet; and
    c. Basalt with 2-3 mm clinopyroxene crystals in JF-5.

Yucca Mountain core provides a unique opportunity to view the volcanic history of the Yucca Mountain area back to 11 million years ago. Unlike previous work that limits analysis to post-5 million-year basalts,[53] the core provides a record from the beginning of basalt volcanism 11 million years ago. Rather than a pattern of decreasing

[53] See "Tectonically Controlled, Time-Predictable Basaltic Volcanism From a Lithospheric Source," (02/07/2007), LSN# DN2002382703 at 1-22,

volume and waning activity, the record from the core combined with data from surface exposures reveals two episodes of activity separated by a several million year period of relative quiet. Within each episode, volcanism occurred periodically with individual peaks of activity lasting from 500,000 to 1 million years. Each super-episode shows chemical evidence of early larger degrees of melt formation followed by a pattern of waning volcanism as revealed by higher Ce/Yb and increasing epsilon Nd values. An important question is whether the Lathrop Wells cone (ca. 78,000 years old) represents the start of a new episode of eruption or whether it represents the end of an episode. Valentine and Perry[54] suggest that it is the lone event in its episode because of the amount of time passed since the event without another eruption. However, because there was a 1 million year period of little to no activity following the eruption of the Crater Flat cones and nearly 2.5 million years of quiet between the eruption of basalt in SE Crater Flat and the 1 million year old Crater Flat volcanoes, there is a strong possibility that the Lathrop Wells cone may herald the beginning of a new eruptive episode.

[54] See LSN # DN2002382703 at 19.

6. Sufficient information to show a genuine dispute with the DOE, along with specific references to the portions of the Application being controverted

This contention challenges the claim in SAR Subsection 2.3.11.2.1.1 that the chemistry of buried basalt bodies is essentially the same as basalt exposed on the surface, and the related claim that predictions of future igneous events may rely on surface data without full and careful consideration of core data. Had the DOE considered core data, which provides a record from the beginning of basalt volcanism 11 million years ago, SAR Subsections 2.2.2.2.3.1, 2.3.11.2.2 and related sections, which indicate that the probability of igneous activity disrupting a repository drift is 1.7×10^{-8} events/year, would have had to be revised as they underestimate that probability, likely by two or more orders of magnitude.

Supporting reasons are given in Section 5 above and may be summarized as follows: Contrary to the claim in SAR Subsection 2.3.11.2.1.1 that the chemistry of buried basalt bodies is essentially the same as basalt exposed on the surface, buried basalt contains rock types not found or rare at the surface. Buried basalt observed in core from borings in Crater Flat, Amargosa Valley and Jackass Flat reveal compositions not found or rare at the surface.

Combining core with surface data reveals a geologic history back to 11 million years characterized by two super-episodes of volcanism each independently showing major and trace element signs of a developing and then dying system that may be replicated in the future. The DOE ignores the rich data set obtained from core and relies on the chemistry of surface basalt erupted over the past 5 million years to make assumptions about the frequency of future events. This approach obscures long-term trends and provides an inaccurate prediction of future events.

1. A brief statement of the contention

The DOE's assessment of the frequency of igneous events does not consider appropriate alternative conceptual models that are consistent with available data and current scientific understanding, with the result that uncertainty is underestimated and not properly characterized.

2. A summary of the basis for the contention

SAR Subsection 2.2.2.3 and related subsections indicate that the Application relies on the results of the 1996 report of the Probabilistic Volcanic Hazard Assessment ("PVHA") expert panel report released in 1996 as the basis for hazard assessment. Except for new work on the tectonics of the Crater Flat area and a brief mention of buried basalt, the DOE has not updated the PVHA findings, but still bases its conclusions on this out-dated report. The PVHA panel of experts based their results on the assumption of shallow melting to produce basaltic magma.

Using this assumption results in an underestimation of the probability of repository disruption and, at the least, the alternative model whereby melting to produce basalt occurs in the asthenosphere should have been included in the total systems performance assessment.

3. A demonstration that the contention is within the scope of the hearing

This contention raises the issue of whether the DOE has complied with the NRC requirements applicable to Yucca Mountain, and falls within the scope of the hearing as specified in section II, paragraph 1 of the Notice of Hearing.

4. A demonstration that the contention is material to the findings the NRC must make to license Yucca Mountain

10 CFR § 63.31(a)(2) states that the NRC may authorize issuance of a construction authorization for Yucca Mountain if it determines that there is reasonable assurance or expectation that the materials described in the Application can be disposed of without unreasonable risk to the health and safety of the public. In reaching this determination, 10 CFR § 63.31(a)(3) requires the Application to satisfy the requirements in 10 CFR § 63.21, and the site and design to comply with Subpart E of 10 CFR Part 63. 10 CFR § 63.21(c)(9) requires an assessment to determine the degree to which features, events and processes of the site that are expected to materially affect compliance with § 63.113 have been characterized, and paragraph (c)(15) requires adequate support for the models used to provide the information required in paragraph (c)(9). 10 CFR § 63.114 (part of Subpart E) requires a performance assessment to be completed to evaluate the ability of the engineered barrier system along with natural barriers to meet the performance objectives of § 63.113, and this performance assessment must include consideration of the probability and consequences of events and processes identified under 10 CFR § 63.21(c)(9). Moreover, 10 CFR § 63.114(c) explicitly requires consideration to be given to alternative conceptual models of features and processes that are consistent with available data and current scientific understanding, and requires an

evaluation of the effects that alternative conceptual models have on the performance of the geologic repository in order that, as required by 10 CFR §§ 63.102(h) and 63.304, uncertainty is properly estimated and accounted for. This contention alleges non-compliance with these regulatory provisions and therefore raises a material issue within the scope of the licensing proceeding.

5. A concise statement of the facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

The DOE relies heavily on the "Probabilistic Volcanic Hazard Analysis for Yucca Mountain, Nevada, BA0000000-01717-2200-00082, Revision 0," June 26, 1996, (LSN# DEN000861156 ("PVHA")) as a basis for calculations of the intersection of the repository footprint by an igneous event. The PVHA report is now out-of-date and does not reflect updated or recent data and information or consider alternative models for volcanism. Indeed, SAR Subsection 2.3.11.2.2.5 at 2.3.11-23 states that "no single base-case conceptual model is appropriate." The 1996 PVHA panel used the assumption that melting to produce basaltic magma is shallow in the lithospheric mantle. The SAR discusses the assumption that basaltic magmas were generated in the shallow lithospheric mantle mainly in SAR Subsections 2.2.2.2.3.1 and 2.3.11.2.2. In SAR Subsection 2.2.2.2.3.1 at 2.2-97, and repeated in Subsection 2.3.11.2.2.5 at 2.3.11-23, the DOE states:

> The PVHA experts generally view volcanism in the Yucca Mountain region as a regional-scale phenomenon resulting from melting processes in the upper lithospheric mantle. . . . Analyses of magmatic processes in the Yucca Mountain region generally indicate that the magnitude of mantle melting has significantly decreased since the middle Miocene. The analyses also suggest that melts in the past few million years were generated within relatively cool ancient lithospheric mantle (compared to asthenospheric mantle), which is a factor that may contribute to the

> relatively small and decreasing volume of basaltic melt erupted in the Yucca Mountain region since the Miocene period.[55]

These statements are contrary to published research that clearly points out that melting of lithospheric mantle to produce basalt late in an extensional event, as the DOE assumes, is difficult if not impossible. In several papers[56] it was demonstrated that lithospheric mantle does not melt to produce basalt about Yucca Mountain. Peridotite of the mantle lithosphere is too cold to melt. The only components that could melt are those with a lower solidus temperature than dry peridotite. These components were probably totally melted during previous events that produced the voluminous rhyolite ash-flow tuffs that now form Yucca Mountain.

Calculations of melting depths[57] indicate that basalts at Yucca Mountain were produced by melting at depths of 115-133 km within the asthenospheric mantle. These calculations were done assuming a dry mantle, but even if water contents of 1-4.5 wt. % are considered, melting is still deep in the asthenosphere.[58] Depth of melting calculations used the Fe-Na[59] and Silica geobarometers[60] and were calibrated using basalt samples

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[55] BSC 2004k, Section 6.3.3.

[56] See "Episodic Volcanism and Hot Mantle: Implications for Volcanic Hazard Studies at the Proposed Nuclear Waste Repository at Yucca Mountain," April 1, 2002, LSN# NEV000002718 at 4-10; Smith, E.I. and Keenan, D.L., "Yucca Mountain Could Face Greater Volcanic Threat," EOS, TRANSACTIONS OF THE AMERICAN GEOPHYSICAL UNION, Vol. 86, No. 35 (2005), at 317; Smith, E.I., Conrad, C.P., Plank, T., Tibbetts, A., and Keenan, D., "Testing Models for Basaltic Volcanism: Implications for Yucca Mountain, Nevada," AMERICAN NUCLEAR SOCIETY, PROCEEDINGS OF THE 12TH INTERNATIONAL HIGH-LEVEL RADIOACTIVE WASTE MANAGEMENT CONFERENCE (2008) at 157-164.

[57] See "A Mantle Melting Profile Across the Basin and Range, SW USA," January 22, 2002, LSN# NEV000004173, at ECV 5-1 through ECV 5-21; NEV000002718 at 4-10; Smith, et al. (2008) at 157-164; and "Yucca Mountain Project Terry Plank Lamont-Doherty Earth Observatory Report on Activities from January 26, 2008 - February 26, 2008," February 26, 2008, LSN# NEV000005026 at 1-4.

[58] See NEV000005026 at 1-4; and Smith, et al. (2008) at 157-164.

[59] See NEV000004173 at ECV 5-1 through ECV 5-21.

[60] Id.

from the Big Pine Volcanic Field in eastern California. In the Big Pine example, both geobarometers placed melting in a zone of low-velocity (high temperature) asthenosphere at depths of 50 to 75 km.[61] These calculations place high confidence in melting depths calculated using both the Fe-Na and Silicon barometers and strongly indicate that melting to produce basaltic magma is in the deep asthenosphere and not in the lithospheric mantle.

Prior to ten million years ago, shallow melting did occur in the Great Basin area, including in the Crater Flat Volcanic Field immediately adjacent to Yucca Mountain. Harry, D.L., Sawyer, D.S. and Leeman, W.P., examined the effects of extension in the Great Basin in relation to melting of lithospheric mantle (shallow melting).[62] They determined that certain components commonly found in the lithospheric mantle (mafic veins or water rich minerals) could be melted during the initial phases of extension. This would explain the widespread silica-rich volcanism during Oligocene time (33.7-23.8 million years ago). These studies also determined that the early melting events exhausted the lower melting temperature components in the lithospheric mantle. Consequently any volcanism after about 10 million years ago could not be from this source and must be from asthenospheric (deep) melting. Gallagher, K. and Hawkesworth, C.J., did a regional study of the Great Basin to determine the effects of the presence of water on subsurface

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[61] Id.

[62] "The Mechanics of Continental Extension in Western North America: Implications for the Magmatic and Structural Evolution of the Great Basin," EARTH AND PLANETARY SCIENCE LETTERS, Vol. 117 (1993) at 59-71, and Harry, D.L. and Leeman, W.P., "Partial Melting of Melt Metasomatized Subcontinental Mantle and the Magma Source Potential of the Lower Lithosphere," JOURNAL OF GEOPHYSICAL RESEARCH, Vol. 100 (1995) at 10255-10269.

melting.[63] Their study concluded that lithospheric mantle will only melt with the presence of water (0.5 wt. %) and that lithospheric mantle will melt before asthenospheric mantle. They also concluded that the early voluminous volcanic activity likely depleted the water component that made lithospheric mantle melting possible. In addition, the large scale extension throughout the region caused thinning of the lithospheric mantle. This allowed upwelling of the asthenospheric mantle. The resulting decrease in pressure in the asthenosphere created conditions favorable to melting of this material. The depletion of water and resulting thinning of the lithosphere due to extension led the authors to the conclusion that little if any lithospheric mantle melting could have occurred more recent than 10 million years ago. Deep melting models are a more accurate way to explain the volcanism that occurred during the last 10 million years.

The DOE uses an isotopic data set that shows that basalt near Crater Flat has higher Sr and lower Nd isotopic signatures than expected for asthenospheric sources. They use this data to support the shallow melting model. This isotopic data does not establish shallow melting because it is not inconsistent with deep melting. Lee, C.-T., Yin, Q., Rudnick, R.L., Chesley, H.T. and Jacobsen, S.B., suggested that basalts with the isotopic signatures found in the Crater Flat volcanic field could be related to contamination either by lithospheric mantle or by subducted crustal material.[64] A later study by Lee, C.T., Yin, Q,, Rudnick, R.L. and Jacobson, S.B., "Preservation of Ancient and Fertile Lithospheric Mantle Beneath the Western United States," NATURE, Vol. 111

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[63] "Dehydration Melting and the Generation of Continental Flood Basalts," NATURE, Vol. 358 (1992) at 57-59, and Hawkesworth, C., Turner, S., Gallagher, K., Bradshaw, T. and Rogers, N., "Calc-Alkaline Magmatism, Lithospheric Thinning, and Extension in the Basis and Range," JOURNAL OF GEOPHYSICAL RESEARCH, Vol. 100 (1995) at 10271-10286.

[64] "Osmium Isotopic Evidence for Mesozoic Removal of Lithospheric Mantle Beneath the Sierra Nevada, California," SCIENCE, Vol. 289 (2000), at 1912-1916.

(2001), at 69-73 determined that Archean (>2.7 billion years old) crust may be present beneath the southern Great Basin area. Melting of Archean crust or contamination from it could account for the isotopic signatures.

In recent years there have been numerous studies based on a variety of data**,** all of which point to the presence of deep melting in the Yucca Mountain area and throughout most of the central Great Basin.[65] Indeed, the DOE originally suggested melting of the asthenosphere to produce basalt. Perry and Crowe, noticed steep rare earth element patterns, which indicate deep melting.[66] Furthermore, several geophysical studies support hotter than normal mantle at depth in the central Nevada region and thus deep melting.[67]

6. Sufficient information to show a genuine dispute with the DOE, along with specific references to the portions of the Application being controverted

This contention challenges the DOE's reliance on one central conceptual model of volcanism, as described mainly in SAR Subsections 2.2.2.2.3., 2.3.11.2.2, 2.2.2.2.3.1, and 2.3.11.2.2, without including full consideration of an alternative conceptual model that is more in accord with, and is certainly consistent with, available data and current scientific understanding.

Supporting reasons are given in Section 5 above and may be summarized as follows: SAR Subsection 2.2.2.3 and related subsections state that the Application relies

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[65] See NEV000004173 at ECV 5-1 through ECV 5-21, and Smith, et al. (2008) at 157-164.

[66] "Geochemical Evidence for Waning Magmatism and Polycyclic Volcanism at Crater Flat, Nevada," April 20, 1992, LSN# DN2001597248 at 1-10.

[67] See Van der Lee, S. and Nolet, G., "Upper Mantle S Velocity Structure of North America," JOURNAL OF GEOPHYSICAL RESEARCH, Vol. 102 (1997) at 22815-22838; Savage, M.K. and Sheehan, A.F., "Seismic Anisotropy and Mantle Flow from the Great Basin to the Great Plains, Western United States," JOURNAL OF GEOPHYSICAL RESEARCH, Vol. 105 (2000), at 13725-13734; and Lowry, A.R., Ribe, N.M. and Smith, R.B., "Dynamic Elevation of the Cordillera, Western United States," JOURNAL OF GEOPHYSICAL RESEARCH, Vol. 105 (2000) at 23371-23390.

on the results of the Probabilistic Volcanic Hazard Assessment expert panel report released in 1996 ("PVHA") as the basis for hazard assessment. Except for new work on the tectonics of the Crater Flat area and a brief mention of buried basalt, the DOE has not updated the PVHA findings, but still bases its conclusions on this out-dated report. The PVHA panel of experts based their results on the assumption of shallow melting to produce basaltic magma. Using this assumption results in an underestimation of the probability of repository disruption and, at the least, the alternative model whereby melting to produce basalt occurs in the asthenosphere should have been included in the TSPA.

CLK-SAFETY-010
THE DOE IGNORES IGNEOUS EVENT DATA EVALUATED SINCE 1996 IN THE TOTAL SYSTEM PERFORMANCE ANALYSIS

1. A brief statement of the contention

DOE's assessment of the frequency of igneous events in the Application ignores information and analyses since 1996 which would, if considered, have required a significant change in the TSPA and, as a result the Application is not complete or accurate in all material respects.

2. A summary of the basis for the contention

SAR Subsection 2.2.2.3 and related sections indicate that the Application relies on the results of the Probabilistic Volcanic Hazard Assessment expert panel report released in 1996 ("PVHA") as the basis for hazard assessment. Except for new work on the tectonics of the Crater Flat area and a brief mention of buried basalt, the DOE has not updated the PVHA findings, but still bases its conclusions on this out-dated report. Much research has been done since 1996 by the DOE, the NRC, the State of Nevada and Clark County that is pertinent to hazard analysis but is not considered in the Application.

3. A demonstration that the contention is within the scope of the hearing

This contention raises the issue of whether the DOE has complied with the NRC requirements applicable to Yucca Mountain, and falls within the scope of the hearing as specified in section II, paragraph 1 of the Notice of Hearing.

4. A demonstration that the contention is material to the findings the NRC must make to license Yucca Mountain

10 CFR § 63.10 requires that the Application be complete and accurate in all material respects and include all information with known significant implications for the public health and safety. In addition, 10 CFR § 63.21(a) requires that the Application be as complete as possible in light of information reasonably available at the time of docketing. This contention alleges violations of these provisions.

5. A concise statement of the facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

Since 1996, the DOE, the NRC, the State of Nevada and Clark County have done much work that is pertinent to volcanic hazard analysis at Yucca Mountain but is not considered in the Application. This includes:

> "Shallow Plumbing Systems for Small-Volume Basaltic Volcanoes, LA-UR-06-5978" (04/25/2007), LSN# DN2002499936;
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> "Localization of Volcanic Activity: 2 Effects of Pre-Existing Structure in Basaltic Fields" (01/31/2007) LSN# DN2002377046;
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> "Tectonically Controlled, Time-Predictable Basaltic Volcanism from a Lithospheric Source" (02/07/2007), LSN# DN2002382703;
>
> "Eruptive Styles and Inferences on Plumbing Systems at Hidden Cone and Little Black Peak Scoria Cone Volcanoes (Nevada, U.S.A.), LA-UR-06-7130" (01/16/2007), LSN# DN2002375513;
>
> "Eruptive and Geomorphic Processes at the Lathrop Wells Scoria Cone Volcano, LA-UR-06-5184" (11/30/2006), LSN# DN2002452726;
>
> "Small-Volume Basaltic Volcanoes: Eruptive Products and Processes, and Post-Eruptive Geomorphic Evolution in Crater Flat (Pleistocene), Southern Nevada" (2006), LSN# DN2002451433;
>
> "Decreasing Magmatic Footprints of Individual Volcanoes in a Waning Basaltic Field, LA-UR-06-3145" (2006), LSN# DN2002453292;
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> "Valentine, G.A., Krogh, K.E.C., 2006, "Emplacement of shallow dikes and sills beneath a small basaltic volcanic center - the role of pre-existing structure (Paiute

Ridge, southern Nevada, USA)," EARTH AND PLANETARY SCIENCE LETTERS, Vol. 246 at 217-230, doi:10.1016/j.epsl.2006.04.031;

"Early-time multiphase interactions between basaltic magma and underground openings at the proposed Yucca Mountain radioactive waste repository" (11/30/2005), LSN# DN2002318671;

"Scoria cone construction mechanisms, Lathrop Wells volcano, Southern Nevada, LA-UR-04-8750" (02/15/2005), LSN# DN2001909760; and,

"Uncovering Buried Volcanoes at Yucca Mountain" (11/22/2005), LSN# DN2002456023.

The Application also omits an important report completed by the NRC contractors that describes water contents in basaltic magma from Crater Flat and the Lathrop Wells cone. "Pre-Eruptive Magmatic Temperatures, Oxygen Fugacities, and Volatile Contents for Trachybasalts from Lathrop Wells and Red Cone, Crater Flat, Nevada, USA" (2005), LSN# NEV000005025, at 1-27.

Another major omission from the Application is the updated report from the "Probabilistic Volcanic Hazard Analysis Update ("PVHA-U") for Yucca Mountain, Nevada Rev 01" (09/02/2008), LSN# DEN001601965. This panel uses eight of the ten experts from the first panel and two additional experts. The report generated by this panel is not considered in the Application. PVHA-U provides new estimates of the probability of repository disruption taking into account the buried basalt and using more modern statistical techniques. Despite the possibility that changes in hazard assessment models and calculations are modest, it is critical that this report be included in the Application.

Omission of all the work cited above results in an underestimation of the probability of repository disruption and of the related uncertainties, which in turn leads to an erroneous TSPA.

6. Sufficient information to show a genuine dispute with the DOE, along with specific references to the portions of the Application being controverted

This contention states that the Application, especially SAR Subsection 2.2.2.3 and related sections, ignores information and analyses since 1996 that would, if considered, have required a significant change in the TSPA. Supporting reasons are given in Section 5 above and may be summarized as follows: SAR Subsection 2.2.2.3 and related subsections indicate that the Application relies on the results of the "Probabilistic Volcanic Hazard Analysis for Yucca Mountain, Nevada ("PVHA"), BA0000000-01717-2200-00082, Revision 0" (06/26/1996), LSN# DEN000861156 expert panel report released in 1996 as the basis for hazard assessment. Except for new work on the tectonics of the Crater Flat area and a brief mention of buried basalt, the DOE has not updated the PVHA findings, but still bases its conclusions on this out-dated report. Much research has been done since 1996 by the DOE, the NRC, the State of Nevada and Clark County that is pertinent to hazard analysis but is not considered in the Application.

1. A brief statement of the contention

High-quality geophysical data is necessary to answer the fundamental question as to whether volcanoes are primarily controlled by upper crustal structure or mantle. The DOE's approach to predicting the location and frequency of future eruptions, as reflected in SAR Subsection 2.2.2.2.3.1 and related subsections, relies heavily on upper crustal structures and the local stress field, but does not provide sufficient geophysical data to support this model. This is inadequate because high-quality geophysical data are necessary to confirm or rule out the proposition, supported by the currently available data, that the primary control of the location of a basaltic field near Yucca Mountain is asthenospheric mantle processes.

2. A summary of the basis for the contention

Although geophysical studies are mentioned in SAR Subsection 2.2.2.1.2 as a way to identify and characterize the orientation of faults in the subsurface, the Application lacks geophysical data to document models proposed by the DOE that use upper crustal structure and the local stress field to explain the location of volcanoes in the Yucca Mountain area. Geophysical studies are also critical for testing and comparing deep versus shallow melting models by revealing the location of low-viscosity zones (hot zones) in the crust and mantle that might contain magma or rock close to the melting temperature. Furthermore, identifying patterns of mantle circulation and the nature of the topography at the base of the lithosphere are important for describing the geometry of

volcanic source zones, which ultimately control the location and shape of volcanic fields at the surface.

3. A demonstration that the contention is within the scope of the hearing

This contention raises the issue of whether the DOE has complied with the NRC requirements applicable to Yucca Mountain, and falls within the scope of the hearing as specified in section II, paragraph 1 of the Notice of Hearing.

4. A demonstration that the contention is material to the findings the NRC must make to license Yucca Mountain

10 CFR § 63.31(a)(2) states that the NRC may authorize issuance of a construction authorization for Yucca Mountain if it determines that there is reasonable assurance or expectation that the materials described in the Application can be disposed of without unreasonable risk to the health and safety of the public. In reaching this determination, 10 CFR §63.31(a)(3) requires the Application to satisfy the requirements in 10 CFR § 63.21, and the site and design to comply with Subpart E of 10 CFR Part 63. 10 CFR § 63.21(c)(9) requires an assessment to determine the degree to which features, events and processes of the site that are expected to materially affect compliance with § 63.113 have been characterized, and paragraph (c)(15) requires adequate support for the models used to provide the information required in paragraph (c)(9). 10 CFR § 63.114 (part of Subpart E) requires a performance assessment to be completed to evaluate the ability of the engineered barrier system along with natural barriers to meet the performance objectives of § 63.113, and this performance assessment must include consideration of the probability and consequences of events and processes identified

under 10 CFR § 63.21(c)(9). This contention alleges non-compliance with these regulatory provisions and therefore raises a material issue within the scope of the licensing proceeding.

5. A concise statement of the facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

SAR Subsection 2.2.2.2.3.1 at 2.2-97 and related subsections indicate that the DOE relies heavily on an assumption of control exerted by upper crustal structures and the local stress field to predict the location of future eruptions. For example the DOE states, The Quaternary volcanoes in the Crater Flat basin and their proximities to Yucca Mountain (Figure 2.2-24) result in the Crater Flat cluster playing a major role in assessing the potential for future volcanism at Yucca Mountain. Research on the Crater Flat structural domain, published largely since the PVHA was conducted (Fridrich 1999), provides evidence that the northeastern and southwestern portions of the basin have different extensional histories that may have influenced the location of basaltic volcanism within the basin (BSC 2004k, Section 6.4).

As noted in the next quote from SAR Subsection 2.3.11.2.1.1 at 2.3.11-17, specific predictions about the location of future volcanoes are based almost entirely on the location of upper crustal structures and extension rate: Thus, the Crater Flat volcanoes, including Lathrop Wells volcano, show that close spatial and temporal relationships exist between areas of extension and volcanism throughout the Crater Flat domain.[68] The occurrence of three episodes of post-Miocene volcanism in the more extended part of the Crater Flat domain suggests future volcanism is more likely to occur

[68] Fridrich, et al. 1999, p. 211.

in southwestern Crater Flat and less likely to occur at Yucca Mountain, which lies outside of the more extended part of the Crater Flat domain.[69] Without geophysical data to determine the subsurface geometry of faults, the thickness and geometry of the crust and lithospheric mantle, and the identification of low velocity zones (hot areas) in the crust and mantle, conclusions that relate volcano location to upper crustal structure and the local stress state are not supportable. Geophysical studies provide important information regarding prediction of the location of future volcanism. The two most important controls of volcano location are mantle source zones and crustal structures and stress fields. More evolved magmas that have a long crustal residence time (rhyolite to andesite) may have a strong upper crustal control, but mafic magmas that melt mantle and rise quickly through the crust to the surface may not be affected by either crustal structures or local stress fields. In reality it is uncommon for basalt dikes or volcanoes to locate on faults.[70] The shape of a basaltic volcanic field more strongly reflects the geometry of the melting anomaly (source zone) than weak local stress fields or shallow upper crustal faults.

Geophysical studies have been used in other volcanic fields close to Yucca Mountain to determine lithospheric thickness, locate hot zones (low velocity) in the mantle and determine whether basalt magma was generated in the lithosphere or asthenosphere. Yang, Y. and D.W. Forsyth, "Rayleigh Wave Phase Velocities, Small-Scale Convection and Azimuthal Anisotropy Beneath Southern California," JOURNAL OF GEOPHYSICAL RESEARCH, Vol. 111 (2006), B07306, doi:10.1029/2005JB004180, prepared a model of seismic shear wave velocities across California at 36.5 degrees north

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[69] BSC 2004a, Section 6.1.1.1.

[70] See "Volcanism Studies Related to the Probabilistic Volcanic Hazard at Yucca Mountain for the Period 1986-1996 (January 1997)," LSN# NEV000000704 at 1-14.

latitude across the Big Pine Volcanic Field. The study revealed a volcanic source zone (low-velocity zone) that extends from the base of the lithosphere at a depth of 50 km to 75 km. Melting depths calculated by both the Na-Fe and Silica geobarometers place melting within this zone of hot mantle.[71] The study also revealed a high-velocity zone just west of Big Pine at a depth of 75 to 175 km that may represent a fragment of the subducted Farallon Plate. Yang and Forsyth ((2006) at 1029/2005JB004180) suggest that this plate generated sufficient mantle circulation to localize volcanism at Big Pine. It is a critical omission of the DOE's research strategy and the Application that this type of information is not available for Yucca Mountain. Conrad[72] and "Technical Progress Report for November 2007,"[73] provide data critical for understanding the occurrence of volcanism in the Yucca Mountain area. Studies of mantle circulation and the effects of lithospheric topography are important for understanding why volcanoes occur where they do.

This type of study was not considered by the PVHA panel and is not included in the Application. This is another major omission and is grounds for questioning the DOE's conclusions regarding the crustal control of volcanism. In detail, Conrad has shown that the mantle beneath the Great Basin and Yucca Mountain is rapidly shearing at rates of up to 5 cm/year.[74] Moreover, mantle circulation and topography at the base of the lithosphere produce mantle upwelling (and the potential for melting) in the Yucca

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[71] See "Yucca Mountain Project Terry Plank Lamont-Doherty Earth Observatory Report on Activities from January 26, 2008 - February 26, 2008," February 26, 2008, LSN# NEV000005026, at 1-4.

[72] "Characterization of Three-Dimensional Mantle Flow Beneath Nevada: Implications for Volcanic Hazard, Technical Progress Report for May 2008," June 10, 2008, LSN# NEV000005021 at 1-19.

[73] December 3, 2007, LSN# NEV000004225 at 1-5.

[74] See LSN# NEV000005021 at 1-19; NEV000004225 at 1-5.

Mountain area. Mantle flow beneath North America is thought to be dominated by descent of a region of dense mantle rocks that lie about 1500 km below the Midwest and Eastern portion of the continent. This structure, known as the "Farallon Slab" can be imaged seismically and was produced by subduction of dense oceanic lithosphere in the mantle interior off the western coast of North America prior to about 30 million years ago.[75] Several studies have shown that descent of this slab produces a broad region of mantle downwelling beneath the eastern portion of North America that depresses the Earth's surface[76] and influences the westward motion of the North American plate.[77] Numerical models of global-scale mantle flow[78] confirm this flow pattern. Within the asthenosphere beneath the southwest United States, these models show eastward-directed flow toward the region of downwelling. The rate of eastward flow at the base of the asthenosphere can be up to 3 cm/yr. Because the overlying North American plate is moving westward with rates of about 2 cm/yr, the asthenosphere beneath the southwestern United States is shearing at rates of up to about 5 cm/yr. This basic pattern of asthenospheric shear produces a seismically fast anisotropic fabric for asthenospheric rocks with an approximately east-west orientation. This orientation is observed by SKS

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[75] See Bunge, H.-P., and Grand, S.P., "Mesozoic Plate-Motion History Below the Northeast Pacific Ocean from Seismic Images of the Subducted Farallon Slab," NATURE, Vol. 405 (2000) at 337-340.

[76] See Conrad, C.P., Lithgow-Bertelloni, C. and Louden, K.E., "Iceland, the Farallon Slab, and Dynamic Topography of the North Atlantic," GEOLOGY, Vol. 32 (2004) at 177-180.

[77] See Bokelmann, G.H.R., "Which Forces Drive North America?" GEOLOGY, Vol. 30 (2002) at 1027–1030.

[78] See Conrad, C.P., Behn, M.D. and Silver, P.G., "Global Mantle Flow and the Development of Seismic Anisotropy: Differences Between the Oceanic and Continental Upper Mantle," JOURNAL OF GEOPHYSICAL RESEARCH, Vol. 112 (2007) at B07317, doi:10.1029/2006JB004608.

splitting observations of anisotropy, thus confirming the presences of strong shear flow beneath the western United States[79]

The vigorous shear flow occurring beneath the southwestern United States occurs within a region of asthenosphere that exhibits large lateral variations in the material properties; these variations can be observed seismically. In particular, variations in seismic velocity observed by van der Lee, S. and A. Frederiksen, "Surface Wave Tomography Applied to the North America Upper Mantle, in Seismic Earth: Array Analysis of Broadband Seismograms," G. Nolet and A. Levander, Eds, GEOPHYSICAL MONOGRAPH SERIES 157 (2007) at 67-80, at about 110 km show several trends that will influence the flow field of the asthenosphere beneath the southwestern United States. First, there is a general increase in seismic velocity moving from the southwest toward the continental interior. In general, faster seismic velocities are thought to represent denser and colder material, with lithospheric rocks featuring both. Thus, the eastward increase in seismic velocity is consistent with an increase in continental thickness moving from the Basin and Range province (with lithosphere shallower than 110 km) to the stable craton of the Midwest (with lithosphere thicker than 110 km). This increase in thickness has been observed by some authors to occur as a sharp increase in lithospheric thickness beneath the Yucca Mountain region.[80] Second, several "pockets" of low-velocity anomalies are evident within the Great Basin asthenosphere at 110 km depth.

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[79] See Becker, T.W., Schulte-Pelkum, V., Blackman, D.K., Kellogg, J.B. and O'Connell, R.J., "Mantle Flow Under the Western United States from Shear Wave Splitting," EARTH AND PLANETARY SCIENCE LETTERS, Vol. 247 (2006) at 235-251.

[80] See Zandt, G., Myers, S.C., and Wallace, T.C., "Crust and Mantle Structure Across the Basin and Range-Colorado Plateau boundary at 37 N Latitude and Implications for Cenozoic Extensional Mechanism," JOURNAL OF GEOPHYSICAL RESEARCH, Vol. 100 (1995) at 10529-10548; and "A Mantle Melting Profile Across the Basin and Range, SW USA," January 22, 2002, LSN# NEV000004173 at 1-21.

These "pockets" may represent portions of the asthenosphere that are unusually low-density, and therefore presumably hotter than the surrounding asthenosphere. These low-velocity "pockets" of asthenosphere have also been observed in other tomographic studies of the western United States.[81]

Thus, the flow field within asthenosphere of the southwest United States likely encounters both a sharp increase in the thickness of the cold lithosphere, as well as several "pockets" of unusually hot asthenosphere. Because the viscosity of mantle rocks is thought to vary strongly with temperature,[82] the cold lithosphere and hot "pockets" can be thought of as high-viscosity and low-viscosity features, respectively.

Thus, the rapid asthenospheric shear flow that is present beneath the Basin and Range province is occurring in the presence of possibly large variations in lithospheric and asthenospheric viscosity. Upwelling produced by the interaction of the shear flow, low velocity "pockets" and lithospheric topography produce melting of the asthenosphere and the generation of basaltic magma. In this way, basaltic magma can be produced for long periods of time in the same geographic area. The primary control of the location of a basaltic field is therefore asthenospheric processes and not upper crustal structure or local stress fields.

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[81] See e.g., Dueker, K., Yuan, H. and Zurek, B., "Thick-Structured Proterozoic Lithosphere of the Rocky Mountain Region," GSA TODAY, Vol. 11, No. 12 (2001) at 4-9.

[82] See Kohlstedt, D.L., Evans, B. and Mackwell, S.J., "Strength of the Lithosphere: Constraints Imposed by Laboratory Experiments," JOURNAL OF GEOPHYSICAL RESEARCH, Vol. 100 (1995) at 17587-17602.

6. Sufficient information to show a genuine dispute with the DOE, along with specific references to the portions of the Application being controverted

This contention challenges SAR Subsection 2.2.2.2.3.1 and related subsections, which indicate that the DOE relies heavily on upper crustal structures and the local stress field to predict the location and frequency of future eruptions. Supporting reasons are given in Section 5 above and may be summarized as follows: Although geophysical studies are mentioned in SAR Subsection 2.2.2.1.2 as a way to identify and characterize the orientation of faults in the subsurface, the Application lacks geophysical data to document models proposed by the DOE that use upper crustal structure and the local stress field to explain the location of volcanoes in the Yucca Mountain area. Whether volcanoes are primarily controlled by upper crustal structure or mantle processes is a fundamental question, and the DOE's approach, which relies on upper crustal structures and local stress fields, is not supportable unless geophysical studies that detail the geometry of upper crustal structures, lithospheric thickness and basal topography, and circulation in the mantle are conducted to confirm or rule out the proposition, supported by the currently available data, that the primary control of the location of a basaltic field near Yucca Mountain is asthenospheric mantle processes.

1. A brief statement of the contention

The DOE lacks the requisite institutional integrity to be granted a license to construct and operate a repository in a safe and secure manner for high level radioactive waste and spent nuclear fuel at Yucca Mountain.

2. A summary of the basis for the contention

The DOE has a well-documented history, pattern, and track record of failures to meet procedural, legal, and contractual obligations. The DOE's actions demonstrate a lack of capacity and competency to effectively manage large, complex, and long-term projects in a safe manner. Taken together these failures call into question the DOE's qualifications as an NRC licensee. Clark County lacks confidence in the DOE's ability to safely and securely construct and operate the proposed repository at Yucca Mountain with the expectation of integrity and a safety conscious work environment that is required of all NRC licensees.

3. A demonstration that the contention is within the scope of the hearing

This contention raises the fundamental issue of whether the DOE has complied with the NRC requirements applicable to Yucca Mountain, and falls within the scope of the hearing as specified in Section II, paragraph 1 of the Notice of Hearing. The DOE's institutional integrity as licensee relate directly to the health and safety of the public, and

thus lies within the scope of the proceeding, as described in the NRC's Notice of Hearing.[83]

4. A demonstration that the contention is material to the findings the NRC must make to license Yucca Mountain

The NRC may authorize issuance of a construction authorization for Yucca Mountain only if it determines that there is a reasonable assurance or expectation the materials described in the Application can be disposed of without unreasonable risk to the health and safety of the public.[84] The Presiding Officer may admit contentions based on claims of poor licensee integrity on the grounds that poor integrity poses a significant safety problem.[85] The general requirement for operating licenses requires a "finding of reasonable assurance of operation without endangering the health and safety of the public."[86] This standard applies to all licensees, and the DOE should be held to no lesser standard.

The Presiding Officer may consider a variety of factors in determining "whether there is reasonable assurance that the licensee has the integrity to operate the facility in a manner consistent with the public health and safety and the NRC requirements."[87] These include "evidence of licensee behavior having a rational connection to safe operation of the facility and some reasonable relationship to licensee's candor, truthfulness, and

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[83] 73 Fed. Reg. 63029 (October 22, 2008).

[84] See 10 CFR § 63.31(a)(2).

[85] See Dominion Nuclear Connecticut, Inc. (Millstone Nuclear Power Station, Units 2 and 3), CLI-01-24, 54 NRC 349, 365 (2001).

[86] Duke Power Co. (Catawba Nuclear Station, Units 1 and 2), LBP-82-116, 16 NRC 1937, 1946 (1982).

[87] Metropolitan Edison Co. (Three Mile Island Nuclear Station, Unit 1), CLI-85-9, 21 NRC 1118, 1136-37 (1985).

willingness to abide by regulatory requirements and accept responsibility to protect the public health and safety."[88]

5. A concise statement of the facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

There is substantial evidence demonstrating that the DOE lacks the requisite institutional integrity to be granted a license to construct and operate a waste repository at Yucca Mountain. Unfortunately, the DOE has a track record that demonstrates a patent disregard for safety and a culture of and unwillingness to abide by regulatory requirements.

One well documented example of the DOE's record is the Waste Isolation Pilot Project at Carlsbad, New Mexico ("WIPP"). WIPP involves a national shipment program of transuranic waste and is the type of waste project most similar to Yucca Mountain.[89] A cursory review of the history of WIPP reveals the DOE's track record of broken promises and the withholding of funds owed to local governments necessary to ensure public health and safety.[90] The DOE there exerted its status as a federal agency to "change the rules" well after it had achieved its objectives and obtained concessions from affected parties.[91]

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[88] Id.

[89] Urban Environmental Research, LLC, "Lessons Learned from New Mexico's Experience with the Development of a Nuclear Waste Repository", at Section 1.1 (January 2001), LSN #CLK000000013.

[90] Id. (LSN #CLK000000013) at Section 2.2.

[91] Id. (LSN #CLK000000013) at Section 2.3.1 (Interview with New Mexico Secretary of Transportation, Peter Rahn, October 4, 2000).

Historically, the DOE has withheld funds for impact assistance, including public safety activities.[92] This unimpressive track record is most evident when it comes to funding emergency response training and equipment, which seem to have been absent or grossly underestimated for WIPP.[93] As noted by the former New Mexico Secretary of Transportation, Peter Rahn, the DOE's contradictory policies indicate that the DOE makes its decisions based on what is expedient and not necessarily what is needed to adequately protect the public health and safety.[94]

There is also ample evidence that the DOE failed to effectively manage other critical projects. This ineffectiveness resulted in cost increases ranging between $139 million and nearly $9 billion[95] and schedule delays ranging between two and fifteen years,[96] not to mention the large number of projects which are never completed. This ineffectiveness reflects a culture at the DOE that fosters contradictory and unclear guidance[97] and forces key technical and budget decisions premised upon assumptions that have little to no basis in reality.[98] Moreover, specific to this proceeding is the DOE Inspector General's conclusion that certain DOE evaluation documents "suggest a premature conclusion regarding the suitability of Yucca Mountain."[99]

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[92] See id. (LSN #CLK000000013) at Sections 3.4 and 5.2.

[93] See id. (LSN #CLK000000013) at Section 3.4.2.

[94] Id. (LSN #CLK000000013) at Section 3.4.2.

[95] See United States Government Accountability Office, "Nuclear Waste: Action Needed to Improve Accountability and Management of DOE's Major Clean-up Projects," Report to the Subcommittee on Energy and Water Development, Committee on Appropriations, House of Representatives, GAO-08-1081, p.14 (September 2008) (in nine out of ten clean-up projects studied). Attachment 7 hereto.

[96] See id. (in ten out of ten clean-up projects studied).

[97] Id. at p.8.

[98] Id. at p.6.

[99] United States Department of Energy, Office of Inspector General, "Memorandum for the Secretary," p.1 (April 23, 2001); *see also id.* at p.8 ("We found several written statements in key Yucca Mountain

The DOE's lack of integrity bears directly to the issue of safety. Clark County has legitimate concerns whether the DOE can or will construct or operate the repository in a safe manner based on documented evidence of the DOE's institutional failures. These failures include, but are not limited to, the DOE's unwillingness to abide by agreements with states and local governments, even when ordered by a Court to comply with the terms of such agreements.[100]

As with WIPP in Carlsbad, New Mexico, the DOE failed to provide an effective emergency management system ("EMS") in Chapter 6 of the Application or the pertinent portions of Appendices A thru H for Yucca Mountain. DOE thus ignored the requirement to address emergency management systems and assurances of maintaining public safety. Rather than addressing such requirements, the DOE improperly relies upon the NWPA Section 180(c) (improperly alleging that the issue of safety and emergency management systems is one of post licensing funding) as justification for its failure to analyze and consider such impacts, and improperly extracted the issue as a matter to be addressed upon implementation *after* the licensing decision is made.[101] Thus, Clark County and the public are left with no assurances or safeguards to prevent the DOE from engaging in the same practices as it has done elsewhere.[102] An evaluation of the lessons learned from the DOE's behavior and actions relative to WIPP raises a legitimate

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evaluation documents that could be considered by an impartial observer to be prematurely conclusive, or inappropriately advocating a position by the Department or its contractors"). Attachment 8 hereto.

[100] See e.g., "Lessons Learned from New Mexico's Experience with the Development of a Nuclear Waste Repository" (LSN #CLK000000013) at Section 2.2.5.

[101] See CLK-NEPA-001, infra.

[102] Supra, n. 100 (LSN #CLK000000013) at Section 2.3.1.

question and concern about the DOE's willingness to abide by regulatory and contractual obligations, and the measures an AULG must take to enforce such obligations.

6. Sufficient information to show a genuine dispute with the DOE, along with specific references to the portions of the Application being controverted

By proffering its application, the DOE contends that it is properly granted a license to construct and operate the repository, and that the Application as provided is sufficient.

1. A brief statement of the contention

The DOE's Final Supplemental Environmental Impact Statement ("FSEIS") fails to provide meaningful analyses concerning the effects on emergency management and public safety impacts on Clark County associated with the siting of a high level radioactive waste and spent nuclear fuel repository, in violation of the NWPA and NEPA and their respective implementing regulations.

2. A summary of the basis for the contention

DOE has failed to undertake reasonable analyses to identify the potential impacts on Clark County emergency management and safety systems. NEPA, in conjunction with Council on Environmental Quality ("CEQ") policy, requires the lead agency for a proposed federal undertaking to provide an effective emergency management system ("EMS") inclusive of an assessment of emergency preparedness and response personnel and standards.[103] The DOE failed to provide any such assessment in Chapter 6 of the FSEIS (LSN # DEN001593557), or the pertinent portions of Appendices A thru H, and instead improperly relies upon the NWPA Section 180(c) as justification for its failure to analyze and consider such impacts, and improperly extracting the issue as a matter to be address upon implementation *after* the licensing decision is made. Insufficient identification and understanding of the demands on emergency management and preparedness endangers public safety and must be considered as part of the

[103] 10 CFR § 51.91, and 10 CFR Part 51, Subpart A, Appendix A.

Environmental Impact Statement ("EIS") in evaluating alternatives to the proposed action.

3. A demonstration that the contention is within the scope of the hearing.

This contention is within the scope of the hearing as set forth in the Commission's Notice of Hearing, wherein the Commission notified all interested parties that the NRC staff determined that it is practicable to adopt, with further supplementation, the Environmental Impact Statement ("EIS") and supplements prepared by the DOE, and that among the matters of fact and law to be considered are whether the Application satisfies the applicable requirements of NEPA and the NRC's NEPA regulations, 10 CFR Part 51.

4. A demonstration that the contention is material to the findings the NRC must make to license Yucca Mountain

10 CFR Part 51 sets forth the NRC's obligations under NEPA, and requires that an EIS or supplement thereto be filed in connection with the issuance of a construction authorization and license for disposal of high level radioactive waste in geologic repositories.[104] 10 CFR § 51.109 requires the NRC staff to present a position on whether it is practicable to adopt, without further supplementation, the EIS prepared by the DOE.[105] Here, the NRC staff has decided to adopt the EIS, as may be supplemented by the DOE. The NRC staff's decision to adopt the DOE's EIS does not cure the DOE's errors or otherwise relieve the DOE of its obligation to address items properly within the scope of the EIS.

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[104] 10 CFR § 51.20(b)(13).

[105] 10 CFR § 51.109(a)(1).

5. A concise statement of the facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

Ensuring safety is of paramount importance to the NRC's decision to authorize the construction of Yucca Mountain; and, ensuring the safety and welfare of its citizens is of paramount importance to Clark County as a local government. There is no question that the undertaking proposed by the DOE will have an impact to Clark County's emergency management and safety system. Yet, admitting that the undertaking will have a significant impact on Clark County's emergency management and safety systems does not relieve the DOE of its duty to undertake a reasonable effort to identify and analyze what those impacts may or will be; to identify whether such impacts can be avoided, if at all; and if so, how such impacts can or will be avoided and/or mitigated.

Inadequate analysis of public safety and emergency management fails to satisfy the purpose of the NRC commission hearings, the NEPA mandated EIS process, and the Application as a whole. Evaluating response capability and all public safety needs is essential to obtaining an accurate assessment as to whether such safety *can* be provided to the public. The DOE failed to analyze impacts associated with the repository on emergency management and safety systems, instead concluding that such concerns can and should be addressed *after* a decision is made on the license Application, and when the local government seeks funding for emergency management services. The DOE's decision to "punt" on this issue to another day is inappropriate and fails to comport with safety requirements and with NEPA.

Clark County plays a critical role in regional first response and emergency management, protection of critical infrastructure (including transportation). The FSEIS

assumes that 80 percent of the onsite Yucca Mountain Repository workers would reside in Clark County (Las Vegas).[106] Furthermore, a total shipment of approximately 9,500 rail casks and 2,700 truck casks would be shipped to Yucca Mountain repository.[107] The State of Nevada estimates that 100% of the truck casks would travel through Clark County, and 8% of the rail cask shipments would traverse Clark County.[108] Clark County owns and operates the University Medical Center with the only Level One Trauma Unit, Burn Unit, and the only radiological decontamination unit in Southern Nevada. A recent study estimates that at least 95,000 residents of Clark County live within one half mile of the Union Pacific route for shipments to Yucca Mountain via Caliente, and at least 113,000 residents of Clark County live within one half mile of a highway route for truck shipments.[109]

Clark County has Memoranda of Understanding or Mutual Aid agreements with a variety of the counties and cities throughout the region that would be employed in the event of an emergency, whereby Clark County would be providing aid to numerous jurisdictions and governmental entities.[110] In short, Clark County's emergency

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[106] DOE Final Supplemental Environmental Impact Statement for a Geological Repository at Yucca Mountain, Appendix A at A-8 (2008). LSN # DEN001593557.

[107] Id. at 6-8, § 6.1.7.

[108] State of Nevada Comments on DOE's Draft Supplement Environmental Impact Statement for a Geological Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, P. 8 (January 9, 2008). LSN # DEN001583031.

[109] Halstead, Robert, "State of Nevada Perspective on the U.S. Department of Energy Yucca Mountain Transportation Program – 8154." Presented at Annual Waste Management Meetings, Phoenix, Arizona (2008). LSN# NEV000005266.

[110] Urban Environmental Research, LLC, "An Update of the Projected Impacts to Clark County and Local Governmental Public Safety Agencies Resulting from the Transportation of High-Level Nuclear Waste to Yucca Mountain." (Aug 2005). LSN# CLK000000055; Conway, Sheila, A. Mushkatel, and K.D Pijawka. "Impacts to Clark County and Local Governmental Public Safety Agencies Resulting From the Yucca Mountain Project." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Oct 2001). LSN # CLK000000006; UER. "Impacts to Clark County Public Safety Agencies Resulting From the Yucca Mountain Project." (Feb 1999). LSN # CLK000000001.

personnel, resources and capacity will be significantly impacted by the NRC's decision. The nature and extent of incidents associated with the federal undertaking such as this, the direct and indirect impact of such incidents on emergency management and safety systems, and a reasonable effort to collect and evaluate supporting data and analyses should have been evaluated as part of a reasonable effort to identify the impacts to Clark County's emergency management and safety systems, and whether such impacts can be avoided or mitigated.

It is a fundamental error for the DOE to try to segment or separate emergency management and public safety systems from the environmental impact statements for the repository or the rail corridor. That the authorization to construct a repository and related transportation of materials to that site will impact emergency management and public safety sectors of Clark County can no longer be disputed. These impacts should have been examined in the environmental impact statements, but were not.

6. Sufficient information to show a genuine dispute with the DOE, along with specific references to the portions of the Application being controverted

The DOE contends that the Application as provided, inclusive of the relevant EIS's, is sufficient.

1. A brief statement of the contention

The DOE's evaluation of rail corridors is patently deficient in its failure to evaluate known alternatives to the Caliente Rail Corridor. The Rail EIS evaluates only two of five feasible known rail corridors, The Caliente Corridor and The Mina Rail Corridor, ultimately coining the Caliente Corridor as the "preferred alternative" to the Mina Rail Corridor. The DOE's analysis sets up a false choice between a feasible and non-feasible corridor, and to the exclusion of the consideration of three additional feasible corridors.

2. A summary of the basis for the contention

NEPA requires the lead agency and author of an EIS to provide analysis of all reasonable alternatives to a proposal.[111] Such consideration is at the heart of the environmental impact statement.[112] Not a single feasible alternative to the Caliente Rail Corridor was considered by the DOE despite the identification of at least three feasible alternatives. The EIS thus fails to comply with the applicable NEPA and NRC standards.

3. A demonstration that the contention is within the scope of the hearing

This contention is within the scope of the hearing as set forth in the Commission's Notice of Hearing, wherein the Commission notified all interested parties that the NRC

[111] 40 CFR § 1502.14.

[112] Id.

staff determined that it is practicable to adopt, with further supplementation, the EIS and supplements prepared by the DOE, and that among the matters of fact and law to be considered are whether the Application satisfies the applicable requirements of NEPA and the NRC's NEPA regulations, 10 CFR Part 51. The Application includes the Rail Alignment EIS, the Nevada Rail Corridor SEIS (LSN# DEN001598766), and FSEIS (LSN# DEN001593557). The sufficiency of each of the EIS's is a fundamental part of the Application and is intrinsically and inextricably linked to the NRC review of the overall Application.

4. Demonstration that contention is material to the findings the NRC must make to license Yucca Mountain.

10 CFR Part 51 sets forth the NRC's obligations under NEPA and requires that an EIS or supplement thereto be filed in connection with the issuance of a construction authorization and license for disposal of high level radioactive waste in geologic repositories.[113] 10 CFR § 51.109 requires the NRC staff to present a position on whether it is practicable to adopt, without further supplementation, the EIS prepared by the DOE.[114] Here, the NRC staff has adopted the EIS, as may be supplemented by the DOE, thus making this issue material to the findings the NRC must make.

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[113] 10 CFR § 51.20(b)(13).

[114] 10 CFR § 51.109(a)(1).

5. A concise statement of the facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

Consideration of alternatives is the heart of the environmental impact statement.[115] The purpose of the EIS is to "present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public."[116] Applying this requirement, courts have been "especially quick to find a discussion of alternatives inadequate if it is conclusory."[117] Applied here, the DOE's failure to undertake a meaningful analysis of known transportation alternatives renders the EIS insufficient.

The NRC cannot license the site if the risks and impacts of a true reasonable and feasible alternative are not rigorously explored and examined. Such examination did not take place with regard to alternatives to the Caliente Rail Corridor. Although NEPA does not require an agency to consider every possible alternative to a proposed action, the identification of a "viable but unexamined alternative renders [the] environmental impact statement inadequate."[118] Stated another way, "[t]he range of alternatives that the agency must consider is not infinite, of course, but it does include all reasonable alternatives to

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[115] 40 CFR § 1502.14.

[116] 40 CFR § 1502.14.

[117] NEPA LAW AND LITIGATION § 10.09[1], at 10-51; Swain v. Brinegar, 517 F.2d 766, 776 (7th Cir. 1975) (stating that discussion of alternatives in selection of "corridors" for highway was inadequate); Chelsea Neighborhood Assoc. v. United States Postal Service, 516 F.2d 378, 379 (2d Cir. 1975) (holding that conclusory discussion of alternatives to parking garage were inadequate under NEPA).

[118] Muckleshoot Indian Tribe v. United States Forest Service, 177 F.3d 800, 813 (9th Cir. 1999) (quoting Citizens for a Better Henderson v. Hodel, 768 F.2d 1051, 1057 (9th Cir. 1985)).

the proposed action. The . . . reasonableness standard applies both to which alternatives the agency discusses and the extent to which it discusses them."[119]

The DOE failed to consider reasonable and viable alternatives to the Caliente Rail Corridor where there is evidence of at least three other reasonable and feasible alternatives. The Rail Alignment EIS evaluated only two rail corridors: the Caliente Rail Corridor and the Mina Rail Corridor.[120] The FSEIS does the same.[121] The DOE referred to the Caliente Corridor as the "preferred alternative" and the Mina Rail Corridor as the "non-preferred alternative."[122] However, the DOE's designation of the Mina Rail Corridor as "non-preferred" suggests that it was a feasible alternative when indeed it was not.

The Mina Rail corridor became a non-alternative upon the withdrawal of support by the Paiute Walker Tribe on April 29, 2007—greater than a year prior to the DOE's submission of the Application. The DOE acknowledged this withdrawal of support in its Application, yet continued to designate the Mina Rail Corridor as an "alternative," (albeit "non-preferred"), rail corridor.[123] Further, the DOE failed to discuss an alternative to the Mina Rail Corridor route that bypasses tribal lands or why this discussion was absent from the FSEIS.

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[119] Utahns for Better Transp. v. U.S. Dept. of Transp., 305 F.3d 1152, 1167 (10th Cir. 2002) (citing City of Grapevine v. Dept. of Transp., 17 F.3d 1502, 1506 (D.C.Cir. 1994)).

[120] See Rail Alignment EIS, at § 2.2.

[121] See FSEIS (LSN# DEN001593557) at §§ 2.1.7.3, 3.2.1.1 and 6.4.

[122] See id. (LSN# DEN001593557) at § 2.1.7.3.1.

[123] See id. (LSN# DEN001593557) at § 6.4.1.9.

There are three reasonable alternatives to the Caliente Rail Corridor: the Carlin Rail Corridor, the Jean Rail Corridor, and the Valley Modified Rail Corridor. The DOE has determined that each of these corridors have minimal land conflict complications.[124] Nevertheless, the DOE failed to examine a single one of these reasonable alternatives in the FSEIS. Instead, the DOE choses to only examine the Caliente and non-alternative Mina Rail Corridors.[125] Further, the DOE failed to provide the basis for eliminating all but the Caliente and Mina routes from its Application. Thus, the DOE's EIS's are deficient and the Application should be denied.

6. Sufficient information to show a genuine dispute with the DOE, along with specific references to the portions of the Application being controverted

The DOE contends that the Application as provided, inclusive of the relevant EIS's, is sufficient.

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[124] See Nevada Rail Corridor SEIS (LSN# DEN001598766), at §§ 5.2.1, 5.3.1 and 5.4.1.

[125] See FSEIS (LSN# DEN001593557) at §§ 2.1.7.3, 3.2.1.1 and 6.4.

1. A brief statement of the contention

The DOE ignored data and wrongly dismissed analyses of stigma related socio-economic impacts resulting from the perceived and actual risks associated with potential accidents during the course of transporting high level nuclear waste. The DOE's assertion in the EIS that the relevant impacts of the Caliente Rail Corridor as the "preferred alternative" on property values and tourism cannot be measured and thus are irreducible ignores evidence and data proffered by Clark County.

2. A summary of the basis for the contention

The DOE's failure to evaluate the impacts of alternative transportation routes to identify the resulting socio-economic impacts for each such feasible alternative route violates 10 CFR § 51.91(c) which requires an EIS to identify the alternatives proposed and evaluated, as well as whether the identified alternatives will accomplish NEPA objectives enumerated in sections 101 and 102.

3. A demonstration that the contention is within the scope of the proceeding

The NRC is responsible for evaluating the quality and conformity of the DOE's submitted Application, including the attached EIS's. The FEIS (LSN # DN2002073507) and Rail EIS (LSN # DEN001593557) included with the Application fail to sufficiently address socio-economic impacts and concerns raised by Clark County.

4. A demonstration that the contention is material to the findings the NRC must make to license Yucca Mountain

10 CFR Part 51 sets forth the NRC's obligations under NEPA and requires that an EIS or supplement thereto be filed in connection with the issuance of a construction authorization and license for disposal of high level radioactive waste in geologic repositories.[126] 10 CFR § 51.109 requires the NRC staff to present a position on whether it is practicable to adopt, without further supplementation, the EIS prepared by the DOE.[127] Here, the NRC staff has adopted the EIS, as may be supplemented by the DOE.

Moreover, "Key topics necessary to adequately evaluate potential impacts from the proposed action" must be discussed in accordance with 10 CFR § 51.91, "Final Environmental Impact Statement – Content, (LSN# DN2002073507)" and 10 CFR Part 51, Subpart A, Appendix A, "Format for Presentation of Material in Environmental Impact Statements." Thus, whether the DOE adequately satisfied the governing regulations is material to the finding the NRC must make.

5. A concise statement of the facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

NEPA requires analysis of both direct and indirect impacts that are reasonably foreseeable. Despite NEPA's mandated analysis, the DOE knowingly fails to evaluate and assess the stigma related impacts that will result from the "reasonably foreseeable" twenty six (26) accidents identified in the Rail EIS at page S-68. Additionally, the DOE concedes that "large impacts are possible if there are accidents with releases of ionizing

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[126] 10 CFR § 51.20(b)(13).

[127] 10 CFR § 51.109(a)(1).

radiation during the transportation of spent nuclear fuel and high level radioactive waste. The social amplification and risk and stigma might become quite relevant after an accident that exposes neighborhoods to ionizing radiation." (Appendix N, FEIS pg. 23, LSN # DN2002033728).

The DOE improperly attempts to circumvent its obligation by claiming that such stigma and related property value impacts are irreducible in Section 2.4.4 of the Repository SEIS (LSN# DEN001593557). Contrary to the DOE's position, a variety of established mechanisms for measuring and mitigating stigma-related impacts resulting from the transportation of spent nuclear fuel exist. Furthermore, monitoring systems to measure and evaluate such impacts are currently utilized in assessing socio-economic impacts resulting from the transport at issue. DOE's own filings acknowledge that property values in Clark County will diminish: Appendix N of the FEIS (LSN # DN2002033728) concedes that property values will diminish by 3% even without incident.

The National Research Council Committee on Transportation of Radioactive Waste found that "the social risks for spent fuel and high level waste transportation pose important challenges to the successful implementation of programs for transporting spent fuel and high level waste in the United States. Such risks can result in lower property values along transportation routes, reductions in tourism and increased anxiety." [128] While many uncertainties exist, current research and practices demonstrate that there are many proactive steps available to reduce and manage social risks. For example, Clark County

[128] "Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States." Committee on Transportation of Radioactive Waste. National Research Council of the National Academies: The National Academies Press; Washington, D.C. (2006). Attachment 9 hereto.

implemented a monitoring program in 2005 that allows it to measure both positive and negative effects resulting from DOE's proposed plan to ship spent nuclear fuel and high level radioactive waste to Yucca Mountain.[129] The DOE can reasonably assess and

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[129] UER. "Baseline Information and Community Perspective on Potential Repository Impacts on Clark County." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Dec 1999). LSN# CLK000000022.

UER. "Boulder City Governmental and Fiscal Impact Report." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Sep 2001). LSN# CLK000000066.

UER. "City of Henderson Governmental and Fiscal Impact Report." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Jul 2001). LSN# CLK000000059.

UER. "City of Las Vegas Governmental and Fiscal Impact Report." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Sep 2001). LSN# CLK000000060.

UER. "City of Mesquite Governmental and Fiscal Impact Report." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Sep 2001). LSN# CLK000000065.

UER. "City of North Las Vegas Governmental and Fiscal Impact Report." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Jul 2001). LSN# CLK000000062.

UER. "DOE and Public Trust in the Proposed Yucca Mountain Repository Program." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Nov 2003). LSN# CLK000000028.

Navis, Irene, and Sheila Conway. "Impact Assessment and Public Outreach Strategies for Local Governments." Incorporated into Clark County's Impact Assessment Report on the Yucca Mountain Program. (Jun 2001). LSN# CLK000000052.

UER. "Impacts to Clark County Non-Public Safety Governmental Agencies Resulting from the Yucca Mountain Repository." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Dec 2001). LSN# CLK000000032.

UER. "Moapa Band of Paiute Indians Governmental and Fiscal Impact Report." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Jun 2001). LSN# CLK000000063.

UER. "Clark County Property Value Report on the Effects of DOE's Proposal To Ship High Level Nuclear Waste to a Repository at Yucca Mountain." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Jun 2001). LSN# CLK000000019.

UER. "The Role of Local and State Governments in Radioactive Waste Transportation Safety." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Feb 2003). LSN# CLK000000027.

UER. "Tribal Concerns about the Yucca Mountain Repository: An Ethnographic Investigation of the Moapa Band of Paiutes and the Las Vegas Paiute Colony." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Oct 2002). LSN# CLK000000033.

UER. "An Update of the Projected Impacts to Clark County and Local Governmental Public Safety Agencies Resulting from the Transportation of High-Level Nuclear Waste to Yucca Mountain." (Aug 2005). LSN#: CLK000000055.

implement a similar Monitoring Program in communities across the transportation corridor alternatives permitting measurement and prevention of any stigma related property value declines for each feasible alternative.

Conway, Sheila, A. Mushkatel, and K.D Pijawka. "Impacts to Clark County and Local Governmental Public Safety Agencies Resulting From the Yucca Mountain Project." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Oct 2001). LSN #: CLK000000006.

UER. "Impacts to Clark County Public Safety Agencies Resulting From the Yucca Mountain Project." (Feb 1999). LSN #: CLK000000001.

UER. "Lessons Learned from New Mexico's Experience with the Development of a Nuclear Waste Repository." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Jan 2001). LSN #CLK000000013.

UER. "Gaming Industry Impacts Resulting from the DOE's Yucca Mountain Proposal." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (June 2001). LSN# CLK000000021

UER. "Yucca Mountain Impact Assessment Report, Clark County, Nevada." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Feb 2002). Attachment 10 hereto.

UER. "Preliminary Site Suitability Evaluation for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada: Formal Response Submitted by Clark County, Nevada." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Oct 2001). LSN #: CLK000000010.

UER. "Sustainable Indicators Report." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Jan 2001). Attachment 11 hereto.

UER. "Community visioning report on behalf of the town of Indian Springs, Clark County, Nevada." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Feb 2004). Attachment 12 hereto.

UER. "Clark County Monitoring Program: Community Survey." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Apr 2008). Attachment 13 hereto.

UER. "Clark County Monitoring Program: Community Survey." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (May 2007). Attachment 14 hereto.

UER. "Clark County Monitoring Program: Community Survey." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Feb 2006). Attachment 15 hereto.

UER. "Clark County Monitoring Program: Community Survey." Prepared for the Clark County Department of Comprehensive Planning Nuclear Waste Division. (Jul 2006). Attachment 16 hereto.

Uncertainty underground: Yucca Mountain and the nation's high-level nuclear waste. Edited by Allison M. Macfarlane and Rodney C. Ewing. Cambridge, Mass.: MIT Press, c2006. LSN #: NEV000003427.

The social amplification of risk. Edited by Nick Pidgeon, Roger E. Kasperson and Paul Slovic. Cambridge : Cambridge University Press, 2003. LSN# DN2000020283.

Gawande, K., and H. Jenkins-Smith. 2001. Nuclear waste transport and residential property values: Estimating the effects of perceived risks. Journal of Environmental Economics and Management Volume 42, Issue 2, September 2001, Pages 207-233. LSN # DEN001355690.

Schweer, K. UNLV Center for Business and Economic Research. Attachment 17 hereto.

Further, the National Research Council has recommended that the Department of Energy expand its Transportation External Coordination Working Group to obtain outside advice on social risks, including impacts and management.[130] The Council also advised that a Transportation Risk Advisory Group be convened under the Federal Advisory Committee Act to provide advice on characterizing, communicating, and mitigating the social, security, and health and safety risks that arise from the transportation of spent fuel and high level nuclear waste to Yucca Mountain.[131]

6. Sufficient information to show a genuine dispute with the DOE, along with specific references to the portions of the Application begin controverted

The DOE contends that the Application as provided, inclusive of the relevant EIS's, is sufficient. Clark County's objection to this position is stated in Section 5 to this contention.

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[130] "Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States." Committee on Transportation of Radioactive Waste. National Research Council of the National Academies: The National Academies Press; Washington, D.C. (2006). Attachment 9 hereto.

[131] Id.

III. CONCLUSIONS

For the foregoing reasons the license application should be denied. Clark County therefore respectfully petitions the Presiding Officer to accept the contentions raised herein, set the matters for hearing, and grant Clark County party status with full rights of participation. Should the Presiding Officer find that none of Clark County's contentions are admissible, Clark County respectfully seeks leave to participate as an IGP.

Respectfully submitted,

signed electronically

Alan I. Robbins
Debra D. Roby
Bryce C. Loveland
Jennings Strouss & Salmon, PLC
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December 22, 2008

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of: U.S. DEPARTMENT OF ENERGY (High Level Waste Repository)	Docket No. 63-001

CERTIFICATE OF SERVICE

I hereby certify that on this day, December 22, 2008, the foregoing was served on all parties listed on the official service list for this proceeding as maintained by the Nuclear Regulatory Commission's Electronic Information Exchange.

Signed Electronically
Debra D. Roby
Jennings Strouss & Salmon, PLC
1700 Pennsylvania Ave, NW
Suite 500
Washington, D.C. 20005
Tel: (202) 464-0539
email: droby@jsslaw.com

Attachment 1

Affidavit of Dr. Alvin Mushkatel

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	
U.S. DEPARTMENT OF ENERGY	Docket No. 63-001
(High Level Waste Repository)	

DECLARATION OF DR. ALVIN MUSHKATEL

1. My name is Dr. Alvin Mushkatel. I am a partner in Urban Environmental Research, LLC ("UER"). My business address is 1120 North Town Center Drive, Suite 100 Las Vegas Nevada.

2. I am also employed by Arizona State University Polytechnic Campus as a Professor of Environmental Policy. My business address there is: Department of Applied Biological Sciences, Arizona State University Polytechnic Campus, 7001 Williams Field Road, Mesa, Arizona 85212.

3. I have 31 years of professional experience in the field of environmental studies and policy.

4. My *curriculum vitae* is attached hereto, and is summarized, in relevant part, as follows:

   a. I have been actively engaged in research and public service in the field of emergency management and disaster research since 1978.

   b. I served as a consultant to the State of Nevada's Nuclear Waste Project Office from 1986 through 1993, and currently am a consultant through my company to Clark County's Nuclear Waste Division.

   c. I am the founder and Director of the former Office of Hazards Research, at Arizona State University.

   d. I have served on over a dozen National Academy of Sciences/National Research Council Committees and Subcommittees providing expertise in emergency management, hazards preparedness, mitigation, response and recovery. These committees often focused on improving the management and performance of various federal agencies.

   e. I have authored or co-authored 5 books examining either facets of high-level nuclear waste policy or on topics related to emergency management and evacuation, as well as over thirty five articles and book chapters, twenty

monographs, and over thirty technical papers and proceedings.

f. I have served as a consultant to the Federal Emergency Management Agency, the Department of Energy, the Arizona Department of Environmental Quality, the Arizona Governor's Office, and the Arizona Division of Emergency Management.

g. I have served on numerous Federal and State commissions aimed at improving governmental preparedness and response to hazard incidents.

h. At Arizona State University I have taught a variety of classes but over the last ten years environmental policy and NEPA and the EIS process have been my primary focus.

5. I have been retained by Clark County, Nevada in connection with the potential siting of a high level radioactive waste repository at Yucca Mountain near Clark County, Nevada, and to assist Clark County with the preparation of contentions regarding inadequacies of the application, including inadequacies of the environmental impact statements.

6. I am familiar with the National Environmental Policy Act and its respective implementing regulations, as well as the regulations of the Council on Environmental Quality.

7. I have reviewed and am familiar with aspects of the Department of Energy's license application for this proceeding, including the DOE's Environmental Impact Statements.

8. CLK-NEPA-001 was prepared by me or under my supervision. The information contained therein is true and correct to the best of my knowledge and belief.

STATE OF ARIZONA)
)
COUNTY OF MARICOPA) **ss.**

OFFICIAL SEAL
ZACHARY MUSHKATEL
NOTARY PUBLIC - State of Arizona
MARICOPA COUNTY
My Comm. Expires May 11, 2012

SUBSCRIBED AND SWORN to before me this 22 day of December, 2008.

Notary Public, in and for said County and State

3193908v1(60297.1)

CURRICULUM VITAE

ALVIN H. MUSHKATEL
678 East Kyle Drive
Gilbert, Arizona85296
(480) 699-0449

Current Position:

Professor of Environmental Policy
Department of Applied Biological Sciences
Arizona State University East
7001 E. Williams Field Road Building 130
Mesa, Arizona 85212
(480) 727 -1311, Fax: (480) 727 - 1236

Birth Place: Cleveland, Ohio

EDUCATION

B.A. Ohio State University, 1967, Political Science

M.S. University of Oregon, 1970, Political Science

Ph.D. University of Oregon, 1975, Political Science

DISSERTATION: "The Effects of Annexation: A Model and Preliminary Investigation." - 1975

ADMINISTRATIVE EXPERIENCE

Coordinator, Bachelor of Science in Planning Program, Arizona State University, 1999-2000

Director, Doctor of Public Administration Program, Arizona State University, 1995 - 1996

Director, Office of Hazards Studies, Arizona State University, October 1989 - 1995

Director, Applied Urban Research, Division of Urban Studies Center, Arizona State University, 1984 - October 1989.

TEACHING AND RESEARCH EXPERIENCE

Professor of Environmental Policy, Arizona State University East (Polytechnic)

Professor of Planning, Arizona State University, Tempe, AZ. 1997 - present.

Professor of Public Affairs, Arizona State University, Tempe, AZ. 1985 – 1996.

Courtesy Appointment as Professor of Political Science, 1985 - 1993.

Associate Professor of Public Affairs, 1980-1985.

Courtesy Appointment as Associate Professor of Political Science, 1981-1985.

Arizona State University, Tempe, AZ. Tenured 1983.

Research Associate, Urban Studies Center, Arizona State University, Tempe, AZ. 1981 - 1983.

Assistant Professor of Political Science, University of Denver, Denver, CO. 1977 - 1980.

Assistant Professor of Political Science, University of Missouri, St. Louis, MO. 1975 - 1977 (Joint appointment in Extension).

Assistant Professor of Political Science, St. John's University, Collegeville, MN. 1973 - 1975.

Research Fellow, Center For The Study of Local Government, St. John's University, Collegeville, MN. 1973 -1975.

Director of Internship Program, St. John's University, January 1973 - 1975.

Teaching Assistant, University of Oregon, 1971 - 1973.

Research Fellow, University of Oregon, 1969 - 1970.

RESEARCH INTERESTS

Environmental Policy and Planning
Affordable Housing and Housing Opportunities for the Homeless
Public and Stake Holder Involvement in Policy Making
The Role of Risk Perceptions in Policy Making
Policy Evaluation
Land Use Planning and Policy Environmental Policy
Technological Hazards Policy
Emergency Management

COURSES TAUGHT

Undergraduate:
Environmental Impact Assessment
Housing Policy and Analysis
Environmental Policy and Planning
Urban Planning - Urban Policy
Urban Politics - Urban Governance
Intergovernmental Relations
Introduction to Public Policy
Introduction to American Government
Public Policy Processes and Issues
State and Local Government
Introduction to Political Science
Introduction to Political Analysis

Graduate:
Environmental Impact Assessment
Core Doctoral Class in Research Methods
Environmental Policy and Management
Core Doctoral Class in Public Policy Analysis & Evaluation
Core Masters Class in Research Methods
Core Masters Class in Public Policy
Housing Policy
Growth Management Planning & Administration
National Urban Policy
Seminar in Urban Politics

Governmental Finance Management
Urban Management and Administration

AWARDS, HONORS AND SPECIAL SERVICE

Member, Committee on the Evaluation of Chemical Events at Army Chemical Agent Disposal Facilities, National Academy of Sciences/National Research Council. April 2001-2002

Member, Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission – Licensed Facilities, National Academy of Sciences/National Research Council. October 2000-2002.

Member, Committee to Assess the Policies and Practices of the Department of Energy to Design, Manage, and Procure Environmental Restoration, Waste Management, and Other Construction Projects, National Academy of Sciences/National Research Council. June 1998 – September 1999.

Member, Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program. National Academy of Sciences/National Research Council,
1992 - 1995. Reappointed 1995 - March, 1999

Member, Panel on Review and Evaluation of Alternative Chemical Disposal Technologies, National Academy of Sciences/National Research Council. September 1995 - July 1996.

School of Public Affairs, Public Service Excellence Award (co-recipient), for the Phoenix Housing Condition Evaluation. April 26, 1996.

Recipient, Governor's Spirit of Excellence Award in Public Service. October 1995.

Recipient, Presidential Multi-Disciplinary Team Award for Excellence in Public Service -- Bronze Award for Phoenix Housing Inventory Study. March 1995.

Member, Committee on Decontamination and Decommissioning of Uranium Enrichment Facilities, National Academy of Sciences/National Research Council. December 1993 – 1995.

Member, Arizona Department of Environmental Quality Cleanup Standards/Policy Task Force. August 1994-

Member, Arizona Corporation Commission Advisory Committee on Externalities from High Voltage Transmission Lines. June 1993 - December 1993.

Member, National Institute of Building Sciences, Building and Science Commission Advisory committee on Standards for Rehabilitation of Existing Structures. May 1993- December 1994.

Recipient, School of Public Affairs, Leg of the Stool Award for Excellence in Research, 1993.

Member, Arizona Council for Earthquake Safety. Appointed by the Governor, February 18, 1993-1995.

Member, Department of Energy-HQ Public Participation Seminar Series Panel, Public Trust and Confidence: What Do The Data Tell Us? Washington, D.C. February 16 - 17, 1993. (One of four academics chosen to participate.)

Member, Arizona Department of Environmental Quality. State Long-Term Improved Management Implementation Advisory Committee, 1992 - 1994.

Member, Arizona Commission on Earthquake Safety. Arizona Division of Emergency Services, 1992.

Recipient, College of Public Programs. Leg of the Stool Award for Outstanding Achievement for Public Service, 1991 - 1992.

Member, Committee on Earthquake Engineering of the Commission on Engineering and Technical Systems. National Academy of Sciences/National Research Council, 1991 - 1992.

Member, National Academy of Sciences/National Research Council. Panel on Assessing the Impact of the National Earthquake Hazards Reduction Act of 1977, 1988 - 1992.

Member, Technical Advisory Committee. Committee on Establishing Priorities for Seismic Rehabilitation of Buildings. Federal Emergency Management Agency, 1988 - 1989.

Member, National Academy of Sciences, Committee on Earthquake Engineering. Panel on Seismic Policy Adoption and Implementation, 1986 - 1989.

Member, National Academy of Sciences, Committee on Earthquake Engineering, Panel on Earthquake Loss Estimation Methodology. Chair sub-panel on State and Local Government User Needs, 1985 - 1987.

Member, Phoenix Community Development Steering Committee. Appointed by the Mayor, September 1985 - 1989.

State of Arizona Representative to the Western States Seismic Policy Council, 1984 - 1985.

Recipient, College of Public Programs. Leg of the Stool Award for Outstanding Achievement for Research, 1983 - 1984.

Member, Technical Advisory Panel, Central United States Earthquake Preparedness Project. Region VII Federal Emergency Management Agency, September 1983.

Member, State Urban Lands Advisory Committee. Appointed by the Governor, September 1982.

Research Fellow, Center for the Study of Local Government. St. John's University, January 1975 - July 1975.

Co-Chairperson, Graduate Student Political Science Association. University of Oregon, 1972 - 1973.

Recipient, Office of Economic Opportunity Scholarship, 1967.

President's Scholarship Award, 1967.

GRANTS AND CONTRACTS AWARDED (SELECTED)

"The Phoenix Housing Quality Survey" City of Phoenix, Neighborhood Service Department Project Director and Principal Investigator ($204,000) June 2004-June 2005.

An Evaluation of Impact Resulting from the Shipment of High-Level Nuclear Waste Through Clark County, Nevada". Co-principal Investigator, Clark County, Nevada Nuclear Waste Division ($485,000) July 2004-June 2005.

An Evaluation of Impact Resulting from the Shipment of High-Level Nuclear Waste Through Clark County, Nevada". Co-principal Investigator, Clark County, Nevada Nuclear Waste Division ($450,000) July 2003-June 2004.

An Evaluation of Impact Resulting from the Shipment of High-Level Nuclear Waste Through Clark County, Nevada". Co-principal Investigator, Clark County, Nevada Nuclear Waste Division ($425,000) July 2002-June 2003.

"An Evaluation of Impact Resulting from the Shipment of High-Level Nuclear Waste Through Clark County, Nevada". Co-principal Investigator, Clark County, Nevada Nuclear Waste Division ($350,000) July 2001 – June 2002.

"Technological Hazards, Vulnerable populations, and Emergency Management Capacity on the US/Mexico Border" with Robert Bolins, Co-principal Investigator, submitted to Southwest Center for Environmental Research and Policy ($52,000, July 2001- present).

" An Evaluation of Impacts Resulting from the Shipment of High-Level Nuclear Waste Through Clark County, Nevada" Co-principal Investigator, Clark County, Nevada Nuclear Waste Division ($325,000) July 2000 – May 2001.

"An Analysis of Public Views' of Property Values and the Shipment of High-Level Nuclear Waste" Co-principal Investigator, Nuclear Waste Project Office, Nevada ($10,000) September 2000 – May 2001

" An Assessment of Property Value Diminution Resulting from the Shipment of High-Level Nuclear Waste Through Clark County, Nevada" Co-principal Investigator, Nuclear Waste Project Office, Nevada ($35,000) May 2000 – August 2000.

" A Review and Assessment of Potential Impacts from High-Level Nuclear Waste Shipments" Co-principal Investigator , Clark County, Nevada ($108,000) May 1999 – May 2000.

"An Evaluation of Assisted Housing Concentration in Phoenix: The Role of Contextual and Environmental Factors" Arizona Department of Health Services. October 1999 – October 2000 ($7500).

"An Evaluation of Housing Programs for the Severely Mentally Ill : The Continuum of Care Reassessed" with ComCare, Phoenix, Arizona, to Substance Abuse and Mental Health Service Administration, Health and Human Services. October 1997 – August 1998 ($150,000).

"The Destruction of Chemical Weapons and Citizen Involvement in the U.S. and Russia: A Linkage Grant." with David Kossan. Submitted to NATO's Committee on Science and Technology, Brussels, Belgium. ($24,750 funded and declined)

"Soil Remediation Workshop." U.S. Environmental Protection Agency and the Arizona Department of Environmental Quality Funding for the workshop -- 165 participants. May 2, 1996.

"Hazardous Waste Minimization Workshop." U.S. Environmental Protection Agency Funding for the workshop on pollution prevention -- 54 participants. February 15, 1996.

"State Institutional Impacts from the High-Level Nuclear Waste Repository". Co-principal Investigator. Nevada Nuclear Waste Project Office ($17,500). March 1994 - January 1995.

"Hazardous Waste Minimization Workshop." U.S. Environmental Protection Agency Funding for the workshop on pollution prevention -- 51 participants. April 1995.

"Urban Impacts and Land Diminution". Co-principal Investigator. Nevada Nuclear Waste Project Office ($15,000). March 1994 - January 1995.

"The Phoenix Housing Condition Inventory." Co-principal Investigator. Phoenix Department of Housing and Neighborhood Improvement ($100,000). May 1994 - June 1995.

"Hazardous Waste Minimization Workshop." U.S. Environmental Protection Agency Funding for the workshop on pollution prevention -- 82 participants. May 1994.

"The Relationship Between Political Trust and Risk Perceptions." Co-principal Investigator. Nevada Nuclear Waste Project Office ($42,500). Continuation of examination. May 1992 - June 1993.

"An Institutional Analysis of Emergency Response In The U.S. - Mexico Border Region." U.S. Environmental Protection Agency with Southwest Center For Environmental Research and Policy ($34,000). 1992 - 1993.

"Emergency Services and Cooperative Arrangements for Esmeralda County". Esmeralda County, Nevada ($15,000). April 1993 - October 1993.

"Hazardous Waste Minimization Workshop." U.S. Environmental Protection Agency and the Arizona Department of Environmental Quality ($2,500). September, 1992. Funding for workshop on hazardous waste minimization -- 85 participants.

"The Relationship Between Political Trust and Risk Perceptions: A Survey of Las Vegas Metropolitan Residents." Co-principal Investigator. U.S. Department of Energy and the Nevada Nuclear Waste Project Office ($18,500). May - September 1992.

"Emergency Response Capacity to High-Level Nuclear Waste and Hazardous Materials Transportation incidents in Esmeralda County". Co-principal Investigator. Esmeralda County, Nevada ($15,500). October 1991 - September 1992.

"The Completion of the Nevada State Comprehensive Emergency Management Plan." Nevada Division of Emergency Management ($15,400). April - September 1992.

"The Relationship Between Political Trust and Risk Perceptions." Co-principal Investigator. Nevada Nuclear Waste Project Office ($17,250). December 1991 - April 1992.

"Analysis of Small Quantity Generators of Hazardous Waste." Co-principal Investigator. Arizona Department of Environmental Quality ($8,500). 1991.

"An Analysis of University Trust Lands Funding Eminent Scholars At The Arizona Universities." Funded by the Office of the Vice President for University Relations ($10,000). 1991.

"Hazardous Waste Minimization Practices and Regulation." Co-principal Investigator. U.S. Environmental Protection Agency and the Arizona Department of Environmental Quality ($9,990). May - October, 1991.

"Dimensions of Trust Perceptions In Siting Hazardous Facilities." Co-principal Investigator. Nevada Nuclear Waste Project Office ($2,750). 1991.

"Risk Perceptions and Guidelines For Siting Noxious Facilities." Co-principal Investigator. U.S. Environmental Protection Agency through the Southwest Center for Environmental Research and Policy ($14,000). June 1991 - May 1991.

"Hazardous Waste Minimization in Arizona." Co-principal Investigator. Arizona Department of Environmental Quality ($2,470). February 1991. Funding for workshop on hazardous waste minimization -- 85 participants.

"Relocated Client Satisfaction Survey: Phase II." Phoenix Neighborhood Improvement and Housing Department ($2,970). October 1990 - May 1991.

"The Development of the Nevada State Emergency Management Plan." Nevada Division of Emergency Management ($17,890). October 1990 - June 1991.

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"The Effects of School District Desegregation on Housing Values: Is There Cause for White Flight?" With Linda G. Mushkatel. Presented at the annual meeting of the Western Social Science Association, Denver, CO. April 1978.

"Urban-Rural Class Conflict in Oregon: Throwing a Monkey Wrench into State Land-Use Planning." With Jerry Medler. Presented at the Annual Meeting of the Western Political Science Association, Los Angeles, CA. March 1978.

"The Effect of Planning in the U.S. and Israel: The Use of Eminent Domain." With Khalil Nakleh. Presented at the Annual Meeting of the International Studies Association, Washington, D.C., February 1978.

"The Emergence of State Planning and Its Potential Impact on Urban Areas." With Linda G. Mushkatel. Presented at the Convergence of Urban Planning and Urban Administration: A Conference for Practitioners and Academics, Kansas City, MO. May 5-7, 1977.

"Problems and Strategies in Evaluating the Effects of State Land-Use Policy." With Linda G. Mushkatel. Presented at the Annual Meeting of the Western Political Science Association, Phoenix, AZ. April 1977.

"Citizen Response to Annexation Policies." With L.A. Wilson II presented at the Annual Meeting of the Western Political Science Association, San Diego, CA. April 1973.

"Annexation Policies of Cities and Urban Conflict." With L.A. Wilson II. Presented at the Annual Meeting of the Pacific Northwest Political Science Association, Washington State University, Pullman, WA. April 1973.

"Professional Education in Political Science Departments." With John Orbell and Lawrence Pierce. Presented at the Annual Meeting of the Western Political Science Association, Albuquerque, NM. April 1971.

BOOK REVIEWS

Review of Gerald Jacob's Site Unseen: The Politics of Siting A Nuclear Waste Repository. With K. David Pijawka. Land Economics, University of Wisconsin Press, Vol. 68, No. 1, February 1992. pp. 123-126

Journal of Politics - Fall 1980

PROFESSIONAL ACTIVITIES (SELECTED)

Member, Editorial Board, Kluwer Academic Publishers (The Netherlands), Advances in Natural and Technological Hazards Research Series. Appointed, 1992 – 1998.

Editorial Advisory Board, Natural Hazards, Journal of the International Society for the Prevention and Mitigation of Natural Hazards. Appointed, 1992 – 1999.

Chairperson of Policy Roundtable, "High-Level Nuclear Waste Policy." Annual Meeting of the American Political Science Association Meetings, Washington, D.C. August 1991.

Chairperson of panel, "Perspectives on Environmental Policy Making." Annual Meeting of the Western Social Science Association, Portland, OR. April 1990.

Participant, National Association of Schools of Public Affairs and Administration and the Federal Emergency Management Agency Workshop, Emmitsburg, MD. May 21-June 2, 1984.

Discussant on panel, "Constraints and Opportunities in Intergovernmental Relations." Annual Meeting of the Political Science Association, San Diego, CA. March 27, 1982.

Discussant on panel, "A Roundtable on Hazards Policy Research." Annual Meeting of the American Political Science Association, Denver, CO. September 10, 1982.

Discussant on panel, "The Politics of Disaster Preparedness and Recovery." Annual Meeting of the Western Political Science Association, Denver, CO. March 24-26, 1981.

Chairperson of panel, "Federal Policy in the City." Annual Meeting of the Western Political Science Association, Denver, CO. March 1981.

Chairperson of panel, "Environment and Policy." Annual Meeting of the Western Social Science Association, Albuquerque, NM. April 1980.

Co-Chair of Local Arrangements Committee, Western Political Science Association Meetings, 1981, Denver, CO. January 1980 - June 1980.

Political Science Program Coordinator - 1979 Western Social Science Association Meeting, Lake Tahoe, NV. April 26-28, 1979.

Chairperson of panel, "The Effects of School Desegregation." Annual Meeting of the Western Social Science Association, Denver, CO. April 1978.

Chairperson of panel, "Urban Growth Management." Annual Meeting of the Western Political Association, Los Angeles, CA. March 1978.

Chairperson of panel, "Comparative Land Use and Housing Policy." Annual Meeting of the International Studies Association, Washington, D.C. February 1978.

Discussant, Panel, "Urban Problems and Services." Annual Meeting of the Western Political Science Association, Sheraton Palace, San Francisco, CA. April 1-3, 1976.

Chairperson of Panel, "Citizen Participation in Land-Use Decisions." Conference sponsored by Minnesota Humanities Commission on Land: Our American Heritage, Collegeville, MN. June 4-6, 1974.

Member, Panel on Graduate Student Education, Pacific Northwest Political Science Association Meeting, Tacoma, WA. April 1971.

Field Associate, Community Development Block Grant Study. Principal Investigator with Paul Dommel. U.S. Department of Housing and Urban Development, Cleveland State University, 1982-1983.

National Science Foundation - Decision, Risk and Management Sciences Program Division of Social and Economic Sciences Directorate of Social, Behavioral and Economic Sciences-referee 2003-2004.

National Science Foundation - Applied Social and Behavioral Science Program - referee 1982 - 1991.

National Science Foundation - Civil & Environmental Engineering/Policy Research - referee - 1981 - 1990.

OTHER PROFESSIONAL ACTIVITIES

Journal of Landscape and Urban Planning – referee- 1995 - present
Earthquake Spectra - referee - 1990 - present
Public Administration Review - referee - 1986 - 1992.
Journal of the American Planning Association - referee - 1986
Plenum Press - book referee - 1984
Policy Studies Review - referee - 1983 - present
Urban Affairs Review (Urban Affairs Quarterly) - referee - 1981 - present
Policy Studies Journal - referee - 1981 - present
Western Political Quarterly - referee - 1980 - present
Urban Affairs Papers/Journal - referee - 1980
Environmental Management - referee - 1980 - 1982, 1988-present
Social Problems - referee - 1979 - 1982
The Western Social Science Journal - referee - 1978 - present
Prentice-Hall - book referee - 1977 - 1978
Holt, Rinehart and Winston - book referee - 1978 - 1980
Reader for validity study of GRE Advanced Political Science Test - 198\

CONSULTING AND COMMUNITY SERVICE

Arizona Department of Environmental Quality
Arizona Department of Health Services
Phoenix Neighborhood Housing and Development Department
Phoenix Housing and Urban Redevelopment Department, 1982- present.
Department Housing, 1982 – 1999.
ComCare Housing Program for Severely Mentally Ill, 1995 - 1998
Arizona Department of Environmental Quality, 1991 - (Pollution Prevention).
Motorola, Inc. 1991- Environmental Education and Risk Analysis.
Arizona Board of Regents, 1991 - (Trust Lands).
Arizona Department of Commerce, 1987 - 1991.
State of Nevada Nuclear Waste Project Office.
Western Arizona Council of Governments. Management Study to Prevent Default 1985-1986.
Town of Parker - Annexation Feasibility Analysis 1985.
Town of Lakeside and Pinetop - Economic Development Analysis with the City Manager.
Lake Havasu City - Growth Related Issues, 1985 - 1990.
California State Seismic Safety Commission, 1984 - 1990.
Building and Seismic Safety Commission - Information Dissemination, 1988 - present.
Western Gateway Planning in Maricopa County for the Communities of Avondale, Litchfield and Goodyear.
Arizona State Land Department, 1980-present.

Governor's Commission on the Arizona Environment, 1980-1982.
Denver Urban Renewal Authority, 1979-1983.
City and County of Denver Community Development Agency, 1978- 1983.
A number of municipalities in 4 different states on local zoning.

PROFESSIONAL MEMBERSHIPS

American Political Science Association
Society For Risk Analysis
American Society of Public Administration
Western Political Science Association
Pi Sigma Alpha, Political Science Honorary
Pi Alpha Alpha, Public Administration Honorary
Earthquake Engineering Research Institute

COMMITTEE SERVIC

2004-2005 Arizona State University East
Member, Department Core Undergraduate Curriculum Committee
Member, Department Core Graduate Curriculum Committee
Member, Recruitment Committee for the Director of the Division of Social Sciences, and the Director of the Humanities Division

2003-2004 Arizona State University East
Member, Recruitment Committee for the Director of the Division of Social Sciences and the Director of the Humanities Division
2002-2003 Arizona State University
Chair, College Personnel Committee
Member, Masters of Environmental Planning Committee

2002-2003 Arizona State University
Member, College Personnel Committee
Member, Masters of Environmental Planning Committee

1999-2000 Arizona State University
Member, College Personnel Committee
Coordinator, Bachelor of Science in Planning Committee
Member, Masters of Environmental Planning Committee

1998-1999 Arizona State University
Member, Personnel Committee
Member, Masters of Environmental Planning Committee
Member, Bachelor of Science in Planning Committee
Member, University parking Committee

1997-1998 Arizona State University
Member, Personnel Committee
Member, Masters of Environmental Planning Committee
Member, Bachelor of Science in Planning Committee
Member, University parking Committee

1996-1997 Arizona State University
Member, Master's of Environmental Planning Committee
Member, Bachelor of Science in Planning Committee

Member, Personnel Committee

1995-1996. Arizona State University
Co-Chair, Personnel Committee
Member, MPA Committee
Member, Recruitment Committee
Member, University Residence Board
Member, Self Study NASPAQ Review Committee

1994-1995. Arizona State University
Chair, Personnel Committee
Member, Recruitment Committee
Member, University Parking Appeals Board
Member, University Residence Board
Technical Advisor, Board of Regents, Eminent Scholars Committee

1992-1993. Arizona State University
Chair, Committee on Establishing an Undergraduate Public Administration/Policy Major
Technical Advisor, Board of Regents, Eminent Scholars Committee
Member, University Parking Appeals Board
Member, University Residence Board
Member, Admissions and Standards Committee, School of Public Affairs

1993-1994. Sabbatical

1991-1992. Arizona State University
Technical Advisor, Board of Regents, Eminent Scholars Committee
Member, Board of Regents Trust Land Exchange Committee
Member, Vice President for Research University Council on Research and Creative Activities
Chair, Subcommittee on Social Science Awards
Member, University Parking Appeals Board
Member, University Residence Board
Member, Admissions and Standards Committee, School of Public Affairs

1990-1991. Arizona State University
Member, Vice President for Research University Council on Research and Creative Activities
Chair, College of Public Programs Committee on Research
Member, Admissions and Standards Committee, School of Public Affairs

1988-1989. Arizona State University
Member, Dean's Search Committee
Member, School Personnel Committee
Chair, Urban Field Committee

1987-1988. Sabbatical

1986-1987. Arizona State University
College Personnel Committee
School Student Affairs Committee

1985-1986. Arizona State University
Chairperson, Center Curriculum Committee

Morrison Institute Director Recruitment Committee
Chair, Urban Field Committee

1984-1985. Arizona State University
Chairperson, Center Curriculum Committee
Morrison Institute Committee
Center Recruitment Committee

1983-1984. Arizona State University
Chairperson, Search Committee for the Center's Director
Chairperson, Center Curriculum Committee
Search Committee for the Urban Studies Center's Director
Honorary Degrees Committee, College
University Library Committee
Undergraduate Curriculum Committee, College

1982-1983. Arizona State University
University Library Committee
University Committee on City and Regional Planning
College Graduate Curriculum Committee
University Hazards Research Committee

1981-1982. Arizona State University
Chairperson, College Graduate Curriculum Committee
Environmental Studies Center Recruitment Committee
Director, MPA Program

1980-1981. Arizona State University
College Graduate Curriculum Committee
Special MPA Committee
Student Affairs Committee
Faculty Representative to Associated Students of the Center for Public Affairs

1977-1980. University of Denver
504 Task Force on Disabled Persons (1980)
Departmental Recruitment Committee
Honors Program Committee
Internship Committee
Curriculum Committee

1975-1977. University of Missouri - St. Louis
University Extension Committee
Departmental Recruitment

1973-1975. St. John's University
University Advisory Committee to the Academic Vice President
University Research Committee
Departmental Recruitment
Departmental Curriculum

REFERENCES

Provided On Request

Attachment 2

Affidavit of Dr. Sheila Conway

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

In the Matter of: U.S. DEPARTMENT OF ENERGY (High Level Waste Repository)	Docket No. 63-001

DECLARATION OF DR. SHEILA CONWAY

1. My name is Dr. Sheila Conway. I am the managing partner in Urban Environmental Research, LLC ("UER"). My business address is 1120 North Town Center Drive, Suite 100, Las Vegas, Nevada.

2. I have over 30 years of professional experience in the field of environmental studies and policy.

3. My *curriculum vitae* is attached hereto. Among other responsibilities, I am currently in charge of the Critical Infrastructure Protection Program (Silver Shield) for the State of Nevada which identifies critical infrastructure, assets, systems, networks and functions critical to the state's economic security, public health and safety, responsible for conducting socio-economic impact analysis, including property value diminution; public safety impacts; government/fiscal impact; and regulatory compliance for Clark County, Nevada.

4. I was retained by Clark County, Nevada in connection with the potential siting of a high level nuclear waste repository at Yucca Mountain near Clark County, Nevada, and to assist Clark County with the preparation of contentions regarding inadequacies of the application, including inadequacies of the environmental impact statements.

5. I have reviewed and am familiar with aspects of the Department of Energy's license application for a high level nuclear waste repository at Yucca Mountain, including the DOE's Environmental Impact Statements.

6. I am familiar with the Nuclear Waste Policy Act and the National Environmental Policy Act and their respective implementing regulations, as well as the regulations of the Council on Environmental Quality.

Affidavit of Dr. Sheila Conway

7. CLK-NEPA-002 CLK-NEPA-003, CLK-SAFETY-002 and CLK-SAFETY-012 were prepared by me or under my supervision. The information contained therein is true and correct to the best of my knowledge and belief.

STATE OF NEVADA)
) **ss.**
COUNTY OF CLARK)

Sheila Conway

SUBSCRIBED AND SWORN to before me this 22 day of December, 2008.

K Pressler

Notary Public, in and for said County and State Nevada

NOTARY PUBLIC
STATE OF NEVADA
County of Clark
K. PRESSLER
No: 04-87155-1
My Appointment Expires Feb. 1, 2012

SHEILA CONWAY
2309 Stone Glen Lane
Las Vegas, NV 89134
(702) 254-0306 (Work) (702) 469-3406
sheila@uerlv.com

EDUCATION

Arizona State University: Ph.D. Environmental Planning and Design
Arizona State University: MA Environmental Geography
University of South Florida: BA Geography

EMPLOYMENT HISTORY

Urban Environmental Research, LLC

Managing Partner 1999-Present

In charge of the Critical Infrastructure Protection Program (Silver Shield) for the State of Nevada which identifies critical infrastructure, assets, systems, networks and functions critical to the state's economic security, public health and safety, responsible for conducting socio-economic impact analysis, including property value diminution; public safety impacts; government/fiscal impact; and regulatory compliance for Clark County, Nevada. Synthesized over a decade of research data addressing socio-economic, demographic, and behavioral research in order to identify key relationships that influence risk perception and behavior. Conducted statistical analysis of a survey of local businesses to determine their perception of risk from the proposed transport of high-level radioactive waste. Analyzed a draft Environmental Impact Statement for NEPA and NWPA compliance. Conducted property value diminution studies and studies analyzing public safety impacts for the following Nevada cities: Las Vegas, North Las Vegas, Mesquite, Henderson, Boulder City. Also, conducted three property value studies for the State of Nevada.

Environmental Synergy, Inc.

President 1994-1997

Established this environmental consulting firm to provide socio-economic impact analysis, property value diminution studies, regulatory compliance planning, and analysis for complex hazardous waste management and other environmental issues.

Colorado Center for Environmental Management

Executive Director 1991-1993

Helped this non-profit organization define its vision and mission; secured an initial seven million dollar grant from the US Department of Energy and managed all of the organization's hazardous work research and community outreach. Analyzed socio-economic impact of DOE clean-up activities at six weapons facilities. Designed and tested a model consensus building strategy for the testing and acceptability review for new environmental technologies. This work is summarized in two books *Environmental Decision-Making. Conflict and Consensus and Methods for Assuring the Use of lnnovative Technologies*

ICF Kaiser Engineers

Project Manager 1985-1991

Experienced in socio-economic impact assessment, risk assessment and management, property valuation studies, key trend analysis, economic impact analysis, and regulatory analysis. Provided extensive technical support in environmental assessment, permitting, and regulatory and public acceptance of sensitive environmental projects. Directed or participated in over a hundred projects, specializing in hazardous waste, high and low level radioactive waste, solid waste and related environmental concerns.

Utah Department of Community and Economic Development

Public and Regulatory Affairs Information Officer 1983-1984

Experienced in energy planning, environmental management, regulatory analysis, public policy, strategic public participation, risk assessment and management. Directed or participated in over a hundred projects, including seven Environmental Impact Statements (EISs), spanning a broad range of energy, hazardous waste, high-level radioactive waste and solid waste.

John Short and Associates

Senior Management Consultant 1982-1983

Provided socio-economic impact assessment related to energy development projects including coal mines, gasification facilities, and synthetic fuels development.

Utah Energy Office

Federal/State Natural Resource Coordinator 1979-1982

Provided energy planning, socio-economic impact assessment, environmental management, regulatory analysis, and policy analysis on a wide number of energy resources and environmental issues.

Utah Office of Labor

Research Analyst 1977-1979

Conducted energy manpower and training analysis for the Tristate Energy Consortium of Utah, Colorado and Wyoming.

AWARDS AND APPOINTMENTS

Letter of Commendation for Signo-Mount Vernon Emergency Response from Regional USEPA Administrator Christopher Daggett, 1991.

New York State Civil Service Commission: Department of Environmental Conservation Subcommittee, 1989-1991

Letter of Commendation for Flood Emergency Management and Preparation from Utah Public Safety Commissioner Larry Lunnen, 1984.

Letter of Commendation for Wilderness Designation Analysis from Governor Scott M. Matheson, 1983.

PUBLICATIONS

Aguero, J., Conway, S., & Navis, I. Community monitoring in a tourism-dependent economy. *Sustainable Tourism II (pp.297-309). Ed.* C.A. Brebbia & F.D. Pineda. WIT Press, Wessex: UK. 2006.

Conway, Sheila. "The 2007 Projected Impacts to Clark County and Local Governmental Public Safety Agencies Resulting from the Transportation of High-Level Nuclear Waste to Yucca Mountain." Waste Management Symposium. Tucson, AZ . Feb 2008.

Conway, Sheila, *Monitoring Program* (Quality of Life Institute, Vermont; 2007).

Conway, Sheila, *Bringing ITS All Together* (Trafford Press, United Kingdom, 2007).

Conway, Sheila. "Yucca Mountain Bottom line: The Cost of Increased Public Safety Services." Midwest Political Science Association. Chicago, Illinois. 2007.

Conway, Sheila. "Clark County, Nevada's Assessment of Land use Conflicts." Waste Management Symposium. Tucson, AZ . Feb 2007.

Conway, Sheila. "Yucca Mountain Bottom Line: The High Cost of Increased Public Safety Services." Waste Management Symposium. Tucson, AZ . Feb 2007.

Conway, Sheila. "Clark County Monitoring Program." The 11th International Conference on Environmental Remediation and Radioactive Waste Management. Bruges, Belgium Sep 2-6 2007.

Conway, Sheila. "Clark County Monitoring Program." Waste Management Symposium. Tucson, AZ . Feb 2006.

Conway, Sheila. "Clark County Monitoring Program." Sustainable Tourism. Bologna, Italy. Sep 2006.

Conway, Sheila. "Clark County Monitoring Program: Economic Impacts of High-level Nuclear Waste Shipments." Environmental Economics. Mykonos, Greece. Sep 2006.

Conway, Sheila. "Spent Fuel Transportation Initiatives." The 10th International Conference on Environmental Remediation and Radioactive Waste Management. Glasgow, Scotland. Sep 4-8 2005.

Conway, Sheila, *Environmental Decision-Making: Conflict and Consensus* (Denver, Colorado: USDOE, 1993).

Conway, Sheila, *Methods for Assuring the Use of Innovative Technologies* (Denver, Colorado: USDOE, 1993).

Conway, Sheila, *Technology/Regulatory Integration Project Summary Report* (Denver, Colorado: USDOE, 1993).

Conway, Sheila, *Improving the Superfund Peer Review Process* (New York, New York: USEPA, 1990).

Conway, Sheila, *Socio-Economic Monitoring Report: Skyline Mines* (Grand Junction, Colorado: USOSM, 1982).

Conway, S, & Navis, I. "Clark County Monitoring Program: Stigma induced property value diminutia from nuclear waste transportation." 24th International Symposium on Forecasting. International Institute of Forecasters. Sydney, Australia. Jul 4-7 2004.

Conway, S, & Navis, I. Commodity Flow Study- Clark County, Nevada, USA. *Urban Transport XIII: Urban Transport and the Environment in the 21st Century. Ed.* C.A. Brebbia. WIT Press, Wessex: UK. 2007.

Conway, S, Washeba, P., & Navis, I. Impact Assessment and public outreach strategies of local governments. *Environmental Health Risk III. Ed.* C.A. Brebbia, Popov, V., & Fayzieva, D. WIT Press, Wessex: UK. 2007.

PAPERS PRESENTED

2004 American Nuclear Society's Waste Management Conference
2003 American Nuclear Society's International High Level Nuclear Waste Management Conference
1997 Southwest Association of Geographers
1994 United States DOE Technology Information Exchange
1993 United States DOE Technology Information Exchange
USEPA Innovative Technologies and Waste Cleanup Workshop, Washington, DC
Federal Facility Compliance, Government Institutes, Inc., Las Vegas, Nevada
DOE/Industry Technology Roundtable
National Association of Professional Environmental Communicators, Chicago, IL
1992 Superfund '92, Washington, DC
Environmental Careers Symposium, University of Denver
National Environmental Health Association Annual Conference
Waste Minimization Research and Development Priorities, Colorado State University
Cleanup Research and Development Priorities Roundtable, Washington, DC
University/Institutional Environmental Research Opportunities Workshop, Washington
USEPA Innovative Technologies and Waste Cleanup Workshop, Washington, DC
Working Together for a Cleaner Colorado, Denver, Colorado
Spectrum '92, Boise, Idaho
1990 Superfund '90, Washington, DC
1982 *Environmental Planning*, Westminister College
1981 *Synfuels: Does It Make Sense?* University of Utah
1979 *Manpower Needs Tristate Energy Manpower Consortium*

PAST AND PRESENT ASSOCIATIONS

Association of American Geographers
National Association of Environmental Professionals
National Association of Environmental Communicators
Association of Pacific Coast Geographers
American Geographical Society
International Association of Public Participation
Gamma Theta Upsilon Lowry Air Force Base

PROFESSIONAL SERVICE

U.S. Department of Energy
U.S. Environmental Protection Agency
State of Colorado
State of Utah

U.S. Department of Interior
U.S. Department of Defense
New York: Department of Environmental Protection
New Jersey: Hazardous Waste Siting Commission
New Jersey: Department of Environmental Protection
Colorado Council on Rocky Flats
Western Governors' Association
Lowry Air Force Base
Rocky Flats Citizens Review Group
Tyndall Air Force Base

SELECTED PROJECT DESCRIPTIONS

ENVIRONMENTAL DECISIONMAKING

- **Wilderness Designation Analysis.** For the State of Utah, assessed the environmental implications of designating 54 Utah sites as wilderness areas. This assessment included developing a decision-making methodology for the regulatory, environmental, and socio-economic impacts and the design of the state preferred package. Participated in the public involvement process for this project and assisted with the Congressional briefings and support necessary for the passage of the 1984 Utah Wilderness Act. For this work, received a commendation from Utah Governor Scott M. Matheson.

- **Environmental Restoration Performance Criteria.** As part of DOE's Environmental Restoration program, updated and integrated the environmental, safety, and health performance criteria for Los Alamos National Laboratory. This work included the development of a management information system for all DOE Orders and Administrative Requirements (ARS), federal, and New Mexico state environmental regulations.

- **High Level Nuclear Waste Siting Analysis.** Supported the assessment of geological, seismic, environmental, health, socioeconomic, and transportation issues for the DOE's proposed development of a high-level nuclear waste repository in Canyonlands, Utah.

- **RCRA Part B Permit Compliance.** Designed a model for incorporating state, local, and public concerns into the permitting process. Evaluated the process, schedule, and results of the trial burns for the incinerator at the Site for the U.S. EPA at the Hyde Park Site, a sensitive and complex Superfund and RCRA facility in Niagara Falls, New York.

- **Fiscal Impact Forecasting Model.** For the State of Utah, developed a fiscal impact model to analyze revenue and expenditure implications on local and state governments for the proposed siting of the MX missiles in Utah. This analysis was then used to develop proposed compensation alternatives.

- **Financial Cost Accounting System.** For five Mid-Atlantic States, managed the development of a financial cost accounting system to meet EPA financial assurance requirements for administering underground storage tank enforcement and corrective action programs.

- **Energy Manpower Forecasting.** For the U.S. Department of Labor Region VIII (Utah, Montana, North Dakota, South Dakota, Wyoming, and Colorado), analyzed energy manpower and training needs. Developed forecasting methodologies and related databases, and conducted analyses of supply alternatives and capacity.

- **Severance Tax Analysis.** Conducted a fiscal impact analysis of alternative severance tax proposals on state and local revenues in Utah and prepared alternative strategies. Provided technical assistance to the Utah state legislature in developing and assessing natural resource regulation and taxing legislation decision-making criteria.

- **Health Care Impact Analysis.** For the Utah State Department of Health, conducted an assessment of the health care impacts from the proposed development of alternative synthetic fuel project scenarios for the Uintah Basin, Utah. This project included developing a model decision-making process for health care facilities in rural areas.

ENVIRONMENTAL MANAGEMENT

- **Environmental Audits.** For the Department of Energy (DOE), participated in several environmental audits at Los Alamos National Laboratory/LANL and at Sandia. Coordinated an evaluation of lab-wide environmental and regulatory deficiencies using Mort analysis at LANL.

- **Environmental Audit.** Managed an environmental audit of a major commercial transaction in Newark, New Jersey for a private developer. This included an environmental due diligence audit; overseeing a voluntary cleanup of asbestos and lead; negotiations with two environmental agencies on cleanup; and expert property valuation study.

- **Land Value Assessment.** In behalf of an insurance company assessed the value of a coastal property in Jersey City, New Jersey after a remediation of PCBs had been completed. This included providing expert testimony in court and negotiating allowable land use with three governmental agencies.

- **Superfund Investigations.** Prepared the Interim Background Investigation Report and provided regulatory compliance analysis for the development of the remedial investigation report for the New Jersey Department of Environmental Protection at the PJP Landfill Site. Provided regulatory compliance analyses for the development of the remedial investigation reports f or the U.S.EPA at the Brook Industrial Park and the Pohatcong Valley Groundwater Contamination Superfund Sites.

- **Environmental Impact Statements.** Assisted in the preparation of EIS's for: the Bonanza Power Plant in Uintah Basin, Utah; the Intermountain Power Project in Delta, Utah; the Uintah Basin Synthetic Fuels Project, a nine project, site specific and

regional EIS in Uintah, Utah; and Skyline Mines 1, 2, and 3 in Carbon County, Utah. Contributed to the Kaiparowits Coal Leasing Program EIS. Support for these EIS's ranged from development of specific analysis, such as socioeconomic impact analyses, to entire project management.

- **Coal Mine Permit Assistance.** Prepared technical analyses necessary to complete federal, state, and local permit requirements including the ongoing monitoring requirements under the Surface Mine Reclamation Act for a private sector client. This included an evaluation of both environmental and socioeconomic impacts for the development of a three-ton per year coal mine, employing 870,workers in a small rural community.

- **Underground Storage Tank Inspector Training.** For the New Jersey Department of Environmental Protection, developed a two-day hands-on training for state inspectors and 6xe marshal to include tank removal, tank testing and monitoring, and corrective action.

- **Underground Storage Tank Training.** For the Virgin Islands and Puerto Rico, conducted a training program on the federal requirements for managing underground storage tanks.

- **Underground Storage Tank Financial Assurance Requirements.** For the Virgin Islands evaluated alternative financial assurance requirements in coordination with the Commissioner of the Environmental Quality Board and the Banking and Insurance Commissioner.

REGULATORY COMPLIANCE

- **Alternative Strategies for Relocation.** Provided support in evaluating regulatory constraints, and options for addressing the temporary and permanent relocation of residents at the Montclair/West Orange and Glen Ridge Radium Sites for the U.S. EPA. This included an analysis of regulatory options available through the Federal Emergency Management Agency, Army Corp of Engineers and New Jersey Department of Environmental Protection.

- **National Compliance Plan.** Managed the regulatory components of an $80 million dollar chromium remediation in Jersey City, New Jersey under an Administrative Consent Order of the New Jersey Department of Environmental Protection.

- **Superfund Training.** Developed and delivered numerous training programs for EPA headquarters, EPA Region II, and other federal and state agencies in New York, New Jersey and the Caribbean. These programs have addressed regulatory compliance under Superfund, RCRA, TOSCA, FIFRA, OSHA, Federal Facilities Compliance Act, NEPA, public involvement, remedial project manager training, implementation

of new guidance, and methods to improve performance and accountability within the Superfund program.

- **Underground Storage Tank Regulatory Support.** For the Virgin Islands, developed a compliance program to meet all federal regulatory, enforcement, administrative, and financial requirements. This included both a decision making model for cleanup alternatives, an enforcement tracking system and a management system for financial assurance.

- **Regulatory and Permit Tracking System.** Conducted an analysis of state permit requirements for natural resource projects and developed a one stop permitting system. This effort included the design and development of a tracking system for all regulatory and permitting activities for natural resource projects for the State of Utah. This tracking system covered coal-fired uranium and coal mines, uranium processing facilities, oil field and oil processing facilities, synthetic fuel projects, and oil and gas pipelines.

- **New York State Spill Prevention Support.** Prepared numerous materials on spill prevention in support of the New York State Department of Environmental Conservation.

- **National Compliance Plan.** Managed the regulatory components of an $80 million dollar chromium remediation in Jersey City, New Jersey under an Administrative Consent Order of the New Jersey Department of Environmental Protection.

- **Synthetic Fuels Permitting Strategies.** For private sector clients, prepared regulatory compliance strategies. For one client, completed all necessary permits for the construction of a pilot tar sands project.

- **Federal Coal Leasing Policies.** In several studies for the State of Utah and the Bureau of Land Management (BLM) analyzed proposed alternative mineral leasing policies on economic development strategies and their environmental impact on the State of Utah. Evaluated impacts of leasing moratoriums and royalty requirements, approaches to determining leasing levels, and other socioeconomic and environmental impacts of this program.

- **Regulatory Compliance Management.** For a number of private clients including commercial developers, hazardous waste facility managers, and solid waste facility owners, prepared all environmental documents including EIS's and RCRA permits.

PUBLIC PARTICIPATION

- **High Level Nuclear Waste Public Involvement Program.** Designed and coordinated the implementation of a public involvement program for the State of Utah in response to DOE's proposed siting of a High Level Nuclear Waste Facility at Canyonlands, Utah. This included utilizing polls and focus groups to determine public response to alternative scenarios, preparing public information materials and position papers for the Governor's Office and presentations to Congress.

- **EPA Superfund Community Relations.** For EPA, managed the design, implementation, and quality assurance of community relation's activities at over one hundred of the most complex and sensitive sites in the nation. Community relations' activities included public involvement plan development, interviewing, focus groups, alternative dispute resolution, consensus building, public meeting support, development of fact sheets and other briefing materials, as well as, multi-media presentations. Under a special assignment, Ms. Conway also managed community relations support activities for a very sensitive removal action project at the Signo-Mount Vernon Site in the Bronx. This removal action required the temporary relocation of thousands of residents. This success earned the project team commendations from USEPA, New York City, and Mount Vernon City for their efforts.

- **NJDEP Superfund Community Relations.** For NJDEP, provided public participation support at over a dozen sites. Support at these sites included the preparation of community relations plans, focus groups, public meeting support, surveying, fact sheets, and audio-visual materials, coordination with local officials, and community relations training and over sight of field activities.

- **Private Party Access and Community Relations Support.** For a large corporation, managed the site access and community relations activities including the temporary relocation of residences and businesses at over two hundred properties, as part of an $80 million chromium remediation project.

- **State Public Participation Programs.** For the State of Utah, designed and implemented public participation programs for the promulgation of state regulations. Reviewed and evaluated public comments, investigated technical and legal issues, and developed recommendations for the governor and senior staff regarding policy.

ATTACHMENT 3

AFFIDAVIT OF EUGENE I. SMITH

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

In the Matter of: U.S. DEPARTMENT OF ENERGY (High Level Waste Repository)	Docket No. 63-001

DECLARATION OF EUGENE I. SMITH

1. My name is Eugene I. Smith. I am a professor of Geology at the University of Nevada, Las Vegas. My contact information is provided in my curriculum vitae, which is attached.
2. I specialize in Volcanology, Igneous Petrology, Geochemistry, Tectonics, and Planetary Geology.
3. I have reviewed and am familiar with aspects of the Department of Energy's license application for this proceeding.
4. I support Clark County's petition in this proceeding, and adopt as my own the opinions and statements expressed in contentions CLK-SAFETY-003 through CLK-SAFETY-011. Said contentions were prepared by me or under my supervision.

STATE OF NEVADA)
) ss.
COUNTY OF CLARK)

SUBSCRIBED AND SWORN to before me this 22 day of December, 2008.

Notary Public, in and for said County and State

NOTARY PUBLIC
STATE OF NEVADA
County of Clark
THOMAS C. ENGLUND
No: 00-56082-1
My Appointment Expires April 8, 2012

3193908v1(60297.1)

CURRICULUM VITAE
EUGENE I. SMITH

November 1, 2008

Mailing Address: Department of Geoscience
University of Nevada (UNLV)
Las Vegas, Nevada 89154-4010

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Educational Background:

University	Degree	Year
University of New Mexico	Ph.D.	1970
University of New Mexico	M.S.	1968
Wayne State University	B.S.	1965

Specialties:, Volcanology, Igneous Petrology, Geochemistry, Tectonics, Planetary Geology

Professional Experience:

8/88 to present: Professor of Geology, UNLV

7/83-7/86: Chair, Department of Geoscience, UNLV

9/80 to 8/88: Associate Professor of Geology, UNLV

9/76-8/80: Associate Professor of Earth Science, University of Wisconsin-Parkside

9/72-9/76: Assistant Professor of Earth Science, University of Wisconsin-Parkside

9/70-6/72: Post-doctoral Research Associate to Professor W.E. Elston, Department of Geology, University of New Mexico

9/68-8/70: Graduate Research Assistant to Professor W.E. Elston, Department of Geology, University of New Mexico

8/68-8/80:	Geologist WAE, U.S. Geological Survey, Branch of Astrogeology, Flagstaff, AZ
6/66-7/68:	Geological Field Assistant WAE, U.S. Geological Survey, Branch of Astrogeology, Flagstaff, AZ
6/64-9/64:	Undergraduate Research Assistant to Professor A.J. Mozola, Department of Geology, Wayne State University, Detroit, MI

Professional Society Memberships:

American Association for the Advancement of Science
American Geophysical Union
Geological Society of America (Fellow)
Geological Society of Nevada
IAVCEI-International Association of Volcanology and Chemistry of the Earth's Interior
Mineralogical Society of America
Phi Kappa Phi
Sigma Gamma Epsilon
Sigma Xi

Grants:

- Bureau of Land Management contract to study the geology of the Sloan Canyon NCA (2006-2008).
- Bureau of Land Management contract to study the geology of the Sloan Canyon NCA (2005)
- Nevada Agency for Nuclear Projects grant to study basaltic volcanism in the Great Basin (2000-2001).
- U.S. Navy Geothermal Office Grant to study volcanic rocks in the Lava Mountains, (1998-1999.
- U.S. Navy Geothermal Office Grant *with Rodney Metcalf* to study volcanic rocks in the Lava Mountains, California and the Mt. Perkins Pluton, Arizona (1996-1998).
- Grants from Nevada Nuclear Waste Project Office (NWPO) to study late- Miocene and younger volcanic activity in southern Nevada (ten years of funding) (1985-1996).
- NSF Grant with J. Faulds and P. Gans to study the structural and geochemical development of the northern Colorado River extensional corridor (1991-1993).
- UNLV Research Council grant to support the study of Tertiary volcanic rocks in Clark County, Nevada (1983).
- NASA Grant NGR 50-009-001 for the study of volcanic fields in California, New Mexico and Wisconsin. The grant also funded the study of volcanic domes and craters on Mars, Mercury, Moon and Earth (6 years of funding)(1973-1979).
- Four University of Wisconsin research grants to support the study of Precambrian igneous rocks of south-central Wisconsin (1973-1977).

Awards:

- Recipient of the Harry Reid Nevada Star Award for Research (2006).
- Recipient of UNLV College of Sciences Distinguished Researcher Award, 1999.
- National Defense Education Act (NDEA) Title IV Fellowship, 9/65-6/68

Current Research:

1. Geology of Quaternary-Pliocene basalts in the southern and central Great Basin and Colorado Plateau.
2. Volcanic hazard studies related to placing a nuclear waste repository at Yucca Mountain, Nevada.
3. Geology of basalts in the Yellowstone Plateau volcanic field, implications for the future development of the Yellowstone volcanic system.
4. Geochemical, structural and field study of the volcanic and plutonic rocks of the Lake Mead Volcanic Field.
5. The formation of intermediate composition igneous rocks in an extensional environment.

Editorial Responsibilities

- Associate editor of the Geological Society of America Bulletin 1999-2008
- Associate editor of the Journal of Geophysical Research (Geochemistry and Volcanology)-1996-1999

Research Advisor for the following students:

University of New Mexico:
- Anthony Sanchez

University of Wisconsin-Parkside:
- James Grimes
- Bill Stupak
- Jill Hartnell
- Ray Spangers
- Cliff Brandon

UNLV:

- **Crow, H. Clay, III**, 1984, *Geochemistry of shonkinites, syenites, and granites associated with the Sulfide Queen carbonatite body, Mountain Pass, California [MS thesis]*: Las Vegas, University of Nevada, 56 p.

- **Myers, Ingrid A.**, 1984, *Geology and mineralization at the Cyclopic mine, Mohave County, Arizona [MS thesis]*: Las Vegas, University of Nevada, 64 p.

- **Mills, James G., Jr.**, 1985, *The geology and geochemistry of volcanic and plutonic rocks in the Hoover Dam 7 1/2 minute quadrangle, Clark County, Nevada and Mohave County, Arizona [MS thesis]*: Las Vegas, University of Nevada, 119 p.

- **Timm, John J.**, 1985, *Age and significance of paleozoic sedimentary rocks in the southern River Mountains, Clark County, Nevada [MS thesis]*: Las Vegas, University of Nevada, 62 p.
- **Feuerbach, Daniel L.**, 1986, *Geology of the Wilson Ridge pluton : a mid-Miocene quartz monzonite intrusion in the northern Black Mountains, Mohave County, Arizona and Clark County, Nevada [MS thesis]*: Las Vegas, University of Nevada, 79 p.
- **Naumann, Terry R.**, 1987, *Geology of the central Boulder Canyon quadrangle, Clark County, Nevada [MS thesis]*: Las Vegas, University of Nevada, 68 p.
- **Schmidt, Casey S.**, 1987, *A mid-Miocene caldera in the central McCullough Mountains, Clark County, Nevada [MS thesis]*: Las Vegas, University of Nevada, 78 p.
- **Sewall, Angela J.**, 1988, *Structure and geochemistry of the upper plate of the Saddle Island detachment, Lake Mead, Nevada [MS thesis]*: Las Vegas, University of Nevada, 84 p.
- **Cole, Erin D.**, 1989, *Petrogenesis of late Cenozoic alkalic basalt near the eastern boundary of the Basin-And-Range: Upper Grand Wash trough, Arizona and Gold Butte, Nevada [MS thesis]*: Las Vegas, University of Nevada, 68 p.
- **Larsen, Lance L.**, 1989, *The origin of the Wilson Ridge pluton and its enclaves, northwestern Arizona: Implications for the generation of a calc-alkaline intermediate pluton in an extensional environment [MS thesis]*: Las Vegas, University of Nevada, 81 p.
- **Bridwell, Hayden L.**, 1991, *The Sloan Sag: A mid-Miocene volcanotectonic depression, north-central McCullough Mountains, southern Nevada [MS thesis]*: Las Vegas, University Of Nevada, 147 p.
- **Cascadden, Tracy E.**, 1991, *Style of volcanism and extensional tectonics in the eastern Basin and Range Province: northern Mojave Co., Arizona [MS thesis]*: Las Vegas, University Of Nevada, 156 p.
- **Morikawa, Shirley A.**, 1993, *The Geology of the Tuff of Bridge Spring: southern Nevada and northwestern Arizona [MS thesis]*: Las Vegas, University of Nevada, 165 pp.
- **Rash, Kelly B.**, 1995, *Geology and geochemistry of Tertiary volcanic rocks in the northern Reveille and southern Pancake Ranges, Nye County, Nevada [MS thesis]*: Las Vegas, University of Nevada, 171 p.
- **Sánchez, Alexander**, 1995, *Mafic volcanism in the Colorado Plateau / Basin-and-Range transition zone, Hurricane, Utah [MS thesis]*: Las Vegas, University of Nevada, 92 p.
- **Boland, Kelly A.**, 1996, *The petrogenesis of andsites produced during regional extension: Examples from the northern McCullough Range, Nevada and Xitle volcano, Mexico [MS thesis]*: Las Vegas, University of Nevada, 127 p.
- **Dickson, Loretta D.**, 1997, *Volcanology and geochemistry of Pliocene and Quaternary basalts on Citadel Mountain, Lunar Crater volcanic field, Pancake Range, Nevada [MS*

thesis]: Las Vegas, University of Nevada, 146 p. (Received the UNLV Alumni Association award for the most outstanding thesis for the academic year 1997-98)

- **Downing Reina**, 2000, *Imaging the Mantle in Southwestern, Utah Using Geochemistry, and Geographic Information Systems* [MS thesis]: Las Vegas, University of Nevada, 129 p.
- **Keenan, Deborah L.**, 2000, *A study of the Lava Mountians, San Bernadino County, California* [MS thesis]: Las Vegas, University of Nevada, 81p.
- **Herrington, Juliana**, 2000, *Significance of the prevolcanic conglomerate of the Colorado River extensional corridor, Nevada and Arizona* [MS thesis]: Las Vegas, University of Nevada, 83p.
- **Sanford, Aaron L.**, 2000, *Geologic history of the McCullough Pass caldera* [MS thesis]: Las Vegas, University of Nevada, 111p.
- **Elizabeth Stickney**, 2004, *Quaternary basaltic volcanism in the northern part of the Lunar Crater volcanic field, Nevada*:, 103 p.
- **Matt Faust,** 2005, *Petrogenesis and geochemistry of Pleistocene and Pliocene basalt flows of the Pine Valley Volcanic Field, Utah and their relationship to the tectonics of the Utah Transition Zone* [MS thesis]: University of Nevada), 116 p.
- **Denise Honn,** 2005, *Nested Calderas of the northern Kawich Range, central Nevada* [MS thesis]: Lasa Vegas, University of Nevada, 92 p.
- **Denise Honn Ph.D**. *Linking a volcanic-plutonic system in the River Mountains and Wilson Ridge Pluton*. (work in progress).
- **Shara Leavitt**, 2006, *Volcanology and Petrogenesis of the Navajo Lake Volcanic Field, Utah* : [MS thesis]: Las Vegas, University of Nevada, 94 p.
- **Kristeen Bennett**, 2006, *Petrogenesis of Pleistocene basalts in the Norris-Mammoth Corridor, Yellowstone National Park* : [MS thesis]: Las Vegas, University of Nevada, 120 p.
- **Matt McKelvey,** *Geology of the southern Reveille Range, Nevada:* [MS thesis]: Las Vegas, University of Nevada, 103 p..
- **Audrey Rager (Ph.D.),** *Basalts, tectonics and Corona on Venus, How is important is plate tectonics* (work in progress).
- **Ashley Tibbetts (Ph.D.),** *Geology of the Death Valley volcanic field (work in progress).*
- **Christi Emery,** *Volcanology of the southern Quinn Canyon Range, central Nevada (work in progress).*
- **Racheal Johnsen,** *Volcanology of two volcanic fields in SW Utah, implications for tectonics and mantle source (work in progress).*

Students who left UNLV before completing their degrees

- Jeff Nejedly
- Robert Yasek
- Tom Wickham
- Joe Blaylock
- Heather Putnam

Post-Doctoral Research Associates

- Jim Faulds (now an research scientist with the Nevada Bureau of Mines and Geology)
- Mark Martin (now a research fellow at MIT)
- Jim Mills (now an associate professor at DePauw University, Indiana)
- Tim Bradshaw (now a science advisor to the House of Lords, London)
- Gene Yogodzinski (now an assistant professor at the University of South Carolina)

Research Associates *(Professional Staff with M.S. degrees)*

- Dan Feuerbach
- Terry Naumann
- Alex Sánchez
- Shirley Morikowa
- Deb Keenan
- Denise Honn

PUBLICATIONS:

A. Journal Articles in refereed journals, symposium volumes and maps:

1. Elston, W.E., Lambert, P.W. and Smith, E.I., 1968, Striated cones: wind abrasion features, not shatter cones: in Short, N.M., and French, B.M., eds., Shock Metamorphism of Natural Materials, Mono Book Corporation, Baltimore, p. 287- 290.

2. Mozola, A.J. and Smith, E.I., 1969, Glacial drift thickness map of Wayne County, Michigan: in Mozola, A.J., Geology for land and ground-water development in Wayne County, Michigan: Geological Survey of Michigan, Report of Investigation 3, 25 pp.

3. Elston, W.E., and Smith, E.I., 1970, Determination of flow direction of rhyolite ash-flow tuffs from fluidal textures: Geological Society of America Bulletin, v. 81, p. 3393- 3406.

4. Elston, W.E., Aldrich, M.J., Smith, E.I., and Rhodes, R.C., 1971, Non-random distribution of lunar craters: Journal of Geophysical Research, v. 76, no. 23, p. 5675-5682.

5. Smith, E.I., 1971, Determination of the origin of small lunar and terrestrial craters by depth-diameter ratio: Journal of Geophysical Research, v. 76, no. 23, p. 5683- 5689.

6. Rhodes, R.C., and Smith, E.I., 1972, Directional fabric of ash-flow sheets in the northwest part of the Mogollon Plateau, New Mexico: Geological Society of America Bulletin, v. 83, p. 1863-1868.

7. Smith, E.I., and Rhodes, R.C., 1972, Flow direction of lava flows: Geological Society of America Bulletin, v. 83, p. 1869-1874.

8. Rhodes, R.C., and Smith, E.I., 1973, Geology and tectonic setting of the Mule Creek Caldera, New Mexico, USA: Bulletin Volcanologique, v. 36, no. 3, p. 401-411.

9. Smith, E.I., 1973, Mono Craters, California: A new interpretation of the eruptive sequence: Geological Society of America Bulletin, v. 84, p. 2685-2690.

10. Smith, E.I., 1973, Identification, distribution and significance of lunar volcanic domes: The Moon, v. 6, nos. 1/2, p. 3-31.

11. Smith, E.I., and Sanchez, A.G., 1973, Fresh lunar craters: morphology as a function of diameter, a possible criterion for crater origin: Modern Geology, v. 4, p. 51-59.

12. Elston, W.E., Damon, P.E., Coney, P.J., Rhodes, R.C., Smith, E.I., and Bickerman, M., 1973, Tertiary volcanic rocks, Mogollon Plateau, New Mexico and surrounding regions: K-Ar dates and patterns of eruption: Geological Society of America Bulletin, v. 84, p. 2259-2274.

13. Elston, W.E., and Smith, E.I., 1973, Mars, evidence for dynamic processes from Mariners 6 and 7: Icarus, v. 19, p. 180-194.

14. Smith, E.I., and Rhodes, R.C., 1974, The Squirrel Springs volcanotectonic depression, a buried cauldron in southwestern New Mexico: Geological Society of America Bulletin, v. 85, p. 1865-1868.

15. Smith, E.I., 1974, Rumker Hills, a lunar volcanic dome complex: The Moon, v. 10, no. 2, p. 175-182.

16. Smith, E.I., and Sanchez, A.G., 1975, Fresh lunar craters: morphology as a function of diameter, a possible criterion for crater origin, Reply: Modern Geology, v. 5, p. 175-176.

17. Smith, E.I., 1976, Comparison of the crater morphology-size relationship for Mars, Moon and Mercury: Icarus, v. 28, p. 543-550.

18. Rhodes, R.C., and Smith, E.I., 1976, Stratigraphy and structure of the northwestern rim of the Mogollon Plateau volcanic province, Catron County, New Mexico: New Mexico Geological Society Special Publication No. 5, p. 57-62.

19. Smith, E.I., 1976, Structure and morphology of the John Kerr Peak dome complex, southwestern New Mexico: New Mexico Geological Society Special Publication No. 5, p. 71-78.

20. Smith, E.I., Aldrich, M.J., Deal, E.G., and Rhodes, R.C., 1976, Fission track ages of Tertiary volcanic rocks, Mogollon Plateau, southwestern New Mexico: New Mexico Geological Society Special Publication No. 5, p. 117-118.

21. Smith, E.I., 1978, Introduction to the Precambrian rocks of south-central Wisconsin: Geoscience Wisconsin, v. 2, p. 1-17.

22. Smith, E.I., Paull, R.A., and Mudrey, M.G., 1978, Precambrian inliers in south-central Wisconsin: Wisconsin Natural History and Geological Survey Field Trip Guide Book No. 2, 89 pp.

23. Smith, E.I., 1978, Precambrian rhyolites and granites in south-central Wisconsin: field relations and geochemistry: Geological Society of America Bulletin, v. 89, p. 975- 980.

24. Smith, E.I., and Stupak, W.A., 1978, A Fortran IV program for the classification of volcanic rocks using the Irvine and Baragar classification: Computers and Geoscience, v. 4, p. 89-99.

25. Smith, E.I., and Hartnell, J.A., 1978, Crater size-shape profiles for the Moon and Mercury: The Moon and Planets, v. 19, p. 479-511.

26. Smith, E.I., Slagle, M.J., and Luzader, S., 1980, Impact cratering experiment for a course in lunar and planetary geology: Journal of Geological Education, v. 28, p. 204-209.

27. Bell, J., and Smith, E.I., 1980, Geological map of the Henderson quadrangle, Clark County, Nevada: Nevada Bureau of Mines and Geology, Map 67.

28. Parolini, J.R., Smith, E.I., and Wilbanks, J.R., 1981, Fission track dating of gravity slide blocks in the Rainbow Gardens, Clark County, Nevada: Isochron/West, no. 30, p. 9-10.

29. Smith, E.I., 1982, Geology and geochemistry of the volcanic rocks in the River Mountains, Clark County, Nevada and comparisons with volcanic rocks in nearby areas: in Frost, E.G., and Martin, D.L. eds., Mesozoic-Cenozoic tectonic evolution of the Colorado River Region, California, Arizona and Nevada: San Diego, California, Cordilleran Publishers, p. 41-54.

30. Smith, E.I., 1984, Geochemistry and evolution of the early Proterozoic Post-Penokean rhyolites and granites, and related rocks of south-central Wisconsin: Geological Society of America Memoir 160, p. 113-128.

31. Smith, E.I., 1984, Geologic map of the Boulder City quadrangle, Nevada: Nevada Bureau of Mines and Geology, Map 81.

32. Choukroune, Pierre, and Smith, E.I., 1985, Detachment faulting and its relationship to older structural events on Saddle Island, River Mountains, Clark County, Nevada: Geology, v. 13, p. 421-424.

33. Myers, I.A., Smith, E.I., and Wyman, R.V., 1986, Control of gold mineralization at the Cyclopic Mine, Gold Basin District, Mohave County, Arizona: Economic Geology, v. 81, no. 6, p. 1553-1557.

34. Smith, E.I., 1986, Field Guide to the Geology of the eastern River Mountains and the Hoover Dam area, Clark County, Nevada: in Rowland, S.R., Field Guide to the Geology of Southern Nevada, prepared for the NAGT-FWS Meeting, Las Vegas, Oct. 3-5, 1986, p. 22-64.

35. Smith, E.I., Anderson, R.E., Bohannon, R.J. and Axen, Gary, 1987, Structure, volcanology, and sedimentology of mid-Tertiary rocks in the eastern Basin-and- Range Province, Southern Nevada: in Davis, G.H. and VandenDolder, Geologic Diversity of Arizona and its Margins: Excursions to Choice Areas: Arizona Bureau of Geology and Mineral Technology, Geological Survey Branch Special Paper 5, p. 383-397.

36. Weber, M.E., and Smith, E.I. 1987, Structural and geochemical constraints on the reassembly mid-Tertiary volcanoes in the Lake Mead area of southern Nevada: Geology, v. 15, p. 553-556.

37. Guth, Peter and Smith, E.I., 1987, Discussion of the paper by Ron and others, "Strike-slip faulting and block rotation in the Lake Mead Fault System", Geology, v. 15, p. 579-580.

38. Smith, E.I., Schmidt, C.S., and Mills, J.G., 1988, Mid-Tertiary volcanoes of the Lake Mead area of southern Nevada and Northwestern Arizona: in Weide, D.L., and Faber, M.L., This Extended Land, Geological Journeys in the southern Basin and Range, Geological Society of America, Cordilleran Section Field Trip Guidebook; UNLV Department of Geoscience, Special Publication No. 2, p. 107-122.

39. Faulds, J.E., Hillemeyer, F.L., and Smith, E.I., 1988, Geometry and kinematics of a Miocene "Accommodation Zone" in the central Black and southern Eldorado Mountains, Arizona and Nevada: in Weide, D.L., and Faber, M.L., This Extended Land, Geological Journeys in the southern Basin and Range, Geological Society of America, Cordilleran Section Field Trip Guidebook; UNLV Department of Geoscience, Special Publication No. 2, p. 293-310.

40. Smith, E.I., Feuerbach, D.L., Naumann, T.R. and Faulds, J.E., 1990, The area of most recent volcanism about Yucca Mountain, Nevada: Implications for volcanic risk assessment: in Proceedings of the International Nuclear Waste Symposium, v. 1, American Nuclear Society and American Society of Civil Engineers, p. 90-97.

41. Smith, E.I., Feuerbach, D.L, Naumann, T.R. and Mills, J.E., 1990, Geochemistry and evolution of mid-Tertiary igneous rocks in the Lake Mead area of Nevada and Arizona: in Anderson, J.L., Cordilleran Magmatism: Geological Society of America Memoir 176, p. 169-194.

42. Larsen, L.L. and Smith, E.I., 1990, Mafic enclaves in the Wilson Ridge Pluton, northwestern Arizona: Implications for the generation of a calc-alkaline intermediate pluton in an extensional environment: Journal of Geophysical Research, v. 95, p. 17693-17716.

43. Duebendorfer, E.M., Sewall, A.J., and Smith, E.I., 1991, The Saddle Island Detachment fault, an evolving shear zone in the Lake Mead area of southern Nevada: in Wernicke, B., Mid-Tertiary extension at the latitude of Las Vegas: Geological Society of America Memoir 176, p. 77-97.

44. Duebendorfer, E.M. and Smith, E.I., 1991, Tertiary structure, magmatism and sedimentation in the Lake Mead region, southern Nevada, in Seedorf, E., ed., Tertiary geology and volcanic-hosted gold deposits of the southern Great Basin: Geological Society of Nevada Special Publication 13, p. 66-95.

45. Naumann, T.R., Smith, E.I., Shafiqullah, M., and Damon, P.E., 1991, New K-Ar ages for mafic to intermediate volcanic rocks in the Reveille Range, Nevada: Isochron West, p. 12-16.

46. Feuerbach, D.L., Smith, E.I., Shafiquallah, M., and Damon, P.E., 1991, New K-Ar dates for mafic late-Miocene to Pliocene volcanic rocks in the Lake Mead area, Arizona and Nevada: Isochron West, p. 17-20.

47. Ho, Chih-Hsiang, Smith, E.I., Feuerbach, D.L. and Naumann, T.R., 1991, Eruptive probability calculation for the Yucca Mountain site, USA: statistical estimation of recurrence rates: Bulletin of Volcanology, v. 53.

48. Metcalf, R.V., Smith, E.I., and Mills, J.G., 1993, Magma mixing and commingling in the northern Colorado River extensional corridor: constraints on the production of intermediate magmas: *in* Lahren, M.M., Trexler, J.H., and Spinosa, C., eds., Crustal evolution of the Great Basin and Sierra Nevada: Cordilleran/Rocky Mountain Section, Geological Society of America Guidebook, Department of Geological Sciences, University of Nevada, Reno, p. 35-56.

49. Smith, E.I., , 1993, 1.76 b.y. old granites and rhyolites in the conterminous United States: *in* Reed, J.C., Bickford, M.E., Houston, R.S., Link, P.K., Rankin, D.W., Sims, P.K., and Van Schmus, W.R., Precambrian: Conterminous U.S., Geological Society of America, Decade of North America Geology (DNAG), v. C-2, p. 64-66.

50. Feuerbach, D.L., Smith, E.I., Walker, J.D. and Tangeman, J.A., 1993, The role of the mantle during crustal extension: constraints from geochemistry of volcanic rocks in the Lake Mead area, Nevada and Arizona: Geological Society of America Bulletin, v 105, p. 1561-1575.

51. Rowell, A.J., Rees, M.N., Duebendorfer, E.M., Wallin, E.T., Van Schmus, W.R., and Smith, E.I., 1993, An active Neoproterozoic margin: evidence from the Skelton Glacier area, Transantarctic Mountains: Journal of the Geological Society, London, v. 150, p. 677-682.

52. Duebendorfer, E.M., Smith, E.I., and Faulds, J.E., 1994, Geologic setting of the area between Lake Mead Nevada, and Needles, California in Sherrod, D. and Nielson, J., eds., Teriary stratigraphy of highly extended terranes: U.S. Geological Survey Bulletin 2053, p. 1-5.

53. Wallin, E.T., Duebendorfer, E.M. and Smith, E.I., 1994, Tertiary stratigraphy of the Lake Mead region in Sherrod, D. and Nielson, J., eds., Teriary stratigraphy of highly extended terranes: U.S. Geological Survey Bulletin 2053, p. 33-35.

54. Bradshaw, T.K., and Smith, E.I., 1994, Polygenetic Quaternary volcanism in Crater Flat, Nevada: Journal of Volcanology and Geothermal Research, v. 63, p. 165-182

55. Purkey, B.W., Duebendorfer, E.M., Smith, E.I., Price, J.G., and Castor, S.B., 1994, Geologic tours in the Las Vegas area: Nevada Bureau of Mines and Geology, Special Publication 16, 156 pp.

56. Metcalf, R.V. and Smith, E.I., 1995, Introduction to special section: Magmatism and Extension: Journal of Geophysical Research, v. 100, no. B7, p. 10,249-10,253.

57. Metcalf, R.V., Smith, E.I., Walker, J.D., Reed, R.C., and Gonzalas, D.A., 1995, Isotopic disequilibrium among commingled hybrid magmas: evidence for a two-stage magma mixing-commingling process in the Mt. Perkins Pluton, Arizona: Journal of Geology, v. 103, p. 509-527.

58. Yogodzinski, G.M., Naumann, T.R., Smith, E.I., Bradshaw, T.K. and Walker, J.D., 1996, Crustal assimilation by alkalic basalt, and the evolution of a mafic volcanic field in the central Great Basin, south-central Nevada: Journal of Geophysical Research, v. 101, p. 17,425-17,445.

59. Ho, C.-H. and Smith, E.I., 1997, Volcanic hazard assessment incorporating expert knowledge: application to the Yucca Mountain Region, Nevada, U.S.A.: Journal Mathematical Geology, v. 29, no. 5, p. 615-627.

60. Duebendorfer, E.M., Beard, Sue, and Smith, E.I., 1998, Restoration of Tertiary Extension in the Lake Mead region, southern Nevada: The role of strike-slip transfer zones: *in* Faulds, J.E. and Stewart, J.H., eds., Accomodation Zones and Transfer Zones: The

Regional Segmentation of the Basin and Range Province: Geological Society of America Special Paper 323, p. 127-148

61. Ho, C.-H. and Smith, E.I., 1998, A Spatial-Temporal/3-D model for volcanic hazard assessment: application to the Yucca Mountain region, Nevada: Mathematical Geology, v. 30, no. 5, p. 497-510.

62. Rees, M.N., Smith, E.I., Keenan, D.L., and Duebendorfer, E.M., 1999, Cambrian Magmatic Rocks of the Ellsworth Mountains, West Antarctica: Antarctic Journal of the United States, Review 1997, v. 32, no. 5, p. 3-5.

63. Faulds, J.E., Smith, E.I., and Gans, Phil, 1999, Spatial and temporal patterns of magmatism and extension in the Northern Colorado River Extensional Corridor, Nevada and Arizona: A preliminary report: in Faulds, J.E., Cenozoic geology of the Northern Colorado River Extensional Corridor, southern Nevada and northwestern Arizona: Economic implications of regional segmentation structures, Nevada Petroleum Society 1999 field trip guidebook, Reno, Nevada, p. 171-183.

64. Smith, E.I. and Sánchez, A., Walker, J.D. and Wang, K, 1999, Geochemistry of mafic magmas in the Hurricane volcanic field, Utah: implications for small and large scale chemical variability of the mantle: Journal of Geology, v. 7, no. 4, p. 433-448.

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100. McKelvey, Matt and Smith, E.I., 2004, Mid-Miocene calderas in the Reveille Range, Nevada: Geological Society of America Abstracts with Programs, Vol. 36, No. 5, p. 431.

101. Druschke, Peter; Honn, Denise; McKelvey, Matt; Nastanski, Nicole; Rager, Audrey; Smith, E.I., and Belliveau, Robert, 2004, Volcanology of the northern Eldorado Mountains, Nevada: new evidence for the source of the tuff of Bridge Spring: Geological Society of America Abstracts with Programs, Vol. 36, No. 5, p. 431.

102. Spell, T.E., Smith, E.I., Nastanski, N., Bennett, K., 2004, Establishment and Evolution of a new Silicic Magma System North of Yellowstone Caldera: Geochronology, Geochemistry and Petrographic Relationships of Extracaldera Basalts and Rhyolites in the Norris-Mammoth Corridor: Eos Transactions of the American Geophysical Union, v. 85, no. 47, Abstract V52B-08.

103. Faust, M.E. and Smith, E.I., 2005, Volcanology of the Santa Clara and Diamond Valley Lava flows, Snow Canyon State Park, Utah: Geological Society of America Abstracts with Programs, Vol. 37, No. 4, p. 67.

104. Honn, Denise and Smith, E.I., 2005, Coalescing calderas and volcanic debris avalanche deposits in the northern Kawich Range, central Nevada: Geological Society of America Abstracts with Programs, Vol. 37, No. 4, p. 65.

105. Honn, Denise and Smith, E.I., 2005, Volcanoes of the McCullough Range, southern Nevada: A window into the pre-extensional history of the Colorado River extensional corridor: Geological Society of America Abstracts with Programs, Vol. 376, No. 7, p. 229-230.

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112. Johnsen, R., and Smith, E.I., 2007, Evidence for dome collapse and coeval mafic-felsic volcanism in the central McCullough Range, Nevada: Geological Society of America Abstracts with Programs, v. 39, no. 5, p. 35.

113. Smith, Eugene, Johnsen, Racheal, Honn, Denise, Brainard, Ray, and Coon, Richard, 2008, A new 3-dimensional view of the mid-Miocene volcanic and plutonic rocks of the River Mountains, southern Nevada: Geological Society of America, Abstracts with Programs, v. 40, no. 1, p. 34.

114. Honn, Denise, Johnsen, Racheal, and Smith, E.I., 2008, Developing geological educational materials for BLM's Sloan Canyon National Conservation Area: Presenting the Miocene volcanic history of the Northern McCullough Mountains, southern Nevada to the public: Geological Society of America, Abstracts with Programs, v. 40, no. 1, p. 90.

115. Johnsen, Racheal and Smith, E.I., 2008, Dome eruption, collapse, and pyroclastic flows of a mid-Miocene volcanic section in the central McCullough Range, southern Nevada: Geological Society of America, Abstracts with Programs, v. 40, no. 1, p. 94.

116. Spell, Terry, Wooton, Katie, Nastanski, Nicole, Smith, E.I., and Bennett, Kristeen, 2008, The role of basalt in eruption of Quaternary rhyolites north of the Yellowstone Caldera: Geological Society of America, Abstracts with Programs, v. 40, no. 1, p. 62.

C. Open File and Technical Reports

1. Anderson, J.L., Young, E.D., Clarke, H.S., Orrell, S.E., Winn, M., Schmidt, C.S., Weber, M.E., and Smith, E.I., 1985, The geology of the McCullough Range Wilderness area, Clark County, Nevada: U.S. Geological Survey, Final Technical Report, 26p.

2. Eggleton, R.E., and Smith, E.I., 1967, Geologic map of the Rumker Quadrangle of the Moon: U.S. Geological Survey Open File Report.

Plus over 300 reports to the Nevada Nuclear Project Office, U.S. Navy's Geothermal Project Office and the Bureau of Land Managment.

ATTACHMENT 4

AFFIDAVIT OF DENNIS BLEY

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	Docket No. 63-001
U.S. DEPARTMENT OF ENERGY	
(High Level Waste Repository)	

DECLARATION OF DENNIS BLEY

1. My name is Dennis C. Bley. I am President of Buttonwood Consulting, Inc. My contact information is provided in my curriculum vitae, which is attached.
2. I have reviewed and am familiar with aspects of the Department of Energy's license application for this proceeding.
3. I support Clark County's petition in this proceeding, and adopt as my own the opinions and statements expressed in contention CLK-SAFETY-001 which was prepared by me or under my supervision.

SUBSCRIBED AND SWORN to before me this 22ND day of December, 2008.

Ima L. Hicks
Notary Public

Ima L. Hicks
Notary Public, District of Columbia
My Commission Expires 01/14/2011

3193908v1(60297.1)

Buttonwood Consulting, Inc.

11738 English Mill Court, Oakton, VA, USA
Telephone 1-703-963-6486, Fax 1-703-648-2546
e-mail: bley@ieee.org

Curriculum Vitae

DENNIS C. BLEY

November 2008

EDUCATION

Ph.D., Massachusetts Institute of Technology, Nuclear Reactor Engineering, 1979

Cornell University, Courses in Nuclear Engineering and Computer Science, 1971-1974

U.S. Navy Nuclear Power School, 1968

B.S.E.E., University of Cincinnati, 1967

Center College of Kentucky, Courses in Mathematics and Physics, 1961-1963

RESEARCH INTERESTS AND RECENT ACTIVITIES

Conducts research in human reliability analysis (HRA), probabilistic risk assessment (PRA) of technological systems, modeling uncertainties in all areas of risk analysis and risk management, extending PRA/HRA to new industries and applications, and technical risk communication.

PROFESSIONAL POSITIONS

Member, USNRC Advisory Committee on Reactor Safeguards (since 2007)

President, Buttonwood Consulting, Inc. (since 1994)

Principal of The WreathWood Group (a joint venture, since 1995)

Consultant, PLG, Inc. (1979-1994)

Commissioned Officer, U.S. Navy Nuclear Propulsion Program (1968-1974)

Engineer, Cincinnati & Suburban Bell Telephone Co. (1967)

SUMMARY OF PROFESSIONAL EXPERIENCE

President of Buttonwood Consulting, Inc., and Principal of The WreathWood Group, with more than 35 years of experience in nuclear and electrical engineering, reliability and availability analysis, data analysis, plant and human modeling for risk assessment, modeling of proliferation resistance and physical protection, expert elicitation, treatment of uncertainty, decision analysis, expert systems, and technical management.

Recognized for development and application of probabilistic risk assessment (PRA) to a wide range of engineered facilities. His approach to PRA takes advantage of extensive review and understanding of operational events to ensure fidelity of the PRA to real world events. Principal Investigator and Project Manager for numerous full scope PRAs for nuclear reactor facilities in all modes of operation, and for the chemical process, defense, transportation, and space industries. Primary utility PRA witness during the 1983 Indian Point hearings–the only Atomic Safety and Licensing Board hearings to examine the risk from licensed, operating nuclear power plants.

Co-developer of the Gen-IV methodology for proliferation resistance and physical protection (PR&PP). Co-developer of "A Technique for Human Event Analysis" (ATHEANA) for the U.S. Nuclear Regulatory Commission, a method for human reliability analysis in support of probabilistic risk analysis (PRA). It is a process that brings together the diverse fields of engineering, PRA, operations, human factors engineering, and behavioral science and focuses on the context under which human actions occur. Developer of the process flow PRA model, applicable to a wide range process systems, where the operational configuration changes as the mission evolves. Developer of a spatial interactions approach to fire and flood analysis for PRA and a mechanistic risk assessment model for the initial stages of fire. Extended human reliability models to nuclear plant low power and shutdown conditions. Co-developer of the Bayesian diagnostic analysis approach to expert systems design.

Lecturer at university, industry, and government short courses on all aspects of PRA.

Operations and maintenance experience in the Reactor Department of the *USS Enterprise,* responsible for personnel and equipment during deployment and refueling-overhaul.

Memberships, Licenses, and Honors

American Association for the Advancement of Science
Association for Computing Machinery
American Nuclear Society
American Statistical Association
Eta Kappa Nu
Institute of Electrical and Electronics Engineers
International PSAM Conference Board of Directors
MIT Sloan Research Trainee, 1974-1975
Registered Nuclear Engineer, State of California
Sherman R. Knapp Fellowship at MIT, 1975-1976
Sigma Xi, The Scientific Research Society
Society for Risk Analysis
U.S. Naval Reserve, Commander, retired

PROBABILISTIC RISK ASSESSMENT (PRA) EXPERIENCE

Summary of Related Experience

Operating Experience: USS Enterprise CVAN 65 nuclear propulsion trained officer/operator. Qualified Propulsion Plant Watch Officer, Central Control Engineering Officer of the Watch, Reactor Duty Officer, and Propulsion Duty Officer. Stood operating watches in individual propulsion plants, responsible for operation of two pressurized water nuclear reactors, each having four steam generators and powering one main turbine and shaft, one catapult, several turbine-generators, and associated auxiliary equipment. Stood operating watches in Central Control responsible for all four propulsion plants and associated auxiliary equipment. As Reactor Duty Officer and Propulsion Duty Officer, responsible for all reactors and propulsion equipment in the absence of the Reactor Officer or Engineer Officer.

Maintenance Experience. USS Enterprise Propulsion Plant Station Officer (engineer), responsible for scheduling and execution of maintenance of all equipment in one propulsion plant during deployment and during refueling-overhaul. Responsible for training of all maintenance personnel. Similar to the duties of a maintenance superintendent in a commercial power plant.

Nuclear Engineering Qualifications. US Navy Nuclear Power School Officers' Course; US Navy Nuclear Power Training Unit; qualifications aboard USS Enterprise; Cornell University, graduate courses in Engineering Physics (nuclear engineering); MIT, Ph.D. in Nuclear Reactor Engineering; registered Nuclear Engineer, State of California certificate number NU 2221.

Nuclear PRA Related Qualifications. Author of many papers and reports on PRA applications and methods development, as detailed in publications list. Principal investigator and analyst for many nuclear and non-nuclear PRA projects as detailed in the following sections.

Member of the Department of Energy Experts Working Group on Assessment Methods for Proliferation Resistance and Physical Protection of Generation IV Nuclear Energy Systems (2003-present) and member of the Department of Energy Generation IV Roadmap Evaluation Methods Group (2000-2002).

Witness on results of PRAs for legal hearings concerning facility safety:

> Bley, D. C., "Declaration of Dennis C. Bley to Superior Court of the State of California for the County of Los Angeles in Support of [Probabilistic Risk Assessment of Hydrogen Fluoride Facilities for South Coast Air Quality Management District]," March 27, 1992.
>
> Garrick, B. J., D. C. Bley, S. Kaplan, and T. E. Potter, "Transcripts of Indian Point Testimony before the U.S. Nuclear Regulatory Commission's Atomic Safety and Licensing Board," 1982-1983.

Member of the Senior Consulting Group to the USNRC's Accident Sequence Evaluation Program (ASEP) and NUREG-1150 risk studies, 1982-1991.

Invited speaker on PRA to USNRC and DOE advisory committees on safety:

> Bley, D. C., "Advantages and Disadvantages of Various PRA Methods in Decision Making," presented at the Seminar on PRA for ACRS Members, Bethesda, Maryland, October 3-4, 1989.
>
> Bley, D. C., "Quantitative Risk Assessment: Overview and Applications," presented to the U.S. Department of Energy Advisory Committee for Nuclear Facility Safety, at the University of California, Irvine, November 30, 1988.

Education/Training Qualifications. Lecturer for short courses in PRA: MIT Summer Nuclear Reactor Safety Course, MIT-NANT (INPO) Risk-Informed Operational Decision Management Course, UCLA PRA/Risk Management Course; MIT IPE Course, USNRC PRA Applications Course; special courses designed for nuclear utility companies, aerospace companies, and US Department of Defense organizations. Member of the Oak Ridge Associated Universities Advisory Committee for the USNRC PRA training program.

Developed procedure guides, organized, and led two-month workshop for Russian analysts to kickoff PRA of the Russian Kalininskya Nuclear Power Plant at Brookhaven National Laboratory for the USNRC. Developed utility company PRA group training programs for most of the PRAs listed in the following section. Each training program included introductory PRA overview courses for the PRA group and utility management, courses on each area of the PRA for utility analysts as each project reached the appropriate stage, courses on use of computer codes, courses on understanding and presenting results of the study, and courses on using the PRA in a risk management mode. In addition, each program included extensive on-the-job training including data gathering in the facility, interpretation of that data, and data analysis. When the students can spend extended time at the contractor site, their training is much more effective for several reasons: lack of interference from other demands of the home office, access to multiple contractor experts in many technical areas, and full-time focus on the PRA.

External Examiner of the University of Hong Kong for a PRA related thesis. Teaching Assistant at MIT for the subject, Engineering of Nuclear Reactors. Instructor at Cornell University's NROTC program: taught Naval Engineering course offered by the Department of Mechanical Engineering.

Reactor Training Assistant on USS Enterprise responsible for technical training and qualification of 400 nuclear-trained officers and men during normal operations and in preparation for annual safeguards examination.

Transportation and Industry Risk Management Experience

Risk Assessment of Shipping in the Aleutians, 2007-present, Member of the National Research Council Committee on Risk of Vessel Accidents and Spills in the Aleutian Islands: Designing A Comprehensive Risk Assessment.

Department of Transportation Human Reliability Analysis of Railroad Control Systems, 2001-present, Facilitator, Researcher and Analyst. Member of a team developing human reliability analysis of activities by conductors, engineers, dispatchers, and roadway workers operating with and without the capabilities of new control systems. Extensive use of expertise of railroad experts: railroad union and management personnel representing all activities involved in operations; FRA and DOT Volpe Center personnel and contractors involved in design, operations, and analysis.

Department of Energy Generation IV Nuclear Energy Systems Project, 2001-present, Member of the Gen-IV Roadmap Evaluation Methodology Group, developing methods and guidance for use by the Technical Working Groups in evaluating proposed next generation nuclear energy systems. Member of the Risk and Safety Crosscut Group. Member of the Proliferation Resistance and Physical Protection methodology group. Developer of a computer-based Implementation Guide to train and assist users of the methodology.

Seabrook Station Human Performance Improvement Effort, 2001, Consultant. Consulting support to the Human Performance group at Seabrook Station, providing advice on all aspects their program. The effort began in January 2001 with an on-site review of the HP program and suggestions for future improvements.

Probabilistic Risk Assessment of U.S. Army's Chemical Weapons Disposal Program:

- 2006, Member of three engineer team performing operational risk assessment during design of a chemical agent destruction pilot plant for the U.S. Army Program Manager for Assembled Chemical Weapons Assessment. Assessment examined potential impact of changes to design in response to operational fires at existing facilities.
- 2001-2003, Member of three engineer team directing operational risk assessment at proposed chemical weapons disposal facilities for the U.S. Army Program Manager for Assembled Chemical Weapons Assessment. The team examined the risk associated with operations and maintenance at two storage/destruction sites comparing three alternative technologies at each site. Risk scenarios initiated by human action, those exacerbated by unsafe acts, and those requiring human intervention are considered.
- 2001-2002, Member of the National Research Council Committee on Evaluation of Chemical Events at Army Chemical Agent Disposal Facilities. Committee reviewed all chemical events at operating disposal facilities and is providing recommendations on evaluating and preventing future events.
- 2000-2003, Member of the independent Pine Bluff Chemical Disposal Facility QRA Expert Panel, under contract to Mitretek, reviewing Army QRA.
- 1994-2000, Member, National Research Council Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program. Committee provides oversight of the chemical demilitarization program for the U.S. Army. Members visit

all facilities, review analyses, evaluate safety programs (emphasis on human performance) meet with program managers and analysts, and prepare reports on a regular basis. Provided extensive review of site-specific PRA/HRA.

Risk Associated with the John Wayne Airport Jet Fuel Storage Tank Farm, 1994, Principal Investigator. Performed at PLG for Koll Irvine Community Association. Analyzed risk to neighbors of airport from airplane crashes into large jet fuel storage tanks adjacent to airport fence.

Probabilistic Risk Assessment of Hydrogen Fluoride Facilities, 1991-1992, Principal Investigator. Performed at PLG for the California South Coast Air Quality Management District. Analyzed risk of accidental release from use of HF at local refineries and an HF supplier. Internal and external events.

8' HTT (High Temperature, Supersonic Wind Tunnel) Probabilistic Risk Assessment, 1990-1991, Investigator. Performed at PLG under subcontract to PRC, Inc. for NASA Langley Research Center. Analyzed risks associated with a unique mach 7 once-through wind tunnel that uses 6000 psig air mixed and fired with methane from a 2000 psig source to provide additional energy. The new design would add liquid oxygen to restore test section air to a 20% oxygen mixture to permit jet engine testing.

Risk Analysis of a Microelectronics Fabrication Facility, 1988-1989, Principal Investigator. Performed at PLG for a joint university/industry experimental fabrication facility. Analyzed risks to employees, adjacent university facilities, and nearby population centers from highly toxic materials and cryogenic materials used in the fabrication of microelectronics devices. Both internal and external hazards were considered.

Space Shuttle Probabilistic Risk Assessment: Auxiliary Power Unit and Hydraulic Power Unit, 1987, Analyst. Performed at PLG for McDonnell Douglas for the National Aeronautics and Space Administration. Developed event sequence model to analyze phased mission of the space shuttle from launch to landing and wheel-stop. A unique model was required that would permit integrating hardware failures and phenomenological modeling and track dependencies across all mission phases. Included significant data collection and analysis.

PRA of Sequoyah Fuels Corp. UF_6 Handling Operations, 1986, Principal Investigator. Performed at PLG for Kerr McGee. Developed unique phased mission model for the UF_6 cylinder filling process. Led visits to the plant and engineering offices. Analyzed the impact of several modification alternatives on risk of release.

Nuclear Power Plant PRA Experience

International HRA Empirical Study, 2007-present. Assisted USNRC as member of the ATHEANA analysis team, performing HRA analyses as part of the study and participating in meetings planning the study. The study is comparing HRA methods with simulator data.

PRA Standards, 1999-present. Member of the ANS writing group developing standards for low power and shutdown PRA of nuclear plants – author of the sections on data analysis and HRA.

ATHEANA HRA Program, 1992-present, Investigator. Performed initially for Brookhaven National Laboratory and, later, Sandia National Laboratories for USNRC. A multidisciplinary project including researchers from several government and private organizations. Participant in ongoing research program to develop an evolutionary second generation HRA method that can account for important factors identified in cognitive psychology to properly model errors of commission and dependencies. The focus is to return to the operating experience to validate models and identify key factors in human response. A systematic search scheme has been developed for identifying human failure events and associated error-forcing contexts that can make error likely. Methods for probabilistic quantification were developed and applied; a number of applications continue.

USNRC Framework for Advanced Reactor Regulation, 2003-2007. Assisted Brookhaven National Laboratory and USNRC develop a process for developing technology-neutral requirements and regulations for future reactors.

USNRC HRA Guidance for Radioactive Waste, 2004-2006. Assisted USNRC develop HRA guidance addressing both good practices and review guidance for applications dealing with the handling of radioactive waste.

Seabrook Station PRA Improvement Effort, 2000-2003, Consultant. Consulting support to the PRA group at Seabrook Station, providing advice on all aspects their PRA. The primary initial work involved developing an approach for improving the HRA in response to criticisms by the industry PRA certification group. Improvements involved providing more thorough consideration of dependencies, identifying a systematic method for ensuring consistency in HRA, extending existing methods to account for uncertainty in plant conditions beyond those modeled in the PRA, organizing and presenting a workshop on these methods for plant staff, and developing a process for long term improvement. Continuing work includes updating of the low power and shutdown PRA.

USNRC Handbook of Parameter Estimation for PRA, 2001-2002. Assisted Sandia National Laboratories and NRC in review and preparation of the handbook.

PRA Standards, 2000-2002. Member of IEEE standards sub-committee 7/5 of the Nuclear Power Engineering Committee working group on Nuclear Risk Management and Reliability (NRMR).

Russian Regulatory Activity: Kalininskya Nuclear Power Plant PRA, 1994-2002, Technical Lead. Supporting USNRC through Brookhaven National Laboratory in organizing the PRA project managed by the Russian regulator (Gozatomnadzor) and performed by six Russian organizations. Required familiarization with Russian regulations and reactor design, many visits to Moscow and the plant, and coordination of analysis activities among the Russian organizations. Specific technical tasks included developing procedure guides for the analysis, developing and leading a two month workshop to kick off project, training Russian analysts through additional workshops and review sessions, providing technical guidance for the project, and reviewing the technical work.

PRA Standards, 1998-2002. Supporting USNRC through Brookhaven National Laboratory in developing draft ASME standards for the performance of PRA that is to be used in regulatory applications. Author and reviewer of data analysis section.

CSD (Japan) Technical Risk Communication Research Program, 1998-2002, Principal Investigator. Research on methods and goals of technical risk communications programs at nuclear utility companies in the U.S. and Europe. Development of a technical risk communications program for internal use by a large nuclear utility company.

Improved Fire Risk Analysis (FRA) Methodology, 1999-2001, Principal Investigator. Developed a methodology for determining the frequency of challenging fires for the U.S. Nuclear Regulatory Commission. Basic idea is to replace the current fire initiating event frequency *severity factor approach with a mechanistic fire initial phase scenario frequency that include uncertainty in the analysis.

Risk-Informed Regulation Standard Review Plans, 1997-1998. Supported USNRC through Princeton Research Associates in reviews of draft Standard Review Plans (SRP) and supporting reports for the Office of Nuclear Reactor Regulation.

INSS (Japan) Walkdown Procedure Research Program, 1996-1999, Principal Investigator. Project to develop a general process for constructing plant-specific walkdown procedures for ensuring that plant systems and operations are conducted in accordance with PRA models and assumptions in all operating modes.

Risk-Based Studies, 1994-1998, Reviewer. Member of a three person review team for a series of studies performed by Idaho National Engineering and Environmental Laboratory for the USNRC. These studies focus on using operating experience to evaluate nuclear plant systems performance and to compare actual experience with predictions from PRA analyses.

Human Interface Analysis of the Surry Low Power and Shutdown Accident Frequencies Program: Level 1 Internal Event Probabilistic Risk Assessment, 1992-1994, Principal Investigator. Performed at PLG for Brookhaven National Laboratory for USNRC. Led an HRA based on SLIM for operators at a “Surry-like PWR” for events occurring during cold shutdown mid-loop operations; i.e., used Surry-specific design, procedures, and training, under the assumption that mid-loop operations would continue. Participated in plant visit and operator interviews. Worked with the BNL PRA Principal Investigator and BNL analysts to revise the event sequence analysis and thermal-hydraulic calculations to

ensure that realistic scenarios would be modeled. The scope was limited, which precluded modeling of most human action related dependencies.

Dodewaard Alternate Modes PSA, 1992-1993, Principal Investigator. Performed at PLG for KEMA and GKN Dodewaard in the Netherlands. Level 1, internal events shutdown PRA of a small BWR plant with an isolation condenser and a unique pressure suppression pool design. Task leader for event sequence analysis and HRA of in-vessel and fuel pool accidents for all shutdown maintenance configurations. Supervised PLG, KEMA, and GKN analysts in the USA and the Netherlands. Planned and conducted plant visits and interviews with operators, trainers, maintenance personnel, and plant management. Trained KEMA PRA team.

Project Plan for Shutdown Events Probabilistic Safety Assessment of a BWR 4/Mark I Plant, 1992, Principal Investigator. Performed at PLG for Toshiba Corporation, Japan. Developed a preliminary event sequence model for a particular BWR4 in the US. The utility agreed to participate to obtain the project plan and preliminary model. The model was based on the specific BWR4 design, its technical specifications, procedures, outage history, and next refueling outage plan. Supervised other analysts supporting the modeling and plan. Provided a course on shutdown PRA for Toshiba engineers.

Advanced Neutron Source Probabilistic Risk Assessment, 1991-1992, Analyst. Performed at PLG for Oak Ridge National Laboratory. Supported the ORNL PRA of the DOE ANS high flux reactor after preliminary design was in place. Visited ORNL and interviewed system designers. Reviewed event sequence analysis. Authored preliminary analysis of events caused by flow blockage, including fuel manufacturing flaws. Due to the very high flow and heat flux, minor flow blockage could lead to rapid and serious damage.

HVAC Systems and Nuclear Plant Safety, 1991-1992, Principal Investigator. Performed at PLG for Electric Power Research Institute. Led a team of analysts to compare the results from six PRAs. Plant-specific HVAC designs were identified and compared as were the risk contributions from the HVAC systems at each plant. Reasons for differences were identified where possible.

PSA Methods for Potential Accidents Initiated at Shutdown, 1991-1992, Contributing Author. Performed at PLG for Computer Software Development Co., Ltd., in Japan. Developed a project plan for conducting shutdown PRA of Japanese PWR's. Trained CSD and MAPI engineers in Tokyo on shutdown PRA techniques.

K-Reactor Restart Safety Basis, 1991, Principal Investigator. Performed at PLG with Stone & Webster Engineering Corp. for Department of Energy Savannah River Operations Office. Restructured information from the K-reactor PRA into a color-coded, hierarchical computer-based flow chart presentation that speaks clearly to engineers, scientists, and managers who have not directly participated in the PRA. It provides an easy-to-understand summary of reactor upset conditions, their likelihood, and the plant capability to safely return to a stable state.

Service Water Systems and Nuclear Plant Safety, 1989-1992, Principal Investigator. Performed at PLG for Electric Power Research Institute. Led a team of analysts to

compare the results from six PRAs. Plant-specific service water designs were identified and compared as were the risk contributions from the service water systems at each plant. Reasons for differences were identified where possible.

Development and Demonstration of Methods for Nuclear Power Plant Aging Risk Analysis: Bayesian Data Analysis and Plant-Specific Data Collection and Interpretation, 1989-1990, Co-Principal Investigator. Performed at PLG for EG&G Idaho, Inc., Idaho National Engineering Laboratory. Supervised a team of analysts who developed a Bayesian aging model. The team also visited a BWR plant with more than fifteen years operating experience, collected failure histories on pumps and valves in key systems, and analyzed the failure data under the Bayesian model. No evidence of aging was detected.

Diablo Canyon Probabilistic Risk Assessment, 1985-1989, Principal Investigator. Performed at PLG for Pacific Gas and Electric Company. Seismic PRA was required to satisfy a license condition placed on the plant because of uncertainties in seismic requirements. Full scope level 1 PRA. Extensive training of utility PRA team.

A Methodology for Assessment of Nuclear Power Plant Seismic Margin, 1986-1988, Investigator. Performed at PLG for the Electric Power Research Institute. With the Principal Investigator, developed success path models for BWR and PWR power plants. Developed an approach for relay chatter analysis. The method was published by EPRI as an alternative way for plants to address the seismic margins issue.

Pneumatic Systems and Nuclear Plant Safety, 1986-1988, Principal Investigator. Performed at PLG for Electric Power Research Institute. Led a team of analysts to perform a two-pronged examination of the risk contribution of pneumatic systems in BWR and PWR plants. Analyzed the data on pneumatic system problems in NUREG-1275 from the viewpoint of risk, specifically tabulating events causing multiple failures and identifying the risk impact of each event. To more clearly identify the impact of component failure on safety systems performance, air systems at two specific plants, a BWR and a PWR, were analyzed with the assistance of utility personnel. Coordinated and participated in plant visits and interviews.

Analysis of Safety Impact of Changes to Technical Specification 3/4.3.4 Turbine Overspeed Protection - San Onofre Nuclear Generating Station Units 2 and 3, 1985-1986, Principal Investigator. Performed at PLG for Southern California Edison. Directed and reviewed a study of the impact of changing the frequency of main turbine overspeed protection on plant safety.

South Texas Project PRA Scoping Study, 1983, Principal Investigator. Performed at PLG for Houston Light and Power. A phased PRA, with Phase 1 setting up fully detailed event trees and including simplified systems models. Careful attention was given to modeling uncertainty. A key sensitivity to HVAC was identified, treated probabilistically, and formed the basis for the phase 2 project plan. Served as Reviewer for the complete phase 2 project.

Zion Nuclear Plant Residual Heat Removal PRA, 1982-1985, Principal Investigator. Performed at PLG for Electric Power Research Institute. The first shutdown PRA of a PWR that specifically identified the impact of changing plant configuration on risk.

Developed a phased mission event sequence model that tracks changes in plant configuration. Initiating events can be random or related to activities involved in changing configurations. Dependencies among initiating events, plant configuration, and subsequent human actions are modeled. Involved extensive data collection, interpretation, and analysis.

Zion and Indian Point Probabilistic Safety Studies, 1980-1983, Principal Investigator. Performed at PLG for Commonwealth Edison, New York Power Authority, and Consolidated Edison. The first full scope PRAs, offering a complete treatment of external events and Level 3 effects. Integrated the efforts of the utilities, three primary contractors, and several additional contractors. Supervised all aspects of the analysis including data collection and analysis and developed new methods for fire analysis, seismic and wind PRA analysis, and the treatment of uncertainty in all areas of the studies. Trained the PRA teams at all three utilities. Defended the PRAs in public hearings before the ASLB.

Seabrook Probabilistic Safety Assessment, Phase I: Preliminary Risk Analysis, 1982, Co-Principal Investigator. Performed at PLG for New Hampshire Yankee. The first nuclear plant phased PRA project, with Phase 1 setting up fully detailed event trees and including simplified systems models. Careful attention was given to modeling uncertainty. Served as Reviewer for the complete phase 2 project.

Reliability Analysis of Safety Injection System Modification, San Onofre Nuclear Generating Station - Unit 1, 1981, Principal Investigator. Performed at PLG for Southern California Edison. Analyzed a unique feedwater/safety injection design that led to a failure of injection during a spurious SI demand. Analyzed alternative design options and associated test programs. Presented to USNRC to support testing program to permit continued operations. Involved data collection and analysis and development of post-fix data collection requirements.

Midland Plant Auxiliary Feedwater System Reliability Analysis, 1981, Principal Investigator. Performed at PLG for Consumers Power Co. Principal investigator, leader of plant visit, organized and conducted interviews with Midland engineers and operators. Analyzed risk significance of system design in response to USNRC request.

Reliability Analysis of Diablo Canyon Auxiliary Feedwater System, 1980, Principal Investigator. Performed at PLG for PG&E. Principal investigator, leader of plant visit, organized and conducted interviews with PG&E engineers and operators. Analyzed risk significance of system design in response to USNRC request.

Oyster Creek Probabilistic Safety Analysis (OPSA), 1979, Reviewer/Author. Full scope PRA including external events and levels 1,2, and 3. Performed at PLG for Jersey Central Power and Light Co. Involved extensive data collection, analysis and methods development. Reviewer and author of 150 page executive summary report. Presented details of analysis to utility and government audiences throughout the USA.

OTHER PROFESSIONAL ACTIVITIES

Invited Speaker, MIT Nuclear Power Reactor Safety Course, Cambridge (2007-present).

Member, National Research Council Committee on Risk of Shipping in the Aleutians (2007-present).

Member, Department of Energy Experts Working Group on Assessment Methods for Proliferation Resistance and Physical Protection of Generation IV Nuclear Energy Systems (2003-present).

Member, National Research Council Committee on Transportation of Radioactive Waste (2003-2006).

Director, Board of Directors of International Association for Probabilistic Safety and Management (1993-2006).

Member, Technical Program Committee, PSAM 7, Berlin (2002-2004).

Invited Speaker, USNRC Fire Risk Research Workshop, New London, August 23-24, 2001.

Member, Pine Bluff Chemical Disposal Facility QRA Expert Panel (2000-2003).

Invited Participant, USNRC PRAB Research Colloquium, Annapolis, April 29-May 1, 2002.

Member, National Research Council Committee on the Evaluation of Chemical Events at Army Chemical Agent Disposal Facilities (2001-2002).

Member, Department of Energy Generation IV Roadmap Evaluation Methods Group (2000-2002).

Director, NATO Advanced Study Institute, “Risk Assessment Activities for the Cold War Facilities and Environmental Legacies,” Bourgas, Bulgaria, May 1-11, 2000.

Chairman, Technical Sessions, “PSA Principles and Insights” and “Revisiting the Assumptions Common to PSAs,” International Topical Meeting on Probabilistic Safety Assessment PSA ’99: Risk-Informed, and Performance-Based Regulation in the New Millennium, August 22-26, 1999, Washington, D.C.

Member, Technical Program Committee, PSA ’99, American Nuclear Society conference on PSA (1998-1999).

Chairman, Technical Session, “PRA Concepts and Algorithms,” PSAM-4 International Conference on Probabilistic Safety and Management, New York (1998).

Invited Participant, INEEL-USNRC Management and Organizational Factors Workshop, Sun Valley, Idaho (1997).

Invited Speaker, MIT-National Academy for Nuclear Training (INPO) Risk-Informed Operational Decision Management, Cambridge (1997-1998).

Chairman, Technical Session, "Innovative Applications of HRA Technique Techniques," ESREL '96 - PSAM-III International Conference on Probabilistic Safety and Management, Crete, Greece (1996).

Invited Speaker, MIT Nuclear Power Reactor Safety Course, Cambridge (1995 - 1998).

Member, National Research Council Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program (1994-2000).

Member, Technical Program Committee PSA '96, American Nuclear Society conference on PSA (1994 - 1996).

Member, Steering Committee, University of California, Irvine, Science, Technology, and Society Network to provide continuous updating of science and technology issues in middle and high school curricula (1994-1996).

Member, Technical Program Committee PSAM III, International Conference on Probabilistic Safety and Management, Crete, 1996 (1994-1996).

Invited Speaker, University of Wisconsin Center for Human Performance in Complex Systems Annual Workshop (1994-1995).

Invited Participant, USNRC workshop on accident precursors, Annapolis, MD (1994).

Invited Speaker, *Human Reliability Models: Theoretical and Practical Challenges*, Workshop II of the International Series on Advanced Topics in Reliability and Risk Analysis, Stockholm, Sweden (1994).

Invited Participant, USNRC workshop on medical applications of radioisotopes, Idaho Falls, ID (1994).

Invited Participant, USNRC workshop on passive reactor safety, Harpers Ferry, WV (1994).

Invited Panelist, Closing Plenary, PSAM II International Conference on Probabilistic Safety and Management, San Diego, CA (1994).

Chairman, Technical Session, "Time Dependence of Equipment Failure Rates–Models, Data, and Impacts on System Modeling," PSAM II International Conference on Probabilistic Safety and Management, San Diego, CA (1994).

Participant, Mission to Sosnovy Bor, Russia, 13-23 November, 1993. Organized by the Dutch Committee for Risk Management and the Kurchatov Institute, Moscow, to plan Sosnovy Bor risk management program with representatives of the town, Moscow, local government and industry officials. Primary facilities include the Leningrad RBMK reactor complex, oil terminal on the Gulf of Finland, Scientific Institute for Testing of

Optoelectronic Devices, the Leningrad Special Plant, and the Scientific Research Technological Institute (1993).

Invited Participant, USNRC workshop on risk-based indicators, Gaithersburg, MD (1993).

Councilor, Southern California Chapter of the Society for Risk Analysis (1993-1996).

Member, University of California, Irvine Science Education Advisory Board (1993-1996).

Vice President for Education, Orange County Engineering Council (1993-1995).

Officer, Executive Committee, Orange County Section of IEEE (1992-1996).

Member, Organizing Committee for PSAM II, International Conference on Probabilistic Safety and Management, San Diego, 1994 (1992-1994).

Invited Speaker, USNRC workshop on Use of PRA Methodology for the Analysis of Reactor Events and Operational Data (1992).

Invited Speaker, NATO Workshop on Dynamic Methods in PSA, Kusadasi, Turkey (1992).

Invited Panelist, Expert Panel, "Future Trends in Licensing and Regulations–Current Issues in PSA Modeling and Quantification," International SMiRT 11 Conference, Tokyo, Japan (1991).

Chairman, Technical Session, "PSA Applications," International SMiRT 11 Conference, Tokyo, Japan (1991).

Invited Speaker, EPRI/NSAC workshop on Instrument Air Systems in Nuclear Powerplants, Baltimore (1991).

Invited Participant, EPRI workshop on future PRA research, Palo Alto.

Invited Speaker, EPRI workshop on Errors of Commission, Gaithersburg, MD (1991).

Chairman, Technical Session, "Methods, Applications, and Insights of PSA," International PSAM Conference, Beverly Hills, CA (1991).

Member, Technical Program Committee PSAM I, International Conference on Probabilistic Safety and Management, Beverly Hills, CA (1990-1991).

Member, Senior Review Group, K-Reactor PRA, 1990.

Chairman, Technical Session, "Managing the Risks of Relay Chatter and Other Seismic Effects," International SMiRT 10 Conference, Anaheim, CA (1989).

Organizer, Naval Research Laboratory Workshop on Risk Assessment and Inference Techniques, Washington, DC (1989).

External Examiner, University of Hong Kong.

Invited Panelist, Expert Panel, “PSA: Safety Issues and Uncertainties,” International SMiRT 9 Conference, Lausanne, Switzerland (1987).

Chairman, Technical Session, ANS Winter Meeting, San Francisco (1986).

Invited Panelist, “Panel Discussion on Relay Functionality,” Symposium on Current Issues Related to Nuclear Power Plant Structure, Equipment and Piping, North Carolina State University, Raleigh (1986).

Member, Oak Ridge Associated Universities Advisory Committee on PRA Training for the USNRC.

Member, Senior Consultant Group for the USNRC ASEP and NUREG-1150 programs (1982-1991).

Publications

Journal Articles, Book Chapters, and Presentations

Bley, D.C., S.E. Cooper, M.S. King, M.A. Junge, and J.E. Thorp, ATHEANA HRA Analysis in the 2007 International HRA Empirical Study," presented at PSA 2008, Knoxville, September 2008.

Bley, D., and G.G.M. Cojazzi, "Lessons Learned from [PR&PP] Demonstration Problem," Global 2007: Advanced Nuclear Fuel Cycles and Systems, Boise, Idaho, September 9-13, 2007.

Bley, D., "The [PR&PP] Implementation Guide," Global 2007: Advanced Nuclear Fuel Cycles and Systems, Boise, Idaho, September 9-13, 2007.

Bley, D., "An Implementation Guide for the PR&PP Methodology," PR&PP Evaluation Methodology GIF User Workshop, Tokyo, November 6, 2006.

Bley, D., "Framework and Major Elements of PR&PP Methodology," PR&PP Evaluation Methodology GIF User Workshop, Ispra, Italy, July 12, 2006.

Bley, D., "An Implementation Guide for the PR&PP Methodology," PR&PP Evaluation Methodology GIF User Workshop, Ispra, Italy, July 12, 2006.

Bari, R., R. Nishimura, P. Peterson, J. Roglans, T. Bjornard, D. Bley, J. Cazalet, G.G.M. Cojazzi, P. Delaune, M. Golay, E. Haas, G. Rochau, G. Renda, M. Senzaki, I. Therios, M. Zentner, "Evaluation Methodology for Proliferation Resistance and Physical Protection of Generation IV Nuclear Energy Systems: An Overview," *Proceedings of the International Conference on Probabilistic Safety Assessment and Management PSAM-8,* May 14-18, 2006, New Orleans, 2006.

Bley, D., and G.G.M. Cojazzi, "Proliferation Resistance and Physical Protection Evaluation Methodology: System Response, PR&PP Workshop, Washington, November 18, 2004.

Bley D., B. Burchill, M. Drouin, J. Julius, K. Kiper, and B. Stillwell, "Differences Between Full Power Operation and Low Power/Shutdown Operation, and the Implications on the LPSD Standard," *Proceedings of the International Conference on Probabilistic Safety Assessment and Management PSAM-7 - ESREL '04,* June 14-18, 2004, Berlin, 2004.

Kolaczkowski A., J. Forester, E. Lois, G. Parry, and D. Bley, "Human Reliability Analysis (HRA) Good Practices," *Proceedings of the International Conference on Probabilistic Safety Assessment and Management PSAM-7 - ESREL '04,* June 14-18, 2004, Berlin, 2004.

Forester, J., D. Bley, S. Cooper, E. Lois, N. Siu, A. Kolaczkowski, and J. Wreathall, "Expert Elicitation Approach for Performing ATHEANA Quantification," *Reliability Engineering & System Safety*, v. 83, pp 207-220, 2004.

Wreathall, J., D. Bley, E. Roth, J. Julter, and T. Raslear, "Using an Integrated process of Data and Modeling in HRA," *Reliability Engineering & System Safety*, v. 83, pp 221-228, 2004.

Bley, D.C., J.G. Droppo, Jr., and V.A. Eremenko, ed., *Risk Methodologies for Technological Legacies*, NATO Science Series, Kluwer Publishers 2002.

Bley, D.C., "New Methods for Human Reliability Analysis," *Environmental Management and Health*, Vol. 13, No. 3, pp. 277-289, Emerald, 2002.

Bley, D.C., S.E. Cooper, J.A. Forester, A.M. Kolaczkowski, N. Siu, E. Thornsbury, and J. Wreathall, "A New Process for Quantification and Treatment of Uncertainty in Human Reliability Analysis (HRA) Based on A Technique for Human Event Analysis (ATHEANA)" *Probabilistic Safety and Management: PSAM-6, Proceedings of the 6th International Conference on Probabilistic Safety Assessment and Management, June 23-28, 2002*, San Juan, Puerto Rico, 2002.

Bley, D.C., R. Budnitz, S. Kaplan, and R. Magee, "A Mechanistic Approach for Fire Initial Phase Modeling in PRA" *Probabilistic Safety and Management: PSAM-6, Proceedings of the 6th International Conference on Probabilistic Safety Assessment and Management, June 23-28, 2002*, San Juan, Puerto Rico, 2002.

Bley, D.C., J.Multer, Tom Raslear, E. Roth, and J. Wreathall, "The Fusion of Indirect Evidence and Opinion in a Human Reliability Study of Railroad Operations," presented at PSAM 6, San Juan, Puerto Rico, June 2002.

Bley, D.C., "Frequency of Challenging Fires," presented at USNRC Fire Risk Research Workshop, New London, August 23-24, 2001.

Bley, D.C., "New Methods For Human Reliability Analysis," *Proceedings of the International Scientific Session on Management of Natural and Technogenic Risks*, University of Mining and Geology "St. Ivan Rilski," 4-8 June, 2001.

Droppo, J.G., and D.C. Bley, "Risk Methodologies For Technological Legacies," *Proceedings of the International Scientific Session on Management of Natural and Technogenic Risks*, University of Mining and Geology "St. Ivan Rilski," 4-8 June, 2001.

Kolaczkowski, A., D. Bley, S. Cooper, J. Forester, N. Siu, E. Thornsbury, H. Woods, and J. Wreathall, "Field Test of ATHEANA (A Technique for Human Event Analysis) in Pressurized Thermal Shock Probabilistic Risk Assessments," OECD/NEA/CSNI Workshop "Building the New HRA: Errors of Commission from Research to Application," Rockville, Maryland, May 7-9, 2001.

Forester, J., S. Cooper, D. Bley, A. Kolaczkowski, N. Siu, E. Thornsbury, H. Woods, and J. Wreathall, "Potential Improvements in Human Reliability Analysis for Fire Risk Assessments," OECD/NEA/CSNI Workshop "Building the New HRA: Errors of Commission from Research to Application," Rockville, Maryland, May 7-9, 2001.

Kojima, S., D. Bley, L. Bowen, and J. Wreathall, “Development of Technical Risk Communication Guideline in NPP,” in *Probabilistic Safety and Management: PSAM-5, Proceedings of the 5th International Conference on Probabilistic Safety Assessment and Management, November 27 – December 1, 2000*, Osaka, Japan, 2000.

Bley, D.C., S.E. Cooper, J.A. Forester, A.M. Kolaczkowski, C. Thompson, A. Ramey-Smith, and J. Wreathall, “A Description of the Revised ATHEANA (A Technique for Human Event Analysis),” in *Probabilistic Safety and Management: PSAM-5, Proceedings of the 5th International Conference on Probabilistic Safety Assessment and Management, November 27 – December 1, 2000*, Osaka, Japan, 2000.

Bley, D.C., “Accident Risk Assessment,” presented at NATO Advanced Study Institute: Risk Assessment Activities for the Cold War Facilities and Environmental Legacies, Bourgas, Bulgaria, May 2-11, 2000.

Eremenko,V.A. Droppo, Jr. J., and Bley, D.C., "Human-Centered Risk Assessment Approaches for Regions with a Heavy Burden of Hazardous Materials and Meager Financial Resources,” presented at the 1999 Annual Conference of the Society for Risk Analysis – Europe: Risk Analysis: Facing the New Millenium, Rotterdam, the Netherlands, 10-13 October 1999.

Cooper, S.E., D.C. Bley, J.A., Forester, A.M. Kolaczkowski, A. Ramey-Smith, C. Thompson, D. Whitehead, and J. Wreathall, “Evaluation of Human Performance Issues for Fire Risk,” *Proceedings of the International Topical Meeting on Probabilistic Safety Assessment PSA ’99: Risk-Informed, and Performance-Based Regulation in the New Millennium, August 22-26, 1999, Washington, D.C.,* M. Modarres, ed., pp. 964-969, American Nuclear Society, La Grange Park, Illinois 1999.

Bley, D.C., and D.H. Johnson, “Revisiting the Assumptions Common to Probabilistic Safety Assessments,” a panel discussion at the International Topical Meeting on Probabilistic Safety Assessment PSA ’99: Risk-Informed, and Performance-Based Regulation in the New Millennium, American Nuclear Society August 22-26, 1999, Washington, D.C.

Bley, D.C., S. Kojima, and J. Wreathall, “Facilitating Technical Risk Communication among Non-Specialists,” *Proceedings of the International Topical Meeting on Probabilistic Safety Assessment PSA ’99: Risk-Informed, and Performance-Based Regulation in the New Millennium, August 22-26, 1999, Washington, D.C.,* M. Modarres, ed., pp. 913-920, American Nuclear Society, La Grange Park, Illinois 1999.

Eremenko,V. A., Bley, D.C., and Droppo, Jr. J.; "Risk Assessment Technique In Deciding Problems Of Environment And Of Human Health In FSU, Eastern Europe And Middle Asian Countries,” presented at the 1998 Society for Risk Analysis Annual Meeting, December 6-9,1998.

Bley, D.C., D.J. Diamond, T-L. Chu, A. Azarm, W.T. Pratt, D. Johnson, A. Szukiewicz, M. Drouin, A. El-Bassioni, and T-M. Su, “NRC Support For The Kalinin (VVER) Probabilistic Risk Assessment,” Transactions of the Twenty-Sixth Water Reactor Safety Information Meeting,” NUREG/CP-0165, Bethesda, Maryland, October 26-28, 1998.

Forester, J.A., A. Ramey-Smith, D.C. Bley, A.M. Kolaczkowski, and S.E. Cooper, "Discussion of Comments from a Peer Review of A Technique for Human Event Analysis (ATHEANA)," Transactions of the Twenty-Sixth Water Reactor Safety Information Meeting," NUREG/CP-0165, Bethesda, Maryland, October 26-28, 1998.

Drouin, M., D. Bley, R. Budnitz, A. Camp, J. Forester, D. Whitehead, A. Kolaczkowski, J. LaChance, J. Lehner, and T. Pratt, "Perspectives on Needed Scope and Level of Detail for a PRA Standard," Transactions of the Twenty-Sixth Water Reactor Safety Information Meeting," NUREG/CP-0165, Bethesda, Maryland, October 26-28, 1998.

Eremenko, V., D.C. Bley, and J. Droppo, "Human-Centered Risk Assessment: An Environmental Strategy for FSU, Eastern Europe and Middle Asian Countries," in Mosleh, A., and R.A. Bari, ed., *Probilistic Safety and Management: PSAM-4, Proceedings of the 4th International Conference on Probabilistic Safety Assessment and Management, 13-18 September 1998, New York City, USA*, Springer, New York, 1998.

Bley, D.C., S.E. Cooper, and J. Wreathall, "Things Not Modeled in Nuclear Plant PSA," in Mosleh, A., and R.A. Bari, ed., *Probilistic Safety and Management: PSAM-4, Proceedings of the 4th International Conference on Probabilistic Safety Assessment and Management, 13-18 September 1998, New York City, USA*, Springer, New York, 1998.

Drouin, M., D. Whitehead, A. Camp, J. Lehner, T. Pratt, J. LaChance, D. Bley, and G. Parry, "Perspectives on PRA Standards," in Mosleh, A., and R.A. Bari, ed., *Probilistic Safety and Management: PSAM-4, Proceedings of the 4th International Conference on Probabilistic Safety Assessment and Management, 13-18 September 1998, New York City, USA*, Springer, New York, 1998.

Onoue, A., S. Kojima, D.C. Bley,and J. Wreathall, "Development of a Plant Walkdown Procedure Utilizing a Plant-Specific Probabilistic Safety Assessment," in Mosleh, A., and R.A. Bari, ed., *Probilistic Safety and Management: PSAM-4, Proceedings of the 4th International Conference on Probabilistic Safety Assessment and Management, 13-18 September 1998, New York City, USA*, Springer, New York, 1998.

Bley, D.C., J. Wreathall, and S.E. Cooper, "Common Elements in Operational Events Across Technologies," presented at the CNRA/CSNI Specialists' Meeting on Human Performance in Operational Transients, Chattanooga, Tennessee, October 13-17, 1997.

Cooper, S.E., D.C. Bley, "The Character of Serious Accidents," presented at the 15th International System Safety Conference, Washington, D.C., August 13-17,1997.

Bley, D.C., "Human Reliability Analysis," presented at the MIT-National Academy for Nuclear Training Risk-Informed Operational Decision Management Course, Cambridge, Massachusetts, July 23, 1997.

Bley, D.C., "Common Factors in Serious Accidents," presented at the MIT Nuclear Power Reactor Safety Course, Cambridge, Massachusetts, July 22, 1997.

Thompson, C., J. Forester, S. Cooper, A. Kolazkowski, D.C. Bley and J.Wreathall, "The Application of ATHEANA: A Technique for Human Error Analysis."; in *Global Perspectives of Human Factors in Power Generation: Proceedings of the 1997 IEEE Sixth Conference on Human Factors and Power Plants*, June 8-13, 1997, Orlando Florida; David I. Gertman, Donald L. Schurman, Harold S. Blackman (ed.) IEEE, pp: 9-13 – 9-17, NY 1997.

Bley, D.C., "Risk Management," presented at the MIT-National Academy for Nuclear Training Risk-Informed Operational Decision Management Course, Cambridge, Massachusetts, January 15, 1997.

Bley, D.C., "Probabilistic Safety Assessment Results," presented at the MIT-National Academy for Nuclear Training Risk-Informed Operational Decision Management Course, Cambridge, Massachusetts, January 15, 1997.

Bley, D.C., S.E. Cooper, G.W. Parry, J. Wreathall, W.J. Luckas, J.H. Taylor, M. Drouin, A. Ramey-Smith, and C.M. Thompson, "Trial Applications of A Technique for Human Error Analysis (ATHEANA)," *Proceedings of the International Topical Meeting on Probabilistic Safety Assessment PSA '96: Moving toward Risk-Based Regulation, September 29 – October 3, 1996, Park City, Utah*, pp 686-690, American Nuclear Society, La Grange Park, Illinois 1996.

Cooper, S.E., D.C. Bley, G.W. Parry, J. Wreathall, E.M. Roth, W.J. Luckas, J.H. Taylor, C.M. Thompson, and M. Drouin, "Knowledge-Base for the New Human Reliability Analysis Method, 'A Technique for Human Error Analysis (ATHEANA),'" *Proceedings of the International Topical Meeting on Probabilistic Safety Assessment PSA '96: Moving toward Risk-Based Regulation, September 29 – October 3, 1996, Park City, Utah*, pp 679-685, American Nuclear Society, La Grange Park, Illinois 1996.

Parry, G.W., D.C. Bley, S.E. Cooper, G.W. Parry, J. Wreathall, W.J. Luckas, J.H. Taylor, C.M. Thompson, and A. Ramey-Smith, "A Process for Application of ATHEANA—A New HRA Method," *Proceedings of the International Topical Meeting on Probabilistic Safety Assessment PSA '96: Moving toward Risk-Based Regulation, September 29 – October 3, 1996, Park City, Utah*, pp 671-677, American Nuclear Society, La Grange Park, Illinois 1996.

Bley, D.C., "Common Factors in Severe Accidents," presented at the MIT Nuclear Power Reactor Safety Course, Cambridge, Massachusetts, July 23, 1996.

Wreathall, J., D.C. Bley, S.E. Cooper, G.W. Parry, W.J. Luckas, C.M. Thompson, and A. Ramey-Smith, "A Reality-Based Method for Assessing Human Performance in Power-Plant Safety," presented at NPIC & HMIT, Pennsylvania State University, May 6-9, 1996.

Bley, D.C., and V.M. Bier, "Intersystem Dependencies Caused by Failures of Instrument Air Systems," presented at Society for Risk Analysis Annual Meeting, Honolulu, December 4-6, 1995.

Bley, D.C., J. Wreathall, S.E. Cooper, G.W. Parry, A. Ramey-Smith, W.J. Luckas, and M.T. Barriere, "An Improved Approach to Human Reliability Analysis Based on Operating Experience," presented at PSA '95, Seoul, Korea, November 26-30, 1995.

“Status of Development of an Improved HRA Method: A Technique for Human Error Analysis” in *Proceedings of the 23rd Water Reactor Safety Information Meeting*, October 1995.

Bley, D.C., “Common Factors in Severe Accidents,” presented at the MIT Nuclear Power Reactor Safety Course, Cambridge, Massachusetts, July 18, 1995.

M.T. Barriere, W.J. Luckas, S.E. Cooper, J.Wreathall, D.C. Bley, A. Ramey-Smith, C.M. Thompson, “An HRA Framework for Quantifying Human Acts of Commission and Dependency: Development Status of a Methodology for Conducting an Integrated HRA/PRA,” presented at the USNRC Water Reactor Safety Conference, Washington, D.C., October 25-26, 1994.

Bley, D.C., M.T. Barriere, W.J. Luckas, S. Cooper, J. Wreathall, G. Parry, J.T. Reason, A. Ramey-Smith, and C.M. Thompson, “USNRC Detailed HRA Project Status,” presented at *Human Reliability Models: Theoretical and Practical Challenges*, Workshop II of the International Series on Advanced Topics in Reliability and Risk Analysis, Stockholm, Sweden, August 22-24, 1994.

Bley, D.C., “Risk Assessment and Risk Management in the Nuclear Power Industry: A Historical Perspective,” presented at the Southern California Society for Risk Analysis Seventh Annual Workshop, University of Southern California, May 19, 1994.

Lin, J.C., D.C. Bley, D.H. Johnson, C.T. Ramsey, R.M. Harrington, and M.A. Linn, "Risk Management of Advanced Neutron Source Reactor," presented at the 4th International Topical Meeting on Nuclear Thermal Hydraulics, Operations and Safety, Taipei, Taiwan, ROC, April 1994.

Johnson, D.H., D.C. Bley, J.C. Lin, J. Schüller, R.W. van Otterloo, C.T. Ramsey, and M.A. Lin, "Examples of the Use of PSA in the Design Process and to Support Modifications," presented at the 4th International Topical Meeting on Nuclear Thermal Hydraulics, Operations and Safety, Taipei, Taiwan, ROC, April 1994.

Bley, D.C., V.S. Ho, and J.P. Kindinger, “Management Experience Using a Novel PRA Format for Safety Communication,” presented at PSAM-II, San Diego, March 20-25, 1994.

Johnson, D.J., D.C. Bley, J.C. Lin, C.T. Ramsey, and M.A. Linn, “Examples of the Use of PSA in the Design Process and to Support Modifications at Two Research Reactors,” *Proceedings of PSAM-II*, March 1994.

Bley, D.C., “Error Prone Conditions in Nuclear Power Plant Operations, presented at PSAM-II, San Diego, March 20-25, 1994.

Lin, J.C., D.C. Bley, D.H. Johnson, and T-L. Chu, “Human Reliability Analysis for Surry Midloop Operation,” *Proceedings of PSAM-II*, March 1994.

Bley, D.C., and D.H. Johnson, “On Encountering Small Numbers: How Good Models Go Bad,” *Proceedings of PSAM-II*, March 1994.

Luckas, W.J., M.T. Barriere, S.E. Cooper, J. Wreathall, D.C. Bley, and W.S. Brown, "Implications of an HRA Framework for Quantifying Human Acts of Commission and Dependency: Development of a Methodology for Conducting an Integrated HRA/PRA," presented at the 1993 U.S.N.R.C. Water Reactor Safety Conference, Washington, D.C., October 26-27, 1993.

Kaplan, S., V.M. Bier, and D.C. Bley, "A Note on Families of Fragility Curves-Is the Composite Curve Equivalent to the Mean Curve?" *Nuclear Engineering and Design*,1993.

Bley, D.C., D.H. Johnson, J.C. Lin, J. Wreathall, Luckas, W.J., S.E. Cooper, M.T. Barriere, "Human Reliability Analysis for Event Sequences Arising During Nuclear Reactor Shutdown Conditions," presented at the 12th International Conference on Structural Mechanics in Reactor Technology Post-Conference Workshop on PRA, Heidleburg, Germany, August 23-24, 1993.

Medhekar, S.R., W.C. Geckler, and D.C. Bley, "Frequency Estimates for Transport-Related Hydrofluoric and Sulfuric Acid Release Scenarios," *Process Safety Progress*, Vol.12, No.3, pp 166-175, July 1993.

Medhekar, S.R., D.C. Bley, and W.C. Geckler, "Prediction of Vessel and Piping Failure Rates in Chemical Process Plants Using the Thomas Model," *Process Safety Progress*, Vol.12, No.2, pp 123-126, April1993.

Bley, D. C., and W. B. Reuland, "Risk-Based Regulation: A Support Systems Perspective," *Proceedings of the 2nd ASME/JSME Nuclear Engineering Joint Conference,* Vol.2, pp. 523-528, San Francisco, California, March 21-24, 1993.

Bley, D. C., "Human Reliability Analysis," presented to U.S. Nuclear Regulatory Commission Senior Consulting Group, Low Power and Shutdown PRA, Brookhaven National Laboratory, Upton, New York, September 22-23, 1992.

Bley, D. C., "Advanced Modeling of Dynamic Process Systems: Where are Targets of Opportunity in PSA?" presented at the NATO Advanced Workshop on the Reliability and Safety Assessment of Dynamic Process Systems, Kusadasi, Turkey, August 24-28, 1992.

Bley, D. C., F. R. McCoy, J. P. Kindinger, C. R. Grantom, W. P. Hennessy, J. R. Patterson, and V. S. Ho, "Management Experience Using a Novel Probabilistic Risk Assessment Format for Safety Communication," *Transactions of the American Nuclear Society*, Boston, Massachusetts, June 7-12, 1992.

Fleming, K. N., and D. C. Bley, "Risk Management Applications of Probabilistic Safety Assessment at PLG," *3rd TÜV Workshop on Living PSA Application*, H. P. Balfanz, ed., Hamburg, Germany, May 11-12, 1992.

Frank, M. V., R. J. Mulvihill, and D. C. Bley, "Risk Assessment of the NASA Langley 8FT HTT Wind Tunnel," presented at the Fifth Annual Workshop by Southern California Chapter of the Society for Risk Analysis, University of Southern California, Los Angeles, California, March 31, 1992.

Bley, D. C., "Living PRA Concept," presented at the U.S. Nuclear Regulatory Commission Office for Analysis and Evaluation of Operational Data Workshop on the Use of PRA Methodology for the Analysis of Reactor Events and Operational Data, Annapolis, Maryland, January 29-30, 1992.

Bley, D. C., S. Kaplan, and D. H. Johnson, "The Strengths and Limitations of PSA: Where We Stand," *Reliability Engineering and Systems Safety*, vol. 38, 1992.

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Attachment 5

"Stockpile Stewardship Program"

NTS (2004)

Stockpile Stewardship

Stockpile Stewardship Program

Introduction

When the Nevada Test Site was established in 1951, it provided a proving ground for a burgeoning U.S. nuclear weapons program. One hundred atmospheric nuclear tests occurred at the test site between 1951and 1962. When the U.S. entered into an atmospheric testing moratorium, all testing moved underground. In 1992, the president instituted a moratorium on nuclear testing. In order to certify the safety and reliability of the nation's nuclear stockpile, developing improved computer models and advanced experimental capabilities that provide accurate predictive capability of weapon performance in the absence of nuclear testing became the main goal of the National Nuclear Security Administration's Stockpile Stewardship Program.

The Birth of the Stockpile Stewardship Program

The Stockpile Stewardship Program was established in response to the 1994 National Defense Authorization Act (Public Law 103-160) which requires, in the absence of nuclear testing, a program to:

1. Support a focused, multifaceted program to increase the understanding of the enduring stockpile;
2. Predict, detect, and evaluate potential problems of the aging stockpile;
3. Refurbish and re-manufacture weapons and components, as required; and
4. Maintain the science and engineering institutions needed to support the nation's nuclear deterrent, now and in the future.

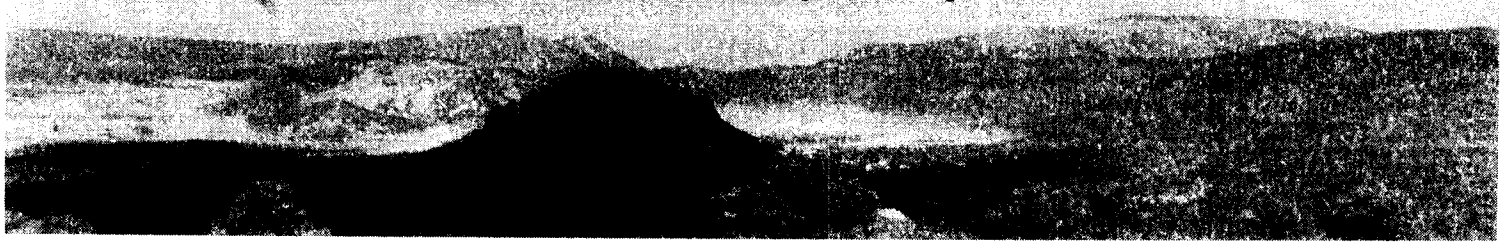
As the civilian steward of the nation's nuclear weapons complex, the U.S. Department of Energy (DOE) National Nuclear Security Administration is responsible for the safety and reliability of the nation's nuclear arsenal. The U.S. Department of Defense (DoD) partners with the DOE in setting requirements and establishing production goals. A key challenge to the Stockpile Stewardship Program is to balance military weapon performance goals against civilian and military surety and safety concerns.

Assessment and Certification

In the absence of nuclear testing, different experiments and tools are relied upon to obtain data relevant to nuclear warhead performance as components within a warhead potentially change properties with age. The Stockpile Stewardship Program utilizes several approaches to assess and certify the nuclear weapons stockpile. Test data from new experiments and improved computer modeling help address the reliability of the nuclear weapons stockpile by allowing scientists to improve understanding of the dynamic properties of aging nuclear materials.

A suite of enhanced capabilities and facilities across the Nuclear Weapons Complex (which includes weapons laboratories, production plants, and the Nevada Test Site) have been developed to fill in the knowledge gaps and to provide data relevant to identified stockpile concerns. Capabilities specific to the Nevada Test Site include the following:

- Subcritical Experiments obtain technical information about the U.S. nuclear weapons stockpile in the absence of nuclear testing. In subcritical experiments, chemical high explosives generate high pressures that are applied to nuclear weapon materials, such as plutonium. The configuration and quantities of explosives and nuclear materials are such that no nuclear explosion will occur. Thus, the experiments are consistent with the existing U.S. nuclear testing moratorium. They are called "subcritical" because there will be no critical mass formed, i.e., no self-sustaining nuclear fission chain reaction will occur. Scientific data is obtained on the behavior of nuclear weapon materials by the use of a wide variety of sophisticated, high speed diagnostic instruments.



- The Joint Actinide Shock Physics Experimental Research (JASPER) two-stage gas gun experiments generate high shock pressures, temperatures, and strain rates that simulate those of a nuclear weapon. The gas gun forces a high-velocity projectile to a target containing special nuclear material. When the projectile hits the target it produces a high-pressure shock wave. Diagnostic equipment, triggered by the initial wave, measures the properties of the shocked material inside the target.

- The Atlas pulse power machine discharges electrical energy into a cylindrical metal shell to produce an intense pressure pulse that implodes a target containing non-nuclear materials of interest. Highly advanced optical and x-ray diagnostic equipment measures the properties of the imploding materials within the target.

- The Big Explosives Experimental Facility (BEEF) is a hydrodynamic testing facility at the Nevada Test Site. BEEF provides data, through conventional high-explosive experiments, to support the Stockpile Stewardship Program, along with a variety of new experimental programs that expand the nation's non-nuclear experiment capabilities.

Maintaining Nuclear Test Readiness

The President directed the U.S. Department of Energy to maintain a test readiness program in the event that resumption of nuclear weapons testing becomes necessary. Overall readiness is supported by experimental programs conducted at the test site. In particular, test readiness at the Nevada Test Site is critically dependent on laboratory-based experiments that exercise high-bandwidth recording and advanced diagnostic development that are not required for non-nuclear experiments.

Program Thrusts

The DOE weapons laboratories are engaged in a balanced and integrated program of computational simulation, fundamental scientific research, and improved nuclear and non-nuclear experiments. Experimental data, obtained from experiments conducted at Atlas and BEEF, are being used to assess weapon component performance. Together with past nuclear test results, they are also being used to validate computer simulations, which rely heavily on fundamental scientific research as a source of data and a basis for the detailed physics models in the weapons codes. Once validated, weapons physics simulations will guide the judgments made about integral stockpile performance, reliability and safety issues.

For more information, contact:
U.S. Department of Energy
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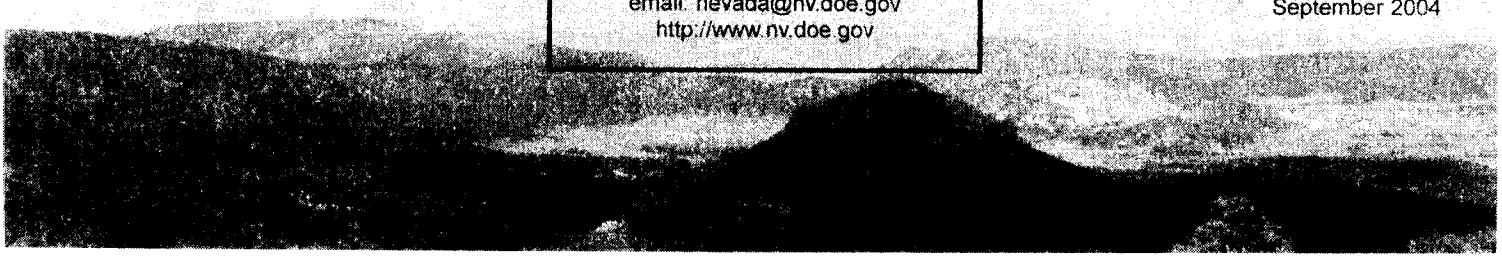
http://www.nv.doe.gov

Stockpile Stewardship

DOE/NV - -1017
September 2004



Attachment 6

"National Security and Nuclear Weapons: Maintaining Deterrence in the 21st Century"

(July 2008)

National Nuclear Security Administration

Fact Sheet

Media Contact(s): NNSA Public Affairs, 202-586-7371

National Security and Nuclear Weapons: Maintaining Deterrence in the 21st Century

A Statement by the Secretary of Energy, Secretary of Defense, and the Secretary of State

(To read the followup paper to this statement, click here (http://www.defenselink.mil/news/nuclearweaponspolicy.pdf))

A principal national security goal of the United States is to deter aggression againstourselves, our allies, and friends. Every American administration since PresidentTruman's day has formulated U.S. national security policy in much the same terms,making clear to adversaries and allies alike the essential role that nuclear weaponsplay in maintaining deterrence. Sustaining U.S. deterrence policy has requireddecades of dedicated service from the men and women of our armed forces, skilledrepresentation by America's diplomats, and painstaking, often dangerous work byAmerica's nuclear scientists, engineers, and technicians. The extension of a credibleU.S. nuclear deterrent has been critical to allied security and removed the need formany key allies to develop their own nuclear forces.

Above all, maintaining a credible deterrent has required a decades-long, bipartisanpartnership with Congress. Some in Congress have recently expressed the view thatwe lack a coherent nuclear weapons strategy that provides the direction and rationalefor the post-Cold War U.S. nuclear force structure. To address these concerns inmore depth, a detailed report will follow this summary paper. The report will lay outthe data and methodology used to determine our nuclear weapons force structure,outline knowledge points for measuring progress in transforming our nuclearstockpile, and dispel a number of myths that have grown up around U.S. nuclearforces.

It is the policy of this Administration to achieve an effective strategic deterrent at thelowest level of nuclear weapons consistent with our national security and ourcommitments and obligations to allies. In 2001, President Bush directed that theUnited States reduce the number of operationally deployed strategic nuclear weaponsfrom about 6,000 to 1,700-2,200 by 2012 – a two-thirds reduction. Correspondingreductions in the nuclear stockpile will result in the lowest level since the EisenhowerAdministration.

Several factors have permitted these dramatic reductions from our large Cold Warnuclear arsenal built and maintained from the 1950s to the 1990s. For severaldecades, the Soviet Union represented

a large, intractable, ideologically motivatedadversary; its fall has allowed us to reassess our nuclear force requirements. In 2001,the President also directed the transition to a new set of military capabilities moreappropriate for credible deterrence in the 21st Century. This “new triad” of strategiccapabilities, composed of non-nuclear and nuclear offensive strike forces, missiledefenses, and a responsive national security infrastructure, reduces U.S. reliance onnuclear weapons while mitigating the risks associated with drawing down U.S.nuclear forces.

However, other contemporary factors lead us to conclude that nuclear weapons willcontinue to be required for the foreseeable future. The future security environment is3very uncertain, and some trends are not favorable. Rogue states either have or seekweapons of mass destruction, including nuclear weapons, and the risk of futureproliferation cannot be ignored. The future direction that any number of states maytake, including some established nuclear powers with aggressive nuclear forcemodernization programs, could have a dramatic effect on U.S. security and thesecurity of our allies. We seek to assure our allies that the U.S. nuclear arsenalcontinues to serve as the ultimate guarantor of their security, thus obviating any needfor them to develop nuclear weapons of their own. Indeed, the nuclear weaponsprograms of North Korea and Iran underscore the importance of U.S. securityguarantees to key allies around the world. Credible U.S. nuclear capabilities and oursecurity commitment to allies remain an indispensable part of deterrence and animportant element in our effort to limit proliferation.

The Administration believes that an operational force between 1,700 and 2,200strategic warheads, while much smaller than our Cold War arsenal, still providessufficient capability to achieve these goals. This force will demonstrate to allies andadversaries alike that the United States has the necessary means, and the political will,to respond decisively against aggression and the use of weapons of mass destruction.The current plan preserves options for future administrations to make additionaladjustments in the U.S. nuclear force posture as changes in the international securityenvironment warrant.

We are at a critical juncture that requires the U.S. to invest now in the capabilitiesneeded to maintain a credible deterrent at the lowest level of nuclear weapons.Without assuming serious risk, further reductions in the total stockpile are onlyachievable with a responsive nuclear infrastructure. Without a responsive nuclearinfrastructure, the United States must continue to manage the technical risksassociated with an aging stockpile of Cold War-era nuclear weapons, and the geopoliticaluncertainties of the years ahead, by maintaining a sizable inventory ofreserve weapons to support the operationally deployed force. This is an increasinglyexpensive and potentially risky approach to stockpile stewardship. Successive effortsat extending the service life of the current inventory of weapons drives these weaponsfarther away from the original source data derived from underground nuclear tests,and risks incorporating or accruing technical changes that could, over time,inadvertently undermine their reliability and performance. The skills andtechnologies needed to refurbish and maintain these older weapon designs areincreasingly difficult to sustain or acquire. Furthermore, some of the materialsemployed in these older weapons are extremely hazardous. Moreover, it is difficult toincorporate modern safety and security features into Cold War-era weapon designs.Finally, as the United States continues to observe a moratorium on undergroundnuclear testing, it becomes increasingly difficult to certify the existing stockpile ofweapons.

To address these issues of sustainability, safety, security and reliability, and toachieve a smaller yet credible nuclear deterrent force, the United States needs to4invest in the Reliable Replacement Warhead (RRW) program. Pursuit of thisprogram is critical to sustaining long-term confidence in our deterrent capability–especially as the U.S. reduces its nuclear forces, the total number of weapons in thestockpile, and the size of the nuclear weapons infrastructure. RRW is a

replacementwarhead – it will help reduce the size of the nuclear stockpile and will not providenew military capabilities. Instead, RRW will make U.S. nuclear weapons safer andmore secure against unauthorized use by incorporating state-of-the-art securityfeatures that cannot be retro-fitted to older weapons. RRW designs will provide morefavorable reliability and performance margins than those currently in the stockpile,and will be less sensitive to incremental aging effects or manufacturing variances.Thus, RRW will allow the United States to manage the risks and challenges of the 21stCentury while reducing the likelihood of returning to nuclear testing to certifyreliability. Over time, RRW will enable the United States to transition to a smaller,more responsive nuclear infrastructure that will enable future administrations to adjustthe U.S. nuclear stockpile as geo-political conditions warrant. RRW is key tosustaining our security commitment to allies, and is fully consistent with U.S.obligations under the Nuclear Nonproliferation Treaty– including Article VI.

Without Congressional support for the Reliable Replacement Warhead program weare concerned for the long-term ability of the United States to sustain its strategy ofdeterrence, meet its security commitment to allies, and pursue further reductions innuclear weapons without assuming additional risk. Delaying progress on RRW willforce the United States to maintain a large stockpile of nuclear weapons and sustain itthrough increasingly costly and risky Life Extension Programs. Delays on RRW alsoraise the prospect of having to return to underground nuclear testing to certify existingweapons.

Maintaining a credible deterrent has required a decades-long, bipartisan partnershipwith Congress; this partnership will be no less critical in the future than in the past.Over the next two decades Congress will make many decisions, including decisionson RRW, that will help determine how fast and how far the United States can go intransforming and reducing its nuclear forces, nuclear stockpile, and nuclearinfrastructure to make them smaller, safer, more secure, and more appropriate tomanaging the risks and challenges of the 21st Century. We must make progresstoward creating a nuclear weapons infrastructure that can respond quickly andeffectively to emerging threats and to technological surprise. This will assure ourability to maintain deterrence over the long-term, and enable future reductions in boththe operationally deployed force and the overall nuclear weapons stockpile. Thesooner Congress authorizes and funds transformative programs like RRW, the soonerthe United States and its allies can realize the benefits this approach holds formaintaining a credible and effective deterrent with the lowest possible level of nuclearweapons.

July 2007

Attachment 7

"Nuclear Waste: Action Needed to Improve Accountability and Management of DOE's Major Clean-up Projects"

United States Government Accountability Office, GAO-08-1081

(September 2008)

United States Government Accountability Office

GAO

Report to the Subcommittee on Energy and Water Development, Committee on Appropriations, House of Representatives

September 2008

NUCLEAR WASTE

Action Needed to Improve Accountability and Management of DOE's Major Cleanup Projects

GAO

Accountability * Integrity * Reliability

GAO-08-1081

September 2008

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Highlights

Highlights of GAO-08-1081, a report to the Subcommittee on Energy and Water Development, Committee on Appropriations, House of Representatives

NUCLEAR WASTE

Action Needed to Improve Accountability and Management of DOE's Major Cleanup Projects

Why GAO Did This Study

The Department of Energy (DOE) spends billions of dollars annually to clean up nuclear wastes at sites that produced nuclear weapons. Cleanup projects decontaminate and demolish buildings, remove and dispose of contaminated soil, treat contaminated groundwater, and stabilize and dispose of solid and liquid radioactive wastes. Ten of these projects meet or nearly meet DOE's definition of major: costs exceeding $1 billion in the near term—usually a 5-year window of the project's total estimated life cycle.

GAO was asked to determine the (1) extent to which the cost and schedule for DOE's major cleanup projects have changed and key reasons for changes, and (2) factors that may hinder DOE's ability to effectively manage these projects. GAO met with project directors and reviewed project documents for 10 major cleanup projects: 9 above the near-term $1 billion threshold, and 1 estimated to cost between $900 million and $1 billion over the near term.

What GAO Recommends

GAO is making a number of recommendations, such as expanding the content of performance reports provided to DOE senior managers and information provided to Congress to better reflect current status of near-term and life cycle baseline cost and schedules and reasons for significant changes; and strengthening DOE guidance and baseline reviews, among other things. In commenting on a draft of this report, DOE agreed with GAO's recommendations.

To view the full product, including the scope and methodology, click on GAO-08-1081. For more information, contact Gene Aloise at (202) 512-3841 or aloisee@gao.gov.

What GAO Found

Nine of the 10 cleanup projects GAO reviewed had life cycle baseline cost increases, from a low of $139 million for one project to a high of nearly $9 billion for another, and life cycle baseline schedule delays from 2 to 15 years. These changes occurred primarily because the baselines we reviewed included schedule assumptions that were not linked to technical or budget realities, and the scope of work included other assumptions that did not prove true. Specifically, the schedules for 8 of the 10 projects were established in response to DOE's 2002 effort to complete cleanup work, which in some cases moved up project completion dates by 15 years or more. For example, to meet the 2012 accelerated completion date for its solid waste disposition project, DOE's Idaho National Laboratory assumed it would process waste at a rate that was more than 50 percent higher than the rate demonstrated at the time it established the baseline. When the laboratory could not meet that processing rate, DOE revised its baseline, adding 4 years and about $450 million to the project. Also, most of the 10 projects had cost increases and schedule delays because the previous baselines (1) had not fully foreseen the type and extent of cleanup needed, (2) assumed that construction projects needed to carry out the cleanup work would be completed on time, or (3) had not expected substantial additional work scope.

DOE has not effectively used management tools—including independent project baseline reviews, performance information systems, guidance, and performance goals—to help oversee major cleanup projects' scope of work, costs, and schedule. For example, DOE's independent reviews meant to provide reasonable assurance that a project's work can be completed within the baseline's stated cost and schedule, have not done so for 4 of 10 projects. For one project, the baseline was significantly modified as little as 7 months after it had been revised and validated by the independent review, while other projects have experienced life cycle cost increases of as much as $9 billion and delays of up to 10 years, within 1 to 2 years after these reviews. In addition, although DOE uses several types of reporting methods for overseeing cleanup projects, these methods do not always provide managers with the information needed to effectively oversee the projects or keep Congress informed on the projects' status. For example, sites' proposals for changes to projects' cost and schedule baselines do not always identify possible root causes, and DOE does not systematically analyze the proposals for common problems across its projects. Therefore, DOE may be missing opportunities to improve management across projects. In addition, guidance for key management and oversight functions are spread across many different types of documents and are unclear and contradictory. As a result, project managers do not consistently implement this guidance, which may lead, for example, to problems in effectively managing risks across projects. Finally, DOE recently changed its goals for "successful" cleanup projects, reducing the amount of work and raising the allowable cost increases against the near-term baseline. DOE has initiated several actions to improve project management, but it is too early to determine whether these efforts will be effective.

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Abbreviations

Army Corps	Army Corps of Engineers
DOE	Department of Energy
EM	Office of Environmental Management
EVM	earned value management
OECM	Office of Engineering and Construction Management
OMB	Office of Management and Budget
QPR	quarterly project review
WTP	Waste Treatment Plant

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United States Government Accountability Office
Washington, DC 20548

September 26, 2008

The Honorable Peter J. Visclosky
Chairman
The Honorable David L. Hobson
Ranking Member
Subcommittee on Energy and Water Development
Committee on Appropriations
House of Representatives

The Department of Energy (DOE) spends billions of dollars annually to clean up nuclear wastes at sites across the nation that produced nuclear weapons. Cleanup projects decontaminate and demolish buildings, remove and dispose of contaminated soil, treat contaminated groundwater, and stabilize and dispose of solid and liquid radioactive wastes, among other things. DOE's Office of Environmental Management (EM) currently oversees more than 80 of these cleanup projects, primarily at government-owned, contractor-operated sites throughout the nation. Some of these highly complex projects have completion dates beyond 2050. Ten of these projects meet or nearly meet DOE's definition of "major": projects whose costs exceed $1 billion in the near-term—usually a 5-year window of the project's total estimated life cycle.[1],[2] These 10 projects have combined estimated near-term costs of almost $19 billion and combined life cycle costs estimated to range between $115 billion and $143 billion, and they account for almost half of EM's $5.5 billion fiscal year 2009 budget request.[3] These 10 projects are described in detail in appendix II and include the remediation, decontamination, and decommissioning, or the stabilization and disposition of:

[1]For this review, we lowered the threshold to $900 million out of concern that some projects not now considered major would become major because of increases in costs, which resulted in the addition of one project to our review (the solid waste stabilization and disposition project at the Hanford Site, near Richland, Washington).

[2]We did not review one major project still in the early stages of development (the nuclear facility decontamination and decommissioning project in Portsmouth, Ohio).

[3]DOE defines life cycle costs as the sum total cost of the direct, indirect, and other related costs incurred or estimated to be incurred in the design, development, production, operation, maintenance, support, and final disposition of a major system over its anticipated useful life span.

- solid waste at Idaho National Laboratory, Idaho;
- nuclear facilities at the East Tennessee Technology Park, Oak Ridge Reservation, Tennessee;
- nuclear materials at the Savannah River Site, South Carolina;
- radioactive liquid tank waste at the Savannah River Site, South Carolina;
- soil and water at Los Alamos National Laboratory, New Mexico;
- nuclear materials at the Hanford Site, Washington;
- solid waste at the Hanford Site, Washington;
- soil and water at the Hanford Site, Washington;
- nuclear facilities at the River Corridor Closure Project, Hanford Site, Washington; and
- radioactive liquid tank waste at the Office of River Protection, Hanford Site, Washington.[4]

DOE established Order 413 in 2000 to provide project management guidance for construction projects—projects that build large complexes often housing unique equipment and technologies that process waste or other radioactive material—and nuclear waste cleanup projects.[5],[6] In 2005 and 2007, EM, in conjunction with DOE's Office of Engineering and Construction Management (OECM), issued further guidance to better tailor the order's requirements to the cleanup projects. This guidance lays out protocols directing DOE project managers to establish a life cycle

[4]Hanford's radioactive liquid tank waste stabilization and disposition project is administered by the Office of River Protection, while the other four major cleanup projects at Hanford are administered by DOE's Richland office.

[5]Order 413.3 was issued in 2000 and amended in 2006, and is now referred to as 413.3A. For this report, we use DOE Order 413 to refer to the order in effect, unless otherwise specified.

[6]We have reported on DOE's management of these construction projects. See GAO, *Department of Energy: Major Construction Projects Need a Consistent Approach for Assessing Technology Readiness to Help Avoid Cost Increases and Delays*, GAO-07-336 (Washington, D.C.: Mar. 27, 2007).

baseline for cleanup projects that includes three key parts: (1) prior year actual costs; (2) a near-term estimate of the scope of the cleanup work (the cleanup activities needed to achieve project goals), cost, and schedule of the cleanup activities (the near-term is generally for 5 years, or the duration of the contract, whichever is longer); and (3) out-year estimates through project completion for those projects that extend beyond the near term.[7] The near-term and out-year estimates also identify the amount of contingency monies that could be needed to cover potential project risks.[8]

Major cleanup projects take years to complete, and often involve unique challenges and a high degree of complexity; therefore, it is critically important that EM develop and implement a rigorous, disciplined approach for developing and managing the baselines. Such an approach includes planning and managing work activities, cost, and schedule to achieve project goals in a stable, controlled manner over the near term and the entire life of the project. DOE has taken several steps to establish such an approach, including the following:

- EM must formally approve changes to the near-term and life cycle baseline.
- Project managers must provide formal and informal reports to DOE headquarters staff, including data entries into databases and quarterly performance reports. These reports contain, among other things, earned value management (EVM) data—a measure of progress against a cost and schedule baseline. Widely used in industry, earned value data makes it possible for managers and others to determine how a project has been performing and to predict future performance trends. Furthermore, both the Office of Management and Budget (OMB) and DOE Order 413 require

[7]In previous years, DOE presented out-year estimates as a single point estimate based on the most probable cost and schedule of its projects. In 2007, DOE developed out-year estimates with cost and schedule ranges to account for the uncertainty associated with long-term projects. The low end of the range is based on the amount of funding needed with a 50 percent level of confidence that the project will be successfully completed, while the high end of the range is based on an 80 percent level of confidence. As discussed elsewhere in this report, DOE does not fund its contingency accounts for these projects.

[8]Contingency funds are funds that may be needed to cover potential cost increases stemming from a variety of project risks, including technical complexities, regulatory issues, and funding shortfalls.

the use of EVM data, and GAO has developed best practices on how to use the data.[9]

- As stipulated in DOE Order 413, OECM must independently review project baselines at critical project stages; OECM conducts these reviews largely with the help of external technical experts. Specifically, for cleanup projects that cost $100 million or more, OECM must review a project's proposed baseline to provide reasonable assurance that the project can be successfully executed. OECM also examines technical scope, cost, schedule, and avoidance and mitigation plans for possible cost and schedule overruns, as well as proposed project management.

Overall, we and others have reported over the past two decades that project management weaknesses have impaired DOE's major projects. In 1990, we designated DOE's contract management (which includes project management) as a high-risk area for fraud, waste, abuse, and mismanagement. In addition, in 1999, the National Academies' National Research Council developed recommendations to address weaknesses in DOE's project management. Recently, in 2007, we reported that DOE had improved its approach to project management but that performance on DOE's projects had not substantially improved.[10] Also in 2007, the National Academy of Public Administration reported specifically on EM's management of nuclear waste and complimented EM on its improvements in project management, but also raised questions about EM's ability to follow through on them. Furthermore, reviews by DOE's Office of Inspector General, the Department of Defense's Army Corps of Engineers (Army Corps), and the National Research Council, among others, have advised DOE on how to better manage its major projects.

In this context, you asked us to determine the (1) extent to which the cost and schedule for DOE's major cleanup projects have changed and the key reasons for these changes, and (2) factors that may hinder DOE's ability to effectively manage these cleanup projects.

To determine the extent to which DOE cleanup projects are experiencing cost or schedule changes and key reasons contributing to these changes,

[9]GAO, *Cost Assessment Guide: Best Practices for Estimating and Managing Program Costs*, GAO-07-1134SP (Washington D.C.: July 2007).

[10]GAO, *Department of Energy: Consistent Application of Requirements Needed to Improve Project Management*, GAO-07-518 (Washington, D.C.: May 11, 2007).

we spoke with DOE project directors and reviewed project management documents for 10 of EM's major cleanup projects—9 projects above the near-term $1 billion threshold, and 1 estimated to cost between $900 million and $1 billion over the near term. For our analysis, we examined the life cycle baseline reported as of the most recent contract awards or major contract modifications—which occurred between 2004 and 2007—and compared these baselines with the updated baselines at the time of our review (dollar amounts used in calculating cost increases are in fiscal year constant 2008 dollars). We conducted site visits and analyzed project documentation, such as project plans, independent reviews, contractor performance data, plans to avoid or mitigate project risks, and documents prepared to guide and control formal changes to the baseline. We also identified factors that may hinder DOE's ability to effectively manage projects in accordance with approved life cycle baselines primarily through a review of project documents and interviews with project officials. Because we and others have previously expressed concern about the data reliability of a key DOE project management tracking database—the Project Assessment and Reporting System—we did not develop conclusions or findings based on information generated through that system.[11] Instead, we collected information directly from project site offices and contractors. In addition, we spoke with officials from EM and OECM in Washington, D.C. We provided an interim briefing to the Subcommittee on the status of our work on April 3, 2008.

We conducted this performance audit from March 2007 to September 2008 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. Appendix I contains a detailed description of our scope and methodology.

Results in Brief

Nine of the 10 cleanup projects we reviewed have experienced cost increases and schedule delays in their life cycle baseline, ranging from

[11]See, for example, GAO, *Department of Energy: Further Actions Are Needed to Strengthen Contract Management for Major Projects*, GAO-05-123 (Mar. 18, 2005); and Civil Engineering Research Foundation, *Independent Research Assessment of Project Management Factors Affecting Department of Energy Project Success* (Washington, D.C., July 12, 2004).

$139 million for one project to more than $9 billion for another, and schedule delays ranging from 2 years to 15 years. These changes arose primarily because the initial baselines made schedule assumptions that were not linked to technical or budget realities, and the scope of work included other assumptions that did not prove true. Specifically:

- *Baselines were not linked to technical or funding realities*. The schedules for 8 of the 10 projects we reviewed were established in response to EM's 2002 effort to accelerate cleanup work, which in some cases moved up project completion dates by 15 years or more. EM wanted to complete cleanups earlier to better safeguard public health and the environment, among other things. However, these dates were not always tied to technical capabilities or likely funding realities. For example, to meet the 2012 accelerated completion date for its solid waste disposition project, DOE's Idaho National Laboratory assumed its waste treatment plant could process waste at a rate that was more than 50 percent higher than the rate demonstrated at the time EM established the baseline. When the waste treatment plant did not meet that processing rate, EM revised its baseline, deferring 4 years of cleanup work, which added about $450 million to the project. In addition, before April 2007, according to several EM officials, project managers were directed to establish cost baselines to meet the accelerated schedules without considering likely funding for the projects. As a result, most projects did not receive funding as planned for in the baselines, hindering their ability to complete the work on time. In April 2007, EM changed its strategy: It limited its funding for all sites and directed that future baselines be based on the expected budget for each site. In part because of this change, some completion dates were extended by as much as 15 years.

- *Baselines' scope of work included optimistic assumptions that did not prove true*. Most of the projects we reviewed also experienced cost increases and schedule delays because the initial baselines had (1) not fully anticipated the type and extent of cleanup that would be needed, (2) assumed that construction projects needed to carry out the cleanup work would be completed on time, or (3) assumed the scope of work activities needed to finish the project would not increase. For example, at a 1940s-era building being demolished at Oak Ridge as part of the nuclear facility decontamination and decommissioning project, the contractor found that the building was far more contaminated and deteriorated than first estimated and had to reinforce the structure in order to safely remove contaminated equipment before demolishing the building. Primarily because these activities had not been adequately anticipated in the baseline, project costs rose by $1.2 billion and completion was extended by 9 years, to 2017. Similarly, the baselines for four of the major cleanup

projects assumed that a related, major construction project would be completed on schedule and available for the cleanup project to use. For example, a 5-year delay in the completion of Hanford's major construction project—the Waste Treatment Plant (WTP)—was the most significant factor behind extending the radioactive liquid tank waste project's schedule by 10 years, and increasing its life cycle costs by $4.8 billion. The delay in WTP's startup date resulted in additional years required to store the waste in the tanks and then to operate the treatment plant.

DOE has not always effectively used management tools—including independent project baseline reviews, performance information systems, guidance, and performance goals—to help oversee major cleanup projects' scope of work, costs, and schedule. Specifically:

- DOE's independent reviews of project baseline estimates, meant to, among other things, provide reasonable assurance that a project's work activities can be accomplished within the baseline's stated cost and schedule, have not done so for 4 of the 10 projects we reviewed. The baselines for these 4 projects were significantly modified shortly after review, revision, and validation. For one project, the baseline was significantly modified as little as 7 months after it had been revised and validated based on the independent review, while other projects had experienced additional life cycle cost increases of as much as $9 billion and delays of up to 10 years, within 1 to 2 years after the baseline reviews. As a result, the usefulness of the independent baseline reviews is questionable when significant baseline changes occur very shortly after the reviews are completed.

- EM managers do not always receive the information needed to effectively manage major cleanup projects or provide detailed reports to Congress on the projects' status. First, sites' proposals for changes to cost and schedule baselines do not consistently identify reasons for the changes or possible root causes, and EM does not systematically analyze the proposals for common problems across its projects. As a result, EM may be missing opportunities to apply lessons learned across projects. Second, in certain cases, the use of EVM data did not conform to industry standards or best practices identified by GAO, in part because the data contained anomalies that skewed analyses or lacked important information on future staffing needs. Third, EM's quarterly performance reports neither consistently provide accurate information about a project's performance against the near-term baseline, nor do they include information about how current performance may affect the life cycle baseline. Finally, DOE's reports to Congress do not include important information that would aid oversight, such as the extent of and reasons for significant changes to near-term and life cycle baseline estimates. In contrast, Department of Defense reports to

Congress on acquisitions for major systems provide detailed information on significant cost and schedule changes and the reasons for those changes.

- Guidance for key management and oversight functions—such as project baseline development, risk management, and contingency funding—is not consolidated, and is contradictory and unclear. Consequently, project managers do not consistently implement this guidance. For example, DOE headquarters officials found that project managers are calculating contingency funding to cover project risks in their baselines in a variety of ways, leading to uncertainty regarding the total contingency funds needed to cover all cleanup projects.

- DOE recently changed its goals for the performance of cleanup projects. Before 2008, a major cleanup project was expected to achieve 100 percent of the scope of work in its life cycle baseline with less than a 10 percent cost increase in the project's life cycle baseline. However, according to EM's current cleanup project performance goal, the projects are successful if they achieve at least 80 percent of the scope of work in their near-term baselines with less than a 25 percent cost increase. The new performance goal permits up to 20 percent of the scope of work to be deferred from the near term to out years, creating a substantially greater risk that life cycle costs will continue to increase and that completion dates will be delayed. According to DOE officials, the agency adjusted performance goals primarily to account for the greater level of uncertainty inherent in cleanup projects. However, by lowering expectations for adhering to near-term baselines, DOE may inadvertently be creating an environment in which large increases to life cycle costs become not only more common, but accepted and tolerated.

- Over the past 2 years, EM has begun a series of efforts to better manage its projects and address long-standing problems. For example, under its "Best-in-Class" Project Management Initiative, EM senior managers have expressed a strong commitment to improving project performance, and under this initiative, EM contracted with the Army Corps to assess project management, and then identified 18 priority actions to correct known problems. Although these efforts are ongoing, EM has yet to combine them into a formal plan, and it is too early to tell whether these efforts will prove effective.

We are making a number of recommendations to the Secretary of Energy to improve management of major cleanup projects, including to report more complete information to senior DOE management and Congress so that they can be fully informed about project status and make informed

decisions about these projects; consolidate, clarify, and update guidance for managing cleanup projects; consolidate all planned and ongoing EM improvements into a comprehensive corrective action plan; and develop the independent baseline reviews to better assure that project work scope can be completed within the baselines' stated cost and schedule.

We provided a draft of this report to the Department of Energy for its review and comment. DOE agreed with our recommendations but provided some suggested changes to them, and provided specific comments on the overall report, which we incorporated as appropriate. We discuss DOE's comments in detail at the end of this letter. DOE also provided some technical comments, which we incorporated as appropriate. DOE's comments are provided in appendix IV.

Background

DOE oversees and implements its major cleanup projects through agreements with contractors who operate the nuclear weapons research and production sites and the cleanup projects at those sites. Some of EM's cleanup projects are located at DOE sites administered by the National Nuclear Security Administration, a separately organized agency within DOE.

EM's major cleanup projects involve efforts to clean up sites where nuclear weapons were produced and production waste stored.[12] EM's cleanup projects handle a wide array of waste types and levels of radioactivity and hazardous constituents, and can involve multiple activities to, among other things, retrieve, characterize, treat, package, store, transport, and dispose of the waste, as well as disassemble, treat, package, store, transport, and dispose of the contaminated containers or processing lines/equipment used for weapons production or for storing or treating the waste. Multiple EM cleanup projects can occur at a single DOE site responsible for a multitude of other noncleanup-related activities. The cleanup projects are organized generally around similar waste types and activities. For example, the soil and water remediation activities at each site are organized under one umbrella, as are the nuclear facility decontamination and decommissioning projects, and the radioactive liquid tank waste projects, among others. EM generally

[12]DOE defines a project as a unique effort that supports a program mission and that has defined points for starting and ending; is undertaken to create a product, facility, or system; and contains interdependent activities planned to meet a common objective or mission.

manages these similar work activities, grouped into a category known as a Project Baseline Summary, through numerical designations; for example, all activities for soil and water remediation are grouped under Project Baseline Summary 30. (See app. II for additional information on the 10 DOE major cleanup projects reviewed.)

Funding for and Costs of DOE's Major Cleanup Projects

Unlike construction projects, which are funded on a line item basis, cleanup projects receive funding through operating funds designated for each DOE site. In 2003, EM began applying project management principles contained in DOE Order 413 to these cleanup projects in order to apply more discipline and rigor in planning and expending these project funds, among other things.

A cleanup project can cost several billion dollars and its life cycle can span several decades. EM divides the life cycle baselines for its major cleanup projects into three distinct parts—prior year costs, near term (usually a 5-year period), and out year (through project completion). Life cycle costs for each project range from a low of almost $1.7 billion to over $44 billion, and some projects might not be completed until after 2050.[13] (See app. III for detailed information on the life cycle baseline costs for the 10 projects we reviewed.)

EM applies different approaches to managing these wastes, depending on the type and extent of contamination and the state or federal regulatory guidelines and milestones it needs to comply with. DOE has agreements with state and federal regulators to clean up sites, and the agreements lay out a framework for determining the cleanup standards to be met. Furthermore, because all projects have a certain degree of uncertainty, such as not fully knowing the condition of buried waste containers, EM needs to plan for this uncertainty and identify ways to prevent serious disruption to projects should problems arise. To address this uncertainty, DOE Order 413 requires project managers to identify contingency funds that may be needed to cover potential cost increases stemming from a variety of project risks, including technical complexities, regulatory issues, and funding shortfalls. Although EM project managers build contingency funding into their near-term and out-year estimates, EM management does not generally include funding in its budget requests to cover contingency for cleanup projects until after it is actually needed to address a problem;

[13]In current year dollars, and excluding EM contingency funding.

therefore, EM contingency for cleanup projects has been referred to as "unfunded contingency."

Earned Value Management for Tracking Work Progress

To be effective, program managers need information on program deliverables and on the progress made in meeting them. One method that can help program managers track this progress is EVM data. These data include, for example, detailed information on budgeted costs and actual costs for work scheduled and work performed, as well as forecasted costs at project completion. Among other things, EVM data can be used to compare (1) budgeted costs to actual costs and (2) the value of work accomplished during a given period with the value of work scheduled for that period. By using the value of work completed as a basis for estimating the cost and time to complete a project, EVM data should alert program managers to potential problems sooner than expenditures alone can.

As a key management tool, EVM has evolved from an industrial engineering concept to a government and industry best practice to better oversee programs. Both OMB and DOE Order 413 require the use of EVM. OMB Circular A-11, part 7, requires the use of an integrated EVM system across an entire program to measure how well the government and its contractors are meeting a program's approved cost, schedule, and performance goals. The American National Standards Institute and the Electronic Industries Alliance have jointly established a national standard for EVM systems.[14] Recognizing the benefits of having these national standards, OMB states in its 2006 Capital Programming Guide that major acquisitions that require product development are to require that contractors use an EVM system that meets the American National Standards Institute guidelines.[15] In addition, DOE Order 413 requires that projects with total cleanup costs of $50 million or more use an EVM system that complies with industry standards and is certified by DOE's OECM to comply with these standards.

[14]See, for example, ANSI/EIA 748 32 Industry Guidelines (American National Standards Institute/Electronic Industries Alliance Standard, Earned Value Management Systems, ANSI/EIA-748-A-1998 (R2002), approved May 19, 1998, revised January 2002).

[15]See OMB, Capital Programming Guide, II.2.4, Establishing an Earned Value Management System. The OMB requirements also are reflected in the Federal Acquisition Regulation at 48 C.F.R. subpart 34.2.

GAO also has developed EVM best practices that, when followed, can help project managers consistently develop and analyze EVM data to gain a complete and accurate understanding of project status. Among other things, our guidance on EVM states that (1) EVM data should not have data errors and anomalies that may skew and distort the EVM analysis, and (2) information such as staffing levels and the root causes of and corrective actions for cost and schedule variances should be reported through the EVM system.

Major Cleanup Projects Experienced Billions of Dollars in Additional Costs and Schedule Delays, Primarily because Initial Baselines Were Overly Optimistic

Nearly all the cleanup projects we reviewed have had cost increases and schedule delays in the life cycle baseline, as much as $9 billion for one project, and schedule delays of as much as 15 years for two projects. These cost increases and schedule delays occurred primarily because the previous baselines for these projects had schedule assumptions that were not linked to technical or budget realities, and other assumptions also proved to be overly optimistic.

Major Cleanup Projects' Costs Have Increased by Billions and Schedules Have Been Delayed by As Much As 15 Years

The estimated costs of the 9 of the 10 DOE major cleanup projects we reviewed have significantly exceeded original estimates, as table 1 shows.

Table 1: Changes in the Estimated Life Cycle Costs for DOE Major Cleanup Projects

Dollars in billions

Project	Previous life cycle cost estimate (year of estimate)[a]	Current life cycle cost estimate range[b]	Life cycle cost increase range[b]	Percentage increase range[b,c]
Solid waste stabilization and disposition, Idaho National Laboratory	$2.851 (2006)	$3.301 – $3.940	$.450 – $1.089	16% – 38%
Nuclear facility decontamination and decommissioning, Oak Ridge Reservation	1.907 (2004)	3.126 – 3.290	1.219 – 1.383	64 – 73
Nuclear material stabilization and disposition, Savannah River Site	7.487 (2004)	10.802 – 11.248	3.315 – 3.761	44 – 50
Radioactive liquid tank stabilization and disposition, Savannah River Site	11.909 (2004)	18.622 – 24.003	6.714 – 12.094	56 – 102
Soil and water remediation, Los Alamos National Laboratory	1.521 (2006)	1.660 – 2.425	.139 – .904	9 – 59
Nuclear material stabilization and disposition, Hanford Site	2.990 (2006)	3.387 – 3.412	.397 – .422	13 – 14
Solid waste stabilization and disposition, Hanford Site	8.219 (2007)	9.596 – 10.639	1.377 – 2.420	17 – 29
Soil and water remediation, Hanford Site	3.902 (2007)	5.623 – 5.759	1.721 – 1.857	44 – 48
Nuclear facility decontamination and decommissioning, Hanford Site[d]	4.762 (2006)	4.762 – 4.892	0	0
Radioactive liquid tank stabilization and disposition, Hanford Site	21.647 (2004)	31.048 – 39.694	9.401 – 18.048	43 – 83

Source: GAO analysis of DOE data.

[a]For purposes of this report, previous cost estimates are the life cycle cost estimates created at the beginning of the most recent contract period for operation of the DOE site or the most recent major contract modification or extension, which in many cases coincided with the beginning of the project's previous near-term baseline. Current life cycle cost estimates are based on the most recently approved near-term baseline, out-year planning estimate ranges, or both.

[b]EM recently began using cost estimate ranges rather than point estimates. According to EM officials, costs at the lower end of the ranges were estimated at the 50 percent level of confidence, while costs at the upper end of the ranges represent the 80 percent level of confidence. For this report, our analysis of cost change uses the lower end of the range, which excludes contingency, because contingency amounts can vary widely between projects and are not typically funded before they are needed.

[c]We calculated the percentage of cost increase on the basis of constant 2008 dollars to make them comparable across projects and to show real increases in cost while excluding increases due to inflation.

[d]As of August 2008, this project has not registered a cost increase. However, project officials told us that they expect to file a baseline change proposal increasing the life cycle cost by at least several hundred million dollars by the end of December 2008.

As the table shows, estimated costs increased from a minimum of $139 million for one project to more than $9 billion for another project. The smallest dollar and percentage increase—$139 million, or 9 percent—occurred at Los Alamos' soil and water remediation project, which is focused on cleaning up known or suspected chemical and radiological contamination in addition to treating soil and groundwater that was contaminated by this waste. This project, however, is expected to further increase its life cycle cost estimate. The largest dollar increase among the 10 major projects—more than $9 billion—was for Hanford's radioactive liquid tank waste project, which is expected to remove, treat, and dispose of more than 56 million gallons of high-level radioactive waste in 177 underground storage tanks. In fact, the other radioactive liquid tank waste project, at Savannah River, registered the second largest dollar increase—almost $7 billion. However, the largest percentage increase—about 64 percent—occurred at Oak Ridge's nuclear facilities decontamination and decommissioning project.

Table 2 shows that 8 of the 10 projects we reviewed experienced delays in scheduled project completion, ranging from 2 years to 15 years.[16]

Table 2: Changes in Estimated Project Schedules for DOE Major Cleanup Projects

Project	Previous completion date estimate[a]	Current completion date estimate[a]	Schedule change (years)
Solid waste stabilization and disposition, Idaho National Laboratory	2012	2016 – 2020	4 – 8
Nuclear facility decontamination and decommissioning, Oak Ridge Reservation	2008	2017	9
Nuclear material stabilization and disposition, Savannah River Site	2015	2024 – 2026	9 – 11
Radioactive liquid tank stabilization and disposition, Savannah River Site	2019	2032 – 2034	13 – 15
Soil and water remediation, Los Alamos National Laboratory[b]	2015	2015	0
Nuclear material stabilization and disposition, Hanford site	2016	2018 – 2019	2 – 3

[16]EM recently began using schedule estimate ranges rather than point estimates. According to EM officials, scheduled completion dates at the lower end of the ranges were estimated at the 50 percent level of confidence, while dates at the upper end of the ranges represent the 80 percent level of confidence. For this report, our analysis of schedule change uses the lower end of the range.

Project	Previous completion date estimate[a]	Current completion date estimate[a]	Schedule change (years)
Solid waste stabilization and disposition, Hanford site	2035	2050 – 2058	15 – 23
Soil and water remediation, Hanford site	2035	2050 – 2059	15 – 24
Nuclear facility decontamination and decommissioning, Hanford site	2019	2019	0
Radioactive liquid tank stabilization and disposition, Hanford site	2032	2042 – 2050	10 – 18

Source: GAO analysis of DOE data.

[a]For purposes of this report, previous project completion dates represent the estimates at the beginning of the new contract period for operation of the DOE site or the major contract modification or extension, which typically coincided with the beginning of the projects' current or previous near-term baseline. Current completion date estimates represent the most recently approved near-term baseline or out-year planning estimate ranges calculated at the 50 percent confidence level at the lower end of the range, to the 80 percent level of confidence at the higher end of the range. EM recently began using schedule estimate ranges rather than point estimates. For this report, our analysis of schedule change uses the lower end of the range.

[b]The June 2008 Baseline Change Proposal shows proposed costs associated with this project at the 80 percent confidence level would extend through fiscal year 2020.

As table 2 shows, the shortest delay is at Hanford's nuclear material stabilization and disposition project, while the longest delays—15 years—also are at Hanford: the soil and water remediation and the solid waste stabilization and disposition projects.

Overly Optimistic Baselines Contributed to Significant Changes in Projects' Life Cycle

The changes in schedule and costs occurred primarily for two reasons. First, initial project baselines were built on accelerated schedules that were not always linked to technical capabilities or available budgets, although EM has begun to tie its new baselines to anticipated funding. Second, the initial baselines included other assumptions that did not hold true, including conditions on the ground at the sites, expected completion dates for related construction projects, and activities that would be included in projects' scopes of work.

Baseline Schedules Were Not Linked to Technical or Funding Realities

The initial baselines for 8 of the 10 major projects we reviewed contained schedules that were influenced by an EM-wide effort to accelerate the office's cleanup work. In 2002, EM management worked with its sites and regulators to create new, earlier milestones for completing key cleanup projects and for closing entire sites to reduce the public health and environmental risks posed by the waste at these sites. Before this effort, some of the major cleanup projects were not estimated to complete work until the 2030s and 2040s. Under the accelerated schedules, four projects'

completion dates were moved up by 15 years or more, as was the case for the radioactive liquid tank waste stabilization and disposition project at the Hanford site; its completion date was moved from 2048 to 2028. The baselines containing the accelerated schedules—those generally created between 2003 and 2006—tied their work scope and funding assumptions to the completion dates and not necessarily to available cleanup technologies. For example:

- *Solid waste stabilization and disposition project at Idaho*. To meet its accelerated completion date of 2012—down from 2018—DOE's Idaho National Laboratory assumed its Advanced Mixed Waste Treatment Plant could process nuclear waste at a rate of about 8,500 cubic meters per year—more than 50 percent faster than the rate of about 5,400 cubic meters per year demonstrated when DOE established the baseline. At the time, because the plant had only recently begun operating, project staff lacked confidence that they could meet the processing rate. Moreover, the independent team reviewing the baseline reported that the rate was optimistically high. Nevertheless, DOE proceeded with the initial baseline, increasing the amount of unfunded contingency in its baseline and attempting to meet the optimistic rate by providing the contractor with performance incentives. Still, the processing rate has fallen short of baseline assumptions—it is currently roughly 6,000 cubic meters per year. To reflect this more realistic rate, DOE subsequently revised its baseline, adding 4 years to the project schedule and increasing costs by about $450 million.

- *Radioactive liquid tank waste stabilization and disposition project at Savannah River*. This project, in part, combines high-level radioactive waste stored in tanks at the Savannah River Site with melted glass and places it in canisters ultimately to be sent to a federal repository for disposal. DOE directed that the project's completion date be accelerated, from 2035 in its early planning documents to 2019 in the initial baseline. In order to make that date, according to project officials, they included some assumptions in the initial baseline they knew at the time would be difficult to realize. Specifically, they assumed that the project's waste processing facility could produce canisters consisting of up to 49 percent high-level waste—with the remaining space filled with melted glass—when at the time it had not been able to produce a canister containing more than 42 percent high-level waste with an existing technology while remaining within the acceptance criteria for the federal repository. Those criteria dictate specific characteristics, including durability and leachability for the glass-waste mixtures in the canisters. DOE has since adjusted these assumptions—the current waste processing plan assumes the canisters will contain 34 percent to 38 percent high-level waste using the existing

technology—contributing to the overall cost increase and schedule delay for this project.

These early baselines also were not tied to expected funding. According to several senior EM officials, before April 2007, project directors were instructed to create cost baselines to meet the accelerated schedules and their regulatory milestones without regard for the likely funding the projects could expect to receive. Consequently, the funding assumptions in the projects' baselines were higher than the amount of funding DOE requested each year. According to a senior EM budget official, these shortfalls required project managers to continually adjust cost and schedule baselines as projects moved work activities into the out years to accommodate the lower funding levels. For example, according to site officials at Oak Ridge, when DOE did not request the full amount of funding in the nuclear facility's decontamination and decommission project's initial baseline, the project could not complete all the work as planned. Project managers responded by pushing work activities into the out years, which contributed, in part, to the project's overall cost increase and schedule delay. Similarly, as noted in a recent DOE internal audit, according to Los Alamos officials, funding has not been sufficient to meet the site's regulatory commitments, and has been a concern since 2003, when the site manager said he was concerned that appropriate resources had not been identified to conduct the necessary environmental restoration activities.[17]

According to EM managers, they have implemented changes to the way baselines are created that address these problems. In April 2007, EM changed its policy for creating project baselines. Instead of tying baselines to the accelerated schedules and regulatory commitments with unconstrained funding, EM limited funding for its sites, directing that all future baselines be based on expected budget numbers generated for each site.

For three of the projects we reviewed, this change in direction resulted in deferral of work and schedule delays because the new funding levels represented significant reductions in what projects were planning on

[17]U.S. Department of Energy, Office of Inspector General, Office of Audit Services, *Audit Report: The Department's Progress in Meeting Los Alamos National Laboratory Consent Order Milestones*, DOE/IG-0793, April 2008.

receiving, and these projects were low on EM's priority list.[18] For example, Hanford's solid waste stabilization and disposition project's funding was reduced to the point where it will receive minimal funding for the next 4 years in order to allow full funding of Hanford's decontamination and decommissioning project at River Corridor, a higher priority. During this period, to comply with the funding levels provided, the project will maintain minimum activities to safeguard materials and will not advance its waste processing goals. As a result, according to project officials, life cycle costs for this project increased in some part to reflect a longer schedule and the additional costs of having to hire and train new workers in the future to complete a job that already was underway.

Not all sites have implemented these changes, however. EM's direction to all sites to create their baselines tied to the funding profile outlined in the June 2007 policy memo has not been applied to two of the major cleanup projects. The Hanford radioactive liquid tank waste stabilization and disposition project—the most expensive cleanup project—and the Los Alamos soil and water remediation project have not aligned their baselines with the funding targets. The Hanford project's baseline was validated just before the policy change took place and, for the period between 2009 and 2030, the baseline contains about $2.6 billion more than the funding targets.[19] Similarly, EM approved the baseline for the Los Alamos project even though it was not aligned with the funding targets. The baseline identifies a projected funding shortfall each year through 2012 that peaks at a cumulative $236 million in 2010. This shortfall does not include an additional $947 million in unfunded contingency. At the same time EM approved the baseline, it directed project managers at the site to change the baseline to bring its costs in line with the targets.

Another likely contributing factor to the cleanup projects' cost increases and extended schedules is DOE's practice of not including contingency funding in its annual budget requests for EM's cleanup projects. Specifically, EM has requested enough funding for its cleanup projects to ensure a 50 percent likelihood of completing the projects within the total estimated project costs. However, the requested amount generally has not

[18]EM's priority list is based on maximizing risk reduction. As such, it has ranked its activities in priority order, from highest to lowest, from stabilizing radioactive tank waste in preparation for treatment down to decontaminating and decommissioning excess facilities.

[19]Figures in this paragraph are in current year dollars.

included contingency funding, which project managers may have to use in order to complete a project on time by addressing risks that materialize during cleanup. For example, in 2007, the radioactive liquid tank waste project at Hanford had an unexpected spill of 85 gallons of radioactive material from one of its storage tanks; this spill required shutting down waste retrieval operations for 11 months in order to clean up the spill. Even though the retrieval operations represent a small percentage of the overall work scope ongoing at the project, the accident added at least $8 million to the retrieval cost for that one tank. Furthermore, in accordance with EM policy, projects are expected to account for the costs of such potential risks by increasing the amount of unfunded contingency in their near-term and life cycle baselines. Because funding for that contingency is not included in the budget request, however, increasing the amount of contingency funding in the near-term baseline is largely a paperwork exercise that has no active impact on preventing or solving problems or anticipating actions that could offset demonstrated slow progress.

According to a December 2007 report by the National Academy of Public Administration, EM's practice of not funding contingency for its cleanup projects has meant that EM has not had additional funding available to address emergency problems when they arise and therefore has either taken money from another project or extended the schedule of the work into future fiscal years to manage them. Furthermore, according to EM officials, by providing enough funding for its projects to ensure that they have a 50 percent chance of meeting their project cost and schedule baselines, EM recognizes that 5 of the 10 major projects are likely to miss their cost and schedule goals. In contrast, DOE funds its construction projects at a level that reflects a greater probability of success—80 percent—an amount that reflects the industry standard for such projects. According to senior EM officials, EM does not fund contingency for its cleanup projects because allotting enough funds to cover the costs of risks that may not materialize would constrain the amount of work EM could perform for the money it receives each year. However, in accordance with a recommendation from the National Academy of Public Administration, EM is evaluating its practice of not including contingency funding in its budget requests for cleanup projects.

Baselines Included Assumptions about the Scope of Work and Technical Challenges That Did Not Hold True

For most of the projects we reviewed, EM included assumptions in its baselines that (1) did not represent the conditions at some of the major projects, (2) did not sufficiently anticipate delays in the completion of related construction projects, and (3) the scope of work activities to be accomplished would not increase. Correcting these assumptions often led to changes in the scope of work, higher costs, and extended schedules.

First, for four of the projects we reviewed—Oak Ridge's nuclear facility decontamination and decommissioning project, Idaho's solid waste stabilization and disposition project, and Savannah River and Hanford's radioactive liquid tank waste stabilization and disposition projects—site conditions were worse than project staff originally estimated, leading to significant changes to the life cycle baseline.[20] For example, at the Oak Ridge project, because a 1940s-era building was far more contaminated and deteriorated than first estimated, DOE changed its cleanup plan and implemented a more extensive—and therefore more expensive—approach to tearing down the building. After a worker fell through a weakened floor, the contractor had to first reinforce the building's structure so that contaminated equipment could be removed safely. Primarily because project officials did not accurately anticipate the site conditions or the types of work activities necessary to safely conduct the work—despite multiple estimates generated by the contractor, DOE, and the Army Corps—this project's costs increased by $1.2 billion and significant amounts of work were delayed, extending the completion date by 9 years, to 2017.

Similarly, the initial baseline for the radioactive liquid tank waste stabilization and disposition project at Hanford assumed that 99 percent of the waste contained in the 177 storage tanks could be removed by using only one type of technology to retrieve the tank waste. However, DOE subsequently determined that almost half of the tanks contained a hardened layer of waste that could not be removed with the chosen technology and therefore a second technology was needed to remove this waste. Correcting the optimistic assumptions—adding the second technology and re-estimating the costs of retrieving waste from the tanks based on field experience gained—increased the baseline by more than $2 billion.

Second, delays in completing related construction projects directly contributed to schedule delays—and corresponding cost increases—for four of the cleanup projects we reviewed. Three of these projects are at the Hanford site in Richland, Washington. The initial baselines for these projects included assumptions that the major construction project there—the Waste Treatment Plant (WTP)—would be ready to begin operations in

[20]According to project officials, site conditions also were worse than estimated at Hanford's nuclear facilities decontamination and decommissioning project at River Corridor, although a baseline change proposal for the cost increase for this project had not been filed with EM headquarters at time of our review.

2011. In 2006, DOE extended the WTP construction completion date by 5 years, resulting in schedule extensions for three cleanup projects.[21] The major cleanup project that will run the WTP—the radioactive liquid tank waste stabilization and disposition project—had to increase its life cycle cost estimate by about $4.8 billion and extend its schedule by 10 years in order to safely maintain the waste storage tanks while the treatment plant is being built and to operate the plant for additional years, among other things. Similarly, in response to the WTP delay, the schedules for the solid waste stabilization and disposition project and the soil and water remediation project were extended by 15 years—increasing costs by more than $4 billion combined. These projects cannot complete their missions until the WTP has finished processing all of the liquid waste in the storage tanks. According to the currently approved baselines, the liquid tank waste project will complete its operations in 2042, and activities under the latter two projects are not expected to be completed until 2050.[22] However, as we recently reported, DOE has acknowledged that the start of waste treatment operations will be delayed by at least 8 years (from 2011 to 2019), not 5 years, which will likely affect further these projects' costs and schedules.[23]

Third, for three of the projects we reviewed, increases in work scope—the activities required to complete the project—contributed to cost increases and schedule delays. For example, a major contributor to the more than $3 billion cost increase and at least 9-year schedule delay at the nuclear materials stabilization and disposition project at Savannah River was DOE's approval of a new initiative in 2006 that added additional amounts of nuclear materials for the project's facilities to disposition, including materials from other DOE sites. Those facilities were originally scheduled to complete their mission in 2007—the new scope extended the mission

[21]In 2006 we reported on the primary causes of the cost and schedule increases at the WTP, some of which echo the issues we found relative to the major cleanup projects: shortcomings in the contractor's performance, DOE management and oversight problems, and technical challenges that were more difficult to address than anticipated. GAO, *Hanford Waste Treatment Plant: Contractor and DOE Management Problems Have Lead to Higher Costs, Construction Delays, and Safety Concerns*, GAO-06-602T (Washington, D.C.: Apr. 6, 2006).

[22]These dates are based on a 50 percent confidence level. With 80 percent confidence, the liquid tank waste is estimated to extend until 2050, the solid waste project is estimated to complete in 2058, and the soil and water project is estimated to extend until 2059.

[23]GAO, *Nuclear Waste: DOE Lacks Critical Information Needed to Assess its Tank Management Strategy at Hanford*, GAO-08-793 (Washington, D.C.: June 30, 2008.)

until 2019.[24] Similarly, Savannah River's other major cleanup project—radioactive liquid tank waste stabilization and disposition—also had significant scope added. Under a law passed in 2004,[25] DOE determined that the salt waste in its tanks is not high-level waste and therefore can be disposed of at the site instead of in a geologic repository. The law required DOE to consult with the Nuclear Regulatory Commission when making this determination. According to DOE, this consultation and the resulting changes to the cleanup process added significant scope to the project, causing DOE to lengthen the estimated time to close the 49 tanks at the site.

According to EM, most of the cost increases and schedule delays experienced by the major cleanup projects were the direct result of unrealized aggressive planning assumptions. EM has since recognized that project baselines must be based on realistic technical and regulatory assumptions and be planned on the basis of realistic out year budget profiles. However, it appears that the practice of incorporating optimistic assumptions into project baselines has not yet been eliminated. As we recently reported, some of the underlying assumptions in the baseline for the Hanford radioactive liquid tank waste project may be overly optimistic.[26] For example, DOE assumes that the tanks will remain viable throughout what has become a protracted waste treatment process, with some tanks expected to remain in service more than 60 years longer than originally anticipated. This extended operation raises the risk of tank failure and leaks to the environment. The baseline also assumes that emptying single-shell tanks will proceed significantly faster than it has to date. Hanford project management officials have since acknowledged that the ambitious retrieval schedule might not be achievable and are adjusting their planning estimates.

[24]As we recently reported, DOE may identify additional nuclear materials to process through these facilities, which could delay the planned 2019 shutdown and increase operational costs. GAO, *Nuclear Material: DOE Needs to Take Action to Reduce Risks Before Processing Additional Nuclear Material at the Savannah River Site's H-Canyon*, GAO-08-840 (Washington, D.C.: July 25, 2008).

[25]Ronald Reagan National Defense Authorization Act for Fiscal Year 2005, Pub. L. No. 108-375 § 3116. This law resolved a lawsuit in which an environmental group alleged that DOE lacked authority to determine that particular wastes were not high-level waste.

[26]GAO-08-793.

DOE Has Not Effectively Used Available Management Tools to Help Control Major Cleanup Projects' Scope of Work, Costs, and Schedule

While DOE has several mechanisms in place to help manage cleanup projects, including independent reviews, performance information systems, guidance, and performance goals, it has not always used them to effectively manage major cleanup projects' scopes, costs, and schedules.

DOE's Baseline Reviews Highlight Problems but Have Not Succeeded in Ensuring Work Can Be Accomplished within Stated Cost and Schedule

OECM's independent reviews of the baselines, meant, among other things, to provide reasonable assurance that the project's work activities can be accomplished within the stated cost and schedule, have not done so for four of the projects we reviewed. Instead, these baselines were significantly modified shortly after approval. As a result, the usefulness of the independent baseline reviews is questionable when significant baseline changes occur very shortly after the reviews are completed, as the following discussion illustrates.

The advanced mixed waste treatment project under Idaho's solid waste stabilization and disposition project. OECM's 2006 independent review accurately noted that the project baseline submitted for validation for the treatment plant included an unrealistic rate for processing waste—more than 50 percent faster than the rate demonstrated at the time the baseline was established. In response, project officials proposed correcting the problem primarily by increasing the amount of unfunded contingency in the baseline, a move that reflected common practice within EM, and OECM officials approved this action and validated the baseline. As the panel predicted, the project's actual processing rate after its baseline was validated was slower than expected. Within 7 months of OECM's validation of the near-term baseline, project officials proposed modifying it. DOE had to defer the activities that the contractor was not able to accomplish in the near term, extending the project life cycle by about 4 years and increasing costs by about $450 million. We believe that DOE's approval of increasing unfunded contingency as a corrective action for an

unrealistic processing rate was ineffective.[27] Although DOE also attempted to increase the processing rates through contractor performance incentives, we believe DOE should have revised the baseline using a more realistic processing rate to calculate baseline cost and schedule before validating it.

Oak Ridge's nuclear facility decontamination and decommissioning project. Significant cost increases began 2 years before OECM's independent validation of the project in 2006, and have continued to increase. Specifically, life cycle costs for the project were estimated at $1.8 billion in 2004—the beginning of the project's previous near-term baseline—with expected project completion by fiscal year 2008. By August 2006, when OECM completed its review of the baseline and issued its validation recommendation, life cycle costs for the project had grown to about $2.2 billion and project completion was extended by about 1 year. However, roughly 1 year after OECM validated the baseline, EM revised it again, adding about $800 million in costs and delaying project completion by an additional 8 years. EM justified the change because, among other things, it wanted to adjust the baseline to conform to new funding targets as directed by DOE in June 2007 and to account for other changes it needed to make in its approach to decontaminating the building.

Los Alamos soil and water remediation project. In March 2008, EM approved an independent review of this project and the associated baseline although it expected that the baseline would change. According to the EM memorandum approving the baseline, changes in EM's priorities and funding plans were likely to necessitate changes to the Los Alamos project's baseline, and the project was directed to submit a baseline change that would align the baseline with funding targets. OECM officials also acknowledged that their independent review of the baseline was based on assumptions that would likely not prove to be true. Specifically, OECM's review assumed that the project would receive the full funding needed even though DOE's funding targets at the time were below the funding levels needed to comply with the state cleanup agreement. As a result, project officials expect that the estimated life cycle costs of nearly $1.7 billion will increase substantially during 2008 but could not tell us the

[27]DOE included $180 million (representing an additional 18 months of work) in its unfunded contingency for this project , which would have covered only part of the $450 million cost increase or the 4-year schedule delay experienced by the project.

extent of the cost and schedule change until they receive DOE's new funding commitments for the project.

Hanford's radioactive liquid tank waste stabilization and disposition project. The most significant cost increase—more than $9 billion—occurred about 2 years after DOE's initial independent review and approval of this project. The project's baseline was first approved in 2004, with life cycle costs expected to be about $22 billion and completion scheduled for 2032. However, in 2006, life cycle costs increased to about $31 billion—not including an additional $8.6 billion in unfunded contingency—and the completion date was extended by 10 years, to 2042. Project officials expect the baseline will require another update and independent review in 2009 to reflect anticipated changes as a result of the project's new contractor and because of changes resulting from ongoing negotiations with state regulators over regulatory agreement milestones.

In addition to changes to the baselines soon after the independent reviews, DOE has recently relaxed standards used for conducting these reviews. In 2003, DOE issued standard operating procedures for conducting independent reviews—primarily of construction projects. These procedures stated that baselines should be considered, once approved, as set in concrete. The EM-OECM 2005 protocol—and its 2007 update—for cleanup projects replaced the standard operating procedures and directed OECM to validate only the near-term baseline for cleanup projects while reviewing the life cycle estimate "for reasonableness." In this way, EM and OECM sought to acknowledge what they believe are the greater uncertainties present in the out-years of a cleanup project compared with a typical construction project. However, within a year of the 2007 protocol, OECM had changed its approach for EM cleanup projects from validating baselines to "certifying" them, which is a more limited statement of assurance than validation. Specifically, according to OECM officials, certification means that the near-term baselines are reasonable if near-term baseline costs are funded as outlined in the baseline and contingency funds are provided as needed. The change is intended to reflect OECM's belief that, because funding for cleanup projects is more uncertain than for construction projects, the same confidence level cannot, nor should, be applied to reviews of EM cleanup project baselines as it is applied to construction projects. Since EM headquarters does not consistently provide contingency funds for its cleanup projects, and half of the major projects have significant contingencies in their near-term baselines, the most likely result for projects experiencing problems is to extend schedules and increase life cycle costs. In commenting on a draft of this report, OECM stated it intends to go back to validating near-term baselines

for cleanup projects, assuming, in part, that funding becomes more stable and EM gains greater experience managing near-term baselines.

DOE Lacks Reliable and Consistent Performance Information

DOE managers depend on data about the performance of EM's major cleanup projects to make informed decisions about how best to handle unexpected events and manage shifting priorities. DOE site and headquarters staff generate a number of regular reports to update senior managers on the status of these projects, both to justify making significant changes to project baselines and to request funding from Congress. Although these reports provide valuable information to managers on the progress of work at cleanup sites around the country, they do not consistently provide the key information needed to make fully informed management decisions about EM's major cleanup projects. Specifically, (1) proposals for baseline changes do not consistently identify reasons for proposed changes or possible root causes that contributed to problems, (2) use of EVM data does not consistently conform to industry standards or GAO's best practices, (3) quarterly reports do not always describe the impact of contractor performance on near-term or life cycle costs and schedules, and (4) reports to Congress on the status of and changes to major cleanup projects are limited to a small snapshot in time and do not provide information necessary for effective oversight.

EM Baseline Change Reports Do Not Consistently Include Needed Information

When a project reaches a point at which it is likely to miss the goals in its baseline, project managers are required to propose changes to the project's cost, schedule, or scope baseline, a process that is akin to hitting the reset button. EM project managers request such a change by, among other things, documenting certain information in a Baseline Change Proposal report, including current approved costs and new proposed costs, proposed project start and end dates, and a justification for the changes. For the key change proposals we reviewed for the major cleanup projects, the information provided describing the changes and their impacts varied widely, with some projects providing little to no explanatory information about what led to the change and others explaining the causes of the changes in detail. For example, a change proposal for Hanford's nuclear material stabilization and disposition project simply described the project's scope of work and did not provide any explanation for why the project's schedule was being delayed by 3 years, while a proposal from Savannah River's radioactive liquid tank waste stabilization and disposition project included information on the causes for its cost and schedule changes, as well as the specific cost and schedule impacts of each cause. However, the change proposals we reviewed generally did not address the root causes that resulted in the changes to the baseline. For example, the Savannah River change proposal

explained that almost $500 million of the total proposed cost increase was due to revising the strategy for finishing the project. However, the proposal did not explain why this strategy needed revision. In investigating the reason for this proposed revision, we determined that a robust strategy for finishing the project was not included in the original baseline because the project was directed to meet a completion date of 2025 and could not do so if it included the thorough closure strategy. Without including this kind of information in the proposals, it would be difficult for EM managers to effectively identify the true causes of the baseline changes, take steps to address them, and transfer any lessons learned to other projects.

In addition, EM does not centrally gather and systematically analyze the narrative information in the baseline change proposals. We recognize that such information is not easily analyzed to identify common causes across projects. However, without such analysis, EM senior managers are potentially hindered in addressing problems collectively. One EM project management official agreed that having the ability to analyze the information in the change proposals across projects would be beneficial, but that his office had not yet made it a priority to collect this information because it was still addressing reliability issues with the data in the change proposals.

EM has made some effort to identify root causes of its project management problems. It recently participated in a DOE-wide effort to identify root causes of project and contract management problems in response to GAO's inclusion of DOE's contract management on its high-risk list.[28] However, DOE's analysis was focused more on construction projects than EM cleanup projects. The report notes that the emphasis of the effort was on the capital line item—construction—projects, but that several of the issues identified also are applicable to other projects, including EM cleanup projects.[29] According to one project participant from OECM, the participants discussed how some of the issues raised related to cleanup projects but they did not examine those projects as extensively as the construction projects. In commenting on a draft of this report, DOE explained that its analysis was based more on data from construction projects than EM cleanup projects because more data exist documenting DOE's past project management deficiencies for construction projects

[28]GAO, *High-Risk Series: An Update*, GAO-07-310 (Washington, D.C.: January 2007).

[29]DOE, *Root Cause Analysis: Contract and Project Management* (Washington, D.C., April 2008).

since those projects have a longer history of a structured, disciplined management process.

Use of Earned Value Data Does Not Always Conform to Industry Standards or GAO-Identified Best Practices

At three of the major cleanup projects—nuclear facilities cleanup at the Hanford Site's river corridor cleanup project, solid waste stabilization and disposition at Idaho National Laboratory, and soil and water remediation at Los Alamos National Laboratory—we found several instances in which the use of EVM data did not conform to industry standards or our best practices.[30] As a result, EM and site project managers using the data may be less able to make informed decisions to effectively manage these projects.

Data anomalies. For all three projects, the EVM systems we assessed contained data errors or anomalies that could potentially distort the analysis of EVM data. Anomalies included, for example, reporting negative actual costs or reporting costs that are not tied to work scheduled or performed. The Los Alamos EVM data contained both types of these anomalies, which may have distorted the results of data analyses by as much as $34 million, preventing managers from understanding the true status of project performance. According to project officials, the anomalies occurred primarily because Los Alamos had initially assigned costs to a general account, and waited up to several months before assigning these costs to the correct specific work activities. In another case, in a significant number of instances the contractor at Hanford's river corridor closure project reported costs incurred for work activities performed that had not been scheduled to start until future years, skewing the reported performance results.[31] The contractor explained that these data anomalies occurred because it had performed work sooner than originally expected—and therefore the work was not incorporated into the project's EVM planned schedule in the periods for which it was actually performed. Project officials at the site stated that they believe the EVM information, as reported, correctly represents the project's status. As such, the summary-level EVM data seem to depict a favorable schedule

[30]We conducted limited assessments of EVM data reliability, compliance with industry standards or our best practices, and other analyses at three of the five EM sites we visited, including data from the Hanford site's river corridor cleanup project, Washington; Idaho National Laboratory's advanced mixed waste treatment plant subproject (within the solid waste stabilization and disposition project), Idaho; and Los Alamos National Laboratory's soil and water remediation project, New Mexico.

[31]Specifically, we found elements where the contractor reported budgeted and actual costs of work performed without a corresponding work schedule.

performance in April 2008; however, our independent analysis of this data shows that when we removed the value of the work that was started and completed ahead of schedule, the remainder of the originally scheduled work was actually behind schedule in April 2008, and trends indicated that the variance was worsening.

Data on the availability of staff to perform future work was not always developed. For one of the projects we reviewed, the EVM system lacked important information on staffing, contrary to GAO-identified best practices. DOE officials at Los Alamos' soil and water remediation project told us they plan to begin asking for staffing information from the contractor, and contractor officials stated they are setting up a staffing report within their EVM system. Without this information, project managers lack important information necessary for ensuring that they have, or will have, an adequate number and type of staff to perform the upcoming scheduled work.

Reliability of earned value systems is questionable. OECM has certified that the earned value system used to report performance for only one of the three systems we assessed meets the required industry standards.[32] The EVM system used by the contractor operating the advanced mixed waste treatment project—a significant portion of the solid waste stabilization and disposition project at the Idaho National Laboratory—has not been reviewed by OECM to determine whether it is compliant with industry standards, and contractor officials stated they believed their system does not meet the standards. In addition, OECM was in the process of reviewing the system used by the contractor responsible for the soil and water remediation project at Los Alamos National Laboratory at the time of our review. As a result, these projects lack the necessary assurances that the EVM data were free of errors and anomalies that could skew and distort the EVM analyses.

Once a system is certified as meeting the standards, regular surveillance is needed in order to ensure its continued compliance. Surveillance allows managers to focus on how well a contractor is using its EVM system to manage cost, schedule, and technical performance, and is important

[32]OECM has certified that all of the EVM systems used by the contractors working on the 10 major cleanup projects are in compliance with the American National Standards Institute/Electronic Industries Alliance standard except that of the Advanced Mixed Waste Treatment Project contractor at Idaho and the major project at the Los Alamos National Laboratory.

because it monitors problems with performance and the EVM data. If these kinds of problems go undetected, EVM data may be distorted and not meaningful for decision making. OECM's surveillance program is under development: it recently hired one staff person to lead its surveillance efforts, and is developing a guide to better define its surveillance protocol. DOE also requires its sites to perform surveillance of EVM monthly contractor performance data, which includes developing EVM surveillance plans and conducting random EVM surveillance.

Furthermore, EM managers do not appear to consistently gather or analyze EVM data to maximize the data's benefits for project management. GAO best practices recommend that EVM system reports include thorough narrative explanations of any root causes of, or proposed corrective actions, for reported cost and schedule variances shown in the data. For the soil and water remediation project at Los Alamos, for example, EM did not require that this information be reported by its contractor. As a result, EM project managers at Los Alamos have not always received the information necessary for ensuring that effective corrective actions are implemented to prevent additional changes to the cost and schedule baselines. According to contractor officials, they reported information on root causes and corrective actions to EM routinely before fiscal year 2008, but DOE asked them to stop providing it. According to the project director for the soil and water remediation project at Los Alamos, the Los Alamos Site Office Assistant Manager had directed the contractor to not provide the variance reports as part of its project status reviews because the contractor's explanation of these variance reports during scheduled meetings was taking several hours to review and wanted instead to use the available time to focus more on risk management and other project issues. However, according to this site official, the site office's direction was not intended to discontinue all variance analysis reporting. Although the contractor discontinued including the variance analyses reports in its project status reviews, the project director stated that DOE continues to obtain information from the contractor by other means, such as cost performance reports and weekly contractor meetings at which DOE and the contractor discuss the root causes of variances that resulted in risks to meeting milestone compliance agreements. However, contractor cost performance reports we reviewed did not provide any narrative information on causes or corrective actions. Furthermore, the weekly contractor meetings discuss only certain root causes of the variances that resulted in risks to milestone compliance agreements and therefore are neither comprehensive nor documented. Because verbal information can easily be forgotten, lost, or misinterpreted, among other things, we believe that a written report would be a best practice.

In addition, EM projects report their EVM data to headquarters managers at the project summary level, which can mask problems occurring in the project that more detailed reporting could reveal. At Idaho, in early 2008, EVM data showed the solid waste stabilization and disposition project was performing ahead of schedule and under cost, although major problems had occurred at the advanced mixed waste treatment project—the primary subproject. Without EVM reports that contain more specific detail, project managers at headquarters may not recognize that a problem is occurring until it becomes large enough to recognize at the summary project level of reporting. In addition, greater detailed information provided to managers earlier in the project potentially could allow for early intervention.

Beyond more detailed reports, some project managers in the field and at headquarters have not always systematically reviewed or independently analyzed the EVM data they received, which also would help improve their understanding, as well as mitigate potential problems occurring within a project. At one site we visited, the DOE official receiving the data said he did not analyze the information before entering it into the EM headquarters database. In turn, headquarters EM project managers told us they also do not analyze the EVM data the projects report. One oversight official indicated he would prefer to analyze the information he receives from the projects but he did not have the time required to do so. A senior EM project management official told us that he recognizes this deficiency and is working to address it: EM intends to pilot a new software package that will allow managers to analyze EVM data. According to EM, the software will enable EM managers to drill down into the EVM data received from the contractors, thus improving their oversight capabilities. In addition, according to EM project management officials, EM has insufficient federal staff to conduct oversight, which is being addressed as part of an ongoing effort to improve project management. In commenting on a draft of this report, EM stated it also intends to provide additional EVM training for its analysts.

Quarterly Reports Do Not Present a Comprehensive Picture of Performance against Near-Term or Life Cycle Commitments

In accordance with Order 413, EM senior managers, including the Assistant Secretary, receive quarterly updates on the status of the major cleanup projects. Two key reports are the quarterly project reviews (QPR), generated by EM project managers, and a quarterly project status report created by OECM. These reports contain contractor performance data and information about new or ongoing issues that need addressing at the sites, but do not always describe how contractor performance affects performance against the near-term or life cycle baselines. Without this information, managers cannot develop a comprehensive assessment of progress against agreed-upon goals.

The QPRs and OECM quarterly reports we reviewed largely use EVM data to assess project performance, but these data only reflect performance against the current contract period. Current contract period start and end dates do not line up with the start and end dates of the near-term baselines for any of the major cleanup projects we reviewed, and contract goals have not always been tied to what would be necessary to meet near-term baseline goals.[33] For example, we found the EVM data for Idaho's solid waste stabilization and disposition project—including the advanced mixed waste treatment subproject—that was reported in the QPRs and OECM quarterly reports from early 2008 did not line up with the near-term baseline because the advanced mixed waste treatment project's contract period was not the same as the near-term baseline period, which ends in 2012. EVM data for this project are reported as a combination of work done by two contractors: disposal of low-level and mixed-low-level waste, among other things, by the major site contractor, whose contract runs through 2012, and the advanced mixed waste treatment project operations contractor, who, in early 2008, was operating under a contract extension that expired in April 2008, 4 years shy of the end of the near-term baseline. In addition, according to project officials, the goal of processing 15,500 cubic meters of waste contained in that contract extension was not based on what was necessary to meet the near-term baseline goal of processing 65,000 cubic meters of waste by 2012, which was DOE's commitment at the time of the extension. Since the advanced mixed waste treatment project's activities make up about 75 percent of the cost baseline for the overall project, EVM data for this project as reported in the QPRs and OECM quarterly reports were not an accurate indicator of how the project was performing against the approved near-term baseline. DOE has further extended the advanced mixed waste treatment project contract through September 2009, and project officials explained the current extension is better linked to the current baseline, meaning EVM data reported should represent a better indication of performance against that baseline.

In addition, although the QPRs we reviewed include data on current life cycle cost and schedule estimates, they do not always include information about changes to the schedule or scope, nor do they explicitly mention when a change to the baseline has been proposed. Instead, the QPRs generally present information on life cycle cost increases and provide

[33]Contract start and end dates for the major cleanup projects do not match near-term baseline start and end dates. Furthermore, EVM data at Los Alamos is reported only against the current fiscal year, not against the full contract period or the near-term baseline.

comparisons to original baselines. QPRs also contain a schedule for each project detailing key milestones and expected end dates. However, when a change to a project completion date is made, the schedule shown in the QPR in most cases does not preserve the original completion date as a point of comparison. Similarly, there does not appear to be any mechanism in the QPR to present a change in a project's scope of work, for example, a move of some work activities from the near term into the out years. As a result, the reports tell only that life cycle costs have increased, but corresponding changes to schedule and scope are not apparent. Furthermore, there is no clear place in a QPR for a project manager to mention that a baseline change proposal has been submitted to headquarters if the results of that proposal are not yet presented in the life cycle cost or schedule information in the report. Including mentions of pending change proposals may help ensure senior managers clearly understand the true state of a project's performance.

A key performance indicator used in OECM's quarterly reports also may create the impression that a project is performing well overall when it is in fact encountering problems. As directed in the 2007 protocol for cleanup projects, OECM uses a traffic light indicator—red-yellow-green—as an at-a-glance way to highlight developing problems for DOE managers. This indicator is intended to represent expected performance against the approved near-term baseline and is based largely on EVM data. However, since projects encountering problems tend to manage those problems by moving work scope into the out years, the effects of problems occurring today show up as increases to out-year cost and schedule estimates and not as increases or delays in a near-term baseline.[34] Therefore, a project rated "green" by OECM may simultaneously be experiencing increases in overall life cycle costs and delays in project completion. OECM officials agreed that it would be beneficial to present projected impacts of current performance on life cycle estimates wherever practical in its reports.

EM Does Not Report Information about Significant Changes to Near-Term and Life Cycle Baselines to Congress

DOE's reports to Congress do not include key information that would aid oversight efforts, including the extent of and reasons for significant changes to near-term and life cycle baseline estimates, and the status of estimated life cycle costs. DOE's annual budget request to Congress for fiscal year 2009 for EM included funding requests for each site and each project, as well as the funding appropriated in fiscal years 2007 and 2008.

[34]In commenting on a draft of this report, EM indicated that scope deferrals or changes to the near-term baseline must now be formally approved by EM management.

The budget request also contains, among other things, descriptive information about the sites and projects, including EM's major cleanup projects, and about cleanup goals, regulatory frameworks, and key uncertainties. However, the request did not provide any project-specific life cycle costs or completion dates.[35] In the previous three budget requests, EM had provided life cycle costs and planned completion dates for each project. Without this information, Congress cannot know what progress each project has made and the extent of work still needed, cannot understand how the project may be changing and has changed over time, and cannot know whether the project experienced problems since the previous budget request and the reasons for these problems. The absence of this information makes it more challenging to effectively oversee the department and its major cleanup projects.

DOE has not been directed to provide such information about its major cleanup projects to Congress. In contrast, Congress has required the Department of Defense to report annually on its major defense acquisition programs—those costing $2 billion or more and typically consisting of a weapons system, such as Navy ships or fighter planes—or report quarterly when programs are experiencing significant cost increases or schedule delays.[36] Congress established the reporting requirement to improve oversight of these defense programs by providing visibility and accountability for any growth in cost that may occur. Known as Selected Acquisition Reports, each annual report includes information on full life cycle program costs, unit costs—the cost per plane or ship—and the history of those costs. A quarterly report also includes reasons for any change in unit cost or program schedule since the previous report, information about major contracts under the program and reasons for any cost or schedule variances, and program highlights. In addition, the Department of Defense includes development and procurement schedules, with estimated costs through program completion, in its annual budget justification submissions to Congress.

[35]DOE's fiscal year 2009 request for EM includes ranges of life cycle costs and completion dates at the site level.

[36]Major defense acquisition programs are those identified by the Department of Defense that require eventual total research, development, test, and evaluation expenditures of more than $365 million or $2.19 billion for procurement in fiscal year 2000 constant dollars.

DOE Guidance for Management and Oversight Functions Is Unclear and Not Implemented Uniformly across Sites

EM's key policies for managing its cleanup projects—including developing project baselines, managing risk, and planning for contingency funding—are not consolidated but spread across various guidance documents and memos and provide contradictory and confusing information. Although Order 413 serves as the overarching policy document for project management, according to EM, the order contains requirements that are unnecessary or expensive and awkward to implement for cleanup projects. EM thus has issued numerous memos outlining the way in which its project managers should implement the order. See table 3 for a list of key memos we identified that contribute to project management guidance and policy for EM cleanup projects.

Table 3: Key Policy Memos for EM Cleanup Projects

Date	Title	Source	Guidance provided
February 3, 2005	EM Contingency Policy	EM	Policy on funding contingency and preferred method for establishing contingency
June 23, 2005	Project Management for the Acquisition of Capital Assets—DOE Manual 413.3-1	DOE Office of Management, Budget and Evaluation	Requirements and guidance on implementing Order 413
July 10, 2006	Policies for EM Operating Project Performance Baselines, Contingency and Federal Risk Management Plans, and Configuration Control[a]	EM	Additional clarification and guidance on process and requirements to identify, develop, control, and validate EM baselines
July 28, 2006	Program and Project Management for the Acquisition of Capital Assets—DOE Order 413.3A	DOE	Project management guidance on acquisition of capital assets and environmental restoration projects
March 2, 2007	Risk Management Policy	EM	Statement of EM risk management policy
April 24, 2007	Protocol for EM Cleanup Project Performance Baselines and Conducting the External Independent Review or the EM Independent Project Review	EM and OECM	Governs review and validation of cleanup projects
June 25, 2007	Guidance for Implementing Baseline Changes to Reflect Funding Targets for Fiscal Year 2008 through the Out-Years	EM	Directed sites to develop baselines tied to specific funding targets provided
February 13, 2008	Configuration Control Process for Project Baselines	EM	Update on EM effort to put baseline under configuration control

Source: GAO's analysis of DOE information.

[a]Configuration control refers to efforts to manage and track any changes to work activities, costs, and schedules.

As the table shows, rather than having a consolidated source for guidance, EM project managers must consult multiple sources to determine how to correctly create a baseline or calculate contingency funding for a project. Furthermore, some of EM's guidance includes vague language and various exceptions to rules, which are likely to contribute to a project manager's difficulty in determining how to implement EM policy. For example, according to the April 2007 protocol for cleanup projects, once a contract is awarded and a detailed near-term baseline is developed, a follow-up independent review will be required if the baseline (1) exceeds the previously validated near-term baseline costs by 15 percent or more, (2) increases the schedule by a year, or (3) modifies scope significantly. The first two conditions for requiring a follow-up review are tied to fairly precise numbers—15 percent and 1 year—although there could be some question as to whether these numbers are to be applied to the original or reset baseline calculations, especially for projects that have been extended multiple times. However, the protocol provides no parameters for determining when the third condition, a "significant" scope modification, has occurred.

In addition, agency officials were not able to provide us with formal documentation of a significant shift in policy. As explained earlier, OECM recently shifted from validation to certification of the cleanup projects' near-term baselines. In response to our request for documentation of the switch to certification, OECM provided us with an e-mail from an OECM official to a DOE Inspector General auditor that defined certification and explained the reasons for the change. According to this e-mail, the change was made to acknowledge OECM's belief that EM cleanup projects should not be reviewed under the same standard as construction projects. The OECM official also directed us to DOE's fiscal year 2009 budget request for an explanation of the new approach. While the budget request includes a description of baseline certification, it neither mentions that the certification is a departure from the previous policy, nor does the request serve as an adequate means of communicating a significant policy change.

Furthermore, different guidance documents appear to be in conflict with one another. Specifically, EM's 2006 memo outlining its policy on contingency funding explained that DOE's risks associated with implementing a project are covered through contingency that is part of the "unfunded" portion of the baseline; that is, its funding is not requested or budgeted in advance of when it may be needed. However, a 2008 EM memo primarily concerned with explaining a new process for entering baseline changes into a database contains a description of the elements of a near-term baseline that includes a line for "other funded contingency,"

which has been interpreted by some EM officials as including DOE contingency. If, according to the 2008 memo, some DOE contingency should be funded—requested in advance—that memo directly contradicts the guidance provided in the 2006 memo. However, although the 2008 memo states it is updating the baseline change process, it does not specifically state that it replaces any part of the 2006 memo.

In part because of this confusion, project managers at cleanup sites have been implementing EM's contingency policy differently. According to EM officials, recent independent reviews have alerted senior EM officials to this inconsistent implementation of the policy guidance. The review teams found that the project managers were using a variety of methodologies to calculate the contingency for their projects. As a result, according to one EM official with expertise in contingency, managers were likely underestimating the amount of contingency needed for their projects. To address this problem, EM senior managers directed the creation of a contingency implementation guide to provide a definitive interpretation of existing EM policy on contingency, and this guide is expected to be issued in September 2008.

Furthermore, at least one of DOE's policies—on independent reviews of cost estimates—is not being implemented at all. According to Order 413 and the April 2007 protocol, an independent cost estimate—a top-to-bottom, independent estimate that serves to cross-check a cost estimate developed by project officials—should be developed as part of the OECM review process for major projects when "complexity, risk, cost, or other factors create a significant cost exposure for the Department." We believe that a review of a major cleanup project, given its level of expected spending over the near term, would meet the criteria for requiring an independent cost estimate. According to an OECM official, OECM has not performed an independent cost estimate for any of EM's major cleanup projects, primarily because OECM lacks the resources required to perform this type of rigorous estimate for the projects. Instead, OECM has taken a less rigorous and less expensive approach in its reviews—examining cost estimates generated by the projects but not producing a separate estimate for comparison.

According to DOE officials, it is addressing some of these guidance issues. By the end of September 2008, officials told us, DOE plans to replace its manual directing implementation of Order 413 with a series of 16 guides. The guides are expected to cover a range of project management issues, including risk management and contingency funding, with one guide providing direction on the management of EM cleanup projects. In

addition to the guides, as part of an EM-wide effort to improve project performance, EM has issued 18 recommended priority actions that contain additional EM-specific requirements for cleanup projects. It is unclear whether the guides and priority actions are expected to supplant all other guidance, or whether they will adequately address the challenge project managers face in determining the most up-to-date, comprehensive guidance to be followed.

DOE Recently Changed Expectations for Cleanup Projects' Performance

According to EM senior managers, EM cleanup projects are significantly different from DOE's construction projects in a number of ways. That is, it is harder in many instances to clearly define up-front requirements for cleanup projects, and there are more unknowns, especially since some of these projects are the first of their kind, with undefined scopes of work and significant risks scheduled many years into the future. Because of these differences and because it has said changing budget priorities may affect funding over time, DOE recently changed its performance goal—the amount of work to be accomplished and the cost margin for accomplishing that work—for EM cleanup projects to reflect a much larger margin of error than the performance goal set for construction projects.

Before 2008, a major cleanup project was measured against the same goal as a construction project: achieve at least 100 percent of the scope of work in its baseline with less than a 10 percent cost increase over the life of the project.[37] However, EM's current cleanup project performance goal applies only to the near-term baseline, and the projects now are considered to be successful if they achieve at least 80 percent of the scope of work in their near-term baselines with less than a 25 percent cost increase. The new performance goal permits up to 20 percent of the scope of work to be deferred from the near term to out years, which creates a substantially greater risk that life cycle costs will continue to increase and that completion dates will be delayed. As a result, for example, under this goal the four major projects each expected to cost more than $2 billion in the near term could increase their costs by $500 million each over that period and be considered successful. Furthermore, because a directed change—defined as a change caused by DOE policy, or regulatory or statutory

[37]As previously reported in GAO-07-518, in 2004 DOE began reporting performance information for EM cleanup projects against the same goal as the line-item construction projects. In late 2005, however, DOE switched to reporting performance only for those projects with validated cost and schedule baselines.

actions—already exempts projects from meeting the performance goals, creating a less stringent goal for EM cleanup projects further waters down the impact of having a performance goal in the first place. By lowering expectations for adhering to near-term baselines, DOE inadvertently may be creating an environment in which large increases to project costs become not only more common, but accepted and tolerated.

DOE Is Undertaking Efforts to Implement Project Management Improvements

EM is undertaking a number of efforts to improve its project performance and address long-standing problems. One such effort is EM's "Best-in-Class" Project Management Initiative through which EM leadership has committed to improving project performance. Under the initiative, EM contracted with the Army Corps to assess the current status of project management at EM headquarters and its offices. Using the Army Corps' analysis, EM identified a set of challenges it faced in executing its mission, which resulted in the creation of the 18 priority actions for it to undertake to address the challenges and implement its initiative. Those priority actions include, among others, completing DOE's project management guide, which is expected to bring all project management guidance documents under one umbrella document; establishing standard reporting formats for project updates produced by project managers, including QPRs; implementing new project management software packages, including those for EVM analysis; and better integrating its project and contract management activities. EM has developed a set of implementing steps and a summary of expected benefits for each priority action. According to EM, 10 of the priority actions are being implemented in fiscal year 2008, and 5 of those are scheduled to be completed by the end of that fiscal year. It appears that execution of the priority actions would create new tools and potentially enhance existing ones in EM's effort to improve its cleanup projects' performance. According to EM, full implementation of the priority actions will address many EM project management problems and deficiencies. However, since the actions are still being implemented, it is too soon to determine their effectiveness.

In addition, EM officials acknowledged that the actions they are implementing to improve the management of EM's overall cleanup efforts, including their Best-in-Class initiative and actions being taken in response to the 2007 National Academy of Public Administration report have not been formally documented into a specific, corrective action plan that includes performance metrics and completion milestones. These officials agreed that such a comprehensive plan would demonstrate a more integrated and transparent commitment to improving the management of EM's cleanup projects.

Conclusions

Cleaning up the nuclear weapons complex is a technically challenging and risky business. Even as DOE works to gain control of and better manage its major nuclear waste cleanup projects, cost increases and project delays continue to mount. Specifically, life cycle costs for EM's major cleanup projects have increased by cumulative $25 billion over the past few years and schedules have been extended by a combined total of more than 75 years, primarily because DOE had to adjust the optimistic baselines it created to accommodate the realities it has encountered at its cleanup projects.

Given the cost and complexity of the major nuclear cleanup projects, it is critically important that DOE fully use the tools it has developed—independent reviews, performance information systems, guidance, and performance goals—to better ensure that projects stay within established parameters for scope of work, costs, and schedule. Independent baseline reviews to ensure that the work promised can be completed on time and for the estimated cost appear to be a useful planning tool, but the significant changes that have occurred within years or even months of the baseline reviews and validations indicate that implementation of these reviews has fallen short. Furthermore, EM's site proposals for changes to cost and schedule baselines, quarterly performance reports, earned value data analysis and reports, and reports to Congress do not consistently provide accurate and comprehensive information on the status of projects, which undermines managers' and Congress's ability to effectively oversee projects and make timely decisions, such as targeting resources to particular projects or renegotiating cleanup milestones and other contract conditions. These problems are compounded by the lack of comprehensive and clear guidance for DOE project managers so that they consistently implement DOE management policies across the projects and EM's recently relaxed performance goals establishing the acceptable baseline change parameters for major cleanup projects. Although DOE has identified a number of improvements it intends to make to its project management approach, it is still in the early stages of implementing these improvements, making it too soon to assess the effort's full effect, and it has not yet formally documented all the improvements in a comprehensive corrective action plan.

Recommendations for Executive Action

So that DOE can better manage its major cleanup projects and more fully inform Congress on the status of these projects, we recommend that the Secretary of Energy direct the Assistant Secretary for Environmental Management to take the following five actions:

- Include in its budget request to Congress life cycle baseline cost estimate information for each cleanup project, including prior year costs, estimated near-term costs, and estimated out-year costs.

- Develop an approach to regularly inform Congress of progress and significant changes in order to improve EM's accountability for managing the near-term baseline and tracking life cycle costs. Similar to the Department of Defense's Selected Acquisition Reports, which include annual information on full life cycle program costs, among other things, EM's report, at a minimum should compare estimated near-term and life cycle scope, cost, and schedules with the original and subsequently updated baselines, and provide a summary analysis of root causes for any significant baseline changes.

- Expand the content of EM performance reports to describe the implications of current performance for the project's overall life cycle baseline, including the near-term baseline cost and out-year cost estimate, using, when appropriate, valid earned value data that conform to industry standards and GAO-identified best practices.

- Consolidate, clarify, and update its guidance for managing cleanup projects to reflect (1) current policy regarding independent baseline reviews and (2) the results of DOE's determination of the appropriate means for calculating and budgeting for contingency so that project managers can consistently apply it across nuclear waste cleanup sites.

- Consolidate all planned and ongoing program improvements, including those stemming from the Secretary's contract and project management root cause analysis corrective action plan, the Best-in-Class initiative, and the 2007 National Academy of Public Administration report, into a comprehensive corrective action plan that includes performance metrics and completion milestones.

Because independent baseline reviews have not always provided reasonable assurance of the stability of projects' near-term baselines or the reasonableness of the life cycle baselines, we recommend that the Secretary of Energy direct the Director of the Office of Management to take the following action:

- Assess the Office of Engineering and Construction Management's current approach and process for conducting baseline reviews of EM cleanup projects to identify and implement improvements that will better provide reasonable assurance that project work scope can be completed within the baselines' stated cost and schedule. Consider including in the

assessment process an analysis of past lessons learned and reasons for baseline changes, and an assessment of project affordability when conducting baseline reviews.

Agency Comments and Our Evaluation

We provided a draft of this report to DOE for its review and comment. DOE agreed with our recommendations but provided some suggested changes to them, which we incorporated as appropriate.

In addition, DOE provided some specific comments on our draft report. First, DOE stated that the report should provide a more balanced and accurate portrayal of EM's cleanup projects by including descriptions of ongoing initiatives, a number of which EM launched in recognition of the need for improvement, as well as providing better context of the challenges and constraints the department's cleanup program faces. The draft report included a brief description of EM's ongoing initiatives, including its Best-in-Class effort, and acknowledged many of the key challenges DOE faces while illustrating the factors contributing to changes in scope, cost, and schedule for its cleanup projects. We also acknowledged DOE's ongoing initiatives and progress in a 2007 report on project management.[38] In addition, DOE cited its successes in the cleanup of Rocky Flats and Fernald as evidence of its project management accomplishments. We commend DOE on its past performance in successfully cleaning up these sites, which has resulted in some lessons learned that DOE can apply to other cleanup efforts, as we reported in 2006.[39] Nevertheless, we found in this review that DOE has not always effectively used its management tools to help oversee the scopes of work, costs, and schedules for its present major cleanup projects.

Second, DOE stated that our draft report appears to confuse the term "baseline." It noted that there is only one project baseline—the near-term baseline approved by EM senior management—for which DOE should be held accountable. Our use of the term "baseline" in this report conforms to EM's guidance documents indicating a project's "lifecycle baseline" is composed of its prior year, near-term, and out-year costs. In addition, we disagree with DOE's assertion that it should be held accountable only for a project's near-term baseline. As we state in this report, since projects encountering problems have tended to manage those problems by moving work scope into the out years, the effects of problems occurring today

[38] GAO-07-518.

[39] GAO, *Nuclear Cleanup of Rocky Flats: DOE Can Use Lessons Learned to Improve Oversight of Other Sites' Cleanup Activities*, GAO-06-352 (Washington, D.C.: July 10, 2006).

show up as increases to out-year cost and schedule estimates and not as increases or delays in a near-term baseline. Therefore, if DOE's performance is measured solely on the basis of the near-term baseline, potentially significant cost and schedule increases would not be accounted for or transparent.

Third, DOE stated that one of our recommendations—to consolidate, clarify, and update its guidance for managing cleanup projects to reflect the results of DOE's determination of the appropriate means for calculating and budgeting for project contingency—could be more specific, and it outlined three contingency options. These options include (1) increasing the amount of contingency funding for cleanup projects to an 80 percent confidence level, the level budgeted for construction projects; (2) creating a general contingency fund available for project managers at DOE headquarters to dispense as needed to manage project risks; and (3) continuing with the current approach of not including contingency funding for cleanup projects in its budget requests—funding cleanup projects at the 50 percent confidence level—and changing its recently established performance goal. We recognize that managing project contingency is an important issue, and in fact note in our report that DOE's current approach is a likely contributing factor to cost increases and schedule delays for EM's major cleanup projects. While we did not specifically assess these three options in our report, DOE should continue to study the lessons learned from managing and budgeting contingency and select the option that would provide contingency funds in an expedient manner to better mitigate the impacts of cleanup project changes while minimizing the amount of unused contingency funding left over at the end of the fiscal year.

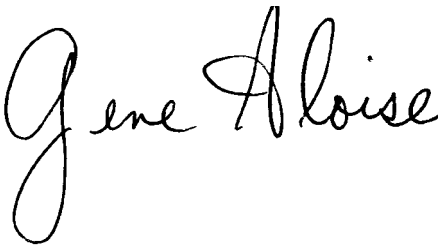
Finally, as part of the explanation of its third option for funding project contingency, DOE stated that GAO has agreed to its recently established performance goal—to accomplish at least 80 percent of the scope of work in the near-term baselines with less than a 25 percent cost increase. GAO has not agreed to this goal. As we state in this report, we are concerned with DOE's new goal given that it is lower than the previous goal for cleanup projects and that DOE may inadvertently be creating an environment in which large increases to project costs become not only more common, but accepted and tolerated.

DOE also provided detailed technical comments, which we have incorporated into our report as appropriate. DOE's comments are reproduced in appendix IV.

We are sending copies of the report to interested congressional committees, the Secretary of Energy, and the Director of the Office of Management and Budget. We will make copies available to others on

request. In addition, the report will also be available at no charge on the GAO web site at http://www.gao.gov.

If you or your staffs have any questions about this report, please contact me at (202) 512-3841 or aloisee@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Other staff contributing to the report are listed in appendix V.



Gene Aloise
Director, Natural Resources
and Environment

Appendix I: Scope and Methodology

To determine the extent to which the cost, schedule, and scope baseline estimates for the Department of Energy (DOE) Office of Environmental Management's (EM) cleanup projects have changed and the key reasons for these changes, we identified 10 major cleanup projects at 5 DOE sites. We first identified 9 major cleanup projects with current near-term cost estimates (usually a 5-year period) above $1 billion, the DOE threshold for major cleanup projects. In addition, to include those projects that could potentially become major projects because of cost growth, we reduced the threshold to $900 million and identified another project, the Richland nuclear material stabilization and disposition project, which is estimated to cost between $900 million and $1 billion over the near term. We focused on these 10 major cleanup projects because of their significant cost—combined estimated near-term costs of about $19 billion and combined life cycle costs estimated at more than $100 billion—and because they account for almost half of EM's $5.5 billion fiscal year 2009 budget request. (See app. II for information on these projects.)

To identify the factors that may hinder DOE's ability to effectively manage these cleanup projects, we spoke with DOE project directors and contractor officials and reviewed project management documents for the 10 major cleanup projects we had identified. We conducted site visits to Idaho National Laboratory, Los Alamos National Laboratory, Oak Ridge Reservation, Savannah River, and Hanford, and analyzed project documentation—contracts, policy directives and memoranda, project management plans, DOE's Office of Inspector General reports, independent reviews, project execution plans, risk management plans, quarterly project reviews, monthly project status reports, earned value management (EVM) surveillance plans, and project control documents prepared to guide and control formal changes to the baselines. For our analysis of projects' scope, cost, and schedule data, we examined the initial baselines reported as of the most recent contract award or major contract modification (which occurred between 2004 and 2007) and compared these baselines with the updated baselines at the time of our review. Initial cost baselines are the estimated life cycle costs at the beginning of the new contract period for operation of the DOE site or associated projects or the major contract modification or extension, which typically coincided with the beginning of the projects' current or previous near-term baseline. We also calculated the percentages of cost increases on the basis of constant 2008 dollars to make them comparable across projects and to show real increases in cost while excluding increases due to inflation. In addition, because EM now is reporting its life cycle cost and schedule estimates as ranges, we included these ranges in the report. However, because the upper ends of these ranges include unfunded

contingency and EM does not include funding in its budget requests for this contingency, we report cost increases and schedule delays based on the lower ends of the ranges.

We also analyzed contractor performance data to determine whether DOE major cleanup projects are consistently developing and analyzing accurate earned value data according to industry standards and best practices. We gathered and analyzed data produced by the EVM system used for one project at each of the following sites: Idaho National Laboratory, Los Alamos National Laboratory, and Hanford.[1] Often, EVM systems differ depending on how the contractor chooses to implement the EVM approach. Because of these differences, we gathered and analyzed information on each EVM system on a case-by-case basis, according to the structure, reporting format, content, and level of detail, among other things, unique to each EVM system. We also considered the best practices developed by GAO for estimating and managing project costs to analyze the contractor EVM data.[2]

In addition, we spoke with DOE officials from EM and the Office of Engineering and Construction Management in Washington, D.C., and with representatives from LMI Government Consulting, which conducts external independent reviews of the projects for DOE, to obtain their perspective on how these projects are managed.

Because we and others previously have expressed concern about the data reliability of a key DOE project management tracking database—the Project Assessment and Reporting System—we did not develop conclusions or findings based on information generated through that system.[3] Instead, we collected information directly from project site offices and the contractors.

[1]We did not analyze the EVM data for the Oak Ridge or Savannah River projects.

[2]GAO, *Cost Assessment Guide: Best Practices for Estimating and Managing Program Costs*, GAO-07-1134SP (Washington D.C.: July 2007).

[3]GAO, *Department of Energy: Further Actions Are Needed to Strengthen Contract Management of Major Projects*, GAO-05-123 (Washington, D.C: Mar. 18, 2005); and Civil Engineering Research Foundation, *Independent Research Assessment of Project Management Factors Affecting Department of Energy Project Success* (Washington, D.C.: July 12, 2004).

We provided an interim briefing to the Subcommittee on Energy and Water Development, House Committee on Appropriations, on the status of our work on April 3, 2008.

We conducted this performance audit from March 2007 to September 2008 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Information on the 10 Department of Energy Major Cleanup Projects Reviewed

Project	Project purpose and objective
Solid Waste Stabilization and Disposition, Idaho National Laboratory, Idaho (PBS 13)	This project will characterize, treat, and ship approximately 64,000 cubic meters of transuranic waste that will ultimately be stored in the Waste Isolation Pilot Plant in New Mexico. Transuranic waste is radioactive waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste with half-lives greater than 20 years, except for high-level radioactive waste. The transuranic waste that must be handled remotely through protective shielding, because it emits penetrating radiation, will be treated at the Radioactive Waste Management Complex. The project also will treat and dispose of a mixed low-level waste backlog and handle on-site low-level waste for disposal at the complex.
Nuclear Facility Decontamination and Decommissioning, Oak Ridge Reservation Tennessee (PBS 40)	The project will decontaminate and decommission approximately 500 facilities and remediate 160 sites in the East Tennessee Technology Park. This project includes the park's two major buildings—the K-25 and K-27 gaseous process buildings—and requires the contractor to remove processing equipment and excess materials stored in the buildings, demolish building structures, and dispose of all associated wastes.
Nuclear Material Stabilization and Disposition, Savannah River Site, South Carolina (PBS 11)	The project will stabilize and dispose of enriched uranium materials and current and projected inventories of aluminum-clad spent nuclear fuel in H-Area facilities. It also will stabilize and dispose of highly enriched uranium solutions, miscellaneous fuels, plutonium residues, enriched uranium residues, and other materials DOE identifies that remain from the production of nuclear weapons. The project also will deactivate F-Area and H-Area facilities; and dispose of special nuclear materials in the K-Area Complex.
Radioactive Liquid Tank Waste Stabilization and Disposition, Savannah River Site, South Carolina (PBS 14C)	The project will remove, treat, and dispose of 49 underground storage tanks holding a total of 37 million gallons of highly contaminated legacy waste This effort includes pretreating radioactive waste such as sludge and salt waste, vitrifying sludge and high-level waste at the Savannah River Site's Defense Waste Processing Facility, and treating and disposing of low-level saltstone waste.
Soil and Water Remediation, Los Alamos National Laboratory, New Mexico (PBS 30)	The project will identify, investigate, and remediate, when necessary, areas with known or suspected chemical and radiological contamination attributable to past Laboratory operations. It will investigate and clean up (as needed) approximately 860 solid waste management units and areas of concern remaining from the original 2,129 sites spread over approximately 39 square miles. The protection of surface water and groundwater resources that may be impacted by these management units and past Laboratory operations also are within the scope of this project.
Nuclear Material Stabilization and Disposition, Hanford, Washington (PBS 11)	The project will stabilize, package, and ship (to the Savannah River Site) nuclear materials and fuels used for the production of plutonium nitrates, oxides, and metal from 1950 through 1989 and now stored primarily in vaults in several facilities. The project will then clean and demolish the facilities.
Solid Waste Stabilization and Disposition, Hanford, Washington (PBS 13C)	The project will treat and store spent nuclear fuel, transuranic waste, mixed low-level waste, and low-level waste generated at the Hanford site and other DOE and Department of Defense facilities. It eventually will transfer and ship spent nuclear fuel elements and 1,936 cesium and strontium capsules to the proposed geologic repository in Nevada. The project also will operate, among other things, the (1) Waste Receiving and Processing Facility to process transuranic waste and low-level waste and (2) Central Waste Complex to store low-level and mixed-low-level waste and transuranic waste pending final disposition.

Project	Project purpose and objective
Soil and Water Remediation, Hanford, Washington (PBS 30)	The project will remediate contaminated groundwater. This effort involves characterizing the movement of radionuclides and chemicals (carbon tetrachloride, chromium, technetium-99, strontium, and uranium plumes); assessing the soil and groundwater characterization results; groundwater and risk assessment modeling; and operation of groundwater remediation systems among other related actions.
Nuclear Facility Decontamination and Decommissioning at River Corridor Closure Project, Hanford, Washington (PBS 41)	Also known as the River Corridor Closure Project, this project will remediate 761 contaminated waste sites at the Hanford site near Richland, Washington, and decontaminate, decommission and demolish 379 surplus facilities that are adjacent to the Columbia River. This project also will dispose of material in the Environmental Restoration Disposal Facility.
Radioactive Liquid Tank Waste Stabilization and Disposition, Office of River Protection, Hanford, Washington (PBS 14)	The project will retrieve, stabilize, treat, and dispose of 53 million gallons of radioactive mixed waste stored in 177 underground tanks at the Hanford site. The project also involves testing and implementing supplemental waste treatment methods; operating the Waste Treatment Plant; providing interim storage of immobilized waste planned for disposal in an offsite repository; receiving and disposing of immobilized low-activity waste on-site in near-surface disposal facilities; and closing tanks and tank farm facilities.

Source: DOE and EM information.

Appendix III: Current Life Cycle Baselines for 10 DOE Cleanup Projects

Dollars in millions (current year dollars)

Project	Prior years' costs	Near term[a] Cost	Near term[a] Years	Out years[b] Cost	Out years[b] Completion date	Total life cycle cost range
Solid waste stabilization and disposition, Idaho National Laboratory, Idaho	$1,398	$1,304	2006 – 2012	$530 – $900	2016 – 2020	**$3,231 – $3,954**
Nuclear facility decontamination and decommissioning, Oak Ridge Reservation, Tennessee	$1,546	$1,518	2008 – 2017	NA	NA	**$3,064 – $3,244**
Nuclear material stabilization and disposition, Savannah River Site, South Carolina	$3,631	$2,468	2008 – 2014	$3,728 – $4,358	2024 – 2025	**$9,827 – $10,457**
Radioactive liquid tank waste stabilization and disposition, Savannah River Site, South Carolina	$4,746	$4,394	2008 – 2014	$11,856 – $20,347	2032 – 2034	**$20,996 – $29,488**
Soil and water remediation, Los Alamos National Laboratory, New Mexico	$579	$1,051	2007 – 2015	NA	NA	**$1,630 – $2,489**
Nuclear material stabilization and disposition, Hanford site, Washington	$1281	$1,143	2008 – 2013	$1,030 – $1,060	2018 – 2019	**$3,453 – $3,490**
Solid waste stabilization and disposition, Hanford site, Washington	$1,163	$918	2008 – 2013	$11,200 – $12,500	2050 – 2058	**$13,281 – $14,594**
Soil and water remediation, Hanford site, Washington	$532	$1.128	2008 – 2013	$6,400 – $6,600	2050 – 2059	**$8,059 – $8,276**
Nuclear facility decontamination and decommissioning at River Corridor, Hanford site, Washington	$1,000	$3,751	2005 – 2019	NA	NA	**$4,751 – $4,910**
Radioactive liquid tank waste stabilization and disposition, Hanford site, Washington	$3,474	$2,330	2007 – 2012	$38,414 – 5$6,227	2042 – 2050	**$44,218 – $62,155**

Source: Office of Environmental Management.

[a]Near-term costs represent DOE's estimated costs based on a 50 percent level of confidence, defined as the amount of funding needed to provide a 50 percent likelihood that the project will be completed successfully.

[b]Out-year values represent DOE's estimated cost and schedule ranges—the cost range covers the full out-year period, while the schedule range represents the time during which the project is estimated to be completed. Costs and schedules at the lower end of the ranges were estimated at the 50 percent level of confidence, while costs and schedules at the upper end of the ranges represent the 80 percent level of confidence.

Appendix IV: Comments from the Department of Energy

Department of Energy
Washington, DC 20585

September 19, 2008

Mr. Gene Aloise
Director of Natural Resources and Environmental
U.S. Government Accountability Office
441 G Street NW
Washington, D.C. 20548

Dear Mr. Aloise:

Thank you for the opportunity to review the draft report on accountability and management of the Department's major cleanup projects managed by the Department of Energy's Office of Environmental Management (EM). We are in agreement with the recommendations you have provided, with some suggested changes, and look forward to reporting in the future on the progress being made. Detailed comments to the draft report are enclosed. Major comments are summarized below.

We believe the report should provide a more balanced and accurate portrayal of EM's cleanup projects by including descriptions of ongoing initiatives and actions, a number of which were launched by EM in recognition of the need for improvement. Additionally, the report should provide better context of the incredible challenges and constraints the Department's cleanup program faces and the difficulties associated with accurate predictions of project cost and schedule for the EM cleanup projects.

For instance, the Government Accountability Office's (GAO) conclusion in 2001 (GAO-01-284, *Nuclear Cleanup: Progress Made at Rocky Flats, but Closure by 2006 Is Unlikely, and Costs May Increase)* states that "Kaiser-Hill and DOE are unlikely to meet the December 2006 target closure date" for Rocky Flats and yet this closure date was indeed met by DOE and the Rocky Flats cleanup contractor Kaiser-Hill. As recommended by the GAO in 2006 (GAO-06-352, *Nuclear Cleanup of Rocky Flats: DOE Can Use Lessons Learned to Improve Oversight of Other Sites' Cleanup Activities),* EM used the lessons learned from Rocky Flats for other cleanup efforts across the complex to accomplish extremely successful cleanups. We won the Project Management Institute award for our prowess in project management in 2006 and 2007 for the Rocky Flats and Fernald cleanup projects, respectively.

There appears to be some confusion over the term "baseline". There is only one project baseline, the near-term baseline that has Critical Decision-2 approval by the Acquisition Executive, for which DOE should be held accountable. The

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Decision-1 type range) which is expected to change, often by significant amounts. For this very reason, DOE no longer expresses lifecycle information on cleanup projects as a point estimate.

Finally, the issue of how we fund and manage project contingency is critical to our long-term success and our ability to mitigate impacts of these changes. We recognize full well that we cannot continue to extend schedules and increase costs every time risks that have been identified and anticipated in advance occur. Your fourth recommendation, with regard to contingency, could be more specific. There are three primary or bounding contingency options as we see it, discussed further in the attachment:

1. **Fund operating cleanup project contingency at 80% confidence level instead of the current 50%.**
   If provided over and above current target levels, approximately $500 million (M) to $700M additional funding annually would be required. However, if risks did not materialize during the budget year, there would be higher uncosted year-end carryover. However, to plan for this level of contingency without additional funding would require deferral of lower priority project scope. To compensate, EM would need to renegotiate compliance milestones or possibly subject the federal government to fines, penalties, and lawsuits; renegotiate and possibly terminate contracts, thus affecting employment; and reprioritize its projects.
2. **Request appropriation of a smaller general contingency fund.**
   The fund (perhaps $100M to $200M annually) would be held, managed, and distributed by the Assistant Secretary for Environmental Management. This option would allow more flexibility and expediency in applying funds where they are needed as risks are realized, and would allow for multi-year business case decision-making. However, controls would need to be put in place on EM's allocation authority during execution so as not to usurp Congressional authority in appropriations.
3. **Continue the current approach of funding 50% confidence levels and changing the corporate metric for the EM cleanup projects agreed to by DOE, the Office of Management and Budget (OMB), and GAO.**
   This approach budgets for contingency at a 50% confidence level for cleanup projects. When risks not covered at this level materialize, work scope is shifted to the outyears when funds can be requested in light of overall program priorities. A 50% confidence level across the EM portfolio connotes that based on statistical analysis half the projects would be expected to be completed within the cost and schedule and half would not. Thus, this current approach appears to be inconsistent with achieving success in the corporate metric that DOE has agreed to with GAO and OMB for cleanup projects (established through DOE's Root Cause Analysis Corrective Action Plan, July 18, 2008). The metric requires that 90% of the projects in EM's portfolio at the end of the approved near-term

baseline period have 80% of the scope completed within 25% of the original cost.

Any GAO recommendations regarding new strategies are welcomed, given the regulatory-driven nature and complexity of this work, the sensitivity of life-cycle costs to relatively small slippages in scope (due to large "hotel" costs), and the need to deliver on commitments made to our regulators, the Congress, and other stakeholders.

Again, thank you for your assistance as we seek to improve our management of cleanup projects. We welcome direct dialogue with you on these issues prior to finalizing your report. We would also appreciate you including the attached comments in the final report. If you have any questions with regard to these comments, please contact me on (202)586-7709, Jack Surash on (202) 586-6382, or Paul Bosco on (202) 586-3524

Sincerely,

James A. Rispoli
Assistant Secretary for
Environmental Management

Enclosure

cc: I. Triay, EM-2
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Appendix V: GAO Contact and Staff Acknowledgments

GAO Contact

Gene Aloise, (202) 512-3841 or aloisee@gao.gov

Staff Acknowledgments

In addition to the individual named above, Rudy Chatlos, Jennifer Echard, James Espinoza, Daniel Feehan (Assistant Director), Mike Gallo, Diane Lund, Mehrzad Nadji, Omari Norman, Brian Octeau, Christopher Pacheco, Leslie Pollock, Karen Richey, and Carol Herrnstadt Shulman made key contributions to this report.

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United States Government Accountability Office

GAO

Report to the Subcommittee on Energy and Water Development, Committee on Appropriations, House of Representatives

September 2008

NUCLEAR WASTE

Action Needed to Improve Accountability and Management of DOE's Major Cleanup Projects

GAO

Accountability * Integrity * Reliability

GAO-08-1081

September 2008

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Accountability • Integrity • Reliability

Highlights

Highlights of GAO-08-1081, a report to the Subcommittee on Energy and Water Development, Committee on Appropriations, House of Representatives

NUCLEAR WASTE

Action Needed to Improve Accountability and Management of DOE's Major Cleanup Projects

Why GAO Did This Study

The Department of Energy (DOE) spends billions of dollars annually to clean up nuclear wastes at sites that produced nuclear weapons. Cleanup projects decontaminate and demolish buildings, remove and dispose of contaminated soil, treat contaminated groundwater, and stabilize and dispose of solid and liquid radioactive wastes. Ten of these projects meet or nearly meet DOE's definition of major: costs exceeding $1 billion in the near term—usually a 5-year window of the project's total estimated life cycle.

GAO was asked to determine the (1) extent to which the cost and schedule for DOE's major cleanup projects have changed and key reasons for changes, and (2) factors that may hinder DOE's ability to effectively manage these projects. GAO met with project directors and reviewed project documents for 10 major cleanup projects: 9 above the near-term $1 billion threshold, and 1 estimated to cost between $900 million and $1 billion over the near term.

What GAO Recommends

GAO is making a number of recommendations, such as expanding the content of performance reports provided to DOE senior managers and information provided to Congress to better reflect current status of near-term and life cycle baseline cost and schedules and reasons for significant changes; and strengthening DOE guidance and baseline reviews, among other things. In commenting on a draft of this report, DOE agreed with GAO's recommendations.

To view the full product, including the scope and methodology, click on GAO-08-1081. For more information, contact Gene Aloise at (202) 512-3841 or aloisee@gao.gov.

What GAO Found

Nine of the 10 cleanup projects GAO reviewed had life cycle baseline cost increases, from a low of $139 million for one project to a high of nearly $9 billion for another, and life cycle baseline schedule delays from 2 to 15 years. These changes occurred primarily because the baselines we reviewed included schedule assumptions that were not linked to technical or budget realities, and the scope of work included other assumptions that did not prove true. Specifically, the schedules for 8 of the 10 projects were established in response to DOE's 2002 effort to complete cleanup work, which in some cases moved up project completion dates by 15 years or more. For example, to meet the 2012 accelerated completion date for its solid waste disposition project, DOE's Idaho National Laboratory assumed it would process waste at a rate that was more than 50 percent higher than the rate demonstrated at the time it established the baseline. When the laboratory could not meet that processing rate, DOE revised its baseline, adding 4 years and about $450 million to the project. Also, most of the 10 projects had cost increases and schedule delays because the previous baselines (1) had not fully foreseen the type and extent of cleanup needed, (2) assumed that construction projects needed to carry out the cleanup work would be completed on time, or (3) had not expected substantial additional work scope.

DOE has not effectively used management tools—including independent project baseline reviews, performance information systems, guidance, and performance goals—to help oversee major cleanup projects' scope of work, costs, and schedule. For example, DOE's independent reviews meant to provide reasonable assurance that a project's work can be completed within the baseline's stated cost and schedule, have not done so for 4 of 10 projects. For one project, the baseline was significantly modified as little as 7 months after it had been revised and validated by the independent review, while other projects have experienced life cycle cost increases of as much as $9 billion and delays of up to 10 years, within 1 to 2 years after these reviews. In addition, although DOE uses several types of reporting methods for overseeing cleanup projects, these methods do not always provide managers with the information needed to effectively oversee the projects or keep Congress informed on the projects' status. For example, sites' proposals for changes to projects' cost and schedule baselines do not always identify possible root causes, and DOE does not systematically analyze the proposals for common problems across its projects. Therefore, DOE may be missing opportunities to improve management across projects. In addition, guidance for key management and oversight functions are spread across many different types of documents and are unclear and contradictory. As a result, project managers do not consistently implement this guidance, which may lead, for example, to problems in effectively managing risks across projects. Finally, DOE recently changed its goals for "successful" cleanup projects, reducing the amount of work and raising the allowable cost increases against the near-term baseline. DOE has initiated several actions to improve project management, but it is too early to determine whether these efforts will be effective.

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Abbreviations

Army Corps	Army Corps of Engineers
DOE	Department of Energy
EM	Office of Environmental Management
EVM	earned value management
OECM	Office of Engineering and Construction Management
OMB	Office of Management and Budget
QPR	quarterly project review
WTP	Waste Treatment Plant

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United States Government Accountability Office
Washington, DC 20548

September 26, 2008

The Honorable Peter J. Visclosky
Chairman
The Honorable David L. Hobson
Ranking Member
Subcommittee on Energy and Water Development
Committee on Appropriations
House of Representatives

The Department of Energy (DOE) spends billions of dollars annually to clean up nuclear wastes at sites across the nation that produced nuclear weapons. Cleanup projects decontaminate and demolish buildings, remove and dispose of contaminated soil, treat contaminated groundwater, and stabilize and dispose of solid and liquid radioactive wastes, among other things. DOE's Office of Environmental Management (EM) currently oversees more than 80 of these cleanup projects, primarily at government-owned, contractor-operated sites throughout the nation. Some of these highly complex projects have completion dates beyond 2050. Ten of these projects meet or nearly meet DOE's definition of "major": projects whose costs exceed $1 billion in the near-term—usually a 5-year window of the project's total estimated life cycle.[1],[2] These 10 projects have combined estimated near-term costs of almost $19 billion and combined life cycle costs estimated to range between $115 billion and $143 billion, and they account for almost half of EM's $5.5 billion fiscal year 2009 budget request.[3] These 10 projects are described in detail in appendix II and include the remediation, decontamination, and decommissioning, or the stabilization and disposition of:

[1]For this review, we lowered the threshold to $900 million out of concern that some projects not now considered major would become major because of increases in costs, which resulted in the addition of one project to our review (the solid waste stabilization and disposition project at the Hanford Site, near Richland, Washington).

[2]We did not review one major project still in the early stages of development (the nuclear facility decontamination and decommissioning project in Portsmouth, Ohio).

[3]DOE defines life cycle costs as the sum total cost of the direct, indirect, and other related costs incurred or estimated to be incurred in the design, development, production, operation, maintenance, support, and final disposition of a major system over its anticipated useful life span.

- solid waste at Idaho National Laboratory, Idaho;
- nuclear facilities at the East Tennessee Technology Park, Oak Ridge Reservation, Tennessee;
- nuclear materials at the Savannah River Site, South Carolina;
- radioactive liquid tank waste at the Savannah River Site, South Carolina;
- soil and water at Los Alamos National Laboratory, New Mexico;
- nuclear materials at the Hanford Site, Washington;
- solid waste at the Hanford Site, Washington;
- soil and water at the Hanford Site, Washington;
- nuclear facilities at the River Corridor Closure Project, Hanford Site, Washington; and
- radioactive liquid tank waste at the Office of River Protection, Hanford Site, Washington.[4]

DOE established Order 413 in 2000 to provide project management guidance for construction projects—projects that build large complexes often housing unique equipment and technologies that process waste or other radioactive material—and nuclear waste cleanup projects.[5],[6] In 2005 and 2007, EM, in conjunction with DOE's Office of Engineering and Construction Management (OECM), issued further guidance to better tailor the order's requirements to the cleanup projects. This guidance lays out protocols directing DOE project managers to establish a life cycle

[4]Hanford's radioactive liquid tank waste stabilization and disposition project is administered by the Office of River Protection, while the other four major cleanup projects at Hanford are administered by DOE's Richland office.

[5]Order 413.3 was issued in 2000 and amended in 2006, and is now referred to as 413.3A. For this report, we use DOE Order 413 to refer to the order in effect, unless otherwise specified.

[6]We have reported on DOE's management of these construction projects. See GAO, *Department of Energy: Major Construction Projects Need a Consistent Approach for Assessing Technology Readiness to Help Avoid Cost Increases and Delays*, GAO-07-336 (Washington, D.C.: Mar. 27, 2007).

baseline for cleanup projects that includes three key parts: (1) prior year actual costs; (2) a near-term estimate of the scope of the cleanup work (the cleanup activities needed to achieve project goals), cost, and schedule of the cleanup activities (the near-term is generally for 5 years, or the duration of the contract, whichever is longer); and (3) out-year estimates through project completion for those projects that extend beyond the near term.[7] The near-term and out-year estimates also identify the amount of contingency monies that could be needed to cover potential project risks.[8]

Major cleanup projects take years to complete, and often involve unique challenges and a high degree of complexity; therefore, it is critically important that EM develop and implement a rigorous, disciplined approach for developing and managing the baselines. Such an approach includes planning and managing work activities, cost, and schedule to achieve project goals in a stable, controlled manner over the near term and the entire life of the project. DOE has taken several steps to establish such an approach, including the following:

- EM must formally approve changes to the near-term and life cycle baseline.
- Project managers must provide formal and informal reports to DOE headquarters staff, including data entries into databases and quarterly performance reports. These reports contain, among other things, earned value management (EVM) data—a measure of progress against a cost and schedule baseline. Widely used in industry, earned value data makes it possible for managers and others to determine how a project has been performing and to predict future performance trends. Furthermore, both the Office of Management and Budget (OMB) and DOE Order 413 require

[7]In previous years, DOE presented out-year estimates as a single point estimate based on the most probable cost and schedule of its projects. In 2007, DOE developed out-year estimates with cost and schedule ranges to account for the uncertainty associated with long-term projects. The low end of the range is based on the amount of funding needed with a 50 percent level of confidence that the project will be successfully completed, while the high end of the range is based on an 80 percent level of confidence. As discussed elsewhere in this report, DOE does not fund its contingency accounts for these projects.

[8]Contingency funds are funds that may be needed to cover potential cost increases stemming from a variety of project risks, including technical complexities, regulatory issues, and funding shortfalls.

the use of EVM data, and GAO has developed best practices on how to use the data.[9]

- As stipulated in DOE Order 413, OECM must independently review project baselines at critical project stages; OECM conducts these reviews largely with the help of external technical experts. Specifically, for cleanup projects that cost $100 million or more, OECM must review a project's proposed baseline to provide reasonable assurance that the project can be successfully executed. OECM also examines technical scope, cost, schedule, and avoidance and mitigation plans for possible cost and schedule overruns, as well as proposed project management.

Overall, we and others have reported over the past two decades that project management weaknesses have impaired DOE's major projects. In 1990, we designated DOE's contract management (which includes project management) as a high-risk area for fraud, waste, abuse, and mismanagement. In addition, in 1999, the National Academies' National Research Council developed recommendations to address weaknesses in DOE's project management. Recently, in 2007, we reported that DOE had improved its approach to project management but that performance on DOE's projects had not substantially improved.[10] Also in 2007, the National Academy of Public Administration reported specifically on EM's management of nuclear waste and complimented EM on its improvements in project management, but also raised questions about EM's ability to follow through on them. Furthermore, reviews by DOE's Office of Inspector General, the Department of Defense's Army Corps of Engineers (Army Corps), and the National Research Council, among others, have advised DOE on how to better manage its major projects.

In this context, you asked us to determine the (1) extent to which the cost and schedule for DOE's major cleanup projects have changed and the key reasons for these changes, and (2) factors that may hinder DOE's ability to effectively manage these cleanup projects.

To determine the extent to which DOE cleanup projects are experiencing cost or schedule changes and key reasons contributing to these changes,

[9]GAO, *Cost Assessment Guide: Best Practices for Estimating and Managing Program Costs*, GAO-07-1134SP (Washington D.C.: July 2007).

[10]GAO, *Department of Energy: Consistent Application of Requirements Needed to Improve Project Management*, GAO-07-518 (Washington, D.C.: May 11, 2007).

we spoke with DOE project directors and reviewed project management documents for 10 of EM's major cleanup projects—9 projects above the near-term $1 billion threshold, and 1 estimated to cost between $900 million and $1 billion over the near term. For our analysis, we examined the life cycle baseline reported as of the most recent contract awards or major contract modifications—which occurred between 2004 and 2007—and compared these baselines with the updated baselines at the time of our review (dollar amounts used in calculating cost increases are in fiscal year constant 2008 dollars). We conducted site visits and analyzed project documentation, such as project plans, independent reviews, contractor performance data, plans to avoid or mitigate project risks, and documents prepared to guide and control formal changes to the baseline. We also identified factors that may hinder DOE's ability to effectively manage projects in accordance with approved life cycle baselines primarily through a review of project documents and interviews with project officials. Because we and others have previously expressed concern about the data reliability of a key DOE project management tracking database—the Project Assessment and Reporting System—we did not develop conclusions or findings based on information generated through that system.[11] Instead, we collected information directly from project site offices and contractors. In addition, we spoke with officials from EM and OECM in Washington, D.C. We provided an interim briefing to the Subcommittee on the status of our work on April 3, 2008.

We conducted this performance audit from March 2007 to September 2008 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. Appendix I contains a detailed description of our scope and methodology.

Results in Brief

Nine of the 10 cleanup projects we reviewed have experienced cost increases and schedule delays in their life cycle baseline, ranging from

[11]See, for example, GAO, *Department of Energy: Further Actions Are Needed to Strengthen Contract Management for Major Projects*, GAO-05-123 (Mar. 18, 2005); and Civil Engineering Research Foundation, *Independent Research Assessment of Project Management Factors Affecting Department of Energy Project Success* (Washington, D.C., July 12, 2004).

$139 million for one project to more than $9 billion for another, and schedule delays ranging from 2 years to 15 years. These changes arose primarily because the initial baselines made schedule assumptions that were not linked to technical or budget realities, and the scope of work included other assumptions that did not prove true. Specifically:

- *Baselines were not linked to technical or funding realities*. The schedules for 8 of the 10 projects we reviewed were established in response to EM's 2002 effort to accelerate cleanup work, which in some cases moved up project completion dates by 15 years or more. EM wanted to complete cleanups earlier to better safeguard public health and the environment, among other things. However, these dates were not always tied to technical capabilities or likely funding realities. For example, to meet the 2012 accelerated completion date for its solid waste disposition project, DOE's Idaho National Laboratory assumed its waste treatment plant could process waste at a rate that was more than 50 percent higher than the rate demonstrated at the time EM established the baseline. When the waste treatment plant did not meet that processing rate, EM revised its baseline, deferring 4 years of cleanup work, which added about $450 million to the project. In addition, before April 2007, according to several EM officials, project managers were directed to establish cost baselines to meet the accelerated schedules without considering likely funding for the projects. As a result, most projects did not receive funding as planned for in the baselines, hindering their ability to complete the work on time. In April 2007, EM changed its strategy: It limited its funding for all sites and directed that future baselines be based on the expected budget for each site. In part because of this change, some completion dates were extended by as much as 15 years.

- *Baselines' scope of work included optimistic assumptions that did not prove true*. Most of the projects we reviewed also experienced cost increases and schedule delays because the initial baselines had (1) not fully anticipated the type and extent of cleanup that would be needed, (2) assumed that construction projects needed to carry out the cleanup work would be completed on time, or (3) assumed the scope of work activities needed to finish the project would not increase. For example, at a 1940s-era building being demolished at Oak Ridge as part of the nuclear facility decontamination and decommissioning project, the contractor found that the building was far more contaminated and deteriorated than first estimated and had to reinforce the structure in order to safely remove contaminated equipment before demolishing the building. Primarily because these activities had not been adequately anticipated in the baseline, project costs rose by $1.2 billion and completion was extended by 9 years, to 2017. Similarly, the baselines for four of the major cleanup

projects assumed that a related, major construction project would be completed on schedule and available for the cleanup project to use. For example, a 5-year delay in the completion of Hanford's major construction project—the Waste Treatment Plant (WTP)—was the most significant factor behind extending the radioactive liquid tank waste project's schedule by 10 years, and increasing its life cycle costs by $4.8 billion. The delay in WTP's startup date resulted in additional years required to store the waste in the tanks and then to operate the treatment plant.

DOE has not always effectively used management tools—including independent project baseline reviews, performance information systems, guidance, and performance goals—to help oversee major cleanup projects' scope of work, costs, and schedule. Specifically:

- DOE's independent reviews of project baseline estimates, meant to, among other things, provide reasonable assurance that a project's work activities can be accomplished within the baseline's stated cost and schedule, have not done so for 4 of the 10 projects we reviewed. The baselines for these 4 projects were significantly modified shortly after review, revision, and validation. For one project, the baseline was significantly modified as little as 7 months after it had been revised and validated based on the independent review, while other projects had experienced additional life cycle cost increases of as much as $9 billion and delays of up to 10 years, within 1 to 2 years after the baseline reviews. As a result, the usefulness of the independent baseline reviews is questionable when significant baseline changes occur very shortly after the reviews are completed.

- EM managers do not always receive the information needed to effectively manage major cleanup projects or provide detailed reports to Congress on the projects' status. First, sites' proposals for changes to cost and schedule baselines do not consistently identify reasons for the changes or possible root causes, and EM does not systematically analyze the proposals for common problems across its projects. As a result, EM may be missing opportunities to apply lessons learned across projects. Second, in certain cases, the use of EVM data did not conform to industry standards or best practices identified by GAO, in part because the data contained anomalies that skewed analyses or lacked important information on future staffing needs. Third, EM's quarterly performance reports neither consistently provide accurate information about a project's performance against the near-term baseline, nor do they include information about how current performance may affect the life cycle baseline. Finally, DOE's reports to Congress do not include important information that would aid oversight, such as the extent of and reasons for significant changes to near-term and life cycle baseline estimates. In contrast, Department of Defense reports to

Congress on acquisitions for major systems provide detailed information on significant cost and schedule changes and the reasons for those changes.

- Guidance for key management and oversight functions—such as project baseline development, risk management, and contingency funding—is not consolidated, and is contradictory and unclear. Consequently, project managers do not consistently implement this guidance. For example, DOE headquarters officials found that project managers are calculating contingency funding to cover project risks in their baselines in a variety of ways, leading to uncertainty regarding the total contingency funds needed to cover all cleanup projects.

- DOE recently changed its goals for the performance of cleanup projects. Before 2008, a major cleanup project was expected to achieve 100 percent of the scope of work in its life cycle baseline with less than a 10 percent cost increase in the project's life cycle baseline. However, according to EM's current cleanup project performance goal, the projects are successful if they achieve at least 80 percent of the scope of work in their near-term baselines with less than a 25 percent cost increase. The new performance goal permits up to 20 percent of the scope of work to be deferred from the near term to out years, creating a substantially greater risk that life cycle costs will continue to increase and that completion dates will be delayed. According to DOE officials, the agency adjusted performance goals primarily to account for the greater level of uncertainty inherent in cleanup projects. However, by lowering expectations for adhering to near-term baselines, DOE may inadvertently be creating an environment in which large increases to life cycle costs become not only more common, but accepted and tolerated.

- Over the past 2 years, EM has begun a series of efforts to better manage its projects and address long-standing problems. For example, under its "Best-in-Class" Project Management Initiative, EM senior managers have expressed a strong commitment to improving project performance, and under this initiative, EM contracted with the Army Corps to assess project management, and then identified 18 priority actions to correct known problems. Although these efforts are ongoing, EM has yet to combine them into a formal plan, and it is too early to tell whether these efforts will prove effective.

We are making a number of recommendations to the Secretary of Energy to improve management of major cleanup projects, including to report more complete information to senior DOE management and Congress so that they can be fully informed about project status and make informed

decisions about these projects; consolidate, clarify, and update guidance for managing cleanup projects; consolidate all planned and ongoing EM improvements into a comprehensive corrective action plan; and develop the independent baseline reviews to better assure that project work scope can be completed within the baselines' stated cost and schedule.

We provided a draft of this report to the Department of Energy for its review and comment. DOE agreed with our recommendations but provided some suggested changes to them, and provided specific comments on the overall report, which we incorporated as appropriate. We discuss DOE's comments in detail at the end of this letter. DOE also provided some technical comments, which we incorporated as appropriate. DOE's comments are provided in appendix IV.

Background

DOE oversees and implements its major cleanup projects through agreements with contractors who operate the nuclear weapons research and production sites and the cleanup projects at those sites. Some of EM's cleanup projects are located at DOE sites administered by the National Nuclear Security Administration, a separately organized agency within DOE.

EM's major cleanup projects involve efforts to clean up sites where nuclear weapons were produced and production waste stored.[12] EM's cleanup projects handle a wide array of waste types and levels of radioactivity and hazardous constituents, and can involve multiple activities to, among other things, retrieve, characterize, treat, package, store, transport, and dispose of the waste, as well as disassemble, treat, package, store, transport, and dispose of the contaminated containers or processing lines/equipment used for weapons production or for storing or treating the waste. Multiple EM cleanup projects can occur at a single DOE site responsible for a multitude of other noncleanup-related activities. The cleanup projects are organized generally around similar waste types and activities. For example, the soil and water remediation activities at each site are organized under one umbrella, as are the nuclear facility decontamination and decommissioning projects, and the radioactive liquid tank waste projects, among others. EM generally

[12]DOE defines a project as a unique effort that supports a program mission and that has defined points for starting and ending; is undertaken to create a product, facility, or system; and contains interdependent activities planned to meet a common objective or mission.

manages these similar work activities, grouped into a category known as a Project Baseline Summary, through numerical designations; for example, all activities for soil and water remediation are grouped under Project Baseline Summary 30. (See app. II for additional information on the 10 DOE major cleanup projects reviewed.)

Funding for and Costs of DOE's Major Cleanup Projects

Unlike construction projects, which are funded on a line item basis, cleanup projects receive funding through operating funds designated for each DOE site. In 2003, EM began applying project management principles contained in DOE Order 413 to these cleanup projects in order to apply more discipline and rigor in planning and expending these project funds, among other things.

A cleanup project can cost several billion dollars and its life cycle can span several decades. EM divides the life cycle baselines for its major cleanup projects into three distinct parts—prior year costs, near term (usually a 5-year period), and out year (through project completion). Life cycle costs for each project range from a low of almost $1.7 billion to over $44 billion, and some projects might not be completed until after 2050.[13] (See app. III for detailed information on the life cycle baseline costs for the 10 projects we reviewed.)

EM applies different approaches to managing these wastes, depending on the type and extent of contamination and the state or federal regulatory guidelines and milestones it needs to comply with. DOE has agreements with state and federal regulators to clean up sites, and the agreements lay out a framework for determining the cleanup standards to be met. Furthermore, because all projects have a certain degree of uncertainty, such as not fully knowing the condition of buried waste containers, EM needs to plan for this uncertainty and identify ways to prevent serious disruption to projects should problems arise. To address this uncertainty, DOE Order 413 requires project managers to identify contingency funds that may be needed to cover potential cost increases stemming from a variety of project risks, including technical complexities, regulatory issues, and funding shortfalls. Although EM project managers build contingency funding into their near-term and out-year estimates, EM management does not generally include funding in its budget requests to cover contingency for cleanup projects until after it is actually needed to address a problem;

[13]In current year dollars, and excluding EM contingency funding.

therefore, EM contingency for cleanup projects has been referred to as "unfunded contingency."

Earned Value Management for Tracking Work Progress

To be effective, program managers need information on program deliverables and on the progress made in meeting them. One method that can help program managers track this progress is EVM data. These data include, for example, detailed information on budgeted costs and actual costs for work scheduled and work performed, as well as forecasted costs at project completion. Among other things, EVM data can be used to compare (1) budgeted costs to actual costs and (2) the value of work accomplished during a given period with the value of work scheduled for that period. By using the value of work completed as a basis for estimating the cost and time to complete a project, EVM data should alert program managers to potential problems sooner than expenditures alone can.

As a key management tool, EVM has evolved from an industrial engineering concept to a government and industry best practice to better oversee programs. Both OMB and DOE Order 413 require the use of EVM. OMB Circular A-11, part 7, requires the use of an integrated EVM system across an entire program to measure how well the government and its contractors are meeting a program's approved cost, schedule, and performance goals. The American National Standards Institute and the Electronic Industries Alliance have jointly established a national standard for EVM systems.[14] Recognizing the benefits of having these national standards, OMB states in its 2006 Capital Programming Guide that major acquisitions that require product development are to require that contractors use an EVM system that meets the American National Standards Institute guidelines.[15] In addition, DOE Order 413 requires that projects with total cleanup costs of $50 million or more use an EVM system that complies with industry standards and is certified by DOE's OECM to comply with these standards.

[14]See, for example, ANSI/EIA 748 32 Industry Guidelines (American National Standards Institute/Electronic Industries Alliance Standard, Earned Value Management Systems, ANSI/EIA-748-A-1998 (R2002), approved May 19, 1998, revised January 2002).

[15]See OMB, Capital Programming Guide, II.2.4, Establishing an Earned Value Management System. The OMB requirements also are reflected in the Federal Acquisition Regulation at 48 C.F.R. subpart 34.2.

GAO also has developed EVM best practices that, when followed, can help project managers consistently develop and analyze EVM data to gain a complete and accurate understanding of project status. Among other things, our guidance on EVM states that (1) EVM data should not have data errors and anomalies that may skew and distort the EVM analysis, and (2) information such as staffing levels and the root causes of and corrective actions for cost and schedule variances should be reported through the EVM system.

Major Cleanup Projects Experienced Billions of Dollars in Additional Costs and Schedule Delays, Primarily because Initial Baselines Were Overly Optimistic

Nearly all the cleanup projects we reviewed have had cost increases and schedule delays in the life cycle baseline, as much as $9 billion for one project, and schedule delays of as much as 15 years for two projects. These cost increases and schedule delays occurred primarily because the previous baselines for these projects had schedule assumptions that were not linked to technical or budget realities, and other assumptions also proved to be overly optimistic.

Major Cleanup Projects' Costs Have Increased by Billions and Schedules Have Been Delayed by As Much As 15 Years

The estimated costs of the 9 of the 10 DOE major cleanup projects we reviewed have significantly exceeded original estimates, as table 1 shows.

Table 1: Changes in the Estimated Life Cycle Costs for DOE Major Cleanup Projects

Dollars in billions

Project	Previous life cycle cost estimate (year of estimate)[a]	Current life cycle cost estimate range[b]	Life cycle cost increase range[b]	Percentage increase range[b,c]
Solid waste stabilization and disposition, Idaho National Laboratory	$2.851 (2006)	$3.301 – $3.940	$.450 – $1.089	16% – 38%
Nuclear facility decontamination and decommissioning, Oak Ridge Reservation	1.907 (2004)	3.126 – 3.290	1.219 – 1.383	64 – 73
Nuclear material stabilization and disposition, Savannah River Site	7.487 (2004)	10.802 – 11.248	3.315 – 3.761	44 – 50
Radioactive liquid tank stabilization and disposition, Savannah River Site	11.909 (2004)	18.622 – 24.003	6.714 – 12.094	56 – 102
Soil and water remediation, Los Alamos National Laboratory	1.521 (2006)	1.660 – 2.425	.139 – .904	9 – 59
Nuclear material stabilization and disposition, Hanford Site	2.990 (2006)	3.387 – 3.412	.397 – .422	13 – 14
Solid waste stabilization and disposition, Hanford Site	8.219 (2007)	9.596 – 10.639	1.377 – 2.420	17 – 29
Soil and water remediation, Hanford Site	3.902 (2007)	5.623 – 5.759	1.721 – 1.857	44 – 48
Nuclear facility decontamination and decommissioning, Hanford Site[d]	4.762 (2006)	4.762 – 4.892	0	0
Radioactive liquid tank stabilization and disposition, Hanford Site	21.647 (2004)	31.048 – 39.694	9.401 – 18.048	43 – 83

Source: GAO analysis of DOE data.

[a]For purposes of this report, previous cost estimates are the life cycle cost estimates created at the beginning of the most recent contract period for operation of the DOE site or the most recent major contract modification or extension, which in many cases coincided with the beginning of the project's previous near-term baseline. Current life cycle cost estimates are based on the most recently approved near-term baseline, out-year planning estimate ranges, or both.

[b]EM recently began using cost estimate ranges rather than point estimates. According to EM officials, costs at the lower end of the ranges were estimated at the 50 percent level of confidence, while costs at the upper end of the ranges represent the 80 percent level of confidence. For this report, our analysis of cost change uses the lower end of the range, which excludes contingency, because contingency amounts can vary widely between projects and are not typically funded before they are needed.

[c]We calculated the percentage of cost increase on the basis of constant 2008 dollars to make them comparable across projects and to show real increases in cost while excluding increases due to inflation.

[d]As of August 2008, this project has not registered a cost increase. However, project officials told us that they expect to file a baseline change proposal increasing the life cycle cost by at least several hundred million dollars by the end of December 2008.

As the table shows, estimated costs increased from a minimum of $139 million for one project to more than $9 billion for another project. The smallest dollar and percentage increase—$139 million, or 9 percent—occurred at Los Alamos' soil and water remediation project, which is focused on cleaning up known or suspected chemical and radiological contamination in addition to treating soil and groundwater that was contaminated by this waste. This project, however, is expected to further increase its life cycle cost estimate. The largest dollar increase among the 10 major projects—more than $9 billion—was for Hanford's radioactive liquid tank waste project, which is expected to remove, treat, and dispose of more than 56 million gallons of high-level radioactive waste in 177 underground storage tanks. In fact, the other radioactive liquid tank waste project, at Savannah River, registered the second largest dollar increase—almost $7 billion. However, the largest percentage increase—about 64 percent—occurred at Oak Ridge's nuclear facilities decontamination and decommissioning project.

Table 2 shows that 8 of the 10 projects we reviewed experienced delays in scheduled project completion, ranging from 2 years to 15 years.[16]

Table 2: Changes in Estimated Project Schedules for DOE Major Cleanup Projects

Project	Previous completion date estimate[a]	Current completion date estimate[a]	Schedule change (years)
Solid waste stabilization and disposition, Idaho National Laboratory	2012	2016 – 2020	4 – 8
Nuclear facility decontamination and decommissioning, Oak Ridge Reservation	2008	2017	9
Nuclear material stabilization and disposition, Savannah River Site	2015	2024 – 2026	9 – 11
Radioactive liquid tank stabilization and disposition, Savannah River Site	2019	2032 – 2034	13 – 15
Soil and water remediation, Los Alamos National Laboratory[b]	2015	2015	0
Nuclear material stabilization and disposition, Hanford site	2016	2018 – 2019	2 – 3

[16]EM recently began using schedule estimate ranges rather than point estimates. According to EM officials, scheduled completion dates at the lower end of the ranges were estimated at the 50 percent level of confidence, while dates at the upper end of the ranges represent the 80 percent level of confidence. For this report, our analysis of schedule change uses the lower end of the range.

Project	Previous completion date estimate[a]	Current completion date estimate[a]	Schedule change (years)
Solid waste stabilization and disposition, Hanford site	2035	2050 – 2058	15 – 23
Soil and water remediation, Hanford site	2035	2050 – 2059	15 – 24
Nuclear facility decontamination and decommissioning, Hanford site	2019	2019	0
Radioactive liquid tank stabilization and disposition, Hanford site	2032	2042 – 2050	10 – 18

Source: GAO analysis of DOE data.

[a]For purposes of this report, previous project completion dates represent the estimates at the beginning of the new contract period for operation of the DOE site or the major contract modification or extension, which typically coincided with the beginning of the projects' current or previous near-term baseline. Current completion date estimates represent the most recently approved near-term baseline or out-year planning estimate ranges calculated at the 50 percent confidence level at the lower end of the range, to the 80 percent level of confidence at the higher end of the range. EM recently began using schedule estimate ranges rather than point estimates. For this report, our analysis of schedule change uses the lower end of the range.

[b]The June 2008 Baseline Change Proposal shows proposed costs associated with this project at the 80 percent confidence level would extend through fiscal year 2020.

As table 2 shows, the shortest delay is at Hanford's nuclear material stabilization and disposition project, while the longest delays—15 years—also are at Hanford: the soil and water remediation and the solid waste stabilization and disposition projects.

Overly Optimistic Baselines Contributed to Significant Changes in Projects' Life Cycle

The changes in schedule and costs occurred primarily for two reasons. First, initial project baselines were built on accelerated schedules that were not always linked to technical capabilities or available budgets, although EM has begun to tie its new baselines to anticipated funding. Second, the initial baselines included other assumptions that did not hold true, including conditions on the ground at the sites, expected completion dates for related construction projects, and activities that would be included in projects' scopes of work.

Baseline Schedules Were Not Linked to Technical or Funding Realities

The initial baselines for 8 of the 10 major projects we reviewed contained schedules that were influenced by an EM-wide effort to accelerate the office's cleanup work. In 2002, EM management worked with its sites and regulators to create new, earlier milestones for completing key cleanup projects and for closing entire sites to reduce the public health and environmental risks posed by the waste at these sites. Before this effort, some of the major cleanup projects were not estimated to complete work until the 2030s and 2040s. Under the accelerated schedules, four projects'

completion dates were moved up by 15 years or more, as was the case for the radioactive liquid tank waste stabilization and disposition project at the Hanford site; its completion date was moved from 2048 to 2028. The baselines containing the accelerated schedules—those generally created between 2003 and 2006—tied their work scope and funding assumptions to the completion dates and not necessarily to available cleanup technologies. For example:

- *Solid waste stabilization and disposition project at Idaho*. To meet its accelerated completion date of 2012—down from 2018—DOE's Idaho National Laboratory assumed its Advanced Mixed Waste Treatment Plant could process nuclear waste at a rate of about 8,500 cubic meters per year—more than 50 percent faster than the rate of about 5,400 cubic meters per year demonstrated when DOE established the baseline. At the time, because the plant had only recently begun operating, project staff lacked confidence that they could meet the processing rate. Moreover, the independent team reviewing the baseline reported that the rate was optimistically high. Nevertheless, DOE proceeded with the initial baseline, increasing the amount of unfunded contingency in its baseline and attempting to meet the optimistic rate by providing the contractor with performance incentives. Still, the processing rate has fallen short of baseline assumptions—it is currently roughly 6,000 cubic meters per year. To reflect this more realistic rate, DOE subsequently revised its baseline, adding 4 years to the project schedule and increasing costs by about $450 million.

- *Radioactive liquid tank waste stabilization and disposition project at Savannah River*. This project, in part, combines high-level radioactive waste stored in tanks at the Savannah River Site with melted glass and places it in canisters ultimately to be sent to a federal repository for disposal. DOE directed that the project's completion date be accelerated, from 2035 in its early planning documents to 2019 in the initial baseline. In order to make that date, according to project officials, they included some assumptions in the initial baseline they knew at the time would be difficult to realize. Specifically, they assumed that the project's waste processing facility could produce canisters consisting of up to 49 percent high-level waste—with the remaining space filled with melted glass—when at the time it had not been able to produce a canister containing more than 42 percent high-level waste with an existing technology while remaining within the acceptance criteria for the federal repository. Those criteria dictate specific characteristics, including durability and leachability for the glass-waste mixtures in the canisters. DOE has since adjusted these assumptions—the current waste processing plan assumes the canisters will contain 34 percent to 38 percent high-level waste using the existing

technology—contributing to the overall cost increase and schedule delay for this project.

These early baselines also were not tied to expected funding. According to several senior EM officials, before April 2007, project directors were instructed to create cost baselines to meet the accelerated schedules and their regulatory milestones without regard for the likely funding the projects could expect to receive. Consequently, the funding assumptions in the projects' baselines were higher than the amount of funding DOE requested each year. According to a senior EM budget official, these shortfalls required project managers to continually adjust cost and schedule baselines as projects moved work activities into the out years to accommodate the lower funding levels. For example, according to site officials at Oak Ridge, when DOE did not request the full amount of funding in the nuclear facility's decontamination and decommission project's initial baseline, the project could not complete all the work as planned. Project managers responded by pushing work activities into the out years, which contributed, in part, to the project's overall cost increase and schedule delay. Similarly, as noted in a recent DOE internal audit, according to Los Alamos officials, funding has not been sufficient to meet the site's regulatory commitments, and has been a concern since 2003, when the site manager said he was concerned that appropriate resources had not been identified to conduct the necessary environmental restoration activities.[17]

According to EM managers, they have implemented changes to the way baselines are created that address these problems. In April 2007, EM changed its policy for creating project baselines. Instead of tying baselines to the accelerated schedules and regulatory commitments with unconstrained funding, EM limited funding for its sites, directing that all future baselines be based on expected budget numbers generated for each site.

For three of the projects we reviewed, this change in direction resulted in deferral of work and schedule delays because the new funding levels represented significant reductions in what projects were planning on

[17]U.S. Department of Energy, Office of Inspector General, Office of Audit Services, *Audit Report: The Department's Progress in Meeting Los Alamos National Laboratory Consent Order Milestones*, DOE/IG-0793, April 2008.

receiving, and these projects were low on EM's priority list.[18] For example, Hanford's solid waste stabilization and disposition project's funding was reduced to the point where it will receive minimal funding for the next 4 years in order to allow full funding of Hanford's decontamination and decommissioning project at River Corridor, a higher priority. During this period, to comply with the funding levels provided, the project will maintain minimum activities to safeguard materials and will not advance its waste processing goals. As a result, according to project officials, life cycle costs for this project increased in some part to reflect a longer schedule and the additional costs of having to hire and train new workers in the future to complete a job that already was underway.

Not all sites have implemented these changes, however. EM's direction to all sites to create their baselines tied to the funding profile outlined in the June 2007 policy memo has not been applied to two of the major cleanup projects. The Hanford radioactive liquid tank waste stabilization and disposition project—the most expensive cleanup project—and the Los Alamos soil and water remediation project have not aligned their baselines with the funding targets. The Hanford project's baseline was validated just before the policy change took place and, for the period between 2009 and 2030, the baseline contains about $2.6 billion more than the funding targets.[19] Similarly, EM approved the baseline for the Los Alamos project even though it was not aligned with the funding targets. The baseline identifies a projected funding shortfall each year through 2012 that peaks at a cumulative $236 million in 2010. This shortfall does not include an additional $947 million in unfunded contingency. At the same time EM approved the baseline, it directed project managers at the site to change the baseline to bring its costs in line with the targets.

Another likely contributing factor to the cleanup projects' cost increases and extended schedules is DOE's practice of not including contingency funding in its annual budget requests for EM's cleanup projects. Specifically, EM has requested enough funding for its cleanup projects to ensure a 50 percent likelihood of completing the projects within the total estimated project costs. However, the requested amount generally has not

[18]EM's priority list is based on maximizing risk reduction. As such, it has ranked its activities in priority order, from highest to lowest, from stabilizing radioactive tank waste in preparation for treatment down to decontaminating and decommissioning excess facilities.

[19]Figures in this paragraph are in current year dollars.

included contingency funding, which project managers may have to use in order to complete a project on time by addressing risks that materialize during cleanup. For example, in 2007, the radioactive liquid tank waste project at Hanford had an unexpected spill of 85 gallons of radioactive material from one of its storage tanks; this spill required shutting down waste retrieval operations for 11 months in order to clean up the spill. Even though the retrieval operations represent a small percentage of the overall work scope ongoing at the project, the accident added at least $8 million to the retrieval cost for that one tank. Furthermore, in accordance with EM policy, projects are expected to account for the costs of such potential risks by increasing the amount of unfunded contingency in their near-term and life cycle baselines. Because funding for that contingency is not included in the budget request, however, increasing the amount of contingency funding in the near-term baseline is largely a paperwork exercise that has no active impact on preventing or solving problems or anticipating actions that could offset demonstrated slow progress.

According to a December 2007 report by the National Academy of Public Administration, EM's practice of not funding contingency for its cleanup projects has meant that EM has not had additional funding available to address emergency problems when they arise and therefore has either taken money from another project or extended the schedule of the work into future fiscal years to manage them. Furthermore, according to EM officials, by providing enough funding for its projects to ensure that they have a 50 percent chance of meeting their project cost and schedule baselines, EM recognizes that 5 of the 10 major projects are likely to miss their cost and schedule goals. In contrast, DOE funds its construction projects at a level that reflects a greater probability of success—80 percent—an amount that reflects the industry standard for such projects. According to senior EM officials, EM does not fund contingency for its cleanup projects because allotting enough funds to cover the costs of risks that may not materialize would constrain the amount of work EM could perform for the money it receives each year. However, in accordance with a recommendation from the National Academy of Public Administration, EM is evaluating its practice of not including contingency funding in its budget requests for cleanup projects.

Baselines Included Assumptions about the Scope of Work and Technical Challenges That Did Not Hold True

For most of the projects we reviewed, EM included assumptions in its baselines that (1) did not represent the conditions at some of the major projects, (2) did not sufficiently anticipate delays in the completion of related construction projects, and (3) the scope of work activities to be accomplished would not increase. Correcting these assumptions often led to changes in the scope of work, higher costs, and extended schedules.

First, for four of the projects we reviewed—Oak Ridge's nuclear facility decontamination and decommissioning project, Idaho's solid waste stabilization and disposition project, and Savannah River and Hanford's radioactive liquid tank waste stabilization and disposition projects—site conditions were worse than project staff originally estimated, leading to significant changes to the life cycle baseline.[20] For example, at the Oak Ridge project, because a 1940s-era building was far more contaminated and deteriorated than first estimated, DOE changed its cleanup plan and implemented a more extensive—and therefore more expensive—approach to tearing down the building. After a worker fell through a weakened floor, the contractor had to first reinforce the building's structure so that contaminated equipment could be removed safely. Primarily because project officials did not accurately anticipate the site conditions or the types of work activities necessary to safely conduct the work—despite multiple estimates generated by the contractor, DOE, and the Army Corps—this project's costs increased by $1.2 billion and significant amounts of work were delayed, extending the completion date by 9 years, to 2017.

Similarly, the initial baseline for the radioactive liquid tank waste stabilization and disposition project at Hanford assumed that 99 percent of the waste contained in the 177 storage tanks could be removed by using only one type of technology to retrieve the tank waste. However, DOE subsequently determined that almost half of the tanks contained a hardened layer of waste that could not be removed with the chosen technology and therefore a second technology was needed to remove this waste. Correcting the optimistic assumptions—adding the second technology and re-estimating the costs of retrieving waste from the tanks based on field experience gained—increased the baseline by more than $2 billion.

Second, delays in completing related construction projects directly contributed to schedule delays—and corresponding cost increases—for four of the cleanup projects we reviewed. Three of these projects are at the Hanford site in Richland, Washington. The initial baselines for these projects included assumptions that the major construction project there—the Waste Treatment Plant (WTP)—would be ready to begin operations in

[20]According to project officials, site conditions also were worse than estimated at Hanford's nuclear facilities decontamination and decommissioning project at River Corridor, although a baseline change proposal for the cost increase for this project had not been filed with EM headquarters at time of our review.

2011. In 2006, DOE extended the WTP construction completion date by 5 years, resulting in schedule extensions for three cleanup projects.[21] The major cleanup project that will run the WTP—the radioactive liquid tank waste stabilization and disposition project—had to increase its life cycle cost estimate by about $4.8 billion and extend its schedule by 10 years in order to safely maintain the waste storage tanks while the treatment plant is being built and to operate the plant for additional years, among other things. Similarly, in response to the WTP delay, the schedules for the solid waste stabilization and disposition project and the soil and water remediation project were extended by 15 years—increasing costs by more than $4 billion combined. These projects cannot complete their missions until the WTP has finished processing all of the liquid waste in the storage tanks. According to the currently approved baselines, the liquid tank waste project will complete its operations in 2042, and activities under the latter two projects are not expected to be completed until 2050.[22] However, as we recently reported, DOE has acknowledged that the start of waste treatment operations will be delayed by at least 8 years (from 2011 to 2019), not 5 years, which will likely affect further these projects' costs and schedules.[23]

Third, for three of the projects we reviewed, increases in work scope—the activities required to complete the project—contributed to cost increases and schedule delays. For example, a major contributor to the more than $3 billion cost increase and at least 9-year schedule delay at the nuclear materials stabilization and disposition project at Savannah River was DOE's approval of a new initiative in 2006 that added additional amounts of nuclear materials for the project's facilities to disposition, including materials from other DOE sites. Those facilities were originally scheduled to complete their mission in 2007—the new scope extended the mission

[21]In 2006 we reported on the primary causes of the cost and schedule increases at the WTP, some of which echo the issues we found relative to the major cleanup projects: shortcomings in the contractor's performance, DOE management and oversight problems, and technical challenges that were more difficult to address than anticipated. GAO, *Hanford Waste Treatment Plant: Contractor and DOE Management Problems Have Lead to Higher Costs, Construction Delays, and Safety Concerns*, GAO-06-602T (Washington, D.C.: Apr. 6, 2006).

[22]These dates are based on a 50 percent confidence level. With 80 percent confidence, the liquid tank waste is estimated to extend until 2050, the solid waste project is estimated to complete in 2058, and the soil and water project is estimated to extend until 2059.

[23]GAO, *Nuclear Waste: DOE Lacks Critical Information Needed to Assess its Tank Management Strategy at Hanford*, GAO-08-793 (Washington, D.C.: June 30, 2008.)

until 2019.[24] Similarly, Savannah River's other major cleanup project—radioactive liquid tank waste stabilization and disposition—also had significant scope added. Under a law passed in 2004,[25] DOE determined that the salt waste in its tanks is not high-level waste and therefore can be disposed of at the site instead of in a geologic repository. The law required DOE to consult with the Nuclear Regulatory Commission when making this determination. According to DOE, this consultation and the resulting changes to the cleanup process added significant scope to the project, causing DOE to lengthen the estimated time to close the 49 tanks at the site.

According to EM, most of the cost increases and schedule delays experienced by the major cleanup projects were the direct result of unrealized aggressive planning assumptions. EM has since recognized that project baselines must be based on realistic technical and regulatory assumptions and be planned on the basis of realistic out year budget profiles. However, it appears that the practice of incorporating optimistic assumptions into project baselines has not yet been eliminated. As we recently reported, some of the underlying assumptions in the baseline for the Hanford radioactive liquid tank waste project may be overly optimistic.[26] For example, DOE assumes that the tanks will remain viable throughout what has become a protracted waste treatment process, with some tanks expected to remain in service more than 60 years longer than originally anticipated. This extended operation raises the risk of tank failure and leaks to the environment. The baseline also assumes that emptying single-shell tanks will proceed significantly faster than it has to date. Hanford project management officials have since acknowledged that the ambitious retrieval schedule might not be achievable and are adjusting their planning estimates.

[24]As we recently reported, DOE may identify additional nuclear materials to process through these facilities, which could delay the planned 2019 shutdown and increase operational costs. GAO, *Nuclear Material: DOE Needs to Take Action to Reduce Risks Before Processing Additional Nuclear Material at the Savannah River Site's H-Canyon*, GAO-08-840 (Washington, D.C.: July 25, 2008).

[25]Ronald Reagan National Defense Authorization Act for Fiscal Year 2005, Pub. L. No. 108-375 § 3116. This law resolved a lawsuit in which an environmental group alleged that DOE lacked authority to determine that particular wastes were not high-level waste.

[26]GAO-08-793.

DOE Has Not Effectively Used Available Management Tools to Help Control Major Cleanup Projects' Scope of Work, Costs, and Schedule

While DOE has several mechanisms in place to help manage cleanup projects, including independent reviews, performance information systems, guidance, and performance goals, it has not always used them to effectively manage major cleanup projects' scopes, costs, and schedules.

DOE's Baseline Reviews Highlight Problems but Have Not Succeeded in Ensuring Work Can Be Accomplished within Stated Cost and Schedule

OECM's independent reviews of the baselines, meant, among other things, to provide reasonable assurance that the project's work activities can be accomplished within the stated cost and schedule, have not done so for four of the projects we reviewed. Instead, these baselines were significantly modified shortly after approval. As a result, the usefulness of the independent baseline reviews is questionable when significant baseline changes occur very shortly after the reviews are completed, as the following discussion illustrates.

The advanced mixed waste treatment project under Idaho's solid waste stabilization and disposition project. OECM's 2006 independent review accurately noted that the project baseline submitted for validation for the treatment plant included an unrealistic rate for processing waste—more than 50 percent faster than the rate demonstrated at the time the baseline was established. In response, project officials proposed correcting the problem primarily by increasing the amount of unfunded contingency in the baseline, a move that reflected common practice within EM, and OECM officials approved this action and validated the baseline. As the panel predicted, the project's actual processing rate after its baseline was validated was slower than expected. Within 7 months of OECM's validation of the near-term baseline, project officials proposed modifying it. DOE had to defer the activities that the contractor was not able to accomplish in the near term, extending the project life cycle by about 4 years and increasing costs by about $450 million. We believe that DOE's approval of increasing unfunded contingency as a corrective action for an

unrealistic processing rate was ineffective.[27] Although DOE also attempted to increase the processing rates through contractor performance incentives, we believe DOE should have revised the baseline using a more realistic processing rate to calculate baseline cost and schedule before validating it.

Oak Ridge's nuclear facility decontamination and decommissioning project. Significant cost increases began 2 years before OECM's independent validation of the project in 2006, and have continued to increase. Specifically, life cycle costs for the project were estimated at $1.8 billion in 2004—the beginning of the project's previous near-term baseline—with expected project completion by fiscal year 2008. By August 2006, when OECM completed its review of the baseline and issued its validation recommendation, life cycle costs for the project had grown to about $2.2 billion and project completion was extended by about 1 year. However, roughly 1 year after OECM validated the baseline, EM revised it again, adding about $800 million in costs and delaying project completion by an additional 8 years. EM justified the change because, among other things, it wanted to adjust the baseline to conform to new funding targets as directed by DOE in June 2007 and to account for other changes it needed to make in its approach to decontaminating the building.

Los Alamos soil and water remediation project. In March 2008, EM approved an independent review of this project and the associated baseline although it expected that the baseline would change. According to the EM memorandum approving the baseline, changes in EM's priorities and funding plans were likely to necessitate changes to the Los Alamos project's baseline, and the project was directed to submit a baseline change that would align the baseline with funding targets. OECM officials also acknowledged that their independent review of the baseline was based on assumptions that would likely not prove to be true. Specifically, OECM's review assumed that the project would receive the full funding needed even though DOE's funding targets at the time were below the funding levels needed to comply with the state cleanup agreement. As a result, project officials expect that the estimated life cycle costs of nearly $1.7 billion will increase substantially during 2008 but could not tell us the

[27]DOE included $180 million (representing an additional 18 months of work) in its unfunded contingency for this project , which would have covered only part of the $450 million cost increase or the 4-year schedule delay experienced by the project.

extent of the cost and schedule change until they receive DOE's new funding commitments for the project.

Hanford's radioactive liquid tank waste stabilization and disposition project. The most significant cost increase—more than $9 billion—occurred about 2 years after DOE's initial independent review and approval of this project. The project's baseline was first approved in 2004, with life cycle costs expected to be about $22 billion and completion scheduled for 2032. However, in 2006, life cycle costs increased to about $31 billion—not including an additional $8.6 billion in unfunded contingency—and the completion date was extended by 10 years, to 2042. Project officials expect the baseline will require another update and independent review in 2009 to reflect anticipated changes as a result of the project's new contractor and because of changes resulting from ongoing negotiations with state regulators over regulatory agreement milestones.

In addition to changes to the baselines soon after the independent reviews, DOE has recently relaxed standards used for conducting these reviews. In 2003, DOE issued standard operating procedures for conducting independent reviews—primarily of construction projects. These procedures stated that baselines should be considered, once approved, as set in concrete. The EM-OECM 2005 protocol—and its 2007 update—for cleanup projects replaced the standard operating procedures and directed OECM to validate only the near-term baseline for cleanup projects while reviewing the life cycle estimate "for reasonableness." In this way, EM and OECM sought to acknowledge what they believe are the greater uncertainties present in the out-years of a cleanup project compared with a typical construction project. However, within a year of the 2007 protocol, OECM had changed its approach for EM cleanup projects from validating baselines to "certifying" them, which is a more limited statement of assurance than validation. Specifically, according to OECM officials, certification means that the near-term baselines are reasonable if near-term baseline costs are funded as outlined in the baseline and contingency funds are provided as needed. The change is intended to reflect OECM's belief that, because funding for cleanup projects is more uncertain than for construction projects, the same confidence level cannot, nor should, be applied to reviews of EM cleanup project baselines as it is applied to construction projects. Since EM headquarters does not consistently provide contingency funds for its cleanup projects, and half of the major projects have significant contingencies in their near-term baselines, the most likely result for projects experiencing problems is to extend schedules and increase life cycle costs. In commenting on a draft of this report, OECM stated it intends to go back to validating near-term baselines

for cleanup projects, assuming, in part, that funding becomes more stable and EM gains greater experience managing near-term baselines.

DOE Lacks Reliable and Consistent Performance Information

DOE managers depend on data about the performance of EM's major cleanup projects to make informed decisions about how best to handle unexpected events and manage shifting priorities. DOE site and headquarters staff generate a number of regular reports to update senior managers on the status of these projects, both to justify making significant changes to project baselines and to request funding from Congress. Although these reports provide valuable information to managers on the progress of work at cleanup sites around the country, they do not consistently provide the key information needed to make fully informed management decisions about EM's major cleanup projects. Specifically, (1) proposals for baseline changes do not consistently identify reasons for proposed changes or possible root causes that contributed to problems, (2) use of EVM data does not consistently conform to industry standards or GAO's best practices, (3) quarterly reports do not always describe the impact of contractor performance on near-term or life cycle costs and schedules, and (4) reports to Congress on the status of and changes to major cleanup projects are limited to a small snapshot in time and do not provide information necessary for effective oversight.

EM Baseline Change Reports Do Not Consistently Include Needed Information

When a project reaches a point at which it is likely to miss the goals in its baseline, project managers are required to propose changes to the project's cost, schedule, or scope baseline, a process that is akin to hitting the reset button. EM project managers request such a change by, among other things, documenting certain information in a Baseline Change Proposal report, including current approved costs and new proposed costs, proposed project start and end dates, and a justification for the changes. For the key change proposals we reviewed for the major cleanup projects, the information provided describing the changes and their impacts varied widely, with some projects providing little to no explanatory information about what led to the change and others explaining the causes of the changes in detail. For example, a change proposal for Hanford's nuclear material stabilization and disposition project simply described the project's scope of work and did not provide any explanation for why the project's schedule was being delayed by 3 years, while a proposal from Savannah River's radioactive liquid tank waste stabilization and disposition project included information on the causes for its cost and schedule changes, as well as the specific cost and schedule impacts of each cause. However, the change proposals we reviewed generally did not address the root causes that resulted in the changes to the baseline. For example, the Savannah River change proposal

explained that almost $500 million of the total proposed cost increase was due to revising the strategy for finishing the project. However, the proposal did not explain why this strategy needed revision. In investigating the reason for this proposed revision, we determined that a robust strategy for finishing the project was not included in the original baseline because the project was directed to meet a completion date of 2025 and could not do so if it included the thorough closure strategy. Without including this kind of information in the proposals, it would be difficult for EM managers to effectively identify the true causes of the baseline changes, take steps to address them, and transfer any lessons learned to other projects.

In addition, EM does not centrally gather and systematically analyze the narrative information in the baseline change proposals. We recognize that such information is not easily analyzed to identify common causes across projects. However, without such analysis, EM senior managers are potentially hindered in addressing problems collectively. One EM project management official agreed that having the ability to analyze the information in the change proposals across projects would be beneficial, but that his office had not yet made it a priority to collect this information because it was still addressing reliability issues with the data in the change proposals.

EM has made some effort to identify root causes of its project management problems. It recently participated in a DOE-wide effort to identify root causes of project and contract management problems in response to GAO's inclusion of DOE's contract management on its high-risk list.[28] However, DOE's analysis was focused more on construction projects than EM cleanup projects. The report notes that the emphasis of the effort was on the capital line item—construction—projects, but that several of the issues identified also are applicable to other projects, including EM cleanup projects.[29] According to one project participant from OECM, the participants discussed how some of the issues raised related to cleanup projects but they did not examine those projects as extensively as the construction projects. In commenting on a draft of this report, DOE explained that its analysis was based more on data from construction projects than EM cleanup projects because more data exist documenting DOE's past project management deficiencies for construction projects

[28]GAO, *High-Risk Series: An Update*, GAO-07-310 (Washington, D.C.: January 2007).

[29]DOE, *Root Cause Analysis: Contract and Project Management* (Washington, D.C., April 2008).

since those projects have a longer history of a structured, disciplined management process.

Use of Earned Value Data Does Not Always Conform to Industry Standards or GAO-Identified Best Practices

At three of the major cleanup projects—nuclear facilities cleanup at the Hanford Site's river corridor cleanup project, solid waste stabilization and disposition at Idaho National Laboratory, and soil and water remediation at Los Alamos National Laboratory—we found several instances in which the use of EVM data did not conform to industry standards or our best practices.[30] As a result, EM and site project managers using the data may be less able to make informed decisions to effectively manage these projects.

Data anomalies. For all three projects, the EVM systems we assessed contained data errors or anomalies that could potentially distort the analysis of EVM data. Anomalies included, for example, reporting negative actual costs or reporting costs that are not tied to work scheduled or performed. The Los Alamos EVM data contained both types of these anomalies, which may have distorted the results of data analyses by as much as $34 million, preventing managers from understanding the true status of project performance. According to project officials, the anomalies occurred primarily because Los Alamos had initially assigned costs to a general account, and waited up to several months before assigning these costs to the correct specific work activities. In another case, in a significant number of instances the contractor at Hanford's river corridor closure project reported costs incurred for work activities performed that had not been scheduled to start until future years, skewing the reported performance results.[31] The contractor explained that these data anomalies occurred because it had performed work sooner than originally expected—and therefore the work was not incorporated into the project's EVM planned schedule in the periods for which it was actually performed. Project officials at the site stated that they believe the EVM information, as reported, correctly represents the project's status. As such, the summary-level EVM data seem to depict a favorable schedule

[30]We conducted limited assessments of EVM data reliability, compliance with industry standards or our best practices, and other analyses at three of the five EM sites we visited, including data from the Hanford site's river corridor cleanup project, Washington; Idaho National Laboratory's advanced mixed waste treatment plant subproject (within the solid waste stabilization and disposition project), Idaho; and Los Alamos National Laboratory's soil and water remediation project, New Mexico.

[31]Specifically, we found elements where the contractor reported budgeted and actual costs of work performed without a corresponding work schedule.

performance in April 2008; however, our independent analysis of this data shows that when we removed the value of the work that was started and completed ahead of schedule, the remainder of the originally scheduled work was actually behind schedule in April 2008, and trends indicated that the variance was worsening.

Data on the availability of staff to perform future work was not always developed. For one of the projects we reviewed, the EVM system lacked important information on staffing, contrary to GAO-identified best practices. DOE officials at Los Alamos' soil and water remediation project told us they plan to begin asking for staffing information from the contractor, and contractor officials stated they are setting up a staffing report within their EVM system. Without this information, project managers lack important information necessary for ensuring that they have, or will have, an adequate number and type of staff to perform the upcoming scheduled work.

Reliability of earned value systems is questionable. OECM has certified that the earned value system used to report performance for only one of the three systems we assessed meets the required industry standards.[32] The EVM system used by the contractor operating the advanced mixed waste treatment project—a significant portion of the solid waste stabilization and disposition project at the Idaho National Laboratory—has not been reviewed by OECM to determine whether it is compliant with industry standards, and contractor officials stated they believed their system does not meet the standards. In addition, OECM was in the process of reviewing the system used by the contractor responsible for the soil and water remediation project at Los Alamos National Laboratory at the time of our review. As a result, these projects lack the necessary assurances that the EVM data were free of errors and anomalies that could skew and distort the EVM analyses.

Once a system is certified as meeting the standards, regular surveillance is needed in order to ensure its continued compliance. Surveillance allows managers to focus on how well a contractor is using its EVM system to manage cost, schedule, and technical performance, and is important

[32]OECM has certified that all of the EVM systems used by the contractors working on the 10 major cleanup projects are in compliance with the American National Standards Institute/Electronic Industries Alliance standard except that of the Advanced Mixed Waste Treatment Project contractor at Idaho and the major project at the Los Alamos National Laboratory.

because it monitors problems with performance and the EVM data. If these kinds of problems go undetected, EVM data may be distorted and not meaningful for decision making. OECM's surveillance program is under development: it recently hired one staff person to lead its surveillance efforts, and is developing a guide to better define its surveillance protocol. DOE also requires its sites to perform surveillance of EVM monthly contractor performance data, which includes developing EVM surveillance plans and conducting random EVM surveillance.

Furthermore, EM managers do not appear to consistently gather or analyze EVM data to maximize the data's benefits for project management. GAO best practices recommend that EVM system reports include thorough narrative explanations of any root causes of, or proposed corrective actions, for reported cost and schedule variances shown in the data. For the soil and water remediation project at Los Alamos, for example, EM did not require that this information be reported by its contractor. As a result, EM project managers at Los Alamos have not always received the information necessary for ensuring that effective corrective actions are implemented to prevent additional changes to the cost and schedule baselines. According to contractor officials, they reported information on root causes and corrective actions to EM routinely before fiscal year 2008, but DOE asked them to stop providing it. According to the project director for the soil and water remediation project at Los Alamos, the Los Alamos Site Office Assistant Manager had directed the contractor to not provide the variance reports as part of its project status reviews because the contractor's explanation of these variance reports during scheduled meetings was taking several hours to review and wanted instead to use the available time to focus more on risk management and other project issues. However, according to this site official, the site office's direction was not intended to discontinue all variance analysis reporting. Although the contractor discontinued including the variance analyses reports in its project status reviews, the project director stated that DOE continues to obtain information from the contractor by other means, such as cost performance reports and weekly contractor meetings at which DOE and the contractor discuss the root causes of variances that resulted in risks to meeting milestone compliance agreements. However, contractor cost performance reports we reviewed did not provide any narrative information on causes or corrective actions. Furthermore, the weekly contractor meetings discuss only certain root causes of the variances that resulted in risks to milestone compliance agreements and therefore are neither comprehensive nor documented. Because verbal information can easily be forgotten, lost, or misinterpreted, among other things, we believe that a written report would be a best practice.

In addition, EM projects report their EVM data to headquarters managers at the project summary level, which can mask problems occurring in the project that more detailed reporting could reveal. At Idaho, in early 2008, EVM data showed the solid waste stabilization and disposition project was performing ahead of schedule and under cost, although major problems had occurred at the advanced mixed waste treatment project—the primary subproject. Without EVM reports that contain more specific detail, project managers at headquarters may not recognize that a problem is occurring until it becomes large enough to recognize at the summary project level of reporting. In addition, greater detailed information provided to managers earlier in the project potentially could allow for early intervention.

Beyond more detailed reports, some project managers in the field and at headquarters have not always systematically reviewed or independently analyzed the EVM data they received, which also would help improve their understanding, as well as mitigate potential problems occurring within a project. At one site we visited, the DOE official receiving the data said he did not analyze the information before entering it into the EM headquarters database. In turn, headquarters EM project managers told us they also do not analyze the EVM data the projects report. One oversight official indicated he would prefer to analyze the information he receives from the projects but he did not have the time required to do so. A senior EM project management official told us that he recognizes this deficiency and is working to address it: EM intends to pilot a new software package that will allow managers to analyze EVM data. According to EM, the software will enable EM managers to drill down into the EVM data received from the contractors, thus improving their oversight capabilities. In addition, according to EM project management officials, EM has insufficient federal staff to conduct oversight, which is being addressed as part of an ongoing effort to improve project management. In commenting on a draft of this report, EM stated it also intends to provide additional EVM training for its analysts.

Quarterly Reports Do Not Present a Comprehensive Picture of Performance against Near-Term or Life Cycle Commitments

In accordance with Order 413, EM senior managers, including the Assistant Secretary, receive quarterly updates on the status of the major cleanup projects. Two key reports are the quarterly project reviews (QPR), generated by EM project managers, and a quarterly project status report created by OECM. These reports contain contractor performance data and information about new or ongoing issues that need addressing at the sites, but do not always describe how contractor performance affects performance against the near-term or life cycle baselines. Without this information, managers cannot develop a comprehensive assessment of progress against agreed-upon goals.

The QPRs and OECM quarterly reports we reviewed largely use EVM data to assess project performance, but these data only reflect performance against the current contract period. Current contract period start and end dates do not line up with the start and end dates of the near-term baselines for any of the major cleanup projects we reviewed, and contract goals have not always been tied to what would be necessary to meet near-term baseline goals.[33] For example, we found the EVM data for Idaho's solid waste stabilization and disposition project—including the advanced mixed waste treatment subproject—that was reported in the QPRs and OECM quarterly reports from early 2008 did not line up with the near-term baseline because the advanced mixed waste treatment project's contract period was not the same as the near-term baseline period, which ends in 2012. EVM data for this project are reported as a combination of work done by two contractors: disposal of low-level and mixed-low-level waste, among other things, by the major site contractor, whose contract runs through 2012, and the advanced mixed waste treatment project operations contractor, who, in early 2008, was operating under a contract extension that expired in April 2008, 4 years shy of the end of the near-term baseline. In addition, according to project officials, the goal of processing 15,500 cubic meters of waste contained in that contract extension was not based on what was necessary to meet the near-term baseline goal of processing 65,000 cubic meters of waste by 2012, which was DOE's commitment at the time of the extension. Since the advanced mixed waste treatment project's activities make up about 75 percent of the cost baseline for the overall project, EVM data for this project as reported in the QPRs and OECM quarterly reports were not an accurate indicator of how the project was performing against the approved near-term baseline. DOE has further extended the advanced mixed waste treatment project contract through September 2009, and project officials explained the current extension is better linked to the current baseline, meaning EVM data reported should represent a better indication of performance against that baseline.

In addition, although the QPRs we reviewed include data on current life cycle cost and schedule estimates, they do not always include information about changes to the schedule or scope, nor do they explicitly mention when a change to the baseline has been proposed. Instead, the QPRs generally present information on life cycle cost increases and provide

[33]Contract start and end dates for the major cleanup projects do not match near-term baseline start and end dates. Furthermore, EVM data at Los Alamos is reported only against the current fiscal year, not against the full contract period or the near-term baseline.

comparisons to original baselines. QPRs also contain a schedule for each project detailing key milestones and expected end dates. However, when a change to a project completion date is made, the schedule shown in the QPR in most cases does not preserve the original completion date as a point of comparison. Similarly, there does not appear to be any mechanism in the QPR to present a change in a project's scope of work, for example, a move of some work activities from the near term into the out years. As a result, the reports tell only that life cycle costs have increased, but corresponding changes to schedule and scope are not apparent. Furthermore, there is no clear place in a QPR for a project manager to mention that a baseline change proposal has been submitted to headquarters if the results of that proposal are not yet presented in the life cycle cost or schedule information in the report. Including mentions of pending change proposals may help ensure senior managers clearly understand the true state of a project's performance.

A key performance indicator used in OECM's quarterly reports also may create the impression that a project is performing well overall when it is in fact encountering problems. As directed in the 2007 protocol for cleanup projects, OECM uses a traffic light indicator—red-yellow-green—as an at-a-glance way to highlight developing problems for DOE managers. This indicator is intended to represent expected performance against the approved near-term baseline and is based largely on EVM data. However, since projects encountering problems tend to manage those problems by moving work scope into the out years, the effects of problems occurring today show up as increases to out-year cost and schedule estimates and not as increases or delays in a near-term baseline.[34] Therefore, a project rated "green" by OECM may simultaneously be experiencing increases in overall life cycle costs and delays in project completion. OECM officials agreed that it would be beneficial to present projected impacts of current performance on life cycle estimates wherever practical in its reports.

EM Does Not Report Information about Significant Changes to Near-Term and Life Cycle Baselines to Congress

DOE's reports to Congress do not include key information that would aid oversight efforts, including the extent of and reasons for significant changes to near-term and life cycle baseline estimates, and the status of estimated life cycle costs. DOE's annual budget request to Congress for fiscal year 2009 for EM included funding requests for each site and each project, as well as the funding appropriated in fiscal years 2007 and 2008.

[34]In commenting on a draft of this report, EM indicated that scope deferrals or changes to the near-term baseline must now be formally approved by EM management.

The budget request also contains, among other things, descriptive information about the sites and projects, including EM's major cleanup projects, and about cleanup goals, regulatory frameworks, and key uncertainties. However, the request did not provide any project-specific life cycle costs or completion dates.[35] In the previous three budget requests, EM had provided life cycle costs and planned completion dates for each project. Without this information, Congress cannot know what progress each project has made and the extent of work still needed, cannot understand how the project may be changing and has changed over time, and cannot know whether the project experienced problems since the previous budget request and the reasons for these problems. The absence of this information makes it more challenging to effectively oversee the department and its major cleanup projects.

DOE has not been directed to provide such information about its major cleanup projects to Congress. In contrast, Congress has required the Department of Defense to report annually on its major defense acquisition programs—those costing $2 billion or more and typically consisting of a weapons system, such as Navy ships or fighter planes—or report quarterly when programs are experiencing significant cost increases or schedule delays.[36] Congress established the reporting requirement to improve oversight of these defense programs by providing visibility and accountability for any growth in cost that may occur. Known as Selected Acquisition Reports, each annual report includes information on full life cycle program costs, unit costs—the cost per plane or ship—and the history of those costs. A quarterly report also includes reasons for any change in unit cost or program schedule since the previous report, information about major contracts under the program and reasons for any cost or schedule variances, and program highlights. In addition, the Department of Defense includes development and procurement schedules, with estimated costs through program completion, in its annual budget justification submissions to Congress.

[35]DOE's fiscal year 2009 request for EM includes ranges of life cycle costs and completion dates at the site level.

[36]Major defense acquisition programs are those identified by the Department of Defense that require eventual total research, development, test, and evaluation expenditures of more than $365 million or $2.19 billion for procurement in fiscal year 2000 constant dollars.

DOE Guidance for Management and Oversight Functions Is Unclear and Not Implemented Uniformly across Sites

EM's key policies for managing its cleanup projects—including developing project baselines, managing risk, and planning for contingency funding—are not consolidated but spread across various guidance documents and memos and provide contradictory and confusing information. Although Order 413 serves as the overarching policy document for project management, according to EM, the order contains requirements that are unnecessary or expensive and awkward to implement for cleanup projects. EM thus has issued numerous memos outlining the way in which its project managers should implement the order. See table 3 for a list of key memos we identified that contribute to project management guidance and policy for EM cleanup projects.

Table 3: Key Policy Memos for EM Cleanup Projects

Date	Title	Source	Guidance provided
February 3, 2005	EM Contingency Policy	EM	Policy on funding contingency and preferred method for establishing contingency
June 23, 2005	Project Management for the Acquisition of Capital Assets—DOE Manual 413.3-1	DOE Office of Management, Budget and Evaluation	Requirements and guidance on implementing Order 413
July 10, 2006	Policies for EM Operating Project Performance Baselines, Contingency and Federal Risk Management Plans, and Configuration Control[a]	EM	Additional clarification and guidance on process and requirements to identify, develop, control, and validate EM baselines
July 28, 2006	Program and Project Management for the Acquisition of Capital Assets—DOE Order 413.3A	DOE	Project management guidance on acquisition of capital assets and environmental restoration projects
March 2, 2007	Risk Management Policy	EM	Statement of EM risk management policy
April 24, 2007	Protocol for EM Cleanup Project Performance Baselines and Conducting the External Independent Review or the EM Independent Project Review	EM and OECM	Governs review and validation of cleanup projects
June 25, 2007	Guidance for Implementing Baseline Changes to Reflect Funding Targets for Fiscal Year 2008 through the Out-Years	EM	Directed sites to develop baselines tied to specific funding targets provided
February 13, 2008	Configuration Control Process for Project Baselines	EM	Update on EM effort to put baseline under configuration control

Source: GAO's analysis of DOE information.

[a]Configuration control refers to efforts to manage and track any changes to work activities, costs, and schedules.

As the table shows, rather than having a consolidated source for guidance, EM project managers must consult multiple sources to determine how to correctly create a baseline or calculate contingency funding for a project. Furthermore, some of EM's guidance includes vague language and various exceptions to rules, which are likely to contribute to a project manager's difficulty in determining how to implement EM policy. For example, according to the April 2007 protocol for cleanup projects, once a contract is awarded and a detailed near-term baseline is developed, a follow-up independent review will be required if the baseline (1) exceeds the previously validated near-term baseline costs by 15 percent or more, (2) increases the schedule by a year, or (3) modifies scope significantly. The first two conditions for requiring a follow-up review are tied to fairly precise numbers—15 percent and 1 year—although there could be some question as to whether these numbers are to be applied to the original or reset baseline calculations, especially for projects that have been extended multiple times. However, the protocol provides no parameters for determining when the third condition, a "significant" scope modification, has occurred.

In addition, agency officials were not able to provide us with formal documentation of a significant shift in policy. As explained earlier, OECM recently shifted from validation to certification of the cleanup projects' near-term baselines. In response to our request for documentation of the switch to certification, OECM provided us with an e-mail from an OECM official to a DOE Inspector General auditor that defined certification and explained the reasons for the change. According to this e-mail, the change was made to acknowledge OECM's belief that EM cleanup projects should not be reviewed under the same standard as construction projects. The OECM official also directed us to DOE's fiscal year 2009 budget request for an explanation of the new approach. While the budget request includes a description of baseline certification, it neither mentions that the certification is a departure from the previous policy, nor does the request serve as an adequate means of communicating a significant policy change.

Furthermore, different guidance documents appear to be in conflict with one another. Specifically, EM's 2006 memo outlining its policy on contingency funding explained that DOE's risks associated with implementing a project are covered through contingency that is part of the "unfunded" portion of the baseline; that is, its funding is not requested or budgeted in advance of when it may be needed. However, a 2008 EM memo primarily concerned with explaining a new process for entering baseline changes into a database contains a description of the elements of a near-term baseline that includes a line for "other funded contingency,"

which has been interpreted by some EM officials as including DOE contingency. If, according to the 2008 memo, some DOE contingency should be funded—requested in advance—that memo directly contradicts the guidance provided in the 2006 memo. However, although the 2008 memo states it is updating the baseline change process, it does not specifically state that it replaces any part of the 2006 memo.

In part because of this confusion, project managers at cleanup sites have been implementing EM's contingency policy differently. According to EM officials, recent independent reviews have alerted senior EM officials to this inconsistent implementation of the policy guidance. The review teams found that the project managers were using a variety of methodologies to calculate the contingency for their projects. As a result, according to one EM official with expertise in contingency, managers were likely underestimating the amount of contingency needed for their projects. To address this problem, EM senior managers directed the creation of a contingency implementation guide to provide a definitive interpretation of existing EM policy on contingency, and this guide is expected to be issued in September 2008.

Furthermore, at least one of DOE's policies—on independent reviews of cost estimates—is not being implemented at all. According to Order 413 and the April 2007 protocol, an independent cost estimate—a top-to-bottom, independent estimate that serves to cross-check a cost estimate developed by project officials—should be developed as part of the OECM review process for major projects when "complexity, risk, cost, or other factors create a significant cost exposure for the Department." We believe that a review of a major cleanup project, given its level of expected spending over the near term, would meet the criteria for requiring an independent cost estimate. According to an OECM official, OECM has not performed an independent cost estimate for any of EM's major cleanup projects, primarily because OECM lacks the resources required to perform this type of rigorous estimate for the projects. Instead, OECM has taken a less rigorous and less expensive approach in its reviews—examining cost estimates generated by the projects but not producing a separate estimate for comparison.

According to DOE officials, it is addressing some of these guidance issues. By the end of September 2008, officials told us, DOE plans to replace its manual directing implementation of Order 413 with a series of 16 guides. The guides are expected to cover a range of project management issues, including risk management and contingency funding, with one guide providing direction on the management of EM cleanup projects. In

addition to the guides, as part of an EM-wide effort to improve project performance, EM has issued 18 recommended priority actions that contain additional EM-specific requirements for cleanup projects. It is unclear whether the guides and priority actions are expected to supplant all other guidance, or whether they will adequately address the challenge project managers face in determining the most up-to-date, comprehensive guidance to be followed.

DOE Recently Changed Expectations for Cleanup Projects' Performance

According to EM senior managers, EM cleanup projects are significantly different from DOE's construction projects in a number of ways. That is, it is harder in many instances to clearly define up-front requirements for cleanup projects, and there are more unknowns, especially since some of these projects are the first of their kind, with undefined scopes of work and significant risks scheduled many years into the future. Because of these differences and because it has said changing budget priorities may affect funding over time, DOE recently changed its performance goal—the amount of work to be accomplished and the cost margin for accomplishing that work—for EM cleanup projects to reflect a much larger margin of error than the performance goal set for construction projects.

Before 2008, a major cleanup project was measured against the same goal as a construction project: achieve at least 100 percent of the scope of work in its baseline with less than a 10 percent cost increase over the life of the project.[37] However, EM's current cleanup project performance goal applies only to the near-term baseline, and the projects now are considered to be successful if they achieve at least 80 percent of the scope of work in their near-term baselines with less than a 25 percent cost increase. The new performance goal permits up to 20 percent of the scope of work to be deferred from the near term to out years, which creates a substantially greater risk that life cycle costs will continue to increase and that completion dates will be delayed. As a result, for example, under this goal the four major projects each expected to cost more than $2 billion in the near term could increase their costs by $500 million each over that period and be considered successful. Furthermore, because a directed change—defined as a change caused by DOE policy, or regulatory or statutory

[37]As previously reported in GAO-07-518, in 2004 DOE began reporting performance information for EM cleanup projects against the same goal as the line-item construction projects. In late 2005, however, DOE switched to reporting performance only for those projects with validated cost and schedule baselines.

actions—already exempts projects from meeting the performance goals, creating a less stringent goal for EM cleanup projects further waters down the impact of having a performance goal in the first place. By lowering expectations for adhering to near-term baselines, DOE inadvertently may be creating an environment in which large increases to project costs become not only more common, but accepted and tolerated.

DOE Is Undertaking Efforts to Implement Project Management Improvements

EM is undertaking a number of efforts to improve its project performance and address long-standing problems. One such effort is EM's "Best-in-Class" Project Management Initiative through which EM leadership has committed to improving project performance. Under the initiative, EM contracted with the Army Corps to assess the current status of project management at EM headquarters and its offices. Using the Army Corps' analysis, EM identified a set of challenges it faced in executing its mission, which resulted in the creation of the 18 priority actions for it to undertake to address the challenges and implement its initiative. Those priority actions include, among others, completing DOE's project management guide, which is expected to bring all project management guidance documents under one umbrella document; establishing standard reporting formats for project updates produced by project managers, including QPRs; implementing new project management software packages, including those for EVM analysis; and better integrating its project and contract management activities. EM has developed a set of implementing steps and a summary of expected benefits for each priority action. According to EM, 10 of the priority actions are being implemented in fiscal year 2008, and 5 of those are scheduled to be completed by the end of that fiscal year. It appears that execution of the priority actions would create new tools and potentially enhance existing ones in EM's effort to improve its cleanup projects' performance. According to EM, full implementation of the priority actions will address many EM project management problems and deficiencies. However, since the actions are still being implemented, it is too soon to determine their effectiveness.

In addition, EM officials acknowledged that the actions they are implementing to improve the management of EM's overall cleanup efforts, including their Best-in-Class initiative and actions being taken in response to the 2007 National Academy of Public Administration report have not been formally documented into a specific, corrective action plan that includes performance metrics and completion milestones. These officials agreed that such a comprehensive plan would demonstrate a more integrated and transparent commitment to improving the management of EM's cleanup projects.

Conclusions

Cleaning up the nuclear weapons complex is a technically challenging and risky business. Even as DOE works to gain control of and better manage its major nuclear waste cleanup projects, cost increases and project delays continue to mount. Specifically, life cycle costs for EM's major cleanup projects have increased by cumulative $25 billion over the past few years and schedules have been extended by a combined total of more than 75 years, primarily because DOE had to adjust the optimistic baselines it created to accommodate the realities it has encountered at its cleanup projects.

Given the cost and complexity of the major nuclear cleanup projects, it is critically important that DOE fully use the tools it has developed—independent reviews, performance information systems, guidance, and performance goals—to better ensure that projects stay within established parameters for scope of work, costs, and schedule. Independent baseline reviews to ensure that the work promised can be completed on time and for the estimated cost appear to be a useful planning tool, but the significant changes that have occurred within years or even months of the baseline reviews and validations indicate that implementation of these reviews has fallen short. Furthermore, EM's site proposals for changes to cost and schedule baselines, quarterly performance reports, earned value data analysis and reports, and reports to Congress do not consistently provide accurate and comprehensive information on the status of projects, which undermines managers' and Congress's ability to effectively oversee projects and make timely decisions, such as targeting resources to particular projects or renegotiating cleanup milestones and other contract conditions. These problems are compounded by the lack of comprehensive and clear guidance for DOE project managers so that they consistently implement DOE management policies across the projects and EM's recently relaxed performance goals establishing the acceptable baseline change parameters for major cleanup projects. Although DOE has identified a number of improvements it intends to make to its project management approach, it is still in the early stages of implementing these improvements, making it too soon to assess the effort's full effect, and it has not yet formally documented all the improvements in a comprehensive corrective action plan.

Recommendations for Executive Action

So that DOE can better manage its major cleanup projects and more fully inform Congress on the status of these projects, we recommend that the Secretary of Energy direct the Assistant Secretary for Environmental Management to take the following five actions:

- Include in its budget request to Congress life cycle baseline cost estimate information for each cleanup project, including prior year costs, estimated near-term costs, and estimated out-year costs.

- Develop an approach to regularly inform Congress of progress and significant changes in order to improve EM's accountability for managing the near-term baseline and tracking life cycle costs. Similar to the Department of Defense's Selected Acquisition Reports, which include annual information on full life cycle program costs, among other things, EM's report, at a minimum should compare estimated near-term and life cycle scope, cost, and schedules with the original and subsequently updated baselines, and provide a summary analysis of root causes for any significant baseline changes.

- Expand the content of EM performance reports to describe the implications of current performance for the project's overall life cycle baseline, including the near-term baseline cost and out-year cost estimate, using, when appropriate, valid earned value data that conform to industry standards and GAO-identified best practices.

- Consolidate, clarify, and update its guidance for managing cleanup projects to reflect (1) current policy regarding independent baseline reviews and (2) the results of DOE's determination of the appropriate means for calculating and budgeting for contingency so that project managers can consistently apply it across nuclear waste cleanup sites.

- Consolidate all planned and ongoing program improvements, including those stemming from the Secretary's contract and project management root cause analysis corrective action plan, the Best-in-Class initiative, and the 2007 National Academy of Public Administration report, into a comprehensive corrective action plan that includes performance metrics and completion milestones.

Because independent baseline reviews have not always provided reasonable assurance of the stability of projects' near-term baselines or the reasonableness of the life cycle baselines, we recommend that the Secretary of Energy direct the Director of the Office of Management to take the following action:

- Assess the Office of Engineering and Construction Management's current approach and process for conducting baseline reviews of EM cleanup projects to identify and implement improvements that will better provide reasonable assurance that project work scope can be completed within the baselines' stated cost and schedule. Consider including in the

assessment process an analysis of past lessons learned and reasons for baseline changes, and an assessment of project affordability when conducting baseline reviews.

Agency Comments and Our Evaluation

We provided a draft of this report to DOE for its review and comment. DOE agreed with our recommendations but provided some suggested changes to them, which we incorporated as appropriate.

In addition, DOE provided some specific comments on our draft report. First, DOE stated that the report should provide a more balanced and accurate portrayal of EM's cleanup projects by including descriptions of ongoing initiatives, a number of which EM launched in recognition of the need for improvement, as well as providing better context of the challenges and constraints the department's cleanup program faces. The draft report included a brief description of EM's ongoing initiatives, including its Best-in-Class effort, and acknowledged many of the key challenges DOE faces while illustrating the factors contributing to changes in scope, cost, and schedule for its cleanup projects. We also acknowledged DOE's ongoing initiatives and progress in a 2007 report on project management.[38] In addition, DOE cited its successes in the cleanup of Rocky Flats and Fernald as evidence of its project management accomplishments. We commend DOE on its past performance in successfully cleaning up these sites, which has resulted in some lessons learned that DOE can apply to other cleanup efforts, as we reported in 2006.[39] Nevertheless, we found in this review that DOE has not always effectively used its management tools to help oversee the scopes of work, costs, and schedules for its present major cleanup projects.

Second, DOE stated that our draft report appears to confuse the term "baseline." It noted that there is only one project baseline—the near-term baseline approved by EM senior management—for which DOE should be held accountable. Our use of the term "baseline" in this report conforms to EM's guidance documents indicating a project's "lifecycle baseline" is composed of its prior year, near-term, and out-year costs. In addition, we disagree with DOE's assertion that it should be held accountable only for a project's near-term baseline. As we state in this report, since projects encountering problems have tended to manage those problems by moving work scope into the out years, the effects of problems occurring today

[38] GAO-07-518.

[39] GAO, *Nuclear Cleanup of Rocky Flats: DOE Can Use Lessons Learned to Improve Oversight of Other Sites' Cleanup Activities*, GAO-06-352 (Washington, D.C.: July 10, 2006).

show up as increases to out-year cost and schedule estimates and not as increases or delays in a near-term baseline. Therefore, if DOE's performance is measured solely on the basis of the near-term baseline, potentially significant cost and schedule increases would not be accounted for or transparent.

Third, DOE stated that one of our recommendations—to consolidate, clarify, and update its guidance for managing cleanup projects to reflect the results of DOE's determination of the appropriate means for calculating and budgeting for project contingency—could be more specific, and it outlined three contingency options. These options include (1) increasing the amount of contingency funding for cleanup projects to an 80 percent confidence level, the level budgeted for construction projects; (2) creating a general contingency fund available for project managers at DOE headquarters to dispense as needed to manage project risks; and (3) continuing with the current approach of not including contingency funding for cleanup projects in its budget requests—funding cleanup projects at the 50 percent confidence level—and changing its recently established performance goal. We recognize that managing project contingency is an important issue, and in fact note in our report that DOE's current approach is a likely contributing factor to cost increases and schedule delays for EM's major cleanup projects. While we did not specifically assess these three options in our report, DOE should continue to study the lessons learned from managing and budgeting contingency and select the option that would provide contingency funds in an expedient manner to better mitigate the impacts of cleanup project changes while minimizing the amount of unused contingency funding left over at the end of the fiscal year.

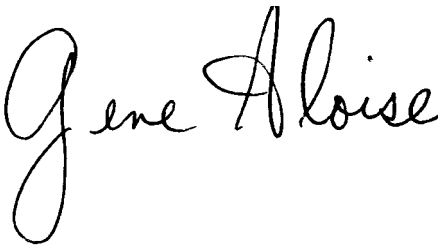
Finally, as part of the explanation of its third option for funding project contingency, DOE stated that GAO has agreed to its recently established performance goal—to accomplish at least 80 percent of the scope of work in the near-term baselines with less than a 25 percent cost increase. GAO has not agreed to this goal. As we state in this report, we are concerned with DOE's new goal given that it is lower than the previous goal for cleanup projects and that DOE may inadvertently be creating an environment in which large increases to project costs become not only more common, but accepted and tolerated.

DOE also provided detailed technical comments, which we have incorporated into our report as appropriate. DOE's comments are reproduced in appendix IV.

We are sending copies of the report to interested congressional committees, the Secretary of Energy, and the Director of the Office of Management and Budget. We will make copies available to others on

request. In addition, the report will also be available at no charge on the GAO web site at http://www.gao.gov.

If you or your staffs have any questions about this report, please contact me at (202) 512-3841 or aloisee@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Other staff contributing to the report are listed in appendix V.



Gene Aloise
Director, Natural Resources
and Environment

Appendix I: Scope and Methodology

To determine the extent to which the cost, schedule, and scope baseline estimates for the Department of Energy (DOE) Office of Environmental Management's (EM) cleanup projects have changed and the key reasons for these changes, we identified 10 major cleanup projects at 5 DOE sites. We first identified 9 major cleanup projects with current near-term cost estimates (usually a 5-year period) above $1 billion, the DOE threshold for major cleanup projects. In addition, to include those projects that could potentially become major projects because of cost growth, we reduced the threshold to $900 million and identified another project, the Richland nuclear material stabilization and disposition project, which is estimated to cost between $900 million and $1 billion over the near term. We focused on these 10 major cleanup projects because of their significant cost—combined estimated near-term costs of about $19 billion and combined life cycle costs estimated at more than $100 billion—and because they account for almost half of EM's $5.5 billion fiscal year 2009 budget request. (See app. II for information on these projects.)

To identify the factors that may hinder DOE's ability to effectively manage these cleanup projects, we spoke with DOE project directors and contractor officials and reviewed project management documents for the 10 major cleanup projects we had identified. We conducted site visits to Idaho National Laboratory, Los Alamos National Laboratory, Oak Ridge Reservation, Savannah River, and Hanford, and analyzed project documentation—contracts, policy directives and memoranda, project management plans, DOE's Office of Inspector General reports, independent reviews, project execution plans, risk management plans, quarterly project reviews, monthly project status reports, earned value management (EVM) surveillance plans, and project control documents prepared to guide and control formal changes to the baselines. For our analysis of projects' scope, cost, and schedule data, we examined the initial baselines reported as of the most recent contract award or major contract modification (which occurred between 2004 and 2007) and compared these baselines with the updated baselines at the time of our review. Initial cost baselines are the estimated life cycle costs at the beginning of the new contract period for operation of the DOE site or associated projects or the major contract modification or extension, which typically coincided with the beginning of the projects' current or previous near-term baseline. We also calculated the percentages of cost increases on the basis of constant 2008 dollars to make them comparable across projects and to show real increases in cost while excluding increases due to inflation. In addition, because EM now is reporting its life cycle cost and schedule estimates as ranges, we included these ranges in the report. However, because the upper ends of these ranges include unfunded

contingency and EM does not include funding in its budget requests for this contingency, we report cost increases and schedule delays based on the lower ends of the ranges.

We also analyzed contractor performance data to determine whether DOE major cleanup projects are consistently developing and analyzing accurate earned value data according to industry standards and best practices. We gathered and analyzed data produced by the EVM system used for one project at each of the following sites: Idaho National Laboratory, Los Alamos National Laboratory, and Hanford.[1] Often, EVM systems differ depending on how the contractor chooses to implement the EVM approach. Because of these differences, we gathered and analyzed information on each EVM system on a case-by-case basis, according to the structure, reporting format, content, and level of detail, among other things, unique to each EVM system. We also considered the best practices developed by GAO for estimating and managing project costs to analyze the contractor EVM data.[2]

In addition, we spoke with DOE officials from EM and the Office of Engineering and Construction Management in Washington, D.C., and with representatives from LMI Government Consulting, which conducts external independent reviews of the projects for DOE, to obtain their perspective on how these projects are managed.

Because we and others previously have expressed concern about the data reliability of a key DOE project management tracking database—the Project Assessment and Reporting System—we did not develop conclusions or findings based on information generated through that system.[3] Instead, we collected information directly from project site offices and the contractors.

[1]We did not analyze the EVM data for the Oak Ridge or Savannah River projects.

[2]GAO, *Cost Assessment Guide: Best Practices for Estimating and Managing Program Costs*, GAO-07-1134SP (Washington D.C.: July 2007).

[3]GAO, *Department of Energy: Further Actions Are Needed to Strengthen Contract Management of Major Projects*, GAO-05-123 (Washington, D.C: Mar. 18, 2005); and Civil Engineering Research Foundation, *Independent Research Assessment of Project Management Factors Affecting Department of Energy Project Success* (Washington, D.C.: July 12, 2004).

We provided an interim briefing to the Subcommittee on Energy and Water Development, House Committee on Appropriations, on the status of our work on April 3, 2008.

We conducted this performance audit from March 2007 to September 2008 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Information on the 10 Department of Energy Major Cleanup Projects Reviewed

Project	Project purpose and objective
Solid Waste Stabilization and Disposition, Idaho National Laboratory, Idaho (PBS 13)	This project will characterize, treat, and ship approximately 64,000 cubic meters of transuranic waste that will ultimately be stored in the Waste Isolation Pilot Plant in New Mexico. Transuranic waste is radioactive waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste with half-lives greater than 20 years, except for high-level radioactive waste. The transuranic waste that must be handled remotely through protective shielding, because it emits penetrating radiation, will be treated at the Radioactive Waste Management Complex. The project also will treat and dispose of a mixed low-level waste backlog and handle on-site low-level waste for disposal at the complex.
Nuclear Facility Decontamination and Decommissioning, Oak Ridge Reservation Tennessee (PBS 40)	The project will decontaminate and decommission approximately 500 facilities and remediate 160 sites in the East Tennessee Technology Park. This project includes the park's two major buildings—the K-25 and K-27 gaseous process buildings—and requires the contractor to remove processing equipment and excess materials stored in the buildings, demolish building structures, and dispose of all associated wastes.
Nuclear Material Stabilization and Disposition, Savannah River Site, South Carolina (PBS 11)	The project will stabilize and dispose of enriched uranium materials and current and projected inventories of aluminum-clad spent nuclear fuel in H-Area facilities. It also will stabilize and dispose of highly enriched uranium solutions, miscellaneous fuels, plutonium residues, enriched uranium residues, and other materials DOE identifies that remain from the production of nuclear weapons. The project also will deactivate F-Area and H-Area facilities; and dispose of special nuclear materials in the K-Area Complex.
Radioactive Liquid Tank Waste Stabilization and Disposition, Savannah River Site, South Carolina (PBS 14C)	The project will remove, treat, and dispose of 49 underground storage tanks holding a total of 37 million gallons of highly contaminated legacy waste This effort includes pretreating radioactive waste such as sludge and salt waste, vitrifying sludge and high-level waste at the Savannah River Site's Defense Waste Processing Facility, and treating and disposing of low-level saltstone waste.
Soil and Water Remediation, Los Alamos National Laboratory, New Mexico (PBS 30)	The project will identify, investigate, and remediate, when necessary, areas with known or suspected chemical and radiological contamination attributable to past Laboratory operations. It will investigate and clean up (as needed) approximately 860 solid waste management units and areas of concern remaining from the original 2,129 sites spread over approximately 39 square miles. The protection of surface water and groundwater resources that may be impacted by these management units and past Laboratory operations also are within the scope of this project.
Nuclear Material Stabilization and Disposition, Hanford, Washington (PBS 11)	The project will stabilize, package, and ship (to the Savannah River Site) nuclear materials and fuels used for the production of plutonium nitrates, oxides, and metal from 1950 through 1989 and now stored primarily in vaults in several facilities. The project will then clean and demolish the facilities.
Solid Waste Stabilization and Disposition, Hanford, Washington (PBS 13C)	The project will treat and store spent nuclear fuel, transuranic waste, mixed low-level waste, and low-level waste generated at the Hanford site and other DOE and Department of Defense facilities. It eventually will transfer and ship spent nuclear fuel elements and 1,936 cesium and strontium capsules to the proposed geologic repository in Nevada. The project also will operate, among other things, the (1) Waste Receiving and Processing Facility to process transuranic waste and low-level waste and (2) Central Waste Complex to store low-level and mixed-low-level waste and transuranic waste pending final disposition.

Project	Project purpose and objective
Soil and Water Remediation, Hanford, Washington (PBS 30)	The project will remediate contaminated groundwater. This effort involves characterizing the movement of radionuclides and chemicals (carbon tetrachloride, chromium, technetium-99, strontium, and uranium plumes); assessing the soil and groundwater characterization results; groundwater and risk assessment modeling; and operation of groundwater remediation systems among other related actions.
Nuclear Facility Decontamination and Decommissioning at River Corridor Closure Project, Hanford, Washington (PBS 41)	Also known as the River Corridor Closure Project, this project will remediate 761 contaminated waste sites at the Hanford site near Richland, Washington, and decontaminate, decommission and demolish 379 surplus facilities that are adjacent to the Columbia River. This project also will dispose of material in the Environmental Restoration Disposal Facility.
Radioactive Liquid Tank Waste Stabilization and Disposition, Office of River Protection, Hanford, Washington (PBS 14)	The project will retrieve, stabilize, treat, and dispose of 53 million gallons of radioactive mixed waste stored in 177 underground tanks at the Hanford site. The project also involves testing and implementing supplemental waste treatment methods; operating the Waste Treatment Plant; providing interim storage of immobilized waste planned for disposal in an offsite repository; receiving and disposing of immobilized low-activity waste on-site in near-surface disposal facilities; and closing tanks and tank farm facilities.

Source: DOE and EM information.

Appendix III: Current Life Cycle Baselines for 10 DOE Cleanup Projects

Dollars in millions (current year dollars)

Project	Prior years' costs	Near term[a] Cost	Near term[a] Years	Out years[b] Cost	Out years[b] Completion date	Total life cycle cost range
Solid waste stabilization and disposition, Idaho National Laboratory, Idaho	$1,398	$1,304	2006 – 2012	$530 – $900	2016 – 2020	**$3,231 – $3,954**
Nuclear facility decontamination and decommissioning, Oak Ridge Reservation, Tennessee	$1,546	$1,518	2008 – 2017	NA	NA	**$3,064 – $3,244**
Nuclear material stabilization and disposition, Savannah River Site, South Carolina	$3,631	$2,468	2008 – 2014	$3,728 – $4,358	2024 – 2025	**$9,827 – $10,457**
Radioactive liquid tank waste stabilization and disposition, Savannah River Site, South Carolina	$4,746	$4,394	2008 – 2014	$11,856 – $20,347	2032 – 2034	**$20,996 – $29,488**
Soil and water remediation, Los Alamos National Laboratory, New Mexico	$579	$1,051	2007 – 2015	NA	NA	**$1,630 – $2,489**
Nuclear material stabilization and disposition, Hanford site, Washington	$1281	$1,143	2008 – 2013	$1,030 – $1,060	2018 – 2019	**$3,453 – $3,490**
Solid waste stabilization and disposition, Hanford site, Washington	$1,163	$918	2008 – 2013	$11,200 – $12,500	2050 – 2058	**$13,281 – $14,594**
Soil and water remediation, Hanford site, Washington	$532	$1.128	2008 – 2013	$6,400 – $6,600	2050 – 2059	**$8,059 – $8,276**
Nuclear facility decontamination and decommissioning at River Corridor, Hanford site, Washington	$1,000	$3,751	2005 – 2019	NA	NA	**$4,751 – $4,910**
Radioactive liquid tank waste stabilization and disposition, Hanford site, Washington	$3,474	$2,330	2007 – 2012	$38,414 – 5$6,227	2042 – 2050	**$44,218 – $62,155**

Source: Office of Environmental Management.

[a]Near-term costs represent DOE's estimated costs based on a 50 percent level of confidence, defined as the amount of funding needed to provide a 50 percent likelihood that the project will be completed successfully.

[b]Out-year values represent DOE's estimated cost and schedule ranges—the cost range covers the full out-year period, while the schedule range represents the time during which the project is estimated to be completed. Costs and schedules at the lower end of the ranges were estimated at the 50 percent level of confidence, while costs and schedules at the upper end of the ranges represent the 80 percent level of confidence.

Appendix IV: Comments from the Department of Energy

Department of Energy
Washington, DC 20585

September 19, 2008

Mr. Gene Aloise
Director of Natural Resources and Environmental
U.S. Government Accountability Office
441 G Street NW
Washington, D.C. 20548

Dear Mr. Aloise:

Thank you for the opportunity to review the draft report on accountability and management of the Department's major cleanup projects managed by the Department of Energy's Office of Environmental Management (EM). We are in agreement with the recommendations you have provided, with some suggested changes, and look forward to reporting in the future on the progress being made. Detailed comments to the draft report are enclosed. Major comments are summarized below.

We believe the report should provide a more balanced and accurate portrayal of EM's cleanup projects by including descriptions of ongoing initiatives and actions, a number of which were launched by EM in recognition of the need for improvement. Additionally, the report should provide better context of the incredible challenges and constraints the Department's cleanup program faces and the difficulties associated with accurate predictions of project cost and schedule for the EM cleanup projects.

For instance, the Government Accountability Office's (GAO) conclusion in 2001 (GAO-01-284, *Nuclear Cleanup: Progress Made at Rocky Flats, but Closure by 2006 Is Unlikely, and Costs May Increase)* states that "Kaiser-Hill and DOE are unlikely to meet the December 2006 target closure date" for Rocky Flats and yet this closure date was indeed met by DOE and the Rocky Flats cleanup contractor Kaiser-Hill. As recommended by the GAO in 2006 (GAO-06-352, *Nuclear Cleanup of Rocky Flats: DOE Can Use Lessons Learned to Improve Oversight of Other Sites' Cleanup Activities),* EM used the lessons learned from Rocky Flats for other cleanup efforts across the complex to accomplish extremely successful cleanups. We won the Project Management Institute award for our prowess in project management in 2006 and 2007 for the Rocky Flats and Fernald cleanup projects, respectively.

There appears to be some confusion over the term "baseline". There is only one project baseline, the near-term baseline that has Critical Decision-2 approval by the Acquisition Executive, for which DOE should be held accountable. The

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Decision-1 type range) which is expected to change, often by significant amounts. For this very reason, DOE no longer expresses lifecycle information on cleanup projects as a point estimate.

Finally, the issue of how we fund and manage project contingency is critical to our long-term success and our ability to mitigate impacts of these changes. We recognize full well that we cannot continue to extend schedules and increase costs every time risks that have been identified and anticipated in advance occur. Your fourth recommendation, with regard to contingency, could be more specific. There are three primary or bounding contingency options as we see it, discussed further in the attachment:

1. **Fund operating cleanup project contingency at 80% confidence level instead of the current 50%.**
   If provided over and above current target levels, approximately $500 million (M) to $700M additional funding annually would be required. However, if risks did not materialize during the budget year, there would be higher uncosted year-end carryover. However, to plan for this level of contingency without additional funding would require deferral of lower priority project scope. To compensate, EM would need to renegotiate compliance milestones or possibly subject the federal government to fines, penalties, and lawsuits; renegotiate and possibly terminate contracts, thus affecting employment; and reprioritize its projects.
2. **Request appropriation of a smaller general contingency fund.**
   The fund (perhaps $100M to $200M annually) would be held, managed, and distributed by the Assistant Secretary for Environmental Management. This option would allow more flexibility and expediency in applying funds where they are needed as risks are realized, and would allow for multi-year business case decision-making. However, controls would need to be put in place on EM's allocation authority during execution so as not to usurp Congressional authority in appropriations.
3. **Continue the current approach of funding 50% confidence levels and changing the corporate metric for the EM cleanup projects agreed to by DOE, the Office of Management and Budget (OMB), and GAO.**
   This approach budgets for contingency at a 50% confidence level for cleanup projects. When risks not covered at this level materialize, work scope is shifted to the outyears when funds can be requested in light of overall program priorities. A 50% confidence level across the EM portfolio connotes that based on statistical analysis half the projects would be expected to be completed within the cost and schedule and half would not. Thus, this current approach appears to be inconsistent with achieving success in the corporate metric that DOE has agreed to with GAO and OMB for cleanup projects (established through DOE's Root Cause Analysis Corrective Action Plan, July 18, 2008). The metric requires that 90% of the projects in EM's portfolio at the end of the approved near-term

baseline period have 80% of the scope completed within 25% of the original cost.

Any GAO recommendations regarding new strategies are welcomed, given the regulatory-driven nature and complexity of this work, the sensitivity of life-cycle costs to relatively small slippages in scope (due to large "hotel" costs), and the need to deliver on commitments made to our regulators, the Congress, and other stakeholders.

Again, thank you for your assistance as we seek to improve our management of cleanup projects. We welcome direct dialogue with you on these issues prior to finalizing your report. We would also appreciate you including the attached comments in the final report. If you have any questions with regard to these comments, please contact me on (202)586-7709, Jack Surash on (202) 586-6382, or Paul Bosco on (202) 586-3524

Sincerely,

James A. Rispoli
Assistant Secretary for
Environmental Management

Enclosure

cc: I. Triay, EM-2
J. Owendoff, EM-3
J. E. Surash, EM-50
M. Sykes, EM-30
I. Kolb, MA-1
P. Bosco, MA-50

Appendix V: GAO Contact and Staff Acknowledgments

GAO Contact

Gene Aloise, (202) 512-3841 or aloisee@gao.gov

Staff Acknowledgments

In addition to the individual named above, Rudy Chatlos, Jennifer Echard, James Espinoza, Daniel Feehan (Assistant Director), Mike Gallo, Diane Lund, Mehrzad Nadji, Omari Norman, Brian Octeau, Christopher Pacheco, Leslie Pollock, Karen Richey, and Carol Herrnstadt Shulman made key contributions to this report.

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Attachment 8

"Memorandum for the Secretary"

United States Department of Energy

Office of Inspector General (April 23, 2001)

U.S. Department of Energy
Office of Inspector General
Case No. I01HQ005

REPORT OF INQUIRY:

Yucca Mountain Project

April 23, 2001

U.S. Department of Energy
Office of Inspector General
Washington, DC 20585

April 23, 2001

MEMORANDUM FOR THE SECRETARY

FROM: Gregory H. Friedman
Inspector General

SUBJECT: Special Review of the Yucca Mountain Project – Case No. I01HQ005

The effort to identify a suitable site for the disposal of the Nation's high-level nuclear waste and spent nuclear fuel is one of the most sensitive and complex challenges faced by the U.S. Government. Under the Nuclear Waste Policy Act, as amended in 1987, the Yucca Mountain site in the State of Nevada is the only site in the United States to be evaluated for this purpose. The Act established a formal, step-by-step methodology for making this evaluation. For the State of Nevada and all other interested parties, the process to evaluate Yucca Mountain as the potential repository has enormous implications. Perhaps paramount among concerns expressed is that the consideration and evaluation be objective, and based on sound and unbiased scientific analysis.

In December 2000, U.S. Senator Harry Reid and former Secretary of Energy Bill Richardson, in separate letters, requested that the Office of Inspector General determine whether the creation and circulation of certain documents during this process reflected bias in the evaluation of the suitability of Yucca Mountain. Part of this request included concerns that appropriated funds may have been used improperly for lobbying purposes.

The Office of Inspector General inquiry focused on the authorship, review and distribution of three documents: (1) multiple versions of the draft Site Recommendation Consideration Report; (2) multiple versions of the draft Overview to the Site Recommendation Consideration Report; and, (3) a 2-page Note, which was attached to one version of the draft Overview. The Report's stated purpose was to "...describe the results of site characterization, the waste forms to be disposed, the preliminary design of the repository and the waste packages, and the results of assessments of potential repository performance." Additionally, it served to provide "...a basis for public and stakeholder comments to be considered before any recommendation by the Secretary."

A summary of our findings follows:

1. We found that there were several statements in the draft Overview and the Note that could be viewed as suggesting a premature conclusion regarding the suitability of Yucca Mountain (page 8); and,

2. We could not substantiate the concern that bias compromised the integrity of the site evaluation process, or that the Department or its contractors considered a formal or informal strategy for supporting the site characterization recommendation in violation of the law (page 11).

Our conclusions, with respect to the Yucca Mountain evaluation process leading up to and including the draft Site Recommendation Consideration Report, are based on interviews of nearly 200 knowledgeable Federal and contractor officials; reviews of thousands of pages of relevant documents; and, our review of the activities of the Nuclear Waste Technical Review Board.

We coordinated this matter with the Public Integrity Section of the U.S. Department of Justice, which advised that the facts presented did not establish a potential violation of the applicable criminal lobbying statute.

Subsequent to our review of the documents cited above and the completion of our field work, we were informed that the Department decided that it would not release the Site Recommendation Consideration Report and the Overview. It is our understanding that the Office of Civilian Radioactive Waste Management now intends to issue a document entitled, "Yucca Mountain Science and Engineering Report." The stated purpose of this report is to "...describe the results of scientific and engineering studies completed to date, the waste forms to be disposed, the repository and waste package designs, and the results of the most recent assessments of the long-term performance of the potential repository."

From the outset, the focus on the Yucca Mountain site as the potential repository for the Nation's high-level nuclear waste has been controversial. Based on correspondence received by the Office of Inspector General, it is fair to observe that, at least in some quarters, public confidence in the Department's evaluation of Yucca Mountain has eroded. Under these circumstances, as the Department moves forward with the evaluation process, including the preparation and issuance of any new documents, we believe that the Department's senior managers should take the opportunity to: (1) re-affirm the commitment to a site suitability evaluation process which is objective, unbiased and based on the best possible science; and (2) review its internal and contractor processes to ensure that this objective is faithfully executed.

REPORT OF INQUIRY
(Case No. I01HQ005)

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I. SCOPE AND METHODOLOGY

The objective of our inquiry was to review allegations of potential bias within U.S. Department of Energy (Department) and contractor operations during the evaluation of the Yucca Mountain site, and concerns that appropriated funds may have been used improperly for lobbying purposes. The inquiry focused on the authorship, review and distribution of three documents: (1) multiple versions of the draft Site Recommendation Consideration Report; (2) multiple versions of the draft Overview to the Site Recommendation Consideration Report; and, (3) a 2-page note, which was attached to the October 2000 version of the draft Overview.

For the purposes of our review, the word "bias" was defined as an inclination or preference, one that interferes with impartial judgment. In this context, the Office of Inspector General developed working criteria to assist inquiry team members with identifying indicators of possible bias. The criteria included:

- Possible non-adherence or non-compliance with established statutory, procurement, and procedural guidelines;
- Unsupported or misrepresented information, direction, and positions with respect to specific issues or the project evaluation as a whole; and,
- Department or contractor formal or informal strategies for supporting, without basis, the site recommendation of Yucca Mountain.

The inquiry involved the review and analysis of numerous documents and the interview of nearly 200 witnesses across 16 states and the District of Columbia. Witnesses included Federal and contractor officials from the Department's Office of Civilian Radioactive Waste Management (OCRWM), Yucca Mountain Project Office, Office of General Counsel, and national laboratories. We also interviewed senior personnel from TRW Environmental Safety Systems, Inc. (TRW), and its subcontractors, each member and selected staff of the Nuclear Waste Technical Review Board, and senior staff of the Nuclear Regulatory Commission.

We identified and analyzed legislative, procurement, and procedural guidelines associated with the evaluation of Yucca Mountain. We also examined the procedures used by OCRWM and the Yucca Mountain Project Office for developing and authoring scientific studies and analytical and process model reports; initiating contract and other procurement related actions; developing and implementing quality assurance procedures and training; and, developing documents for internal and external consumption.

The Office of Inspector General did not perform an assessment of the validity of the technical and scientific analysis generated in association with the site evaluation process.

II. BACKGROUND

Under the Nuclear Waste Policy Act of 1982 (Act), the Federal Government assumed responsibility for providing for the permanent disposal of the Nation's civilian spent nuclear fuel and high-level defense radioactive waste. The Act adopted geologic disposal as the Nation's long-term strategy for managing radioactive wastes. It also created OCRWM within the Department and charged the Secretary of Energy with the siting, construction and operation of potential repositories for the disposal of this waste.

In 1987 the Act was amended, and the Department was directed to focus on Yucca Mountain to determine its suitability as the sole candidate for the repository. The amendment to the Act also established the Nuclear Waste Technical Review Board as an independent Federal agency, to evaluate the technical and scientific validity of the Department's efforts to study Yucca Mountain.

According to Section 114 of the Act, the Secretary of Energy is required to hold public site consideration hearings in the vicinity of Yucca Mountain at such time that the site is being considered for potential recommendation to the President of the United States. The Act establishes that the Secretary may consider recommendation of the site upon completion of site characterization and consideration hearings. If, upon completion of the hearings, the Secretary decides to recommend approval of the site to the President of the United States, the Secretary must notify the Governor and Legislature of the State of Nevada of the proposed decision. The Secretary must wait

30 days following notification to Nevada officials to submit a Site Recommendation Report to the President recommending approval of the site. If the President recommends the site to the U.S. Congress, and the site is approved, the Department may then apply to the Nuclear Regulatory Commission for a license to construct a repository at the site.

In May 1996, the Department initiated a 5-year program of work to support a decision by the Secretary by 2001, on whether or not to recommend Yucca Mountain as the repository site.

In 1999, OCRWM initiated development of the Site Recommendation Consideration Report, which is not mandated by the Act. TRW had primary responsibility for producing the report, and supporting data were compiled and written by assorted Department, contractor, national laboratory and other Government personnel. According to Fiscal Year 2000 through 2003 guidance from the Department to TRW, in preparation for the site recommendation consideration hearings, a report will be developed to inform the public, the States, affected Indian tribes, and other stakeholders. The guidance further states that information in volumes 1 and 2 of the report will be compiled and be subject to public review and comment. According to the Site Recommendation Consideration Report, it serves to "...describe the results of site characterization, the waste forms to be disposed, the preliminary design of the repository and the waste packages, and the results of assessments of potential repository performance. The information presented here provides a basis for public and stakeholder comments to be considered before any recommendation by the Secretary."

The Department and its contractors prepared annotated outlines jointly in the initial stages of the Site Recommendation Consideration Report's development, denoting the content and format of its various sections. The authors of these sections referred to compiled scientific and technical data when writing the Site Recommendation Consideration Report. Reviewers, separate and apart from the authors, identified errors in the sections and indicated where additional information was required or recommended.

The Site Recommendation Consideration Report initially consisted of two volumes, intended to describe the technical information pertaining to Yucca Mountain for use by the public and government officials during consideration hearings. A third volume was added to address concerns

by the Nuclear Waste Technical Review Board and others over remaining uncertainties as the program moved toward possible site recommendation. The Office of Inspector General was informed that the Site Recommendation Consideration Report was developed using seven key-supporting documents, including:

- Analysis and Modeling Reports;
- Process Model Reports;
- Repository Safety Strategy;
- System Description Documents;
- Preliminary Pre-closure Safety Evaluation;
- Total System Performance Assessment; and,
- Yucca Mountain Site Description.

In 2000, OCRWM initiated development of the Overview to the Site Recommendation Consideration Report. The Department tasked TRW to produce the Overview. TRW, in turn, assigned the writing of the Overview to JK Research Associates, Inc. According to Fiscal Year 2001 guidance from the Department to TRW, "The necessity of the [Site Recommendation Consideration Report] overview is defined by the need to summarize and explain the basis for the Secretary of Energy's consideration of a possible recommendation...." The Fiscal Year 2001 Statement of Work for JK Research Associates included general direction to develop an Overview of approximately 50 pages that summarizes the information in volumes 1 and 2 of the Site Recommendation Consideration Report. According to page one of the Overview, it "...summarizes information presented in the *Site Recommendation Consideration Report* and other technical reports, and provides additional information about U.S. policy on disposing of the nation's nuclear waste. The *Overview* and the *Report* are intended to serve as the basis for public comment on the Secretary's consideration of the Yucca Mountain site."

Based on timelines developed during our review, we found that the Overview underwent approximately 18 draft revisions. Senior officials told us that the draft revisions were sent internally to Department, contractor, and Nuclear Waste Technical Review Board representatives for review and comment.

We were informed at the initiation of the Office of Inspector General inquiry that a decision to release the Site Recommendation Consideration Report and the Overview would be held in abeyance pending completion of our review, while activities relating to the evaluation of Yucca Mountain would continue.

III. FINDINGS

A. *We found several written statements in key Yucca Mountain evaluation documents that could be considered by an impartial observer to be prematurely conclusive, or inappropriately advocating a position by the Department or its contractors.*

Two of these statements were found in the "Note to Reviewers of the [Site Recommendation Consideration Report] Overview," which was written by JK Research Associates and attached to a draft of the "Yucca Mountain Site Recommendation Consideration Report: Overview." We learned that the Note appeared only with the October 2000 draft, and had not been included in any prior or subsequent versions. The statements are as follows:

> "To resolve the question of the appropriate tone for the Overview, we have assumed that the 'author' is the OCRWM Director and that the purpose of the document is to convey the Director's recommendation that the Secretary recommend the site. Therefore, the Overview makes a convincing case that Yucca Mountain is a technically suitable site for a repository, though a formal suitability finding will not have been made."
>
> "...the primary message is that [the Department of Energy] has a comprehensive plan to solve the nation's nuclear waste problem and that a Yucca Mountain repository is the key component in that comprehensive solution."

Other questionable statements were found in the December 2000 version of the draft Overview, with similar language appearing in the October and November versions. They are as follows:

> "Based on over 20 years of scientific and engineering work, [the Department of Energy] believes that a repository can be safely constructed and operated at the Yucca Mountain site in a manner consistent with the safety standards proposed by [the Environmental Protection Agency] and the licensing requirements proposed by [the Nuclear Regulatory Commission]."

"All of the evidence to date indicates that Yucca Mountain is an appropriate site for a repository that can achieve the purposes of the [Nuclear Waste Policy Act]."

Contrary to the apparent message conveyed in the statements, the purpose of the Overview was to summarize information in the Site Recommendation Consideration Report and other technical reports, and provide additional information about U.S. policy on disposing of the nation's nuclear waste. The Overview, along with the Site Recommendation Consideration Report, is intended to serve as the basis for public comment on the Secretary's consideration of the Yucca Mountain site.

The Act requires that the Secretary hold public hearings in the vicinity of the Yucca Mountain site for purposes of informing the residents of the area and receiving their comments regarding consideration of a possible recommendation of the site. If upon completion of the hearings the Secretary decides to recommend approval of the site to the President of the United States, the Secretary must notify the Governor and Legislature of the State of Nevada of the proposed decision. The Secretary must wait 30 days following notification to Nevada officials to submit a Site Recommendation Report to the President recommending approval of the site.

In the context of the statutorily mandated process described above, we concluded that a fair reading of the draft Overview suggests a premature position supporting a recommendation to the President, *prior to* public hearings and notification of Nevada officials and receipt of their comments. We learned that Department and contractor representatives provided feedback to JK Research Associates at various stages of the Overview's revision. Available evidence confirmed that JK Research Associates was advised that the draft Overview contained statements that were inappropriately conclusive. The Office of Inspector General did not find similar statements in the draft Site Recommendation Consideration Report.

When interviewed, JK Research Associates informed the Office of Inspector General, in part, that the purpose of the Overview was to provide a broad audience with a brief summary of the technical information presented in the Site Recommendation Consideration Report and other reports, in addition to background information on the program as a whole and related U.S. policy. The company stated its belief, however, that it would be irresponsible for the Department to issue the

Site Recommendation Consideration Report and Overview, and request the public's involvement, if it did not have a reasonable degree of confidence that the site could meet technical requirements.

JK Research Associates added that its intent was not to communicate that the Department or the Secretary had already decided to recommend Yucca Mountain. In support of this assertion, the following excerpt was identified in the "Note to Reviewers of the [Site Recommendation Consideration Report] Overview":

> "The purpose of the Overview is to provide the basis for comments by anyone and everyone who wishes to comment on the Secretary's consideration of the site. This broader public audience includes the residents in the vicinity of Yucca Mountain and other interested and affected parties, including States and Tribes through whose jurisdiction waste will be transported to a Yucca Mountain repository."

Additional support was also found in the December 2000 version of the draft Overview of the Site Recommendation Consideration Report, which was written by JK Research Associates and included the following statement:

> "The Secretary will hold public hearings in the State of Nevada in 2001 to inform area residents that recommendation of the site is being considered and to receive their comments."

Concern had also been expressed about the following statement in the "Note to Reviewers of the [Site Recommendation Consideration Report] Overview":

> "In fact, the technical suitability of the site is less of a concern to Congress, than the broader issue of whether the nuclear waste problem can be solved at an affordable price in both financial and political terms."

When interviewed, JK Research Associates informed the Office of Inspector General that this portion of the Note was intended to advise reviewers that the draft Overview was designed to provide a broader context beyond technical suitability by also addressing other issues, such as cost, transportation, and community concerns, that are recognized as being important considerations in the final recommendation decision. JK Research Associates stated its belief that Congress is less concerned with technical suitability because it has the Nuclear Waste Technical Review Board to evaluate technical aspects of the Yucca Mountain site.

Although this may have been the intent of the drafters, the Office of Inspector General concluded that this statement could be interpreted as downplaying the relative importance to the Congress of the technical suitability of Yucca Mountain in a manner inconsistent with the Nuclear Waste Policy Act.

B. *We could not substantiate the concern that bias compromised the integrity of the site evaluation process, or that the Department or its contractors considered a formal or informal strategy for supporting the site characterization recommendation in violation of the law.*

The Office of Inspector General reviewed and analyzed numerous documents and conducted over 200 witness interviews with representatives from the Department's OCRWM, Yucca Mountain Project Office, Office of General Counsel, and national laboratories, as well as senior personnel from TRW and its subcontractors, and the Nuclear Regulatory Commission. We did not, based on these record reviews and interviews, develop any additional data that would support the concern that bias compromised the integrity of the site evaluation process, or that a formal or informal strategy had been developed to support the site characterization recommendation in violation of the law.

Furthermore, the Office of Inspector General interviewed each of the 11 members of the Nuclear Waste Technical Review Board, and reviewed relevant Board documentation, regarding the issue of potential bias in the evaluation process. The U.S. Congress created the Board in 1987 as an independent agency within the executive branch of the Federal Government. The Board consists of individuals nominated by the National Academy of Sciences for appointment by the President. The Board does not direct the activities of the Department but, rather, evaluates the technical and scientific validity of activities undertaken by the Secretary of Energy to characterize Yucca Mountain for its suitability as a location for a repository. The Board reports its findings, conclusions and recommendations to the U.S. Congress and the Secretary at least twice annually. Additionally, the Board has held public hearings in the vicinity of Yucca Mountain and other

locations, and has reported the results to the Director of OCRWM. The Board also meets periodically with Department and contractor officials.

Based on discussions with members of the Board, and a review of its reports to the U.S. Congress and the Secretary of Energy that are in the public domain, we learned that the Board has raised scientific and technical issues regarding the proposed Yucca Mountain repository. However, based on our direct questioning of the Board's membership, there was no indication that bias compromised the integrity of the Department's evaluation of the Yucca Mountain site. Because of the Board's independent charter and the distinguished credentials of its membership, this finding carried significant weight in reaching our overall conclusion regarding the integrity of the Yucca Mountain evaluation process.

IV. COORDINATION WITH THE DEPARTMENT OF JUSTICE

Concerns had also been raised to the Office of Inspector General that appropriated funds may have been used improperly for lobbying purposes. This was based, in part, on a statement in the "Note to Reviewers of the [Site Recommendation Consideration Report] Overview." Specifically, JK Research Associates wrote that the Overview "...provides information that potential supporters can use in expressing support for a site recommendation" but that "It is not intended to convert those who oppose a Yucca Mountain repository or any solution to the nuclear waste problem."

The Office of Inspector General coordinated with the Public Integrity Section of the U.S. Department of Justice. The purpose of the coordination was to allow the Department of Justice to evaluate whether information in the "Note to Reviewers of the [Site Recommendation Consideration Report] Overview" or the Site Recommendation Consideration Report Overview constituted a possible violation of the criminal lobbying statute. The Department of Justice advised that no violation had occurred.

V. OTHER MATTERS

Our review disclosed several additional matters that the Department needs to consider as it proceeds with the evaluation of the Yucca Mountain site. Specifically, several witnesses were critical of a Department or contractor position, report, or process relating to Yucca Mountain.

One witness, for instance, stated that he was not aware of any information being misrepresented in technical documents or Department or contractor bias regarding the evaluation and potential recommendation of Yucca Mountain. He expressed the belief, however, that more studies should be conducted in the areas of low-temperature operating conditions and the discovery of "Chlorine 36."

A second witness stated his belief that the Department has not created incentives for people to question computer modeling assumptions or to "rock the boat." The witness stated that while the Department has changed assumptions when given supporting data, two factors must be true before assumptions will be changed: (1) the evidence must be unambiguous, and (2) the resulting change cannot threaten the program. The witness had no examples, however, of bias, efforts to cover-up evidence threatening to the program, or an organizational conspiracy to conceal safety problems at the site.

Two other witnesses expressed concern over the methodology by which the Site Recommendation Consideration Report was authored and reviewed. One witness said that the Site Recommendation Consideration Report's referencing process denied scientists proper credit for the work they performed. The other witness advised that during the final stages of preparing the Site Recommendation Consideration Report, sections of the report were transferred to members of a contractor Senior Support Team, which made changes without further input from the authors. The witness stated his belief that none of the changes were deliberate or significant, and that he was unaware of any misrepresented or unsupported information in the Site Recommendation Consideration Report.

One of the documents supporting the Site Recommendation Consideration Report was the "Repository Safety Strategy" (RSS). The RSS explains the roles that natural and engineered systems of a potential Yucca Mountain repository are expected to play in containing radionuclides within the waste package over a period of thousands of years. The RSS was developed using formal and approved quality assurance measures. The RSS had multiple authors. One witness expressed concerns that the review schedule for this document was too short and that it was not designed to capture technical errors. While this is an important concern, no other witness interviewed by the Office of Inspector General raised this issue.

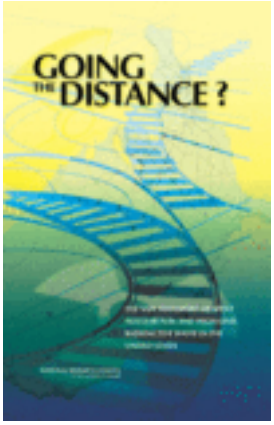
We also found that the December 2000 version of the draft Overview was not subjected to the same standards of quality assurance review as the other key documents. The draft Site Recommendation Consideration Report and supporting documents were subject to a structured quality assurance process as part of an overall management plan. This process included informational cross-indexing by non-authors and certifications of content accuracy. The Site Recommendation Consideration Report had a formal mechanism for tracking reviewer comments and author feedback. The mechanism, an extensive electronic "storyboard," is part of a detailed historical record of the development of the Site Recommendation Consideration Report.

JK Research Associates provided cross-indexed and referenced copies of the November and December 2000 versions of the draft Overview which had been distributed internally to the Department, contractors and the Nuclear Waste Technical Review Board for review. We found that there was no formal mechanism for tracking reviewer comments of the various versions of the draft Overview. The Office of Inspector General was informed that feedback was provided via one-on-one personal discussions, email messages and telephone calls. According to JK Research Associates, complete electronic mail records were unavailable to the Office of Inspector General due to a computer malfunction. Consequently, because a complete record of interactions between the contractor and the reviewers was not available, the Office of Inspector General was unable to obtain a complete, verifiable history of the development of the draft Overview.

Attachment 9

"Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States."

Committee on Transportation of Radioactive Waste. National Research Council of the National Academies: The National Academies Press; Washington, D.C. (2006).



Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States

Committee on Transportation of Radioactive Waste, National Research Council

ISBN: 0-309-65316-9, 339 pages, 6 x 9, (2006)

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THE SAFE TRANSPORT OF SPENT NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE IN THE UNITED STATES

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Summary[1]

This study was initiated by the National Academies to meet what it perceived to be a national need for an independent, objective, and authoritative analysis of spent nuclear fuel and high-level radioactive waste transportation in the United States in light of

- The federal government's program to construct and operate a repository at Yucca Mountain, Nevada, to permanently dispose of the nation's spent fuel and high-level waste; and
- The commercial nuclear industry's program to construct and operate a facility in Utah for the temporary (interim) storage of spent fuel from some of its power reactors.

As this study was being completed, the federal government initiated another program to assess the feasibility of developing an integrated facility to receive, store, and recycle commercial spent fuel. If executed, these programs could involve the shipment of large quantities[2] of spent fuel and

[1]This summary provides a brief overview of the findings and recommendations in this report. A more detailed summary of the findings and recommendations is presented in the next chapter.

[2]This report identifies two general types of transportation programs, *small-quantity shipping programs* and *large-quantity shipping programs*. While there is no precise quantity demarcation between these two program types, the former involve shipment on the order of tens of metric tons of spent fuel or high-level waste, while the latter involve shipment on the order of hundreds to thousands of metric tons.

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high-level waste over the nation's railways and roadways for periods of several decades.

The Committee on Transportation of Radioactive Waste (hereafter referred to as the committee; see Appendix A) was appointed by the National Academies to carry out this study. The original objectives of this study were to examine the risks and identify key current and future technical and societal concerns for the transport of spent nuclear fuel and high-level radioactive waste in the United States. After this study was under way, its scope was expanded to include a congressionally requested and U.S. Department of Transportation (DOT) sponsored examination of the procedures used by the U.S. Department of Energy (DOE) for selecting routes for transporting research reactor spent fuel between its facilities in the United States. This report provides background information on spent fuel and high-level waste transportation (Chapter 1) and the committee's findings and recommendations with respect to the original study charge (Chapters 2, 3, and 5) and the expanded study charge (Chapter 4).

This report does not examine the security[3] risks for spent fuel and high-level waste transportation because of an inability to access classified and otherwise restricted information. It also does not examine the viability of temporary storage or permanent disposal sites for spent fuel and high-level waste, or the risk trade-offs involved in transporting spent fuel and high-level waste to centralized interim storage or permanent disposal sites versus leaving them in place at current storage sites. The committee operated within the constraints of federal policy decisions that have set the nation on a clear path to transport spent fuel and high-level waste for permanent disposal. The intent of this study is to improve understanding of the issues associated with the transportation of spent fuel and high-level waste regardless of their ultimate destination.

A brief summary of the committee's findings and recommendations is presented below. Readers are strongly encouraged to examine the full text of the findings and recommendations in the referenced sections of this report for additional details.

- The committee could identify no fundamental technical barriers to the safe[4] transport of spent fuel and high-level radioactive waste in the United States. However, there are a number of social and institutional

[3] *Security* refers to measures taken to protect spent fuel and high-level waste against sabotage, attacks, and theft while it is in transport.

[4] *Safety* refers to measures taken to protect spent fuel and high-level waste during transport operations from failure, damage, human error, and other inadvertent acts.

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challenges to the successful[5] initial implementation of large-quantity shipping programs that will require expeditious resolution (see Section 3.2 and Section 5.1). The challenges of sustained implementation should not be underestimated.

- Malevolent acts against spent fuel and high-level waste shipments are a major technical and societal concern, but the committee was unable to perform an in-depth examination of transportation security because of information constraints. The committee recommends that an independent examination of the security of spent fuel and high-level waste transportation be carried out prior to the commencement of large-quantity shipments to a federal repository or to interim storage (see Section 5.1).
- Transportation packages[6] play a crucial role in transportation safety by providing a robust barrier to the release of radiation and radioactive material. Current international standards and U.S. regulations are adequate to ensure package containment effectiveness over a wide range of transport conditions. However, recently published work suggests that there may be a very small number of extreme accident conditions involving very long duration fires that could compromise package containment effectiveness. The committee recommends that the U.S. Nuclear Regulatory Commission (USNRC) undertake additional analyses of very long duration fire scenarios that bound expected real-world accident conditions as outlined in Section 2.5. Based on the results of these investigations, the USNRC should implement operational controls and restrictions on spent fuel and high-level waste shipments as necessary to reduce the chances that such conditions might be encountered in service.
- The committee strongly endorses the use of full-scale testing to determine how packages will perform under both regulatory and credible extraregulatory[7] conditions. The committee recommends that full-scale package testing continue to be used as part of integrated analytical, computer simulation, scale-model, and testing programs to validate package performance. Full-scale testing of packages to deliberately cause their destruction should not be required as part of this integrated analysis or for compliance demonstrations (Section 2.5).
- This report provides quantitative health and safety risk comparisons for both normal transport conditions and accidents (Section 3.3). The

[5]The committee defines *success* in terms of the program's ability, under existing statutes, regulations, agreements, and budgets, to transport spent fuel and high-level waste in a safe, secure, timely, and publicly acceptable manner.

[6]Containers used for the transport of spent fuel or high-level waste, whether loaded or empty.

[7]That is, under conditions that exceed those embodied in current regulatory requirements.

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radiological health and safety risks associated with the transportation of spent fuel and high-level waste are well understood and are generally low, with the possible exception of risks from releases in extreme accidents involving very long duration, fully engulfing fires. The likelihood of such extreme accidents appears to be very small, however, and their occurrence and consequences can be reduced further through relatively simple operational controls and restrictions. The committee recommends that transportation planners and managers undertake detailed surveys of transportation routes to identify and mitigate the potential hazards that could lead to or exacerbate extreme accidents involving very long duration, fully engulfing fires (see Section 3.4).

- The social risks[8] of spent fuel and high-level waste transportation pose important challenges to the successful initial implementation of programs for transporting spent fuel and high-level waste in the United States. Transportation implementers should take early and proactive steps to establish formal mechanisms for gathering high-quality and diverse advice about social risks and their management on an ongoing basis using the steps recommended in Section 3.4.

The committee also provides several recommendations for improving current and future programs to transport spent fuel and high-level waste to a federal repository or to interim storage. Although these recommendations are directed at DOE and DOT, they would also apply to programs for shipping commercial spent fuel to private storage.

- DOE's procedures for selecting routes within the United States for shipments of foreign research reactor spent fuel appear on the whole to be adequate and reasonable. DOT routing regulations are a satisfactory means of ensuring safe transportation, provided that the shipper actively and systematically consults with the states and tribes along potential routes and that states follow the route designation procedures prescribed by the department. The committee recommends that DOT take steps to ensure that states that designate routes for shipment of spent nuclear fuel rigorously comply with regulatory requirements that such designations be supported by sound risk assessments (see Section 4.4).
- The committee strongly endorses DOE's decisions to ship spent fuel and high-level waste to the federal repository by mostly rail using dedicated trains. The committee recommends that DOE fully implement

[8]Social risks arise from both *social processes*, which influence peoples' interactions and shape their communities, and *perceptions*, which influence peoples' behaviors, whether or not such perceptions are an accurate picture of reality.

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these decisions by completing construction of the Nevada rail spur and making other necessary arrangements before commencing the large-quantity shipment of spent fuel and high-level waste to the federal repository. DOE should also examine the feasibility of further reducing its needs for cross-country truck shipments of spent fuel (see Sections 5.2.1 and 5.2.3).

- DOE should identify and make public its suite of preferred highway and rail routes for transporting spent fuel and high-level waste to a federal repository as soon as practicable to support state, tribal, and local planning, especially for emergency responder preparedness. DOE should follow the practices of its foreign research reactor spent fuel transport program (see Chapter 4) of involving states and tribes in these route selections (see Section 5.2.2).
- DOE should negotiate with commercial spent fuel owners to ship older fuel first to a federal repository or to federal interim storage. Should these negotiations prove to be ineffective, Congress should consider legislative remedies. Within the context of its current contracts with commercial spent fuel owners, DOE should initiate transport to the federal repository through a pilot program involving relatively short, logistically simple movements of older fuel from closed reactors to demonstrate its ability to carry out its responsibilities in a safe and operationally effective manner (see Section 5.2.4).
- DOE should begin immediately to execute its emergency responder preparedness responsibilities defined in Section 180(c) of the Nuclear Waste Policy Act using the innovative steps recommended in Section 5.2.5.
- DOE, the Department of Homeland Security, DOT, and USNRC should promptly complete the job of developing, applying, and disclosing consistent, reasonable, and understandable criteria for protecting sensitive information about spent fuel and high-level waste shipments. They should also commit to the open sharing of information that does not require such protection and should facilitate timely access to such information, for example, by posting it on readily accessible Web sites (see Section 5.2.6).
- The Secretary of Energy and the U.S. Congress should examine options for changing the organizational structure of DOE's program for transporting spent fuel and high-level waste to a federal repository to increase its chances for success. The following three alternative organizational structures, which are representative of progressively greater organizational change, should be examined: (1) a quasi-independent DOE office reporting directly to upper-level DOE management; (2) a quasi-government corporation; or (3) a fully private organization operated by the commercial nuclear industry (see Section 5.3).

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Summary of Findings and Recommendations

The findings and recommendations from this report are reproduced in full in this summary. Additional background and supporting information can be found in the body of the report.

S.1 TRANSPORTATION SAFETY AND SECURITY

Based on its examination of spent fuel and high-level waste transportation in the United States, the committee developed a principal finding on transportation safety and a finding and recommendation on transportation security. These are described in greater detail in Chapter 5, Section 5.1.

PRINCIPAL FINDING ON TRANSPORTATION SAFETY: The committee could identify no fundamental technical barriers to the safe[1] transport of spent nuclear fuel and high-level radioactive waste in the United States. Transport by highway (for small-quantity shipments[2]) and by rail (for large-quantity shipments) is, from a technical viewpoint, a low-

[1]As noted in Chapter 1, *safety* refers to measures taken to protect spent fuel and high-level waste from failure, damage, human error, and other inadvertent acts during transport operations.

[2]This report identifies two general types of transportation programs, *small-quantity shipping programs* and *large-quantity shipping programs*. While there is no precise quantity demarcation between these two program types, the former involve the shipment on the order of tens of metric tons of spent fuel or high-level waste, while the latter involve the shipment on the order of hundreds to thousands of metric tons.

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radiological-risk activity with manageable safety, health, and environmental consequences when conducted with strict adherence to existing regulations. However, there are a number of social and institutional challenges to the successful[3] initial implementation of large-quantity shipping programs that will require expeditious resolution as described in this report. Moreover, the challenges of sustained implementation should not be underestimated.

The wording of this finding is carefully and narrowly constructed and is focused on the technical aspects of transportation programs and the conduct of transportation operations. It is predicated on the assumption that these technical tasks are being carried out with a high degree of care and in strict adherence to regulations. The finding is also based on an assessment of past and present transportation programs and would apply to future programs only to the extent that they continue to exercise appropriate care and adhere to applicable regulations.

PRINCIPAL FINDING ON TRANSPORTATION SECURITY: Malevolent acts against spent fuel and high-level waste shipments are a major technical and societal concern, especially following the September 11, 2001, terrorist attacks on the United States. The committee judges that some of its recommendations for improving transportation safety might also enhance transportation security. The Nuclear Regulatory Commission is undertaking a series of security studies, but the committee was unable to perform an in-depth technical examination of transportation security because of information constraints.

RECOMMENDATION: An independent examination of the security of spent fuel and high-level waste transportation should be carried out prior to the commencement of large-quantity shipments to a federal repository or to interim storage. This examination should provide an integrated evaluation of the threat environment, the response of packages to credible malevolent acts, and operational security requirements for protecting spent fuel and high-level waste while in transport. This examination should be carried out by a technically knowledgeable group that is independent of the government and free from institutional and financial conflicts of interest. This group should be given full access to the necessary classified documents and Safeguards Information to carry out this task. The findings and recommen-

[3]The committee defines "success" in terms of the program's ability, under existing statutes, regulations, agreements, and budgets, to transport spent fuel and high-level waste in a safe, secure, timely, and publicly acceptable manner.

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dations from this examination should be made available to the public to the fullest extent possible.

The committee was unable to perform this examination because much of the needed information is either classified or otherwise restricted. There appears to be sufficient information available, however, to undertake a substantive review of spent fuel and high-level waste transportation security by a cleared group if it is given unrestricted access to the relevant literature. The cooperation of several federal agencies would be required to obtain the information necessary to carry out this study.

S.2 TRANSPORTATION RISK

This report provides an examination of two types of transportation risks: *health and safety risks* and *social risks*. These risks arise both during *normal* transport operations and from *accidents* involving packages loaded with spent fuel or high-level waste. The health and safety risks arise from the potential exposure of transportation workers, as well as other people who travel, work, or live near transportation routes, to radiation that may be emitted or released from these packages. Social risks arise from social processes and human perceptions and can have both direct socioeconomic impacts and perception-based impacts. The health and safety risks and social risks are collectively referred to as *societal risks* in this report.

This report also provides comparisons between health and safety risks for transporting spent fuel and high-level waste and certain other risks that confront members of society. Comparisons are provided for both normal and severe accident conditions in Chapter 3 (see especially Figures 3.3 and 3.4). The committee's objective in presenting these comparisons is to inform readers' understanding about the risks of spent fuel and high-level waste transportation, not to persuade readers that such risks are—or are not—acceptable. Acceptability is a normative judgment; there is no basis in science for judging the acceptability of transportation risks.

FINDING: There are two potential sources of radiological exposures from transporting spent fuel and high-level waste: (1) radiation shine[4] from spent fuel and high-level waste transport packages under normal transport conditions; and (2) potential increases in radiation shine and release of radioactive materials from transport packages under accident conditions that are severe enough to compromise fuel element and package integrity. The ra-

[4]Radiation emitted from a transportation package containing spent fuel or high-level waste.

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diological risks associated with the transportation of spent fuel and high-level waste are well understood and are generally low, with the possible exception of risks from releases in extreme accidents involving very long duration, fully engulfing fires. While the likelihood of such extreme accidents appears to be very small, their occurrence cannot be ruled out based on historical accident data for other types of hazardous material shipments. However, the likelihood of occurrence and consequences can be reduced further through relatively simple operational controls and restrictions and route-specific analyses to identify and mitigate hazards that could lead to such accidents.

RECOMMENDATION: Transportation planners and managers should undertake detailed surveys of transportation routes to identify potential hazards that could lead to or exacerbate extreme accidents involving very long duration, fully engulfing fires. Planners and managers should also take steps to avoid or mitigate such hazards before the commencement of shipments or shipping campaigns.

The finding that "radiological risks . . . are well understood and are generally low" is based on a large set of data and studies described in Chapters 2 and 3. These include the following:

- Rigorous international standards and U.S. regulations for the design, construction, testing, and maintenance of spent fuel packages;
- More than four decades of worldwide experience in transporting spent fuel without a significant release of radioactive materials during an accident;[5] the broad sharing of information on experiences and best practices by transportation planners, implementers, and regulators through organizations such as the International Atomic Energy Agency promotes the continued maintenance of this safety record;
- Full-scale crash testing of transport packages under severe accident conditions;
- A series of increasingly sophisticated analytical studies of spent fuel transport package performance; and
- Reconstructions of the mechanical and thermal loading conditions from severe accidents that did not involve spent fuel transport to asses how spent fuel packages would have performed under such conditions.

The finding that spent fuel transportation risks are "generally low" at present does not necessarily mean that such risks will continue to be low in

[5]Minor releases have been reported in obsolete packages that are no longer approved for use for transporting spent fuel (see Table 3.3).

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the future. Future risks depend on a number of factors (e.g., the care taken in fabricating transport packages and executing transportation operations). Ongoing vigilance by regulators and shippers will be essential for maintaining low-risk programs in the future, especially during the scale-up and operation of large-quantity shipping programs.

FINDING: The *social risks* for spent fuel and high-level waste transportation pose important challenges to the successful implementation of programs for transporting spent fuel and high-level waste in the United States. Such risks, which can result in lower property values along transportation routes, reductions in tourism, and increased anxiety, have received substantially less attention than health and safety risks, and some are difficult to characterize. Current research and practice suggest that transportation planners and managers can take early proactive steps to characterize, communicate, and manage the social risks that arise from their operations. Such steps may have additional benefits: they may increase the openness and transparency of transportation planning and programs; build community capacity to mitigate these risks; and possibly increase trust and confidence in transportation programs.

RECOMMENDATION: Transportation implementers should take early and proactive steps to establish formal mechanisms for gathering high-quality and diverse advice about social risks and their management on an ongoing basis. The committee makes two recommendations for the establishment of such mechanisms for the Department of Energy's program to transport spent fuel and high-level waste to a federal repository at Yucca Mountain: (1) expand the membership and scope of an existing advisory group (Transportation External Coordination Working Group; see Chapter 5) to obtain outside advice on social risk, including impacts and management; and (2) establish a *transportation risk advisory group* that is explicitly designed to provide advice on characterizing, communicating, and mitigating the social, security, and health and safety risks that arise from the transportation of spent fuel and high-level waste to a federal repository or interim storage. This group should be comprised of risk experts and practitioners drawn from the relevant technical and social science disciplines and should be convened under the Federal Advisory Committee Act or a similar arrangement to enhance the openness of its operations. Its members should receive security clearances to facilitate access to appropriate transportation security information. The existing federal Nuclear Waste Technical Review Board, which will cease operations no later than one year after the Department of Energy begins disposal of spent fuel or high-level waste in a repository, could be broadened to serve this function.

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This finding and recommendation spring from several factors: social risk is a poorly understood phenomenon; expert opinion frequently differs; the Department of Energy (DOE) does not, to the committee's knowledge, have any precedent to guide its understanding and management of social risks; and most transportation program staff are not likely to be well acquainted with either theory or practice on this issue. Consequently, the committee concluded that broad input and advice on social risks will be essential to the establishment and ultimate success of large-quantity shipping programs to transport spent fuel and high-level waste to a federal repository or interim storage.

The recommendation outlines pragmatic steps that transportation implementers can take immediately and at relatively low cost to better understand and, working with affected communities, manage the social risks from their programs. The recommendation is focused primarily on DOE, but it would also apply to any program for shipping large quantities of spent fuel to a private interim storage site (e.g., Private Fuel Storage in Utah).

S.3 CURRENT CONCERNS ABOUT TRANSPORTATION OF SPENT FUEL AND HIGH-LEVEL WASTE

The report examines two current concerns about transportation of spent fuel and high-level waste in the United States: (1) the performance of packages used to transport spent fuel and high-level waste under both normal and extreme mechanical forces and thermal loading conditions; and (2) the procedures used by DOE to select highway and rail routes for shipping research reactor spent fuel between DOE facilities in the United States.[6]

S.3.1 Package Performance

Package performance—the ability of a transportation package to maintain a high level of containment effectiveness in long-term routine use and under extreme mechanical forces and thermal loading conditions—is a crucial issue for transportation safety and key to understanding and quantifying transportation risks. Packages used to transport spent fuel and high-level waste are robust structures typically constructed of steel, lead, depleted uranium, and(or) concrete to provide structural strength and durability as well as radiation shielding. The International Atomic Energy Agency (IAEA) has established safety standards for such packages, and these standards are

[6]This assessment was requested by the Department of Transportation at the direction of Congress after the study was under way. The study schedule was extended to allow additional time for information gathering, deliberation, and expansion of this report to address the added study charge.

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reflected in regulations (10 CFR Part 71) issued by the U.S. Nuclear Regulatory Commission (USNRC). Packages used in the United States must meet testing requirements in 10 CFR Part 71 involving a free-drop test onto an essentially unyielding surface, a puncture test, an immersion test, and a thermal test, all with less than the specified loss of containment effectiveness. The USNRC permits quantitative analysis, scale-model, and full-scale testing of packages or package components and comparisons with existing approved package designs to be used to demonstrate such compliance. Testing of full-scale packages is not a requirement of the regulations. Some participants at the committee's information-gathering meetings asserted that full-scale testing should be required and that some tests to intentionally destroy the packages should be carried out, presumably to establish their ultimate strength.

There is a good deal of quantitative information available on the performance of transportation packages under extreme loading conditions. This information is derived from analytical, computer modeling, scale-model, and full-scale testing studies carried out in the United States and abroad over the past three decades. Additional work is now under way at the USNRC to examine the effects on package performance of severe accidents and very long duration, fully engulfing fires.

FINDING: Transportation packages play a crucial role in the safety of spent fuel and high-level waste shipments by providing a robust barrier to the release of radiation and radioactive material under both normal transport and accident conditions. International Atomic Energy Agency package performance standards and associated Nuclear Regulatory Commission regulations are adequate to ensure package containment effectiveness over a wide range of transport conditions, including most credible accident conditions. However, recently published work suggests that extreme accident scenarios involving very long duration, fully engulfing fires might produce thermal loading conditions sufficient to compromise containment effectiveness. The consequences of such thermal loading conditions for containment effectiveness are the subject of ongoing investigations by the Nuclear Regulatory Commission and other parties, and this work is improving the understanding of package performance. Nonetheless, additional analyses and experimentation are needed to demonstrate a bounding-level understanding of package performance in response to very long duration, fully engulfing fires for a representative set of package designs.

RECOMMENDATION: The Nuclear Regulatory Commission should build on recent progress in understanding package performance in very long duration fires. To this end, the agency should undertake additional analyses of very long duration fire scenarios that bound expected real-

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world accident conditions for a representative set of package designs that are likely to be used in future large-quantity shipping programs. The objectives of these analyses should be to

- Understand the performance of package barriers (spent fuel cladding and package seals);
- Estimate the potential quantities and consequences of any releases of radioactive material; and
- Examine the need for regulatory changes (e.g., package testing requirements) or operational changes (e.g., restrictions on trains carrying spent fuel) either to help prevent accidents that could lead to such fire conditions or to mitigate their consequences.

Strong consideration should also be given to performing well-instrumented tests for improving and validating the computer models used for carrying out these analyses, perhaps as part of the full-scale test planned by the Nuclear Regulatory Commission for its package performance study.

Based on the results of these investigations, the Commission should implement operational controls and restrictions on spent fuel and high-level waste shipments as necessary to reduce the chances that such fire conditions might be encountered in service. Such effective steps might include, for example, additional operational restrictions on trains carrying spent fuel and high-level waste to prevent co-location with trains carrying flammable materials in tunnels, in rail yards, and on sidings.

FINDING: The committee strongly endorses the use of full-scale testing to determine how packages will perform under both regulatory and credible extraregulatory conditions. Package testing in the United States and many other countries is carried out using good engineering practices that combine state-of-the-art structural analyses and physical tests to demonstrate containment effectiveness. Full-scale testing is a very effective tool both for guiding and validating analytical engineering models of package performance and for demonstrating the compliance of package designs with performance requirements. However, deliberate full-scale testing of packages to destruction through the application of forces that substantially exceed credible accident conditions would be marginally informative and is not justified given the considerable costs for package acquisitions that such testing would require.

RECOMMENDATION: Full-scale package testing should continue to be used as part of integrated analytical, computer simulation, scale-model, and testing programs to validate package performance. Deliberate full-scale

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testing of packages to destruction should not be required as part of this integrated analysis or for compliance demonstrations.

S.3.2 Route Selection for Research Reactor Spent Fuel Transport

DOE transports and stores spent fuel from foreign and U.S. research reactors at two facilities: the Savannah River Site in South Carolina and the Idaho National Laboratory. Foreign research reactor spent fuel is transported by ship to the Charleston Naval Weapons Station in South Carolina. From there it is transported by rail or highway to the Savannah River Site in South Carolina. Some of these shipments continue onward to the Idaho National Laboratory using one of three highway routes established by DOE in consultation with states and tribes. A 2001 shipment of foreign research reactor spent fuel across one of these routes prompted a congressional mandate to the Department of Transportation (DOT) for a National Academies examination of the procedures used by DOE to select routes for highway and rail shipments of this fuel. That examination was carried out as part of this study because it is a good example of a current concern for transporting spent fuel. The committee's examination of DOE's routing practices resulted in the following findings and recommendations.

FINDING: The Department of Energy's procedures for selecting routes within the United States for shipments of foreign research reactor spent fuel appear on the whole to be adequate and reasonable. These procedures are risk informed; they make use of standard risk assessment methodologies in identifying a suite of potential routes and then make final route selections by taking into account security, state and tribal preferences, and information from states and tribes on local transport conditions. The Department of Energy's procedures reflect the agency's position (which is consistent with Department of Transportation regulations) that the states are competent and responsible for selecting highway routes. For rail route selection, the Department of Energy's practice of negotiating routes with carriers in consultation with states is analogous to its interaction with states on highway routing.

RECOMMENDATION: The Department of Energy should continue to ensure the systematic, effective involvement of states and tribal governments in its decisions involving routing and scheduling of foreign and DOE research reactor spent fuel shipments.

FINDING: Highway routes for shipment of spent nuclear fuel are dictated by DOT regulations (49 CFR Part 397). The regulations specify that ship-

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ments normally must travel by the fastest route using highways designated by the states or the federal government. They do not require the carrier or shipper to evaluate risks of portions of routes that meet this criterion. These regulations are a satisfactory means of ensuring safe transportation, provided that the shipper actively and systematically consults with the states and tribes along potential routes and that states follow the route designation procedures prescribed by the DOT.

RECOMMENDATION: DOT should ensure that states that designate routes for shipment of spent nuclear fuel rigorously comply with its regulatory requirement that such designations be supported by sound risk assessments. DOT and DOE should ensure that all potentially affected states are aware of and prepared to fulfill their responsibilities regarding highway route designations.

S.4 FUTURE CONCERNS FOR TRANSPORTATION OF SPENT FUEL AND HIGH-LEVEL WASTE

The examination of future concerns focused on five operational issues and one organizational issue related to the federal program for transporting spent fuel and high-level waste to a repository at Yucca Mountain, Nevada (Appendix C). Although these recommendations are focused on DOE's program for transporting spent fuel and high-level waste to a federal repository or interim storage facility, some of them also apply to any large-quantity shipping program, whether federally or privately operated.

S.4.1 Mode for Transporting Spent Fuel and High-Level Waste to a Federal Repository

DOE has decided that it will ship spent fuel and high-level waste to a federal repository using the "mostly rail" option defined in its final Environmental Impact Statement (EIS) for Yucca Mountain. DOE estimates that this option will require 9600 rail shipments and 1100 highway shipments to transport the legally mandated limit of 70,000 metric tons of spent fuel and high-level waste to the repository. To implement this option, DOE must construct a 319-mile (~513-kilometer) rail spur in Nevada and may have to make other infrastructure improvements to provide rail access at commercial nuclear sites. DOE must also procure a fleet of rail packages and railcars. If DOE fails to complete these tasks prior to the opening of the federal repository, legal and contractual obligations to accept spent fuel may create pressure for it to initiate a large-scale interim shipping program using trucks.

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FINDING: Transport of spent fuel and high-level waste by rail has clear safety, operational, and policy advantages over highway transport for large-quantity shipping programs. The committee strongly endorses DOE's selection of the "mostly rail" option for the Yucca Mountain transportation program for the following reasons:

- **It reduces the total number of shipments to the federal repository by roughly a factor of five, which reduces the potential for routine radiological exposures, conventional traffic accidents, and severe accidents (Table 3.8).**
- **Rail shipments have a greater physical separation from other vehicular traffic and reduced interactions with people along transportation routes, which also contributes to safety.**
- **Operational logistics are simpler and more efficient.**
- **There is a clear public preference for this option.**

The committee does not endorse the development of an extended truck transportation program to ship spent fuel cross-country or within Nevada should DOE fail to complete construction of the Nevada rail spur or procure the necessary rail equipment by the time the federal repository is opened.

RECOMMENDATION: DOE should fully implement its mostly rail decision by completing construction of the Nevada rail spur, obtaining the needed rail packages and conveyances, and working with commercial spent fuel owners to ensure that facilities are available at plants to support this option. These steps should be completed before DOE commences the large-quantity shipment of spent fuel and high-level waste to a federal repository to avoid the need to procure infrastructure and construct facilities to support an extended truck transportation program. DOE should also examine the feasibility of further reducing its needs for cross-country truck shipments of spent fuel through the expanded use of intermodal transportation (i.e., combining heavy-haul truck, legal-weight truck, and barge) to allow the shipment of rail packages from plants that do not have direct rail access.

S.4.2 Route Selection for Transportation to a Federal Repository

DOE's program to transport spent fuel and high-level waste to a federal repository will involve shipments from more than 70 sites in 31 states, most passing through or near one or more major U.S. metropolitan centers. DOE did not designate routes for these shipments in its final EIS for Yucca Mountain but instead plans to make selections about five years before the federal repository opens. Once DOE selects routes, it may be required to

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undertake selected route infrastructure improvements before any shipments can be made. It also must decide on safety and security procedures, arrangements for state inspections of shipments, communications and tracking, emergency responder training, and handling of en route contingencies. Most of these operations would be carried out by contractors.

FINDING: DOE has not made public a specific plan for selecting rail and highway routes for transporting spent fuel and high-level waste to a federal repository. DOE also has not determined the role of its program management contractors in selecting routes or specific plans for collaborating with affected states, tribes, and other parties.

RECOMMENDATION: DOE should identify and make public its suite of preferred highway and rail routes for transporting spent fuel and high-level waste to a federal repository as soon as practicable to support state, tribal, and local planning, especially for emergency responder preparedness. DOE should follow the practices of its foreign research reactor spent fuel transport program of involving states and tribes in these route selections to obtain access to their familiarity with accident rates, traffic and road conditions, and emergency responder preparedness within their jurisdictions. Involvement by states and tribes may improve the public acceptability of route selections and may reduce conflicts that can lead to program delays.

S.4.3 Use of Dedicated Trains for Transport to a Federal Repository

There has been a long-running controversy in the United States about whether rail shipments of spent fuel and high-level waste should be carried out using *dedicated trains*, which would carry only spent fuel or high-level waste, or *general trains*, which would carry other freight in addition to spent fuel or high-level waste. DOE's final EIS for Yucca Mountain did not provide a detailed analysis of the benefits of dedicated trains to support a decision on this issue. However, a decision by DOE to use dedicated trains was announced in July 2005.

FINDING: Studies carried out to date on transporting spent fuel by dedicated versus general trains have failed to show a clear radiological risk-based advantage for either option. However, the committee finds that there are clear operational, safety, security, communications, planning, programmatic, and public preference advantages that favor dedicated trains. The committee strongly endorses DOE's decision to transport spent fuel and high-level waste to a federal repository using dedicated trains.

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RECOMMENDATION: DOE should fully implement its dedicated train decision before commencing the large-quantity shipment of spent fuel and high-level waste to a federal repository to avoid the need for a stopgap shipping program using general trains.

S.4.4 Acceptance Order for Commercial Spent Fuel Transport to a Federal Repository

The Nuclear Waste Policy Act (NWPA) specifies that DOE must accept spent fuel based on the amount and order in which it was discharged from owners' reactors. Each time a commercial nuclear plant discharges fuel from its reactor, the owner receives an allocation in the "acceptance queue" to ship an equivalent amount of spent fuel to a federal repository. DOE will accept commercial spent fuel for shipment to the federal repository starting at the beginning of the queue and will work its way through the queue during the planned 24-year life of the transportation program. The NWPA allows owners to make available to DOE for shipment to the federal repository any spent fuel from any of their sites for each of their allocations in the acceptance queue. There are two exceptions to this requirement: (1) DOE may accord priority for acceptance of spent nuclear fuel from reactors that have been permanently shut down; and (2) with the approval of DOE, owners of spent fuel can exchange positions in the acceptance queue.

The order for accepting commercial spent fuel that is mandated by the NWPA could require DOE to initiate its transportation program with movements of spent fuel from multiple, geographically dispersed sites. Further, it gives DOE limited control over the age and radiological content of the fuel that is provided by owners for transport. Shipping older fuel first would give DOE a better ability to optimize routing, scheduling, and emergency responder planning and training, especially during the early phases of the program.

FINDING: The order for accepting commercial spent fuel that is mandated by the Nuclear Waste Policy Act (NWPA) was not designed with the transportation program in mind. In fact, the acceptance order prescribed by the NWPA could require DOE to initiate its transportation program with long cross-country movements of younger (i.e., radiologically and thermally hotter) spent fuel from multiple commercial sites. There are clear transportation operations and safety advantages to be gained from shipping older (i.e., radiologically and thermally cooler) spent fuel first and for initiating the transportation program with relatively short, logistically simple movements to gain experience and build operator and public confidence.

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RECOMMENDATION: DOE should negotiate with commercial spent fuel owners to ship older fuel first to a federal repository or federal interim storage, except in cases (if any) where spent fuel storage risks at specific plants dictate the need for more immediate shipments of younger fuel. Should these negotiations prove to be ineffective, Congress should consider legislative remedies. Within the context of its current contracts with commercial spent fuel owners, DOE should initiate transport through a pilot program involving relatively short, logistically simple movements of older fuel from closed reactors to demonstrate the ability to carry out its responsibilities in a safe and operationally effective manner. DOE should use the lessons learned from this pilot activity to initiate its full-scale transportation program from operating reactors.

S.4.5 Emergency Response Planning and Training

The transportation of spent nuclear fuel to a federal repository would utilize the same state and local emergency response capabilities that are in place to deal with existing materials transport accidents and incidents (see Appendix C). However, DOE has special responsibilities under the Nuclear Waste Policy Act for providing technical assistance and funding to states and tribal nations for training on both routine transportation procedures and emergency response. DOE will not begin providing such support until it identifies the routes for shipping spent fuel and high-level waste to Yucca Mountain.

FINDING: Emergency responder preparedness is an essential element of safe and effective programs for transporting spent fuel and high-level waste. Emergency responder preparedness has so far received limited attention from DOE, states, and tribes for the planned transportation program to the federal repository. DOE has the opportunity to be innovative in carrying out its responsibilities for emergency responder preparedness. Emergency responders are among the most trusted members of their communities. Well-trained responders can become important emissaries for DOE's transportation program in local communities and can enhance community preparedness to respond to other kinds of emergencies.

RECOMMENDATION: DOE should begin immediately to execute its emergency responder preparedness responsibilities defined in Section 180(c) of the Nuclear Waste Policy Act. In carrying out these responsibilities, DOE should proceed to (1) establish a cadre of professionals from the emergency responder community who have training and comprehension of emergency response to spent fuel and high-level waste transportation accidents and

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incidents; (2) work with the Department of Homeland Security to provide consolidated "all-hazards" training materials and programs for first responders that build on the existing national emergency response platform; (3) include trained emergency responders on the escort teams that accompany spent fuel and high-level waste shipments; and (4) use emergency responder preparedness programs as an outreach mechanism to communicate broadly about plans and programs for transporting spent fuel and high-level waste to a federal repository with communities along planned shipping routes.

These recommended innovations are also potentially applicable to the transportation program operated by Private Fuel Storage. The committee judges that there would be significant benefits to that program in terms of capacity and public confidence building through early and innovative actions to support emergency responder preparedness.

S.4.6 Information Sharing and Openness

Some participants at the committee's information-gathering meetings expressed concerns that federal agencies, in reaction to the September 11, 2001, terrorist attacks, are withholding information that could help the public evaluate the safety and security of spent fuel and high-level waste shipments. The committee itself encountered information restrictions in its efforts to obtain information on the number of past spent fuel shipments in the United States.

FINDING: There is a conflict between the open sharing of information on spent fuel and high-level waste shipments and the security of transportation programs. This conflict is impeding effective risk communication and may reduce public acceptance and confidence. Post–September 11, 2001, efforts by transportation planners, managers, and regulators to further restrict information about spent fuel shipments make it difficult for the public to assess the safety and security of transportation operations.

RECOMMENDATION: The Department of Energy, Department of Homeland Security, Department of Transportation, and Nuclear Regulatory Commission should promptly complete the job of developing, applying, and disclosing consistent, reasonable, and understandable criteria for protecting sensitive information about spent fuel and high-level waste transportation. They should also commit to the open sharing of information that does not require such protection and should facilitate timely access to such information: for example, by posting it on readily accessible Web sites.

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The public has a general right, subject to legitimate privacy and national security restrictions, to obtain information about government programs that affect their communities. Some general information is appropriate to share before shipments commence: This includes the reasons for making the shipments; information about the materials to be shipped; likely shipping modes; and general shipping time frames. Appropriate post-shipment information includes more details on the shipments, including specific modes and routes used for the shipments; the timing of shipments and quantities of materials shipped; accidents and incidents during the shipments; and any resulting response actions.

S.4.7 Organizational Structure of the Federal Transportation Program

The program for transporting spent fuel and high-level waste to a federal repository is embedded within the DOE's Office of Civilian Radioactive Waste Management. This agency is responsible for licensing, constructing, and operating the planned repository at Yucca Mountain, Nevada. Certain characteristics of the Yucca Mountain transportation program will make it exceptionally challenging to carry out successfully. The transportation program

- Will last for more than two decades;
- Is decentralized and involves a large number of parties in both government and the private sector over which DOE has limited control;
- Must operate with a high degree of consistency and reliability;
- Has limited flexibility over schedules because of spent fuel acceptance requirements; and
- Has limited budgetary control within DOE and is subject to the annual congressional appropriations process.

The transportation program is unusual in another sense: The committee knows of no other federal government-run program that has a requirement to take ownership of private-sector waste for the purposes of transport and disposal. Such programs are usually private-sector responsibilities.

FINDING: Successful execution of DOE's program to transport spent fuel and high-level waste to a federal repository will be difficult given the organizational structure in which it is embedded, despite the high quality of many current program staff. As currently structured, the program has limited flexibility over commercial spent fuel acceptance order (Section 5.2.4); it also has limited control over its budget and is subject to the annual federal appropriations process, both of which affect the program's ability to plan for, procure, and construct the needed transportation infrastruc-

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ture. Moreover, the current program may have difficulty supporting what appears to be an expanding future mission to transport commercial spent nuclear fuel for interim storage or reprocessing. In the committee's judgment, changing the organizational structure of this program will improve its chances for success.

RECOMMENDATION: The Secretary of Energy and the U.S. Congress should examine options for changing the organizational structure of the Department of Energy's program for transporting spent fuel and high-level waste to a federal repository. The following three alternative organizational structures, which are representative of progressively greater organizational change, should be specifically examined: (1) a quasi-independent DOE office reporting directly to upper-level DOE management; (2) a quasi-government corporation; or (3) a fully private organization operated by the commercial nuclear industry. The latter two options would require changes to the Nuclear Waste Policy Act. The primary objectives in modifying the structure should be to give the transportation program greater planning authority; greater budgetary flexibility to make the multiyear commitments necessary to plan for, procure, and construct the necessary transportation infrastructure; and greater flexibility to support an expanding future mission to transport spent fuel and high-level waste for interim storage or reprocessing. Whatever structure is selected, the organization should place a strong emphasis on operational safety and reliability and should be responsive to social concerns.

The committee strongly encourages the program to seek expert advice to learn about and incorporate best industry practices for designing and operating this transportation system using an integrated systems approach.

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1
Introduction

The National Academies' Board on Radioactive Waste Management[1] and Transportation Research Board initiated this study to address what they perceived to be a national need for an independent, objective, and authoritative analysis of spent nuclear fuel and high-level radioactive waste[2] transportation in the United States. The objectives of this study (Sidebar 1.1) were to identify key current and future technical and societal concerns about the transportation of spent fuel and high-level waste in the United States and technical and policy options for addressing those concerns and managing transportation risks.

This study also examined the selection of highway and rail routes for shipping research reactor spent fuel between U.S. Department of Energy (DOE) facilities in the United States (Sidebar 1.2). This additional examination was requested by the U.S. Department of Transportation (DOT) at the direction of Congress[3] after the study was under way. With the consent of the National Academies and the original study sponsors, the schedule for the study was extended to allow additional time for information gathering,

[1]The Board on Radioactive Waste Management was merged with another National Academies board in early 2005 to form the Nuclear and Radiation Studies Board.

[2]Also referred to as *spent fuel* and *high-level waste* in this report.

[3]Consolidated Appropriations Resolution, 2003, P.L. 108-7, February 20, 2003, Division I, Section 334.

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deliberation, and expansion of this report to address this added study charge.

The "current concerns" referred to in the original study charge (Sidebar 1.1) are associated with currently operating transportation programs and with current planning efforts for future transportation programs. The congressionally mandated charge (Sidebar 1.2) to examine the routing of research reactor spent fuel is a good example of a concern about a currently operating program. The "future concerns" referred to in the original charge are associated primarily with plans to transport spent fuel and high-level waste for interim storage or permanent disposal (see Section 1.3.2). As described in some detail in Chapter 5, these future concerns relate primarily to the difficulties in scaling-up transportation systems from the relatively small, centralized programs that presently exist for moving small quantities of spent fuel to the more complex decentralized programs that will likely be

SIDEBAR 1.1 Transportation of Radioactive Waste Study Task

The principal task of this study is to develop a high-level synthesis of key technical and societal issues for spent fuel/high-level waste transport and to identify technical and policy options for addressing these issues and managing transportation risk. The principal focus of this study is on the transportation of spent fuel and high-level waste in the United States, but the study will draw on international experiences as well as experiences with transporting other waste types. The study addresses and provides findings and recommendations on the following four questions:

1. What are the principal risks for transporting (including container handling, modal transfers, and conveyance) radioactive waste, and how do they compare with other societal risks? To what extent have these risks been addressed by previous analyses?
2. At present, what are the principal technical and societal concerns for transporting radioactive waste? To what extent have these concerns been addressed, and what additional work is needed?
3. What are likely to be the key principal technical and societal concerns for radioactive waste transportation in the future, especially over the next two decades?
4. What options are available to address these concerns, for example, options involving changes to planned transportation routes, modes, procedures, or other limitations/restrictions; or options for improving the communication of transportation risks to decision makers and the public?

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SIDEBAR 1.2 Transportation Routing Study Task

The principal task of this study will be to assess the manner in which the Department of Energy and its contractors:

(1) Select potential highway and rail routes for the shipment of spent nuclear fuel from foreign and domestic research nuclear reactors.
(2) Select specific land routes for such shipments.
(3) Conduct assessments, if any, of the risks associated with such shipments.

The following factors will be considered in conducting the assessments in point (3):

(i) Proximity of routes to major population centers and the risks associated with shipments of spent nuclear fuel from research nuclear reactors through densely populated areas.
(ii) Current traffic and accident data with respect to the routes under consideration.
(iii) Quality of the roads comprising the routes under consideration.
(iv) Emergency response capabilities along the routes under consideration.
(v) Proximity of the routes under consideration to places or venues (including sports stadiums, convention centers, concert halls and theaters, and other venues) where large numbers of people gather.

The assessment should identify deficiencies, if any, in current procedures for selecting routes that have important potential health or safety consequences. In making recommendations to address these deficiencies, a clear distinction should be made between technical and policy considerations. Recommendations should be directed at competent regulating authorities or the United States Congress.

required to move large quantities of spent fuel and high-level waste to interim storage or permanent disposal.[4]

1.1 STUDY PROCESS

Most National Research Council studies are undertaken in response to requests from federal agencies, the White House, or Congress. In contrast, the transportation study described in Sidebar 1.1 was self-initiated by the

[4]This report refers to these two types of programs as *small-quantity shipping programs* and *large-quantity shipping programs*. While there is no precise quantity demarcation between these two program types, the former involves shipment on the order of tens of metric tons of spent fuel or high-level waste, while the latter involves shipment on the order of hundreds to thousands of metric tons.

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National Research Council. Three federal agencies and two not-for-profit private organizations recognized the importance of this study and provided the necessary financial support to enable the National Research Council to carry it out. These organizations are DOE, DOT, U.S. Nuclear Regulatory Commission (USNRC), Electric Power Research Institute (EPRI), and National Cooperative Highway Research Program. The National Academies also contributed funding to this effort.

The study was carried out using established National Research Council procedures to ensure its objectivity and freedom from inappropriate influences of sponsors and other outside organizations. A committee of 16 experts was provisionally appointed by the chair of the National Research Council to carry out the study. These appointments were finalized after a careful screening for conflicts of interest and consideration of public comments on committee balance and bias. The committee had diverse expertise and perspectives, including experts with experience in a variety of transportation sectors and related technical disciplines. The biographical sketches of the committee members (Appendix A) illustrate their collective range of technical and policy expertise.

The committee was responsible for designing and executing this study. It made an effort to reach out broadly to obtain information and perspectives, and it benefited greatly from the willingness of a large number of individuals and organizations to share information and viewpoints. The committee held six information-gathering meetings in different regions of the country to address its original charge. The committee chose the locations of its meetings to enhance attendance and participation of interested individuals and organizations. An additional information-gathering meeting was added to address the congressionally mandated study charge (Sidebar 1.2). A list of presentations received at these meetings is provided in Appendix B.

The committee also visited Yucca Mountain and some of the potential highway and rail routes within Nevada. Subgroups of the committee visited a spent fuel storage facility at an operating nuclear power plant (Exelon Nuclear Corporation's Dresden Plant in Chicago); the Transportation Technology Center in Pueblo, Colorado, to learn about rail transportation research and development programs; and Germany and the United Kingdom to learn about European transportation programs.

Open-microphone sessions were scheduled at each of the committee's information-gathering meetings so that any interested individual could speak directly to the committee. The committee also gathered a large amount of written material, ranging from peer-reviewed scientific articles to advocacy papers, for use in its deliberations.

The committee established an electronic notification list so that interested parties could be informed of upcoming meetings. Additionally, the

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committee established a Web site (*http://www.national-academies.org/transportationofradwaste*) for the study, where copies of the meeting agendas and electronic copies of the meeting presentations were posted. This site allowed visitors to provide feedback to the committee. The National Academies Press carried out an informal survey of selected government and nongovernmental organizations to obtain feedback to guide the future development of information products from this study.

The committee's final report was subjected to National Research Council peer review before being approved for unlimited public release. The report was reviewed by 15 people selected by the Report Review Committee of the National Research Council to provide a diversity of disciplinary expertise and viewpoints. The reviewers were asked to comment on whether the report addressed the study charges (Sidebars 1.1 and 1.2) in a fair and objective manner and whether the findings and recommendations were supported by fact and analysis. The committee was required by the National Research Council to make appropriate revisions to its report to address those comments.

The report's findings and recommendations were not provided to the study sponsors or to the public until the review process had been completed and the report was approved for release. This is standard National Research Council procedure to ensure that no outside organization is able to influence the outcome of its studies inappropriately.

The committee heard a wide range of opinions about spent fuel and high-level waste transportation during its information-gathering meetings. It was presented with a range of views about the safety and security[5] of spent fuel transportation in the United States and—although it was not within the purview of the study—about the desirability of a federal repository at Yucca Mountain, Nevada, or a centralized interim storage facility in Utah. It quickly became clear to the committee that there are many individuals and groups with strongly held "pro" and "anti" positions on issues related to nuclear technology, and that some of these positions are expressed in terms of support for or opposition to the transport of spent fuel and high-level waste. This report is written in the hopes of providing these individuals and groups with a broad range of factual information and analyses to enable them to reach their own conclusions about spent fuel and high-level waste transportation, and also to inform future planning and decision making by federal agencies and the private sector.

[5]*Safety* refers to measures taken to protect spent fuel and high-level waste during handling and transport from failure, damage, human error, and other inadvertent acts. *Security* refers to measures taken to protect spent fuel and high-level waste during handling and transport from sabotage, attacks, and theft.

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Although this is a technical report, it was written with the intention that it be accessible to non-experts. The committee has endeavored to keep the use of technical terms and acronyms to a minimum and to provide clear definitions when such terms must be used. A glossary of terms and a list of acronyms are provided in Appendixes D and E, respectively.

1.2 STRATEGY FOR ADDRESSING THE STUDY CHARGES

The original study charge (Sidebar 1.1) was broadly scoped to give the committee flexibility in carrying out this study. The committee found it necessary to make several explicit choices to narrow the scope of its charge to meet the study schedule. In this section, the committee explains these choices to set readers' expectations for the remainder of this report.

The original study charge directed the committee to examine the risks of transporting spent fuel and high-level waste in the United States. Risk is a multidimensional concept: It includes the health and safety risks that potentially arise from exposures of workers and members of the public to radiation from spent fuel and high-level waste transport. Such exposures can have both short-term and long-term health and safety consequences. There is another broad class of risks, referred to as *social risks*, that is described in this report. Social risks arise from social processes and human perceptions and can have economic, institutional, and psychological consequences. The health and safety risks and social risks are collectively referred to as *societal risks* in the statement of task given in Sidebar 1.1.

The committee examined the health and safety and social risks associated with spent fuel and high-level waste transportation activities (Chapter 3) in isolation from the larger systems in which they are embedded. Programs for transporting spent fuel and high-level waste for interim storage or permanent disposal represent the "back ends" of much larger technological systems: Commercial spent fuel transport represents the back end of the nuclear electric power generation system of the United States, whose needs, benefits, and risks are the subject of controversy for some members of the public; research reactor spent fuel transport represents the back end of systems that generate scientific and medical benefits for U.S. society; and defense spent fuel and high-level waste transport represents the back end of systems that generated plutonium for national defense.

A risk-benefit analysis of spent fuel and high-level waste transportation within the context of these larger technological systems, although certainly desirable, would involve the consideration of issues that are well beyond the scope of this study. Such issues would include, for example, national energy policy, global climate change, nuclear nonproliferation, and homeland security. Such an analysis would also have to address the risks and benefits of transporting spent fuel and high-level waste to interim storage or

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permanent disposal sites versus leaving it at reactor sites for an indeterminate period of time.

While comparisons of the transport versus leave-in-place options are conceptually simple, the analysis is not. Each of these options involves different kinds of risks that have different spatial and time-scale dependencies. The transport option involves the transfer of risk across populations and geographic regions, possibly leading to significant disproportionate impacts: for example, the transfer of nuclear materials such as spent fuel from existing storage sites to new storage or disposal sites that did not previously contain any nuclear materials or activities. Analysis of these options would also have to consider important secondary effects: The transport of spent fuel and high-level waste, for instance, might result in improvements to transportation infrastructure or first-responder training. These improvements could result in a reduction of other types of hazardous materials transport risks.

The committee concluded that while such an analysis would be a useful contribution to the policy process, it could not be carried out in the abstract but would have to examine real scenarios. Instead, the committee operated within the constraints of federal policy decisions, beginning with the Nuclear Waste Policy Act as described in Section 1.3.2, which set the nation on a clear path to transport spent fuel and high-level waste for permanent disposal. The intent of this study is to enhance the technical and societal bases for the transportation of spent fuel and high-level waste, regardless of their ultimate destination.

The committee also decided to focus its examinations on the transport of spent fuel and to give less attention to the transport of defense high-level radioactive waste. The committee judged that the transport of spent fuel posed more important technical and societal challenges because most spent fuel is generated commercially (see Table 1.1); it is being stored at a large number of sites across the United States; and it has been transported on the nation's road and rail systems for several decades.

Defense high-level waste, on the other hand, is government generated and owned and is being stored at only four government sites (Figure 1.1), all of which have direct rail access. High-level waste has radiological properties similar to spent fuel, especially for fission product inventories, which are the greatest contributors to potential external radiation doses during normal transport.[6] However, high-level waste will be transported in an inert solid form, and the process used to solidify this waste (see Sidebar 1.3) eliminates the gaseous fission products that are present in spent fuel. Under

[6]Some long-lived radionuclides, primarily uranium and plutonium, are removed from high-level waste during reprocessing.

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TABLE 1.1 Inventories of Spent Nuclear Fuel and High-Level Waste in the United States

Material	Approximate Quantity at End of 2005
Commercial spent fuel	54,000 MTHM[a]
DOE-managed spent fuel[b]	2433 MTHM
Colorado (Fort St. Vrain)	15 MTHM
Hanford Site	2129 MTHM
Idaho National Lab	277 MTHM
Savannah River	27 MTHM
High-level waste	386,000 cubic meters of unprocessed waste,[c] which when processed will consist of[d] 21,000 cubic meters 58,000 metric tons[e] 22,000 canisters[f]

NOTE: MTHM = metric tons of heavy metal.

[a]This quantity is an estimate and was obtained by adjusting the 2002 DOE Energy Information Administration (DOE-EIA) estimate of 47,023 MTHM to account for spent fuel discharges during 2003–2005. Those discharges were estimated using the average of the annual discharges reported by DOE-EIA for the period 1999–2002. The result was rounded to the nearest 1000 MTHM.

[b]Data from DOE, written communication. Includes production reactor fuel, naval spent fuel, foreign and domestic research reactor fuel, and DOE-managed commercial spent fuel.

[c]Data from DOE (2005a) for Savannah River and written communications to the National Academies for Hanford and Idaho.

[d]Data on the processed waste from DOE (2002a, Table A-27).

[e]This is the processed mass of the waste, not MTHM.

[f]Canisters contain high-level waste that has been processed (vitrified) in glass matrices. The canisters are 24 inches (60 centimeters) in diameter by 10 or 15 feet (3 to 4.5 meters) in length. This number is an estimate because only a small fraction of the high-level waste at DOE sites has been immobilized (see Sidebar 1.3).

current plans, high-level waste will be transported to the federal repository in the same types of packages used to transport commercial spent fuel, but high-level waste shipments will comprise fewer than 20 percent of the total planned number of shipments to the federal repository at Yucca Mountain under the "mostly rail" option now favored by DOE (see Table 3.8).

The committee describes the high-level waste locations and inventories and the plans for disposing of it elsewhere in this chapter. It also reviews the risk estimates for transport of high-level waste to the federal repository as part of its risk examinations in Chapter 3. The committee judged that its focused examination of spent fuel transport would likely identify and bound

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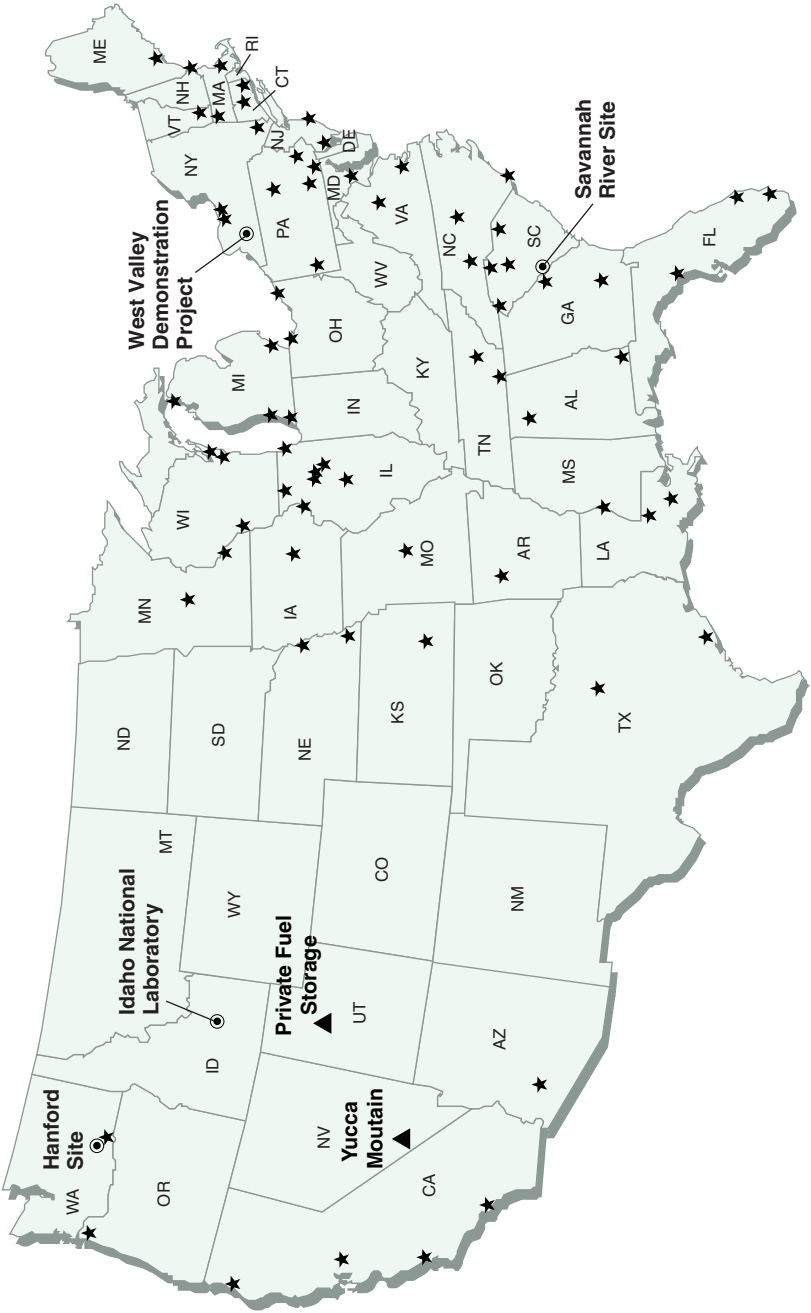

FIGURE 1.1 *Continues*

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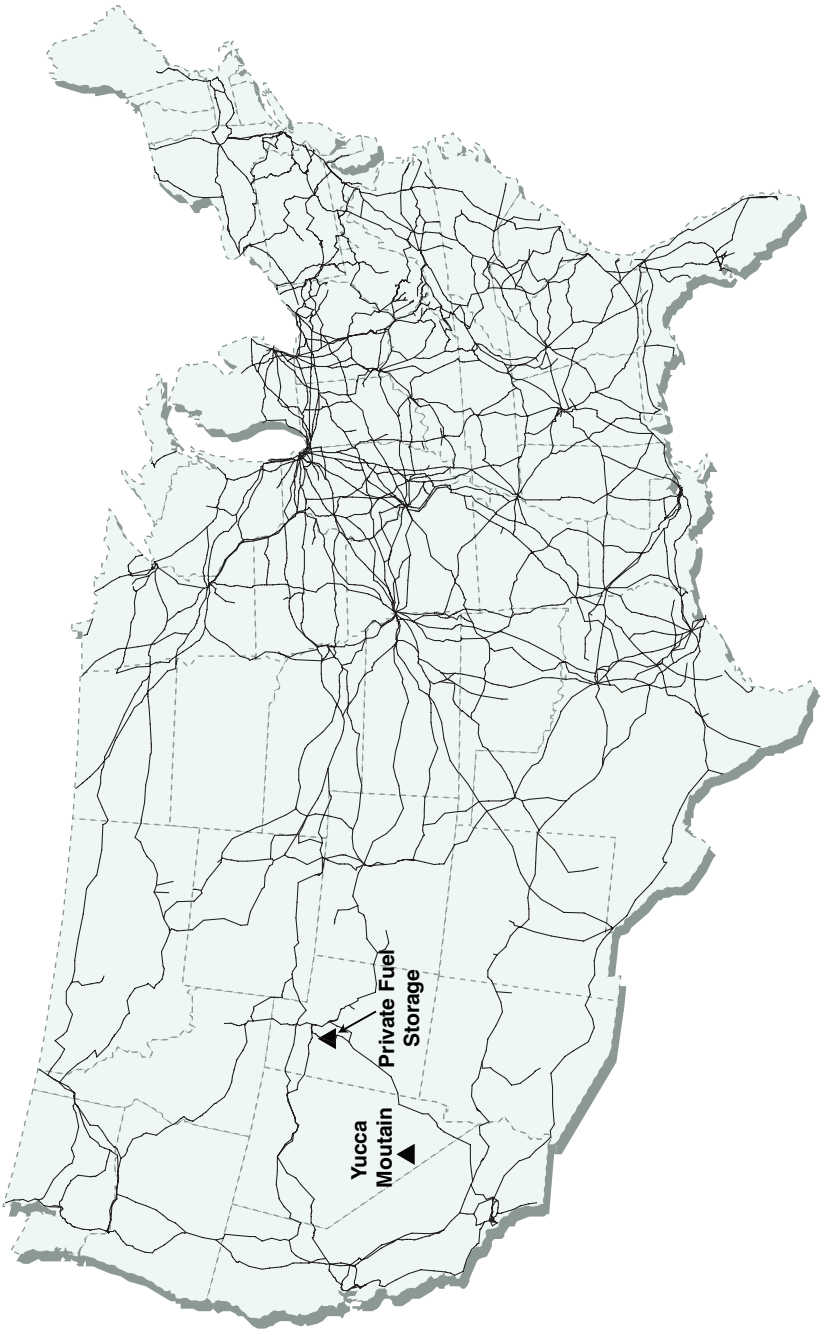

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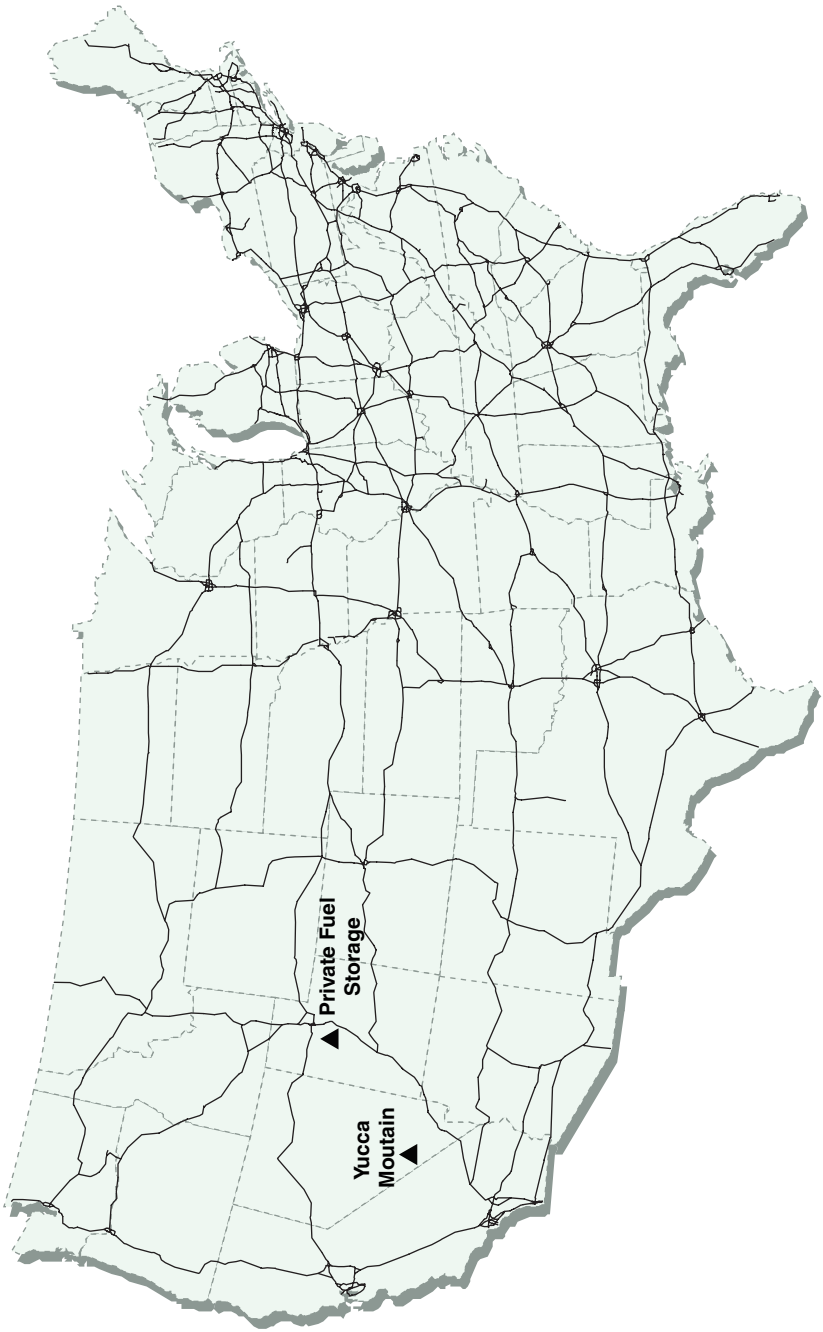

FIGURE 1.1 *Top:* Locations of current spent fuel and high-level waste storage sites, Yucca Mountain, and Private Fuel Storage. *Middle:* National railroad transportation grid. *Bottom:* National interstate highway system. SOURCE: modified from DOE (2002a).

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SIDEBAR 1.3 Spent Nuclear Fuel and High-Level Radioactive Waste

The nuclear fuel for most commercial reactors consists of pellets of uranium dioxide surrounded by a zirconium oxide alloy (zircaloy) fuel cladding that is formed into long rods. These *fuel rods* are between 3.5 and 4.5 meters in length and are bundled together into *fuel assemblies* (see figure), each weighing between about 600 and 1500 pounds (275 to 685 kilograms). The uranium dioxide pellets contain two isotopes of uranium: About 3 to 5 percent by weight is uranium-235, which sustains the fission chain reaction in a nuclear reactor, and about 95 to 97 percent is uranium-238, which can capture a neutron to produce plutonium and other heavy elements (known as *actinides*). The fission of uranium-235 and plutonium in an operating reactor generates heat, which is used to produce steam. This steam drives turbines that produce electricity. The fission and neutron-capture reactions also convert uranium, plutonium, and other actinides into nearly 300 other radionuclides in the fuel. These include *fission products* such as strontium-90 and cesium-137 and actinides such as neptunium-237.

As uranium-235 is consumed by fission reactions in an operating reactor, the fuel gradually loses its ability to sustain a chain reaction at full power. After a period of residence in the reactor (typically four to six years for most currently operating reactors), the fuel is considered to be *spent* and is removed from the reactor. At the time of discharge from a reactor, a spent fuel assembly typically generates on the order of tens of kilowatts of heat and radiation doses on the order of thousands of rads per hour (see Sidebar 3.2) at its surface. It must be cooled and heavily shielded to protect workers and the public. A person standing next to an unshielded spent fuel assembly could receive a lethal dose of radiation in a very short time: on the order of minutes for freshly discharged fuel with a high fission product content. Heat production and radioactivity diminish with time as shorter-lived radionuclides decay away. However, some longer-lived radionuclides persist in the spent fuel for hundreds of thousands of years.

High-level radioactive waste is the liquid by-product of the first stage of chemical reprocessing of spent fuel. Civilian reprocessing of commercial spent fuel is used to recover the uranium and plutonium in the spent fuel for recycling into fresh fuel.[a] Reprocessing of fuel from defense production reactors was used to recover plutonium for use in nuclear weapons. High-level waste contains most of the radioactive constituents of the spent fuel except for long-lived radionuclides such as uranium and plutonium. This liquid waste also contains a variety of organic and inorganic chemicals from processing operations.

High-level waste is solidified before it can be transported for interim storage or disposal. The current U.S. technology for solidifying high-level waste is vitrification in borosilicate glass. High-level waste is processed to reduce its volume and remove chemicals that would interfere with the glass-forming process. This processed waste is mixed with molten glass, and the mixture is poured into stainless steel canisters and allowed to solidify (see figure). Twenty-five percent (by mass) or higher waste loadings in the glass can typically be achieved with current technologies. Like spent fuel, the high-level waste canisters generate heat and intense radiation fields. They must be heavily shielded to protect workers and the public.

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[a]As noted previously, the United States does not currently reprocess commercial spent fuel, but power-reactor fuel is reprocessed by some other countries.

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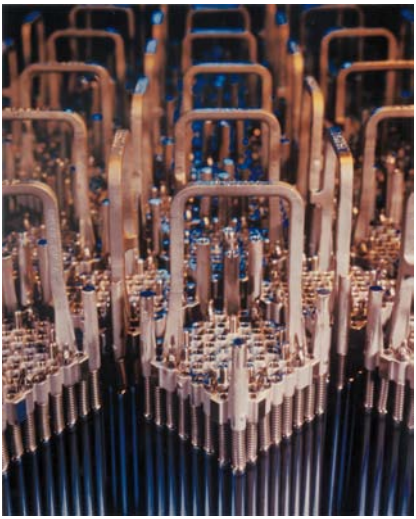

Top: Fuel rods are bundled together into fuel assemblies as shown here. These fuel assemblies are for a boiling water reactor. *Bottom:* Canister of high-level waste from the West Valley Demonstration Project. The canister is 2 feet (0.6 meter) in diameter, 10 feet (3 meters) long, and weighs about 2 metric tons. SOURCES: Top photo courtesy of the Nuclear Energy Institute. Bottom photo courtesy West Valley Nuclear Services Company.

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the risks and the technical and societal challenges for transport of high-level waste.

The committee also did not address the *security risks* of spent fuel and high-level waste transportation in this report. Transportation security has received a great deal of media and public attention since the September 11, 2001, terrorist attacks on the United States. In fact, several presenters at the committee's information-gathering meetings highlighted this issue as an important current concern for transportation of spent fuel and high-level waste in the United States.

The committee explored the feasibility of including a substantive examination of transportation security risks in this report. The committee determined that there is a rich literature in existence that could inform such an examination. However, much of this literature is classified or otherwise restricted from public access, and most committee members do not have the necessary security clearances to access it. At the committee's request, staff from the USNRC's Spent Fuel Project Office provided a classified briefing to four committee members and one staff member with security clearances. This briefing provided an overview of current USNRC-sponsored studies to assess the vulnerability of transportation packages to certain types of terrorist attacks. This briefing confirmed the committee's initial view that adequate information exists to undertake a substantive examination.

The committee also requested written guidelines from the USNRC on the public disclosure of information from these and related vulnerability studies. Commission staff were supportive of this request but were unable to provide the necessary guidelines in time for use in this study.[7] The committee concluded that, given these information-access difficulties and the lack of written guidelines for using such information, it could not provide a substantive examination of transportation security in this report.

As will be discussed in Chapter 3, the committee judged that transportation security remains a critical technical issue with important societal implications for spent fuel and high-level waste transportation in the United States. While the committee could not examine transportation security in this report, it judged that this issue could be addressed in a substantive fashion by a future committee if it is given unrestricted access to the classified literature on this topic.

1.3 BACKGROUND ON SPENT FUEL AND HIGH-LEVEL WASTE

Spent nuclear fuel and high-level radioactive waste (Sidebar 1.3) are the by-products of commercial nuclear energy generation, defense plutonium

[7]The guidelines were still under internal review within the Commission when the committee held its last meeting in July 2005.

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production, and research and medical activities that utilize nuclear reactors or fission product nuclides. In the United States, these waste by-products are now being stored at more than 70 sites in 31 states (Figure 1.1). Current national policy, which is embodied in the Nuclear Waste Policy Act (NWPA; see Section 1.3.2), calls for these materials to be transported and permanently disposed of in an underground repository that is licensed, constructed, and operated by the federal government.[8] The federal government is now attempting to site and construct a repository for this purpose at Yucca Mountain, Nevada (see Figure 1.1). The federal government is also required by the NWPA to accept ownership of commercial spent fuel for transport to and disposal in this repository.

While this study is silent on policy decisions related to the storage and disposal of spent fuel and high-level waste, the decisions themselves are important to understand because they influence many of the issues that are addressed in this report. The objective of this section is to provide more detailed background information on spent fuel and high-level waste, plans for their long-term disposition, and an overview of the regulations that govern their transport across the nation's highways and railways. This background information will support the more detailed discussions of transportation concerns in subsequent chapters. Knowledgeable readers may wish to skip this section and turn directly to Chapter 2.

1.3.1 Origin of Spent Fuel and High-Level Waste

The Atomic Energy Act (AEA) of 1954[9] opened the way for privately owned companies to build and operate commercial nuclear power plants in the United States. The nation's first commercial nuclear power reactor began operations at Shippingport, Pennsylvania, in late 1957, slightly more than three years after the AEA became law. Over the ensuing three decades, more than 100 power reactors were licensed to operate within the United States. Many more reactors were planned, but their construction was never realized because of an electrical supply overcapacity and the rapid escalation in nuclear plant construction costs due to increased construction times and high interest rates.

The development of commercial nuclear reactor designs, siting requirements, and regulation was based on a number of expectations and requirements. Two of these—situating reactors near populated areas and reprocessing of nuclear fuel—have had a significant influence on shaping programs transporting commercial spent fuel and also gave rise to many

[8]Referred to in this report as the "federal repository."
[9]P.L. 83-703, August 30, 1954.

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of the current and future transportation concerns that are addressed in this report.

Commercial power reactors were designed to meet stringent siting criteria that permitted their construction near power consumers, an important requirement in the 1960s and 1970s because of technology limitations on electric power transmission distances.[10] Metropolitan sprawl over the past four decades has greatly increased population densities around many commercial nuclear power plants, especially in the eastern and midwestern United States. It has also increased population densities along highways and rail routes, many of which are linked through major cities. Much of the U.S. commercial spent fuel inventory is now being stored at sites near major populations, many spent fuel shipments originate from highly populated areas, and most shipments will pass through population centers on their way to temporary storage or permanent disposal.

It was also envisioned that the commercial nuclear power industry would operate under a *closed fuel cycle* in which spent fuel would be reprocessed to recover its reusable contents. This could include the recovery of uranium and plutonium[11] for recycling into fresh reactor fuel and other radionuclides for use in industry, medicine, and research. The liquid waste product from this operation, *high-level radioactive waste*, was to be immobilized in solid matrices and eventually disposed of in a permanent repository (see Sidebar 1.3). Power plant operators would be required to store spent fuel on-site in *spent fuel pools* (see Sidebar 1.4) only for about six months after its discharge from a reactor. The spent fuel would then be transported off-site to be reprocessed.

Commercial facilities to reprocess spent fuel were constructed at West Valley, New York, in the 1960s and Morris, Illinois, in the 1970s (Figure 1.1). The construction of a third facility at Barnwell, South Carolina, was eventually withdrawn from the licensing process. The West Valley facility operated from 1966 to 1972 and reprocessed both commercial and defense spent fuel. The reprocessing facility at Morris never opened because of design problems. The facility did, however, accept about 700 metric tons

[10]Proximity of electrical production to consumption is dictated by electrical generating and transmission technologies. The U.S. electrical transmission system utilizes mostly alternating-current circuits so that transformers can be used to control voltages. However, capacitance build-up in alternating-current transmission lines limits transmission distances to about 300 miles. High-voltage direct-current transmission lines, which allow electrical power to be moved over longer distances, did not come into common use until the 1970s and are now used primarily to transmit electricity among different geographic regions of the United States.

[11]As described in Sidebar 1.3, plutonium, like uranium-235, can be used as a fuel for commercial power reactors because it is *fissile*. That is, it can undergo fission after capturing a thermal neutron.

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of spent fuel for reprocessing from commercial power plants. That spent fuel remains in pool storage today.

In early 1977, President Jimmy Carter made a policy decision not to provide further federal support for reprocessing of commercial spent fuel because of the perceived risk of diversion of plutonium.[12] This decision was made to set an example for other nations in the hope that they would abandon reprocessing. The decision was later reversed in 1981 during the administration of President Ronald Reagan, but no U.S. commercial reprocessing facilities have been constructed as a result of this decision.[13]

The decision by President Carter would have far-reaching implications for the management, transport, and disposal of spent fuel and high-level waste. Most significantly, it changed the operating basis for the U.S. commercial nuclear power industry to an *open fuel cycle* in which spent fuel is discarded rather than recycled.

The Atomic Energy Commission (AEC), the predecessor agency to the USNRC and DOE, had established a program in the mid-1950s to investigate options for disposing of high-level waste from commercial reprocessing. However, decisions about locating and constructing a disposal facility were still decades away, and little thought had been given up to that point to disposing of spent fuel directly. Lacking a near-term disposal option, power plant operators were forced to make provisions for interim storage of spent fuel at plant sites.

By the late 1970s, spent fuel pools at the oldest operating commercial nuclear power plants were approaching their design storage capacities. Operators were able to increase storage capacities at some plants by replacing the original storage racks, which were designed with open spaces between fuel storage cells for water circulation, with dense racks that reduced this open space. This *re-racking* process allowed plant operators to increase storage densities in their pools up to about a factor of five (Emit et al., 2003). This step postponed but did not eliminate the need for additional spent fuel storage at most commercial nuclear power plants.

To relieve the growing shortage of spent fuel storage space, the commercial nuclear industry also developed "dry" systems for storing spent fuel that had been out of the reactor for at least five years (Sidebar 1.4). These

[12]Fresh commercial nuclear fuel typically contains between 3 and 5 percent uranium-235 and 95 to 97 percent uranium-238. In an operating reactor, plutonium-239 is formed when uranium-238 captures a neutron.

[13]France, Russia, and the United Kingdom reprocess spent fuel from power reactors, and Japan is constructing a reprocessing facility. The United Kingdom shut down its facility for reprocessing oxide fuel (Thorp) in 2005 when a radioactive leak was discovered in one of its operating cells. It is not clear whether this facility will be ever be restarted. Reprocessing of metallic (Magnox) fuel continues.

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SIDEBAR 1.4 Spent Fuel and High-Level Waste Storage

Immediately after removal from a nuclear reactor, spent fuel assemblies are stored in deep water-filled pools called *spent fuel pools* (see figure). The water provides radiation shielding and cooling and also captures non-fixed radioactive material on the external surfaces of the fuel rods. The fuel is stored in racks that contain neutron absorbers (e.g., boron, hafnium, cadmium) to help prevent criticality events (i.e., self-sustaining nuclear reactions such as those that occur when the fuel is in the reactor). The pool water is circulated through heat exchangers for cooling and ion-exchange filters to capture radioactive contaminants.

When a spent fuel pool reaches its storage capacity, the older fuel in the pool may be moved to other pools or placed into dry casks, as shown in the figure. These casks are typically constructed of steel and concrete and are designed to be placed outdoors on reinforced concrete storage pads at reactor sites. The casks are loaded by placing them directly into the spent fuel pool. Once loaded, the cask is closed, water is drained out, the fuel is dried, and the cask is filled with an inert gas. The exterior surfaces of the cask are also decontaminated to remove radioactive materials picked up from the pool water. The cask is moved by cranes and shielded transport vehicles to the storage pad.

Dry casks provide passive cooling of the spent fuel through a combination of heat conduction, natural convection, and thermal radiation. Shielding against radiation is provided by the cask materials: Concrete, lead, depleted uranium, or steel are used to shield penetrating beta and gamma radiation, and polyethylene, concrete, and boron-impregnated metals or resins are used to shield neutrons (neutrons are created in spent fuel by spontaneous fission and alpha particle interactions). Criticality control is provided by the basket that holds the spent fuel assemblies within individual compartments in the cask. The basket may contain boron-doped metals to absorb neutrons.

Standard industry practice is to place in dry storage only spent fuel that has cooled for five years or more after removal from the reactor. Dry casks are designed for specific types of spent fuel and for specific fuel burn-ups. The latter is a measure of the degree to which uranium-235 has been utilized in the reactor, which determines the amount of heat generation and radiation in the spent fuel. Dry casks are designed either for storage only or for both storage and transport. The former are referred to as single-purpose storage systems, and the latter as dual-purpose systems.

Dry cask storage first began in the United States in the mid 1980s and utilized single-purpose systems. Today, dry storage facilities utilize dual-purpose systems that are also suitable for rail transport. A large number of designs are available commercially.

Top: View into a spent fuel pool showing racks for storage of spent fuel. Workers are manipulating a spent fuel assembly. SOURCE: Nuclear Energy Institute. *Bottom:* Spent fuel storage (gray) and transportation (white) packages on a storage pad at a power plant. The smaller photo shows one of the storage packages being moved to the storage pad. The workers in the figure provide scale. SOURCE: Southern Company

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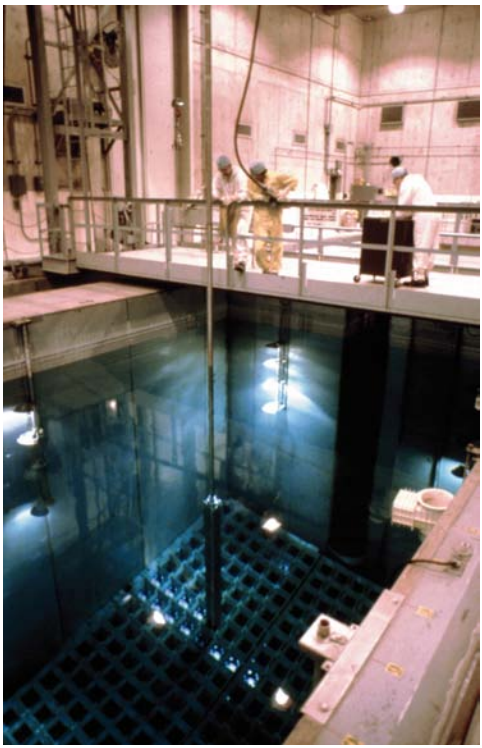

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systems store spent fuel in large steel and concrete casks designed to be placed outdoors on reinforced concrete pads at power plant sites. Each cask can typically store between about 10 and 18 metric tons (11 and 20 short tons[14]) of spent fuel. The first dry cask storage facility was established at the Surry Nuclear Power Plant (Virginia) in 1986. By 2004, dry storage facilities had been established at 29 U.S. power plants. This number is expected to increase in the future, especially if there are further delays in the construction of a federal repository or if away-from-reactor interim storage is not licensed or constructed.

Nuclear power plant operators in some states have encountered opposition from state regulatory agencies and the public to the establishment of dry storage facilities at their plant sites. Partly as a result, a consortium of operators (Private Fuel Storage, LLC) was formed to construct and operate a centralized dry cask storage facility on Goshute tribal lands in the desert southwest of Salt Lake City (see Figure 1.1) to relieve the growing storage pressures at plant sites. If constructed, this facility could store up to 40,000 metric tons of commercial spent fuel from multiple power plants. A license application for this facility was submitted to the USNRC in 1997. On September 9, 2005, following extensive hearings by the Atomic Safety Licensing Board, the Commission found that there were no further adjudicatory issues to be resolved. It authorized staff to issue a license to construct and operate this facility under the conditions in 10 CFR 72.40.[15]

The consortium expects to begin shipping spent fuel to this facility primarily by dedicated train[16] before the end of this decade. To ship by train, however, the consortium must first build a rail line across lands managed by the federal Bureau of Land Management (BLM). BLM cannot approve the use of its land for this purpose until the Secretary of Defense submits a report to Congress that evaluates the impacts of such construction on military training, testing, or operational readiness.[17] Additionally, the State of Utah strongly opposes this facility and is considering an appeal or court action to block the licensing decision.

Approximately 54,000 metric tons (60,000 short tons) of spent fuel were in storage at commercial power plants nationwide at the end of 2005

[14]A short ton is 2000 pounds (about 900 kilograms); a metric ton is 1000 kilograms.

[15]Title 10 Part 72 of the Code of Federal Regulations: Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste. Part 72.40 describes the conditions under which a license can be issued.

[16]Dedicated trains are trains that transport only spent fuel and high-level waste and no other cargo. These are described in more detail in Chapter 5.

[17]This provision was added to the fiscal year 2000 defense bill by a member of the Utah congressional delegation.

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(Table 1.1). The U.S. commercial nuclear industry generates about 2000 metric tons (2200 short tons) of spent fuel each year, approximately 20 metric tons (22 short tons) from each of the 103 currently operating reactors. Under current U.S. policy, all of this spent fuel will continue to be stored at power plant sites or at a centralized storage facility such as Private Fuel Storage, LLC, until it can be transported to a federal repository for permanent disposal.

The federal government holds substantial inventories of spent fuel and high-level waste. The government operated defense reactors and reprocessing plants at sites near Hanford, Washington, and Savannah River, South Carolina, to produce plutonium for nuclear weapons. These facilities operated into the 1980s and produced more than 100 metric tons of plutonium. The government operated a facility at the Idaho National Laboratory[18] to reprocess naval and test reactor spent fuel. As noted previously, the commercial facility at West Valley, New York, also reprocessed a small amount of defense spent fuel. The volumes of currently stored high-level waste from these reprocessing operations are shown in Table 1.1. About 386,000 cubic meters of high-level radioactive waste[19] is stored at Hanford, Savannah River, and Idaho. Current U.S. policy calls for all of this high-level waste to be processed by immobilizing it in glass matrices (a process known as vitrification) and stored on-site until it can be shipped to a federal repository.

There are also about 2129 MTHM (metric tons of heavy metal) of defense reactor spent fuel in storage at the Hanford Site. This fuel was irradiated in one of the plutonium production reactors (the N-reactor) at that site but was never reprocessed. The fuel, much of which is highly corroded from decades of storage underwater, is being dried and placed in storage canisters. It too will eventually be shipped to a federal repository.

The federal government (through DOE) also supplies reactor fuel to university, government, and foreign research reactors, the latter under the Atoms for Peace Program.[20] Some of this fuel will eventually be returned to DOE. Foreign spent fuel is being transported from overseas by ship to the

[18]Formerly named the Idaho National Engineering and Environmental Laboratory.

[19]This waste was generated from the reprocessing of about 170,000 metric tons of spent fuel from plutonium production reactors. The original volumes of high-level waste were much greater. Volume reductions were obtained through various processing methods.

[20]The Atoms for Peace Program began under the Eisenhower Administration in 1954. The U.S. government supplied research reactor technology and nuclear fuel to foreign nations that agreed to forgo the development of nuclear weapons. Research reactors were built in 41 countries. In 1996, DOE issued an Environmental Impact Statement (DOE, 1996a) on the management of this fuel and issued a Record of Decision (DOE, 1996b) to return this fuel to the United States for eventual disposal. See Chapter 4.

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Naval Weapons Station in Charleston, South Carolina.[21] From there it is offloaded and transported by either train or truck to the Savannah River Site, and some is transported onward to the Idaho National Laboratory by truck. Domestic research reactor spent fuel is being shipped to Savannah River and Idaho by reactor operators. Additional details on this program are provided in Chapter 4. Under current U.S. policy, all DOE's spent fuel and high-level waste will eventually be disposed of in a federal repository.

The DOE Naval Nuclear Propulsion Program is responsible for managing spent fuel from the U.S. Navy. This spent fuel is from nuclear submarines, ships, and training reactors belonging to the U.S. Navy. The spent fuel is offloaded at Navy facilities and shipped by commercial train to a naval spent fuel storage facility at the Idaho National Laboratory using U.S. government-owned transport packages and rail cars. The Naval Propulsion Program also will be responsible for shipping its naval spent fuel to the federal repository. At the end of 2005, about 19.5 MTHM of naval spent fuel was in storage at the Idaho site.

Under current U.S. policies, all of the spent fuel and high-level waste in the United States will be permanently disposed of in a federal repository. These policies are described in the next section of this chapter.

1.3.2 Disposal of Spent Fuel and High-Level Waste

The AEC began to consider options for disposal of high-level waste in the early 1950s. Conferences were held in 1954 at Woods Hole, Massachusetts, and Washington, D.C., to explore options for disposing of this waste in the oceans and on land. In 1955, the AEC signed a contract with the National Academy of Sciences to establish a committee of leading scientists to conduct additional conferences on methods for disposing of radioactive waste and to recommend a program of research.

The first AEC-sponsored Academy conference was held at Princeton University in September 1955 to discuss the land disposal of radioactive waste. The proceedings from this conference were published in the National Research Council report entitled *The Disposal of Radioactive Waste on Land* (NRC, 1957). Although the main topic of consideration at this conference was disposal options, issues related to transportation cost, feasibility, and safety figured prominently in one of the discussions.

Government research on land disposal options continued through the 1970s and culminated in an unsuccessful effort to establish a disposal facility in a salt cavern near Lyons, Kansas. Attention then shifted to salt

[21]In the past, one shipment of foreign research reactor fuel was received at Concord Weapons Station in northern California for transport to Idaho National Laboratory. However, DOE has no plans to receive future fuel shipments at this site.

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disposal in the Delaware Basin in Texas and New Mexico. These investigations eventually led to the establishment of what was to become the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. This disposal facility, which is used to dispose of transuranic waste[22] from defense programs, was opened in 1999.[23]

The slow pace for addressing the waste disposal problem prompted action from the U.S. Congress in the 1980s. In 1982, Congress passed the Nuclear Waste Policy Act,[24] which established a federal responsibility and a federal policy for the disposal of spent fuel and high-level waste and a schedule for siting, constructing, and operating a federal repository. The NWPA established that the federal government is responsible for disposal of spent fuel and high-level waste and that the generators and owners of spent fuel and waste are responsible for paying the costs of such disposal.

The NWPA vests authority with the Secretary of Energy for carrying out the federal government's spent fuel and high-level waste disposal program, including transportation. It established a Nuclear Waste Fund[25] to cover the costs of transportation and disposal. It also authorized the Secretary of Energy to enter into contracts with owners of spent fuel and high-level waste of domestic origin. These contracts allow the Secretary of Energy to take title to spent fuel and waste for transportation and disposal.

The Nuclear Waste Policy Act established a process to identify two repository sites in different regions of the United States (one in the eastern or midwestern United States and the other in the western United States) for disposal of the nation's spent fuel and high-level waste. After the NWPA was passed, DOE initiated a screening program that eventually resulted in the selection of three potential repository sites in the western United States: Hanford, Washington; Deaf Smith County, Texas; and Yucca Mountain, Nevada.

In 1987, Congress amended the Nuclear Waste Policy Act. This amended act directed DOE to terminate its characterization activities at all sites except Yucca Mountain. It capped the disposal capacity of Yucca Mountain at 70,000 MTHM (77,000 short tons) until after a second repository is oper-

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[22]Transuranic waste is a by-product of nuclear weapons production activities. It contains long-lived radioactive transuranic elements such as plutonium in concentrations greater than 100 nanocuries per gram.

[23]The land withdrawal act for the Waste Isolation Pilot Plant (P.L. 102-579) specifically prohibits the transport of spent fuel and high-level waste to WIPP or disposal in the WIPP repository.

[24]The Nuclear Waste Policy Act of 1982, P.L. 97-425 (January 7, 1983) and amendments (P.L. 100-203, Subtitle A [December 22, 1987]; P.L. 100-507 [October 18, 1988]; and P.L. 102-486 [October 24, 1992]).

[25]The Nuclear Waste Fund was established by the U.S. Treasury and is funded through a 1.0 mil (0.1 cent) per kilowatt-hour fee on nuclear-generated electricity (see DOE, 2001a).

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ating. This capacity has been allocated by DOE for disposal of both commercial spent fuel and DOE-owned spent fuel and high-level waste (Table 1.2). It also directed DOE to postpone the identification of a site for a second repository.

After the passage of the amended act, DOE initiated what would ultimately be a 15-year program to characterize the Yucca Mountain site to determine its suitability to host a repository. In 1998, DOE issued a viability assessment for this site in which it concluded (DOE, 1998a, summary, p. 2) that "Yucca Mountain remains a promising site for a geologic repository" and "work should proceed to support a decision in 2001 on whether to recommend the site to the President for development as a repository."

In late 2001, then Secretary of Energy Spencer Abraham recommended to President G. W. Bush that a federal repository be developed at Yucca Mountain. The President forwarded the recommendation to Congress, which in July 2002—and over the objections of Nevada—authorized DOE to submit an application to the USNRC for a license to construct and

TABLE 1.2 Spent Fuel and High-Level Waste Disposal at Yucca Mountain

Material	Quantity[a]	Number of Shipping Sites
Commercial spent fuel	29,000 cubic meters 63,000 MTHM[b]	73 (72 commercial power plant sites and one commercial storage facility)
Defense spent fuel and high-level waste	7000 MTHM	From sites shown below
Naval spent fuel	900 cubic meters 65 MTHM	1 (INL)
Other DOE spent fuel[c]	1000 cubic meters 2435 MTHM	4 (Hanford, INL, SRS, Fort St. Vrain)
High-level waste	When processed: 21,000 cubic meters 58,000 metric tons 22,000 canisters	4 (Hanford, INL, SRS, West Valley)

NOTE: INL = Idaho National Laboratory; SRS = Savannah River Site.

[a]The quantities of commercial and defense waste listed in this table represent the current legislated capacity of Yucca Mountain. Quantities are given in terms of volumes and masses.
[b]Metric tons of heavy metal.
[c]Includes defense and research reactor spent fuel.

SOURCE: DOE (2002a, Appendix A).

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operate a repository. DOE planned to submit this application to the USNRC before the end of 2004 and to begin operating the repository by 2010.

DOE was unable to submit the application in 2004, however, and has encountered setbacks that could delay its plans to establish a repository at Yucca Mountain. In 2004, the Federal Court of Appeals for the District of Columbia struck down part of the Environmental Protection Agency's (EPA's) health and safety standards for Yucca Mountain (Title 40, Part 197 of the Code of Federal Regulations). This remanded standard must be reissued[26] by the EPA before the USNRC can issue a license for Yucca Mountain. DOE also encountered problems in establishing the database of information that will be used to support its license application for Yucca Mountain. The Nuclear Waste Policy Act requires that this database, referred to as the Licensing Support Network, be established at least six months before the license application is docketed by the USNRC. DOE brought this database on-line in 2004, but the USNRC has so far refused to certify that it is complete.

The Nuclear Waste Policy Act committed the federal government to begin disposing of commercial spent fuel in the federal repository by January 31, 1998. However, siting such a repository turned out to be a more arduous process than envisaged by Congress when the NWPA was passed. After the 1998 deadline passed, commercial power plant operators began filing lawsuits against DOE to recover the additional costs incurred for extended on-site storage of spent fuel. The U.S. government settled with one of the plaintiffs (Exelon Nuclear Power Corp.) in 2004. Sixty cases are still pending before the courts, and discussions are under way to settle some of these cases. The Exelon settlement commits the federal government to pay the utility $80 million immediately, with further annual payments as costs are incurred for continued storage of spent fuel at its sites. The federal government will pay Exelon a total of about $300 million if Yucca Mountain opens by 2010, and possibly more if the opening is delayed beyond that date. Settlement costs for the entire nuclear industry could cost taxpayers[27] billions of dollars. DOE is under pressure from the nuclear industry and Congress to move forward with Yucca Mountain or establish one or more centralized interim storage sites to reduce the growing spent fuel inventories at commercial power plant sites as well as the federal government's future monetary liabilities.

The Private Fuel Storage facility could be used as an interim step to-

[26]The EPA issued a new draft standard for public comment on August 8, 2005. The final standard had not yet been issued when this report was being finalized for publication in December 2005.

[27]Settlements are being paid out of the federal government's judgment fund, not out of the Nuclear Waste Fund.

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ward permanent disposal at Yucca Mountain. The facility's location in Utah was selected in part because of its proximity to Nevada. Even though Private Fuel Storage, LLC, is now poised to receive a license from the USNRC, it may still face several obstacles to opening. These include opposition from the State of Utah as well as other states and communities along likely transportation routes.

1.3.3 Spent Fuel and High-Level Waste Transportation

Small-quantity spent fuel shipping programs have been carried out routinely by both the federal government and the private sector for several decades. The primary objective of these programs has been to move spent fuel to interim storage. The federal agency responsible for government transport of spent fuel is DOE. This agency has transported foreign research reactor spent fuel, DOE research reactor spent fuel, naval spent fuel, and commercial spent fuel from some shut-down power reactors (e.g., Three Mile Island Unit 2) to centralized interim storage sites in South Carolina and Idaho. University and non-DOE government research reactor operators have also transported spent fuel to these interim storage sites. Commercial nuclear power plant operators have transported spent fuel between reactor sites to consolidate storage.

Transportation of spent fuel and high-level waste takes place under a number of federal, state, and local statutes and regulations.[28] The complexity of the regulatory environment is illustrated schematically in Figure 1.2 and in tabular form in Table 1.3. The principal federal regulators are DOT and the USNRC.[29] DOT is responsible for regulating the safety of hazardous material shipments, including radioactive material shipments, under several statutes, including the Department of Transportation Act (49 USC 1655) and the Hazardous Materials Transportation Act (49 USC 1801–1812).[30] The USNRC is responsible for licensing and regulating the receipt, possession, transfer, and use of source materials, byproduct materials, and special nuclear materials (see glossary in Appendix D) under the Atomic Energy Act (42 USC Chapters 6–8) and the Energy Reorganization Act (42 USC 5841).

[28]See Clark County Nuclear Waste Division (2004) for a summary of state requirements concerning the transportation of radioactive waste.

[29]Under 10 CFR Part 150, the USNRC retains authority for licensing and regulating spent fuel storage and transport in USNRC Agreement States. All states retain their authorities for carrier safety and emergency response as shown in Table 1.3.

[30]Shipments made for national security purposes by the Department of Defense or DOE may be exempted from DOT regulations if they comply with the security escort requirements in 49 CFR 173.7(b).

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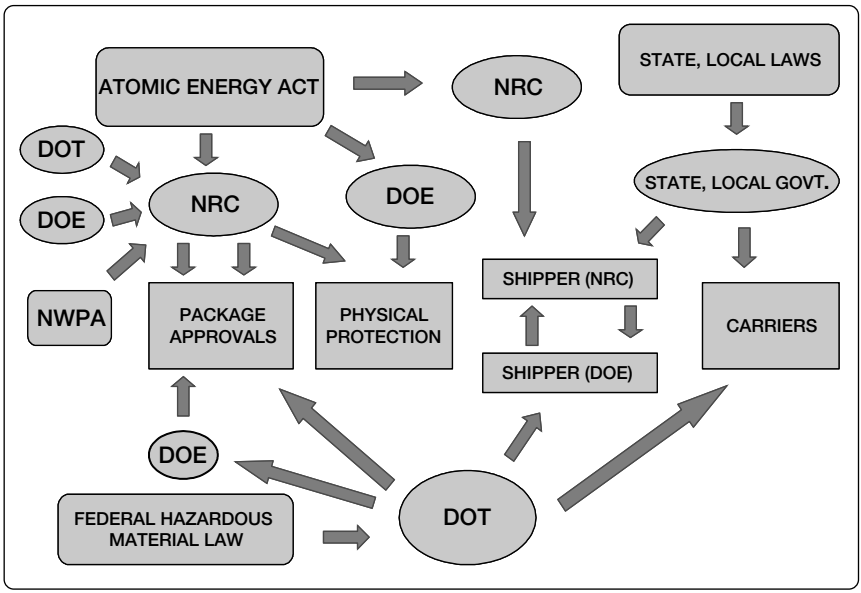

FIGURE 1.2 Schematic illustration of the regulatory bases for spent fuel and high-level waste transportation in the United States. As illustrated by the figure, spent fuel and high-level waste transport is regulated by the federal government and states under a number of statutes. SOURCE: Earl Easton, USNRC.

DOT and the USNRC have signed a memorandum of understanding (MOU) (44 FR 38690, July 2, 1979) that delineates responsibilities for regulating the transport of radioactive materials. This MOU gives USNRC the primary responsibility, in consultation with DOT, for the development of standards and regulations for the design, performance, and inspection of transportation packages for fissile materials, which include spent fuel and high-level waste. USNRC also has the primary responsibility for approval of domestic and foreign package designs used to transport spent fuel solely within the United States.[31] The MOU recognizes the USNRC's responsibility for imposing DOT regulations and conducting inspection activities for shipments of spent fuel by its licensees. In addition, DOT routing regulations (49 CFR 397.101) recognize the USNRC's responsibility for providing physical protection requirements for spent fuel shipments.

[31]While DOT has the responsibility for approving packages for import and export shipments, it relies on USNRC's review under the MOU as the basis for approving or revalidating the use of foreign-designed spent fuel packages.

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TABLE 1.3 Principal Responsibilities for Spent Fuel and High-Level Waste Transportation in the United States

	USNRC Licensee Spent Fuel (AEA)			DOE Spent Fuel (AEA, NWPA)	
	Commercial Reactors	Research Reactors	Commercial Reactors	Foreign Research Reactors	Naval Reactors[a]
Package approvals and inspections	USNRC	USNRC	USNRC	DOE and USNRC[b]	DOE and USNRC[b]
Highway route selection criteria[c]	DOT	DOT	DOT	DOT	DOT
Carrier safety	DOT, states	DOT, states	DOT, states	DOT, states	DOT[d]
Emergency response	Federal, state, tribal, and local governments	Federal, state, tribal, and local governments	Federal, state, tribal, and local governments	Federal, state, tribal, and local governments	Federal, state, tribal, and local governments
Route security approval	USNRC	USNRC	DOE	DOE and USNRC[e]	DOE
Physical protection	USNRC	USNRC	DOE and USNRC[f]	DOE	DOE

NOTE: AEA = Atomic Energy Act; NWPA = Nuclear Waste Policy Act.

[a]Naval Reactors has voluntarily chosen not to designate shipments of defense-related spent fuel as national security shipments under 49 CFR 173.7 and instead chooses to comply voluntarily with DOT regulations.

[b]DOE seeks technical reviews from the USNRC on package designs. The USNRC review provides the basis for DOT approval of foreign package designs under 49 CFR 171.12 or for USNRC certification of U.S. package designs.

[c]DOT does not have route selection criteria for rail shipments.

[d]Shipments are subject to the Federal Rail Safety Act, which governs railcars and track. DOE also voluntarily complies with DOT inspection requirements.

[e]DOE has made a practice to seek approval from USNRC under a reimbursable agreement for the foreign research reactor spent fuel shipments that it handles. USNRC approval is not required when DOE has title and possession of spent fuel.

[f]DOE is required under the Nuclear Waste Policy Act to follow USNRC prenotification requirements. These are described in Appendix C.

The MOU recognizes DOT as having the primary responsibility, in consultation with USNRC, for issuing safety requirements for the transport of radioactive materials, including labeling of packages; placarding of vehicles; equipment maintenance requirements; carrier personnel qualifica-

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tions; procedures for loading, unloading, handling, and storage during transport; and special transport controls (excluding safeguards controls) for radiation safety during transport. DOT also has the primary responsibility for inspecting transportation activities by carriers for both USNRC licensee and non-USNRC licensee activities (e.g., shipments by DOE and USNRC Agreement State licensees).

As shown in Table 1.3, responsibilities for regulating the transport of spent fuel and high-level waste are somewhat different for USNRC licensees[32] and DOE. USNRC licensees are required to use USNRC-certified packages for domestic shipments or a DOT-certified package for import-export shipments. DOE has authority under DOT regulations (49 CFR 173.7), unless otherwise specified in law, to certify packages for the domestic transport of its own spent fuel and high-level waste—for example, its shipments of spent fuel from West Valley to Idaho.

DOE's import shipments of foreign reactor fuel, unless designated as national security shipments, must be made in DOT-approved packages. This could include either a USNRC-certified package, a DOE-certified package, or a foreign package design that is revalidated by DOT. However, under a cost-reimbursable agreement, DOE has sought USNRC review of foreign package designs that can be used as the basis for DOT revalidation. DOE has also made a policy decision to seek USNRC approval of the physical protection measures used for its shipments of foreign research reactor spent fuel. Research reactor shipments are discussed in Chapter 4. A description of some of the USNRC regulations for package certification and associated package tests is provided in Section 2.1.

States and local governments also play important roles in spent fuel and high-level waste transportation. States have an important responsibility for enforcing DOT highway safety regulations concerning federal motor carrier safety and hazardous materials transportation. Highway shipments of spent fuel and high-level waste are subject to state inspection, and state enforcement officials can stop and inspect vehicles and inspect the premises of motor carriers to check for compliance with federal and state requirements regarding equipment, documentation, and driver fitness. States can also require carriers to obtain special permits to operate these vehicles and

[32]The Atomic Energy Act gives the USNRC the authority to issue licenses to private and government (except DOE) organizations to possess radioactive materials, conduct operations involving the emission of radiation, and dispose of radioactive waste. Operators of nuclear reactors for research and power generation are USNRC licensees since these facilities involve the emission of radiation and the generation of radioactive materials.

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charge fees for such permits.[33] Rail shipments of spent fuel and high-level waste are not subject to state regulation, but they are subject to inspection by DOT's Federal Railroad Administration.

Federal, state, tribal, and local governments and shippers share the responsibility for emergency response and preparedness. The Federal Emergency Management Agency within the Department of Homeland Security is responsible for providing a national incident response plan. State, tribal, and local governments are responsible for providing the first line of government response to accidents and incidents within their jurisdictions and can enlist the assistance of other agencies and organizations as circumstances require.

More detailed information on responsibilities and regulations is provided in other chapters. Chapter 4 provides a detailed description of highway and rail routing regulations. Chapter 2 describes package performance standards and regulations. Chapter 5 provides descriptions of other regulations governing the transport of spent fuel and high-level radioactive waste to a federal repository.

[33]However, the federal hazardous materials transportation law is explicit that federal rules preempt state rules in cases of conflict (49 USC 5125), consistent with the goal of nationally uniform regulation. DOT has administrative authority to determine when state rules are to be preempted. DOT has determined that state requirements for special permits for highway shipments of radioactive materials are preempted if they require documentation or prenotification in excess of federal requirements. DOT also has determined that state fees imposed on hazardous materials transport are preempted if they are excessive or if the revenue is not used for purposes related to hazardous materials transport.

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2
Transportation Package Safety

Package performance—the ability of a transportation package[1] to maintain a high level of containment effectiveness in long-term normal use and under extreme mechanical forces and thermal loading conditions (i.e., thermomechanical conditions) generated during severe accidents—is a crucial issue for transportation safety and key to understanding and quantifying transportation risks. The regulatory requirements for the design, fabrication, certification, and maintenance of these packages are substantially more rigorous than those for transporting most other types of hazardous materials (e.g., hazardous chemicals). Accordingly, the packages used to transport spent fuel and high-level waste are designed to withstand extreme thermomechanical conditions without a significant loss of containment. The slogan "safety is built into the package" is commonly used by package manufacturers and vendors to describe the ability of these packages to maintain their containment effectiveness under most conceivable accident conditions.

This chapter provides a summary of investigations carried out in the United States and several other countries to examine the performance of transportation packages. The chapter provides a brief overview of the re-

[1]Transportation containers loaded with spent fuel or high-level waste are referred to as *packages* in international standards, whereas the containers themselves without their contents are referred to as *packagings*. For simplicity, the term *packages* is used throughout this report. The terms *casks* and *flasks* (the latter term is commonly used in the United Kingdom) are sometimes used synonymously to refer to such packages.

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quirements for spent fuel and high-level waste transportation packages; describes some key investigations of package loading conditions that have furthered technical understanding of package performance; and offers findings and recommendations about current standards and regulations and about improvements in package performance.

There is extensive literature on package performance in response to extreme thermomechanical conditions. Some of this work appears in the "gray" literature,[2] which may or may not be peer reviewed. There is also extensive classified literature on package performance in response to potential terrorist acts.[3] As discussed in Chapter 1, the committee did not review this classified literature or perform an in-depth examination of package performance in response to terrorist acts. The committee does, however, comment on this issue in Chapter 5.

2.1 TRANSPORTATION PACKAGE DESIGNS AND REGULATIONS

Packages for the transport of spent fuel and high-level waste are designed to meet three basic requirements both during normal conditions of transport[4] and during a range of hypothetical accident conditions established in 10 CFR Part 71:[5]

1. Prevent an unsafe configuration (i.e., accidental criticality[6]) of spent fuel.
2. Prevent or limit the release of radioactive contents.
3. Limit dose rates on external package surfaces to acceptable levels.

A wide range of package designs have been developed to meet these general performance requirements.

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[2]The U.S. Interagency Gray Literature Working Group defines gray literature as "foreign or domestic open source material that usually is available through specialized channels and may not enter normal channels or systems of publication, distribution, bibliographic control, or acquisition by booksellers or subscription agents." (Gray Information Functional Plan, January 18, 1995, accessed at *http://www.osti.gov/graylit/whatsnew.html*). This literature includes technical reports, conference proceedings, and business documents.

[3]In addition, some unclassified literature on this topic was removed from public circulation after the September 11, 2001, terrorist attacks.

[4]Normal conditions of transport subject packages to minor mishaps due to rough handling or exposure to weather. Such conditions would not be expected to compromise the vital containment functions of the package.

[5]Title 10, Part 71 of the Code of Federal Regulations, Packaging and Transport of Radioactive Material. The hypothetical accident conditions are described in subpart 73 (i.e., 10 CFR 71.73).

[6]That is, a configuration that allows the establishment of a self-sustaining nuclear chain reaction as occurs in an operating nuclear reactor.

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Most packages consist of a hollow cylindrical body that is open at one end (Figure 2.1). The body is typically constructed of multiple layers of the following materials: Steel is used to provide structural strength and durability; steel, lead, depleted uranium, or concrete is used to provide shielding against gamma radiation; and water, borated polymers, or concrete is used to provide shielding against neutrons.

The package closure system consists of one or two steel lids that are attached to the open end of the package body with steel bolts. Elastomer or

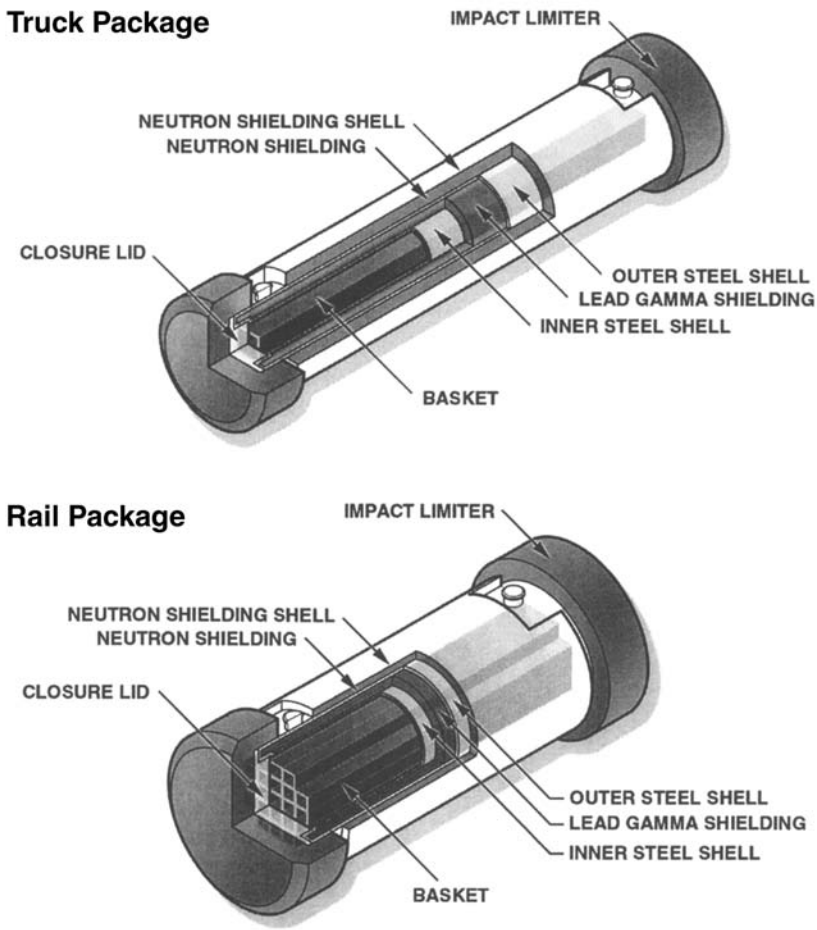

FIGURE 2.1 Generic truck and rail spent fuel packages. In these particular designs, lead is used as the shielding material. Other materials such as steel and concrete are used in other package designs. SOURCE: Sprung et al. (2000).

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metal seals are used between the body and lids to obtain airtight seals. The package body and lids may contain sealable openings, such as pipes and tubes, to allow for the removal of water, the addition of inert gases, leak testing of lid seals, and monitoring of internal pressures after the package is closed. The lid, lid bolts, pipes, and valves are usually recessed to protect them from damage.

The package is also designed with impact limiters to absorb mechanical forces generated in the event of transport accidents and to provide thermal protection for the lid seals in case of fires. Impact limiters, which are usually attached to the ends of packages, are typically constructed of wood, rigid foam, or honeycombed metal. Metal fins may also be machined into (or welded onto) the exterior surfaces of the package body and closures for additional impact protection and heat dissipation.

The interior of the package contains a basket to hold the spent fuel assemblies in a fixed configuration to ensure criticality control and minimize damage to the fuel during transport. In packages designed to hold multiple spent fuel assemblies, the baskets are typically constructed of materials containing neutron absorbers (e.g., borated metals) to provide a further margin of criticality safety. In some package designs, these baskets are placed into a stainless steel canister with a welded lid, which in turn is placed into a transportation overpack. Packages containing such canisters are sometimes referred to as *canister-based packages*. Packages without such canisters are sometimes referred to as *bare-fuel packages* because the fuel basket is placed directly into the package body.

Packages designed for transport by legal-weight trucks[7] typically carry between about 0.5 and 2 metric tons (0.55 and 2.2 short tons) of spent fuel. These packages are about 3 feet (0.9 meter) in diameter and weigh up to about 25 metric tons (28 short tons) when loaded. Packages designed to be transported by train can hold about 10 to 18 metric tons (11 to 20 short tons) of spent fuel. The packages typically have diameters of about 8 feet (2.4 meters) and can weigh 150 metric tons (165 short tons) or more when loaded.

The number and types of spent fuel assemblies that can be carried in a package are, of course, determined by its size. Package size, in turn, depends on transportation mode (i.e., rail versus truck). Legal-weight truck package size is limited primarily by highway weight regulations, whereas rail package size is usually not weight limited but instead limited by railcar clearance requirements. Regulatory limits on radiation levels on the exterior surfaces of packages (10 CFR 71.47) also restrict the age and burn-up of spent fuel that can be carried in the package.

[7]A truck having a total gross weight (i.e., including cargo) of 80,000 pounds (36,300 kilograms) or less.

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The International Atomic Energy Agency (IAEA) has established standards for the safe transportation of radioactive materials. These standards were first issued in 1961[8] and have undergone several revisions and amendments; the latest edition was issued in 2005 (IAEA, 2005a). The IAEA standards establish recommended requirements for a number of different package types, each designed to transport specific quantities and types of radioactive materials:

- *Excepted packages* are designed for transport of very small quantities of radioactive material such as radiopharmaceuticals.
- *Industrial packages* are designed for transport of low-specific-activity materials such as uranium ore and low-level radioactive wastes.
- *Type A packages* are designed for transport of materials of limited radioactivity—for example, uranium hexafluoride and fresh nuclear fuel.
- *Type B packages* are designed for transport of larger quantities of radioactive material including spent fuel, high-level waste, and mixed oxide fuel.[9]
- *Type C packages* are designed for air transport of quantities of radioactive material exceeding a defined (large) threshold including, for example, plutonium and mixed oxide fuel.

This report is concerned with Type B packages.

IAEA safety standards are recommendations and are not legally binding on member states. However, the United States and many other member states adopt these standards, either in whole or in part, in their own national regulations. U.S. regulations for the packaging and transport of radioactive materials are provided in 10 CFR Part 71 (see footnote 5). The Nuclear Regulatory Commission (USNRC) and Department of Transportation (DOT) recently modified these regulations (USNRC, 2004a) to reflect the 1996 amended version of the IAEA standards (IAEA, 2000).[10,11]

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[8]The first comprehensive set of regulations for transporting radioactive materials by common carrier were established by the Interstate Commerce Commission in 1947–1948. These regulations were drafted by the National Research Council's Subcommittee on Shipment of Radioactive Substances (see NRC, 1951). These and subsequent U.S. regulations served as an important basis for the establishment of IAEA standards (see Pope, 2004).

[9]Mixed oxide fuel, or MOX, contains uranium and plutonium.

[10]The updated regulations did not incorporate the IAEA standards for Type C packages, because U.S. federal law mandates more stringent requirements for air shipments of plutonium.

[11]The IAEA issued updated safety standards in 2003 and 2005 (see *http://www-ns.iaea.org/standards/documentpages/transport-of-radioactive-material.htm*). USNRC and DOT staff were discussing whether to update U.S. regulations to bring them into conformance with these updated standards when this report was being finalized for publication in December 2005.

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Type B packages that are to be used for transporting spent fuel and high-level waste in the United States are required to be certified by the USNRC. To receive a certification, the applicant (i.e., the package manufacturer or vendor) must demonstrate to the Commission's satisfaction that the package design will meet the testing requirements in 10 CFR Part 71, the key elements of which are described in Sidebar 2.1. Under these regulations, packages are required to survive a free-drop test onto an essentially unyielding surface (Sidebar 2.2) as well as a puncture test, an immersion test,[12] and a thermal test with less than the specified loss of containment effectiveness (see Sidebar 2.1).

The USNRC permits quantitative analysis (e.g., computer simulations using finite element models), scale-model (typically one-quarter or one-half scale; see Sidebar 2.3), and full-scale testing of packages or package components, and comparisons with existing approved package designs to be used to demonstrate compliance with the regulations. Testing of full-scale packages[13] is not a requirement of the regulations.

Testing of full-scale spent fuel packages is not carried out routinely because of the cost. A full-scale package can cost more than a million dollars, and it is generally not reusable after undergoing full-scale testing in accordance with USNRC regulations. The paucity and costs of suitable testing facilities are also impediments. There are no package testing facilities in the United States capable of handling large truck or rail packages. A new facility was recently opened in the Horstwalde region in Germany, which is located near Berlin.[14] Two full-scale 9-meter (30-foot) free-drop tests on rail packages were carried out at this facility in late September 2004 in conjunction with the 14th International Symposium on Packaging and Transportation of Radioactive Materials (PATRAM 2004). A subgroup of the committee's members visited this facility and witnessed a full-scale test of a 180 metric ton (198 short ton) rail package (Figure 2.2).

USNRC regulations also require that transportation packages be de-

[12]Package immersion is not discussed at much length in this chapter because the committee judges it to be of a lower concern than the thermomechanical conditions generated during truck and train accidents.

[13]There is sometimes confusion about what is meant by "full scale" in regard to package testing. The regulatory tests described in Sidebar 2.1 are full-scale tests because they are carried out using actual Type B packages. These tests are referred to as *certification tests*. The term full-scale can also apply to tests made on actual Type B packages under simulated accident conditions such as those described in Section 2.3. These tests are referred to as *demonstration tests*.

[14]This facility is operated by the German Federal Institute for Materials Research and Testing (BAM).

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signed and manufactured using an approved quality assurance program.[15] Packages must be designed to standards that include conservative assumptions and design margins for material properties such as yield stress and ductility. This requirement provides for a built-in "safety margin" (see Sidebar 2.4) and offers increased confidence that packages will survive thermomechanical conditions somewhat more severe than regulatory requirements.

The USNRC has certified several spent fuel storage and transportation package designs for use in the United States. These include storage-only packages as well as packages that are designed for both transportation and storage (see JAI, 2005).

IAEA standards and USNRC regulations for Type B packages (see Sidebar 2.1) were not derived from a comprehensive bounding analysis of all possible extreme thermomechanical conditions resulting from package mishandling and accidents. Rather, their development, which dates from the early 1960s as noted previously, was based on then-available data on typical impacts (e.g., drops from cranes, other mechanical accidents, vehicular collisions) and thermal environments (e.g., fires from spilled fuel) to which a package might be exposed in the course of transport (see Pope, 2004). As such, they do not necessarily reflect the most extreme conditions that might be encountered during spent fuel or high-level waste shipments.

Nevertheless, during the committee's information-gathering meetings, several industry presenters asserted that it is very unlikely that a certified Type B package for spent fuel or high-level waste would fail under any credible loading conditions that might be encountered during transport. This assertion is based on the confidence that these presenters place in the combination of rigorous regulatory requirements for package certification, the built-in margins of safety in current package designs (see Sidebar 2.4), and the worldwide decades-long record of spent fuel transport without a significant package failure (see Chapter 3). However, other presenters pointed out that the spent fuel transport experience in the United States is limited, and that the planned large future shipping campaigns to a federal repository could expose transportation packages to a wider range of loading conditions and longer-term use than have been experienced to date.

[15] 10 CFR 71.101 defines the term *quality assurance* as those "planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality assurance actions related to control of the physical characteristics and quality of the material or component to predetermined requirements." Quality assurance requirements apply to the design, fabrication, assembly, testing, maintenance, repair, modification, and use of the proposed package.

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SIDEBAR 2.1 U.S. Regulations for Type B Transport Packages

Type B packages for transporting spent fuel and high-level waste are designed to withstand severe accident conditions without a loss of containment or an increase in external radiation *to levels that would endanger emergency responders or the general public*. USNRC regulations for Type B packages contain requirements for both "normal conditions of transport" and "hypothetical accident conditions." Under normal transport conditions, the regulations require that Type B packages maintain their containment effectiveness as given by the following three conditions:

1. No loss or dispersal of radioactive contents to a sensitivity of 10^{-6} A_2 per hour.[a]
2. No substantial reduction in packaging effectiveness.
3. No substantial increase in external surface radiation levels.

For hypothetical accident conditions, the regulations allow for some degradation of the packages' containment effectiveness as given by the following four conditions:

1. No escape of krypton-85 exceeding 10 A_2 in 1 week.
2. No escape of other radioactive material exceeding a total amount A_2 in 1 week.
3. No external radiation dose rate exceeding 10 millisieverts per hour (1 rem per hour) at 1 meter (about 40 inches) from the external surface of the package.[b]
4. Compliance with these requirements may not depend on filters or mechanical cooling systems.

These release and radiation limits are designed primarily to protect emergency responders and members of the public in case of an accident. The values for A_2 are tabulated in 10 CFR Part 71 and are radionuclide specific. For krypton-85, the A_2 value from Table A-1 in 10 CFR Part 71 is 10 terabecquerels (TBq; approximately 270 curies).[c] The regulations do not place any limits on the physical form of the radioactive materials (e.g., particulate size) that could be released in a hypothetical accident.

The USNRC is responsible for certifying the design of Type B packages. The requirements for certification (10 CFR 71.73) are derived directly from IAEA standards:

> Evaluation for hypothetical accident conditions is to be based on the sequential application of the tests specified in this section, in the order indicated, to determine their cumulative effect on a package or array of packages . . . . [E]xcept for the water immersion tests, the ambient air temperatures before and after the tests must remain constant at that value between –29°C and +38°C which is the most unfavorable for the feature under consideration. The initial internal pressure within the containment system must be the maximum normal operating pressure, unless a lower internal pressure, consistent with the ambient temperature presumed to precede and follow the tests, is more unfavorable.

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[a]The regulations also provide guidance on determining A_2 activity values for mixtures of radionuclides. See the glossary (Appendix D).

[b]These increased doses would result from structural damage to the package shielding.

[c]The fission product krypton-85 was selected for use in this regulation because it is the only noble gas that exists in significant quantities in irradiated fuel that has been cooled for several years. While it is not a significant contributor to dose, it is likely to be among the most mobile of radionuclides in a spent fuel package.

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The following tests are specified in the regulations (10 CFR 71.73; see figure below):

- A *free-drop* test in which the specimen is dropped through a distance of 9 meters (about 30 feet) onto a flat, essentially unyielding horizontal surface (see Sidebar 2.2), with the package striking the surface in the position expected to produce maximum damage. A package dropped from this height strikes the ground at a speed of about 13 meters per second (48 kilometers per hour, or about 30 miles per hour).
- A *puncture* test in which the specimen used in the free-drop test is dropped through a distance of 1 meter (about 40 inches) onto the upper end of a 6-inch (15.2-centimeter) diameter solid, vertical, cylindrical mild steel bar mounted on an essentially unyielding horizontal surface. The package is dropped onto the bar in a position that is expected to produce maximum damage.
- A *thermal* test in which the same specimen is fully engulfed in a hydrocarbon-fuel fire with an average flame temperature of at least 800°C (about 1475°F) for a period of 30 minutes.
- An *immersion* test in which a separate, undamaged specimen is subjected to a pressure head equivalent to immersion in 15 meters (about 50 feet) of water. Additionally, 10 CFR 71.61 also specifies that for packages designed for transport of spent fuel with activity exceeding 37 petabecquerels (PBq; 10^6 curies), the undamaged containment system must be able to withstand an external water pressure of 2 megapascals (290 pounds per square inch) for one hour without collapse, buckling, or in-leakage of water. This pressure corresponds to a water depth of about 200 meters (650 feet), typical of maximum water depths on the U.S. continental shelf.

The velocity of package impact in the free-drop test described above is lower than many real world crashes (e.g., the Central Electricity Generating Board's [CEGB's] full-scale crash described in Section 2.3.3). Nevertheless, the impact forces on the package are much higher in the free-drop test because the impact surface is "essentially unyielding."

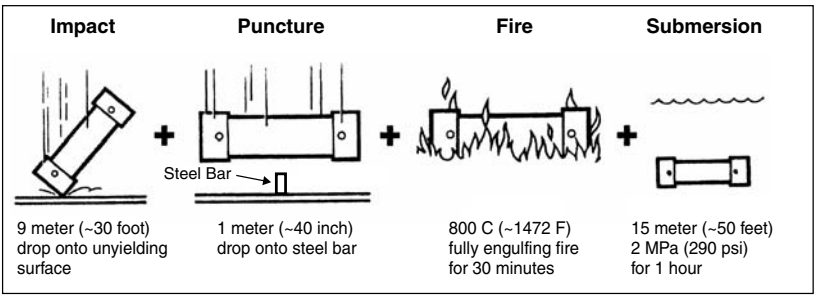

Illustration of the hypothetical accident conditions in 10 CFR Part 71. SOURCE: Modified from a USNRC circular.

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SIDEBAR 2.2 What Is an "Essentially Unyielding" Surface?

An *essentially unyielding surface* is used for impact tests on Type B packages under both International Atomic Energy Agency standards (IAEA, 2000) and U.S. regulations (10 CFR Part 71). The standards and regulations require that the impacting surface be essentially unyielding, that is, sufficiently massive and stiff to produce maximum damage to the specimen being tested. Such surfaces are usually constructed of a thick reinforced concrete slab with a steel plate floated onto its surface (i.e., slid onto the concrete surface while still wet). The concrete provides a large reaction mass and the steel plate provides stiffness. For tests of Type B packages, the slab and plate should have a combined mass at least 10 times that of the specimen being tested (IAEA, 2002).

An article such as a spent fuel transportation package that is dropped onto such an unyielding surface will be subjected to higher impact forces and will consequently experience greater deformation than if the same article is dropped onto a surface that is itself deformed by the impact (i.e., a yielding surface). An article dropped onto an essentially unyielding surface in the 9-meter (30-foot) regulatory drop test (Sidebar 2.1), for example, will be traveling at about 13 meters per second (30 miles per hour, or 48 kilometers per hour) when it impacts the surface. The deformation of the article caused by this impact will be essentially identical to the deformation resulting from the head-on collision between two identical copies of that article if each is traveling at 13 meters per second. This is comparable to the difference between a collision of a moving vehicle and a parked car versus a head-on collision between two moving vehicles. The head-on collision between moving vehicles results in much greater damage.

Gonzales et al. (1986) compared the hardness of an essentially unyielding target to several other target types in a series of impact tests. These tests involved impacts of a 2500 kilogram (5500 pound) cylindrical steel test unit resembling a

They also questioned the adequacy of regulations that do not require full-scale testing to demonstrate package performance.

There is, in fact, a good deal of quantitative information available on the performance of transportation packages under extreme loading conditions. This information comes from modeling and full-scale testing studies carried out in the United States and Europe over the past three decades. A summary of selected studies is provided in the following sections.

2.2 PACKAGE PERFORMANCE MODELING STUDIES

Computer simulation models are routinely used to estimate the thermomechanical behaviors of truck and rail packages under a range of extreme loading conditions that would not be practicable to obtain from actual

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spent fuel transportation package onto four targets: desert soil, a concrete runway, a concrete highway, and an unyielding target. The unyielding target was constructed of a 56 metric ton (62 short ton), 3.6-meter (11.8-feet) thick reinforced concrete slab with a steel face plate. The table below shows the results of these tests for an impact speed of 13 meters per second (30 miles per hour), which corresponds to the impact speed for the 9-meter (30-foot) regulatory free-drop test.

In the table, the second column shows how far the test unit penetrated into each of the targets, and the third column shows the maximum strain in the test unit. Penetrations ranged from 48 centimeters (19 inches) for the soil target to 0 centimeters for the unyielding surface. The maximum strains experienced during the impact of the test unit on the unyielding surface were several times greater than for the other target types. The reason for this is simple: The other targets absorbed some of the impact forces, whereas the test unit absorbed essentially all of the impact forces when impacted against an unyielding surface. In fact, in only one case—impact onto the unyielding target—was the strain great enough to produce permanent deformation of the test unit.

Experimental Results Obtained by Gonzalez et al. (1986)

Target	Test Unit Penetration, centimeters (inches)	Maximum Strain, microstrains[a]
Soil	48 (19)	90
Concrete highway	10 (4)	400
Concrete runway	0.6 (0.25)	500
Unyielding target	0	3500

[a]Microstrains are measured in parts per million, for example, centimeters per 10^6 centimeters.

testing of full-scale articles. "Generic" truck and rail packages, which incorporate the salient design features of certified packages, are typically investigated with such models. The loading conditions used in these models are usually derived from historical accident reconstructions, but hypothetical accident scenarios may also be used to investigate conditions that exceed those of any known historical accident. The committee selected a number of modeling studies for discussion in the following subsections. These are summarized in Table 2.1.

2.2.1 Modal Study

The modal study (Fischer et al., 1987) examined the expected responses of spent fuel transportation packages to thermomechanical conditions de-

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SIDEBAR 2.3 Scale Modeling

The term *scale modeling* is conventionally taken to mean the testing of either an article that is a miniaturized version of a large structure (see figure), or a large component of a complex structure. The major benefit of scale modeling is that it reduces material, fabrication, and testing costs, thus allowing more variables to be explored, and a multiplicity of data to be obtained, for the same cost as a single test on the full-scale structure. This is of particular value when the structure is very expensive, the article needs to be tested to a point at which it has no further utility, and/or the loads that must be applied exceed the capacities of readily available testing apparatuses. Typically models of at least one-quarter scale are used in engineering tests of spent fuel transport packages, although models as small as one-eighth scale have been used for initial scoping tests.

The failure condition for the full-scale structure generally can be estimated from the results of scale-model testing through the application of well-known scaling laws. However, there are a number of pitfalls in this procedure. The most important is that the weak points in a complex structure are generally associated with joining processes—bolts, welds, and adhesives—that may not scale precisely. For example, in a weldment, the heat-affected zone sizes and mechanical properties, and the residual stresses that are induced, will depend on the number of weld passes that are made and the heat input rate that is used, and these parameters depend on the thicknesses of the materials that are joined. Similarly, the strength of an adhesive joint will depend on the sizes and surface quality of the materials involved, as well as the thickness of the adhesive layer.

Structures that utilize many component materials that are off-the-shelf items (e.g., bolts, seals, gaskets) may be hard to scale because these items may not be available in the exact size or quality that is needed. Also, bolts and other fasteners that may be required for the actual structure are not always available in the same metallurgical form in scaled-down sizes. Additionally, there are scaling issues in monolithic and composite structures. Metallic parts may have different thermomechanical properties because of differences in heat treatments, which are affected by article sizes. Scaling of composite laminates can be done in a practical manner only by reducing the number of plies, essentially making it into a different material.

Finally, cracks and other potential initiators of brittle failure also do not scale because it is their absolute size that is of first-order importance, with their relative sizes generally being of second-order importance. In its simplest form, crack instability and growth is generally governed by a parameter of the form $K = \sigma[\pi c]^{1/2}\,\beta(c/h)$, where K is the stress intensity factor, c denotes the crack size, σ is the applied stress, and β is a function of the ratio of the crack size to one of the component dimensions (h). For small- to moderate-sized cracks, β is on the order of unity. Although the mathematical relationships for corrosion pits, dents, and gouges are not as well established as in fracture mechanics, their qualitative behavior will be similar to cracks. This can make it very difficult to duplicate the failure mechanism in a small-scale test.

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This does not mean that scale modeling is without value. Rather, it means only that direct application of the results of small-scale testing to the full-scale article should be done with great caution. In cases where some features of the test article cannot be modeled accurately at reduced scale (e.g., the valve assemblies used on spent fuel transport packages), it may be possible to combine a simplified reduced-scale model to determine decelerations and then separately test the full-scale component when subjected to the appropriately scaled decelerations. Another approach is to use scale modeling as a test bed for the calibration and validation of a computational analysis simulation of the structure. Then, with the further assurance gained from viable predictions of the results of a small but representative set of independent "proof-of-concept" tests made on a full-scale structure, the computer simulation can be used with confidence, and in a highly cost-effective manner, for further evaluations of the performance of the structure in a broad range of anticipated and accident service conditions.

Scale modeling is routinely used in spent fuel transport package testing and certification. A good technical discussion of scaling laws and properties for materials in pristine condition is provided in Donelan and Dowling (1985). Recent work on scaling laws for materials with flaws is provided by Bazant (2004).

Full-scale (background) and ½-, ¼-, and ⅛-scale models (foreground) of the Magnox flask. SOURCE: Magnox Electric Ltd.

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FIGURE 2.2 The German Federal Institute for Materials Research and Testing (BAM) carried out two 9-meter regulatory drop tests in September 2004 at its recently completed testing facility near Berlin. One of the tests was conducted on the180 metric ton (198 short ton) Mitsubishi rail package shown in these photos. The top photo shows the package orientation for this test. The package was hoisted and dropped onto the steel plate embedded in the floor. The bottom photo shows the package after the test. SOURCE: Photo by K.D. Crowley.

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SIDEBAR 2.4 Margin of Safety

To reduce the possibility of catastrophic failure, engineering structures in which the weight of the structure is not a critical concern (e.g., buildings, dams, bridges, power plants, storage tanks) are generally designed with large "margins of safety." These safety margins are generally achieved in two ways. First, conservative values of the mechanical properties of the materials used in the structure (i.e., values that underestimate the potential strength of the materials) are selected for use in the design. Second, "worst-case" assumptions are made on the applied loads that the structure must resist, and/or an arbitrary "factor of safety" is introduced to artificially inflate the expected loads.

Factors of safety range from as low as 1.4 for natural gas transmission pipelines located in unpopulated areas to 10 or more in especially sensitive applications, with a value of 3 being a typical choice for noncritical structures. The cumulative effect of conservative design choices and the imposition of a factor of safety on each structural component means that the actual margin of safety, while not specifically known, could be well above the safety margin for each individual component. In a typical design, loads sufficient to cause structural failure could be more than four to five times greater than the load anticipated in actual, normal service.

Large safety margins are necessary because of the multitude of uncertainties that could affect the integrity and durability of a structural design. These uncertainties include the potential for fabrication defects from inadequate workmanship and less than satisfactory material properties and joining techniques; in-service mechanical damage, fatigue and environmental degradation (e.g., corrosion); and unexpectedly severe operating conditions due to accidents or sabotage. Structures that are designed with large safety margins are very likely to be able to resist catastrophic failure over their intended service lifetime, even when the expected operating conditions are substantially exceeded once or many times during service.

In contrast, in engineering structures for which the weight of the structure is a critical concern (e.g., aircraft), the safety margins are generally much lower. Airplanes are typically designed and tested to achieve a margin of safety of only about 50 percent over the maximum anticipated operating loads. In these applications, considerable effort is placed on analytical projections of times to failure based on anticipated defects or other forms of damage, and rigorously scheduled inspections to determine if or when damage has come to exist at critical locations within the structure. This approach has come to be known as damage tolerance methodology.

There are built-in margins of safety for the design of spent fuel transportation packages. USNRC guidance for the design of spent fuel transportation packages (USNRC, 1978) adopts portions of the American Society for Mechanical Engineers (ASME) code for boilers and pressure vessels. The ASME code specifies the use of highly ductile materials that accommodate unusually high stresses through deformation rather than fracture. The code also specifies maximum stress limits for these materials that are well below their yield strengths. Vessels that are properly designed, manufactured, and maintained to these codes should perform as intended even under conditions that exceed design specifications because of this built-in margin of safety.

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TABLE 2.1 Summary of Selected Studies on Package Performance Modeling

Test Description	Results in Brief	Reference
Modeling the performance of a generic truck and rail package under mechanical and thermal loading conditions derived from historical accident records	A very small number of rail accident scenarios could result in package releases in excess of regulatory limits	Modal study: Fischer et al. (1987)
Modeling the performance of two generic truck packages and two generic rail packages for impacts at various orientations against unyielding and yielding surfaces at 30, 60, 90, and 120 miles per hour (48, 96, 144, and 192 kilometers per hour)	No package penetration at any orientation or impact speed against yielding or unyielding surfaces; package seals may leak during high-speed impacts against unyielding surfaces in excess of regulatory test limits	Spent fuel shipment risk reexamination study: Sprung et al. (2000)
Comparison of the thermomechanical conditions from severe historical accidents to regulatory test limits and other modeling studies	No accident produces mechanical loads in excess of the 9-meter regulatory free-drop test. Two accidents could have produced thermal loads in excess of the IAEA 30-minute fully engulfing fire test	Fischer et al. (1987); Ammerman et al. (2002, 2003); Ammerman and Ginn (2004)
Modeling of thermal performance of a rail package in the July 2001 Howard Street tunnel fire near Baltimore, Maryland	No package releases would have occurred	USNRC (2003a)
Analysis of the thermal conditions in the December 1984 Summit Tunnel fire near Manchester, England, and the likely effect on a fuel package	Thermal conditions would have exceeded those of the regulatory thermal test such that package seals might have failed should a package have been exposed in this fire	UK Department of Transport (1986)

rived from the historical record of truck and train accidents in the United States. These data were compiled from government and private databases. The data included accident speeds and impact angles, the hardness of impacted objects (i.e., other vehicles, wayside terrain), and the frequency and duration of accident-associated fires. The data were used to develop a suite of historical accident scenarios and associated accident probabilities that

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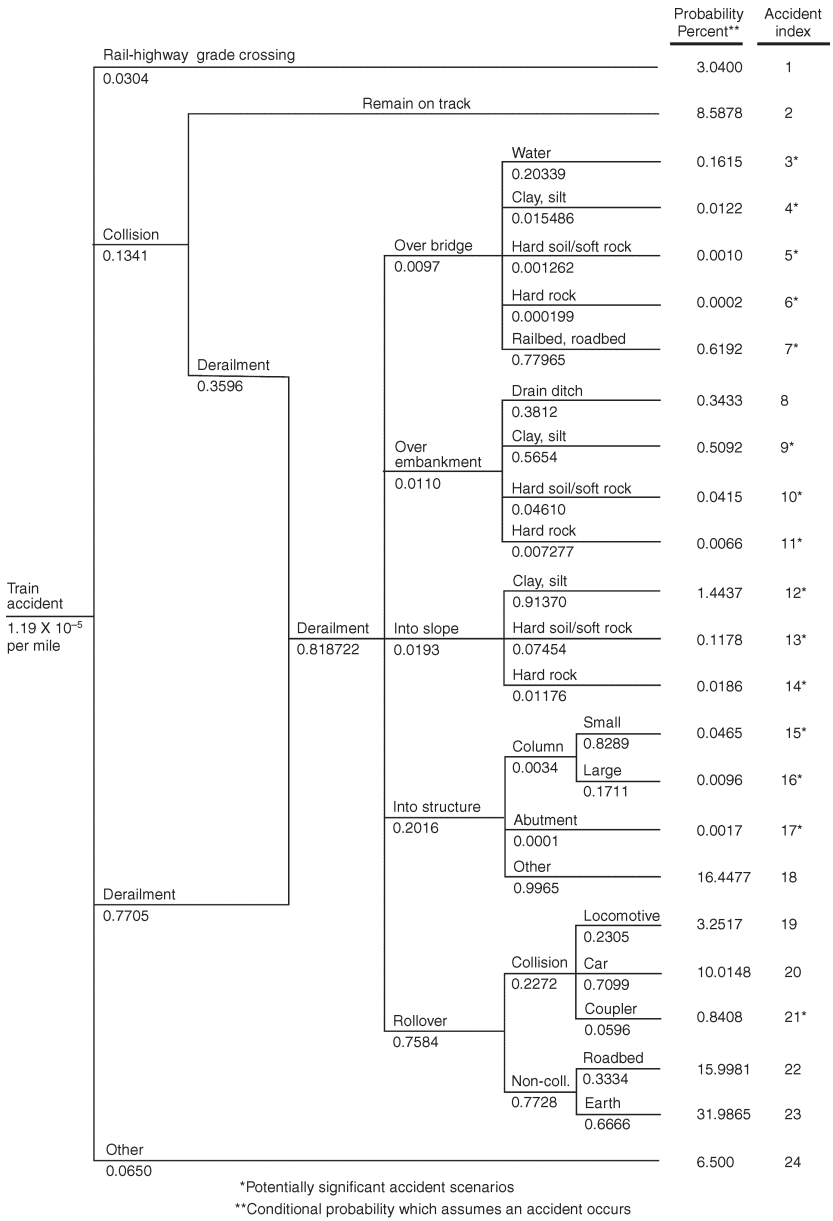

FIGURE 2.3 The event tree for train accidents from the 1987 modal study (Fischer et al., 1987). The numbers shown at each branch are probabilities for the accident branch based on an analysis of historical data. The accident scenarios marked with an asterisk were determined to produce consequences that would approach or exceed regulatory limits. SOURCE: Fischer et al. (1987, Figure 2-5).

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SIDEBAR 2.5 Radioactive Material Releases in Severe Transportation Accidents

There are two barriers to the release of radioactive materials from spent fuel packages into the environment during a severe accident. The first is the package itself. As described in this chapter, Type B packages used to transport spent fuel are designed to withstand severe accidents without a significant loss of containment or an increase in external radiation to levels that would endanger emergency responders or the general public.

The second barrier is the fuel rod cladding. The cladding for most commercial nuclear fuel is made from a zirconium metal alloy, referred to as *zircaloy*, which is fabricated into long (3.5 to 4.5 meter [11.5 to 14.75 feet]) tubes (Sidebar 1.3). These tubes, which contain the uranium dioxide fuel pellets, are pressurized and sealed to resist collapse or leaks when placed into the high-pressure operating environment of the reactor core. Fuel rods are bundled together into fuel assemblies using metal structural supports. These supports also help to prevent the fuel rods from collapsing and buckling in a severe transportation accident.

The release of significant quantities of radioactive materials from a loaded spent fuel transport package into the environment during a severe accident would occur only if the package *and* one or more fuel rods were breached (small amounts of radioactive contamination from the external surfaces of the fuel rods [crud] could be released from the package if the package seals were compromised, even if the fuel rods maintained their integrity). Fuel rod breaching could potentially occur by two processes: mechanical rupture or thermal creep. The former could occur if impact forces exceed the mechanical strength of the cladding, causing it to buckle. The latter could occur at elevated temperatures due to time-dependent elongation of the cladding along fracture planes. High burn-up fuel rods may be more susceptible to breaching because of cladding embrittlement resulting from their longer residence in the reactor.

If breached, the fuel rods would depressurize, and radioactive material could

could be displayed as "event trees" (Figure 2.3). Quantitative analyses were carried out to assess the effects of the loading conditions represented by these event trees on generic train and truck transportation packages that were similar in design to the packages in service in the mid-1980s. A more complete discussion of this study is provided in Chapter 3.

The analysis involved a two-stage screening process. Phase 1 screening used dynamic linear stress analysis and standard transient heat-transfer models to screen out those accident scenarios in which the thermomechanical conditions did not exceed the regulatory testing requirements in 10 CFR Part 71 (Sidebar 2.1). For these scenarios, any radioactive material releases from the packages were assumed to fall below regulatory limits. Approximately 99.4 percent of all truck accidents and 99.7 percent of the rail accident scenarios analyzed fell into this category (Fischer et al., 1987,

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be released into the interior of the transportation package by depressurization flow. Two types of radioactive materials could be released: (1) gaseous materials (e.g., radioactive noble gases such as krypton-85 and volatile materials such as cesium-137) produced by fission reactions while the fuel is in the nuclear reactor; and (2) fine particles of the fuel itself, referred to as *fuel fines*, which are created by mechanical fracturing. The particle-size distributions of the fuel fines will depend on the burn-up of the fuel and the magnitude of the mechanical forces on the fuel pellets during the accident.

Only fuel fines smaller than the size of the cladding breach can be released from the fuel rod into the package; larger particles can also clog the cladding breach and reduce the quantity of fine-particle releases into the package. Most of the released fines would be deposited onto the interior surfaces of the package. Some of the remaining airborne fines (which typically comprise only a few percent of the fines released into the package; see Sprung et al., 2000, p. 7-30) and radioactive gases could be released into the environment, but only if *all* of the package barriers (i.e., the package lids and, if present, the inner canister) were breached. Volatile components such as cesium-137, if present, would condense upon cooling. The quantity of materials released from the package would depend on the size of the breaches and the presence of a driving force (e.g., depressurization) to propel material out of the package. Once air pressure between the package interior and outside environment was equalized, further material releases would occur by much slower diffusion processes.

The process for the release of radioactive materials from transportation packages containing high-level waste is similar to that for spent fuel with three notable exceptions. First, high-level waste does not contain fission-produced noble gases; those gases were removed from the waste during processing. Second, high-level waste to be transported in a vitrified (glass) form is contained in stainless steel canisters (see Sidebar 1.3), rather than zircaloy cladding. Third, the canisters are not pressurized, so there are no large depressurization forces to drive radioactive material releases from the canister into the package or the environment.

p. 9-2). Phase 2 screening involved more sophisticated analyses of package responses and radiological releases for the relatively small number of accident scenarios that exceeded the 10 CFR Part 71 testing limits. This screening employed nonlinear dynamic stress analysis models to estimate package deformation and transient thermal models that took into account the phase change accompanying the melting of lead shielding in the package at high temperatures. These analyses assumed that the packages contained five-year-cooled pressurized water reactor fuel having a burn-up of 33,000 megawatt-days per metric ton, which was typical of spent fuel at that time.[16] The analyses also considered breaches of the spent fuel cladding due

[16]Present-day fuel burn-ups are typically between 50,000 and 60,000 megawatt-days per metric ton.

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to both impact and thermally induced creep (see Sidebar 2.5). The radiological effects considered included releases of radioactive materials from the package as well as increased radiation doses resulting from damage to the package shielding.

Based on the phase 2 screening, Fischer et al. (1987) concluded that roughly 0.3 to 0.6 percent of extreme accidents would result in radioactive releases that approach or slightly exceed the regulatory limits in 10 CFR Part 71 (Sidebar 2.1), with less than 0.001 percent of the truck and 0.012 percent of the rail accident scenarios actually having releases that would exceed regulatory limits. Because these conditions pushed the capabilities of the computer codes, there was no attempt made to model the releases for the most extreme accidents. Instead, estimates of the releases for these very extreme accidents were extrapolated from the release behavior during less extreme accidents.

2.2.2 Reexamination Study

In a "reexamination study," Sprung et al. (2000) updated the modal study analyses using different package designs and modeling approaches. This study examined the performance of four generic transportation packages: steel-lead and steel-depleted uranium truck packages and steel-lead and monolithic steel train packages. These packages were similar in design to the USNRC-certified packages that were in use in the late 1990s. A detailed description of this study is provided in Chapter 3.

Mechanical performance was estimated using a three-dimensional finite element code (PRONTO 3D[17]), which was developed by Sandia National Laboratories for modeling large deformations in nonlinear mechanical behavior for materials subjected to very high strain rates. The code was used to estimate the mechanical response of the four packages to end, center-of-gravity over corner, and side impacts onto unyielding and yielding surfaces at speeds of 30 (the impact speed for the regulatory free-drop test; see Sidebar 2.1), 60, 90, and 120 miles per hour (about 48, 96, 144, and 192 kilometers per hour). The package impact limiters were assumed to be in place but fully crushed before impact occurred. This is a very conservative assumption; in an actual accident the impact limiters would be expected to absorb most of the impact forces by crushing, as they are designed to do.

Impacts onto unyielding surfaces provide the most rigorous test of package performance. Based on their modeling analysis, Sprung et al. (2000)

[17]PRONTO 3D is a Lagrangian finite element code developed by Sandia National Laboratories that is roughly comparable to LS DYNA 3D, a code that is used worldwide for transport package design and verification analyses.

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concluded that package impacts onto an unyielding surface would have produced strains lower than those required for package penetration at all of the modeled impact speeds and orientations. The models indicate that the seals on the truck packages maintained their integrity in all but possibly the 120 mile per hour impact; however, for the latter impact, the seal leak areas would have been small. The models also suggest that for rail packages, some seal leakage could occur for some impact orientations at impact speeds onto unyielding surfaces as low as 60 miles per hour and possibly at all orientations at speeds of 120 miles per hour.

A one-dimensional heat transport code was used to estimate the time required to cause the failure of the elastomeric package seals and rupture fuel rods when the package was subjected to a fully engulfing optically dense fire at 800°C (1472°F) (the regulatory thermal test; see Sidebar 2.1) and 1000°C (1832°F). Failure temperatures for elastomeric seals were estimated from data available in the literature. These data suggested that the seals would experience rapid degradation at temperatures exceeding 350°C (662°F). For the 800°C fire (1472°F), it was found that the minimum time to the 350°C (662°F) seal degradation temperature was just over one hour for one of the truck packages, with the maximum time being almost 2.5 hours for a rail package. For a 1000°C (1832°F) fire, the minimum and maximum times to degradation were about 0.6 and 1.4 hours, respectively, for a truck package and a rail package. As noted previously, packages are required by USNRC regulations to withstand a 30-minute, fully engulfing fire (see Sidebar 2.1).

2.2.3 Historical Accident Reconstructions

Additional investigations have been undertaken to reconstruct the thermomechanical conditions from a number of historical accidents that, had they involved spent fuel or high-level waste transportation packages, could have provided a severe test of package performance. It should be emphasized that none of these accidents actually involved shipments of spent fuel or high-level waste. The modal study (Fischer et al., 1987) developed estimates of the thermomechanical conditions for four severe accidents selected from a database of 400 train and truck accidents in the United States that were known to have produced extreme loading conditions. These are summarized in Table 2.2. The authors concluded that only one of the four accidents—the September 1982 Livingstone, Louisiana, train derailment and fire—could have resulted in any releases of radioactive materials. Whether releases would have occurred depended on where the package was placed on the train relative to the location of the fire, which was allowed to burn for several days.

Ammerman and colleagues (Ammerman et al., 2002, 2003; Ammerman

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TABLE 2.2 Severe Accident Scenarios Examined in the 1987 Modal Study

Date	Location	Description	Conclusions About Accident Severity by Fischer et al. (1987)
January 1979	Hunter, Alabama	Five railcars plunged off a rail bridge into the muddy bottom of a river about 23 meters (75 feet) below	No radioactive material releases or increases in external radiation expected
March 1981	San Francisco, California	A tractor trailer traveled through a bridge railing and fell onto a soil surface about 19.5 meters (64 feet) below the bridge	No radioactive material releases or increases in external radiation expected
April 1982	Oakland, California	A truck fire in a highway tunnel involving about 33,300 liters (8800 gallons) of gasoline	No radioactive material releases or increases in external radiation expected
September 1982	Livingston, Louisiana	A train derailment and fire fed by plastics and petroleum products; fires burned for several days	Package releases could have exceeded regulatory limits depending on where the package was located in the fire

SOURCE: Fischer et al. (1987).

and Ginn, 2004) from the Sandia National Laboratories examined the thermomechanical conditions for 12 historical accidents, some of which had been identified by the State of Nevada as potentially being severe enough to compromise the containment effectiveness of spent fuel transportation packages (Table 2.3). Accident loading conditions were reconstructed from National Transportation Safety Board reports and newspaper accounts. These conditions were compared to the loads experienced by transportation packages during regulatory testing (e.g., the 9-meter drop test; 30-minute thermal test); to the accident scenarios estimated in the modal study (Fischer et al., 1987); and to the 2000 reexamination study estimates (Sprung et al., 2000).

The authors concluded that the thermomechanical conditions described in Table 2.3 were encompassed by the event trees used in the Sprung et al. (2000) study (see Chapter 3). They also concluded that none of these acci-

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TABLE 2.3 Severe Accident Scenarios Examined by Sandia National Laboratories

Date	Location	Description	Conclusions About Accident Severity by Ammerman and Colleagues
June 1983	Greenwich, Connecticut	Two trucks and two cars plunged off an interstate highway bridge into a river about 21 meters (70 feet) below	Impact would have been less severe than the 9-meter drop test onto an unyielding surface
August 1985	Checotah, Oklahoma	Transported military ordnance (2000-pound Mk-84 bombs) exploded after a truck accident	Detonation of military ordnance would not have caused package failure
July 1986	Miamisburg, Ohio	A train carrying yellow phosphorus and molten sulfur derailed and caught fire	Fire would not have exceeded the 30-minute regulatory thermal test
April 1987	Amsterdam, New York	Several cars and a truck plunged off an interstate highway bridge, falling about 24 meters (80 feet) into a rain-swollen creek	Impact would have been less severe than the 9-meter drop test onto an unyielding surface
December 1988	Memphis, Tennessee	A tanker truck carrying about 9500 gallons of propane caught fire and exploded	Package would have experienced only superficial damage
February 1989	Helena, Montana	A runaway train collided with a locomotive at 15 to 25 miles per hour, causing two large explosions from hazardous cargo	Fire would not have exceeded the 30-minute regulatory thermal test
February 1989	Akron, Ohio	One railcar carrying butane ruptured, releasing its contents in the form of a fireball	Fire would not have exceeded the 30-minute regulatory thermal test
May 1989	San Bernardino, California	A train derailed at high speed (100 miles per hour); a gas pipeline failed catastrophically following cleanup of the derailment	Impact would not have caused package breach or release of contents

continues

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TABLE 2.3 Continued

Date	Location	Description	Conclusions About Accident Severity by Ammerman and Colleagues
July 1989	Freeland, Michigan	A derailed freight train carrying flammable materials burned for several days	Fire could have exceeded the 30-minute regulatory thermal test, but conditions would not have exceeded those shown by Sprung et al. (2000) to be necessary to cause package seal failure
October 1989	Oakland, California	The upper level of a viaduct collapsed onto the lower deck	Collapse of viaduct onto a truck package would not have been severe enough to cause seal failure, but package shield could be somewhat compromised
December 1994	Cajon, California	A runaway freight train struck the rear of another train at a speed of about 45 miles per hour	No significant damage to package would have occurred
February 1996	Cajon Junction, California	The derailment of a freight train caused a fire that burned for several days	Fire conditions would not have exceeded those shown by Sprung et al. (2000) to be necessary to cause package seal failure

SOURCE: Ammerman et al. (2002, 2003); Ammerman and Ginn (2004).

dents would have produced thermomechanical conditions that exceeded the regulatory test conditions in 10 CFR Part 71.

The USNRC undertook a detailed thermal analysis of the July 2001 fire in the Howard Street tunnel in Baltimore, Maryland, that resulted from the derailment of a train carrying hazardous materials. The fire was fed by a tanker railcar carrying about 28,600 gallons (106,300 liters) of liquid tripropylene. A National Institute for Standards and Technology (NIST) study of the fire (McGrattan and Hamins, 2003) used detailed numerical simulations to develop estimates of temperatures in the tunnel for the most severe portion of the tripropylene fire, which occurred between the time of its ignition and the rupture of a water main within the tunnel about three

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hours later.[18] The study estimated that peak temperatures in the narrow flaming region in the tunnel reached about 1000°C (1832°F) and that the tunnel walls reached peak temperatures of about 800°C (1472°F). The hot gas layer near the fire had average temperatures of about 500°C (932°F).

Tunnel temperatures were also estimated by analyzing oxide layer thickness, metal loss, and metal melting on railcar components recovered after the fire (Garabedian et al., 2002). This analysis suggested that gas temperatures in excess of 800°C (1472°F) existed for more than 30 minutes near the fire source. At 20 meters (66 feet) from the fire source, the analysis suggested that maximum surface temperatures of 600°C (1112°F) could have been reached for much less than 30 minutes.

USNRC staff modeled the thermal behavior of a specific USNRC-approved spent fuel package[19] subjected to these estimated "extraregulatory" thermal conditions. The package and its cradle were modeled using a two-dimensional finite element code for two scenarios: first assuming a one-railcar (20-meter, or 66-foot) separation between the package and fire source, as would be required by DOT regulations had spent fuel and hazardous materials been transported together; and second assuming a 5-meter (16.4-foot) separation. Both scenarios were analyzed for 150 hours of fire exposure at the maximum temperature conditions estimated by the NIST model.

The committee received a briefing from USNRC staff on the results of this analysis, which can be summarized as follows (see also Bajwa, 2002; USNRC, 2003a): For the first scenario, the temperature of the fuel element cladding exceeded regulatory limits of 570°C (1058°F)[20] after about 166 hours of fire exposure. For the second scenario, the fuel cladding would have reached 570°C (1058°F) after 37 hours of exposure. Calculations were also carried out to estimate the stresses on the welded canister resulting from fire exposure. Those calculations indicated that the welded canis-

[18]The NIST study noted that the distribution of tripropylene fuel within the tunnel, and thus the duration of the tripropylene fire, are difficult to estimate. The study suggests that the tripropylene fire was extinguished sometime between 3 and 12 hours after ignition either from a lack of fuel or from water suppression. Smoldering of combustible materials contained in closed boxcars on the train continued for several days after the tripropylene fire was extinguished.

[19]The Holtec Hi-Star MPC package was modeled. This rail package is designed to hold five-year-old pressurized water reactor spent fuel assemblies with maximum burn-ups of 45,000 megawatt-days per metric ton. It has a bolted external closure and an internal welded canister. For the purposes of the USNRC analysis, the spent fuel assemblies were assumed to generate the maximum internal heat (20 kilowatts) allowed by the package design.

[20]The 570°C (1058°F) regulatory limit was established to prevent fuel cladding failure from thermal creep during storage. The actual burst temperature for zircaloy fuel rods is about is about 750°C (1382°F) (see USNRC, 2003b).

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ter would have maintained its integrity. Consequently, USNRC staff concluded that no radioactive material would have been released from this package in this fire.

It is noteworthy that this analysis contains several significant "conservatisms" (i.e., assumptions that resulted in more dire predictions of package performance than might have occurred in an actual fire): The maximum fire temperatures in the tunnel were assumed to have been maintained for 150 hours—more than 6 days. The actual duration of the tripropylene fire in the Howard Street tunnel was estimated by NIST (McGrattan and Hammins, 2003) to last from 3 to 12 hours. A two-dimensional thermal model was used in the analysis. This model ignored axial direction heat transfer, which could have reduced the peak temperatures.[21] Also, the package was assumed to have the maximum allowed internal heat load from spent fuel decay heat.

The USNRC is extending its Howard Street tunnel fire analyses to examine the performance of two additional spent fuel packages: a TN68 rail package mounted on a railcar and NAC-LWT truck package in an ISO (International Organization for Standardization) container mounted on a railcar. Both are bare-fuel packages (see Section 2.1). These packages are currently certified by the USNRC for use in the United States, and the transport of truck packages by rail, which is one of the scenarios being examined, is allowed under current regulations.

A draft report containing the Howard Street tunnel fire analyses (Adkins et al., 2005) was made available to the committee in early September 2005, after the committee held its last meeting for this study.[22] Just prior to the committee's final meeting in July 2005, the State of Nevada also provided a preprint of a paper describing a thermal analysis of a generic steel-lead-steel

[21]Marvin Resnikoff of Waste Management Associates criticized the USNRC's analysis on the basis that it did not use a three-dimensional thermal model and did not explicitly model the bolts and seals on the external closure. While the committee agrees that additional details in the models would have been informative, it also judges them unlikely to have changed the results, given that the modeling predicted that there were no failures of the internal welded canister of the package.

[22]This analysis assumed that the packages were located 20 meters (66 feet) from the fire source and that the fire burned for seven hours, a shorter time than the original analysis. According to the draft paper, the analysis shows that the maximum temperatures on the seals of the TN68 and NAC-LWT packages would have exceeded their rated service temperatures, making it possible for the release of radioactive materials to occur. An analysis was also carried out to estimate the radioactive releases from these packages. They were characterized in the paper as "very small—less than an A_2 quantity" (see Sidebar 2.1) and consisting of non-fixed radioactive material (crud) from the external surfaces of the fuel rods. The draft paper indicates that the fuel cladding would have maintained its integrity.

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truck package exposed to a fully engulfing hydrocarbon fire (Greiner et al., 2005).[23] Because these papers were provided so late in the study, the committee was unable to analyze, discuss, and integrate them into this report.

The United Kingdom Department for Transport (1996) analyzed the thermal loading conditions in the Summit rail tunnel fire near Manchester, England, on December 20, 1984. The fire resulted from the derailment of 10 tank cars carrying gasoline. The fire burned for about four days (Figure 2.4) and completely destroyed several tanker cars. The analysis showed that fire conditions in the tunnel exceeded those required in the regulatory thermal test, which suggested that there could have been releases of radioactive materials had a spent fuel transportation package been involved in the derailment and fire. As a result of this analysis, an operational rule was established that prohibited English trains carrying spent fuel packages and trains hauling flammable materials from crossing in rail tunnels.

2.3 FULL-SCALE PACKAGE TESTING UNDER EXTREME CONDITIONS

Full-scale testing on transportation packages under severe extraregulatory conditions has been carried out in both the United States and the United Kingdom. In the United States, these tests have been carried out under the sponsorship of the Atomic Energy Commission and its successor agencies, the Energy Research and Development Administration (ERDA) and the USNRC. In the United Kingdom, one test has been carried out by the British Central Electricity Generating Board (CEGB). In addition, the USNRC plans to carry out an additional test on a rail package when funds are made available by Congress. These studies are described in the following sections, and the results are summarized in Table 2.4.

2.3.1 Sandia National Laboratories Air-drop Tests

Two air-drop tests were conducted by Sandia National Laboratories in 1975 to provide a demonstration of the ruggedness and survivability of shielded containers in a manner that was thought to be better appreciated by the general public than a regulatory test (Waddoups, 1975). The test

[23]According to this analysis, the elastomeric seal for this generic package would reach its melting temperature (referred to as the "temperature of concern" in the paper) in about two hours if the impact limiter is attached to the lid end of the package and about 0.7 hour without the impact limiter. The paper did not provide an analysis of the consequences of exceeding the seal melting temperature in terms of possible releases of radioactive materials from the package.

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FIGURE 2.4 Photos from the December 1984 Summit Tunnel fire near Manchester, England. The top photo shows two fire plumes emerging from tunnel ventilation shafts. The bottom photo is an interior view of the tunnel. Part of the tunnel ceiling has collapsed onto one of the tank cars. SOURCE: Photos taken by a member of the West Yorkshire Fire Brigade or Manchester Fire Brigade (used with permission of *www.todchat.com*).

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TABLE 2.4 Full-scale Package Tests Described in this Chapter

Test Description	Results in Brief	Reference
600-meter (2000-foot) air drop of two small packages onto hard soil	Less severe damage observed than for a 9-meter free-drop test onto an unyielding surface	Waddoups (1975)
Crash of a truck carrying a 20 metric ton (22 short ton) package mounted on a trailer into a massive reinforced concrete barrier at 98 kilometers per hour (61 miles per hour) and 135 kilometers per hour (84 miles per hour)	Superficial package damage for 98 kilometers per hour (61 miles per hour) test; deformation of package with small amount of water leakage observed for 135 kilometers per hour (84 miles per hour) test	Huerta (1977)
Crash of locomotive into 25 metric ton (28 short ton) package mounted on a trailer at 130 kilometers per hour (81 miles per hour)	Package was deformed, and a small leak was detected when the package was pressurized	Huerta and Yoshimura (1983)
Crash of a 68 metric ton (75 short ton) package mounted on a railcar into a massive reinforced concrete barrier at 131 kilometers per hour (82 miles per hour)	Superficial package damage	Huerta (1981)
9 meter free-drop tests of a package onto its side and corner	Water spray from lid-body joint at impact releasing up to a few liters of water	IME (1985)
Crash of a locomotive into a package mounted on a railcar at 160 kilometers per hour (100 miles per hour)	Superficial damage with an internal pressure drop corresponding to the loss of about 0.5 liter (0.1 gallon) of water through the package seal	IME (1985)
Full-scale testing of a rail package mounted on a rail carrier car placed at 90 degrees to a simulated rail crossing, subjected to a collision with a locomotive and several freight cars traveling at 60 miles per hour, followed by a fully engulfing, optically dense, hydrocarbon fire for a duration of one-half hour post-collision	Test has not yet been carried out	USNRC (2003c, 2004b,c,d, 2005a,b)

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involved 600-meter (almost 2000-foot) air drops of two "obsolete"[24] packages: a Pratt and Whitney 1 package[25] and an OD-1 Oak Ridge Research Reactor Spent Fuel Carrier.[26] These drops were made onto a hard prairie (a hard, dry, sandy silt soil) at the Sandia Edgewood Test Range in New Mexico.

The packages impacted the prairie at speeds exceeding 100 meters (350 feet) per second and created deep impact craters (in one case exceeding 2 meters [7 feet] in depth). One of the packages experienced superficial damage, while the other experienced some bulging and shifting of its internal lead shielding. Waddoups (1975) noted that the impact velocities for these drop tests reached speeds of about 230 and 246 miles per hour (103 and 110 meters per second), many times greater than the 30 mile per hour (about 13 meter per second) speeds in the 9-meter regulatory drop test. However, the hard prairie surface at the test site was not "essentially unyielding," as evidenced by the deep craters created by the impacts. Based on a comparison of damage to one of the packages, Waddoups (1975, p. 15) concluded that "the 30-foot drop test onto an unyielding surface is a more severe environment than the 2000-foot drop onto hard soil."

2.3.2 Sandia National Laboratories Crash Testing

ERDA (predecessor agency to the Department of Energy) sponsored a full-scale testing program at Sandia National Laboratories to obtain a better understanding of the behavior of transport packages in severe accident environments (Jefferson and Yoshimura, 1977). This program had two primary objectives: (1) assess and demonstrate the validity of analytical modeling and scale modeling for predicting the damage to transport packages in accidents; and (2) develop quantitative information on the conditions in extreme accident environments.

This full-scale test program was carried out in three separate phases: (1) use of computational methods to predict the conditions in accident environments and the potential damage to shipping containers in such

[24]Both packages were considered obsolete because they were not designed to meet fire standards with an acceptable loss of shielding. They also were not as rugged as then-licensed packages.

[25]This package had a 0.622-meter (25-inch) outside diameter, 0.9065-meter (36-inch) outside height, and a weight of 3054 kilograms (3.4 short tons). The package is smaller than many of the packages currently in use to transport commercial spent fuel.

[26]This package had a 0.8-meter (32-inch) outside diameter, 1.2-meter (48-inch) outside height, and a weight of 7410 kilograms (8.2 short tons). The package also is smaller than many of the packages currently in use to transport commercial spent fuel.

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environments; (2) determination of physical damage mechanisms through scale-model testing; and (3) full-scale testing of representative hardware to validate the computational analysis methodology.

Several criteria were considered in selecting the test scenarios. These included the desire to expose transport packages to realistic and severe accident environments, tractability of the scenarios to mathematical analysis and scale-model testing, cost-effectiveness, and the likelihood of successful execution. The last criterion eliminated scenarios that were difficult to replicate such as skids into barriers. The cost criterion prompted the use of out-of-service transport packages, used tractors, and a military surplus locomotive in the tests. Three full-scale test scenarios were eventually selected:

1. Impacts of tractor-trailer rigs carrying spent fuel transport packages into a concrete barrier at nominal speeds[27] of 100 kilometers (62 miles) per hour and 130 kilometers (about 80 miles) per hour.
2. Impact of a locomotive into a spent fuel transport package mounted on a truck trailer at a simulated grade crossing at a nominal speed of 130 kilometers (about 80 miles) per hour.
3. Impact of a spent fuel transport package mounted on a railcar into a concrete barrier at a nominal speed of 130 kilometers (about 80 miles) per hour, followed by exposure to a fire.

Prior to performing these tests, Sandia carried out both analytical and one-eighth scale-model tests to predict the response of the vehicles and transport packages under each of these impact conditions. Analyses were conducted using "lumped parameter models" of the transport systems in which the vehicle system and package are represented as a series of loads and couplings. A limited amount of finite element modeling was also carried out to elucidate the details of package deformation.

Scale-model testing was carried out in two phases. First, scale-model packages were impacted directly against rigid barriers to identify and quantify potential damage mechanisms. Then, scale models of the entire transport system were tested to understand total system response. The latter tests helped researchers determine the appropriate vehicle-package configurations for the full-scale testing described in the following sections.[28]

[27]Actual test speeds varied slightly from these nominal speeds in some cases.

[28]Videos of these tests are available on the Department of Energy's web site at *http://www.ocrwm.doe.gov/newsroom/videos.shtml*.

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Tractor-trailer Impact Tests

The tractor-trailer impact tests (Huerta, 1977) were carried out using an obsolete spent fuel transport package weighing 20,500 kilograms (45,000 pounds) that was mounted on a trailer in a head-on position. The trailer was attached to a standard tandem-axle tractor. The package contained an unirradiated fuel assembly and was filled with water. Conventional balsa-wood impact limiters were mounted on each end of the package. The tractor-trailer was crashed into a massive (626 metric tons [690 short tons]) reinforced concrete barrier backed by more than 1500 metric tons (1650 short tons) of soil. The target was described by Jefferson and Yoshimura (1977, p. 13) as "essentially unyielding" and of a weight greatly exceeding what would be encountered along normal truck routes.

The tests were carried out at Sandia's sled test-track facility on January 18 and March 16, 1977 (Figure 2.5). For each of the two tests, a tractor-

FIGURE 2.5 High-speed (135 kilometers per hour [84 miles per hour]) crash of a spent fuel package mounted on a truck trailer into a massive barrier carried out at Sandia National Laboratories in 1977. The truck cab was destroyed in the crash, but the package remained attached to the trailer. SOURCE: Sandia National Laboratories.

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trailer was accelerated to the target by a rocket sled mounted on guide rails behind the trailer. The sled was disengaged from the trailer prior to impact to allow the vehicle to coast into the barrier at the predetermined speed. The same transport package was used in both full-scale tests. It was instrumented with accelerometers, triaxial strain gauges near the front (impact) end, and passive water pressure sensors inside the package to measure peak pressures. The tests were recorded by high-speed photography.

On the first test, the trailer impacted the concrete barrier at a speed of 98 kilometers per hour (61 miles per hour). The tractor and the front end of the trailer were completely destroyed. The package remained attached to the trailer throughout the test, although the front package tie-down failed and the rear tie-down was damaged. The package suffered only superficial damage. There was no water leakage from the package, and the fuel assembly was intact and undamaged. The package experienced a peak deceleration of about 18 times the acceleration of gravity (i.e., 18 *g*'s) based on a velocity-time analysis of the crash photos (see Sidebar 2.6).

On the second test, the vehicle hit the concrete barrier at 135 kilometers per hour (84 miles per hour). At this speed the vehicle had approximately double the kinetic energy[29] of the first test. Nonetheless, the response of the tractor-trailer was similar to the first test, and the package remained attached to the trailer. The front impact limiter was partially crushed and displaced, allowing the package to impact the rigid barrier. The front end of the package was slightly deformed and the package length was reduced by about 6 centimeters (2.4 inches). The impact created a 0.95-centimeter (0.4-inch) gap between the lead shielding and the outer shell at the back of the package. A small amount of water seepage (two drops per minute) was observed at the package head (Jefferson and Yoshimura, 1977, p. 29). Mechanical means had to be employed to remove the package head and a large force applied to remove the fuel assembly because the package had deformed. Some of the fuel rods were buckled by the impact.

Rail Grade-crossing Impact Test

The grade-crossing test (Huerta and Yoshimura, 1983) involved a crash of a locomotive traveling at 130 kilometers per hour (81 miles per hour) into a tractor-trailer holding a spent fuel transport package at a simulated grade crossing (Figure 2.6). The test was carried out on April 24, 1977,

[29]The kinetic energy of a body in motion is equal to $\frac{1}{2} mv^2$, where m is the body mass and v is the body velocity. Because the package masses are the same in both tests, the ratio of the kinetic energies is equal to the ratios of the test velocities squared: that is, $(135/98)^2 \approx 1.90$.

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SIDEBAR 2.6 Impact Severity

The *accelerations* and *strains* that are routinely measured during package impact tests provide quantitative information for the verification of computation simulation analyses. Analyses of this kind are particularly important for comparing the relative severity of full-scale crash tests and regulatory free-drop tests.

The tests described in this chapter were designed to generate large forces on transport packages by accelerating them to a known speed and then impacting them against rigid barriers. The forces generated by the impact can be calculated using Newton's equation:

$$\text{Force } (F) = \text{mass } (m) \times \text{acceleration } (A).$$

During an impact, the package undergoes a rapid and negative change in A (i.e., it decelerates) as its velocity goes to zero. It is possible to determine a nominal (average) value for A directly by measuring the change in position of the package as a function of time. This measurement is typically made using photographs taken during the crash by high-speed cameras, which record at up to 3000 frames per second. Instruments, called accelerometers, also can be mounted on the package to provide this information. Unfortunately, the highest decelerations and forces occur locally at the point of impact where measurements are very difficult.

Estimates of A as a function of time are usually given in the form of a smooth curve (see figure), where acceleration is expressed relative to the acceleration imparted by Earth's gravity field. The units of measurement are expressed in g's, (1 g = 9.8 meters per second squared, or 32 feet per second squared). Because the mass of the package is known and does not change during the test, the average forces (F) acting on the package can be determined directly using the above equation. The peak of the curve provides a good estimate of the peak force of the test.

The forces imparted during the test will cause both the package and the barrier to deform. If the deformations are below the *elastic limit* they will be temporary, and the deformed materials will return to their original shapes after the forces are removed. If the deformation is above that limit, the deformations will be permanent. This *elastic limit* is material specific but tends to be less than 1 percent strain for steel objects.

using a 2545-kilogram (56,000-pound) stainless steel and lead package[30] containing an unirradiated fuel assembly. The package was mounted to the trailer with heavy steel bands. The trailer in turn was attached to a used gasoline tractor. A military surplus locomotive weighing 109,000 kilo-

[30]This package was constructed of a 2.54-centimeter (1-inch) thick outer stainless steel shell and a 1.9-centimeter (0.75-inch) thick inner stainless steel shell with a 21.3-centimeter (8.37-inch) thick sandwich of lead shielding. The package head was attached by eight 2.54-centimeter (1-inch) diameter stainless steel bolts.

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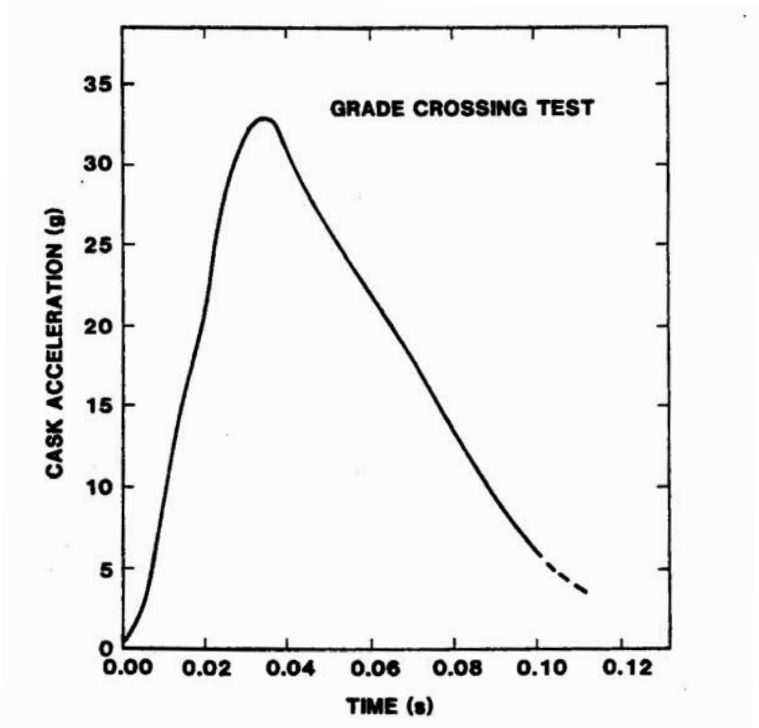
The amount of deformation can be measured directly by installing strain gauges on the package. These devices provide an estimate of the maximum local (i.e., where the strain meter is installed) changes in dimension (strain) of the object. Strain is usually expressed in units such as microstrains (see table in Sidebar 2.2).



Curve showing the variation in package acceleration as a function of time after impact in the Sandia National Laboratories grade-crossing test. SOURCE: Huerta and Yoshimura (1983, Figure 24, p. 25).

grams (240,000 pounds) was used in the tests. The package was instrumented with strain gauges and accelerometers, and the crash was recorded by high-speed photography.

The test geometry was such that the heavy locomotive frame, which was constructed of I-beams and welded steel plates, impacted the package below its centerline. Upon impact, the package plowed through about 3 meters (10 feet) of the lighter locomotive superstructure above the heavy frame and then became detached from the trailer, which became wrapped around the front of the locomotive. The impact forces launched the pack-

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FIGURE 2.6 High-speed (130 kilometers per hour [81 miles per hour]) crash of a locomotive into a package mounted on a truck trailer carried out at Sandia National Laboratories in 1977. The top photo shows the impact of the locomotive and the trailer. The end of the package can be seen near the center of the photo. The bottom photo shows the package after the test. SOURCE: Sandia National Laboratories.

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age into the air. It hit the ground about 46 meters (150 feet) from the point of impact and tumbled for another 15 meters (49 feet). The package attained a maximum horizontal velocity in flight of about 60 meters per second (about 50 miles per hour).

The impact produced two indentations in the package where it was struck by the frame of the locomotive. The cooling fins on the package were crushed and the outer package shell was bulged inward by about 2.5 centimeters (1 inch). A small leak in the package head was detected when the package was pressurized following the test (Jefferson and Yoshimura, 1977, p. 37). The inside cavity of the package was undeformed, however, and although some of the fuel rods had bowed slightly, the assembly was otherwise undamaged. The maximum deceleration on the package was about 33 *g*'s based on a velocity-time analysis of the high-speed photos. Two accelerometers mounted on the package gave peak readings of about 90 *g*'s and 200 *g*'s, but these readings may have been affected by package rotation, which reached a peak of about 1500 rotations per minute. The peak strain readings were below the yield strain for the package material.

Railcar Impact Tests

The third full-scale Sandia test involved the high-speed crash of a railcar-mounted spent nuclear fuel package into the same concrete barrier used in the truck crash tests (Huerta, 1981). The railcar system used in this test was constructed around 1960 but was no longer in use at the time of the tests. The package weighed about 68,000 kilograms (150,000 pounds). It was mounted in a steel-frame railcar with a package encasement system of about the same weight.

The transport package was larger than that used in the rail-crossing test, but it had a similar construction.[31] It was designed to carry 10 spent fuel assemblies in water. For the purposes of this test, the package was loaded with nine mock assemblies and one unirradiated assembly, and it was filled with water. The package was mounted in the railcar with its closure end facing forward (i.e., toward the impact end of the railcar). The railcar and package were extensively instrumented with strain gauges and accelerometers. The crash was recorded by high-speed photography using both stationary and railcar-mounted cameras.

The test was conducted on September 27, 1977 (Figure 2.7). The railcar impacted the barrier at a speed of 131 kilometers per hour (82 miles per

[31]It had two stainless steel shells, 3.5 centimeters (1.375 inch) thick on the outside and 0.95 centimeter (0.375 inch) thick on the inside. The lead shielding was sandwiched between these shells. The package head was attached to the body with 24 high-strength bolts.

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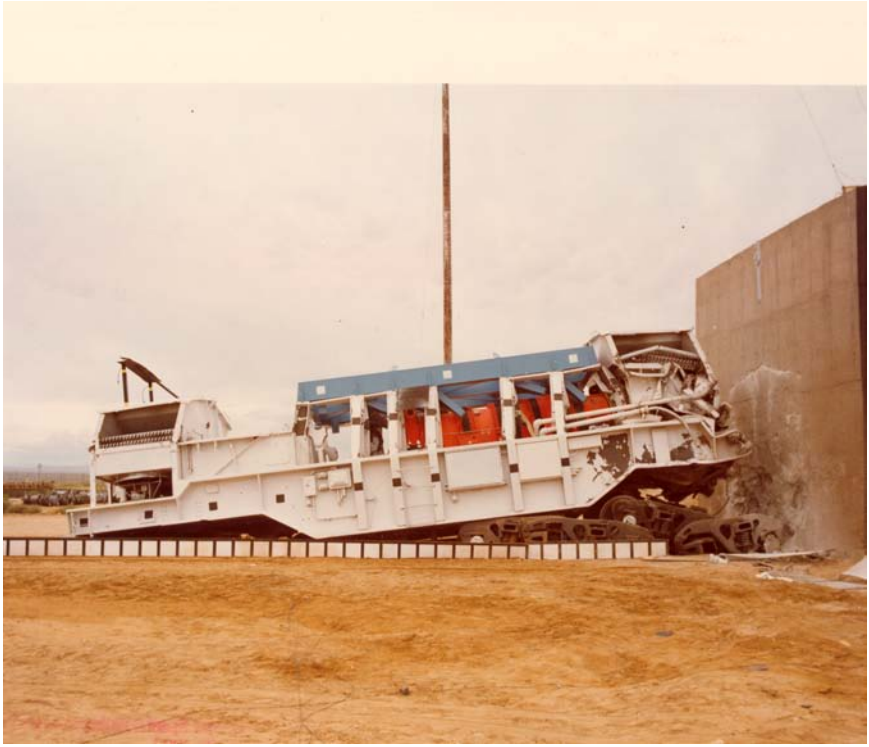

FIGURE 2.7 High-speed (131 kilometers per hour [82 miles per hour]) crash of a spent fuel package mounted in a railcar into a massive barrier carried out at Sandia National Laboratories in 1977. The railcar was destroyed in the crash, but the package sustained only superficial damage. SOURCE: Sandia National Laboratories.

hour). The impact crushed both the front end of the railcar and a spacer device that was placed at the forward end of the package. The package suffered some external damage to its cooling fins, but was otherwise undeformed. The package remained leaktight after the test. The fuel rods themselves were undamaged, although one of the support brackets was slightly distorted.

High-speed photography was used to estimate the deceleration-time curves for the package. Maximum decelerations were calculated to be 32 *g*'s. The strain gauge data from the package and fuel showed that maximum strains were below the elastic limits for these materials, which is consistent with the observation of no permanent deformations of those objects.

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2.3.3 British Central Electricity Generating Board Tests

In the early 1980s, the British CEGB undertook a testing program aimed at improving understanding of the performance of spent fuel transport packages. The program had three objectives:

1. Understand how to assess package impact resistance and demonstrate compliance with regulatory requirements.
2. Estimate the probabilities of transport accident scenarios.
3. Demonstrate to the public that the Generating Board's packages that meet regulatory requirements will withstand severe accident conditions.

The impact performance of transportation packages was investigated over a period of four years through a carefully planned progression of analytical studies, scale-model testing, drop testing, and a full-scale crash test. A discussion of these tests is provided in Blythe et al. (1984) and an Institution of Mechanical Engineers (IME, 1985) report.

CEGB selected the Magnox package for this testing program. This package has been used since the 1950s for transporting Magnox fuel[32] to the Sellafield site for reprocessing. By the early 1980s this package was being used for most of CEGB's fuel movements to Sellafield as well as shipments to Sellafield by the Scotland Electricity Board and British Nuclear Fuels Limited (BNFL). The package has undergone several design improvements since being introduced into service. It has a monolithic cuboid body with a bolted lid with welded steel fins for cooling. A photograph of this package is shown in Sidebar 2.3. The package can hold up to 400 Magnox fuel elements and 1 metric ton (1.1 short tons) of water for heat transfer and radiation shielding. The loaded weight of the package is about 48 metric tons (53 short tons). The packages are transported mostly by train on specially designed railcars called flatrols.

Analytical studies carried out under the CEGB project indicated that because of their massive construction, the package body and package lid would be unlikely to sustain major damage in an accident. Any damage would likely be minor (e.g., bent cooling fins). These studies also suggested that any package releases would most likely be caused through impacts that result in bolt extension and decompression of the elastomer seals at the lid closure (Dallard, 1985, p. 49).

Analytical studies and scale-model testing undertaken by CEGB had shown that the maximum deformation would be sustained in a drop test in

[32]Magnox fuel contains uranium metal encased in a magnesium alloy "can." The United Kingdom now operates 6 Magnox reactors, down from a peak of 26. The first reactor (Calder Hall) began operating in 1956 and is now shut down.

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which there is no package rotation at impact. To achieve this condition, the drop tests were designed so that the center of gravity of the package was located directly above the impact point. The drop tests were designed to produce maximum deformation of the lid-body joint, because this would have a direct effect on containment integrity. Tests were conducted using one-quarter- and one-half-scale models and a full-scale package (shown in Sidebar 2.3). The packages were instrumented by transducers to measure forces on the bodies, lid displacements, and internal water pressures. Strain gauges were fitted to the closure bolts to measure elongations. High-speed photography was used to capture a detailed visual record of each test.

Two full-scale tests were carried out: In the first, the package was dropped onto the corner of the lid, and the second public demonstration test, the package was dropped onto the lid edge (Figure 2.8). The same package was used for both tests. The "public demonstration" drop test was conducted in March 1984. The package was filled with steel bars to simulate the Magnox fuel, and it also contained the other internal components and water in a manner that would be typical in an actual package shipment. It was pressurized to 100 pounds per square inch (6.9 bars) for leak testing.

A detailed discussion of the results of these tests is given in IME (1985). There was generally good agreement between the measured accelerations and displacements in the scale-model and in the full-scale drop tests. It was concluded that package behavior can be characterized accurately in scale-model tests "provided that all the important features are accurately represented in the models" (Barnfield and Donelan, 1985, p. 82; see Sidebar 2.3).

A small decrease in internal package pressures (ranging from about 1.5 to 6 pounds per square inch [0.1 to 0.4 bar]) was measured in both the scale-model and the full-scale drop tests. High-speed photography of the full-scale and half-scale tests showed a water spray from the lid-body joint lasting about 20 milliseconds. The water loss from one of the full-scale tests was estimated to be on the order of a few liters. Calculations based on this observation suggested that the associated radiological releases would have been less than about 5 percent of the amount permissible under IAEA regulations for accident conditions.[33]

The next phase of the CEGB study involved the identification of package transport impact hazards along transport routes. The objective of this hazard analysis was to estimate the probability of occurrence of various accident scenarios for use in designing the full-scale impact tests. Most spent fuel transport in the United Kingdom is carried out using rail, so the analysis focused on the identification of potential hazards along current and future rail routes used to transport packages to Sellafield. CEGB recog-

[33]These are given by the A_2 values described in Sidebar 2.1.

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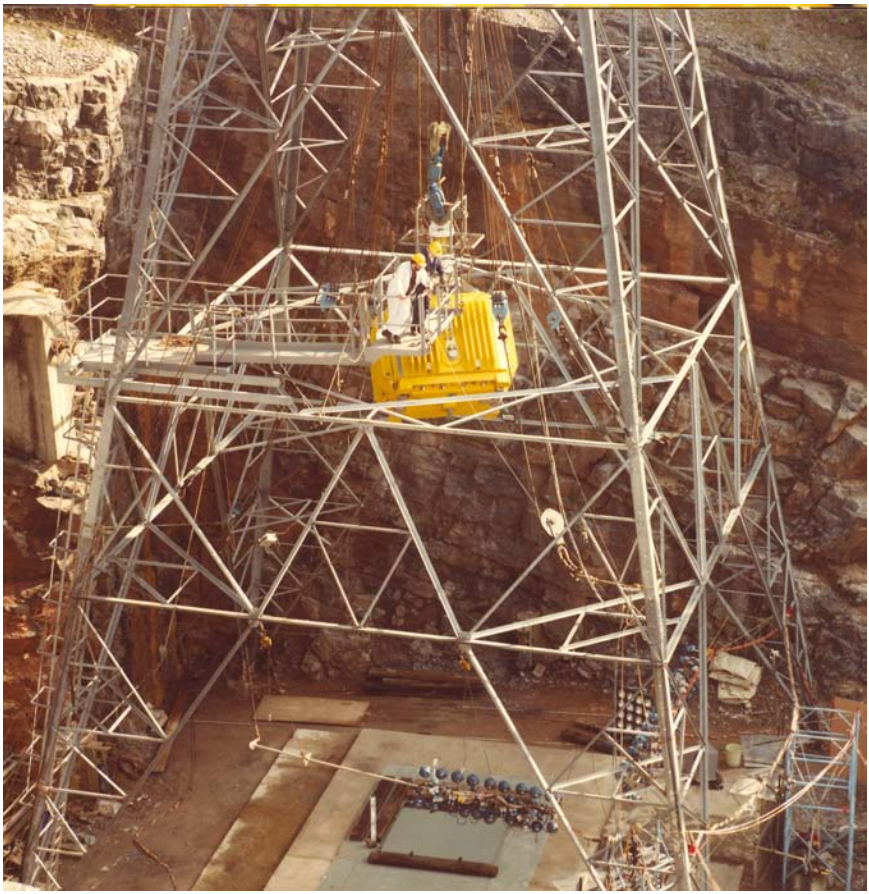

FIGURE 2.8 Preparation of a Magnox spent fuel package (behind the workers on the scaffold) for the March 1984 CEGB free-drop test. The package was subjected to a 9-meter (30-foot) drop onto an unyielding surface. SOURCE: Magnox Electric Ltd.

nized that most people would have difficulty comparing the severity of a 9-meter drop test required by the regulations to a rail accident that might occur when a package was being transported at high speeds on the British rail system. This test was designed to provide a graphic demonstration of such a rail accident.

Information was collected on topography, geology, tunnel and bridge abutments, mobile hazards such as road vehicles and aircraft, and previous railway collisions. This information was used to construct event trees (e.g., see Figure 2.3) that could be used to assess the probability of future acci-

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dent occurrences. The hazard analysis identified a range of potential events and estimated their probabilities of occurrence. The most likely accident scenarios range from derailments (5 chances in a hundred per year [5×10^{-2} per year]) to the impact of a package onto rock from a height exceeding 20 meters (70 feet) (1 chance in 100 million per year [1×10^{-8} per year]).

Two scenarios were considered initially for the full-scale crash test (Hart et al., 1985a, p. 116) based on the hazard analysis: (1) package-flatrol impact following a fall of 20 meters (65 feet); and (2) a package-flatrol striking a bridge or tunnel abutment at a speed exceeding 20 meters per second (about 45 miles per hour), which was the speed limit for trains carrying spent fuel packages at the time these tests were carried out.[34] A third scenario was added because it was frequently mentioned as a cause of public concern: a derailed package-flatrol struck by a train traveling at a closing speed of greater than 20 meters per second (45 miles per hour). Other possible scenarios were eliminated from consideration because they were thought to have a very low probability of occurrence. These included aircraft impacts, explosions, and blasts.

The third scenario (train crash into a derailed package-flatrol) was finally selected for demonstration because model tests showed that of the three scenarios, this one would inflict the most damage on the package closure. The testing was limited to one full-scale crash because of cost and logistical considerations.

The crash test was carried out using the heaviest locomotive in service, which had an operating weight of about 140,000 kilograms (310,000 pounds) and a maximum operating speed approaching 45 meters per second (100 miles per hour). Three passenger coaches were hooked to the locomotive to "add realism to the test" (Collins et al., 1985, p. 206), even though calculations suggested that they would not increase its severity.

The test configuration chosen was similar to that used for the drop test: an impact on the package-closure joint with the center of mass of the locomotive aligned with the center of mass of the package to minimize rotational forces. The same package body used in the drop tests was used for this crash test, but it was fitted with a new lid. The package was mounted on a flatrol railcar, which was turned on its side and laid diagonally across the track so that the front coupler on the locomotive was aligned with the package-closure joint (Figure 2.9). The locomotive and package were instrumented with accelerometers and strain gauges, and the test was recorded using high-speed photography.

The test was carried out at a test track at Old Dalby in Leicester,

[34]This speed limit has since been raised to 65 miles per hour (104 kilometers per hour).

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FIGURE 2.9 Configuration for the July 1984 full-scale crash test of a Magnox spent fuel package carried out in Leicester, England by the CEGB. The Magnox package was mounted on a flatrol railcar, which was turned on its side and laid diagonally across the track as shown in this photograph. The wires leading away from the package are connected to instruments for monitoring conditions during the early phases of the crash. SOURCE: Magnox Electric Ltd.

England on July 17, 1984, and was shown live on national television.[35] In the crash, which was described as "first and foremost a visual spectacle" (Hart et al., 1985b, p. 234; Figure 2.10), the package suffered only superficial damage. The peak recorded acceleration, about 49 *g*'s, occurred about 10 milliseconds after impact. The pressure within the package was checked after the crash and was found to have decreased by 0.012 megapascal, corresponding to a fluid loss of about 0.5 liter (Hart et al., 1985b, p. 234).

A significant observation from this test is that the peak force on the package during the test (29 meganewtons [MN]) was considerably less than the peak force in the 9-meter drop test (75 MN) on the same package. In other words, this visually spectacular crash was actually a much less severe mechanical test of package containment than the 9-meter free-drop test used in the IAEA standards and USNRC regulations (see Sidebar 2.1).

[35]A video of this test is available on the Department of Energy's Web site at *http://www.ocrwm.doe.gov/newsroom/videos.shtml*.

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FIGURE 2.10 Full-scale crash test of a Magnox spent fuel package carried out in Leicester, England by the CEGB in July 1984. This photograph was taken just after the locomotive, which was traveling at 100 miles per hour (45 meters per second), collided with the package and flatrol. The collision has lifted the package and flatrol off the ground. SOURCE: Magnox Electric Ltd.

2.3.4 Package Performance Study

In 1999, the USNRC initiated a five-year project, referred to as the Package Performance Study, which had the following three objectives (USNRC, 2003c, p.4):

1. Assess whether finite element analysis is a valuable tool for characterizing package and fuel response in extreme thermomechanical environments.
2. Demonstrate the inherent safety of spent fuel package design using public outreach as a significant element.
3. Refine dose and risk estimates to the public and workers through the collection of additional empirical data and improved transportation statistics.

USNRC staff embarked on an effort to obtain public input to inform this study. Initially, the staff held public meetings and solicited comments through its Web site to identify concerns that could be addressed in this

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study. An analysis of these comments by Sandia National Laboratories (Sprung et al., 2001) identified several common concerns: Some commenters asserted that the regulatory testing requirements in 10 CFR Part 71 were unconvincing as a demonstration of a transport package's performance under severe accident conditions. They wanted more realistic full-scale testing to demonstrate package performance. Some members of the public also thought that the accident statistics used in the analytical studies of package performance in severe accidents (e.g., the 1987 modal study) needed to be reanalyzed in light of increased truck traffic and vehicular speed limits on interstate highways.

USNRC staff then held additional public meetings to help them assess the accuracy of the Sprung et al. (2001) analyses of public comments and to obtain additional comments on a set of proposed package tests. These comments were used to develop a set of draft protocols for extraregulatory tests of rail and truck packages (USNRC, 2003c). Two draft protocols were proposed:

1. High-speed (75 miles per hour [120 kilometers per hour]) impact tests involving drops of rail and truck packages from a tall tower onto an essentially unyielding surface. The rail package drop would be a package-corner-over-center-of-gravity test with the impact limiter in place. The truck package drop would be onto the package body in a so-called back-breaker orientation that bypassed the impact limiters.
2. A fire test for both the rail and the truck packages that would involve a fully engulfing, optically dense hydrocarbon fire of a greater-than-30-minute duration.

Both of these tests are extraregulatory in the sense that they would exceed the test requirements in 10 CFR Part 71 (Sidebar 2.1). The 9-meter free-drop test, for example, produces, neglecting windage, a terminal speed of 13.3 meters per second, which is approximately 30 miles per hour (or approximately 48 kilometers per hour). This impact speed is much lower than the 75 mile per hour (120 kilometers per hour) impact speed envisioned in the staff's draft test protocol.

USNRC staff proposed to perform full-scale testing on two packages that are currently certified in the United States. These packages are similar in construction to the generic packages that were used in Sandia's spent fuel shipping risk reexamination (Sprung et al., 2000).

These draft testing protocols were put out for additional public comment. USNRC staff identified several groups of suggestions from the public comments on the draft testing protocols (USNRC, 2004c): full-scale testing should be conducted to regulatory limits; tests should be based on realistic accident scenarios; they should be designed to test packages to failure; and

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they should address terrorist acts. USNRC staff commented in its recommendations to the Commissioners (USNRC, 2004c, p. 3) that having realistic accident scenarios and testing to failure are incompatible goals. Staff also noted that terrorism was being addressed in other studies currently under way within the USNRC that "are not suitable for the public participatory approach."

USNRC staff rejected the suggestion to test packages to failure as unrealistic and unworkable for the following reasons: There is no readily agreed-upon definition of package failure among various stakeholders; package failure is a design-specific issue that would have little generic application to risk insights; and there are no realistic accident scenarios that are sufficiently severe to lead to package failure.

USNRC staff also decided to eliminate extraregulatory testing. In its place, staff recommended to the Commissioners that one or more of the following tests be carried out on full-scale truck and train packages:

- A test of a rail package to the regulatory limit. This would subject a rail package with impact limiters to the regulatory tests in 10 CFR Part 71.
- A test of a truck package with its impact limiters to the same regulatory limits, except that the 2-megapascal pressure test might be eliminated if the truck and rail packages are tested in combination.
- A full-scale crash demonstration of a rail package with impact limiters and its railcar with a simulated bridge abutment at about 75 miles per hour (120 kilometers per hour), followed by a fire from a ruptured tank car.
- A full-scale crash test of a truck package with impact limiters and its trailer by a locomotive traveling at about 75 miles per hour (120 kilometers per hour) on a grade crossing followed by a fire.

The staff proposed to the Commissioners a testing protocol involving various combinations of these tests, as well as an option to perform the extraregulatory tests originally outlined in USNRC (2003c). In December 2004, the Commissioners approved a modified full-scale test that will be carried out when funds are made available by Congress (USNRC, 2004d). USNRC staff was directed to plan for a demonstration test involving a single rail spent fuel package involved in a "viable" transportation accident. The Commissioners directed that

> the test should consist of a simulated rail crossing with a train traveling at an appropriate speed colliding at a ninety degree angle with a transportation cask on its rail carrier car in a normal transportation configuration. . . . The test will consist only of the collision and the natural results of that collision. No separate fire testing or immersion testing will be conducted on the cask.

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The Commissioners directed USNRC staff to prepare an information paper that provided details and estimated costs of the test.

The requested information paper was submitted to Commissioners in March 2005 (USNRC, 2005a). The staff proposed a test involving a full-scale package of the kind that is likely to be used by the Department of Energy (DOE) in its Yucca Mountain transportation program. The package would contain surrogate fuel elements and would be mounted on a rail carrier car placed at 90 degrees to a simulated rail crossing. The rail package would be subjected to a collision with a locomotive and several freight cars traveling at 60 miles per hour (96 kilometers per hour). In accordance with the Commissioners' December 2004 directive, no fire or immersion testing was included in the proposed testing plan.

The Commissioners approved this proposed test in June 2005 (USNRC, 2005b). In addition, the Commissioners reversed their earlier instructions concerning the thermal test, directing the staff to "add a fire test scenario . . . involving [a] fully engulfing, optically dense, hydrocarbon fire for a duration of one-half hour post-collision." The Commissioners directed staff to inform it of the details and estimated costs for the proposed fire test. They also noted that the proposed test plan provided by staff (USNRC, 2005a) "is not the final word on this issue, as the project is subject to additional modifications and Commission direction once additional information becomes available." The Commissioners directed staff to engage with higher-level management in DOE to request financial support for the demonstration test and to request increased funding from Congress if DOE is unable to provide support.

2.4 CRITICAL ASSESSMENT OF PACKAGE PERFORMANCE

It is clear to the committee that package performance under severe accident conditions is a major concern for transportation safety among many members of the public, especially those who live and work along shipping routes. Finding a way to resolve this issue continues to be a challenge to regulators in the United States and may eventually become a challenge for DOE and the private sector in their commercial spent fuel transportation programs.

The packages used to transport spent fuel and high-level waste are designed to contain their radioactive contents under normal transport conditions and to withstand accident conditions without an increase in external radiation to levels that would endanger emergency responders or the general public. The package performance standards developed by the IAEA and embodied in USNRC regulations (Sidebar 2.1) were developed to help ensure that properly manufactured, certified packages provide such containment effectiveness. The 9-meter regulatory free-drop test onto an essen-

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tially unyielding surface, for example, is a more severe mechanical test of package performance than has been produced in any of the severe full-scale crash tests described in this chapter (see Section 2.3).

The safety of transporting spent fuel and high-level waste depends to a great extent on the "inherent" safety of transportation packages to contain their contents even under severe accident conditions. The committee observes that while the full-scale crash tests described in this chapter have imposed mechanical conditions on packages that are less severe than the regulatory free-drop test, some of these tests have resulted in small releases from package containments.[36] However, these releases would not have exceeded regulatory limits, which have as their goal the protection of emergency responders and the general public. The committee judges that the regulatory free-drop test imposes mechanical forces that are severe enough to bound conditions likely to be encountered in foreseeable real-life accidents. At the same time, the committee understands that any releases of radioactivity could have substantial social risk implications (see Chapter 3).

The accident reconstruction and modeling studies described in Section 2.2.3 suggest that there may be a very small number of credible accident conditions involving very long duration, fully engulfing fires[37] that are potentially capable of damaging the seals on transportation packages if such fires are allowed to burn in an uncontrolled manner for long periods of time. Such damage could potentially lead to the release of radioactive material from the package through the processes described in Sidebar 2.5.

The potential for radioactive material releases from packages involved in such fires and the consequences of such releases are incompletely understood at present. USNRC staff has completed a solid technical analysis of the response of one package design to a realistically extreme thermal event resulting from the Howard Street tunnel fire. Additionally, staff are completing analyses of the performance of two additional package types for this fire exposure (see footnote 22 in this chapter). The committee judges that additional analyses of this type are needed to better understand package performance for realistic accident conditions involving very long duration fires.

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[36]The releases described in this chapter consisted of water that leaked from the package interiors. This water may have been slightly contaminated with radioactive material from the fuel rod cladding (crud), but the fuel itself remained intact. It is important to note that in the United States, packages now in use to transport commercial spent fuel are filled with inert gas, not water. Inert gas is a much less efficient medium than water for transporting radioactive contamination out of leaking packages.

[37]The committee uses this term to describe fires that burn for periods of hours (or longer). Such fires could produce thermal loading conditions that exceed those for the regulatory thermal test specified in 10 CFR 71.73. Some of the real-world accidents described in this chapter involved fires that burned for hours to days.

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The number of additional analyses might be small in number, especially if they focused on fire scenarios that would essentially bound expected real-world accident conditions,[38] and if they examined the performance of a representative set of package designs that are likely to be used in future large-quantity shipping programs. The analyses have to address both the containment effectiveness of packages in response to very long duration fires and the consequences of any radioactive releases that result from package seal failures.

The purpose of these analyses would be to inform changes, if needed, to regulatory and operational practices to reduce the likelihood of occurrence and potential consequences of accidents involving very long duration fires. At least two options are available to regulators and implementers if such changes are needed:

1. Operational steps to reduce the likelihood of occurrence of long-duration fires during spent fuel transport, and/or
2. Design or testing requirements to improve the thermal resistance of transportation packages.

The first option would clearly be preferable from a cost and implementation standpoint. The objective of taking such operational steps would be to reduce the potential for accidents between trucks or trains carrying spent fuel and other vehicles carrying large quantities of flammable materials, especially flammable liquids, in places where it might be difficult to mount an effective firefighting response.[39] Operational controls are used routinely by railroads to control transportation hazards. Such controls would probably be more easily implemented and enforced when shipments of spent fuel and high-level waste are made by dedicated train.

The second option would be more difficult and expensive to implement, because it very likely would require expensive changes to regulatory testing requirements and some existing package designs. However, there would be no reason to change the testing requirements or package designs if effective operational controls could be implemented.

The committee received several comments at its meetings on the testing of transportation packages under extreme loading conditions, especially

[38]The historical accident record provides perhaps the best available information to identify bounding accident scenarios. For example, the Livingston, Louisiana, fire (see Table 2.2) and Summit Tunnel fire (see Section 2.2.3 and Figure 2.4) are possible examples of bounding scenarios.

[39]Tunnel fires are of special concern because of access restrictions that can delay or prevent an effective firefighting response. Such delays could allow the fires to burn in an uncontrolled manner for long periods of time.

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with respect to the USNRC's Package Performance Study. Many commenters asserted that the regulatory testing requirements in 10 CFR Part 71 are unconvincing as a demonstration of a transport package's performance under severe accident conditions. They wanted realistic full-scale testing to be conducted to demonstrate package performance. The State of Nevada suggested that comprehensive full-scale testing would improve the overall safety of the package and vehicle system and enhance confidence in risk analysis techniques. Full-scale testing was proposed as a way to potentially increase the acceptance of spent fuel shipments by state and local officials and members of the general public and to "potentially reduce adverse social and economic impacts caused by public perception of transportation risks" (Hall, 2003, p. 3).

Full-scale testing can be used to determine how packages will perform under both regulatory and credible extraregulatory conditions. To be of value, however, the committee believes that extraregulatory tests must be designed to closely mimic conditions that would reasonably be expected to be encountered in actual service. The test program undertaken by the CEGB in the 1980s (Section 2.3.3) provides an excellent example of the appropriate use of full-scale testing. In that program, the full-scale test was the end point of a much larger deliberative investigation of the conditions that could be encountered during transport of spent fuel. The full-scale test was used both to validate the analytical and scale-modeling work that had been carried out beforehand, and at the same time to provide a demonstration of the containment effectiveness of the packages in a way that could be appreciated by the general public.

The USNRC's Package Performance Study has elements of an appropriate full-scale testing program. The design for a full-scale test was developed through a deliberative process that involved technical analysis and provided many opportunities for public comment. However, none of the tests that emerged from this process were selected by the USNRC for execution. In fact, the scenario that was selected (a collision between a locomotive and a package mounted on a railcar placed at 90 degrees to the rail crossing in an upright position; see Section 2.3.4) duplicates many features of the rail-crossing impact test carried out by Sandia National Laboratories more than 25 years ago. One very important difference between the Sandia test and the currently proposed test is the packages selected for testing. The Sandia test used an obsolete truck transport package. The proposed test would use a rail package that is currently certified and of the type to be used by DOE for transport of spent fuel to the federal repository. If executed properly, this full-scale test will be valuable for validating scale-model and computer simulations of package performance and thereby increasing confidence in current regulatory testing approaches. The test is also likely to be

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visually powerful and could provide the public with useful information about the performance of transportation packages.

The committee also endorses package testing studies that integrate full-scale testing, scale-model testing, and finite element and associated structural analysis methods to demonstrate compliance with regulatory standards. These analysis methods allow a much wider variety of failure scenarios to be examined than is possible with full-scale testing alone. The analysis codes (e.g., LS DYNA, PRONTO) have been well benchmarked for these applications. Full-scale testing has two primary uses in this integrated test regime. First, it can be used to validate the computer codes for each package design, thus providing additional confidence in package performance under real-world conditions. Second, it provides a direct demonstration of a package's ability to meet specific regulatory test conditions.

Several participants at the committee's information-gathering meetings strongly urged that testing to failure should be carried out on all package designs that will be used to transport spent fuel and high-level waste to Yucca Mountain. However, they were not clear on what would constitute a failure. When pressed for specifics, the committee understood that what was generally meant was that full-scale testing should be carried out to destruction, presumably to establish the ultimate strength of transportation packages. The State of Nevada specifically recommended that the USNRC undertake an evaluation of the costs and benefits of destructive testing of a randomly selected production model cask (Hall, 2003, p. 3).

The principal argument in favor of destructive testing is that it can provide information on the magnitudes of thermomechanical loads required to eliminate containment effectiveness, thus establishing a "safety factor" for a given package design. There are significant drawbacks to this approach, however. Most importantly, each of the tests would involve only one thermal or mechanical loading condition out of the set of many possible conditions, and the selected loading condition would likely far exceed what could reasonably be expected to occur even in the most extreme real-world accidents. Moreover, a separate package might have to be acquired for each test, which would greatly increase the costs of a testing program for even a single package design.

It is important to recognize that *any* transportation package could be destroyed if no limits are placed on the loads that act upon it. Moreover, the failure of a package, in the sense that it can no longer perform its intended containment function, will generally occur under conditions that are much less severe than needed for destruction. Consequently, even if costs were not prohibitive, testing to destruction would provide little or no insight into the conditions that would cause a loss of package containment under real service conditions.

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Even full-scale testing to failure could be problematical. Because examining the multitude of possible accident conditions and failure scenarios through full-scale testing is clearly impractical, the committee judges that the bounding approach that the IAEA has established is entirely appropriate. The approach is one that reflects four plausible accident-like conditions: free drop, puncture, thermal exposure, and water immersion (see Sidebar 2.1).

The important question to be answered by testing is not whether a package could be made to fail; as noted previously, it would certainly be possible to design tests that would accomplish this goal. Rather, the question that needs to be answered is whether there are *credible* accident conditions that would result in releases of radioactivity to the environment that would endanger emergency responders or the general public. It is clear from the modeling and full-scale tests described in this chapter that transportation packages are extremely rugged. The committee judges that packages designed, fabricated, used, and maintained under current regulatory standards are very unlikely to encounter loading conditions under real-world conditions, with the possible exception of very long duration fires, that would lead to releases in excess of regulatory limits. The committee recognizes, however, that even minor releases from package containment might have important social implications. These are discussed in Chapter 3.

2.5 PACKAGE PERFORMANCE FINDINGS AND RECOMMENDATIONS

The committee offers the following findings and recommendations based on the analysis of package performance provided in this chapter.

FINDING: Transportation packages play a crucial role in the safety of spent fuel and high-level waste shipments by providing a robust barrier to the release of radiation and radioactive material under both normal transport and accident conditions. International Atomic Energy Agency package performance standards and associated Nuclear Regulatory Commission regulations are adequate to ensure package containment effectiveness over a wide range of transport conditions, including most credible accident conditions. However, recently published work suggests that extreme accident scenarios involving very long duration, fully engulfing fires might produce thermal loading conditions sufficient to compromise containment effectiveness. The consequences of such thermal loading conditions for containment effectiveness are the subject of ongoing investigations by the Nuclear Regulatory Commission and other parties, and this work is improving the understanding of package performance. Nonetheless, additional analyses and experimentation are needed to demonstrate a bounding-level understand-

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ing of package performance in response to very long duration, fully engulfing fires for a representative set of package designs.

RECOMMENDATION: The Nuclear Regulatory Commission should build on recent progress in understanding package performance in very long duration fires. To this end, the agency should undertake additional analyses of very long duration fire scenarios that bound expected real-world accident conditions for a representative set of package designs that are likely to be used in future large-quantity shipping programs. The objectives of these analyses should be to

- Understand the performance of package barriers (spent fuel cladding and package seals);
- Estimate the potential quantities and consequences of any releases of radioactive material; and
- Examine the need for regulatory changes (e.g., package testing requirements) or operational changes (e.g., restrictions on trains carrying spent fuel) either to help prevent accidents that could lead to such fire conditions or to mitigate their consequences.

Strong consideration should also be given to performing well-instrumented tests for improving and validating the computer models used for carrying out these analyses, perhaps as part of the full-scale test planned by the Nuclear Regulatory Commission for its package performance study.

Based on the results of these investigations, the Commission should implement operational controls and restrictions on spent fuel and high-level waste shipments as necessary to reduce the chances that such fire conditions might be encountered in service. Such effective steps might include, for example, additional operational restrictions on trains carrying spent fuel and high-level waste to prevent co-location with trains carrying flammable materials in tunnels, in rail yards, and on sidings.

FINDING: The committee strongly endorses the use of full-scale testing to determine how packages will perform under both regulatory and credible extraregulatory conditions. Package testing in the United States and many other countries is carried out using good engineering practices that combine state-of-the-art structural analyses and physical tests to demonstrate containment effectiveness. Full-scale testing is a very effective tool both for guiding and validating analytical engineering models of package performance and for demonstrating the compliance of package designs with performance requirements. However, deliberate full-scale testing of packages to destruction through the application of forces that substantially exceed credible accident conditions would be marginally informative and is not

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justified given the considerable costs for package acquisitions that such testing would require.

RECOMMENDATION: Full-scale package testing should continue to be used as part of integrated analytical, computer simulation, scale-model, and testing programs to validate package performance. Deliberate full-scale testing of packages to destruction should not be required as part of this integrated analysis or for compliance demonstrations.

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3
Transportation Risk

The original statement of task for this study (Sidebar 1.1) directs the committee to examine the "principal risks" for transporting spent fuel and high-level waste; determine how well these risks are understood; and compare them to other risks that confront members of society. Those tasks are addressed in this chapter.

As noted in Chapter 1, risk is a multidimensional concept: It includes *health and safety risks* that arise from exposures of workers and members of the public to radiation from shipments of spent fuel and high-level waste. It also includes *social* risks that arise from social processes[1] and people's perceptions,[2] even in the absence of radiation exposures. The health and safety risks and social risks are collectively referred to as *societal risks* in the statement of task given in Sidebar 1.1.

A great deal of work has been carried out over the past four decades to understand the risks (Sidebar 3.1) arising from the transport of spent fuel, both in the United States and abroad. Although the principal focus of this

[1]*Social process* is defined as "a characteristic mode of social interaction" (*Webster's Third New International Dictionary*). Social interactions shape the communities in which people live by, for example, influencing choices about where to purchase or rent a home, where to work, and where to send children to school.

[2]Perception is defined as the "integration of sensory impressions of events in the external world . . . as a function of nonconscious expectations derived from past experience" (*Webster's Third New International Dictionary*). Perceptions can have a strong influence on peoples' behavior, whether or not such perceptions are an accurate picture of reality.

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SIDEBAR 3.1 Background on Risk

Risks for spent fuel and high-level waste transportation arise from conventional vehicular accidents and exposures to ionizing radiation under both normal and accident conditions. Radiation risks are primarily a concern for people who live near, or travel on, spent fuel shipment routes.

Risk considers both the likelihood of occurrence of a specific hazard and its consequences. Frequently, one considers several scenarios that involve different kinds of hazards, each with a different likelihood of occurrence and consequence. One way in which risk can be expressed is in terms of a triplet (Kaplan and Garrick, 1981):

$$\text{Risk} = f\,(\text{scenarios, probability, consequences}),$$

Where, for spent fuel shipments,

- *Scenarios* represents transport conditions that can lead to an exposure to ionizing radiation from either routine operations or severe accidents,
- *Probability* expresses quantitatively the likelihood that a scenario will actually occur during one shipment; it is expressed as a dimensionless quantity that ranges in value from 0 (impossible) to 1 (certain)—for example, a probability of 0.5 indicates that a particular scenario has a 50 percent chance of occurring, and
- *Consequences* describe the undesirable results if the scenario does occur: for example, undesirable health effects.

The risks from spent nuclear fuel transport can be characterized by several measures. For example, risk can be expressed in terms of the expected number of deaths per quantity of spent fuel transported, per number of packages shipped, or per number of package shipments. It also could be expressed in terms of the number of deaths expected for a specific subpopulation exposed to ionizing radiation, for example, the subpopulation of transportation workers. Although they are difficult to quantify, consequences may also include socioeconomic outcomes.

The choice of scenarios and consequences selected for a risk calculation can make a difference in how that risk is understood by potentially affected populations. A risk may be understood as low by one measure in comparison to another, even though the same risk is being considered (NRC, 1996). This has implications for informing decision makers, for communicating about risks with non-experts, and for the legitimacy of risk comparisons in the eyes of interested and affected people (NRC, 1989, 1996). Comparing risks arising from fundamentally different activities also requires care in the selection of appropriate scenarios and consequences. This point is discussed in more detail elsewhere in this chapter.

report is on transportation in the United States, much can be learned from international experiences. Spent fuel and high-level waste are being transported in many other countries, in some cases in much greater quantities than in the United States. The committee has drawn upon the experiences

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of foreign transportation programs to inform its judgments. This information has been acquired through the review of published documents and from first-hand experience.[3]

Transportation risks can arise both during *normal* transport operations and from *accidents* involving loaded spent fuel or high-level waste shipping packages.[4] Table 3.1 describes the transportation impacts for these two operational scenarios. These risks can also arise from *incidents* (e.g., terrorist attacks) involving packages containing spent fuel or high-level waste; such incidents are not addressed in this report (see Section 1.2).

The health and safety risks to be discussed in this chapter arise from exposures of people who travel, work, or live near transportation routes, and transportation workers themselves, to radiation (Sidebar 3.2) from loaded spent fuel and high-level waste transportation packages. During normal operations, such exposures can occur as the result of *radiation shine*[5] from transportation packages loaded with spent fuel or high-level waste. Although the radiation doses to individuals near transport routes are likely to be very low, large numbers of individuals may receive exposures, producing a "collective dose" that can be used to estimate health impacts (see Sidebar 3.3). Degradation and/or loss of package containment in a severe accident has the potential to increase such radiation exposures and possibly result in the release of radioactive material from the package to the environment, although the committee notes in Chapter 2 that the robust design of transportation packages makes such releases unlikely.

Health and safety risks are frequently characterized in terms of human health effects: for example, injuries and loss of human life. Modern society generally considers such consequences to be the most severe harms that can

[3]Committee member Clive Young has extensive experience with the transport of spent fuel in the United Kingdom. In addition, a group of committee members visited Germany and the United Kingdom in September 2004 (see Appendix B) to obtain first-hand information about European transportation programs.

[4]International Atomic Energy Agency regulations for the safe transport of radioactive materials define three levels of severity for transportation conditions: routine conditions of transport, normal conditions of transport, and accident conditions of transport. Routine conditions are free of any transport mishaps; normal conditions can involve minor mishaps due to rough handling or exposure to weather. Accidents subject packages to severe conditions that well exceed normal conditions of transport.

[5]Transportation packages contain heavy shielding to protect workers and the public from the radiation emitted by the spent fuel or high-level waste contained within them. The packages are effective in shielding well over 99 percent of this emitted radiation, but a small amount (below regulatory limits) of radiation, primarily gamma rays, can escape from the interior of the packages and provide external doses to workers and the public. This report uses the term *radiation shine* to refer to this external radiation.

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TABLE 3.1 Transportation Risks Examined in this Report

	Transportation Impacts	
Transportation Conditions	Health and Safety Risks	Social Risks
Normal	Health impacts arising from the emission of radiation (i.e., radiation shine) from transportation packages	Direct socioeconomic impacts: loss of economic or social well-being as a direct result of transportation program operations Perception-based impacts: anxiety and associated illness; loss of property values; and reduced economic activity
Accidents	Health and environmental impacts arising from elevated radiation and/or the physical release of radioactive material as a result of the degradation or loss of package containment	Direct socioeconomic impacts: Temporary loss of transportation route use and associated business disruptions such as a loss of tourism Perception-based impacts: social amplification of the normal impacts as a result of accidents; these can result in secondary or tertiary impacts, including stigmatization of people and places; loss of trust in transportation program management; moratorium on transportation program operations; and/or increased program costs

result from any hazard, especially anthropogenic hazards that can be controlled through regulation. Society places a high value on human life and routinely demands that governments strictly regulate life-threatening hazards. Reductions in severe injuries and loss of human life are generally considered to be primary measures of regulatory effectiveness. Because of this emphasis on protecting human life, risk assessment experts have developed methodologies to quantitatively estimate risks to human life. Sidebar 3.1 provides a description of one way in which such risks are estimated.

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Social risks can have both direct socioeconomic and perception-based impacts such as those shown in Table 3.1. These risks may reduce the desirability of living and working in communities associated with spent fuel and high-level waste transportation operations. The social risks of interest in this chapter are harder to measure than the corresponding health and safety risks, and even identifying cause-and-effect relationships can be difficult. The impacts of social risk occur within a much larger sphere of social and economic activities that can mask important effects. The measurement of perception-based impacts can be especially difficult, because it frequently requires the use of surveys to measure people's anticipated, rather than actual, behaviors.

The health and safety risks and the social risks associated with spent fuel and high-level waste transportation can have significant interactions. Increases in radiation exposures or in the incidence of health effects from transportation operations (e.g., because of well-publicized mishaps, accidents, or fatalities) may, over time, increase the perception-based impacts. On the other hand, transportation operations that are carried out without demonstrable health impacts may, over time, reduce the perception-based impacts. A shipping incident or accident that leads to a moratorium on transportation operations might well change the entire profile of social risks associated with a transportation program.

There is another class of nonradiological impacts that are not considered in detail in this chapter: *conventional vehicular impacts* associated with the transportation of spent fuel and high-level waste. These include the health impacts of exhaust emissions from transport conveyances and vehicular accidents that result in fatalities, injuries, and property damage. While these impacts are real and predictable, they generally do not garner the same level of awareness or concern among members of the public as the radiation-based impacts described previously. Moreover, it could be argued that given the higher standards for driver training and equipment maintenance, and the conduct of vehicle and package inspections and operations for spent fuel and high-level waste transportation, conventional vehicular impacts associated with accidents would actually be lower than for other types of hazardous materials or heavy-freight transport. In any case, spent fuel and high-level waste transportation programs are a very small component of the overall transport system for hazardous materials, as measured both by load mass and by volume of traffic.

The committee provides an examination of health and safety risks of spent fuel and high-level waste transportation in Section 3.1. The social risks are examined in Section 3.2, and the risk comparisons called for by the study charge (see Sidebar 1.1) are described in Section 3.3. The committee's findings and recommendations on transportation risks are provided in Section 3.4.

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SIDEBAR 3.2 Radiation Dose

Materials that are *radioactive* are unstable (i.e., the nuclei in the atoms of the material possess too much energy) and transform spontaneously (*decay*) through the emission of *radiation*. This radiation may be in the form of energetic particles, such as alpha particles, beta particles, or neutrons, or energy may be emitted in the form of electromagnetic radiation (e.g., gamma rays). Collectively these emissions are known as *ionizing radiation* because they are sufficiently energetic to directly or indirectly ionize the matter (i.e., remove electrons from the atoms) they travel through.

Absorption of radiation energy by a cell of a living organism can alter its chemical and physical state. The absorption of large amounts of radiation can produce short-term or "acute" effects in the cell. The most severe effect would be cell death. Small amounts of radiation (not sufficient to cause cell death) potentially can damage the cell's genetic material (i.e., DNA contained in the chromosomes). If the cell's natural repair mechanisms cannot repair this damage correctly, it may lead to the induction of cancer at some future time. Because of the long time periods involved in their development, such cancers are referred to as "latent."

The following quantities are commonly used to characterize radiation exposures in living organisms:

- *Absorbed dose.* The quantity of ionizing radiation deposited into an organ or tissue, expressed in terms of the energy absorbed per unit mass of tissue. The basic unit of absorbed dose is the rad or its SI (international system of units, also known as the metric system) alternative the gray (Gy; 1 Gy = 100 rad).
- *Equivalent dose.* The absorbed dose averaged over the organ or tissue of interest multiplied by a weighting factor that accounts for the differences in biological effects (per unit of absorbed dose) for different types of radiation. The weighting factor ranges from 1 for X-rays and gamma rays to 20 for alpha particles and some neutrons. The equivalent dose is expressed in units of rem or its SI alternative the sievert (Sv; 1 Sv = 100 rem).
- *Effective dose.* A measure of dose that accounts for the differences in biological effects of different types of radiation and for the varying sensitivity of different organs to the biological effects of radiation. Effective doses are also expressed in rem or sieverts.

Radiation and radioactivity can be found in nature in a number of different forms. The *natural radiation environment* consists of cosmic and solar radiation, external radiation from radioactive materials present in rocks and soil, and inhaled

3.1 HEALTH AND SAFETY RISKS

Two approaches are used in this section to estimate the health and safety risks of spent fuel and high-level waste transportation: (1) an examination of the worldwide record of spent fuel transport (Section 3.1.1); and

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and ingested radioactive materials from air, food, and water. These sources have been present since the creation of Earth and provide an effective dose to all living organisms. The table below shows that, worldwide, the average annual effective dose to individuals is about 2.4 millisieverts (mSv; 240 millirem). This annual exposure is a good starting point to use in judging the magnitude of equivalent doses received from man-made sources. The National Council on Radiation Protection and Measurements (NCRP, 1987) estimates that man-made sources of radiation and radioactivity contribute an additional effective dose of 0.6 mSv (60 millirem) annually to an average person living in the United States. Most of this dose is due to medical procedures such as diagnostic X-rays and nuclear medicine procedures. Since the NCRP report was published, new diagnostic medical procedures that utilize ionizing radiation (especially computed tomography scanning) have come into wide use in the United States. Consequently, the average annual doses from medical procedures are probably increasing.

It is important to keep in mind that the effective dose statistics presented in this sidebar are averages. Individuals can receive much more or much less than the average depending on where they live (i.e., location as well as height above sea level), the type of house in which they reside, their occupation, the medical procedures they undergo, and many other factors determined by the individual life-style (e.g., air travel, watching television, diet).

TABLE Worldwide Exposure to Natural Sources of Radiation and Radioactive Material

Source of Exposure	Average Annual Effective Dose, mSv (millirem)	Typical Range of Effective Doses, mSv (millirem)
Cosmic radiation	0.39 (39)	0.3–1.0 (30–100)
External terrestrial radiation	0.48 (48)	0.3–0.6 (30–60)
Inhalation (U, Th, ^{222}Rn, ^{220}Rn)	1.26 (126)	0.2–10.0 (20–1,000)
Ingestion (^{40}K)	0.29 (29)	0.2–0.8 (20–80)
Total	2.42 (242)	1.0–10.0 (100–1,000)

SOURCE: Adapted from UNSCEAR (2000, Annex B, Table 31).

(2) an examination of the principal quantitative risk analyses that have been carried out for spent fuel and high-level waste transport, including the analysis for transporting spent fuel and high level-waste to a federal repository at Yucca Mountain, Nevada (Section 3.1.2).

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SIDEBAR 3.3 Collective Dose and Latent Cancer Fatalities

Collective dose is defined as the sum of all radiation doses received by all members of a population at risk (NCRP, 1995). The units of collective dose are usually given as person-sieverts or person-rem. This concept is frequently used in radiation protection applications, both for controlling actual exposures and for estimating potential exposure risks. The use of the collective dose for radiation protection purposes assumes the following (NCRP, 1995):

1. There is a direct proportionality between radiation dose and risk over their respective ranges of concern.
2. Risk is independent of dose rate.
3. A radiation dose leads to an identical risk whether it is administered to a single individual or to a population.

NCRP (1995, p. 1) notes that "[w]hile these assumptions may or may not be valid, they are considered to be conservative and have been generally accepted by the scientific community concerned with radiation protection."

The Department of Energy (DOE) used the collective dose concept to estimate *latent cancer fatalities* (LCFs) in the final Yucca Mountain Environmental Impact Statement (EIS). These cancers are expected to be produced many years after a radiation dose is received (i.e., after a latency period) and are never traceable directly to the received dose. DOE calculated collective doses for populations of workers and the public from prospective exposures to radiation from its transportation program. These doses were calculated using computer programs such as RADTRAN (see Sidebar 3.4). DOE then estimated the number of latent cancer fatalities using the International Commission on Radiological Protection (ICRP, 1991) recommended conversion factors: 5×10^{-4} latent cancer fatality per person-rem (5×10^{-2} per person-sievert) of collective dose for the general public and 4×10^{-4} latent cancer fatality per person-rem (4×10^{-2} per person-sievert) of collective dose for workers; these factors were doubled when doses greater than 20 rem are received over short time periods. The conversion factor for the public is higher because it applies over an entire lifetime, whereas the factor for workers applies only for working ages.

Radiation is a weak carcinogen at the low doses involved in the routine transport of spent fuel and high-level waste. Consequently, the incremental increase in latent cancers from low doses of radiation is very small relative to the natural occurrence of this disease in human populations. Moreover, radiation-induced cancers do not have any special characteristics that allow them to be differentiated from cancers developed from other causes.

3.1.1 Historical Record of Spent Fuel Transport

Spent fuel has been transported routinely in more than a dozen countries, including the United States, for many decades. The quality of record keeping on these shipments varies significantly, especially between the mid-

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1940s and 1970s. The committee first provides a brief review of the transportation experience in the United States and then examines experiences in some other countries.

U.S. Transportation Experience

The United States has been transporting irradiated nuclear fuel since World War II. The first irradiated fuel shipments were made by the Manhattan Project as part of the national effort to develop atomic weapons. More than 170,000 MTHM[6] of irradiated fuel were transported within the Hanford (Washington) and Savannah River (South Carolina) sites as part of the nuclear weapons production effort between 1944 and the end of the Cold War in the late 1980s. Most of this transport occurred over very short distances (a few kilometers [miles]) on publicly restricted lands, mostly by rail.

By the early 1960s, civilian spent fuel was being transported routinely on the nation's road and rail systems by the Atomic Energy Commission (AEC).[7] In 1974, the AEC was reorganized,[8] and authority for regulating the commercial transport of radioactive materials transportation was given to the newly established U.S. Nuclear Regulatory Commission (USNRC). The most complete records of spent fuel transportation date from the creation of this agency.

Most spent fuel transport across the nation's public highways and private railroads has involved small-quantity shipments of commercial spent fuel. Estimates of quantities of commercial spent fuel shipments are available from several sources. Pope et al. (1991, 2001) provide commercial spent fuel shipping estimates since 1964. These estimates were developed from Department of Energy (DOE) and Department of Transportation (DOT) databases supplemented with data from the USNRC and private sources. Pope et al. (1991) note that their estimates do not include shipments from six commercial reactors because of the difficulty in obtaining data.

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[6]Metric tons of heavy metal, where the heavy metal is uranium. This is a commonly used measure of fuel quantity. For comparison purposes, a typical reactor core contains about 100 MTHM (110 short tons) of nuclear fuel. A typical truck transport package typically holds between 0.5 and 2 MTHM (0.55 and 2.2 short tons) of spent fuel; a typical rail package holds between 10 and 18 MTHM (11 and 20 short tons).

[7]The AEC was created by the Atomic Energy Act (also known as the McMahon Act) in 1946 to control and promote the use of nuclear power.

[8]The Energy Reorganization Act of 1974 abolished the AEC and created two federal agencies in its place: the Nuclear Regulatory Commission and the Energy Research and Development Administration. The Energy Research and Development Administration became the Department of Energy after the Energy Reorganization Act of 1977.

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TABLE 3.2 Commercial Spent Nuclear Fuel Shipments in the United States, 1964–2004

	Mass of Spent Fuel Shipped (MTHM)		Number of Shipments	
Time Period	Highway	Rail	Highway	Rail
1964–1978	473	348	1565	126
1979–1997	356	1097	1181	153
1998–2004	16	766	102	261
Totals	845	2211	2848	540

NOTE: MTHM = metric tons of heavy metal.

SOURCES: Pope et al. (1991, 2001); USNRC, written communication, 2005.

Additional unpublished information was made available to the committee from Energy Resources International (Supko, 2000; Supko, 2005, written communication) and the USNRC (USNRC, 2005, written communication). The latter communication provided shipping data for 1998–2004 based on shipper notifications required under regulation 10 CFR Part 73.[9] This communication is an update of USNRC's public circular on spent fuel shipments (USNRC, 1998). Updated information has not been released since the September 2001 terrorist attacks. The agency was preparing an updated version for public release when the present report was being finalized in December 2005.

Table 3.2 provides an estimate of commercial spent fuel shipments in the United States since 1964. The committee was not able to assess the completeness or accuracy of these data, except to note that the pre-1979 data are likely incomplete. Information on spent fuel shipments prior to 1964 is not available, although accident and incident reports dating back to the mid-1950s are available, as discussed elsewhere in this chapter.

One conclusion that can be drawn from these data is that the previous U.S. spent fuel shipping experience as measured by the total number of shipments or mass of spent fuel shipped is small compared with anticipated future transportation campaigns. The federal repository and Private Fuel Storage, LLC, programs, for example, plan to ship about 20 and 13 times, respectively, the amount of commercial spent fuel that has been shipped in the United States since 1964. Moreover, both programs plan to ship spent fuel primarily by rail. The planned number of rail shipments to a federal

[9]Code of Federal Regulations, Title 10, Part 73: Physical Protection of Plants and Materials.

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repository at Yucca Mountain under the mostly rail scenario (9600 shipments; see Table 3.8) is approximately 18 times the number of rail shipments that have occurred in the United States since 1964.

Spent nuclear fuel shipments in the United States are usually made under the USNRC's or DOT's exclusive use regulations (10 CFR 71.47(b)).[10] Such shipments can be transported using public road and rail systems in the United States only if they do not exceed the following dose limits:

- 2 millisieverts (mSv) per hour (200 millirem [mrem] per hour) (see Sidebar 3.2) on the external surface of the transport package[11] and at any point on the outer surface of the vehicle.
- 0.1 mSv per hour (10 mrem per hour) at any point 2 meters (6.5 feet) from the outer lateral surfaces (but not the top or bottom) of the vehicle.
- 0.02 mSv per hour (2 mrem per hour) in any normally occupied space. This provision does not apply to private carriers if exposed personnel under their control wear approved radiation dosimetry devices.[12]

U.S. agencies do not collect records of radiation exposures resulting from the transportation of irradiated nuclear fuel as is done for personnel exposures in nuclear power plants. Private carriers will keep records for those workers who use radiation monitoring devices in accordance with regulations, but these records are not published. Consequently, the doses received by workers and the public associated with spent nuclear fuel shipments in the United States are not precisely known, although the committee judges that they are likely to be relatively small given the external dose limits allowed by regulations combined with the small numbers of shipments that have been made to date. Estimates of doses to populations and to hypothesized maximally exposed individuals in future shipments have been made by the USNRC, DOE, and DOT based on the projected number and characteristics of shipments and the populations that live in the proximity of planned transportation routes. These estimates have generally assumed that the dose rates from the packages are the maximum allowed

[10]*Exclusive use* is defined in 10 CFR 71.4 as "sole use by a single consignor of a conveyance for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of the consignor or consignee. The loading and unloading must be carried out by personnel having radiological training and resources appropriate for the safe handling of the consignment."

[11]A limit of 10 mSv per hour (1000 mrem per hour) applies when the shipment is made in a closed transport vehicle in which the package is secured so that its position remains fixed and there are no loading or unloading operations between the beginning and end of transportation.

[12]In this case, the normal occupational dose limits apply (see Table 3.10).

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under USNRC or DOT regulations. This is illustrated elsewhere in this chapter for the planned transportation program to a federal repository at Yucca Mountain.

Information on accidents and incidents involving spent fuel shipments in the United States has been reported since the late 1940s. Data for 1949–1971 are provided in AEC reports. In 1971, DOT established the Hazardous Materials Incident Reporting System (HMIS).[13] This computerized database contains information on incidents involving the interstate transportation of hazardous (including radioactive) materials by air, highway, rail, and water. DOT regulations (49 CFR 171.15) require that all accidents and incidents involving radioactive materials transport that meet one or more of the following criteria be reported to it for inclusion in this database:

- Deaths or injuries requiring hospitalization
- Property damage in excess of $50,000
- Evacuations of the public that last for one or more hours
- Closure of major transportation arteries or facilities
- Changes to flight patterns or routing of aircraft
- Fire, breakage, spillage, or suspected contamination involving radioactive materials
- Unintentional release from a package or any discharge during transportation

USNRC regulations (10 CFR 20.2201-2206; 10 CFR 73.71) also require that thefts, exposures, and releases of radioactive materials be reported.

In 1981, the Transportation Technology Center at Sandia National Laboratories established the Radioactive Material Incident Report (RMIR) database (Weiner and Tenn, 1999). This database contains information about radioactive materials transportation incidents that have occurred in the United States since 1971. It incorporates information from the HMIS in addition to information from the USNRC and other organizations such as state radiological authorities and the media.

The RMIR records *accidents* involving vehicles carrying radioactive materials that involve fatalities or injuries or that involve sufficient damage that the vehicle cannot move under its own power. It also records *incidents* that involve actual or suspected releases or surface contamination that exceeds regulatory limits. This database was discontinued in 1998 due to funding cutbacks. DOT's HMIS is now the primary source of data on hazardous material transportation incidents in the United States.

[13]Information about this database can be found on the DOT Web site at *http://hazmat.dot.gov/abhmis.htm*.

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TABLE 3.3 Summary of Spent Fuel Shipping Accidents and Incidents, 1949–1996

Time Period	Accidents or Incidents Reported	Radioactive Material Contamination[a]	Surface Contamination[b]	No Description	Vehicular Deaths[c]
1949–1970	14	6	None reported[d]	2	1
1971–1996	58	2[e]	49	0	1

[a]Any detectable loss, dispersal, or escape of radioactive material from the package's containment system.

[b]Detectable non-fixed contamination on external surfaces.

[c]Deaths caused by vehicular accidents, not the release of radiation.

[d]It is unclear whether surface contamination was routinely tested for or reported during this period.

[e]One incident (in 1984) involved an empty package; the other (in 1976) involved a pinhole leak of coolant or moderator on the outside jacket of the package, not the release of spent fuel.

SOURCE: Data compiled by DOE Office of Civilian Radioactive Waste Management.

A summary of available data on transportation accidents and incidents is provided in Table 3.3. These data were compiled by DOE's Office of Civilian Radioactive Waste Management. According to DOE, the AEC reported radioactive material contamination incidents between 1949 and 1970. This contamination involved the package and/or the conveyance and in some cases the surrounding environment. Two additional radioactive material contamination incidents were reported between 1971 and 1996. One involved an empty package, and the other involved a pinhole leak of coolant or moderator. These older incidents apparently involved packages that were designed to transport spent fuel in water for cooling and shielding, and the leaks presumably involved the release of small amounts of this water through holes in pipes, valves, and seals. At present, only spent fuel cooled for more than five years is transported in the United States, and all spent fuel is transported in a dry state. However, some package designs still utilize water jackets for shielding neutrons, but these are physically separated from and are not in contact with the interior of the package.

Most of the reported incidents did not involve package leaks, but rather the detection of non-fixed surface contamination[14] on the transport pack-

[14]Non-fixed contamination adheres to the outer surfaces of the package and can be detected by wiping. The limits for such contamination, which are established by international standards and U.S. regulations (49 CFR 173.443 and 10 CFR 71.87 (i) by reference to 49 CFR 173.443), are as low as reasonably achievable and not to exceed 4 becquerels per square

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ages, and these incidents were described as minor. Such surface contamination typically results from inadequate decontamination of packages following the loading of spent fuel.[15] However, there is no confirmation of cause of contamination in the database.

Table 3.4 provides a list of transportation accidents involving spent fuel transport packages between 1971 and 2005 in the United States. There were four accidents involving trucks and five accidents involving trains during this time.[16] None of these accidents resulted in the release of radioactivity. It is important to recognize that all but the December 1971 accident were minor in that they did not result in severe impacts or fires that would test the integrity of transport package containment. However, claims about this safety record in the United States have to be interpreted carefully given that spent fuel transport quantities are quite limited, especially for rail transport.

The U.S. government opened a repository for the disposal of defense transuranic waste in New Mexico in 1999. This repository, the Waste Isolation Pilot Plant (WIPP), had, as of April 2005, received shipments of waste from eight DOE sites across the continental United States. About 3500 truck shipments traveling about 3.5 million truck-miles had been made to the repository as of April 2005[17] using Type B packages of a special design mounted on legal-weight trucks. To date, there have been three highway accidents involving WIPP shipments. None resulted in the release of radioactivity from the transportation package to the environment.

Worldwide Transportation Experience

There is no centralized database for the worldwide shipment of radioactive materials, nor is there an international mandate to collect such infor-

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centimeter averaged over a 300 square centimeter sampling area for beta, gamma, and low-toxicity alpha emitters, and one-tenth that limit for other alpha emitters. The International Atomic Energy Agency (IAEA) recently issued a technical document resulting from a coordinated research project aimed at evaluating the adequacy of these limits under current radiological protection and transportation practices. The document notes (IAEA, 2005b, p. 84) that "the studies carried out under [the research project] indicate that the present limits on non-fixed contamination on the surfaces of packages and conveyances are conservative."

[15]Contamination occurs when the package is placed into the spent fuel pool for loading and is contaminated with small amounts of radioactive material present in the pool water. The external surfaces of these packages are decontaminated to remove non-fixed contamination before shipment.

[16]It is interesting to note that while the number of rail accidents exceeded the number of truck accidents during this period, the number of truck shipments was much higher (Table 3.2). Between 1979 and 2004, for example, there were roughly three times more truck shipments than rail shipments.

[17]*http://www.wipp.ws/shipments.htm*. Accessed on April 18, 2005.

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TABLE 3.4 Summary of Transportation Accidents Involving Commercial Spent Fuel Packages, 1971–2005[a]

Mode	Date	Location	Description
Truck	December 8, 1971	Tennessee	Package thrown free of trailer and landed in ditch following head-on collision with car. No package damage or release. Driver killed
Truck	February 2, 1978	Illinois	Trailer collapse while crossing railroad tracks. No package damage or release
Truck	August 13, 1978	New Jersey	Trailer collapse while empty package was being loaded. Package not damaged
Truck	December 9, 1983	Indiana-Illinois border	Trailer's fifth wheel failed. No package damage or release
Train	March 29, 1974	North Carolina	Empty package struck by a derailed tank car on adjacent track. Superficial package damage. No release
Train	March 24, 1987	Missouri	Train-auto collision at grade crossing. No package damage or release
Train	January 9, 1988	Illinois	Train carrying empty packages derailed. No damage to packages
Train	December 14, 1995	North Carolina	Railway car carrying empty packages derailed. No damage to packages
Train	September 22, 2005	New York	Railcar carrying an empty spent fuel package derailed in a rail yard. Railcar tipped over. No release

[a]This table lists only accidents involving loaded and empty spent fuel packages; it does not include all of the incidents listed in Table 3.3.

SOURCES: Weiner and Tenn (1999); data from the RMIR compiled by Energy Resources International (December 11, 1997) and DOE correspondence; media reports (for the 2005 accident).

mation. However, since 1980, the International Atomic Energy Agency (IAEA)[18] has been collecting such data at the recommendation of its transportation advisory committee.[19] The agency is developing databases on

[18]The IAEA was established under the United Nations in 1957 as part of the "Atoms for Peace" program to promote the safe, secure, and peaceful uses of nuclear technologies.

[19]The Standing Advisory Group on the Safe Transport of Radioactive Material was the predecessor body to the Transport Safety Standards Committee (TRANSSC). Committee member Clive Young is a past chairman of TRANSSC.

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radioactive materials shipments, accidents, and radiation exposure. Member states provide information to these databases on a voluntary basis. The response of member states to requests for information to populate these databases has been mixed. Consequently, the databases are incomplete and contain only a limited representation of available data.

As part of this database development effort, the IAEA launched a literature search and a series of informal contacts with 25 member countries in 2000 to obtain information on worldwide shipments of spent fuel[20] and high-level radioactive waste. A summary of this information was provided in a paper published by IAEA staff (Pope et al., 2001; see Table 3.5). This information is characterized by Pope et al. (2001) as "informal and incomplete" because not all countries responded, and some respondents provided incomplete data or data that were inconsistent with other published sources.

Although the data are incomplete, they nevertheless allow several useful observations to be made about the worldwide spent fuel transportation experience. Spent fuel is being transported within and across the borders of many countries. Worldwide, a major purpose for shipping spent fuel is to reprocess it. Reprocessing facilities have been constructed in France (La Hague) and the United Kingdom (Sellafield) for reprocessing domestic and foreign spent fuel. Belgium, Germany, Italy, Japan, and Spain have shipped spent fuel to these facilities for reprocessing, and some return shipments of high-level waste have been made to some of these countries. Spent fuel from Finland also has been shipped to the USSR or Russia for reprocessing. Most of the other spent fuel shipments being made within or between countries are for the purpose of interim storage.

The total quantity of spent fuel shipped worldwide was estimated in the 2001 IAEA study (see Table 3.5) to be between about 73,000 and 98,000 MTHM. The amount of spent fuel shipped in the United States is small in comparison. The total quantity of spent fuel transported worldwide also exceeds the legislated capacity of Yucca Mountain (70,000 MTHM) and is about twice the planned capacity of Private Fuel Storage (40,000 MTHM). Moreover, a majority of the worldwide spent fuel shipments have been by rail, the preferred mode for shipping to Yucca Mountain and Private Fuel Storage. Shipments to reprocessing plants in France and the United Kingdom have been made for more than 35 years. In contrast, the shipment of the first 70,000 MTHM of spent fuel and high-level waste to a federal repository or interim storage facility would likely take place over periods of a little more than two decades.

Spent fuel rail shipments to France are made using general and dedicated trains, whereas shipments within the United Kingdom are made using

[20]The IAEA refers to this fuel as "irradiated nuclear fuel."

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TABLE 3.5 Worldwide Spent Fuel Transportation Estimates

Country of Origin	Mass of Spent Fuel Shipped (MTHM)[a]	Number of Packages Shipped	Shipping Modes	Destination
Canada	100	187		
Czech Republic	242	65	Rail	To and from Slovakia
Finland	233	65	Highway and rail	USSR or the Russian Federation
France				
Domestic	11,700	2,600	Mostly rail	La Hague
Other Europe	10,000	2,500	Mostly rail	La Hague
Japan	2,940	660	Sea and highway	La Hague
Germany	>25	66	Highway and rail	Domestic
Hungary	258	72		
Italy	81	52	Highway	Domestic
Japan				
1995–1999	161	50	Sea and land	Domestic
2000–2004 (proj.)	1,700		Sea and land	
Russian Federation	3,500	500		Domestic
Slovakia	239–380	635–700		
Sweden	3,300	1,100	Sea	Domestic
Ukraine	1,300	300		
United Kingdom				
Domestic	20,900–43,200	11,300–28,900	Mostly rail	Sellafield
Other Europe	2,860	1,100	Rail	Sellafield
Japan	4,720	1,420	Sea and rail	Sellafield
United States	2,270	3,020	Highway and rail	Domestic
Approximate Totals	73,000–98,000	24,000–43,000		

[a]Numbers are rounded to three significant figures.

SOURCE: Modified from Pope et al. (2001).

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dedicated trains.[21] DOE recently announced that it planned to use dedicated trains when possible for shipments to a U.S. federal repository (see Chapter 5). The shipments in Europe share the rails with other freight and passenger trains. This is similar to current plans for spent fuel shipments in the United States. Moreover, trains carrying spent fuel in France and the United Kingdom are on routes that pass through large cities. This too is likely to be the case for spent fuel and high-level waste transport in the United States because many mainline rail routes pass through large cities. Some of the spent fuel being transported to La Hague and Sellafield is cooled for less than a year before being shipped.[22] In contrast, current practice in the United States is to cool commercial spent fuel for at least five years before shipping it, and some of the spent fuel to be shipped to Yucca Mountain will have been cooled much longer than five years.[23] Road and rail shipping distances to La Hague and Sellafield are generally 1000 kilometers (about 600 miles) or less, compared with the several thousand kilometers for shipping spent fuel from the eastern United States to interim storage or a federal repository in the United States. In the United Kingdom, the average transport package transport distance is about 300 miles (480 kilometers).

Data on accidents and incidents are kept by individual countries, but there is no standardized reporting format. In the United Kingdom, for example, accidents and incidents have been tracked since 1958 in the Radioactive Material Transport Events Database. Since 1989, annual reports of accidents and incidents have been issued. The latest report reviewed by the committee was issued in 2003 (Watson and Jones, 2004).

Since 1958, there have been 786 incidents involving the transport of radioactive materials in the United Kingdom. Approximately 24 percent of these have involved transport of spent fuel. These range from derailments of the conveyance to incidents involving non-fixed radioactive contamination above regulatory limits on the external surfaces of transport packages (see footnote 14). There have been no reported accidents involving spent fuel transport packages that have resulted in the release of radioactive material from the containment system to the environment.

The most recent significant spent fuel transport incidents in Europe occurred in 1997–1998, when inspections by the French nuclear safety

[21]As noted in Chapter 1, dedicated trains are trains that transport only spent fuel or high-level waste and no other cargo.

[22]As discussed in Chapter 5, decay heat production in spent fuel drops rapidly in the first five years after its discharge from a power reactor; see Figure 5.2.

[23]See, however, Section 5.2.4 for a discussion of the acceptance order for commercial spent fuel to be shipped to Yucca Mountain.

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regulator (Nuclear Installations Safety Directorate) showed that a high percentage of transport packages and conveyances at one reactor and at the rail terminal at Valognes (the receiving terminal for La Hague) contained non-fixed external contamination in excess of regulatory limits. The cause was eventually traced to inadequate decontamination of transport packages after they were loaded with spent fuel at reactors in France, Germany, and Switzerland. There was a three-year moratorium on spent fuel shipments in these countries while the incidents were investigated and new procedures were put into place to eliminate the contamination problems. A subsequent investigation by regulatory authorities concluded that no workers or members of the public had received radiation doses exceeding the relevant regulatory limits as a consequence of these incidents (HSK, 1998).

Two major conclusions can be drawn from the historical record of worldwide transport of spent fuel. The first is that there have been no recorded instances of which the committee is aware of any releases of radioactive material exceeding regulatory limits from any transport package in Western Europe, Japan, or the United States. There are, however, well-documented instances of exposures to radioactivity from inadequate decontamination of the external surfaces of transport packages after they are loaded with spent fuel. However, these releases have been small, and the committee is not aware of any documented instances in which exposures to workers or the public exceeded regulatory limits.

3.1.2 Quantitative Analyses

The AEC and its successor agencies have conducted several assessments of radioactive materials transport risk in the United States. These assessments have used numerical models, informed by expert judgment, to estimate the performance of transportation packages under normal and accident conditions. These studies are summarized in Table 3.6 and are described in this section. Two of these assessments have produced quantitative estimates of risks to workers and members of the public from such transport activities.

The committee was not charged to perform an in-depth technical review of these studies to assess the technical quality of the assumptions, models, results, and uncertainties. The committee does, however, provide comments where appropriate on the assumptions used in these studies and their impact on the resulting consequence estimates. All of these studies have undergone some level of technical review by the issuing organizations, but there are differences in assumptions and approaches among the studies that must be considered when comparing results.

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TABLE 3.6 Description of the Analytical Assessments of Transportation Risk Described in This Chapter

Study Reference	Objective	Summary of Results	
WASH-1238	Estimate doses to workers and public from spent fuel transport	Risks due to radiological effects from transportation accidents are small	AEC (1972)
Transportation EIS	Estimate radiological effects from land, water, and air transport of radioactive materials	Impacts of normal transport and accidents are sufficiently small to allow continued shipments of radioactive materials by all modes	USNRC (1977)
Modal study	Improve understanding of spent fuel package performance under severe accident conditions	Risks from severe accidents involving spent fuel were lower by at least a factor of three than estimated in the transportation EIS	Fischer et al. (1987)
Reexamination study	Update the modal study using improved models and data	Risks from severe accidents are comparable to or lower than modal study estimates	Sprung et al. (2000)
Final Yucca Mountain EIS	Estimate spent fuel and high-level waste shipping risks for transportation of spent fuel and high-level waste to Yucca Mountain, Nevada	Expected transportation impacts are small given the size of the transport program	DOE (2002a)

WASH-1238 Study (1972)

The first analytical study of the health effects of spent fuel transportation in the United States was undertaken by the AEC in 1972 (AEC, 1972). This study is known as the "WASH-1238" study after its report identification number. This study estimated doses to workers and the general public from nuclear fuel and solid radioactive waste transport both under normal transport conditions and for severe accidents. The study's main conclusion was (AEC, 1972, p. 2) that "[w]hen both the probability of occurrence and extent of the consequences are taken into account, the risk to the environment due to radiological effects from transportation accidents is small."

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The study has limited applicability to modern-day spent fuel transport programs: It examined highway transport of spent fuel along routes with very different population densities than present-day routes using transportation packages that do meet current regulatory requirements.

Transportation Environmental Impact Statement (1977)

A transportation Environmental Impact Statement (EIS) was undertaken by the USNRC to evaluate the effectiveness of its regulations for the transport of radioactive materials by air and other modes (USNRC, 1977). This EIS provided a more complete analysis of the radiological consequences for land, water, and air transport of radioactive materials than WASH-1238 and has become the "baseline" analysis for assessing radioactive materials transportation risk in the United States.

The 1977 transportation EIS characterized environmental impacts in terms of fatalities, expressed as an annual probability of occurrence for two types of transport: incident-free transport, where the main health impact is expected to be cancer fatalities due to exposure of workers and the general public to small doses of radiation from the shipping containers; and accidents that produce either conventional traffic fatalities or, for more severe conditions, latent cancer fatalities resulting from the release of radioactive materials from a damaged transport package.

Sandia National Laboratories performed this study. A computer code (RADTRAN 1; Sidebar 3.4) was developed to estimate radiation doses and latent cancer risks of transporting (including temporary storage and modal transfers) 25 different radioactive materials by plane, truck, train, ship, or barge. One of the 25 categories of materials considered was spent power reactor fuel. The study estimated risks to workers involved in shipping the materials and to members of the general public who lived near or traveled on the transportation routes. Latent cancers during incident-free transport were assumed to arise solely from external radiation doses from the transport packages. Latent cancers during accidents were assumed to arise from both internal and external exposure pathways.

The study estimated risks for transport of spent fuel on a generic highway route and a generic rail route. The study provided only a limited consideration of accidents in highly urbanized areas—one analysis was carried out for an accident in New York City. Additional analyses of releases in highly urbanized areas were undertaken in a subsequent series of studies known as the "urban studies" (DuCharme et al., 1978; Finley et al., 1980; Sandoval et al., 1983; Sandoval, 1987). Public circulation of all but one of the unclassified versions of these reports (Sandoval et al., 1983) was restricted after the September 11, 2001, terrorist attacks; consequently, these reports were not available for review by the committee.

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SIDEBAR 3.4 RADTRAN

RADTRAN is a computer code that can be used to estimate radiological exposures and consequences under both incident-free and accident conditions. It can provide estimates of collective dose as well as doses to maximally exposed individuals. The code was first developed by Sandia National Laboratories for use in the 1977 transportation EIS (USNRC, 1977). The code has been expanded and refined several times and is now in version 5 (RADTRAN 5). This code, which is written in FORTRAN 77, is available from Sandia National Laboratories. It has become a worldwide standard for assessing incident-free radiological transportation risks.

The program allows risks to be estimated for seven different transport modes (two highway modes, rail, barge, ship, and two air modes) using a series of models that account for the following:

- Sources and isotopic contents of transport packages,
- Transportation routes and stops,
- Population distributions of workers, residents who live along transportation routes, and vehicle occupants on transportation routes,
- Number and severity of accidents,
- Releases of radioactivity from packages in accidents,
- Dispersion of released radioactivity in the environment,
- Radiation exposure pathways for inhalation, ingestion, resuspension, cloudshine, and ground-shine exposures,
- Radiological fatalities using a dose-response model,
- Nonradiological fatalities, including vehicular fatalities and fatalities from vehicle emissions.

Like all computer codes, the validity of the results is only as good as the information used as input to the various models and embedded assumptions in the models themselves. Of particular importance in this regard is the input information for population densities, accident numbers and severities, radiation releases, and dispersion in the environment.

INTERTRAN 2 is a development of RADTRAN for international application. It was developed by the Swedish Nuclear Power Inspectorate (SKI) for the IAEA.

The 1977 transportation EIS concluded that the average radiation doses to at-risk populations from radioactive materials transportation were a small fraction of the limits recommended for the general public from all anthropogenic sources of radiation other than medical sources. The USNRC determined that the "environmental impacts of normal transportation of radioactive material and the risks attendant to accidents involving radioactive material shipments are sufficiently small to allow continued shipments by all modes" (USNRC, 1977, p. viii). The Commission concluded that

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"present regulations are adequate to protect the public against unreasonable risk from the transport of radioactive materials" (46 FR 21629, April 13, 1981).

The applicability of the 1977 transportation EIS for estimating risks for current and potential future transport of spent nuclear fuel is limited, owing mainly to the simple models and limited data used in the analysis. Since the issuance of this EIS, the USNRC has sponsored two additional studies to improve its understanding of the risks from commercial spent nuclear fuel transportation by road and rail. Those studies are discussed in the following sections.

Modal Study (1987)

The modal study (Fischer et al., 1987) was undertaken to improve understanding of spent fuel shipping package performance under severe accident conditions. The study examined the response of generic truck and rail spent fuel packages to both severe impact and fire conditions. As part of the analysis, historical data on real accidents were compiled from government and private databases to develop accident scenarios and their probabilities (see Figure 2.3). The scenarios are displayed as "event trees." These trees provide a graphic illustration of the sequence of events leading to an accident along with the probability of each event. Each branch of the tree depicts a sequence of events that leads to the accident outcome depicted at the end of the branch. The probability of an accident is equal to the product of the probabilities of each segment along the branch.

Historical data also were used to estimate the magnitudes of impacts and fire loads associated with each scenario. These were calculated from records of accident speeds and angles, the hardness of the objects involved in the impacts, and the frequency and duration of accident-associated fires. A total of 31 truck accident scenarios and 24 train accident scenarios were developed for the analysis. The 1977 transportation EIS, in contrast, defined only eight accident severity categories based on expert judgment.

Analyses were carried out to assess the effects of these accident scenarios on generic rail package and truck packages. The design of these packages was based on analyses of the features of rail packages and truck packages in service at the time of the study and accounted for typical built-in safety margins (see Sidebar 2.4).

The analysis involved a two-stage screening process. Phase 1 screening used dynamic linear and standard transient heat-transfer models to identify those accident scenarios in which the impact and fire conditions would not exceed the regulatory requirements in 10 CFR Part 71 (see Sidebar 2.1). For these scenarios, any releases from the packages are presumed to be below regulatory limits. Approximately 99.4 percent of truck accidents and

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99.7 percent of the rail accident scenarios analyzed fell into this category (Fischer et al., 1987, p. 9-2).

Phase 2 screening involved more sophisticated analyses of package responses and radiological releases for those accident scenarios that exceeded the 10 CFR Part 71 limits. This screening employed dynamic nonlinear models to estimate package deformation and transient thermal models that took into account the phase change that accompanied the melting of lead shielding at high temperatures. The analyses assumed that the packages contained five-year-cooled pressurized water reactor fuel having a burn-up of 33,000 megawatt days per metric ton, typical of spent fuel for that day.[24] The analyses considered breaches of the spent fuel cladding due to both impact and thermal creep (see Sidebar 2.5). The radiological effects considered included releases of radioactive materials from the package as well as increased radiation doses from a loss of package shielding.

Based on the Phase 2 screening, the authors concluded that roughly 0.39 percent of severe accidents involving truck or rail packages would result in radioactive material releases or doses that approached or slightly exceeded the regulatory limits in 10 CFR Part 71. The report concluded that fewer than 0.001 percent of the truck and 0.012 percent of the rail accident scenarios could actually produce hazards that would likely exceed regulatory limits.[25] No attempt was made to model the radioactive releases for the most severe accidents, because these conditions pushed the capabilities of modeling programs. Instead, estimates of the releases for these very severe accidents were simply extrapolated from the release behavior during less severe accidents (see Fischer et al., 1987, Table 8.3).

The 1987 study did not include "consequence calculations" to estimate risks to workers and the public from exposure to radiation as was done in the 1977 transportation EIS. However, a comparison of the frequencies and magnitudes of radiological releases from the two studies led the authors of the 1987 study to conclude that their risk estimates for both truck and rail were at least three times lower that those documented in the 1977 transportation EIS (Fischer et al., 1987, p. 9-11). There are several possible reasons

[24]Present-day fuel burn-ups are typically between 50,000 and 60,000 megawatt-days per metric ton. High-burn-up fuel produces more decay heat than low-burn-up fuel of the same age, which has implications for internal package heating in an accident involving fires. However, the generic packages used in the modal study analysis probably would not be suitable for transporting high-burn-up fuel.

[25]To place these numbers in perspective, consider that the planned transportation program to a federal repository at Yucca Mountain by the "mostly rail" scenario (described later in this chapter) would, according to DOE, involve about 9600 rail shipments and 1100 truck shipments (see Table 3.8). Multiplying these shipment numbers by the number of modal study scenarios that result in radiation releases above regulatory limits results in about 0.01 truck release and 1.1 rail releases during the life of the repository transportation program.

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for this difference, including reductions in accident rates in the decade between this study and the 1977 transportation EIS.

Resnikoff (1994, unpublished paper) criticized several aspects of the modal study. These included the transport package designs used in the analyses; the failure to model the end closures of the packages; and the methods and data used to estimate impact and fire conditions. He provides an analysis of 38 severe accidents that he claims shows that the 1977 transportation EIS and 1987 modal study underestimate severe impact and fire conditions and probabilities. He provides his own estimates of releases based on a reanalysis using the RADTRAN 4 code. He concludes that these releases are many times higher than estimated by the 1977 transportation EIS.[26] Resnikoff's analysis prompted Sandia researchers to perform additional historical accident reconstructions (described in Chapter 2), for which they concluded that spent fuel packages would likely maintain their containment integrity in all but possibly the most severe accidents involving long-duration fires.

Reexamination of Spent Fuel Shipment Risk Estimates (2000)

In 2000, Sandia National Laboratories published a reexamination of spent fuel shipment risk estimates (Sprung et al., 2000) using updated models and data. Since this is the most current generic study and has been used as the basis for a more recent analysis of transportation to a Yucca Mountain repository, as discussed later in this chapter, it is described in some detail in this section.

The 2000 reexamination study utilized an updated version of RADTRAN (RADTRAN 5; see Sidebar 3.4) to estimate population doses to workers and the general public during both incident-free transport and severe accidents involving releases of radioactivity or loss of shielding. Estimates were obtained for five potential exposure pathways (direct inhalation, resuspension inhalation, ingestion, cloud shine, and ground shine; see glossary in Appendix D) versus the single direct inhalation pathway considered in the 1977 transportation EIS.

The 2000 study considered transport of spent fuel along 741 truck and 741 rail routes: 249 truck routes and 249 rail routes developed in a previous routing study (Cashwell et al., 1986), as well as 492 truck and 492 rail routes developed specifically for this study. The latter routes connect the 79 spent fuel storage sites in existence when the study was initiated with six hypothetical interim storage sites located in different regions of the United States (474 routes), and those interim storage sites to three hypothetical

[26]The committee did not undertake a detailed review of Resnikoff's claims.

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permanent repository sites (18 routes). One of the permanent repository sites considered was Yucca Mountain.

To make the analyses tractable, these routes were sampled to obtain a smaller set of routes having representative characteristics. The samples were generated as follows. First, distributions were constructed of route lengths; fractions of those lengths that contain urban, suburban, and rural population densities; and the actual population densities for each of those length fractions for the 741 truck and 741 rail routes. Next, these distributions were sampled using Monte Carlo methods to generate two sets of "representative" routes: 200 highway routes and 200 rail routes. These representative routes were used in the RADTRAN calculations.

The 2000 reexamination study used slightly modified versions of the accident event trees from the 1987 modal study (Figure 3.1). An additional branch was added to the rail event tree to account for accidents involving fires that did not result from either collisions or derailments. Additionally, new estimates of route wayside hardness were developed based on surveys of selected transportation routes and Department of Agriculture data on near-surface locations of coherent rock formations. This information was used to estimate how "yielding" these surfaces would be in accidents involving impacts of truck and rail transportation packages.

Truck and train accident rates used in the study were estimated separately from state-level data for the 48 contiguous U.S. states. These data represent heavy-truck accidents on interstate highways and train accidents on mainline rail routes. The heavy-truck data were detailed enough to support the development of accident rate distributions for suburban and rural routes as well as a single average accident rate for urban routes. The rail data were only detailed enough to support the development of a single accident rate distribution by combining all of the state-level data.

The study modeled the performance of four generic package types whose physical specifications were based on a review of data on packages in use at the time of the study: steel-lead and steel-depleted uranium truck packages and steel-lead and monolithic steel rail packages. The packages were assumed to contain total activities equivalent to three-year-cooled pressurized water reactor (PWR) fuel with a burn-up of 60,000 megawatt-days per metric ton, or three-year-cooled boiling water reactor (BWR) fuel with a burn-up of 50,000 megawatt-days per metric ton. These estimates are characterized in the study as conservative.[27] The rail package was

[27]The study characterizes the total activities used in the RADTRAN calculations as being conservative by about a factor of 4. While these high burn-up levels are now achieved routinely in U.S. power reactors, most stored spent power reactor fuel has much lower burn-ups. Moreover, spent fuel is generally expected to be stored for at least five years before being moved from pools to dry casks for storage or transport, and some of it will have been stored for several decades.

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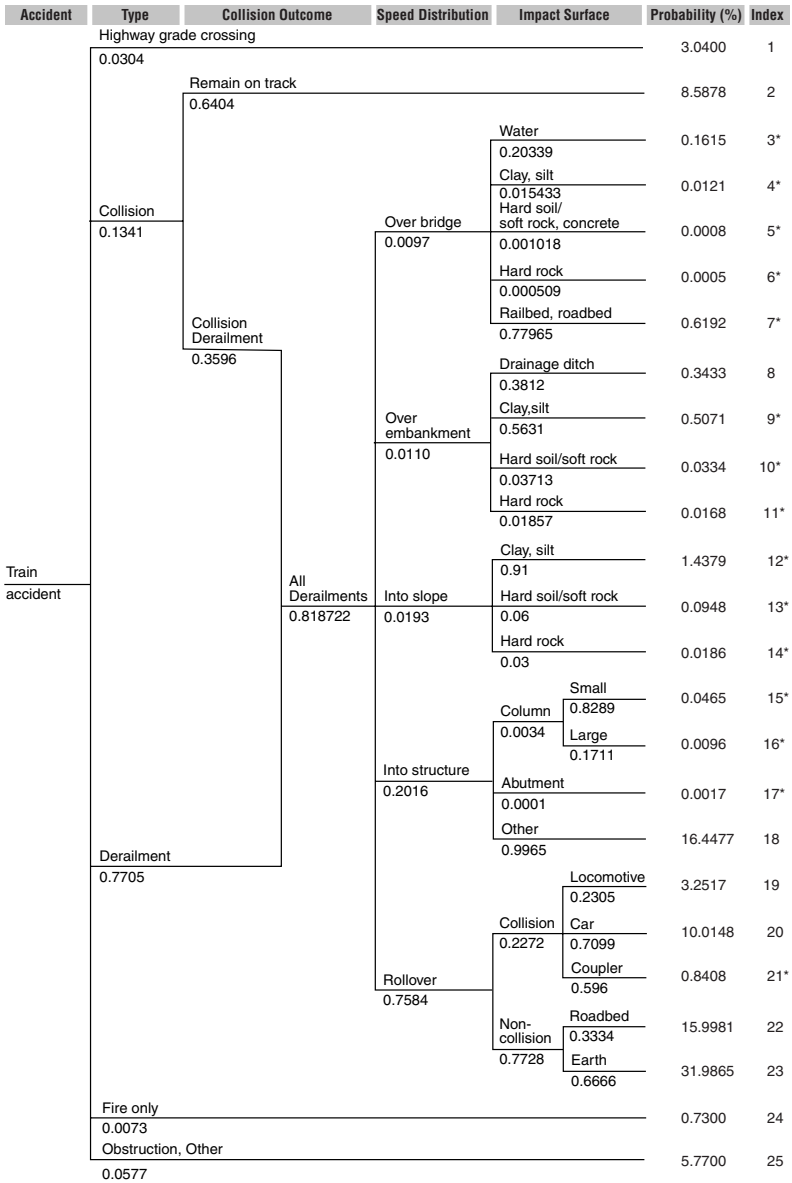

FIGURE 3.1 Accident event trees for rail accidents from the 2000 reexamination study, slightly modified from the modal study (see Figure 2.3). The numbers shown at each branch are probabilities for the accident branch based on an analysis of historical data. The accident scenarios that are marked with an asterisk were determined to produce consequences that would approach or exceed regulatory limits. SOURCE. Sprung et al. (2000, Figure 7.4, p. 7-12).

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assumed to contain 24 PWR or 52 BWR assemblies. The truck package was assumed to contain between 1 and 3 PWR or 2 and 7 BWR assemblies.

External package surface dose rates were also important inputs to the model. These were estimated for commercial spent fuel discharged from reactors in the United States. These dose rates depend on fuel burn-up, time since discharge (or cooling time), and package shielding. For conservatism, the dose rate distribution estimates were rescaled upward so that their upper limits were equal to the regulatory dose limit of 0.1 mSv (10 mrem) at 2 meters (about 6.5 feet) from the package surface.

Analyses of package behavior in severe accidents were carried out using a standard finite element code (PRONTO 3D). This computer code is commonly used to model high strain rates in nonlinear materials. Although material failure is not included explicitly in this code, such failure can be estimated based on the calculated deformation of package components such as lid bolts. This code was used to estimate package deformations resulting from impacts onto unyielding surfaces (see Sidebar 2.2) at speeds of 30, 60, 90, and 120 miles per hour (48, 96, 144, and 192 kilometers per hour). To make the results conservative, the impact limiters were assumed to be attached to the package but fully crushed before impact.

The analyses indicate that even at the highest of these impact speeds, strains were well below the levels needed to fail or penetrate the package body or lid. The analyses also indicate that the truck package seals would not fail in any impact orientation at any impact speed. Nevertheless, it was arbitrarily assumed that seal leaks having a cross section of 1 square millimeter would result from impacts of these packages onto unyielding surfaces at speeds of 120 miles per hour (193 kilometers per hour). The analyses also suggest that for rail packages, some seal leakage could occur for some impact orientations at impact speeds onto unyielding surfaces as low as 60 miles per hour (97 kilometers per hour) and possibly at all orientations at speeds of 120 miles per hour (193 kilometers per hour).

Surfaces along transportation routes (e.g., soils, concrete structures) are likely to be partially yielding and will absorb some impact energy in severe accidents. Consequently, the finite element results for impacts onto unyielding surfaces must be adjusted to account for this energy loss. This was done by calculating the impact speeds onto three types of yielding surfaces (soil, concrete, hard rock) that would result in the same peak contact forces on the package as the equivalent impact onto an unyielding surface. This calculation took into account the energy-absorbing effects of the package impact limiters.

If the package seal was determined to fail in an accident, the release of radioactive material (noble gases, volatiles, and particulates), collectively referred to as the *accident source term*, was calculated. These calculations took into account several phenomena: rod cladding failures; radionuclide

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inventory releases from the failed rods; partial deposition of radionuclides on internal surfaces in the package; pressurization of the package interior from failed rods or package heating; and leakage of radionuclides through package seal failures driven by package depressurization (see Sidebar 2.5). The estimates of particulate releases and behavior were based on actual experiments performed on spent fuel rods subjected to burst failure.

For accidents involving fires, package heating calculations were carried out using a commercial code (PATRAN/PThermal), which can be used to model heat convection, conduction, and radiation transport processes. Calculations were made for each of the four generic packages for a fully engulfing, optically dense hydrocarbon fire that would heat the package sufficiently to cause the pressurized rods to fail by burst rupture. The calculations included the effects of internal package heating from radioactive decay of three-year-cooled spent fuel.[28] Package seal leakage and accident source terms were estimated in a manner similar to that described previously for severe accidents.

Several sets of RADTRAN calculations were performed in this study:

- Calculations for the 200 truck and 200 rail routes obtained by Monte Carlo sampling as described previously;
- Calculations for 5 truck and 5 rail routes selected from the 1977 transportation EIS or from the 474 routes that connect spent fuel storage sites to the locations of the hypothetical interim storage facilities considered in this study—the latter calculations were carried out to demonstrate that results for real routes would fall within the envelope of results for the representative 200 rail and 200 truck routes;
- Calculations comparing the consequences and risks for RADTRAN 1 with RADTRAN 5 for a single transportation route; and
- Calculations comparing the risks and consequences using the package inventories and assumptions about radionuclide releases developed for the 1977 transportation EIS, 1987 modal study, and this study.

The study provided RADTRAN calculations for both incident-free and severe accident scenarios. The conservative assumptions used in these analyses (e.g., the packages contain three-year-old spent fuel with high burn-ups; the external package dose rate distribution estimates were rescaled upward so that their upper limits were equal to the regulatory dose limits; package

[28]The use of three-year-cooled spent fuel in the calculations yielded external steady-state package surface temperatures as high as 194°C (Sprung et al., 2000, Table 6.4). This would have exceeded the regulatory limits in 10 CFR 71.43(g), which restricts external surface temperatures to 85°C for exclusive-use shipments. The authors described these temperatures as "conservative" for the purposes of the analysis.

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deformation estimates were made using fully crushed impact limiters; truck package seals were assumed to have small leaks at high-impact speeds even though the analyses did not indicate seal failure) are reasonable for producing bounding estimates of accident consequences or radiological exposures. However, the 200 rail and 200 truck routes selected through Monte Carlo techniques for use in the analyses were based on realistic, not bounding, characteristics. Consequently, the overall results of the Sandia analyses are likely to be neither realistic nor bounding and probably overestimate the transport risks.[29]

One result is discussed below for the sake of illustration: Population risk estimates for severe accidents involving rail transport of PWR spent fuel in a steel-lead rail package. This example was selected because PWR fuel is the most common fuel used in U.S. power reactors and because train transport is the preferred mode for shipping to a federal repository and to Private Fuel Storage (see Chapter 2).

The population risk estimates for each of the 200 route calculations for the rail package are displayed as *complementary cumulative distribution functions* (CCDFs), which are also sometimes referred to as "risk curves" (Figure 3.2). The horizontal (x-axis) is referred to as the accident consequence value. Simply put, this is the collective dose that would be received by the population defined in the model as a result of the assumed accident scenario calculated by the model. The vertical (y-axis) is the probability that the collective dose will exceed that accident value on a per-shipment basis. This probability is given in dimensionless units ranging from 0 to 1. The right vertical axis is the expected number of years between accidents exceeding the accident consequence value when 100 shipments per year are assumed.

The total set of 200 CCDFs would produce a plot like that shown in the inset in Figure 3.2. To improve the visual utility of such plots, *compound CCDFs* can be constructed that represent certain statistical properties of the 200 individual CCDFs. For the compound CCDFs shown in Figure 3.2,

- The mean compound CCDF is computed by averaging the 200 CCDFs;
- The 50th percentile compound CCDF represents the median value of the 200 CCDFs; and
- The 95th and 5th percentile compound CCDFs represent the 190th highest and 10th lowest of the 200 CCDFs.

[29]The committee hedges this statement with the word "probably" because there are a great many other uncertainties in the input data to the calculations, especially with respect to local accident rates and route wayside conditions, that could affect the realism of the calculations.

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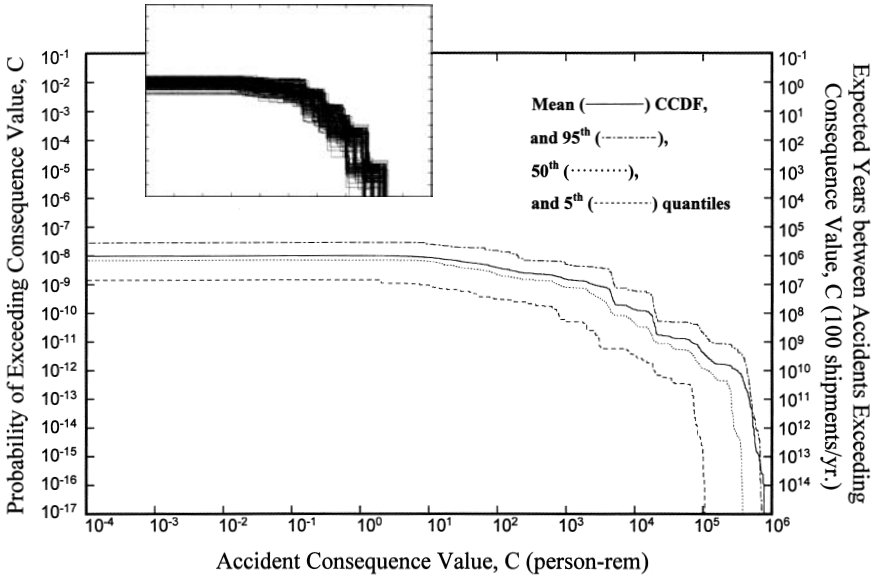

FIGURE 3.2 Compound CCDF (complementary cumulative distribution function) for train transport of PWR fuel using steel/lead packages. The left vertical axis is the probability expressed on a per-shipment basis; the right vertical axis represents the expected years between accidents assuming 100 shipments per year. Inset: Plot showing individual CCDFs for 200 routing calculations of the type used to derive the compound CCDFs shown in the main figure. SOURCE: Sprung et al. (2000, Figure 8.7).

Two general observations can be made from this plot. First, the estimated risk of exposure from an accident that is severe enough to compromise fuel rod and package seal integrity is very small on a per-shipment basis. For example, the expected (mean) probability of receiving a population dose of 1 person-rem (i.e., 10^0 person-rem in the figure) is about 1 in 100 million (10^{-8}) per package shipment. Assuming a shipment frequency of 100 packages per year, the expected mean time between such accidents is estimated to be about 1 million years.

Second, the spread of probability (left vertical axis) values of the compound CCDFs at a given consequence value (horizontal axis), which is represented by the vertical distance between the 5th and 95th percentile compound CCDFs, reflects the sensitivity of the calculations to route characteristics (e.g., route length, wayside hardness, traffic conditions). The variability is about an order of magnitude at low consequence values and increases to more than 5 orders of magnitude at high consequence values.

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The collective dose risk[30] for all of the RADTRAN 5 calculations displayed in the figure is equal to 9.4×10^{-6} person-rem on a per-shipment basis. If an accident has a 1 in one million probability of occurrence (i.e., 1×10^{-6}), the mean collective dose received by the population (the size of which must be specified) would be about 9 rem per accident. The mean collective dose risks are most useful as a tool to compare different accident risks as shown in Table 3.7.

The population (collective) dose risks for all of the packages modeled in the 2000 reexamination study are shown in Table 3.7. The authors of this study also calculated the collective dose risks using the source terms from the 1977 transportation EIS and the1987 modal study. Two observations are particularly noteworthy. First, estimated population dose risks for the reexamination study are on the order of 10^{-6} to 10^{-7} person-rem per shipment for all of the packages and scenarios examined in the study. Given the uncertainties in the parameters used in the calculations, these values are essentially identical. Second, estimated population dose risks from the 2000 reexamination study are about three orders of magnitude lower than estimates calculated using the source terms in the1977 transportation EIS and the 1987 modal study. These differences are probably significant and may reflect a lack of realism in some of the assumptions used in the earlier analyses, especially with respect to package release behavior in a severe accident. As noted previously, this behavior was based largely on expert judgment in the 1977 transportation EIS. Release behavior was modeled explicitly in the 2000 reexamination study.

Final Yucca Mountain EIS (2002)

DOE has prepared an EIS (DOE, 2002a) as part of a larger effort to site and construct a federal repository for spent fuel and high-level waste at Yucca Mountain, Nevada. This EIS provides estimates of spent fuel and high-level waste transportation risks. The EIS considers two scenarios for transporting spent nuclear fuel and high-level radioactive waste from 72 commercial and 5 defense sites to the proposed repository at Yucca Mountain, Nevada: a *mostly truck scenario* that would involve transporting most of the spent fuel and high-level waste by legal-weight truck across the

[30]The mean collective dose risk is the collective dose that is received by the population from an accident times the probability of occurrence of that accident. This follows from the general risk equation, risk = probability x consequences, where consequences = collective dose. The collective dose is conditional because it will be received only if the accident occurs. In that case, the collective dose can be calculated by dividing the risk by the probability that the accident will occur, or consequences = risk ÷ probability. The mean collective dose risk is most useful as a comparative tool.

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TABLE 3.7 Population (Collective) Dose Risks for Severe Accidents from the 2000 Reexamination Study

	Population Dose Risk (person-rem)[a]			
	Truck		Rail	
Package Type	PWR	BWR	PWR	BWR
2000 reexamination study				
Steel-lead	8.0×10^{-7}	3.3×10^{-7}	9.4×10^{-6}	9.2×10^{-6}
Steel-DU	2.3×10^{-6}	1.1×10^{-6}		
Monolithic steel			2.0×10^{-6}	1.5×10^{-6}
Calculated using 1977 transportation EIS and 1987 modal study sources terms	1.3×10^{-2} to 1.3×10^{-4}		1.9×10^{-2} to 4.9×10^{-4}	

NOTE: Numbers are rounded to two significant figures; BWR = boiling water reactor; DU = depleted uranium; PWR = pressurized water reactor.

[a]Expected values per shipment.

SOURCE: Sprung et al. (2000, Tables 8.4, 8.5, E.2).

nation's highways, and alternatively, a *mostly rail scenario* that would involve transporting most of this material using commercial railroads and a railroad spur to be constructed in Nevada. The numbers of truck and rail shipments under each scenario are shown in Table 3.8.

DOE considered the impacts of two repository scenarios in this EIS. The first assumes that Yucca Mountain would receive the legislatively mandated limit of 70,000 metric tons of spent fuel and high-level waste over a period of 24 years. The second assumes that the repository would operate for 38 years and would receive between 119,000 and 125,000 metric tons of spent fuel, high-level radioactive waste, and other special requirements waste (e.g., greater-than-class-C waste).

DOE's analysis of transportation impacts examined several classes of hazards for workers and the general public, two of which are of particular interest in this discussion:

1. Incident-free transportation in which populations in proximity to transportation routes would receive small radiation doses during the routine transport of spent fuel and high-level waste. These doses would be the result of radiation shine from the transport packages.
2. Accidents that involve a loss of transport package shielding, which could result in more severe radiological exposures. The EIS analyzed a

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TABLE 3.8 Transportation Scenarios, Collective Doses, and Radiological Impacts from the 2002 Yucca Mountain Repository EIS for Routine Transport and Accidents

	Mostly Truck Scenario	Mostly Rail Scenario	Comment
Scenario Definitions			
Operational period (years)	24		
Repository capacity (MTHM)	70,000		
Number of legal-weight truck shipments			
Commercial SNF	41,000	1100	
DOE SNF	3500		
DOE HLW	8300		
Number of rail shipments			
Commercial SNF	300	7200	
DOE SNF		770	
DOE HLW		1700	
Radiological Impacts, Routine Transport[a]			
Worker collective dose (person-rem)	29,000	7900–8800	Collective dose received over 24 years assuming specified crew sizes for loading, transport, and inspections; total numbers of workers not specified
Dose to maximally exposed worker (rem)	48	48	Assumes that worker receives the DOE occupational administrative dose limit of 2 rem per year for 24 years[b]
Estimated number of worker latent cancer fatalities	12	3.2–3.5	

continues

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TABLE 3.8 Continued

	Mostly Truck Scenario	Mostly Rail Scenario	Comment
Dose to maximally exposed member of the public (rem)	2.4	0.29	Maximally exposed person for mostly truck is a service station worker; mitigation would be required to keep doses below 0.1 mSv (100 mrem) per year. Maximally exposed person for mostly rail is resident near a rail stop
Public collective dose (person-rem)	5000	1200–1600	Distributed across 10.4 million people for mostly truck scenario and 16.4 million people for mostly rail scenario over 24 years
Estimated number of public latent cancer fatalities	2.5	0.6–0.8	
Total estimated number of latent cancer fatalities	14	3.8–4.3	
Radiological Impacts, Maximally Reasonably Foreseeable Accident (MRFA)[c]			
Accident scenario	Long-duration fire that leads to breach of a package and dispersal of a portion of its contents	Long-duration fire that leads to breach of a package and dispersal of a portion of its contents	
Annual probability that the accident will occur	2.3 in 10 million	2.8 in 10 million	During each year of the 24-year shipping campaign
Dose to maximally exposed individual assuming the accident does occur (rem)	3	29	Maximally exposed individuals are located downwind of the package and receive dose from a cooling plume of radioactive particles released from the package

continues

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TABLE 3.8 Continued

	Mostly Truck Scenario	Mostly Rail Scenario	Comment
Collective dose assuming the accident does occur (person-rem)	1100	9900	Analysis assumes that the accident occurs in an urban area, and that populations up to 50 miles (80 kilometers) from the release point could receive a dose. Population densities used in the calculations were based on 1990 census data extrapolated to 2035 for 21 large urban centers in the United States. Accident was assumed to occur at the center of the population zone
Total number of latent cancer fatalities assuming accident does occur	0.6	5	Calculated by multiplying the collective dose by the nominal probability coefficient
Annual collective dose risk (rem)	2.5×10^{-4}	2.8×10^{-3}	See footnote 30
Nonradiological Impacts			
Total fatalities from vehicular collisions, industrial accidents, and air emissions	6.8	3.1–4.2	

NOTE: Numbers are rounded to two significant figures.

[a]The dose estimates shown in this section of the table have a probability of occurrence of 1; that is, it is certain that these doses would be received by workers and members of the public if the Yucca Mountain transportation program were carried out as described in Appendix J of the final Yucca Mountain EIS.

[b]The final Yucca Mountain EIS also notes that if a lower administrative dose limit is imposed on transportation workers in the future, maximally exposed worker doses would be correspondingly lower.

[c]Dose estimates shown in this section of the table are conditional upon the actual occurrence of the accident, which has a very low probability of occurrence.

SOURCES: DOE (2002a, Table 6-1, Table J-1, Table J-16, table on p. S-69, table on p. S-80).

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"maximum reasonably foreseeable accident"[31] to provide some perspective on the largest expected transportation impacts on populations that live along potential transportation routes. The EIS analyzed the consequences of accidents that are expected to occur with a frequency greater than 10^{-7} (i.e., with a likelihood greater than 1 in 10 million times per year).

The EIS estimated the consequences of these hazards to several groups of individuals: workers involved in loading, transporting, inspecting, and escorting the shipments; members of the public in vehicles that share transportation routes with the shipments; members of the public who live in proximity to transportation routes; and members of the public who are exposed while shipments are stopped en route to Yucca Mountain.

Appendix J of the final Yucca Mountain EIS provides a detailed discussion of the models, data, and assumptions that were used to produce these estimates. In developing these analyses, DOE used the RADTRAN 5 code developed by Sandia National Laboratories (see Sidebar 3.4) for estimating collective radiological doses under both incident-free and accident conditions. DOE relied heavily on the accident scenarios and the transport package release mechanisms developed in the 2000 reexamination study. The RISKIND[32] computer code was used to calculate radiological doses to

[31]According to DOE, maximally reasonably foreseeable accidents are characterized by extremes of mechanical and thermal forces, and other conditions not specified, that lead to the "highest reasonably foreseeable consequences" (DOE, 2002a, p. 6-45). The thermomechanical forces in these accidents would exceed regulatory limits and would be applied to a package in such a way as to cause the greatest damage and would lead to the release of radioactive materials. DOE defines any accident that has the chance of occurring more than 1 in 10 million times per year as being reasonably foreseeable. The Final Yucca Mountain EIS analyses of maximally reasonably foreseeable accidents were based on an examination of the accident scenarios presented in the reexamination study (Sprung et al., 2000). The analyses are described in Appendix J of the EIS. The scenario determined to be most severe for both rail and truck packages is a long-duration fire.

[32]The RISKIND code was developed in 1993 by Argonne National Laboratory to estimate local, scenario-specific radiological doses to maximally exposed individuals. This code performs similar calculations for incident-free exposures as the RADTRAN code. However, the two codes use different mathematical representations for external dose rate as a function of the distance between the source and receptor (Steinman and Kearfoot, 2000). Steinman et al. (2002) compared the estimates from these models against experimental measurements on moving conveyances containing radioactive materials. They found that both the RADTRAN and the RISKIND models predict doses to within an order of magnitude of the experimentally measured values. The RISKIND model estimates agreed more closely with the measured values at short distances (within a few meters) from the package, whereas RADTRAN provided better agreement at distances that the authors characterized as more typical of residential populations alongside of roads.

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maximally exposed individuals for incident-free transportation and to populations and maximally exposed individuals for maximally reasonably foreseeable accident conditions.

To make incident-free radiological impact assessments, DOE assumed that each transportation package would have the maximum external dose rate allowed under DOT transport regulation 49 CFR 173.441(b) (as well as USNRC regulation 10 CFR 71.47(b)(3)): 0.1 mSv per hour (10 mrem per hour) at 2 meters (6.5 feet) from the lateral surfaces of the transport vehicles. This is a conservative assumption when the packages contain aged spent fuel.[33]

Estimates of the number of shipments were based on information on current inventories of spent fuel at reactor sites as well as projections of future inventories based on industry trends. The analysis took into account factors such as package handling capabilities[34] at each site and package capacities to meet heat generation and criticality requirements. In some cases, these requirements would necessitate the shipment of partial packages. The analysis used 31 shipping package configurations: 9 for legal-weight truck and 22 for rail.

Highway routing selections were made using actual highway data and DOT rules for Highway Route-Controlled Quantities of Radioactive Materials in 49 CFR 397.101. Population densities within 800 meters (0.5 mile) of the routes were used to calculate incident-free doses.[35] These densities used data derived from the 1990 and 2000 census data and were extrapolated to the year 2035 based on Bureau of the Census forecasts.

Rail routing selections were made using rules based on the historical routing practices of U.S. railroads from a database of 94 rail networks representing current railroad conditions. Rail routes were determined by minimizing shipping "impedance," which is accomplished by reducing travel distances and the number of railroad companies involved and by using main line (i.e., generally better maintained) tracks. Population densities within 800 meters (0.5 mile) of the routes were used to calculate incident-free doses. These densities used data derived in the same manner as for highway shipments. Route selections were made for all but six sites that do not have the capacity to load or handle rail packages.

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[33]However, as discussed in Chapter 5, the first fuel shipped to Yucca Mountain might not be thermally and radiologically cool.

[34]For the mostly rail scenario, the analysis assumed that sites that had insufficient crane capacity to handle rail packages would be upgraded after the plant shut down.

[35]Calculating doses out to 800 meters is a very conservative approach. If the dose rate at 2 meters (6.5 feet) is 0.1 mSv per hour (10 mrem per hour), then the dose rate at 800 meters (0.5 mile) is 6.25×10^{-7} mSv per hour (6.25×10^{-5} mrem per hour). This is a negligible exposure and becomes trivial when the conveyance is moving.

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For the mostly truck scenario, DOE assumed that all shipments would be made by legal-weight truck except for naval spent fuel, which would be shipped by rail. For the mostly rail scenario, DOE assumed that all sites would ship by rail except for the six commercial sites that do not have the capability to load rail packages. DOE assumed that these sites would ship by legal-weight truck until the sites shut down. They would then be upgraded to load rail packages and would ship by direct rail (or heavy-haul truck or barge). Another 24 commercial sites that do not have rail access would ship by heavy-haul truck or barge to railheads.

Table 3.8 provides a summary of the EIS analyses for Yucca Mountain for a 24-year transportation program involving the movement of 70,000 metric tons of spent fuel and high-level waste to the repository. The table provides several types of consequence estimates:

- Estimates of radiation exposures during incident-free transport. Two types of exposures are estimated: the collective dose (see Sidebar 3.3) to workers and to members of the public during incident-free transport, and doses to the maximally exposed worker and member of the public.
- Estimates of the annual probabilities of the maximally reasonable foreseeable accident.
- Estimates of collective doses and the maximally exposed individual if the maximally reasonably foreseeable accident does occur.
- Estimates of latent cancer fatalities from these exposures calculated as described in Sidebar 3.3.
- Estimates of the annual collective dose risk.

For comparison purposes, the estimated number of fatalities from nonradiological exposures are given at the bottom of the table. These fatalities are estimated to arise from vehicular collisions, industrial accidents during loading and handling of the transport packages, and air emissions from the transport vehicles.

Several observations from Table 3.8 are noteworthy. First, and perhaps most important, a Yucca Mountain transportation program will not be risk free. Workers and members of the public who are exposed to radiation from the transportation packages could have an elevated risk of developing fatal cancer. However, the absolute risk, as measured by the total number of fatalities, will be very small for either rail or truck transport for both incident-free and accident scenarios.

It is important to recognize that these risk estimates are based on a large number of parameter estimates having varying degrees of uncertainty. In view of these uncertainties, it is unclear whether the estimates of radiological fatalities for either the mostly truck or the mostly rail scenarios are significantly different. Also, the estimates of fatalities represent averages for

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all shipments over all routes. There may be individual routes, shipments or persons that could have risks that are significantly higher or lower than those shown in Table 3.8.

The maximally foreseeable reasonable accident probabilities are similar for both truck and rail accidents (on the order of 10^{-7} occurrences per year [i.e., 1 occurrence every 10 million years]). This is a very low recurrence rate compared to other kinds of transportation accidents that result in the release of hazardous materials to the environment. The collective dose estimates shown in Table 3.8 are also based on some conservative assumptions: for example, the accidental releases are assumed to occur at the center of a large urban area having a population density extrapolated to 2035. Also, the collective doses are calculated out to a distance of 50 miles (80 kilometers) from the release point and would include large numbers of people who receive very small doses. The resulting collective dose risks shown in the table (2.8×10^{-3} to 2.5×10^{-4}) reflect these conservative assumptions.

It is worth emphasizing the differences between the dose estimates shown in Table 3.8 for incident-free transport and the maximally reasonably foreseeable accident. The incident-free estimates have a probability of occurrence of 1 (i.e., the hazard is always present during transport) if the transportation is carried out as described in Appendix J of the final Yucca Mountain EIS (DOE, 2002a). The dose estimates for the maximally reasonable foreseeable accident, on the other hand, are conditional on the occurrence of that accident. The probability of occurrence of such an accident is estimated to be very low, on the order of 1 chance in 10 million each year the program is in operation. This is a very low probability, so these doses are very unlikely ever to be received by workers or the public. This low probability is reflected in the small collective dose risk estimates shown in the table.

The State of Nevada provided extensive commentary on the Yucca Mountain draft EIS estimates of transportation risk (Nevada, 2000). The state believes that incident-free transportation risks based on truck transport have been underestimated and that the models and scenarios used for the accident consequence estimations are also unrealistic, echoing earlier criticisms by Resnikoff (1994). As noted previously, the final EIS for Yucca Mountain relied heavily on the data and modeling approaches used in the 2000 reexamination study. The State of Nevada has criticized this approach because the 2000 study was performed by a contractor and was not subjected to the public review and comment process used for the 1977 transportation EIS.

Some participants at the committee's information-gathering meetings suggested that the accident statistics used in these analytical studies needed to be reanalyzed in light of increased truck traffic and vehicular speed limits

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on interstate highways. Participants also raised concerns about whether these studies have appropriately analyzed the consequences of the very low frequency but high-magnitude accident scenarios that could result in releases from spent fuel packages.

The committee has not performed an in-depth analysis of the methods used in the final Yucca Mountain EIS to estimate the radiological impacts shown in the table. The calculation of maximum incident-free impacts can be made if reliable data on shipments, routes, and populations can be obtained. The State of Nevada's specific concerns about incident-free exposures for the mostly truck scenario would have limited relevance for a mostly rail scenario, which DOE has announced as its preferred scenario for shipments to a federal repository. Many fewer total shipments would be required under this scenario (see Table 3.8), and in general there are likely to be greater distances between packages and members of the public along main line railways. To the extent that truck shipments are made under this scenario, however, the likelihood of exposure to radiation will depend to a great extent on the routing of these shipments through populated areas. Since routing decisions have not yet been announced, the committee cannot evaluate these potential impacts.

3.2 SOCIAL RISKS

As defined by the committee, *social risks* arise from both social processes and human perceptions (see footnotes 1 and 2 in this chapter). They can arise during the construction of transportation facilities, during routine transportation operations, and as a result of transportation accidents. Social risks are associated with the two types of impacts shown in the rightmost column of Table 3.1: direct social and economic (i.e., socioeconomic) impacts,[36] and perception-based impacts. These two types of impacts can be difficult to separate in practice because they can have similar manifestations, as described below.

A number of direct socioeconomic impacts can result from the transport of spent fuel and high-level waste. Routine transport operations, for example, might result in increased visual impacts (i.e., increased numbers of visually conspicuous shipments of spent fuel through communities), especially from large-quantity shipping programs at the "funnel end" of a transportation system where large numbers of conveyances would be expected to travel along a single route. These activities may have direct impacts on

[36]These kinds of "standard" socioeconomic impacts are included as factors that must be considered in environmental impact statements under the National Environmental Policy Act: for example, see Chapter 8 of the final EIS for Yucca Mountain (DOE, 2002a).

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quality of life, property values, and/or business activities, especially if they persist over extended periods of time. Severe accidents involving loaded transportation packages might lead to the temporary loss of use of a transportation route, which could result in business disruptions and other inconveniences with economic and quality-of-life impacts.

These direct socioeconomic impacts arise from generally well understood social processes. For example, most people prefer to live in neighborhoods with roads that carry low volumes of mostly local vehicular traffic. Such neighborhoods tend to be quieter and safer for unsupervised children. The preference for such neighborhoods is reflected by their higher property values compared with nearby neighborhoods along major roads. Similarly, most people prefer to shop at stores that offer easy access by foot, public transportation, or (in most suburban areas) automobile. People will tend to avoid stores along highly congested routes if comparable but more easily accessible alternatives are available. These preferences are examples of social processes in action.

Perception-based impacts arise from people's beliefs and values concerning the consequences of transportation activities on their well-being and that of their communities (Sidebar 3.5). Such perceptions can shape

SIDEBAR 3.5 Well-being and Social Risk

The general proposition that peoples' well-being changes systematically as events interact with beliefs and values has been central to economic and social theories for generations. Broadly speaking, these processes take place around us (and to us) continuously. Except for truly isolated hermits, people's well-being is inevitably affected by the behavior of others; this is why being treated respectfully so often matters, cell phone use is unwelcome in concert halls, and social ostracism hurts.

Social rules governing behaviors that affect people's well-being are often informal and subject to change over time (this explains why Ann Landers, an expert in informal rules governing behaviors that impinge on the well-being of others, had such a hugely successful career). When there is broad agreement that a behavior damages the well-being of a sufficient number of others, it is often proscribed by formal rules: Noise ordinances in some cities preclude the too-enthusiastic sharing of music, zoning rules forbid certain kinds of property use, nudity is illegal in most public places, and smoking is heavily regulated. Many arguments can be (and are) made about the nature and extent of the losses associated with these behaviors, but in common they reflect a sense of lost well-being on the part of affected people. The bottom line remains that in a representative political system, if enough people perceive a loss of well-being, rules regulating the offending behavior are likely to be forthcoming.

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TABLE 3.9 Examples of Impacts of Social Risks

Social Risk Impacts	Reference Examples
Increased stress and anxiety (psychosocial risks)	NCRP (2001); Slovic (2001a,b); Tuler (2002); Webler (2002)
Loss of sense of security and safety	NCRP (2001); Slovic (2001a,b); Williams et al. (1999)
Loss of trust and confidence in government and government agencies	Freudenberg (1993); Slovic (1993); Satterfield and Levin (2002); Tuler (2002); Rosa and Clark (1999)
Reduced desirability as a place to live	Hunsperger (2001); Slovic et al. (2001)
Reduced economic activity (e.g., tourism and other business activities)	Easterling (1997); Easterling and Kunreuther (1993); Hunsperger (2001); Slovic et al. (2001); UER (2001, 2002)
Reduced property values	UER (2000); Gawande and Jenkins-Smith (2001); Hunsperger (2001)

peoples' behaviors and can materially affect both individual and community welfare.[37] The impacts of social risks may be manifested in different ways, ranging from stress or depression to more direct socioeconomic impacts including losses in jobs or wealth and to sociopolitical impacts that include loss of institutional trust, but in common they result from the ways in which people understand and then respond to the effects of a hazard on their well-being.

While these perception-based impacts can produce a systematic reduction in people's sense of well-being (or utility), the mechanism of loss can vary. Table 3.9 provides examples of some of the potential consequences resulting from actual or feared exposures to radioactive materials or beliefs about the ways such materials are managed. Previous research suggests that while such consequences *may* result from concerns about radiation, these kinds of consequences are not guaranteed to result; the social dynamics of how perceptions and consequences emerge is complex and incompletely understood.

Perception-based impacts arise in many different contexts. With respect to a spent fuel and high-level waste transportation program, risks might arise as follows. The advent of a program for transporting spent fuel and high-level waste—perhaps even in the planning stages—might produce im-

[37]Another term used to describe these effects is "special impacts." Appendix N of the final EIS for Yucca Mountain (DOE, 2002a) includes a section that evaluates these potential impacts.

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agery and messages (i.e., signals) about the program's impacts on local communities (Slovic et al., 1991). The signals originate from an array of sources, including the program's implementing organization, opposition groups, government agencies, and others. These signals are typically transmitted to individuals though the news media (Kasperson et al., 1988), but also through public meetings and government reports.

These signals are *discerned* (filtered, interpreted, and evaluated) by members of affected communities in light of their prior beliefs and values (Jenkins-Smith and Smith, 1994). Given that signals and images of nuclear waste are usually very negative (Slovic, 1987; Slovic et al., 1991), it is not surprising that the prospect or advent of a transport program through a community may widely be perceived to be threatening.

The discernment of a threat posed by spent fuel and high-level waste shipments—regardless of whether it is consistent with technical estimates of risk—has real implications for affected individuals. The threat can diminish individuals' sense of well-being, sometimes in an acute manner, as the understood threat undermines health expectations and increases emotional and physical stress (MacGregor and Flemming, 1996; but see Renn, 1997). The sense of loss can be exacerbated by a sense that the imposition of the risk is unjust or inequitable. When a community—for example, a low-income or minority community—has historically been subjected disproportionately to harms emanating from industrial and other undesirable activities, is less endowed with the resources needed to manage the risks, or holds values that are unusually susceptible to infringement by additional discerned threats (e.g., cultural or spiritual beliefs attached to a place), the loss is likely to be seen as unjust.

This "substantive" injustice can also be matched by "procedural injustice": that is, a sense of injustice stemming from the belief that the *process* by which the threat was imposed is unfair (Gusterson, 2000). The losses potentially associated with a pervasive sense of injustice are numerous and may include loss of trust in government institutions, reduced faith that citizen involvement can result in appropriate public policy (i.e., a sense of disempowerment), and a reluctance to participate in planning processes (e.g., public meetings) (Kasperson, 1983; Fischer, 2001; Bradbury et al., 2003).

Federal (e.g., EO, 1994; CEQ, 1997; EPA, 1998a; DOE, 1995a; DOT, 2002), some state (American Bar Association, 2004) and city governments, and a growing number of other organizations (e.g., NCHRP, 2004) have recognized the importance of environmental justice[38] impacts, and some

[38]Environmental justice is the fair treatment and meaningful involvement of people regardless of race, gender, national origin, or level of attained education in the development of laws, regulations, and policies that affect them (see IOM, 1999).

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have enacted laws, regulations, and policies to address them. Additionally, a rich literature on environmental justice has developed over the past 20 years (e.g., GAO, 1983; United Church of Christ, 1987; Bullard, 1990a,b; Bryant and Mohai, 1992). It has many thrusts, such as identifying and characterizing the causes of disproportionate harms (Adeola, 1994), often through community-based participatory research (Shepard et al., 2002); investigating the effects of scale of measurement (e.g., census tract, block group) on disproportionate impacts on communities (Eady, 2003); and developing mitigating tools, such as good neighbor and community benefits agreements.

Should the perceived threat become broadly associated with a place or community, it could have a potentially lasting stigmatizing[39] effect (Kasperson et al., 2001; Slovic et al., 2001). For spent fuel and high-level waste shipments, concern about stigma would be associated chiefly with severe accidents, but it could also result from frequent and widely publicized shipments or minor vehicular accidents involving spent fuel or high-level waste shipments.

Publicity about transportation incidents, even minor incidents, can result in the *social amplification of risk* in which "the consequences of risk and risk events . . . often exceed the direct physical harm to human beings and the ecosystems to include more indirect effects on the economy, social institutions, and well-being associated with the amplification-driven impacts" (Kasperson et al., 2001, p. 18; see also, Slovic et al., 1991). Discerned risks from hazards such as spent fuel and high-level waste shipments also can change behaviors. A perceived threat to health may modify the way people use residential properties (Berrens et al., 2002) or change the attractiveness of areas for residency, vacations, and conferences (Easterling and Kunreuther, 1993).

Changed perceptions of places resulting from discerned threats may result in changes in perceived values of residential and commercial properties (Ketkar, 1992; Mendelsohn et al., 1992; Kiel, 1995; Hunsperger, 2001). These perceived losses may translate into reductions in market values as sellers become more eager to leave and buyers more wary of the affected locale.

Because perception-based impacts derive from the manner in which individuals recognize and understand the hazard, social risks are sometimes mistakenly treated by technical experts and policy makers as imaginary, or less real, than the health and safety risks discussed in Section 3.1. The general difficulty in quantifying social risks no doubt contributes to this

[39]Stigma marks a person, place, product, or technology as deviant, flawed, or undesirable. When the particular stigmatizing characteristic is observed, the person, place, product, or technology may be denigrated or avoided.

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view. Nevertheless, it is clear from social science research, some of which is described in the next section of this chapter, that social risks are as real and important to many people as the associated health and safety risks. They can impact individuals and communities in ways other than injury or death. In addition, social risks may exacerbate concerns about the likelihood of future, unanticipated health and safety risks. For example, an erosion of trust in a program or the agency overseeing such a program can arise from frequent minor problems; these continuing problems may lead people to conclude that the agency lacks the capacity to effectively manage the program over the long term. Left unaddressed, these risks could diminish the ability of implementers to mobilize the necessary resources for managing the health and safety risks of transportation systems.

Technical experts and policy makers sometimes attribute the concerns about social risks expressed by others as based on misinformation about or ignorance of the "real" (i.e., health and safety) risks. This attribution is frequently coupled with calls for better public education about risk, with the unspoken implication that such education would encourage the public to behave more rationally (i.e., more like technical experts). Although there is no doubt that the public would benefit from more accurate information about transportation risks, one should not expect that such information would result in a widespread change of public behavior. Such "information deficit" approaches to behavior change have largely been discredited (e.g., Kollmuss and Agyeman, 2002).

In fact, people may be acting rationally if they oppose spent fuel and high-level waste transportation on health and safety grounds even if they agree with the experts that the estimated health and safety risks are low. Most people recognize that transportation programs are run by fallible institutions and that institutional and human errors play a large role in determining transportation risks. There are many examples of technological systems where the experts were wrong or overly optimistic (Schrader-Frechette, 1995; Perrow, 1999; Freudenburg, 2003). They also recognize that the risk of an accidental release from a spent fuel shipment, while low, is not zero and, moreover, that such a release can have a range of consequences: health, safety, and social. Rational people care about all consequences that can impact their lives and communities, not just health and safety consequences that are the main concern of technical experts (NRC, 1996).

3.2.1 Research on Social Risk

There is a large body of research on social risk that focuses on the perceptions of and responses to nuclear power, nuclear weapons, and radioactive waste disposal. This research has shown that perceptions of risk

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can have gender, racial, and cultural predispositions. A brief review of this research is provided below.

Studies have found that men tend to "rate a wide range of hazards as lower in risk than do women" including nuclear technologies (e.g., Finucane et al., 2000, p. 169). Flynn et al. (1994, p. 1101) found that white men have been found on average to perceive risks, including technologies such as nuclear power and waste "as much smaller and much more acceptable" than other people (also see Finucane et al., 2000). Vaughan (1995; see also Vaughan and Nordenstam, 1991) found that African Americans, when compared with others, tend to perceive risks as higher and support stricter regulatory actions for issues involving nuclear power plants or the disposal of radioactive waste. These predispositions may be related to the sociocultural contexts within which people live, including their beliefs about the trustworthiness of risk management institutions. Vaughn (1995, p. 175) notes:

> Because prior beliefs about risk, perceptions about the trustworthiness of various government agencies and beliefs about risk management process evolve within sociocultural contexts, they likely are not independent of broader social experiences that bound and structure perspectives and worldviews. . . . Different patterns of belief and value systems relevant to risk management are likely to be observed across diverse ethnic and socioeconomic communities to the degree to which these communities' social and cultural contexts have varied.

These sociocultural predispositions have been the topic of numerous studies (e.g., Dake, 1991, 1992; Jenkins-Smith and Smith, 1994; and Peters and Slovic, 1996).

There is also quantitative and qualitative evidence (e.g., United Church of Christ, 1987; GAO, 1983; Zimmerman, 1993; Goldman and Fitton, 1994) that not all people and communities bear the burden of environmental problems equally, including those arising from transportation of hazardous materials. This disproportionate burden has been associated particularly with minority and low-income communities (Bryant and Mohai, 1992). The imposition of preexisting risks on these communities may affect their conceptualization and framing of risk problems and make them even more vulnerable to risks from new activities (Sidebar 3.6).

A large body of published work has examined public perceptions concerning the proposed federal repository at Yucca Mountain, Nevada; much of the initial work was supported by the State of Nevada (e.g., Kasperson et al., 2001; see also, NRC, 1984; Slovic et al., 1991, 1994; Gregory et al., 1995). Consistent with the Nevada-sponsored studies, a National Research Council committee that examined the development of geologic repositories noted that the "[g]eneral public in almost every nation where data have

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SIDEBAR 3.6 Publics, Affected Communities, and Vulnerable Communities Defined

There is a temptation to talk of "the public" or "the community" when thinking of risk estimates or tasks such as communication or the provision of information. However, the situation is far more complex than this. There are many *publics* (Jacobson, 1999) differentiated by both demographic (ethnicity, income) and interest-based criteria, and many groups or *communities* differentiated by numerous criteria of which demographics is just one.

In addition, for any project with potentially adverse consequences, such as those that might result from the transportation of spent nuclear fuel and high-level waste, there are *affected* groups and *vulnerable* groups. Affected groups are all communities within an influence zone of a transportation project. This is a hypothetical zone, which, for spent fuel and high-level waste transportation, would extend out some distance on either side of designated shipping routes. Within these affected communities will be vulnerable groups who, because of disproportionate exposures to other health-affecting substances, or because of ethnic, linguistic, or socioeconomic issues, may be less able to read or understand information from the authorities, to act in a first-responder role, to exit the area in a timely manner in an emergency, or to otherwise cope with an emergency. The 2005 Hurricane Katrina disaster in New Orleans is an unfortunate illustration of this point: many poor, mostly black, New Orleans residents had no means to evacuate the city and were stranded in their homes or in shelters of last resort. These vulnerable groups may have to be identified and given special consideration by the authorities, including—but not limited to—translated materials, emergency warnings in different languages, and appropriate first-responder training.

been collected perceives nuclear technologies and radioactive wastes as the riskiest of all hazards and expresses great concern about them" (NRC, 2003, p. 56).

There is a smaller body of research that specifically examines the potential social risks of transporting radioactive waste. This research has generally followed one of two approaches. The first and most common approach relies on survey interviews taken from systematic samples of people (adults) from the affected populations. The second approach, often referred to as "hedonic studies," relies on direct measures of behaviors that reflect responses to the transportation of nuclear waste.

Survey research has the immediate advantage of obtaining individuals' responses to specific questions about their own risk perceptions, beliefs, preferences, and anticipated behaviors. Of course, anticipated behaviors do not always match real behaviors. Surveys can be targeted to respondents of particular relevance to the transportation program. Quite a num-

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ber of surveys have focused on nuclear waste transport, many of which are accessible on the Nevada Nuclear Waste Project Office Web site (*http://www.state.nv.us/nucwaste/*). Some of the most directly relevant survey research is summarized in the following paragraphs.

The University of New Mexico (UNMIPP, 2004) reported on a decade-long series of surveys on public perceptions of the risks associated with the Waste Isolation Pilot Plant among New Mexico residents. One survey item asked respondents to indicate whether they believed the facility was safe to open or was slightly, somewhat, or very risky. Over time, support gradually increased, and it appeared to increase significantly once the first shipments of transuranic waste reached the facility without incident.

A DOE-sponsored telephone-based survey of South Carolina residents living near the Savannah River Site examined residents risk perceptions of radioactive waste cleanup and disposal activities at the site, including the transport of radioactive waste (not explicitly including spent fuel) to and from the site. The study authors (Williams et al., 1999, p. 1028) noted that respondents were also more than four times more likely to believe that transport of waste from the site posed a fair to certain chance of harm than a small or no chance of harm. Truck was seen as being the most risky mode of transport. The study found that heightened risk perceptions among these residents were based upon their expectation of economic loss, their financial security, proximity to the site, and their trust in Savannah River Site officials (Williams et al., 1999, p. 1033).

The State of Nevada is located at the end of the transportation funnel for shipments to the planned Yucca Mountain repository. Consequently, larger numbers of spent fuel and high-level waste shipments will pass through communities in that state than anywhere else in the country if a federal repository at Yucca Mountain is opened. Two surveys—one of residents, the other of bankers and appraisers—were undertaken by the Urban Environmental Institute, LLC (UER) in 2000 to assess potential transportation-related impacts in Clark County, Nevada, which includes the city of Las Vegas. More than 70 percent of the respondents to UER's residential survey indicated that they would not consider purchasing residential property near a highway designated for spent fuel transport. The UER survey of appraisers and bankers indicates that under routine transport conditions, residences 1 mile from transportation routes may see property value decreases of 2.0 to 3.5 percent, while commercial-office properties and industrial properties might decline in value from 0.5 to 3.0 percent. The study found that significant and adverse impacts on property values are likely to extend up to at least 3 miles from planned transportation routes (UER, 2000, p. 71).

UER also has studied the potential impacts of spent fuel transport near Moapa tribal lands in Nevada (UER, 2001). These lands are located near

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Interstate 15, a route identified for possible truck shipments to Yucca Mountain. Tribal lands are located within 5 miles of I-15, and the major revenue source for the tribe is a gaming center located near the interstate. The UER concluded that an accident near Moapa lands would put the "tribe in an extremely vulnerable position in terms of economic well-being since that enterprise generates 90 percent of the tribe's revenues" (UER, 2001, p. 40). The tribe has plans for future economic developments along I-15, including a truck stop and sales of agricultural produce. The study concluded that an accident involving a spent fuel shipment near the Moapa exit along I-15 may cause declining property values and lost revenues, resulting in potentially severe adverse economic impacts on the tribe.

The UER has also conducted a survey to identify the potential impacts of spent fuel transportation on the Las Vegas and Moapa Paiutes (UER, 2002; see also, Nevada, 2002). Survey respondents noted that they were concerned not only with economic impacts, but also with what they termed the "moral" issue of transporting nuclear waste through Indian communities that have already experienced exposure to radioactivity from atomic bomb tests at the Nevada Test Site.

Intertech Services Corporation completed a study for Lincoln County, Nevada, on the potential adverse impacts to Caliente, Nevada, from a Yucca Mountain transportation program (Intertech Services Corporation, 2001). Caliente is the planned site for a rail spur junction to Yucca Mountain. The development of this junction is supported by city and county leaders. The study concluded that the transportation program would have "negative impacts on community cohesion, population driven effects, emergency management, highway accident risk, radiation exposure risk, and impacts from stigma that may reduce the desirability of Lincoln County as a place to live and as a destination for tourists" (Intertech Services Corporation, 2001, ES-2). The report notes (p. 51) that although "scientific estimates of risk for an accident resulting in a release of radiation into the environment may be quite low, the risk is not zero." The report also notes (p. 51–52), "To the degree that media amplifies the incident, even when there is no radiation release, the economic and fiscal consequences can be expected to be much greater than from a similar accident without nuclear waste."

Transportation-related surveys taken in other parts of the country are broadly consistent with these results. A national survey of 972 people, which was part of the University of Maryland 1997 Omnibus Survey (Flynn et al., 1998), examined the perceived risks and property value losses resulting from the transportation of spent fuel. The survey found that nearly two-thirds of the respondents thought the value of properties located along spent fuel transportation routes would be lowered. Seventy percent of respondents thought that terrorist groups could successfully attack spent fuel

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shipments. Most respondents stated an unwillingness to live near a spent fuel transportation route, and a majority of the respondents reported that they considered the transport of spent fuel to be more risky than the transport of industrial chemicals or gasoline.

There are fewer hedonic studies of people's reactions to nuclear waste transport, in part because these studies are more expensive and more difficult to carry out. Only one study, which is described below, was available for review by the committee.

A DOE-sponsored study of real estate transactions in South Carolina (Gawande and Jenkins-Smith, 2001) measured the effects of a series of highly publicized shipments of foreign spent fuel to the Savannah River Site (research reactor spent fuel shipments to the Savannah River Site are described in more detail in Chapter 4). The authors found no correlation between the spent fuel shipments and property values in rural Aiken County, where there is a long experience with nuclear materials management. In urban and populous Charleston County, however, "the net gain in value associated with being 5 miles away from the route relative to a property on the route was nearly 3 percent of the average home value" (Gawande and Jenkins-Smith, 2001, p. 229) once the shipments were under way. The authors caution about making generalizations concerning the effects of hazardous material shipments based on this survey, however, because of data limitations.

During the scoping process for the draft EIS for Yucca Mountain, DOE received many public comments about the need to address risk perceptions and the potential stigmatization of Nevada, in particular the Las Vegas area, due to the transportation and disposal of spent fuel and high-level waste. In response, DOE sponsored a review of relevant perception-based impacts and stigma effects literature, in which qualitative assessments were made of the likelihood of these impacts. The literature reviewed included studies sponsored by DOE, Nevada, and others. The report resulting from this review concluded (O'Connor, 2001, p. 2):

> . . . absent accidents, there is no reason to expect impacts to property owners in areas beyond the transportation corridors. Even absent accidents, however, two studies report that, at least temporarily, a decline in residential property values of approximately 3 percent may be expected in transportation corridors in urban areas. . . . More research on whether property values have fluctuated with the transportation of radioactive materials would be beneficial, although the research would not allow analysts to know with certainty whether there would be any impacts from perceptions of shipments of spent nuclear fuel and high-level waste to a Yucca Mountain Repository, or how long such impacts would persist.

The final EIS for Yucca Mountain reached a similar conclusion (DOE, 2002a, p. N21):

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> There is a consensus among social scientists that a quantitative assessment of the potential impacts from risk perceptions of the proposed repository and the transportation of spent nuclear fuel and high-level radioactive waste is impossible at this time and probably unlikely even after extensive additional research. The implication is not that impacts would probably be large, but simply difficult to quantify.

In summary, scientific research has generally shown the following:

- The public generally perceives nuclear-related activities to carry a higher risk than non-nuclear activities.
- These risks are not perceived in isolation, but in a broader context of social experiences and risk management processes—for example, in the context of proposals for increasing reliance on nuclear energy that would also require transportation of additional spent fuel.
- Social processes have the potential to amplify or attenuate social risks arising from the transport of spent fuel and high-level waste.
- Risk perceptions may have gender, cultural, and ethnic predispositions.
- Social risks are difficult to quantify and there are no universally agreed-upon metrics for comparing them.
- Trust and confidence can play important roles in modulating these risks.

The last point about trust and confidence suggests that risk perceptions can be modulated (i.e., amplified or dampened) by the actions of organizations involved in implementing or opposing a transportation program. On the one hand, the publics' trust of groups that seek to mobilize opposition to a transportation program may increase the perceived risks of transportation. On the other hand, public trust and confidence in government agencies that manage and regulate transport (e.g., DOE, USNRC, and their contractors) may amplify or dampen these effects. In other words, *trust and confidence* serves to amplify or dampen the publics' response to signals sent by those who make claims and counterclaims about the risks of transportation (Freudenberg, 2003; Frewer, 2003).

Responses to programs for transporting spent fuel and high-level waste among members of the public will depend to a great extent on perceptions about the need for such transport as well as the risks involved. Those responsible for implementing transport programs can take several steps to inform public understanding of needs, options, risks, and benefits. They can also benefit from a better understanding of the reasons for public responses, whether in the form of support or opposition to a proposed program. Improved understandings of these issues by the public and transportation implementers can support better planning and operational deci-

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sions, improve confidence in transportation management, improve safety, and potentially reduce conflict.

3.3 COMPARATIVE RISK

The statement of task for this study (Sidebar 1.1) directs the committee to provide a comparison between the principal risks for transporting spent fuel and high-level waste and other risks that confront members of society. In this section, the committee provides a comparison of the health and safety risks of spent fuel and high-level waste transportation with other types of risks to address this charge.

The committee made no attempt to compare social risks because of the difficulties in quantifying such risks. The committee has followed the common approach for risk comparisons by comparing risks on dimensions for which the most information currently exists. The committee is well aware that these dimensions may not represent the outcomes that are most important to some people. However, data are lacking to make meaningful quantitative or qualitative social risk comparisons, and there are no agreed-upon metrics for making such comparisons.

The committee's objective in presenting this comparison is to inform readers' understanding about the risks of spent fuel and high-level waste transportation, not to persuade readers that such risks are—or are not—acceptable. The committee recognizes that acceptability is a normative judgment; that is, there is no basis in science for judging the acceptability of transportation risks. Societal acceptability of risk is ultimately a public policy decision and may vary over time and among different societies. Individual acceptability is based on personal judgments.

There is a rich literature on risk comparisons that informed the committee's work (Sidebar 3.7). An important finding from research on risk communication is that different audiences frequently find different information and comparisons more (or less) informative and relevant; some may be critical of a particular comparison, while others will find it helpful for understanding particular risks. At best, comparisons can help to improve people's understandings about the risks of a given activity, which may or may not change their views about its acceptability. At worst, such comparisons can be seen as trying to manipulate public opinion or to "sell" a particular technology or approach. People can reasonably disagree about the "best" comparisons to use because each comparison will privilege some aspects of the risk context at the expense of others (Vaughan and Seifert, 1992; NRC, 1996). In short, there is no single "right" comparison that will satisfy and be understood by all audiences or that will convey all of the relevant information associated with a complex risk.

The committee was guided by two principles in developing compari-

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SIDEBAR 3.7 Comparative Risks

A growing body of research has been used to inform the practice of risk comparisons (e.g., NRC, 1989, 1996; Roth et al., 1990; MacGregor et al., 2002a, 2002b; Johnson, 2003, 2004; Johnson and Chess, 2003). Key insights from this research include the following:

- Comparisons can have subtle effects on judgments about relative risks and their significance.
- Comparisons on multiple dimensions can be more helpful than comparisons on a single dimension.
- Comparisons of different risks on a single dimension can be problematic when the risks are viewed as qualitatively different (e.g., voluntary vs. involuntary, familiar vs. unfamiliar).
- Use of point estimates can be misleading when uncertainties are large.
- Risk denominators (e.g., periods of exposure, population base) to the risk should be defined.
- Risks should be meaningful to those presented with the comparisons.

Choices about which risk comparisons to make involve personal judgments about which risk *outcomes* are important (Crouch and Wilson, 1982; Vaughan and Seifert, 1992; NRC, 1996): for example, human fatalities, human morbidity, ecological impacts, economic costs, procedural fairness, distributional equity, intergenerational effects, personal rights, effects on institutional trust and risk management regimes. It may also be important to consider benefits alongside such outcomes to fully inform understandings and decisions. Choices about which outcomes to use in the comparison are not only technical or scientific; rather, they also reflect values—implicitly or explicitly—about the characteristics of the risks that are important to people. They are embedded in and reflect social values.

There are a potentially large number of competing outcomes and measures that may be relevant in a risk comparison. Meaningful comparison of risks need not consider all possible outcomes or measures. Instead, decisions must be made about what will be most useful and relevant. A previous National Research Council committee offers some cautionary advice in this regard (NRC, 1989, p. 172).

> Risk comparisons can be helpful, but they should be presented with caution. Risk comparisons must be seen as one of several inputs to risk decisions, not as determinants of decisions. There are proven pitfalls when risks of diverse character are compared, especially when the intent of the comparison can be seen as that of minimizing a risk (by equating it to a seemingly trivial risk). More useful are comparisons of risks that help convey the magnitude of a particular risk estimate, that occur in the same decision context (e.g., risks from flying and driving to a given destination), and that have a similar outcome. Multiple comparisons may avoid some of the worst pitfalls.

There is a frequent tendency to compare risks on dimensions that can be quantified (e.g., estimates of fatalities). These dimensions do not always represent the outcomes that may be most important to people, but they may be the outcomes for which most information exists. Other outcomes—for example, those for the social risks described in Section 3.2—may be equally important, but data may be lacking to make meaningful comparisons.

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sons of health and safety risks. First, the committee considered it important to compare risks associated with *like physical causes*. Radiation is the primary hazard of concern in spent fuel and high-level waste transportation. Thus, the committee's comparisons focus on risks associated with radiological exposures.

Second, the committee considered it important to compare risks associated with similar outcomes. Human exposure to radiation can lead to undesirable health outcomes. The primary health effect of concern from exposure to ionizing radiation is cancer.[40] Exposure to low and moderate levels of radiation can lead to the induction of cancer, usually years to decades after the exposures occur; some of these induced cancers will be fatal. Exposure to high levels of radiation can result in radiation sickness and death in a much shorter period of time. Thus, the committee separates comparisons of *doses* associated with routine radiological transport risks, which have the potential to provide chronic exposures, and severe accident risks, which have the potential to provide acute exposures.

Risk estimates for cancer incidence and mortality from exposure to radiation and radionuclides are available (e.g., EPA, 1999; NRC, 2005a). Some individuals may find cancer incidence to be a more meaningful factor for risk comparisons given the dread that is often associated with this disease. Nobody welcomes a cancer diagnosis, even if the cancer is treatable. Cancer incidence is also used as the basis for U.S. compensation programs for workers, veterans, and members of the public exposed to radiation from national defense activities (NRC, 2005b). Moreover, the incidence of health effects (including cancer) is commonly used in risk assessments for chronic exposures to hazardous chemicals.

The numerical relationship between cancer incidence and cancer mortality varies with cancer site within the human body.[41] Average lifetime lung cancer mortality in males, for example, is about 100 percent of cancer incidence. On the other hand, average lifetime prostate cancer mortality in males is about 22 percent, and average lifetime breast cancer mortality in females is about 25 percent. The average lifetime mortality for all solid cancers[42] in the U.S. population is about 48 percent of cancer incidence. For leukemia, the average lifetime mortality rate is closer to 85–90 percent.

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[40]Radiation exposure may have other health effects besides cancer. For example, recent research suggests that such exposures can contribute to the development of cardiovascular disease.

[41]Average lifetime risk estimates for non-radiation-induced cancer incidence and mortality for several cancer sites are available for the U.S. population. See NRC (2005a, Table 12-4) for example.

[42]Solid cancers (cancers manifested by the formation of tumors) constitute more than 98 percent of all human cancers in the U.S. population. Leukemia (cancer of the blood or blood-forming organs) constitutes the remaining cancers.

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Cancer incidence is most readily used for comparing chronic radiation exposures during routine transport to chronic radiation exposures from other activities. Alternatively, one can compare the magnitudes of the chronic exposures for different activities directly. People who are concerned about exposures to any anthropomorphic radiation, regardless of its health effects, may find this sort of comparison useful. For those interested in how these exposures relate to cancer incidence and mortality, the appropriate multiplicative conversion factors (see Sidebar 3.3) can be applied. The committee uses exposures in its comparisons for routine transport but also provides examples of how these exposures relate to cancer incidence and mortality.

The committee uses mortality in its comparative assessments for transportation accidents. This allowed the committee to compare cancer mortality from exposures to ionizing radiation in a spent fuel transportation accident with other types of hazardous material accidents—for example, deaths from an accident involving releases of chlorine from a rail tanker car.

The committee has used a wide range of comparison factors, some of which are more directly comparable than others. As noted previously, different individuals will find different measures to have more or less meaning. The committee hopes that its presentation of a large range of factors will provide most individuals with comparisons that are helpful.

3.3.1 Risks for Normal Transport

As described elsewhere in this chapter, transportation packages do not completely shield the radiation emitted by the spent fuel or high-level waste contained within them. Consequently, individuals who travel, work, and live along the routes used for shipping spent fuel and high-level waste might receive small radiation doses when loaded packages are transported in their vicinity. The dose received by given individuals will vary as the inverse square of their distances from the packages[43] and directly in proportion to their exposure times. Individuals closest to the packages will receive comparatively larger doses for a given exposure time. Doses will drop off quickly, however, as the distance between the individual and the package increases.

The doses received by any one individual may be very small, but a large number of individuals may receive radiation doses over the life of a transportation program. The *collective dose* to the population of people exposed

[43]That is, doubling the distance results in one-fourth of the exposure. The inverse square law assumes that the radiation emanates from a point source. A transportation package is not a point source, however, so the inverse square law is only a rough approximation at close distances to it.

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to radiation, which is obtained by summing the doses received by all individuals within the population, can be used to estimate radiological risks from normal transport (Sidebar 3.3). The outcome of principal concern for routine exposures is cancer incidence and cancer mortality.

Quantitative risk assessment models that describe the association between radiation dose and cancer incidence or cancer mortality have been deduced from epidemiological and biological studies. A linear no-threshold association between dose and cancer risk from exposure to ionizing radiation such as X-rays and gamma rays[44] is consistent with current epidemiological and biophysical understanding (NRC, 2005a). That is, the risk of radiation-induced cancer rises linearly with dose with no threshold below which the risk falls to zero. The relationship between radiation dose and radiation-induced cancer can be expressed as a straight-line function that passes through zero risk at zero dose.[45] The slope of the line, referred to as the nominal probability coefficient, is between about 4×10^{-2} and 5×10^{-2} fatal cancer per sievert (4×10^{-4} to 5×10^{-4} fatal cancer per rem; ICRP, 1991). These estimates have high uncertainties at the low doses typical of normal transport conditions (NRC, 2005a).

This risk model is a probabilistic function. It expresses the average number of fatal cancers that would be expected to occur in a population of individuals having a typical age and gender distribution for workers or the U.S. population for a given level of radiation exposure. Such risk models are used for setting standards for radiation exposure in the United States and many other countries. These models are also used for estimating risks to populations from specific activities involving the use of radiation. For example, such models were used to estimate latent cancer fatalities in the final Yucca Mountain EIS (DOE, 2002a; see Table 3.8) for the transport of spent fuel and high-level waste.

The routine radiological risks to a given population are scenario specific. That is, the risks depend on factors such as the number of packages transported; package inventories; shipping modes and routes; and population densities along shipping routes. The most complete estimate of scenario-specific routine radiological risks for spent fuel and high-level waste transportation is provided by the planned Yucca Mountain transportation program. Those estimates, which are provided in the final Yucca Mountain EIS and described in Section 3.1.2, were used by the committee for some of the comparisons in this section.

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[44]This radiation is sometimes referred to as low energy transfer (LET) radiation.

[45]While the risk of developing a radiation-induced cancer is zero at zero dose according to the linear no-threshold model, the risk of developing cancer from other causes is much greater than zero. As noted elsewhere in this chapter, about 42 percent of the U.S. population will develop some form of cancer in their lifetimes due to causes other than radiation exposure.

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The final Yucca Mountain EIS (DOE, 2002a) provides estimates of routine radiological risks for both the mostly truck and mostly rail transport scenarios (see Section 3.1.2 and Table 3.8). While DOE has announced its preference for the mostly rail scenario, the committee provides estimates of radiological risks for both scenarios to help readers put these risks in perspective.

The estimated collective dose for the mostly rail scenario is 1200 to 1600 person-rem (Table 3.8), which applies to the public. Multiplying this dose by the nominal probability coefficient for fatal cancers produces an estimated average of about one latent cancer fatality among the 16.4 million people estimated to be exposed to radiation during the 24-year operational life of the transportation program. The estimated collective dose for the mostly truck scenario is 5000 person-rem, which would be expected to produce on average about three latent cancer fatalities out of the 10.4 million people that are estimated to be exposed to this radiation during the 24-year transport program. Of course, this comparison does not address some associated issues that people may care about, such as the voluntariness of the exposures.

To put these numbers in perspective, it is instructive to compare them to average cancer incidence and mortality in the U.S. population. Approximately 42 out of 100 people in the United States will be diagnosed with solid cancers during their lifetimes, and about 20 of those cancers will be fatal (NRC, 2005a, Table 12-4). Thus, of the 10.4 million to 16.4 million people who are estimated to be exposed to radiation (in almost all cases at very small levels) from transport of spent fuel and high-level waste to Yucca Mountain, approximately 4 million to 6 million would be expected to be diagnosed with solid cancers during their lifetimes for causes unrelated to the transportation program; about 2 million to 3.3 million of those cancers would be expected to be fatal. The estimated cancer fatalities from exposure to radiation during incident-free transport to Yucca Mountain—one for the mostly rail scenario and about three for the mostly truck scenario—would not be detectable in this much larger population of fatal cancers.

Other comparisons based directly on radiation dose[46] are also possible. In Table 3.10 and Figure 3.3, the committee compares the estimated doses for maximally exposed workers and members of the public to radiation from the Yucca Mountain transportation program (DOE, 2002a, Chapter 6 and Appendix J), to three other types radiation exposures:

1. Permissible maximum doses to workers and the public under current radiation standards and regulations

[46]Dose and risk are interchangeable in an arithmetic sense by multiplying or dividing by the nominal probability coefficient.

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2. Doses received by members of the U.S. public from natural background radiation
3. Doses received from selected medical diagnostic procedures that utilize radiation

Radiation standards and regulations establish ceilings for the maximum permissible radiation doses that workers and members of the public are allowed to receive from anthropogenic activities involving ionizing radiation. International standards are developed by international groups of radiation experts and health practitioners. These standards do not have the force of law but are frequently used as starting points by U.S. authorities (and authorities in other nations) for establishing national regulations.

U.S. regulations have been developed by the federal government through an elaborate administrative procedure[47] that provides opportunities for public input. As such, these regulations represent a kind of social contract between the government and its citizens to protect worker and public health and safety. These standards set limits on what are often involuntary exposures to radiation, especially for members of the public. The exposures from spent fuel transport to a Yucca Mountain repository also will be largely involuntary for the individuals who receive them.

Natural background radiation consists of cosmic and solar radiation, external radiation exposure from radioactive materials present in rocks and soil, and radioactivity that is inhaled or ingested (see Sidebar 3.2). The committee presents four different estimates of natural background radiation in Table 3.10 (see also Figure 3.3): (1) the annual natural radiation background dose in Florida, the state with the lowest estimated annual natural background dose; (2) the annual natural radiation background dose in South Dakota, the state with the highest estimated annual natural background dose; (3) the average annual natural radiation background dose in the United States; and (4) the galactic cosmic background radiation dose received in a single round-trip airline flight between New York and Tokyo and also between St. Louis and Tampa.[48]

Natural background radiation is usually viewed as an involuntary and

[47]This procedure is specified by the Administrative Procedures Act: United States Code, Title 5, Part I, Chapter 5, SubChapter II.

[48]Airline travel subjects passengers to elevated doses of cosmic radiation originating from stars and galaxies. Radiation exposure increases with altitude and latitude and can also increase significantly during solar disturbances. The Federal Aviation Administration has developed a computer program (CARI-6) that calculates the effective dose of cosmic radiation received by individuals flying in aircraft on great circle routes between two airports. See *http://www.faa.gov/education_ research/research/med_humanfacs/aeromedical/radiobiology/cari6/index.cfm.*

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TABLE 3.10 Radiation Dose Comparisons

Estimated Radiation Doses Received by Yucca Mountain Transportation Workers and the Public for Routine Transportation Operations[a]	Maximum Radiation Doses Allowed by International Standards and U.S. Regulations[b]
	DOE annual occupational dose limit established in 10 CFR Part 835
Approximate annual dose to maximally exposed transport worker, mostly truck and mostly rail scenarios (DOE, 2002a, Tables 6-9, 6-12)	ICRP recommended annual occupational dose limit (ICRP, 1991, Table 6)
	Current DOE annual occupational administrative dose limit (DOE, 1999)
	All-pathways annual dose limit to reasonably maximally exposed individual near Yucca Mountain at time periods greater than 10,000 years after repository closure (70 FR 49014, August 22, 2005)
Approximate annual dose to maximally exposed service station worker, mostly truck scenario (DOE, 2002a, Table 6-9)	ICRP recommended annual public dose limit (ICRP, 1991, Table 6)

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Examples of Natural and Anthropogenic Radiation Exposures	Radiation Dose Limits or Exposures, mSv (mrem)	Notes
	50 (5000)	
	20 (2000)	ICRP standards are for doses averaged over defined periods of 5 years, not to exceed 50 mSv (5000 mrem) in any one year
	20 (2000)	Maximally exposed transport worker is assumed to receive the maximum allowable DOE occupational administrative dose
Single whole-body CT scan (Brenner and Elliston, 2004)	12 (1200)	Weighted average dose to major organs
Approximate annual natural background radiation dose in South Dakota (Mauro and Briggs, 2005)	9.6 (960)	Includes doses from exposure to radon
	3.5 (350)	EPA draft standard (40 CFR Part 197)
Average U.S. annual natural background radiation dose (NCRP, 1987)	3 (300)	Includes doses from exposure to radon
Approximate annual natural background radiation dose in Florida (Mauro and Briggs, 2005)	1.3 (130)	Includes doses from exposure to radon
	1 (100)	Maximally exposed worker is assumed to receive the maximum allowable dose under ICRP guidelines and 10 CFR Part 20
		ICRP guideline is for doses from all sources except natural, medical, and accidental exposures

continues

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TABLE 3.10 Continued

Estimated Radiation Doses Received by Yucca Mountain Transportation Workers and the Public for Routine Transportation Operations[a]	Maximum Radiation Doses Allowed by International Standards and U.S. Regulations[b]
	All-pathways annual dose limits for release of radiation to the environment from land disposal facilities (10 CFR Part 61)
	All-pathways annual dose limit to reasonably maximally exposed individual near Yucca Mountain for first 10,000 years after repository closure
Approximate annual dose to maximally exposed resident near rail stop, mostly rail scenario (DOE, 2002a, Table 6-12)	
	Maximum hourly dose allowed at 2 meters (about 6.5 feet) from the lateral surfaces of a transport vehicle carrying spent fuel or high-level waste (49 CFR 173.441(b) and 10 CFR 71.47(b)(3))
Approximate annual dose to maximally exposed resident along rail route, mostly rail scenario (DOE, 2002a, Table 6-12)	

NOTE: EPA = Environmental Protection Agency; ICRP = International Commission on Radiological Protection.

[a]Annual doses were calculated by dividing the total estimated dose given in DOE (2002a) by the 24-year length of the transportation program.

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Examples of Natural and Anthropogenic Radiation Exposures	Radiation Dose Limits or Exposures, mSv (mrem)	Notes
X-ray of human hip joint (Ngutter et al., 2001)	0.60 (60)	
	0.25 (25)	
	0.15 (15)	EPA standard 40 CFR Part 197
Round-trip airline flight between New York and Tokyo (Friedberg and Copeland, 2003)	0.145 (14.5)	45-year average (1958–2002) dose calculated using the CARI-6 computer program, which estimates the effective dose of galactic cosmic radiation
	0.12 (12)	Applies to maximally exposed residents who live near rail yards and crew change stops
Single chest X-ray (NRC, 2005a)	0.1 (10)	
Single X-ray of a human extremity (Mettler et al., 2000)	0.01 (1)	
Round-trip airline flight between St. Louis, Mo. and Tampa, Fla. (Friedberg and Copeland, 2003)	0.009 (0.9)	45-year average (1958–2002) dose calculated using CARI-6 computer program, which estimates the effective dose of galactic cosmic radiation
	0.0007 (0.07)	

[b]Radiation protection standards and regulations also include an ALARA (as low as reasonably achievable) requirement that usually results in doses to workers and the public that are well below the limits in this table. Moreover, constraints are sometimes placed on individual sources of radiation or practices involving the use of radiation to limit worker and public exposures.

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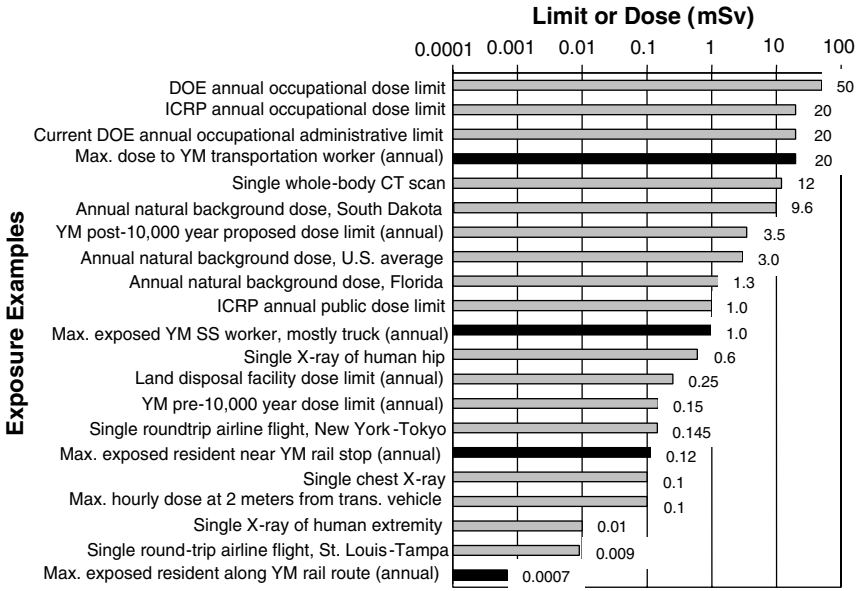

FIGURE 3.3 Graphical illustration of the radiation dose comparisons shown in Table 3.10. The dose data are plotted on a logarithmic scale to better illustrate the spread of values. Doses shown in the figure are annual limits (for standards and regulations) or exposures except for medical procedures and round-trip airline flights, which are one-time exposures. Black bars depict doses to workers or residents for the Yucca Mountain (YM) transportation program (SS = service station).

uncontrollable risk. In principle, people do have some control over the background dose they receive based on where they choose to live. In practice, however, the great majority of people probably do not explicitly include radiation dose considerations in decisions about where to live. Most people probably do not even know the average background radiation dose in their current location of residence.

Similarly, the radiation received by members of the public from a Yucca Mountain transportation program is also frequently viewed as involuntary and uncontrollable. Again, this is not completely true in principle; people have some control based on where they choose to live. In practice, however, it would be very difficult to make such a choice, given that transportation routes and schedules have not been established by DOE (see Chapter 5).

There is also a qualitative difference between natural background radiation and radiation from a Yucca Mountain transportation program. The former is natural, whereas the latter is the result of human activities. Although exposures to radiation from these two sources have identical bio-

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logical effects on living organisms, the committee recognizes that some people may view the acceptability of these exposures differently given their different origins.

Under the linear no-threshold risk model, background doses would be expected to elevate the risk of a fatal cancer.[49] The use of background radiation in risk comparisons has been criticized by some (e.g., MacGregor et al., 2002a,b) because it implicitly suggests that anthropogenic exposures of the same magnitude as background radiation are acceptable to society and it does not address the possible effects of cumulative exposures. The committee uses natural background radiation to give interested readers an established benchmark for making comparisons and makes no value judgments about the acceptability of doses at background levels.

Table 3.10 and Figure 3.3 also present the radiation doses received from a small number of common medical treatments. Comparisons using medical diagnostic procedures might be viewed by some people as inappropriate because the circumstances under which they are received are qualitatively different from spent fuel and high-level waste transportation: medical diagnostic procedures are voluntary and familiar and are widely perceived as having positive health benefits. The committee acknowledges these differences, but nevertheless decided to use medical procedures in its comparisons precisely because they would be familiar to many readers. The committee selected medical diagnostic procedures that represent relatively high, medium, and low radiation exposures to aid readers in making comparisons.

The entries in Table 3.10 and Figure 3.3 are arranged from high to low dose to provide a visual comparative ranking. This "risk ladder" is commonly used to display comparative information (Covello et al., 1989). Several noteworthy observations can be made. First, according to analyses presented in the final Yucca Mountain EIS (DOE, 2002a), maximally exposed workers (primarily transportation crews, escorts, and inspectors) for the Yucca Mountain transportation program (first column in Table 3.10) are assumed to receive annual doses at the limits of the current international standards and DOE administrative limits shown in the second column of the table. The final EIS (DOE, 2002a, p. 6-43) notes that "individual crew members who operated legal weight trucks and escorts for rail shipments could be exposed to as much as 48 rem over 24 years of operation (maximum exposure of 2 rem each year)." In practice, this probably means that DOE will monitor worker doses to ensure that they do not exceed these limits. These exposures will be about seven times higher than average annual natural background radiation doses and about twice as high as the dose received in a whole-body CT (computed tomography) scan.

[49]However, epidemiologic studies have not observed an association between background exposures and latent cancer incidence or fatalities.

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According to the final EIS, under the mostly truck scenario, the maximally exposed service station worker could receive a dose of about 1.3 mSv (130 mrem) per year, which would exceed current allowable dose limits to members of the public of 1.0 mSv (100 mrem) per year from all anthropogenic, nonmedical sources. The final Yucca Mountain EIS (DOE, 2002a, p. 6-40) notes that measures would be taken to keep this dose at or below the 1.0 mSv (100 mrem) limit. It should be noted that this worker dose estimate is very conservative: it assumes that every spent fuel and high-level waste truck shipment bound for Yucca Mountain stops at the service station during the 1800 hours the worker is on duty each year for 24 years.

Maximally exposed members of the public are estimated to receive substantially lower annual radiation doses from a Yucca Mountain transportation program as shown by the two bottom-most entries in the first column of the table. The maximally exposed resident near a rail stop (for the mostly rail scenario) would receive an annual dose of about 0.12 mSv (12 mrem). This is roughly equivalent to the dose from about one chest X-ray or one round-trip airline flight between New York and Tokyo. The maximally exposed resident near a rail route (again for the mostly rail scenario) would receive about 0.0007 mSv (0.07 mrem), which is about 6 percent of the dose received in an X-ray to a human extremity (e.g., hand or foot).

3.3.2 Transport Accident Risks

Given the robust construction of spent fuel transportation packages and the rigorous regulatory requirements for transporting them (Chapter 2), significant releases of radioactive material are very unlikely except possibly in extreme accidents, as indicated by the studies in Section 3.1.2. The final Yucca Mountain EIS estimates that the probability of such accidents is very low: 2.3 in 10 million per year for trucks to 2.8 in 10 million per year for trains (Table 3.8). This EIS also estimates exposures from releases in such accidents (Table 3.8): Estimated exposures in a maximally reasonably foreseeable accident would range from about 1100 person-rem for truck accidents to 9900 person-rem for train accidents. The maximally exposed individual is estimated to receive between 3 and 29 rem of radiation, which would be insufficient to cause acute radiation sickness or death. This exposure is estimated to produce between 0.5 and 5 latent cancer fatalities.

The committee provides a comparison of the potential consequences of extreme accidents involving spent fuel transportation packages with those for other types of hazardous materials transport using cumulative complementary distribution functions. The construction of these functions for accidents involving a loaded spent fuel package is described in Section 3.1.2.

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For this comparison, the committee used the mean CCDF for accidents involving rail transport of PWR spent fuel that was analyzed in the reexamination study (Sprung et al., 2000) and is shown in Figure 3.2. The committee compared this mean CCDF to those for accidents involving rail transport of three other kinds of hazardous materials: a flammable liquid (methanol), a flammable gas (propane), and a toxic gas (chlorine). These materials were selected because they behave differently under accident conditions and produce a wide range of consequences.

The CCDFs for these hazardous materials were estimated using a computer model that was designed to study the risks of hazardous materials shipments by rail.[50] The model was a joint effort of the Chemical Manufacturers Association (now the American Chemistry Council), the Association of American Railroads, and the Railway Progress Institute. The model was designed to be used by the participating associations and their member companies to evaluate changes to rail hazardous material transportation equipment, routings, and operating practices and to evaluate the effectiveness of options for reducing the risk of accident-caused hazardous material releases from tank cars through such changes. The model has not been published in the open literature, but it was peer reviewed during its development.

The overall model has two main components:

1. A frequency submodel that provides an estimate of the probability of occurrence and size of a release as a function of railroad operating factors (e.g., speed, track class) and tank car type
2. A consequence submodel that provides estimates of the consequences of a release of a defined volume of a specific chemical for human and/or environmental impact[51]

The model also has an extensive database that contains accident rates, benefits of risk reduction options, release probabilities, ignition probabilities, spill size distributions, basic sets of weather conditions, chemical properties for eight preselected materials, and other information needed to run the model. The eight materials included in the model are acetaldehyde, ammonia, chlorine, ethylene oxide, methanol, propane, sodium hydroxide, and styrene.

[50]Inter-Industry Rail Safety Task Force's Detailed Rail Model, Version 2.0, 1996.

[51]SuperChems™ is the consequence modeling package used within the model to generate the hazard zones for potential human impacts.

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The model is designed to run "projects." A project is defined by

- A hazardous material of interest,
- A designated type of railcar,
- A specified number of trips (trains) of interest, and
- A route, which includes information on length, track class, train speed, train length, number of hazardous material cars of interest per train, population density (for human impact) and/or soil type (for environmental impact).

Each route is generally subdivided into pieces, called segments, within which the variables listed above are essentially constant.

This model was used to calculate CCDFs for a single railcar carrying 20,000 gallons of three types of hazardous materials (chlorine, propane, and methanol) being transported in a general train with typical train speeds, track conditions, and train lengths. The number of shipments (100), the route lengths (about 1600 miles), and the population densities along the shipping routes were approximately the same for these three types of hazardous material shipments and the spent fuel shipments. The results should not be taken as exact estimates, but they are useful for comparison purposes.

The results of the calculations are plotted in Figure 3.4. The horizontal axis represents the number of expected fatalities from an accident having an annual frequency shown on the vertical axis. The CCDF for spent fuel shown on the figure was plotted by multiplying the mean CCDF curve shown in Figure 3.2 by a nominal probability coefficient of 5.75×10^{-2} fatal cancer per sievert (5.75×10^{-4} fatal cancer per rem)[52] (EPA, 1998b, Table 7.3).

Several features of this plot are noteworthy: First, the mean CCDF for chlorine has a relatively flat shape and has the highest accident frequencies and fatalities of the four cases examined. Chlorine gas is highly toxic and can be fatal if inhaled. Once released, gas can be dispersed widely by wind and can have adverse consequences even at relatively low concentrations. Thus, accidental releases can have adverse consequences even in lightly populated areas and can produce many casualties in densely populated areas.

Accidental releases of flammable gases such as propane can have similar consequences to toxic gas releases, but the expected number of fatalities is lower. The primary consequence of concern in a flammable gas release is an explosion or large fire. This requires an ignition source to be present when the proper fuel-air mixture is attained following the accident. The

[52]For low-dose, low linear energy transfer radiation, assuming uniform irradiation of the body. This nominal probability coefficient is age and gender averaged.

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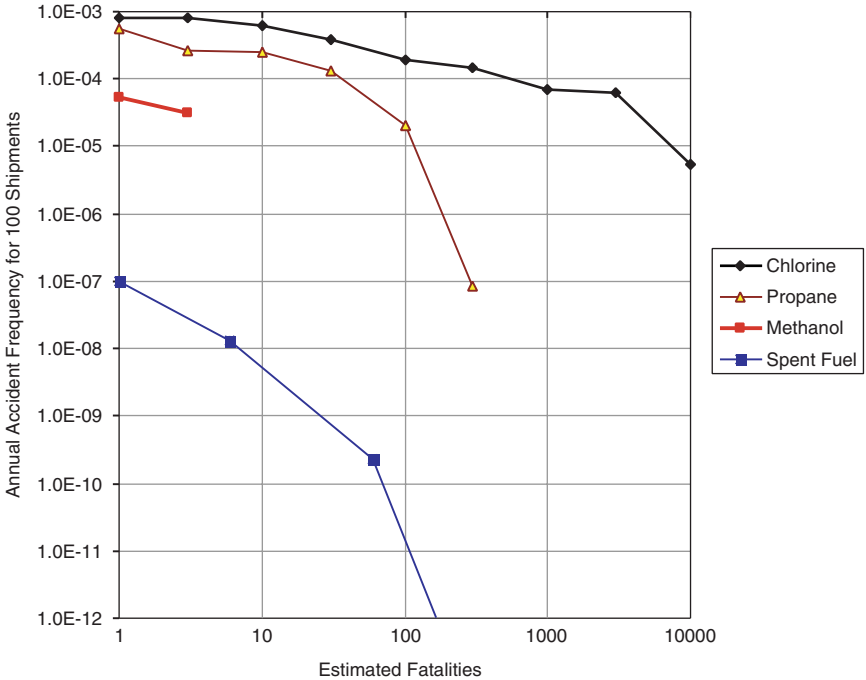

FIGURE 3.4 Complementary cumulative distribution functions showing expected fatalities from hypothesized accidents during transport of three types of hazardous materials and spent fuel. Calculations are explained in the text.

consequences of an explosion or fire will be more localized than a toxic gas release; hence, the expected fatalities from accidental releases are lower.

Accidental releases of flammable liquids such as methanol would be expected to have even fewer consequences. These consequences will generally be more localized to the area of the spill, and not all releases will yield fatalities. The mean CCDF is truncated at about three fatalities due to these localized effects.

The mean CCDF for accidental releases of radioactive material from spent fuel packages has the same general shape as the CCDF for propane. However, the frequency of accidents that lead to such releases is expected to be four to five orders of magnitude lower because of the robust construction of the transportation packages. Figure 3.4 shows that on a comparative basis, the likelihood of extreme accidents that would lead to fatalities is several orders of magnitude lower for spent fuel than for the other hazardous materials shown in the figure. In Section 3.1.2, the committee notes

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that the risk estimates provided in the reexamination study (Sprung et al., 2000) from which this CCDF was taken are likely to be neither realistic nor bounding and may overestimate the risks. In other words, the risk estimates for accidents involving spent fuel shown in Figure 3.4 may be higher than is actually the case.

3.4 TRANSPORTATION RISKS: FINDINGS AND RECOMMENDATIONS

The committee concludes this chapter with findings and recommendations in response to the first three charges of its original statement of task shown in Sidebar 1.1:

FINDING: There are two potential sources of radiological exposures from transporting spent fuel and high-level waste: (1) radiation shine from spent fuel and high-level waste transport packages under normal transport conditions; and (2) potential increases in radiation shine and release of radioactive materials from transport packages under accident conditions that are severe enough to compromise fuel element and package integrity. The radiological risks associated with the transportation of spent fuel and high-level waste are well understood and are generally low, with the possible exception of risks from releases in extreme accidents involving very long duration, fully engulfing fires. While the likelihood of such extreme accidents appears to be very small, their occurrence cannot be ruled out based on historical accident data for other types of hazardous material shipments. However, the likelihood of occurrence and consequences can be reduced further through relatively simple operational controls and restrictions and route-specific analyses to identify and mitigate hazards that could lead to such accidents.

RECOMMENDATION: Transportation planners and managers should undertake detailed surveys of transportation routes to identify potential hazards that could lead to or exacerbate extreme accidents involving very long duration, fully engulfing fires. Planners and managers should also take steps to avoid or mitigate such hazards before the commencement of shipments or shipping campaigns. (See also the recommendation to transportation regulators in Chapter 2 on operational controls and restrictions on spent fuel and high-level waste shipments to reduce the chances that such hazards might be encountered in actual service.)

The finding that "radiological risks . . . are well understood and are generally low" is based on a large set of observational data and studies described in this chapter and in Chapter 2. These include the following:

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- Rigorous international standards and U.S. regulations for the design, construction, testing, and quality assurance of spent fuel packages, including the built-in safety margin requirements for package designs (see Chapter 2); and more than four decades of worldwide experience in transporting spent fuel (Section 3.1). Although there have been accidents and incidents, to the committee's knowledge there has never been a large-scale release of radioactive materials reported from the failure of a spent fuel package during an accident. The broad sharing of information on experiences and best practices by transportation planners, implementers, and regulators through organizations such as the IAEA promotes the continued maintenance of this safety record.
- Full-scale crash testing of transport packages under severe accident conditions (Section 2.3). These tests show that properly constructed spent fuel packages can withstand severe accidents without a loss of containment that would result in releases of radioactive material that exceed regulatory limits. These tests also illustrate that the regulatory requirements for spent fuel packages (e.g., free-drop tests) produce in many cases more severe tests of package integrity than do severe accidents.
- A series of increasingly sophisticated analytical and computer modeling studies of spent fuel transport package performance (Section 3.1.2). The most recent of these studies (Sprung et al., 2000; DOE, 2002a) have attempted to estimate risks using actual spent fuel transport package, fuel, route, and severe accident characteristics and generally conservative assumptions and models.
- Other studies that examine the mechanical and thermal loading conditions from severe accidents that did not involve spent fuel transport (Section 2.2.3). These studies have shown that with the possible exception of very long duration fires, the loading conditions from these accidents would not have exceeded regulatory limits.

Of course, spent fuel transportation is not risk-free, and past experience is not necessarily a useful predictor of future performance. The fact that spent fuel transportation risks have been low in the past does not necessarily mean that risks will also be low in the future. Future risks depend on a number of factors including the quantities and ages of spent fuel transported, associated scaling issues related to the overall size of the transport program, transport modes, and the care taken in fabricating and maintaining transport packages and executing transportation operations. Ongoing vigilance by regulators and shippers will be essential for maintaining low-risk programs in the future, especially for the scale-up and operation of large-quantity shipping programs. Any accident or terrorist attack that results in the large-scale release of radioactive material into the environment would likely have worldwide implications and could result in a

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temporary or even permanent halt to ongoing transportation programs for spent fuel in the United States.

The recommendation calls for transportation implementers to survey the routes they plan to use for spent fuel and high-level waste to identify hazards that could lead to very long duration fires. This recommendation arises from the finding in Chapter 2 that very long duration, fully engulfing fires might produce thermal loading conditions sufficient to compromise package containment effectiveness. The recommended survey would involve traveling the route in advance of a shipment (or shipping campaign if several shipments are planned) to identify

- Facilities close to the route that use or store large quantities of flammable materials (e.g., refineries, petroleum and gas storage tanks);
- Large-volume flammable hazardous material shipments along the routes to be used; and
- Other route conditions (e.g., the presence of multitrack tunnels, bridges, rail yards, and sidings, as well as remote locations) that could make it difficult to deploy an effective firefighting capability.

Once these conditions have been identified, implementers can take steps to avoid or mitigate these hazards. For example, routes can be altered to avoid multitrack train tunnels, and time spent in rail yards and sidings, where packages could be exposed to other trains carrying large amounts of flammable materials, can be minimized. Where such hazards cannot be avoided completely, shipments can be scheduled to minimize encounters with other hazardous materials trains, or emergency response preparedness can be improved along specific route segments of concern.

The committee judges that none of these recommended survey and mitigation actions would be difficult or expensive to implement. Transportation implementers and regulatory authorities now routinely survey routes to identify other safety and security concerns prior to shipping spent fuel. This recommended action simply represents an expansion of an activity that many implementers already carry out on a routine basis.

FINDING: The *social risks* for spent fuel and high-level waste transportation pose important challenges to the successful implementation of programs for transporting spent fuel and high-level waste in the United States. Such risks, which can result in lower property values along transportation routes, reductions in tourism, and increased anxiety, have received substantially less attention than health and safety risks, and some are difficult to characterize. Current research and practice suggest that transportation planners and managers can take early proactive steps to characterize, communicate, and manage the social risks that arise from their operations. Such

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steps may have additional benefits: they may increase the openness and transparency of transportation planning and programs; build community capacity to mitigate these risks; and possibly increase trust and confidence in transportation programs.

RECOMMENDATION: Transportation implementers should take early and proactive steps to establish formal mechanisms for gathering high-quality and diverse advice about social risks and their management on an ongoing basis. The committee makes two recommendations for the establishment of such mechanisms for the Department of Energy's program to transport spent fuel and high-level waste to a federal repository at Yucca Mountain: (1) expand the membership and scope of an existing advisory group (Transportation External Coordination [TEC] Working Group; see Chapter 5) to obtain outside advice on social risk, including impacts and management; and (2) establish a *transportation risk advisory group* that is explicitly designed to provide advice on characterizing, communicating, and mitigating the social, security, and health and safety risks that arise from the transportation of spent fuel and high-level waste to a federal repository or interim storage. This group should be comprised of risk experts and practitioners drawn from the relevant technical and social science disciplines and should be convened under the Federal Advisory Committee Act or a similar arrangement to enhance the openness of its operations. Its members should receive security clearances to facilitate access to appropriate transportation security information. The existing federal Nuclear Waste Technical Review Board, which will cease operations no later than one year after the Department of Energy begins disposal of spent fuel or high-level waste in a repository, could be broadened to serve this function.

This finding and recommendation spring from several factors: Social risk is a poorly understood phenomenon; expert opinion frequently differs; DOE does not, to the committee's knowledge, have any precedent to guide its understanding and management of social risks; and most transportation program staff are not likely to be well acquainted with either theory or practice on this issue. Consequently, the committee concluded that broad input and advice on social risks will be essential to the establishment and ultimate success of programs to transport spent fuel and high-level waste to a federal repository or interim storage.

The recommendation represents pragmatic steps that transportation implementers can take immediately and at relatively low cost to better understand and (working with affected communities) manage the social risks from their programs. These groups are not intended to undertake research on risk. Instead, the committee intends that they have a practical, problem-solving focus and be committed to working closely with program

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staff to help it become more effective in carrying out the program's mission. One of the most important functions of these advisory groups would be to foster continuous learning and improvement.

The recommendation to expand the scope and membership of the TEC Working Group builds on and complements existing public participation and communication activities within DOE's transportation program for Yucca Mountain. The TEC Working Group is now comprised of state, tribal, local, and industry representatives, and it provides a conduit for communication and advice on topics such as emergency response, inspection and enforcement, training, and public information. The committee recommends that the membership of TEC be expanded to include social risk experts and representative stakeholders from affected communities to provide information on social risks of DOE's transportation operations and their management.

The committee also recommends the establishment of a separate transportation risk advisory group that would advise DOE on characterizing, communicating, and mitigating the social, security, and health and safety risks to communities near transportation routes. The suggestion that the Nuclear Waste Technical Review Board could be broadened to serve this function is intended to take advantage of an established capability within the federal government. This group is independent of DOE and its membership is drawn from the scientific and technical communities. The procedures for nominating and appointing members to this board (i.e., presidential appointments based on nominations by the National Academy of Sciences) are designed to ensure that it is balanced and credible to carry out its mission.

Finally, although this recommendation is focused primarily on DOE, it also applies to any large-quantity shipping program, including the program to ship commercial spent fuel to centralized interim storage (e.g., Private Fuel Storage, LLC, in Utah).

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4

Transport of Research Reactor Spent Fuel to Interim Storage

Since the 1950s, the Department of Energy (DOE), other federal civilian agencies, and U.S. universities have regularly transported spent nuclear fuel from research reactors[1] to DOE facilities. These shipments have passed through many regions of the country. These transportation programs have at times been controversial and have led to conflicts between DOE and state governments, and DOE has been compelled to revise and improve its practices regarding evaluation, planning, and consultation with states and tribes. This chapter responds to the U.S. Department of Transportation's (DOT's) request, as directed by congressional study charge (Sidebar 1.2), for the committee to examine the procedures that are followed in selecting routes for these shipments. The routing of research reactor spent fuel is also a good example of a "current concern" identified in the original statement of task for this study (Sidebar 1.1).

The first section of this chapter describes DOE's involvement in managing spent fuel from research reactors. The second section summarizes provisions of federal regulations governing transportation of spent nuclear fuel that are particularly relevant to the congressional study charge. DOE routing practices for research reactor spent fuel shipments are described in the

[1]As the term is used here, *research reactors* are small nuclear reactors used primarily to conduct research, to develop theoretical practices, and for education or medical purposes. Their output is typically a fraction of a percent of the output of a commercial electric utility reactor. They serve as sources of neutrons for spectrographic and radiographic applications and for the manufacture of isotopes for medical and other uses.

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third section, in the order presented in the study charge. The final section presents the committee's findings and recommendations.

4.1 DOE MANAGEMENT OF RESEARCH REACTOR SPENT FUEL

DOE has responsibilities for managing spent nuclear fuel from three categories of research reactors (Table 4.1):

1. Research reactors located at DOE facilities: there are two operating reactors, one at Oak Ridge National Laboratory in Tennessee (the High Flux Isotope Reactor) and one at Idaho National Laboratory (the Advanced Test Reactor).
2. Foreign research reactors located in 41 countries that use fuel manufactured in the United States from fissionable material provided by the U.S. government under the Atoms for Peace Program.
3. Research reactors operated by U.S. universities, U.S. government agencies other than DOE, and private-sector firms. All such reactors are required to be licensed by the U.S. Nuclear Regulatory Commission (USNRC). As of July 2005, there were 33 operating research reactors and 11 in the process of decommissioning (USNRC, 2005c) (Figure 4.1).

TABLE 4.1 DOE Research Reactor Spent Fuel Management Activities

Activity	Points of Origin[a]	Packages Shipped, 1996–2004	USNRC Approval of Shipment Route Required?	DOT Highway Routing Regulations Apply?
FRR spent fuel acceptance	2[b]	168	yes, by DOE policy	yes
Non-DOE U.S. research reactors	36	45[c]	yes	yes
DOE research reactors	2	93[b]	no	yes

NOTE: FRR = foreign research reactors. USNRC = U.S. Nuclear Regulatory Commission.

[a]Number of places within the United States where shipments of research reactor spent fuel originated.

[b]Charleston Naval Weapons Station and DOE Savannah River Site. Future shipments from Canada are also possible.

[c]Through 2002.

SOURCE: DOE (2004c); DOE Office of Environmental Management, written communication.

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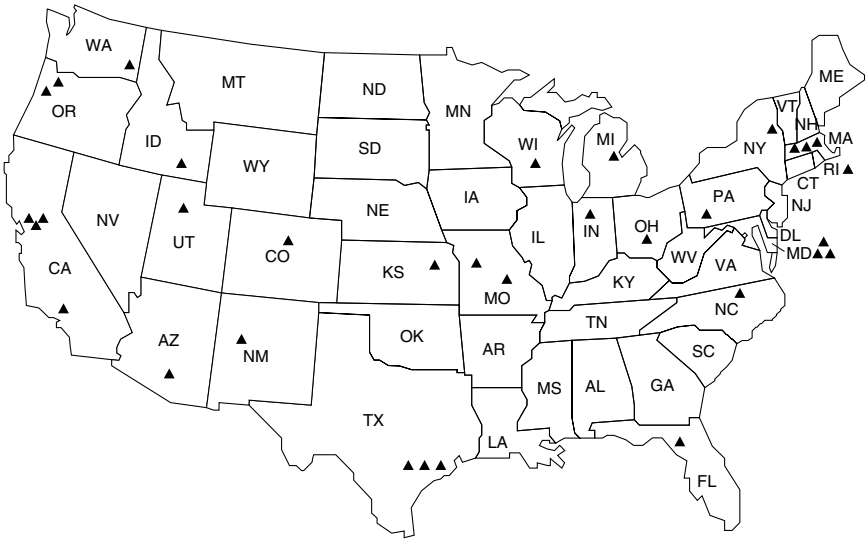

FIGURE 4.1 Sites of U.S. domestic non-DOE research reactors. SOURCE: Modified from USNRC (2003).

DOE provides interim storage for the spent nuclear fuel it receives from these reactors and is responsible for preparing that fuel for eventual shipment to a federal repository for disposal.

Research reactor fuel includes highly enriched uranium (HEU), fuel enriched in the fissile isotope uranium-235 to concentrations of 20 percent or greater, as well as low enriched uranium (LEU). By the 1970s, most research reactors in the United States and abroad were using HEU.[2] HEU fuel contains material that is potentially usable in nuclear weapons and is therefore a nuclear proliferation concern. Also in the 1970s, the United States began programs to promote the conversion of research reactors to LEU and to return all U.S.-origin HEU to the United States, with the goal of eliminating HEU in civilian applications worldwide (GAO, 1994, 2004a, pp. 10–11). Today, DOE transports and stores both HEU and LEU spent fuel from some foreign and U.S. research reactors (GAO, 2004a, pp. 11–22; 2004b, p. 28).

[2]HEU was used for applications that were thought not to be possible with LEU reactors. Use of HEU also allowed some economies, in part because less frequent refueling was required (GAO, 2004a, p. 10).

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Research reactor spent fuel is received and stored at two DOE facilities: the Savannah River Site in South Carolina and the Idaho National Laboratory. Savannah River stores research reactor spent fuel containing aluminum-uranium matrices and aluminum cladding. Idaho National Laboratory stores other types of spent fuel, for example, stainless steel-clad fuel with uranium-zirconium matrices.

Since 1996, between about 20 and 60 packages containing research reactor spent fuel have been shipped annually to Savannah River or Idaho National Laboratory. Foreign research reactor spent fuel accounts for about 55 percent of the packages shipped during this period (Figure 4.2). Domes-

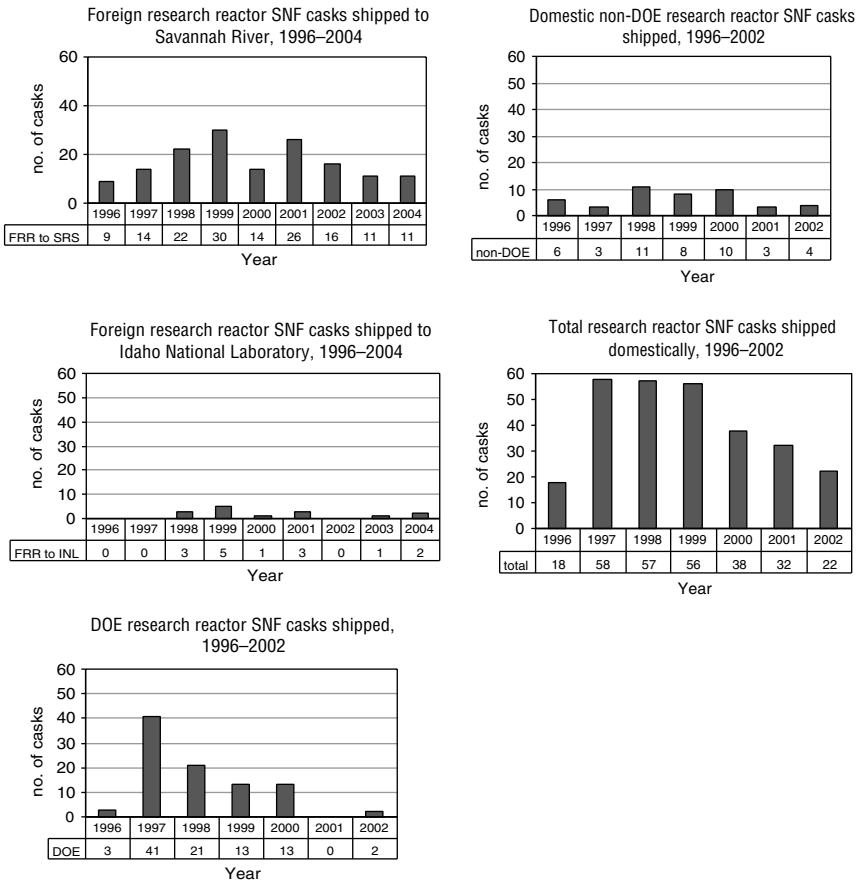

FIGURE 4.2 Numbers of research reactor spent fuel casks shipped domestically, 1996–2004. NOTE: SNF = spent nuclear fuel. SOURCES: DOE (2004c); DOE Office of Environmental Management, written communication.

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tic research reactor spent fuel is transported to Savannah River or Idaho by truck (Figure 4.3). Foreign research reactor spent fuel arrives from overseas at the Charleston Naval Weapons Station in South Carolina and is transported to Savannah River (141 packages by rail and 9 packages by truck during 1996–2004). Foreign research reactor spent fuel to be stored at Idaho National Laboratory is transported from Savannah River to Idaho National Laboratory (12 packages during 1996–2004, all by truck). In addition, three packages of foreign research reactor spent fuel that were landed at Concord Naval Weapons Station in California in 1998 were shipped to Idaho National Laboratory by rail. Also, three packages have been shipped from Canada to Savannah River by truck.

DOE has prepared Environmental Impact Statements (EISs) evaluating its management of research reactor spent fuel (DOE, 1995b, 1996a). These EISs and the Records of Decision (RODs) that followed (DOE, 1995c, 1996b) described the anticipated scope of DOE's research reactor spent fuel transportation activities (Table 4.2). Projections from the EISs indicate the

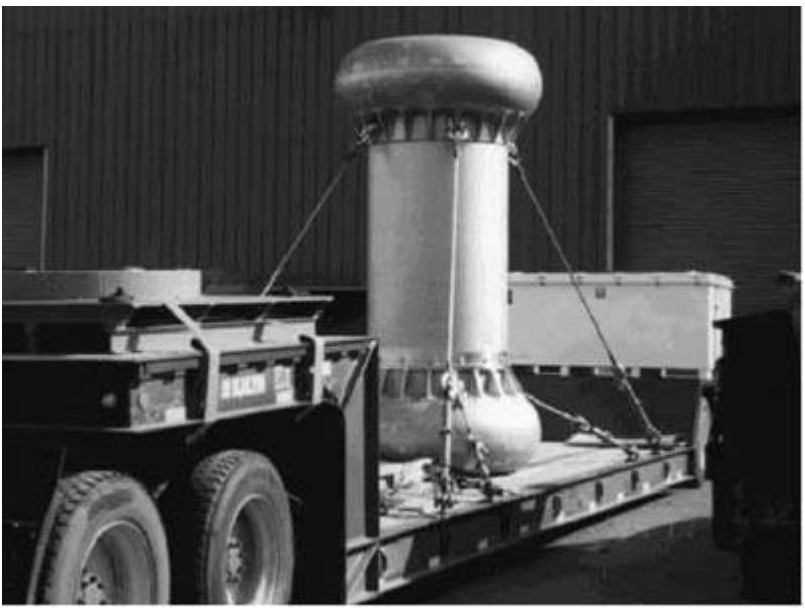

FIGURE 4.3 The package pictured above shows the GE Model-2000 package, which is used to transport research reactor spent fuel and other byproduct, source, or special nuclear materials. This package has a specially fabricated liner and basket for shipping High Flux Isotope Reactor spent fuel from Oak Ridge to the Savannah River Site. SOURCE: DOE (2001e).

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TABLE 4.2 EIS Projections of Quantities of Research Reactor Spent Fuel to be Shipped

	To be Shipped During Program[a]		
Origin of Spent Fuel	MTHM	Packages	Program Duration
Foreign research reactors			
Stored at SRS	19	815	1996–2019[b]
Stored at INL	1	162	1996–2019[b]
DOE domestic	1.8		1996–2035[c]
Non-DOE domestic	5.5		1996–2035[c]

NOTE: INL = Idaho National Laboratory; MTHM = metric tons of heavy metal; SRS = Savannah River Site.

[a]The quantities of actual shipments probably will differ considerably from these projections, which were prepared in 1995 and 1996.

[b]DOE originally scheduled the foreign research reactor program to end in 2009 (DOE, 1995b), but in 2004 DOE extended it to 2019 (DOE, 2004a).

[c]2035 is the planning horizon of the EIS but not necessarily the end of the programs.

SOURCES: DOE (1995b, Table 1.1; 1996a, p. S-21).

order of magnitude of expected shipments, but actual quantities will differ because of changes in the utilization of reactors and because some countries that received research reactor fuel from the United States have decided not to ship it back. By 2004, 29 percent of the quantity (measured in numbers of fuel assemblies) of foreign research reactor spent fuel receipts anticipated in the 1996 EIS had been shipped, but presently scheduled shipments would bring the total over the life of the foreign research reactor acceptance program to only about half the quantity projected in the EIS (DOE, 2005a).

Because research reactors are small compared to commercial power reactors, the sizes of shipments of research reactor spent fuel are also relatively small. Most types of transportation packages used for research reactor fuel have loaded weights of 40,000 pounds (about 18,200 kilograms) or less, small enough to be carried by a legal-weight truck (DOE, 2004b).

DOE, employing commercial carriers, is directly responsible for the transportation of spent nuclear fuel from its own research reactors and for transportation from Savannah River to Idaho National Laboratory. DOE oversees all aspects of the planning and conduct of shipments from Charleston Naval Weapons Station to Savannah River. However, in some cases, the shipper makes arrangements for contracting with a commercial carrier to transport the fuel. DOE does not arrange the shipment.

Shipment of spent nuclear fuel from U.S. university and other domestic research reactors, including selection of routes to comply with DOT regula-

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tions and submission of routes to the USNRC for approval as required by USNRC regulations (see Table 1.3), is the responsibility of reactor licensees and their commercial carriers. Because DOE plays no role in route selection for these shipments, this transportation activity is not within the scope of the congressional charge for the present study (Sidebar 1.2). However, the committee examined practices for these shipments because this experience is relevant to the problem of route selection and to the committee's original task statement (Sidebar 1.1) to identify technical and societal issues concerning spent fuel transport. The management of transportation of spent fuel from the two sources (foreign research reactors and U.S. university reactors) demonstrates two alternative organizational approaches: assigning responsibility to DOE versus leaving responsibility with the private owners of the fuel.

4.1.1 Controversies Regarding Shipment of Research Reactor Spent Fuel

The questions about DOE's routing practices that are embodied in the congressional charge arose as a result of past DOE shipments of research reactor spent fuel. A review of the history of some of these controversies is helpful in understanding the intent of the study charge.

Research reactor spent fuel was shipped in the United States for many decades in quantities equal to or exceeding present shipment rates with relatively little public attention. The first shipment of spent fuel from a foreign reactor under the Atoms for Peace Program occurred in 1958. However, in the 1980s, DOE was challenged in court by environmental organizations, states, and others for failing to comply with National Environmental Policy Act (NEPA) requirements for evaluation of potential impacts of its transportation activities. To justify its activities, DOE had relied on earlier EISs (USNRC, 1977; DOE, 1980) and other evaluations that had concluded that transportation of spent nuclear fuel is generically a safe activity with negligible environmental impacts. Complainants argued that DOE was required to perform analyses of the actual conditions for specific planned shipments and to evaluate alternative shipping routes. Some of the subsequent court rulings found that DOE analyses had been inadequate (DOE, 2002a, pp. 16–19). DOE suspended acceptance of foreign research reactor spent fuel from 1988 to 1994 while new analyses were prepared. In 1995 and 1996, DOE published EISs evaluating its management of research reactor spent fuel and other materials (DOE, 1995b, 1996a) and RODs defining new DOE policies for transporting and storing these materials (DOE, 1995c, 1996b). The contents of these EISs and RODs that are relevant to the committee's study charge are summarized below.

Before DOE's EIS studies were completed, the State of South Carolina challenged DOE plans to store foreign research reactor spent fuel at the

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Savannah River Site, which is located in the state. The state's primary concerns centered on the safety of indefinite storage of the spent fuel in South Carolina, rather than on transportation (Schill, 1996, 1997, 1998). The state filed three state lawsuits in federal court that were unsuccessful.

Following the publication of the foreign research reactor EIS (DOE, 1996a) and ROD (DOE, 1996b), the California State government criticized DOE's designation of the Concord, California, Naval Weapons Station as one of the ports of entry for foreign research reactor spent fuel. The state argued that DOE had failed to take into account analyses showing that alternative routes (using ports in Washington or Oregon) were safer than routes using Concord. The state had been one of the parties challenging DOE spent fuel transportation activities in the 1980s. However, the state decided not to take legal action in 1996, so the legal challenge of a California city and county to DOE's transportation plans failed (California, 1998).

Three packages of research reactor spent fuel from Korea were shipped through Concord and then onto Idaho National Laboratory by rail in July 1998. This shipment was made following discussions between DOE and the affected states and tribes concerning routes and other procedures and after extensive preparation of emergency responders along the route. Since 1998, all shipments of research reactor spent fuel from East Asia have arrived at Charleston Naval Weapons Station.

In 2001, DOE decided to send a shipment of three packages of foreign research reactor spent fuel from Savannah River to Idaho National Laboratory via Interstate 70 through Missouri. The state objected, as California had earlier, that DOE was not basing its routing decisions on comparisons of the safety of alternative routes. Missouri had not acquiesced to DOE's plan, announced in 1998, identifying three potential highway routes for shipments from Savannah River to Idaho National Laboratory. Cross-country shipments in 1999 and 2000 had avoided the state, traveling over the alternative route through Illinois and Iowa instead (see Figure 4.4). The development of the Savannah River-to-Idaho National Laboratory highway routes is described below.

DOE staff reported to the committee that for the 2001 shipment, DOE selected the route through Missouri at the insistence of the USNRC, because it was shorter than the Illinois-Iowa alternative route. The USNRC was insistent that travel time be minimized because one of the packages in the 2001 shipment was nearing the end of its design life. After DOE announced its intention to use the Missouri route in 2001, the state attempted to block use of the route by declaring that Interstate 70 was unsuitable for spent fuel shipments because of high accident rates and because of construction. The state argued that the route through Illinois and Iowa would be safer and questioned the basis for DOE's decision to switch to the Missouri route from the route used for the 1999 and 2000 shipments. A negotiated resolu-

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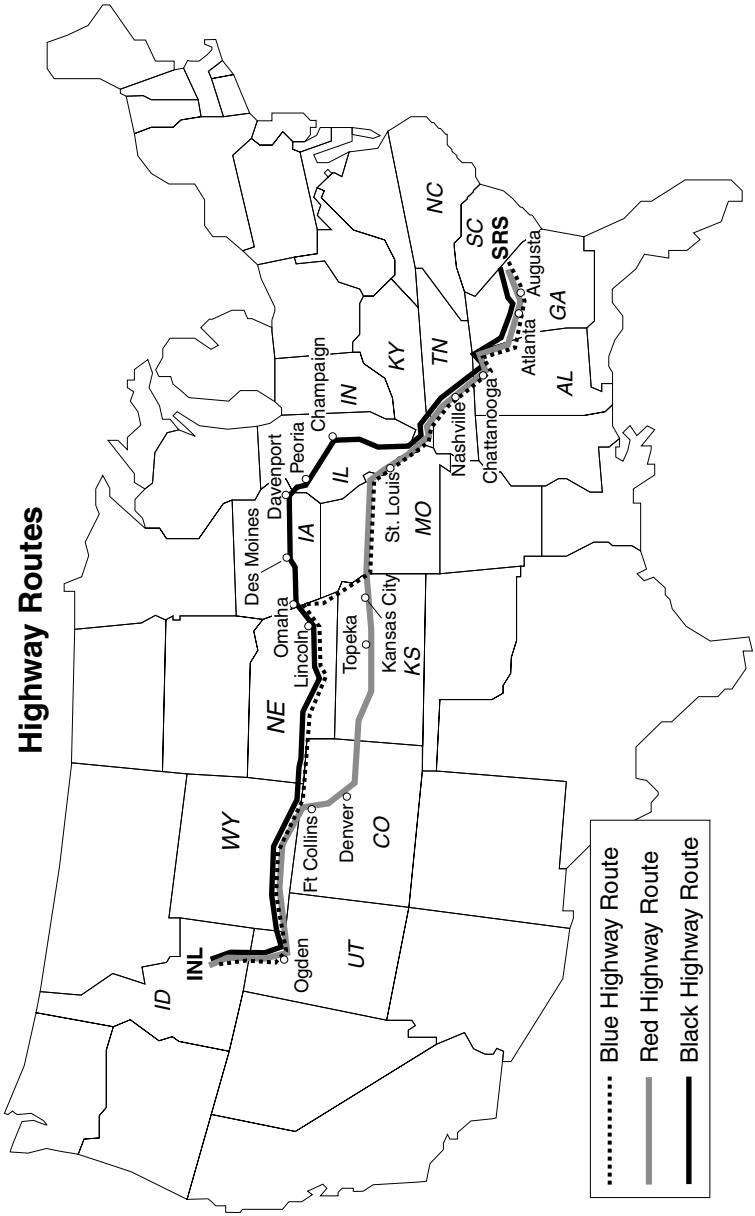

FIGURE 4.4 Highway routes for transportation of foreign research reactor spent nuclear fuel from the Savannah River Site to Idaho National Laboratory. SOURCE: DOE (2003a).

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tion was reached that allowed the shipment to proceed as originally planned with state cooperation. This agreement provided for special safety measures in Missouri, including additional vehicle inspections and escorts, training of state personnel, and scheduling to avoid city rush hours. The state later complained that DOE had not abided by all of these commitments, including the schedule for notifying the state, in its management of this shipment (Bell, 2001; DOE, 2001b,c; Holden, 2001; Shields, 2001).

In summary, the history of these controversies shows that states and others have challenged DOE to justify its selection of specific routes for its shipping campaigns. As the description of DOE route selection practices below indicates, DOE generally has not based route selection on quantitative comparisons of risks of alternative routes, but rather on application of the routing rules contained in DOT regulations, taking into account advice from states and tribes along potential routes.

4.2 REGULATIONS GOVERNING SELECTION OF ROUTES FOR SHIPPING SPENT FUEL

DOT and USNRC regulations that affect the selection of routes for domestic shipments of spent nuclear fuel are described briefly in Section 1.2.3. Certain provisions of these regulations, relating specifically to the route selection practices relevant to this chapter, are summarized below.

The DOT administers regulations governing the routing of highway shipments of spent nuclear fuel (49 CFR 397.101 and 397.103) that apply to any shipment of a quantity of radioactive material meeting the regulatory definition of "highway route controlled quantity." These require the following:

- The carrier must operate the vehicle containing the material only over "preferred routes." Preferred routes include all Interstate System highways (see Figure 1.1), except where the state has designated an alternative route to a particular Interstate System highway segment, and other state-designated routes.
- A state may designate a preferred route for transport of radioactive materials after it conducts a risk analysis and consults with neighboring states, and must notify DOT of the designation.
- Among preferred routes, the carrier must select the route that minimizes time in transit, except that the carrier must select Interstate System bypasses around cities unless the state has designated an alternative.
- The carrier may deviate from preferred routes only for security reasons (as specified in a required security plan or at the direction of the USNRC), for pickup and delivery of shipments, for rest stops, and for emergencies.

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- In traveling between the origin and a preferred route and from a preferred route to the destination, the carrier may select either the shortest-distance route or another route that minimizes radiological risk considering accident rates, transit times, population density, activities, time of day, and day of week, provided this route does not exceed the length of the shortest-distance route by more than 25 miles and is less than five times the length of the shortest-distance route.

Literal application of these regulations would practically dictate a unique highway route in many circumstances. The regulation does not explicitly require the carrier to consider risks of individual routes, except in the circumstance that the shortest-distance route is not chosen for travel to a designated highway from the shipment origin or from a designated highway to the destination.[3] Rather, the primary responsibility of the carrier is to keep to the designated preferred route system, and a burden is placed on the states to make whatever adjustments are necessary in the designated route system to ensure safety.

In a Notice of Proposed Rulemaking, DOT explained its justification for the routing regulation as follows (DOT, 1980, p. 7144): "In view of statistics showing lower accident rates and reduced travel times in travel on Interstate highways, this proposal favors use of the Interstate System. [DOT] believes that in most cases this policy will produce the most significant transportation safety impact reduction and it offers a clear standard for compliance and enforcement purposes." For quantitative support, DOT cites the USNRC's transportation EIS (USNRC, 1977; this EIS is described in Chapter 3 of this report), which, DOT states, determined that restricting carriers of large quantities of radioactive materials to Interstate System highways would be a cost-effective measure (DOE, 1980, p. 7149).

For rail shipments of spent fuel, there are no federal regulations governing route selection analogous to the highway routing regulations. As the following section on DOE's practices for shipping research reactor spent fuel describes, the absence of regulation has not meant in practice that railroads have selected routes for these shipments without government oversight. Historically, DOE has specified rail routes in its contracts with the

[3]The regulation states: "Except as provided in paragraph (b) of this section [which requires the carrier to operate on preferred routes and to minimize travel time] . . . , a carrier . . . operating a motor vehicle that contains [a highway route controlled quantity of radioactive material] . . . shall: (1) Ensure that the motor vehicle is operated on routes that minimize radiological risk; (2) Consider available information on accident rates, transit time, population density and activities, and the time of day and the day of week during which transportation will occur to determine the level of radiological risk . . . ." Therefore, following preferred routes will always comply with the regulation, although the carrier apparently is required in addition to consider time of day and activities along the route in planning the shipment.

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railroads. The states lack the authority over rail routes that federal regulations give them over highway routes, although DOE has consulted the states on rail route selections.

USNRC regulations (10 CFR 73.37) require that any licensee shipping spent nuclear fuel exceeding a threshold quantity obtain the USNRC's approval of shipment routes. Normally, the transportation services contractor arranging a spent fuel shipment submits the planned route for USNRC review. USNRC approval of a route is valid only for shipments by the party submitting the application and for a term of two years. Rail as well as highway routes must be submitted for review.

The USNRC route review is among the regulatory requirements intended to "minimize the possibilities for radiological sabotage . . . [and] . . . [f]acilitate the location and recovery of spent fuel shipments that may have come under the control of unauthorized persons" (10 CFR 73.37 (a)). The regulation does not specify the security factors that the USNRC takes into account in its review. USNRC staff reported to the committee that proposed routes are examined in detail and that the review considers travel time and distance and, for highway shipments, adequacy of provisions for safe havens, that is, preplanned locations where the vehicle may stop in case of an emergency and receive protection by police or other security forces.

Shipments of spent fuel made directly by DOE or by contractors to DOE are not legally subject to USNRC regulations because DOE is not a licensee. The regulations do apply to shipments performed by non-DOE operators of research reactors, including universities, private firms, and other government agencies. These operators are USNRC licensees. Certain domestic shipments of foreign research reactor spent fuel are carried out by contractors to the foreign operators of the research reactors, and these are subject to USNRC regulations as well. For shipments of foreign research reactor spent fuel carried out by DOE contractors, DOE as a matter of policy seeks USNRC approval of the routes (DOE, 2003a, p. 6; DOE, 2003b, p. 4).

4.3 SELECTION OF ROUTES FOR SHIPPING RESEARCH REACTOR SPENT FUEL

As specified by the Congress, the charge in this task (Sidebar 1.2) is to analyze how DOE

- Selects potential routes for shipment of research reactor spent fuel to DOE facilities;[4]

[4]The congressional study charge refers to shipments "between or among" DOE facilities. This language could be interpreted as limiting the charge to shipments from Savannah River

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- Selects a route for a specific shipment;
- Assesses risks of such a route; and
- Considers proximity to population, current traffic and accident data, road quality, emergency response capabilities, and proximity to gathering places.

The questions about routing of shipments of research reactor spent fuel, and also the points of contention in the controversies about specific shipments that led to the congressional request for this study, focus on methods of comparing risks of the selected routes with risks of alternatives and the use of such comparisons in routing decisions.

The steps that were followed by DOE to select routes for shipment of foreign research reactor spent fuel are the same steps that DOE expects to follow in its program to ship commercial spent nuclear fuel to a federal repository: first, development of a plan for the program that identifies sets of potential or candidate routes and, then, selection of a specific route at the time of each shipment, with each step guided by, among other considerations, an assessment of the risks of the favored routes versus alternative routes and modes. These steps are dictated by DOE's general policies regarding transportation of spent nuclear fuel (DOE, 2002b) and are consistent with DOE statements concerning its plans for selecting routes for shipping spent fuel to a federal repository (see Chapter 5). DOE's experience with research reactor spent fuel shipments therefore has general relevance to commercial spent fuel transportation, although the relevance is limited because the scales of the two activities differ greatly. The foreign research reactor spent fuel transport program is a small-quantity shipping program, whereas the transport program to the federal repository will be a large-quantity shipping program (see glossary, Appendix D).

The subsections below address the questions posed to the committee in the congressional study charge: The first is about procedures for selecting potential routes; the second, about selecting routes for specific shipments; and the third, about consideration of population, traffic, accident, and emergency response capabilities in route selection. DOE's methods of assessing risk are described in each of these subsections. The descriptions refer primarily to procedures for selecting routes for shipping spent fuel from foreign research reactors, which is the largest category of shipments for which DOE has direct responsibility (see Table 4.1 and 4.2). The final

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to Idaho National Laboratory or from Oak Ridge National Laboratory to Savannah River or Idaho National Laboratory. Such shipments constitute only a minority of all domestic shipments of research reactor spent fuel. The committee decided to consider routing practices for all domestic research reactor spent fuel shipments as explained previously.

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subsection identifies differences in practices for transport of spent fuel from domestic research reactors.

4.3.1 Potential Routes: Foreign Research Reactor Spent Fuel

DOE has identified the following potential routes for shipments of foreign research reactor spent fuel from Charleston Naval Weapons Station to the Savannah River Site, from Savannah River to Idaho National Laboratory, and from Concord Naval Weapons Station to Idaho National Laboratory:

- Three alternative highway routes from Savannah River to Idaho National Laboratory (Figure 4.4), named the blue, red, and black highway routes and published in DOE's transportation plan for foreign research reactor spent fuel shipments from Savannah River to Idaho National Laboratory (DOE, 2003a, Appendix 8.1). The plan specifies each road segment and junction on the routes.
- Preferred and alternate rail routes and one highway route from Charleston Naval Weapons Station to Savannah River published in the DOE transportation plan for foreign research reactor spent fuel shipments between these points (Figure 4.5) (DOE, 2003b, Appendix 8.1).
- Preferred and alternate rail routes and one highway route from the Concord Naval Weapons Station in California to Idaho National Laboratory announced in advance of the shipment that departed from Concord in 1998 (Figure 4.6) (Nevada, 1997; California, 1998).

These routes were evaluated and published well in advance of shipments, with the intent that routes for specific shipments occurring over a period of years would be selected from among these potential routes. In addition to shipments on these routes, highway shipments of research reactor spent fuel from Canada to Savannah River occurred in 1996 (one package) and 2000 (two packages). No future shipments from Canada are planned at this time (DOE, 2004c, 2005a).

The milestones in development of these potential routes were as follows:

- The EIS on foreign research reactor spent fuel (DOE, 1996a), which identified and evaluated representative truck and rail routes between 10 potential ports of entry and five potential DOE storage sites.
- The ROD on the foreign research reactor spent fuel management program (DOE, 1996b), which identified two ports of entry and two storage sites and declared that the preferred transport mode would be rail.
- Discussions of potential routes with states and tribes through two working groups formed in 1996: the Cross Country Transportation Work-

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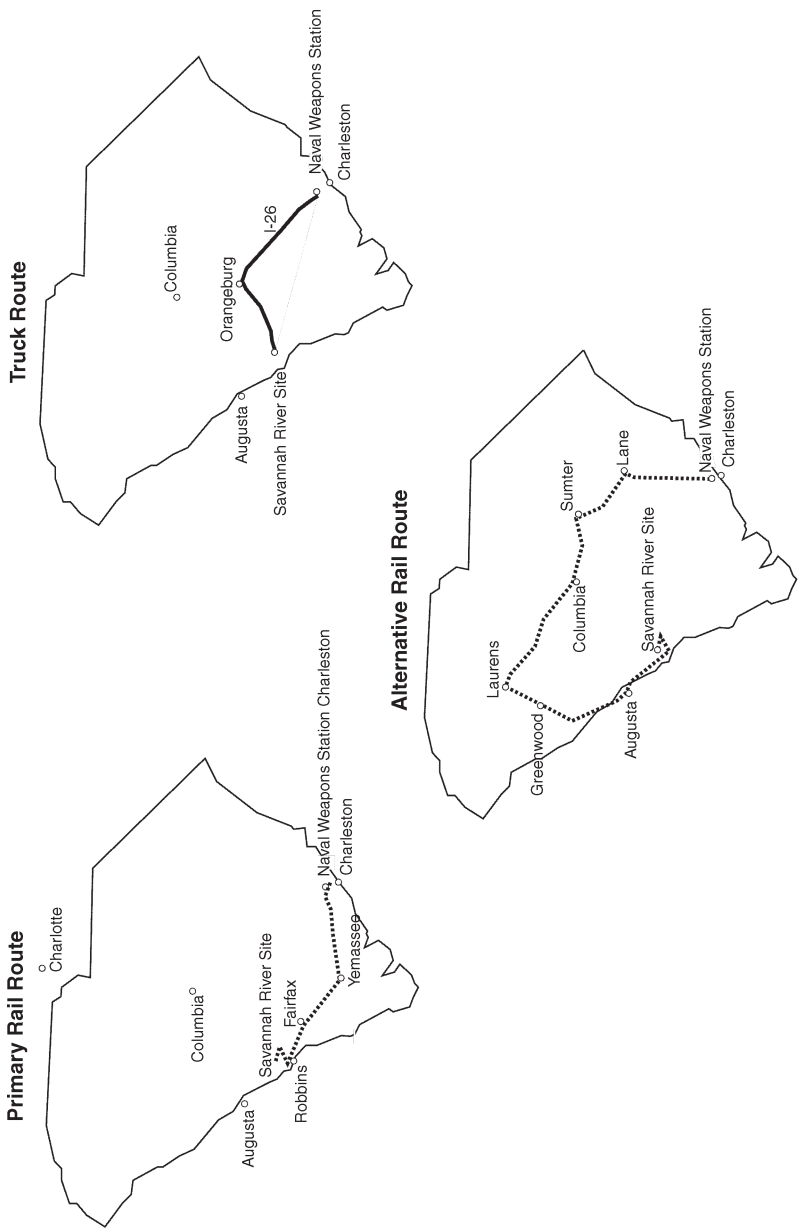

FIGURE 4.5 Highway and rail routes in South Carolina for transportation of foreign research reactor spent nuclear fuel from Charleston Naval Weapons Station to the Savannah River Site. SOURCE: Modified from DOE (2003b).

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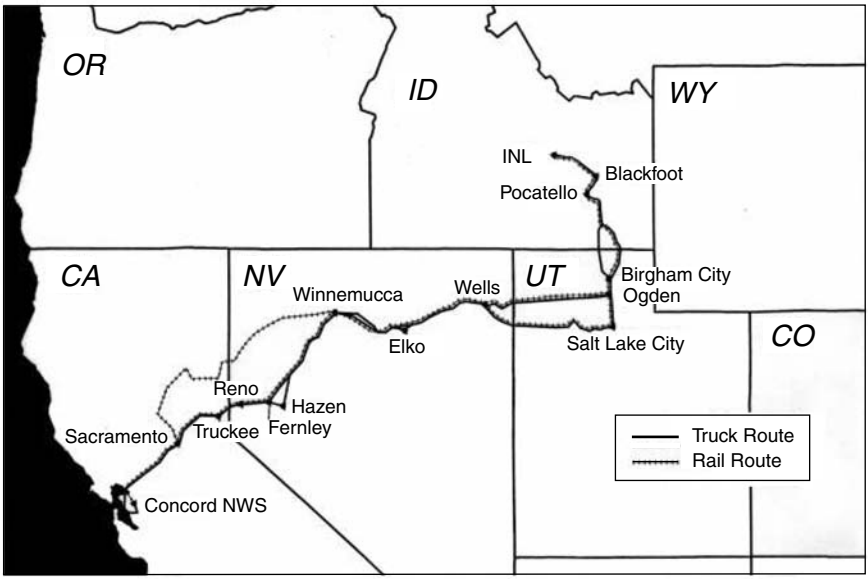

FIGURE 4.6 Highway and rail routes for transportation of foreign research reactor spent nuclear fuel from Concord Naval Weapons Station to Idaho National Laboratory. SOURCE: Nevada (1997).

ing Group, dealing with shipments from Savannah River-to-Idaho National Laboratory, and the Foreign Research Reactor Spent Nuclear Fuel Transportation Working Group, dealing with shipments from Charleston to Savannah River. Similar discussions took place between DOE and the affected states and tribes concerning the Concord-to-Idaho National Laboratory route.

- Publication of transportation plans for shipments from Charleston to Savannah River in 1996, with updates in 1998 and 2003 (DOE, 2003b), and publication of plans for shipments from Savannah River to Idaho National Laboratory, most recently updated in 2003 (DOE, 2003a), specifying the potential routes as well as procedures for scheduling, advance information, and safety and security en route.

Route Assessments in the EIS and ROD

The 1996 EIS evaluated the risks of transportation of foreign research reactor spent fuel over "representative routes," by truck and rail, from

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Charleston to Savannah River, Savannah River to Idaho National Laboratory, and Concord to Idaho National Laboratory, as well as other pairs of origins and destinations that were later eliminated from consideration (DOE, 1996a, Appendix E). The risk assessment evaluated specific highway and rail routes, but the selection of routes for evaluation was not intended to indicate that the evaluated routes would necessarily be used for shipments. The EIS states that "specific routes cannot be identified in advance because the route would not be finalized until it had been reviewed and approved by the [US]NRC. The selection of the actual route would be responsive to environmental and other conditions . . . at the time of shipment" (DOE, 1996a, p. E-21).

The routes evaluated were chosen using two models, HIGHWAY and INTERLINE. These employ databases characterizing the highway and rail networks, respectively, with information on speed and distance for each link in the networks and population densities adjacent to each link. The models can be used to search for routes that minimize time or distance traveled (or some function of distance and time) between a specified origin and destination. Highway routes are constrained to comply with DOT regulations regarding use of the Interstate System highways or state-designated alternate preferred routes, use of Interstate System bypasses around cities, and minimizing the distance traveled between origin and destination points and the Interstate System highway (DOE, 1996a, p. E-33).

The risk of fatalities during transport of foreign research reactor spent fuel was estimated in the EIS using RADTRAN (described in Section 3.1.2 and Sidebar 3.4). The model, which was developed by Sandia National Laboratories, can be used to estimate the expected health consequences of human exposures to radiation during routine transport and in severe accidents. The model also can be used to estimate the expected number of conventional fatalities (i.e., vehicular and pedestrian fatalities) during transportation.

RADTRAN was used to estimate the expected fatalities for the entire foreign research reactor shipping program, based on the quantities of materials and numbers of shipments projected in the EIS, for a scenario in which all shipments are transported by truck and with fuel destined for Idaho National Laboratory or Savannah River according to fuel type (DOE, 1996a, Tables E-14 and E-17). The estimates are as follows:

- Fatalities from routine transport: 0.1 to 0.2 LCF (latent cancer fatality)
- Fatalities from releases in severe accidents: 10^{-5} to 10^{-4} LCF
- Conventional fatalities: 0.05 to 0.1 expected fatality

On the basis of these estimates, DOE concluded that "the Final EIS demon-

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strates that the spent fuel and target material could be safely transported overland within the United States by either truck or rail . . ." (DOE, 1996b, Sec. VII).

The EIS risk analysis did not seek minimum-risk routes or compare the risks of alternative routes or modes between origin-destination pairs. Truck-versus-rail comparisons may be derived from the results presented, but DOE evidently did not regard the differences in risks as significant. DOE states in its ROD that it "will generally seek to use rail" because "there appears to be a strong preference by some members of the public in the port areas for the use of rail" (DOE, 1996b, Sec. I, IX), rather than on the basis of a comparison of truck and rail risks. In response to public comments about the absence of route specifications in the EIS, DOE explains that "conditions could well change [by] the time the shipments would be made. . . . Selection of the actual route would be accomplished in consultation with the affected States, Tribes, local officials, and the carrier . . ." (DOE, 1996b, Sec. VI).

State Working Groups and Transportation Plans

After publication of the ROD, DOE convened two state working groups to serve as forums for consultation with the states and tribes along potential foreign research reactor shipping routes from Charleston to Savannah River and from Savannah River to Idaho National Laboratory. The consultations were to cover road conditions, emergency response capabilities and needs, and any specific state highway route designations. This approach followed the model of consultation on radioactive waste transportation that had been developed for earlier DOE activities, especially the Waste Isolation Pilot Plant (WIPP) program (see Section 5.2.2).

The Foreign Research Reactor Spent Nuclear Fuel Transportation Working Group addressed plans for transportation from Charleston to Savannah River and involved South Carolina officials from health, law enforcement, and emergency response agencies. It was organized with the cooperation of the Southern States Energy Board, an organization formed by an interstate compact of 16 southeastern states providing for cooperative energy and environmental programs.

For highway transportation in South Carolina, DOE originally proposed to the working group the predominantly Interstate System route dictated by DOT routing regulations. This route had been evaluated in the EIS (DOE, 1996a, p. E4) and cited in the Web version of the ROD (DOE, 1996c). The state rejected this route because it is indirect, passes near the urban areas of Columbia and Augusta, and includes an interchange with a high accident frequency. The state proposed another highway route, which was adopted in the Charleston-Savannah River transportation plan (DOE,

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2003b, Appendix 8.1). The alternate route follows mostly roads other than Interstate System highways but is shorter than the Interstate System route, avoids the cities of Columbia and Augusta, and avoids the high-accident interchange. DOT has not published this route as a state-designated preferred route. Selection of the alternate route appears to have been based primarily on the local knowledge and professional judgment of the officials involved, although state officials report that a comparison of accident rates on the routes was carried out.

Because the 1996 ROD had declared that rail would be the preferred mode, the DOE-South Carolina working group began by developing procedures for rail shipments. Whereas the states have authority under federal law to regulate highway routes of spent fuel shipments, they have no legal control over rail routes. Nonetheless, primary and alternate rail routes for Charleston-Savannah River shipments (Figure 4.4), as well as safety procedures, were defined by DOE after consultation with the state and discussions involving the railroad and the Federal Railroad Administration. Rail shipments have been by dedicated train, with routes specified in DOE contracts with the carrier. It is part of DOE's arrangement with the state that rail will be used for all shipments from Charleston to Savannah River except that truck may be used when four or fewer packages are awaiting transport. Since 1996, 20 of the 23 shipments from Charleston to Savannah River (most comprising multiple packages) have been by rail.

To consult with the states and tribes on Savannah River-to-Idaho National Laboratory shipments, DOE convened the Cross-Country Transportation Working Group, with support from the Southern States Energy Board and the Council of State Governments-Midwestern Office, an association of midwestern states that coordinates those states' interactions with DOE on radioactive materials transportation. The membership of the working group included representatives of 17 states, two tribal nations, the state regional organizations, and federal agencies (Huizenga et al., 1999). At DOE's request, the state members were gubernatorial appointees.

DOE initially proposed four highway routes to the group, developed with the HIGHWAY model and similar to the "representative routes" in the EIS. These routes were modified according to recommendations of working group members, and one of the four (the green route, departing South Carolina to the north, through North Carolina) was eliminated because of the group's concerns about weather and terrain. Some of the state recommendations were based on more detailed examinations of the physical characteristics of the routes than DOE had carried out. For example, South Carolina recommended an improved access route from Savannah River to the Interstate System. The states also favored routes that had been used earlier for radioactive waste shipments, because emergency responders along these routes had already received training.

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During this consultation process, DOE analyzed the transportation risks of the alternative routes using RADTRAN (Weiner and Mills, 1999) and presented the results to the working group. These show small differences among the routes in risks of radiation exposure (ranging from 1 LCF in 10 million trips for the route with the lowest radiation risk to 1 LCF in 6 million trips for the route with the highest risk) and of truck accidents (ranging from 1 fatal truck accident in 16,000 trips to 1 truck accident in 13,500 trips). There is no indication that these estimates had any influence on the initial specification of the routes or on subsequent selection of routes for individual shipments. The green route, the route dropped from consideration because of objections from several states, appears in the RADTRAN estimates to have the lowest risk of radiation exposure fatalities, because it has the lowest total population in proximity to the route, and the second lowest risk of fatalities from truck crashes. It should be noted that many of the working group objections to DOE route proposals arose from particular local conditions that are not taken into account in the RADTRAN estimates. For example, RADTRAN uses state-level average truck accident rates rather than rates specific to individual highway sections.

The understandings that DOE reached with the states and tribes in the working groups regarding routes and transportation procedures for foreign research reactor shipments to Savannah River and Idaho National Laboratory were documented in the two transportation plans (DOE, 2003a, 2003b). These include the following:

- Maps specifying the highway and (for shipments from Charleston to Savannah River) rail routes to be used
- Definitions of the responsibilities of all federal and state agencies involved and of commercial carriers
- Specification of advance notification and shipment tracking practices
- Specification of additional safety practices, including state-by-state vehicle inspection procedures and use of dedicated trains for rail shipments
- A public communications plan
- An emergency response plan that specifies the responsibilities of the parties in the event of an incident during transport
- In the plan for shipments from Savannah River to Idaho National Laboratory, a list of special events and of urban areas with rush hours that the states and tribes asked DOE to avoid in scheduling shipments; DOE agreed to minimize conflicts and to notify the state if a conflict were to arise

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4.3.2 Routes for Specific Shipments: Foreign Research Reactor Spent Fuel

All recent and currently planned domestic foreign research reactor spent fuel shipments have been from Charleston to Savannah River or from Savannah River to Idaho National Laboratory. Packages destined for Idaho National Laboratory normally would arrive at Charleston by sea, be shipped by rail or truck to Savannah River, and remain at Savannah River no more than a few days before being shipped by truck to Idaho National Laboratory (DOE, 2003a, p. 9). Selection of a route for a specific shipment therefore entails deciding which of the potential routes published in the two DOE plans for these movements (DOE, 2003a,b) will be used, and checking to determine if any immediate circumstances require modifying the route.

A transportation services contractor organizes transport and all related activities, with oversight from DOE. For shipments originating in high-income economy countries,[5] the foreign reactor operator hires the contractor. For shipments from other than high-income economy countries,[6] DOE hires the contractor. The contract specifies that transportation must comply with the provisions of the DOE transportation plan (DOE, 2003a, pp. 5–9). The contractor is responsible for obtaining approval of the intended route from the USNRC, according to the regulatory requirements of 10 CFR 73.37.

DOE officials reported to the committee that in selection of routes for specific shipments, the following factors are considered:

- DOT highway route selection regulations
- State and tribal advice regarding
  —Road conditions and construction zones
  —Planned events (e.g., sporting events or festivals)
  —Emergency response and radiological training needs
  —Shipment and truck inspection requirements
  —Rush hour periods through cities
- RADTRAN accident analysis
- Shipment schedule, particularly the season of the year

[5]DOE (1996b) identifies the following countries as high-income economy countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Israel, Italy, Japan, Netherlands, Spain, Sweden, Switzerland, Taiwan, and United Kingdom.

[6]DOE (1996b) identifies the following as other than high-income economy countries: Argentina, Bangladesh, Brazil, Chile, Colombia, Greece, Indonesia, Iran, Jamaica, Malaysia, Mexico, Pakistan, Peru, Philippines, Portugal, Romania, Slovenia, South Africa, South Korea, Thailand, Turkey, Uruguay, Venezuela, and Zaire.

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- Number and type of packages to be shipped
- Possibility of coordination of the foreign research reactor shipment with shipments from DOE or university facilities
- Any other factor that could affect shipment transit time

DOE reported that the route selection process leads to a recommendation to the Assistant Secretary for Environmental Management for approval.

4.3.3 Consideration of Risk Factors: Foreign Research Reactor Spent Fuel

The study charge asks how route selection takes into account proximity to populations, traffic and accident data, road conditions, emergency response capabilities, and proximity to gatherings. These characteristics of individual trips all affect risk. They depend on the schedule of the trip (time of day, day of the week, and season) as well as the route.

DOE's practice, in dealing with states and tribes through working groups devoted to foreign research reactor spent fuel transportation, has been to place responsibility for detailed review of highway routes on the states and tribes. In particular, DOE has relied on the states' and tribes' local knowledge of accident rates, road and traffic conditions, and public events. Assigning this responsibility to the states is consistent with DOT highway routing regulations, which give states authority to designate preferred routes.

For rail routing, some general guidelines in DOE's *Radioactive Material Transportation Practices Manual* (DOE, 2002c, p. 16) state that DOE is to consider track quality (including guidance from the Association of American Railroads concerning rail lines suitable for carrying spent fuel and other hazardous materials) and "operational input from carriers," and to consult with states and tribes on rail routes. DOE would primarily be dependent on carriers for information on line conditions that would affect safety.

DOE's quantitative risk analysis of representative routes in the 1996 EIS takes into account population density along the routes, but the risk estimation procedure does not employ data for specific road segments about traffic condition, accident rates, road quality, or places of public gatherings or about analogous factors for specific rail lines. These factors have been explicitly addressed in DOE's consultation with the states and tribes. The foreign research reactor transportation plans (DOE, 2003a,b), developed cooperatively with the states and tribes, place responsibility on the states and tribes to identify particular conditions that would affect the safety of a route proposed for an individual shipment. During development of the plans, state officials recommended adjustments to the potential routes based

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on their knowledge of accident histories and traffic conditions at specific locations. The plan for truck shipments to Idaho National Laboratory lists events, public gatherings, and other circumstances along the routes and stipulates that shipments will avoid "major" special events (DOE, 2003a, p. 11). According to the descriptions of the consultative process presented to the committee by the involved parties, decisions on adjustments to routes and schedules arising from consideration of these factors have sometimes been made without benefit of supporting quantitative analysis.

4.3.4 Domestic Research Reactor Spent Fuel

Foreign research reactor spent fuel transportation is an ongoing program managed directly by DOE. The program conforms to detailed published plans and has received considerable scrutiny in the press, from interest groups, and from the state-federal working groups. Transportation of spent fuel from university and other domestic research reactors, in contrast, is a decentralized activity, managed by individual reactor operators. Each operator is responsible for arranging for transportation from its site to a DOE facility and for ensuring that DOT and (for shipments from non-DOE domestic reactors) USNRC regulations are complied with. Perhaps because of this structure, spent fuel transport from domestic research reactors seems rarely to have been a focus of controversy. Thus, for example, while a single shipment of foreign research reactor spent fuel across Missouri in 2001 led to a federal-state confrontation, the University of Missouri research reactor has shipped spent fuel to Savannah River several times a year for many years without comparable notice.

A university that plans to ship spent fuel from a research reactor that it operates will usually contract with a transportation services firm to arrange all aspects of the shipment. The firms that undertake this work are the same firms that contract with DOE to handle its shipments, because the work requires special equipment and expertise. The contractor selects the route for shipment and submits it to the USNRC for approval. The USNRC review checks for compliance with DOT routing regulations (all shipments in recent years from domestic research reactors have been by truck) and with USNRC's own security requirements. USNRC publishes approved routes. To satisfy USNRC security and notice requirements as well as state procedures, the contractor must coordinate with state public safety officials to arrange for inspections, escorts, permits, and any other special state requirements. Some universities have acted as their own prime contractor, selecting routes themselves and dealing directly with jurisdictions along the routes, and have employed a contractor solely for transportation.

For domestic university research reactor shipments, there is no published plan analogous to the plans DOE prepared for shipments from

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Charleston to Savannah River and Savannah River to Idaho National Laboratory (DOE, 2003a, 2003b) and no formal standing multistate working groups have been organized. DOE did consider representative routes between university reactors and DOE facilities in its 1995 EIS on spent fuel management (DOE, 1995b), although that analysis did not compare risks for alternative routes.

DOE has shipped research reactor spent fuel from its facilities at Oak Ridge National Laboratory in Tennessee to Idaho National Laboratory and to Savannah River. Transportation plans have been prepared for these shipments following a format similar to that of the foreign research reactor spent fuel transportation plans. The plans were submitted to the states for comment. DOE procedures for preparation of these plans, including the outline of the plans' contents and provision for state review, are specified in DOE's *Radioactive Material Transportation Practices Manual* (DOE, 2002c).

4.3.5 Discussion

In the committee's judgment, DOE's procedure for selecting transportation routes in the foreign research reactor spent fuel program appears on the whole to be adequate and reasonable. The elements of this procedure have been the following:

- A quantitative risk analysis of representative routes and alternative modes is conducted as part of an EIS, to judge whether the transportation activity meets a threshold standard of acceptable safety (but not for the purpose of choosing among alternative routes). In the case of research reactor spent fuel, these evaluations have always concluded that risks are very low.
- Potential routes are identified following DOT regulations (for highways) in consultation with states and tribes and in discussions with railroads, states, and tribes for rail routes.
- The actual route used for an individual shipment is selected from among the potential routes, again in consultation with states and tribes, after a review of immediate circumstances (e.g., special events, road construction). Actual route choices also have reflected DOE's desire to avoid conflicts and minimize delays.

This procedure reflects DOE's position (which is consistent with DOT regulations) that the states and tribes are competent and responsible for selecting highway routes and, in particular, for having detailed and current local knowledge about accident rates, road and traffic conditions, and events. The route selection process may be described as risk-informed; that is, quantitative estimates of risks are considered alongside other factors,

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including costs, administrative feasibility, local preferences, and inevitable political considerations. Route selection is not determined wholly by a risk assessment because DOE recognizes that these other valid factors must also be considered.

Experience with research reactor spent fuel shipments indicates that selection of highway routes by complying with DOT highway routing regulations is a reasonable substitute for a process that selects routes through quantitative risk assessments that explicitly compare alternative routes, provided that the shipper actively and systematically consults with the states and tribes along potential routes and that states comply with DOT route designation regulations. Analyses indicate that differences in risk among routes attributable to the factors that current models represent adequately (e.g., distance and population density) are relatively small. Up-to-date, comprehensive, and detailed data on accident rates and other risk factors that would be required for more refined quantitative comparisons of alternative routes do not exist. Factors that cannot readily be incorporated into a quantitative assessment (e.g., emergency response capabilities, schedules of road construction and other transient events) may be predominant influences on differences in risk among alternative routes and must therefore be considered alongside the quantitative risk estimates.

Information on local transport conditions supplied by states and tribes is an essential element in route selection decisions. Detailed state reviews allow for the identification of high-accident-rate segments of the Interstate System as well as the identification of acceptable non-Interstate System routes that would substantially reduce mileage and travel time. Judgments of state officials on such matters are most useful when supported with quantitative evidence.

In controversies over routing, states and others repeatedly have criticized DOE for failure to carry out comparative quantitative risk evaluations of alternative routes. DOE could respond to this concern by developing improved risk evaluation tools for comparative route analysis and by giving the results of such analyses appropriate weight in decision making.

In planning routes for the foreign research reactor program, trade-offs were made whose safety implications were not explicitly analyzed. For example, instances were described to the committee in which route selection was influenced by state officials' preference for one proposed route over an alternative with a lower population density that was believed to have a higher accident rate, without a quantitative assessment of the risk implications. Also, states have sometimes expressed preference for routes on which emergency response personnel have already received the necessary training. This could favor the selection of routes through more densely populated areas if emergency responders there have higher levels of training. As a final example, complying with schedule restrictions on shipments

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might conceivably entail delaying a vehicle en route rather than driving through a city during peak traffic periods (rush hour). DOE does not have a methodology for quantitatively evaluating the risk implications of such trade-offs.

For rail route selection, DOE's practice of negotiating routes with carriers in consultation with states is analogous to its interaction with states on highway routing. There is no indication that enacting regulations governing rail route selection for spent fuel shipments would improve safety compared with the present DOE practice of contractually specifying routes that have been negotiated with carriers, after consultation with the states and tribes.

Procedures for shipments from university reactors differ from DOE's practices for planning foreign research reactor spent fuel shipments. In particular, route planning for university shipments generally has not included procedures similar to DOE's formal consultations with working groups of state and tribal representatives or DOE's publication of transportation plans specifying routes, shipment procedures, and responsibilities and commitments of all parties. University shipments are not a direct DOE responsibility, so DOE's policies regarding preparation of transportation plans do not apply to them. Nonetheless, if similar plans were published for university shipments, there might be some gains in safety (e.g., because they would help to facilitate discussions between shippers, states, and tribes and could thereby lead to more coordinated shipping operations) and in public understanding of these shipments.

4.4 RESPONSES TO THE STUDY CHARGE

The charge for the committee's task regarding routing of spent fuel shipments from research reactors (Sidebar 1.2) was defined by Congress in Section 334 of the Consolidated Appropriations Resolution, 2003. Each of the main provisions of that charge appears in italics below, followed by a summary of the committee's response. The charge refers only to shipments for which DOE is responsible. These include shipments from DOE reactors and shipments of spent fuel from foreign research reactors. The committee also examined practices for shipments from other domestic research reactors (which are not carried out by DOE) because that experience is relevant to the problem of route selection and to the committee's original task of identifying technical and societal issues concerning spent fuel transport.

Sec. 334 (b) . . . the National Academy of Sciences shall analyze the manner in which the Department of Energy—

(1) selects potential routes for the shipment of spent nuclear fuel from

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research nuclear reactors between or among existing Department facilities currently licensed to accept such spent nuclear fuel.

DOE has selected potential routes for domestic shipments of foreign research reactor spent fuel since 1996 according to the following procedure: First, quantitative risk analyses of representative routes and alternative modes were conducted as part of the NEPA process and published in EISs. The objective of these analyses was to determine whether the transportation activity would meet a threshold standard of acceptable safety. Second, DOE issued RODs that narrowed the range of potential origins, destinations, modes, and routes, citing considerations of practicality, safety, and preferences expressed in public comments. Third, a set of potential routes was specified in detail, based primarily on DOT regulations (for highways) and following a formal consultation process with affected states and tribes, and after discussions with railroads and states (for rail routes). Finally, potential routes were published in transportation plans that were reviewed by the states and tribes. Planning for shipments from DOE research reactors has followed a similar procedure. The committee's analysis of selection of potential routes appears in Section 4.3.1.

(2) selects such a route for a specific shipment of such spent nuclear fuel.

For shipments of spent fuel from foreign research reactors, the route for each shipment is selected from among potential routes defined in the transportation plans. All such shipments that are now planned will be between Charleston Naval Weapons Station and DOE's Savannah River Site in South Carolina or between the Savannah River Site and Idaho National Laboratory. States and tribes are consulted as part of this selection procedure, and state and tribal preferences are taken into account in making final route selections. DOE may also in the past have taken into account the quality of its working relationships with states along the potential routes in making final selections. Once a route has been selected, states and tribes are required to receive advance notification of shipments and are to inform DOE of conditions within their jurisdictions that may affect these shipments. Before a route is selected for a specific shipment, it is submitted to the USNRC for approval of security provisions. USNRC evaluations have influenced final route selections (see, for example, Section 4.1.1).

Procedures for shipments from DOE research reactors are similar, except that routes for these shipments are not submitted to the USNRC for approval. For shipments from university reactors, normally an agent of the licensee who is managing the transportation submits a proposed route complying with DOT regulations for USNRC review and coordinates the movement with jurisdictions along the route. The committee's analysis of the selection of routes for specific shipments appears in Section 4.3.2.

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FINDING: The Department of Energy's procedures for selecting routes within the United States for shipments of foreign research reactor spent fuel appear on the whole to be adequate and reasonable. These procedures are risk informed; they make use of standard risk assessment methodologies in identifying a suite of potential routes and then make final route selections by taking into account security, state and tribal preferences, and information from states and tribes on local transport conditions. The Department of Energy's procedures reflect the agency's position (which is consistent with Department of Transportation regulations) that the states are competent and responsible for selecting highway routes. For rail route selection, the Department of Energy's practice of negotiating routes with carriers in consultation with states is analogous to its interaction with states on highway routing.

RECOMMENDATION: The Department of Energy should continue to ensure the systematic, effective involvement of states and tribal governments in its decisions involving routing and scheduling of foreign and DOE research reactor spent fuel shipments.

(3) conducts assessments of the risks associated with shipments of such spent nuclear fuel along such a route.

The EISs included quantitative risk assessments that produced estimates of expected numbers of fatalities for representative routes from transportation accidents, radiation exposure during incident-free transportation, and as a consequence of releases of radioactive material during accidents. The risk assessments did not seek minimum-risk routes or compare risks of alternative routes. DOE stated that more refined assessments were not possible in the EISs because actual routes could not be selected until shipments are actually made, after consultation with states and review by USNRC. DOE presented additional estimates of risks of alternative routes to the states and tribes during development of the foreign research reactor spent fuel transportation plans, but these estimates appear not to have influenced route selections. The committee's analysis of DOE's assessments of risks of shipments appears in Sections 4.3.1, 4.3.2, and 4.3.3.

(c) The analysis under subsection (b) shall include a consideration whether, and to what extent, the procedures analyzed for purposes of that subsection take into account the following:

(1) The proximity of the routes under consideration to major population centers and the risks associated with shipments of spent nuclear fuel from research nuclear reactors through densely populated areas.
(2) Current traffic and accident data with respect to the routes under consideration.
(3) The quality of the roads comprising the routes under consideration.

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(4) Emergency response capabilities along the routes under consideration.
(5) The proximity of the routes under consideration to places or venues (including sports stadiums, convention centers, concert halls and theaters, and other venues) where large numbers of people gather.

DOE's practice has been to place responsibility for detailed review of highway routes on the states and tribes. The quantitative risk analyses in the EISs take into account population density, but not traffic conditions, accident rates for specific route segments, road quality, emergency response capabilities, or places of public gatherings. Rather, DOE has considered these factors through its consultations with the states and tribes and in consultations on rail routes involving carriers, states, and the Federal Railroad Administration. DOE has modified routes according to state proposals derived from consideration of these factors. In some instances, states themselves have examined accident data or conducted risk analyses of specific routes, but most state proposals on routing have been based primarily on judgments of state officials. The committee's analysis of DOE's consideration of the listed factors in route selection appears in Section 4.3.

FINDING: Highway routes for shipment of spent nuclear fuel are dictated by DOT regulations (49 CFR Part 397). The regulations specify that shipments normally must travel by the fastest route using highways designated by the states or the federal government. They do not require the carrier or shipper to evaluate risks of portions of routes that meet this criterion. These regulations are a satisfactory means of ensuring safe transportation, provided that the shipper actively and systematically consults with the states and tribes along potential routes and that states follow the route designation procedures prescribed by the DOT.

RECOMMENDATION: DOT should ensure that states that designate routes for shipment of spent nuclear fuel rigorously comply with its regulatory requirement that such designations be supported by sound risk assessments. DOT and DOE should ensure that all potentially affected states are aware of and prepared to fulfill their responsibilities regarding highway route designations.

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5

Improving Spent Fuel and High-Level Waste Transportation in the United States

The focus of this chapter is on the last two charges of the original statement of task for this study (see Sidebar 1.1):

- What are likely to be the key principal technical and societal concerns for radioactive waste transportation in the future, especially over the next two decades?
- What options are available to address these concerns, for example, options involving changes to planned transportation routes, modes, procedures, or other limitations/restrictions; or options for improving the communication of transportation risks to decision makers and the public?

The task statement makes a clear distinction between current and future transportation activities. This distinction was made in recognition of the fact that the federal government is planning to initiate a large-scale, multidecade program to transport much of the nation's commercial spent nuclear fuel and Department of Energy (DOE) spent fuel and high-level radioactive waste to a federal repository. To this end, DOE plans to submit an application to the U.S. Nuclear Regulatory Commission (USNRC) for a license to construct and operate a repository at Yucca Mountain, Nevada (see Chapter 1). At the time the task statement was developed, the National Academies anticipated that there were likely to be specific technical and societal concerns associated with a transportation program to a federal repository. This is in fact the case as shown in this chapter.

The committee was not directed by the statement of task to undertake

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a detailed programmatic review of the federal repository transportation program, nor did it attempt to do so. While many of the concerns raised in this chapter apply specifically to this federal transportation program, they could also apply to other transportation programs designed to move large quantities of spent fuel and(or) high-level waste within the United States to other federal repositories or to interim storage—for example, the Private Fuel Storage, LLC program. A detailed description of the transportation system for this federal repository is provided in Appendix C.

5.1 PRINCIPAL FINDINGS AND RECOMMENDATION

PRINCIPAL FINDING ON TRANSPORTATION SAFETY: The committee could identify no fundamental technical barriers to the safe[1] transport of spent nuclear fuel and high-level radioactive waste in the United States. Transport by highway (for small-quantity shipments) and by rail (for large-quantity shipments) is, from a technical viewpoint, a low-radiological-risk activity with manageable safety, health, and environmental consequences when conducted in strict adherence to existing regulations. However, there are a number of social and institutional challenges to the successful[2] initial implementation of large-quantity shipping programs that will require expeditious resolution as described in this report. Moreover, the challenges of sustained implementation should not be underestimated.

Spent fuel has been transported in the United States and several other countries for several decades; the committee knows of no releases of radioactive materials from package containments above regulatory limits.[3] This safety record can be attributed to the robust design and construction of the packages used for transport and the rigorous regulatory oversight of transportation operations. Studies of package performance have demonstrated the effectiveness of package containment over a wide range of transport conditions, including most severe accident conditions (Chapter 2). Similarly, studies of the health and safety risks of spent fuel transportation (Chapter 3) indicate that such risks are generally well characterized and are

[1]As noted in Chapter 1, *safety* refers to measures taken to protect spent fuel and high-level waste during transport operations from failure, damage, human error, and other inadvertent acts.

[2]The committee defines "success" in terms of the program's ability, under existing statutes, regulations, agreements, and budgets, to transport spent fuel and high-level waste in a safe, secure, timely, and publicly acceptable manner.

[3]As described in Section 3.1, however, there are well-documented instances in which radioactive contamination on the external surfaces of packages have exceeded regulatory limits. The committee is aware of no documented instances in which this contamination has resulted in exposures of workers or the public above regulatory limits.

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generally low. However, the social risks and related institutional challenges may impinge on the successful implementation of large-quantity shipping programs. Transportation programs can take proactive steps to identify and manage these risks and challenges as discussed in Chapter 3 and elsewhere in this chapter.

The wording of this finding—"The committee could identify no fundamental technical barriers to the safe transport of spent fuel and high-level radioactive waste in the United States"—is carefully and narrowly constructed. This finding is focused on the technical aspects of transportation programs: package and conveyance design, fabrication, and maintenance and the conduct of transportation operations. It is predicated on the assumption that these technical tasks are being carried out with a high degree of care and in strict adherence to regulations. The finding also is based on an assessment of past and present transportation programs and would apply to future programs only to the extent that they continue to exercise appropriate care and adhere to applicable regulations. Continued vigilance by all parties involved in these transportation programs—planners, implementers, and regulators—will be required to ensure that transportation operations in the United States continue to be conducted in a safe manner, especially as large-quantity shipping programs to interim storage and a federal repository are ramped up over the next one to two decades. Some issues of particular concern are discussed in Section 5.2.

In Chapter 2, the committee notes concerns about the potential impacts of very long duration fires on package containment effectiveness. Specifically, the committee notes that there may be a very small number of credible accident conditions involving long-duration, fully engulfing fires that are potentially capable of damaging the seals on transportation packages if such fires are allowed to burn in an uncontrolled manner for long periods of time (many hours to days). The committee also recommends that additional investigations be carried out to obtain a bounding-level understanding of the risks and consequences of such accidents. In Chapter 3, the committee describes a relatively simple operational step that can be taken to mitigate these risks. Consequently, the committee judges that very long duration fires do not present a technical barrier to transportation safety.

PRINCIPAL FINDING ON TRANSPORTATION SECURITY: Malevolent acts against spent fuel and high-level waste shipments are a major technical and societal concern, especially following the September 11, 2001, terrorist attacks on the United States. The committee judges that some of its recommendations for improving transportation safety might also enhance transportation security. The Nuclear Regulatory Commission is undertaking a series of security studies, but the committee was unable to perform an

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in-depth technical examination of transportation security because of information constraints.

RECOMMENDATION: An independent examination of the security of spent fuel and high-level waste transportation should be carried out prior to the commencement of large-quantity shipments to a federal repository or to interim storage. This examination should provide an integrated evaluation of the threat environment, the response of packages to credible malevolent acts, and operational security requirements for protecting spent fuel and high-level waste while in transport. This examination should be carried out by a technically knowledgeable group that is independent of the government and free from institutional and financial conflicts of interest. This group should be given full access to the necessary classified documents and Safeguards Information to carry out this task. The findings and recommendations from this examination should be made available to the public to the fullest extent possible.

Several participants at the committee's information-gathering meetings highlighted security[4] as an important current concern for transportation of spent fuel and high-level waste in the United States. The committee concurs with this view and judges that such concerns are likely to grow in the future, especially once shipments commence to centralized interim storage or a federal repository.

As reported in Section 1.2, the committee was unable to perform an examination of transportation security risks because of information restrictions: much of the information available on this topic is either classified or otherwise restricted. The committee concluded that it would be difficult to provide a substantive assessment of security issues because not all committee members have the necessary clearances to access this information.

Four members of the committee and one staff member with appropriate security clearances were given a classified briefing by USNRC staff on investigations under way within that agency to assess the security of transportation packages. Some of these members also have some knowledge of the extensive classified and unclassified literature on this topic. There appears to be sufficient information available to undertake a substantive review of spent fuel and high-level waste transportation security by a cleared group if it is given unrestricted access to the relevant literature and information. The cooperation of several federal agencies (USNRC, DOE, and the

[4]As noted in Chapter 1, *security* refers to measures taken to protect spent fuel and high-level waste during handling and transport from sabotage, attacks, and theft.

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Department of Homeland Security [DHS]) would be required to obtain the information needed to carry out this study.

The committee's recommendation that an examination of spent fuel and high-level waste transportation security be carried out independently of the government and by a group free of financial and institutional conflicts of interest is made in the spirit of improving its objectivity and public credibility. The committee's recommendation that the findings and recommendations of this examination be presented in a format that can be shared with the public is made in the spirit of improving the quality of informed dialogue on this sensitive but important issue. The preparation of findings and recommendations that are suitable for public release will require that the group charged with this examination be given access to appropriate and timely classification guidance.

While the recommendations in this report are focused primarily on improving transportation safety, the committee judges that some of these might also improve transportation security. For example, the recommended operational changes to reduce the number of total shipments to a federal repository (Section 5.2.1), to limit shipment travel times and stops (Section 5.2.3), and to encourage transport of older (and radiologically cooler) spent fuel (Section 5.2.4) would help to reduce the opportunities for some types of malevolent acts or limit their potential consequences.

5.2 TRANSPORTATION OPERATIONS

The committee uses the term *transportation operations* to refer to the spectrum of activities associated with the actual shipments of spent fuel and high-level waste in the United States. The committee provides findings and recommendations on the following six operational issues in this section:

1. Mode (road vs. rail) for transporting spent fuel and high-level waste to a federal repository (Section 5.2.1)
2. Route selections for transport to a federal repository (Section 5.2.2)
3. Use of dedicated trains for transport to a federal repository (Section 5.2.3)
4. Acceptance order for commercial spent fuel transport to a federal repository (Section 5.2.4)
5. Emergency response planning and training (Section 5.2.5)
6. Information sharing and openness (Section 5.2.6)

Although these recommendations are focused on DOE's program for transporting spent fuel and high-level waste, they also apply to any large-quantity shipping programs whether federally or privately operated. *The committee intends that these recommendations would also apply to the*

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Private Fuel Storage program for transporting large quantities of commercial spent fuel to centralized interim storage in Utah, if that facility is constructed and opened.

5.2.1 Mode for Transporting Spent Fuel and High-Level Waste to a Federal Repository

FINDING: Transport of spent fuel and high-level waste by rail has clear safety, operational, and policy advantages over highway transport for large-quantity shipping programs. The committee strongly endorses DOE's selection of the "mostly rail" option for the Yucca Mountain transportation program for the following reasons:

- **It reduces the total number of shipments to the federal repository by roughly a factor of five, which reduces the potential for routine radiological exposures, conventional traffic accidents, and severe accidents (Table 3.8).**
- **Rail shipments have a greater physical separation from other vehicular traffic and reduced interactions with people along transportation routes, which also contributes to safety.**
- **Operational logistics are simpler and more efficient.**
- **There is a clear public preference for this option.**

The committee does not endorse the development of an extended truck transportation program to ship spent fuel cross-country or within Nevada should DOE fail to complete construction of the Nevada rail spur or procure the necessary rail equipment by the time the federal repository is opened.

RECOMMENDATION: DOE should fully implement its mostly rail decision by completing construction of the Nevada rail spur, obtaining the needed rail packages and conveyances, and working with commercial spent fuel owners to ensure that facilities are available at plants to support this option. These steps should be completed before DOE commences the large-quantity shipment of spent fuel and high-level waste to a federal repository to avoid the need to procure infrastructure and construct facilities to support an extended truck transportation program. DOE should also examine the feasibility of further reducing its needs for cross-country truck shipments of spent fuel through the expanded use of intermodal transportation (i.e., combining heavy-haul truck, legal-weight truck, and barge) to allow the shipment of rail packages from plants that do not have direct rail access.

Mode selection is of special concern for the federal repository transpor-

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tation program given its size and multidecade duration. DOE has decided that the mostly rail alternative defined in the final Yucca Mountain Environmental Impact Statement (EIS; DOE, 2002a) is its preferred alternative for transporting spent fuel and high-level waste to a federal repository (DOE, 2004d). In this EIS, DOE noted that it referred to rail as its preferred mode as early as 1998 in the draft request for proposals for contractor support for waste acceptance and transportation (DOE, 2002a, p. M-9). In identifying mostly rail as the preferred mode, DOE evidently does not mean that it prefers each of the detailed site-specific mode choices assumed in the final EIS (DOE, 2002a), but rather that it will seek to employ rail transportation to the extent practicable.

DOE summarized its evaluation of transportation mode options in the final EIS as follows (DOE, 2002a, p. 2-97–2-98):

> DOE believes that the EIS provides the environmental impact information necessary to make certain broad transportation-related decisions, namely the choice of a national mode of transportation outside Nevada (mostly rail or mostly legal-weight truck), the choice among alternative transportation modes in Nevada (mostly rail, mostly legal-weight truck, or heavy-haul truck with use of an associated intermodal transfer station), and the choice among alternative rail corridors or heavy-haul truck routes with use of an associated intermodal transfer station in Nevada.
>
> DOE has identified mostly rail as its preferred mode of transportation, both nationally and in Nevada. The environmental impacts for mostly rail are expected to be less overall than the impacts for mostly truck. For the mostly rail scenario, 9,600 rail and 1,100 truck shipments[5] are expected for shipping 70,000 MTHM [metric tons heavy metal] and, for the mostly truck scenario, 53,000 truck and 300 rail shipments are expected. The reduced number of shipments to move 70,000 MTHM and corresponding expected reduction in environmental impacts are the basis for preferring the mostly rail scenario.

The impacts that weighed most heavily in DOE's mode preference are safety related, primarily involving fatalities from exposure to ionizing radiation and conventional traffic fatalities (see Table 3.8). DOE noted that

[5]For commercial spent fuel, one shipment, as the final EIS uses the term, apparently is equal to one package moving to the repository. Although the risk analysis in the EIS assumes one package per train, DOE states that in practice up to five railcars, each carrying one spent fuel package, could move together in one train (DOE, 2002a, p. J-14). DOE also states that its present plans call for three packages per train, or about 3000 trains entering Nevada (DOE, 2004d, p. 18559). A truck would carry only one package. This is based on a rail package capacity of 6 to 12 metric tons (about 7 to 13 short tons) heavy metal (MTHM), compared with 1.8 MTHM (2 short tons) for a legal-weight truck package (DOE, 2002a, Table J-2); the ratio of the number of shipments in the mostly rail scenario, compared with mostly truck, is about the ratio of truck package capacity to rail package capacity.

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security considerations also support its rail preference. The analysis in the final EIS indicates that in the event of a terrorist attack on a transport package in transit, the likely consequences for a rail shipment would be less than for a legal-weight truck shipment, mainly because of the rail package's thicker wall.[6] The committee did not examine the risks of terrorist attacks on spent fuel packages and therefore cannot confirm this conclusion.

Table 3.8 shows that the mostly rail option results in about a factor of five decrease in the number of shipments to the federal repository (53,000 mostly truck shipments versus 9600 mostly rail shipments[7]) over a period of 24 years. The mostly rail option also results in almost a factor of four reduction in expected radiation-related fatalities during routine transport, from 15 fatalities to 4. The number of expected fatalities for the maximally reasonably foreseeable accident is higher for the rail option than for the truck option (five fatalities versus less than one fatality), but the likelihood of occurrence of such a rail accident is very small (less than 3 in 10 million chances of occurring per year).

The committee also sees clear operational advantages to the mostly rail option. Railroads in the United States are privately owned and operated, which allows for greater control over other activities on the rail line and a more coordinated regime for carrying out safety inspections. Rail transport can also result in reduced shipment travel times, especially if dedicated trains are used, which allows for the more efficient utilization of transport packages and conveyances.[8]

DOE's mostly rail transportation strategy will require the development of a rail spur within Nevada, because the Yucca Mountain site is currently without direct rail access.[9] The final EIS (DOE, 2002a) examined three alternative, but not mutually exclusive, provisions for transportation within Nevada: (1) a rail alternative that would entail constructing a rail spur from

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[6]While it is true that rail packages have thicker walls, they also hold greater inventories of spent fuel. It is not immediately obvious to the committee how these two factors would trade off for various types of terrorist attacks.

[7]It should be noted that these shipment numbers are small compared to other types of hazardous material transport that occur on the nation's highways, railroads, and waterways each year. About 400,000 large trucks are dedicated to hazardous materials service, including most tank trucks. About 115,000 railroad tank cars and more than 3000 tank barges operating on the inland and coastal waterways are in hazardous materials service. See NRC (2005c) for details.

[8]In principle, reducing the travel time allows more round trips to be carried out per unit time or, at a fixed throughput, reduces the required numbers of packages and conveyances.

[9]The EIS for the rail spur was under way when the present report was being finalized (December 2005). The transportation risks on rail spur will not be known publicly until the EIS and spur design are released. The committee presumes that the rail spur will be constructed up to modern-day standards and therefore will have risks similar to or less than other rail lines used to transport spent fuel and high-level waste to the repository.

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a point on an existing rail line to the repository; (2) a heavy-haul truck alternative, in which full-size rail packages would be removed from railcars at a terminal constructed near an existing rail line and loaded onto heavy-haul trucks for transport to the repository; and (3) a legal-weight truck alternative involving the transport of spent fuel and high-level waste from commercial and DOE sites to the repository by truck. The final EIS stated that mostly rail is also the preferred mode within the State of Nevada (DOE, 2002a, p. S-2). DOE examined five possible rail corridors in Nevada in its final EIS (Figure 5.1) but it did not express a preference among them.

In December 2003, DOE published a notice[10] announcing that one of the five corridors, the Caliente corridor, is its preferred corridor in which to construct a rail line, and that a second route, the Carlin corridor, is its secondary preference. The notice explains the significance of this designation as follows: "If the Department adopts the mostly rail mode in Nevada, DOE will issue a Record of Decision selecting a rail corridor. . . . If the Department selects a rail corridor, DOE will issue a Notice of Intent in the Federal Register to initiate the preparation of a rail alignment EIS . . . to consider alternative alignments within the selected corridor. . . ." Concerning the basis for the selection, the notice states: "The Department's preference for Caliente takes into account many factors, including its more remote location, the diminished likelihood of land use conflicts, concerns raised by Nevadans, and national security issues raised by the U.S. Air Force on the Caliente-Chalk Mountain corridor [another corridor analyzed in the EIS]." DOE further explained its preferred mode designation and selection of the corridor in a Record of Decision (ROD) published in April 2004 (DOE, 2004d) and at the same time announced (DOE, 2004e) that it was beginning an EIS covering the selection of the alignment within the Caliente corridor and construction and operation of the rail line, with a draft to be issued in early 2005.

The Caliente corridor begins at a point on the Union Pacific rail line near Caliente Nevada, 120 miles northeast of Yucca Mountain; runs west, passing north of the Nevada Test and Training Range, a military facility; and then turns south to Yucca Mountain (Figure 5.1). The final Yucca Mountain EIS estimates the cost of building the rail line in this 319-mile (513-kilometer) corridor to be $880 million in 2001 dollars and the construction time to be 46 months (DOE, 2002a).[11] The three nonpreferred corridors are shorter and have lower estimated construction costs than the

[10]DOE, "Notice of Preferred Nevada Rail Corridor," 68 FR 74951–74952, December 29, 2003.

[11]In December 2005, DOE acknowledged that construction costs had increased to $2 billion, presumably in current year (2005) dollars.

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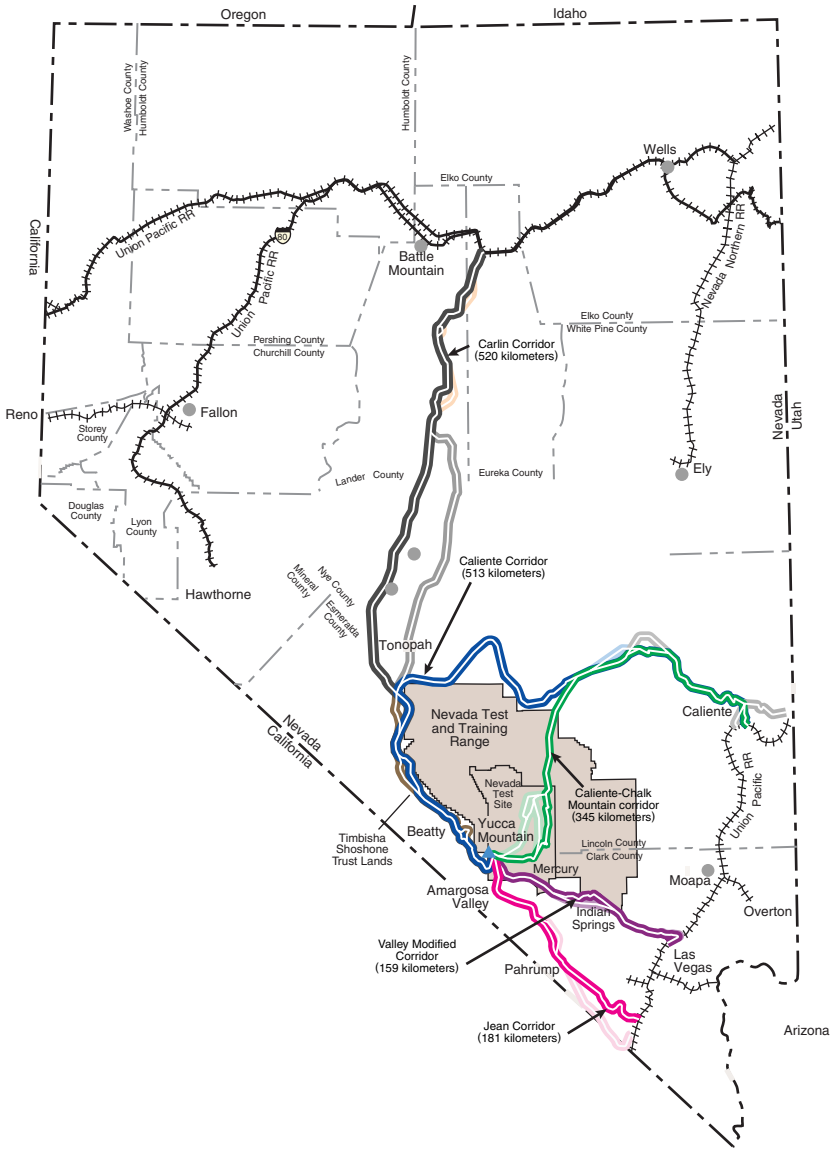

FIGURE 5.1 Potential corridors for the Nevada rail spur. The Caliente corridor starts near the town of Caliente at the lower right and runs north and west of the Nevada Test and Training Range. SOURCE: Modified from DOE (2002a).

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Caliente route, but would have routed shipments through or near Las Vegas or through the Nellis Range.

In its notice on beginning the alignment EIS (DOE, 2004e), DOE invited comments on whether it should allow private entities to ship commercial commodities on its rail line. The possibility of commercial use might make construction of the route more acceptable to some local interests. The choice of whether the line should be available for public use has implications for regulatory oversight of the line's construction and operation. According to federal law, the Surface Transportation Board[12] has jurisdiction over rate and service issues for common carrier rail lines (i.e., rail lines available for public use). The board must approve construction, and all state and local environmental or permitting requirements are preempted. Construction of a track for exclusive DOE use would not require board approval. Federal law would not preempt state and local regulation of construction of such a track.

DOE's preferred rail transportation strategy will also require the execution of an ambitious intermodal transportation scheme to move transportation packages to railheads from commercial sites lacking direct rail connections. The final Yucca Mountain EIS notes that 24 commercial spent fuel storage sites have no rail service but do have facilities to load rail packages. Of these 24, 17 have access to waterways, and the other 7 can ship to railheads by heavy-haul truck. There are an additional 6 sites that lack crane capacity or other facilities to load rail packages (DOE, 2002a, p. J-15, Tables J-5 and J-26).

Of the 9600 train shipments in the final EIS mostly rail scenario, on the order of 2000 would be moved from sites without rail access to a railhead by heavy-haul truck or barge over distances of 6 to 256 kilometers (4 to 160 miles) (DOE, 2002a, Tables J-5, J-26, J-27). DOE's illustrative heavy-haul truck (DOE, 2002a, Figure 2-29) is 67 meters (220 feet) long and weighs 90 metric tons (100 short tons) empty and around 180 metric tons (200 short tons) loaded. For comparison, a legal-weight truck carrying a spent fuel package would be about 18 meters (60 feet) in length and have a loaded weight of 36 metric tons (40 short tons).

The possibility of a large volume of barge shipments of spent nuclear fuel has been a point of controversy. State representatives reported to the committee that there is opposition in the upper Midwest to spent fuel barge shipments on the Great Lakes. The final EIS estimates were not based on an evaluation of whether barge would be preferred from the standpoint of cost or risk at any sites of origin. Until up-to-date and detailed local site access

[12]The board is an independent agency and the successor agency to the Interstate Commerce Commission.

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assessments are available, it is not possible to say whether any significant volume of local barge transport will occur.

The final EIS assessments of spent fuel origin site (i.e., commercial nuclear plant sites and independent spent fuel storage installations) capabilities to ship by rail, either directly or with local truck or barge haul to a nearby railhead, were based on two DOE studies published in 1992: the Facility Interface Capabilities Assessment (FICA) (Viebrock et al., 1992) and Near Site Transportation Interface (NSTI) study (Viebrock and Mote, 1992). FICA was a study of the capability of each nuclear generator site to handle spent fuel packages of four dimensions: legal-weight truck package, an overweight truck package, and two rail or barge packages. The NSTI study examined on-site and near-site rail and barge infrastructure at 76 reactor sites.

It is likely that changes have occurred at some origin sites since these studies were completed. The NSTI warned that rail line abandonment was tending to curtail rail access to reactor sites. Development in areas surrounding origin sites since 1990 may also have restricted transportation options. On the other hand, facilities that have developed on-site dry spent fuel storage facilities (see Sidebar 1.4) may have improved their package-handling capabilities.

The State of Nevada has argued that DOE is underestimating the significance of origin site access and handling capabilities as constraints on transportation options and, as a consequence, DOE's estimate of the total number of shipments to the repository in the mostly rail scenario (9600 rail and 1000 truck, as described above) is overly optimistic. A 1996 analysis for the Nevada Nuclear Waste Project Office concluded that substantial truck shipping would be likely, even after Nevada rail access was constructed.[13]

The Nevada analysis used data from the FICA and NSTI studies to construct scenarios for possible Yucca Mountain shipping campaigns, similar to the transportation scenarios in the final EIS for Yucca Mountain, but with more specificity about modes and routes and with explicit consideration of how each origin site would go about analyzing its mode choice. It concluded that with Nevada rail access to the repository in place, it would be reasonable to expect at least 17 utilities to ship by truck for the entire journey to the repository, rather than the 6 assumed in the final Yucca Mountain EIS analysis. Nevada officials stated to the committee that it is their expectation that, even with a Nevada rail link, at least 25 percent of

[13]Planning Information Corporation, The Transportation of Spent Nuclear Fuel and High-Level Radioactive Waste: A Systematic Basis for Planning and Management at the National, Regional, and Community Levels, September 1996, *http://www.state.nv.us/nucwaste/trans/1pichome.htm*.

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all commercial spent fuel would travel by truck,[14] implying 10 times the volume of truck movements in the final EIS mostly rail scenario.

Nuclear power industry participants dispute the state's estimates.[15] They note that shipment by truck would be unattractive to commercial operators: The cost and time required for loading and shipping a truck package would be comparable to that for a rail package that held seven times the quantity of spent fuel. Moreover, loading large amounts of spent fuel for truck transport would overburden origin site facilities. These representatives believe that origin sites will have a strong preference to ship by rail whenever possible.

The degree to which DOE must defer to the spent fuel owners' preferences regarding transport mode is governed by the terms of the standard contracts (see Appendix C and Sidebar 5.1). The owners' delivery commitment schedule, required under the contract, will specify a "proposed shipping mode" (truck, rail, or barge). DOE can disapprove a delivery commitment schedule, in which case "the parties shall promptly seek to negotiate mutually acceptable schedules" (Standard Contract, Article V.B). However, the contract also specifies that DOE must provide transport packages "suitable for use at the Purchaser's [spent fuel owner's] site" (Article IV.B), so DOE apparently could not require a utility to use a rail package if doing so would require site modifications.

DOE is now updating the FICA information regarding on-site capabilities to load and handle shipping packages of various dimensions that will be needed to order shipping packages; DOE plans to update the NSTI data as well.[16] Until these updates are complete, estimates of the likely number of rail and truck shipments must be considered uncertain.

Other modal options that might conceivably play a useful role have not yet been evaluated fully. These include intermodal transportation employing conventional trucks; that is, placing spent fuel at the point of origin into standard truck packages, transporting the containers by truck to a nearby rail terminal, transferring them to railcars for transportation to the repository, and finally transferring them back to truck at a point near the repository if the repository does not have rail access. Trucks could be of the

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[14]Statement of Robert R. Loux to the committee, July 25, 2003.

[15]Tiffany Wlazlowski. 2002. U.S. seeks ways to safely transport radioactive waste to Yucca Mountain. *Transport Topics*, June 3. p. 1.

[16]"The data on transportation infrastructure in the vicinity of sites, . . . will . . . be updated. . . . Updating this information close to the time of actual shipment ensures that the latest information is used for identifying site-specific transportation needs" (DOE, 2003c, p. 9). Presumably DOE recognizes the necessity of updating this information immediately, because it may be critical to its transportation plan and because interventions to preserve or develop facilities may be needed. It would also be necessary to further update the information as shipping dates approach.

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SIDEBAR 5.1 Standard Contract for Disposal of Spent Fuel and High-Level Waste

Title 10, Part 961 of the Code of Federal Regulations, Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste, specifies the responsibilities of DOE and purchasers of its services (i.e., the owners of commercial spent fuel) for transportation of spent fuel to the federal repository:

- DOE is responsible for providing transport packages to the purchaser at the purchaser's site, and also for providing procedures and training for handling and loading such packages.
- The purchaser is responsible for preparing, packaging, and loading spent fuel into the packages in accordance with all applicable laws and regulations. DOE may designate a representative to observe these activities. The purchaser must notify DOE at least 60 days in advance of commencement of such activities. This notification must provide DOE with a description of the material to be loaded.
- DOE must accept title to the loaded packages "freight-on-board" at the purchaser's site. Once title has passed, the purchaser is no longer responsible for the spent fuel. DOE has the right to dispose of this spent fuel as it sees fit and is not obligated to provide compensation to the purchaser for this material.
- DOE must provide the means for transporting the packages from the purchaser's site to the repository.

The standard contract also establishes the priority order for DOE acceptance of commercial spent nuclear fuel as follows:

- DOE acceptance will be based on the date and amount of fuel discharged from the reactor (see Sidebar 5.2 for further details), except as noted in the next two bullets.
- DOE may accord priority for acceptance of spent nuclear fuel from reactors that have been permanently shut down.
- The purchaser also has the right to exchange delivery schedules with parties to other contracts, but DOE has the right to approve or disapprove such exchanges in advance.

DOE and the purchaser are also responsible for exchanging the following information on an annual basis:

- DOE must provide the purchaser with the projected annual receiving capacity for spent nuclear fuel at the repository.
- DOE also must provide the purchaser with other pertinent information on the waste disposal program, including cost projections, project plans, and project reports.
- The purchaser must provide DOE with information on actual discharges of spent fuel to date and projected discharges for the next 10 years.

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dimensions that are legal to operate on all main highways (80,000 pounds [approximately 36 metric tons] total weight, limiting the weight of the container and spent fuel to about 50,000 pounds [approximately 22 metric tons]) or that exceeded the legal weight but were within the range of weights that states routinely approve for operation after issuance of special permits (at least 120,000 pounds [approximately 53 metric tons] in most states, allowing packages that weigh 80,000 pounds [approximately 36 metric tons]).

Nevada representatives, among other observers, have expressed concern that in spite of DOE's expressed rail preference, events may be directing it toward commencing shipments to the repository by truck, possibly with the intention of a later conversion to mostly rail transportation.[17] The Western Governors' Association (WGA) also acknowledged the prospect of interim transportation arrangements for initial shipments in a 2005 resolution (WGA, 2005, p. 1): "For many years, Western Governors have consistently urged the federal government to develop a comprehensive transportation plan, including the preparation of contingency plans for events such as the early shipment of waste."

DOE has acknowledged that to deal with the uncertainties and complexities of the Yucca Mountain program, the goal of its transportation planning has been to maintain as much flexibility as possible, including the flexibility to ship by truck as well as by rail.[18] DOE's desire for flexibility conflicts with the states' preference for early and specific decisions on transportation. The ROD on mode and corridor choices states DOE's current position on the use of trucks (DOE, 2004d):

> The Department would use truck transport where necessary, depending on certain factors such as the timing of the completion of the rail line proposed to be constructed in Nevada. This could include building an intermodal capability at a rail line in Nevada to take legal-weight truck casks from rail cars and transport them the rest of the way to the repository via highway, should the rail system be unavailable at the time of the opening of the repository. In addition, since some commercial utilities are not able to accommodate rail casks, they would ship by legal-weight truck to the repository.

The option of shipping in legal-weight truck packages on railcars to Nevada and then on truck to the repository was considered in the final Yucca Mountain EIS, but dismissed as impractical, at least as the primary

[17]Robert M. Halstead, Testimony to the U.S., House of Representatives, Committee on Transportation and Infrastructure, April 25, 2002; Robert L. Loux from the State of Nevada made a similar statement to the committee as its meeting on Las Vegas on July 25, 2003.

[18]Statements of Margaret Chu and Jeff Williams to the Nuclear Waste Technical Review Board, January 28, 2003.

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method of operation over the life of the transportation program (DOE, 2002a, pp. J-74–J-75). Nevada has raised questions about the safety of shipping truck packages by rail, especially with respect to the performance of these packages under extreme accident conditions. (Such shipments are allowed under current USNRC regulations.) The risk analyses described in Chapter 3 have not considered this transportation scenario, so additional analyses might be prudent if DOE were to ship truck packages by rail.[19]

The costs of initiating the transport of spent fuel and high-level waste to Yucca Mountain using trucks followed by the initiation of rail could be considerable, especially if an extended, high-throughput initial truck campaign was planned. It would require setting up essentially two independent transportation systems, each requiring funding for planning, scheduling, package and conveyance procurement, and package maintenance. It might also require the modification of package-receipt facilities at the federal repository to handle large numbers of smaller truck packages. If the costs of standing up and operating the truck program were high, DOE might not have the resources to complete the construction and procurement of rail infrastructure, and DOE and the nation could be saddled with a long-term truck transportation program.

Several challenging tasks remain before DOE will be in a position to fully implement the mostly rail option:

- Completion of the Nevada rail EIS and construction of the Nevada rail line
- Completion of the NSTI study on rail and barge infrastructure at commercial sites
- Completion of the FICA surveys on infrastructure to load and handle shipping packages at commercial sites
- Construction of any needed infrastructure improvements at commercial sites and along planned routes
- Acquisition of a transport package and conveyance fleet to support the mode decision

Time and adequate resources will be required to complete these tasks in advance of the opening of a federal repository at Yucca Mountain. Failure to complete these tasks before the repository is opened may create pressure on DOE to initiate its transportation program using legal-weight or overweight trucks. Similarly, an early congressional directive to open an interim storage facility for commercial spent fuel at another government site could also result in large numbers of truck shipments. The extensive use of trucks

[19]As noted in Section 2.2.3, the USNRC is examining the performance of a truck package in a rail tunnel fire.

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in the early stages of these programs could divert time and resources away from implementation of the mostly rail option, especially if DOE is forced to procure truck packages and conveyances. It could also affect the receiving facilities at the repository, which presumably will be designed primarily to handle rail packages. Finally, it could increase opposition to the transportation program and reduce trust and confidence in DOE's transportation program and its managers, which could conflict with DOE's stated desire (as noted previously) to maintain flexibility in mode selection.

Even under the mostly rail option envisioned in the final EIS for Yucca Mountain, there will still be 1100 truck shipments (DOE, 2002a). DOE has an opportunity to further reduce the truck shipments, especially cross-country shipments, through an expanded use of intermodal transport for those sites that lack direct rail access.

5.2.2 Route Selection for Transportation to a Federal Repository

FINDING: DOE has not made public a specific plan for selecting rail and highway routes for transporting spent fuel and high-level waste to a federal repository. DOE also has not determined the role of its program management contractors in selecting routes or specific plans for collaborating with affected states, tribes, and other parties.

RECOMMENDATION: DOE should identify and make public its suite of preferred highway and rail routes for transporting spent fuel and high-level waste to a federal repository as soon as practicable to support state, tribal, and local planning, especially for emergency responder preparedness. DOE should follow the practices of its foreign research reactor spent fuel transport program of involving states and tribes in these route selections to obtain access to their familiarity with accident rates, traffic and road conditions, and emergency responder preparedness within their jurisdictions. Involvement by states and tribes may improve the public acceptability of route selections and may reduce conflicts that can lead to program delays.

Implementation of DOE's transportation program for Yucca Mountain will be a daunting task, given its size coupled with its lack of control over budgets and schedules (see Section 5.3), the large number of involved parties, the geographic extent of the transportation system (Figure 1.1), and the long time frames for transportation operations. This argues for simplification, and one of the best ways to simplify the program is to ship by rail whenever practicable. There will be many fewer shipments that need to be routed, and transport will take place over private rights of way. Railroads have established procedures in place for selecting routes for hazardous materials carriage. These procedures, however, do not take into account all

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of the concerns of the states and tribes (e.g., avoiding large population centers and being sensitive to environmental justice concerns). The DOE program for transporting foreign research reactor spent fuel (Chapter 4) is a good model for involving states and tribes in rail routing decisions.

Once DOE selects the suite of routes[20] it will use for its shipments, it may be required to undertake selected route infrastructure improvements before any shipments can be made, as described in Appendix C. It also must decide on safety and security measures, procedures for notification of jurisdictions through which shipments pass, arrangements for state inspections of shipments, communications and tracking, and handling contingencies en route. Most of these operations would be carried out by contractors. DOE has proposed and withdrawn two proposals for the organization of contractor support for management of transportation operations.

Comments submitted on the final Yucca Mountain EIS revealed frustration over DOE's lack of specificity on route designations. DOE has asserted that it was not required in the EIS to specify routes for each site or the decision process for route selection. The EIS does, however, state DOE's conception of route selection as follows (DOE, 2002a, p. J-23):

> Approximately 4 years before shipments to the proposed repository begin, the Office of Civilian Radioactive Waste Management plans to identify the preliminary routes that DOE anticipates using in state and tribal jurisdictions so it can notify governors and tribal leaders of their eligibility for assistance under the provisions of Section 180(c) of NWPA.

Section 180(c) refers to assistance for emergency responder training. This issue is discussed in more detail in Section 5.2.5 of this chapter.[21]

DOE summarizes its rail routing practices for spent fuel as follows (DOE, 2002a, p. M-6):

> Except for requirements contained in 10 CFR 73.37, there are no Federal regulations pertaining to rail routes for shipment of spent nuclear fuel or high-level radioactive waste. The shipper and railroad companies (carriers) determine rail routes based on best available route and track conditions, schedule efficiency, and cost effectiveness.

The regulation cited, 10 CFR 73.37, provides the USNRC's require-

[20]The NWPA requirements for emergency responder training requires that DOE select routes well in advance of shipments (see Section 5.2.5). For security reasons, DOE will not provide advanced public notice of shipments along these routes, only advanced notification to state governors and law enforcement officials. See Appendix C, Section C.1.4, for more details.

[21]Emergency responder preparedness has been used as a route selection criterion in the research reactor transport program as described in Chapter 4. DOE could in principle use emergency responder preparedness as a route selection criterion in the federal repository program, but to the committee's knowledge has not announced any plans to do so.

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ments for physical protection of spent nuclear fuel in transit (see Appendix C). Specifically, it gives the Commission the authority to preapprove proposed routes for spent fuel shipments based on security considerations. However, DOE is not subject to these regulations because it accepts ownership of commercial spent fuel at the plant gate.

The final Yucca Mountain EIS describes the rail route evaluation process envisioned as follows (DOE, 2002a, p. M-10):

> The Regional Servicing Contractor would identify rail transportation routes in conjunction with the appropriate rail carriers. Because railroad companies determine the routing of shipments, the Contractor would rely on the rail carrier to provide primary and secondary route recommendations consistent with safe railroad operating practices. Guidelines would include . . . use of key routes as described in [the Association of American Railroad's] *Recommended Railroad Operating Practices for Transportation of Hazardous Materials*. . . .

Although DOE has not proceeded with the Regional Servicing Contractor arrangement, this statement presumably reflects its general plan for rail route selection through consultation with railroads. It is not clear from this statement whether DOE would in any circumstances impose route choices on rail carriers, for example, for security reasons or to avoid large population centers. No specific mention is made of consultation with the states on rail routes. Some states are seeking greater specificity and control of the process for reaching decisions on rail routing or on ensuring that the appropriate notification procedures and emergency response capabilities are in place as noted later in this section.

In 1996, DOE stated that it did not intend to produce general routing criteria for spent fuel and high-level waste shipments and would instead rely on standard railroad practice to determine rail routes (WIEB, 1995, p. 44). Such practices do not normally provide for much state and tribal consultation. On the other hand, DOE has shown a willingness to consult with states and tribes in planning for and carrying out spent fuel shipments. As described in some detail in Chapter 4, DOE consulted with South Carolina in developing rail routes for foreign research reactor spent fuel shipments to Savannah River. DOE even agreed to identify an alternate rail route at the state's request.

DOE has also imposed routing restrictions on carriers, including requirements to minimize time, distance, and number of interchanges; to use the best track; to avoid population centers; and to schedule movements through cities outside peak commuter hours for other spent fuel transportation campaigns. Examples of such special provisions include the rail shipping arrangements for transport of core debris from Three Mile Island in 1986 to 1990 and several series of rail shipments from commercial nuclear plants to temporary storage (WIEB, 1991, pp. 90–92).

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For highway routing, the Regional Servicing Contractor would first select a route consistent with U.S. Department of Transportation (DOT) regulations and with consideration of infrastructure adequacy along routes. Then (DOE, 2002a, p. M-9),

> . . . the Contractor would submit the route plan to DOE for approval. DOE would interact with states and Native American governments concerning these selections. . . . With DOE approval, the Contractor would then submit the route plans to the Nuclear Regulatory Commission. . . .

Although the Regional Contractor plan is no longer current, the statement provides an indication of DOE's intentions on how route selections would be made.

In past DOE highway routing debates, the states have tended to urge DOE in the direction of taking an active role in route designation and of reducing the discretion of carriers to choose routes. DOE worked closely with affected states to select highway routes for foreign research reactor shipments from the Savannah River Site to Idaho National Laboratory (see Chapter 4). In preparing for transportation of transuranic waste[22] to the Waste Isolation Pilot Plant (WIPP), an underground repository in New Mexico, DOE specified a set of routes in consultation with the states, and these routes were incorporated in state alternate preferred route designations. DOE then specified routes in its contracts with carriers (see TEC, 2002). The WGA (2005) cites the WIPP transportation program as the model DOE should follow in planning for the Yucca Mountain transportation program.

The WGA has repeatedly expressed its concern that DOE is not on track to produce a transportation plan that is sound, timely, and built on adequate consultation with the states. It recommended that DOE undertake a series of actions that include the following[23] (see also WGA, 2005):

- Develop criteria and a methodology for evaluating and selecting routes and modes;
- Propose a set of shipping routes to the affected states and tribes for review and comment;
- Through this consultation with states and tribes, identify a set of primary and secondary routes for each site of origin to each destination; and
- Require the use of these routes through contract provisions with the private parties engaged in transportation.

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[22]Primarily materials such as clothing, containers, and debris generated during nuclear weapons development and production.

[23]WGA, Policy Resolution 02-05: Transportation of Spent Nuclear Fuel and High-level Radioactive Waste, June 25, 2002.

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While the WIPP transportation program in some ways offers useful lessons for how DOE could collaborate with states, there are some important differences between transuranic waste and spent fuel or high-level waste that limit the relevance of this model. The cooperative effort to develop the WIPP transportation program was led by western governors who had a strong interest in moving waste out of their states to WIPP. Moreover, the development of the WIPP repository was supported by its host state (New Mexico). In contrast, for the Yucca Mountain program, some important transit states and the repository state (Nevada) have no spent fuel or high-level waste to be shipped. Additionally, the requirements for transport to the Nevada repository are more demanding, given the greater hazards of the materials being shipped. Consequently, security arrangements and emergency responder preparation will require more resources and pose more difficult logistical problems.

The WIPP transportation program is not a useful model for the transportation operations addressed by this study in other ways. Transportation to WIPP has so far been entirely by truck, whereas transportation to Yucca Mountain (and to Private Fuel Storage, LLC) is planned to be mostly by rail. The schedule for opening a WIPP repository was aggressive and did not allow much time for transportation planning. There were unanticipated delays in opening the repository, however, which allowed enough time for the transportation program to develop. While the outcome was good, the process for getting there was not. Recent delays in the aggressive schedule for opening the federal repository at Yucca Mountain program might also provide additional time for transportation planning and route selection.

Past DOE experience in routing spent fuel and transuranic waste shipments has demonstrated the benefits of state and tribal consultations. Such consultations provide DOE with information on accident rates for specific routes, road conditions that could affect shipments, and emergency responder preparedness—information that DOE could not easily obtain on its own. The selection of routes will ultimately require that DOE, in consultation with states, balance these factors and its own programmatic and security considerations in a transparent and supportable fashion.

5.2.3 Use of Dedicated Trains for Transport to a Federal Repository

FINDING: Studies carried out to date on transporting spent fuel by dedicated versus general trains have failed to show a clear radiological risk-based advantage for either option. However, the committee finds that there are clear operational, safety, security, communications, planning, programmatic, and public preference advantages that favor dedicated trains. The committee strongly endorses DOE's decision to transport spent fuel and high-level waste to a federal repository using dedicated trains.

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RECOMMENDATION: DOE should fully implement its dedicated train decision before commencing the large-quantity shipment of spent fuel and high-level waste to a federal repository to avoid the need for a stopgap shipping program using general trains.

In July 2005, DOE's Office of Civilian Radioactive Waste Management (OCRWM) announced that DOE was adopting the following policy regarding rail operating practices for shipments to Yucca Mountain: "The Department of Energy will use dedicated train service . . . for its usual rail transport of spent nuclear fuel . . . and high-level radioactive waste . . . to the Yucca Mountain Repository site in Nevada when the repository is operational" (DOE 2005b).

This declaration follows a long-running controversy in the United States about whether rail shipments of spent fuel and high-level waste should be carried out using

- *Dedicated trains*, which would carry only spent fuel and high-level waste; or
- *General trains*, which could carry other freight in addition to spent fuel and high-level waste, just as other routine hazardous materials shipments are handled. Certain additional practices and precautions would still be applied to such trains.[24]

During the 1960s, some railroads in the eastern United States announced that they would refuse to handle spent nuclear fuel and some other radioactive waste shipments under the rates and terms of common carriage (i.e., by general train service). The railroads announced that they would require special contracts for these shipments. Such contracts typically include a hold-harmless clause covering the railroad, an obligation on the part of the shipper to guarantee connecting line service, and a stipulation that the service would be made by dedicated trains (Klassen, 1982, pp. 1–3).

The Energy Research and Development Administration (a DOE predecessor agency), the USNRC, and commercial nuclear utilities challenged the legality of the railroads' tariff actions in 1975. These plaintiffs argued that dedicated trains could not be shown to significantly improve safety and that their use added to costs. The Interstate Commerce Commission ruled against

[24]For example, the Association of American Railroads has developed and issued "Performance Specification for Trains Used To Carry High-Level Radioactive Material" (Standard S-2043). This standard establishes requirements for coupling systems, brakes, and dynamic load tests for railcars used to transport spent fuel and high-level waste. These cars could be used on both dedicated and general trains.

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the railroads, and the railroads appealed the case to the Supreme Court, which upheld the ruling in 1980. The railroads were thus required to publish tariffs for transporting spent fuel and to cancel mandatory special train tariffs (Klassen, 1982, p. 2-3).

Although some spent fuel shipments have moved in general service trains in recent years,[25] dedicated trains appear to be standard practice in the United States.[26] DOE and the railroads have agreements in place on a set of safety and security protocols and special operating restrictions for spent fuel movements. These cover the make-up of trains as well as security provisions and operating restrictions and controls. There appears to be strong industry support for the use of dedicated trains.[27] The Association of American Railroads has adopted a policy recommending shipment of spent fuel by dedicated train.[28] Private Fuel Storage, LLC, a consortium of commercial nuclear utilities that plans to build an interim storage facility for spent fuel in Utah (see Chapter 1), plans to ship spent fuel primarily using dedicated trains. A representative from the Nuclear Energy Institute, the nuclear energy industry's policy and lobbying arm, told the committee at one of its information-gathering meetings that the industry also prefers dedicated trains for shipping its spent fuel to Yucca Mountain.

DOE's final EIS for Yucca Mountain (DOE, 2002a) did not provide a detailed analysis of the benefits of dedicated trains to support a decision on the issue. The EIS noted (p. J-76) that "DOE has not determined the commercial arrangements it would request from railroads for shipment of spent nuclear fuel and high-level radioactive waste." It acknowledged the policy of the railroad industry favoring dedicated trains but also cited a 1998 study by the Research and Special Programs Administration[29] (RSPA) of the U.S. Department of Transportation (DOT, 1998), which concluded that shipments by dedicated train would result in a greater number of nonradiological accident fatalities than shipments in general trains because there would be more trains on the rails.

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[25]Specifically, some naval spent fuel shipments have been transported to the Idaho National Laboratory in general freight.

[26]Allan Rutter, testimony before the Subcommittees on Railroads and on Highways and Transit, Committee on Transportation and Infrastructure, U.S. House of Representatives, April 25, 2002.

[27]Private Fuel Storage, LLC and the Association of American Railroads are cooperating on the development of an advanced railcar for transporting spent fuel. A subgroup of the committee had the opportunity to see this railcar when it visited the Federal Railroad Administration's Transportation Technology Center in Pueblo, Colorado, in October 2003.

[28]Edward R. Hamberger, "Transportation of Spent Rods to the Proposed Yucca Mountain Storage Facility," testimony before the Subcommittees on Highways and Transit and on Railroads, Committee on Transportation and Infrastructure, U.S. House of Representatives, April 25, 2002.

[29]Now the Research and Innovative Technology Administration.

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The Government Accountability Office (GAO) examined the question of the relative safety of dedicated and general trains for the transport of spent fuel in a July 2003 report (GAO, 2003). The report identifies three arguments that are commonly made by proponents of dedicated trains that the use of such trains lowers transportation risks. First, dedicated trains have a shorter travel time from origin to destination than a railcar in general service, thus reducing exposure to terrorist attacks. GAO cites a rail industry estimate that a spent fuel package would travel from the East Coast to Nevada in 3 to 4 days by dedicated train versus 8 to 10 days by general train. In the industry estimate, the extra time for the general rail movements would be spent primarily in rail yards. Second, the use of dedicated trains would ensure that cars carrying spent fuel packages are not mixed with cars carrying flammable materials. This reduces the consequences of potential accidents involving fires and explosions. Third, because cars carrying spent fuel packages are much heavier than typical freight cars (470,000 pounds [210,000 kilograms] versus about 200,000 pounds [90,000 kilograms], according to GAO), mixing spent fuel cars with ordinary cars in a train creates stability problems and increases the likelihood of train derailments. GAO concluded (p. 23) that "it is not clear that the advantages of dedicated trains outweigh the additional costs"; however, it did not cite cost data.

The July 2005 dedicated train policy statement identifies the following grounds for DOE's decision (DOE, 2005b):

- "[R]adiological risk resulting from transport [via dedicated train] without incident may be lower due to decreased time in transit."
- Dedicated trains have "potential advantages" for security, although "DOE shipments have been and will continue to be made securely using both [dedicated train service] and general freight service."
- The "primary benefit" of dedicated trains would be "significant cost savings over the lifetime of the Yucca Mountain project" because any higher costs of dedicated train operations would be offset by savings from shorter transit and turnaround times, which allow operations with fewer packages and railcars.

Although not cited in DOE's policy statement, a study by the Federal Railroad Administration (FRA) on use of dedicated trains provides support for DOE's arguments. The study was prepared in response to a congressional directive and transmitted by the Secretary of Transportation to Congress in September 2005 (FRA, 2005).[30] The study concluded that

[30]This study was released after the committee's last meeting, so the committee did not have an opportunity to review and analyze it in detail.

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dedicated train service would result in lower risk to the general public than general train service from radiological exposure in incident-free operations; the probability that a package carried in a dedicated train will be involved in an accident is lower than for a regular service train; a package on a dedicated train has lower risk of being exposed to an engulfing fire in the event of an accident; and radiological exposure in the event of a severe accident involving a dedicated train would be less, compared with a comparable accident involving a regular train, because wreckage could be cleared more quickly. The study also concluded that "regardless of the type of train, the potential exposures are essentially benign when compared to a lifetime of normal background radiation exposure . . ." (FRA, 2005, p. 3).

FRA acknowledges that its study did not compare the risks, for dedicated trains and regular service, of injuries and fatalities that result from train accidents and are unrelated to radiation exposure. As noted above, the 1998 RSPA study (DOT, 1998) concluded that the use of dedicated trains would lead to greater losses of this kind, compared with regular train service, because the use of dedicated trains would increase the total nationwide annual train-miles of traffic. However, the FRA report argues that the disadvantage of dedicated trains in this respect would be less than proportional to the increase in train-miles because superior equipment and operational requirements would be placed on dedicated trains and because the frequency of some operations that carry higher risks, such as switching at the origin point of the shipment, would be the same whether dedicated trains or regular service were employed.

Although DOE's policy statement on dedicated trains, along with the railroads' professed unwillingness to handle spent nuclear fuel in regular service, would appear to settle the question, critics of DOE's Yucca mountain repository plan have noted that the wording of the policy statement is vague on some points. In particular, the meaning of the term "usual rail transport" and the significance of the statement that "DOE shipments have been and will continue to be made securely using [dedicated trains] and general freight service" have been questioned.[31]

In summary, the committee's recommendation that DOE implement its dedicated train decision before commencing the large-quantity shipment of spent fuel and high-level waste to Yucca Mountain is based on the following operational, safety, security, communications, planning, and programmatic advantages:

- *Increased efficiency of operations*. The use of dedicated trains would allow greater control over schedules and routes, reduce travel times

[31]Senator Harry Reid and Senator John Ensign, letter to Hon. Samuel W. Bodman, Secretary, Department of Energy, August 17, 2005, *http://reid.senate.gov/record2.cfm?id=244114*.

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to the repository, and simplify tracking. This could increase throughputs and reduce costs for equipment (conveyances and packages) and escort personnel, and allow more flexibility in the planning and deployment of those escorts.

- *Increased safety of operations.* Reduced travel times would help limit worker[32] and public radiation exposures during incident-free transport (see Chapter 3). If desired and feasible, such trains also could be routed to avoid major population centers. The separation of spent fuel and high-level waste shipments from other freight would reduce the potential for accidents involving very long duration fires (see Chapters 2 and 3). Dedicated trains can be designed and operated to higher safety standards than are currently required for general trains, further reducing the potential for accidents, especially train derailments.
- *Increased security of operations.* Security concerns have become more central to this issue since the September 11, 2001, attacks on the United States. These concerns, especially with respect to layovers in rail yards and routing through large population centers, have not been fully addressed by previous studies. The use of dedicated trains would help reduce transit times and therefore reduce opportunities for malevolent acts, especially in rail yards. Additional security escorts also could be added more easily to dedicated trains when needed.
- *Reduced program risks.* An accident involving spent fuel or high-level waste transport packages could cause substantial program delays, particularly if it involves fatalities and/or results in damage to the transportation package, even in the absence of any radiation releases. The use of dedicated trains would allow DOE greater control over avoidance of situations (e.g., avoid tunnels, switching yards, and peak traffic conditions on heavily traveled corridors; minimize stops in yards and on sidings) that could contribute to such accidents.

5.2.4 Acceptance Order for Commercial Spent Fuel Transport to a Federal Repository

FINDING: The order for accepting commercial spent fuel that is mandated by the Nuclear Waste Policy Act (NWPA) was not designed with the transportation program in mind. In fact, the acceptance order prescribed by the NWPA could require DOE to initiate its transportation program with long cross-country movements of younger (i.e., radiologically and thermally hotter) spent fuel from multiple commercial sites. There are clear transportation operations and safety advantages to be gained from shipping older

[32]As shown in Table 3.8, some estimated worker exposures for the Yucca Mountain transportation program are at DOE administrative limits; however, public doses are much lower.

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(i.e., radiologically and thermally cooler) spent fuel first and for initiating the transportation program with relatively short, logistically simple movements to gain experience and build operator and public confidence.

RECOMMENDATION: DOE should negotiate with commercial spent fuel owners to ship older fuel first to a federal repository or federal interim storage, except in cases (if any) where spent fuel storage risks at specific plants dictate the need for more immediate shipments of younger fuel. Should these negotiations prove to be ineffective, Congress should consider legislative remedies. Within the context of its current contracts with commercial spent fuel owners, DOE should initiate transport through a pilot program involving relatively short, logistically simple movements of older fuel from closed reactors to demonstrate the ability to carry out its responsibilities in a safe and operationally effective manner. DOE should use the lessons learned from this pilot activity to initiate its full-scale transportation program from operating reactors.

The NWPA, as amended, establishes the order in which DOE must accept spent fuel from commercial reactors for transport to Yucca Mountain (Appendix C and Sidebar 5.2). The NWPA specifies that DOE must accept spent fuel based on the amount and order in which it was discharged from the owner's reactors. Each time a nuclear plant discharges fuel from its reactor, its owner receives an allocation in the "acceptance queue" to ship an equivalent amount of spent fuel to the federal repository. DOE will accept commercial spent fuel for shipment to the federal repository starting at the beginning of the queue and will work its way through the queue during the planned 24-year life of the transportation program. The NWPA allows owners to ship any spent fuel from any of their sites for each of their allocations in the acceptance queue.

There are two exceptions to this requirement (see Sidebar 5.2):

1. DOE may accord priority for acceptance of spent nuclear fuel from reactors that have been permanently shut down.
2. The owners of spent fuel can exchange positions in the acceptance queue, but only with the approval of DOE.

The latest report on acceptance priority ranking and annual capacity, which DOE is required to issue annually under its standard contract with commercial spent fuel owners (see Sidebar 5.1), was issued in July 2004 (DOE, 2004f). This report provides DOE's current plans for accepting commercial spent fuel for transport to Yucca Mountain. This ranking shows that DOE will nominally be required to accept 400 MTHM of commercial spent fuel during the first year of repository operations (estimated in the

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SIDEBAR 5.2 Order for Acceptance of Commercial Spent Fuel for Shipment to a Federal Repository

The NWPA establishes the order in which DOE must accept commercial spent fuel from its owners for disposal at a federal repository. The NWPA specifies that DOE must accept spent fuel based on the amount and order in which it was discharged from the owner's reactors. Each time a nuclear plant discharges fuel from its reactor, its owner receives an allocation in the "acceptance queue" to ship an equivalent amount of spent fuel to the federal repository. DOE will accept commercial spent fuel for shipment to the federal repository starting at the beginning of the queue and will work its way through the queue during the planned 24-year life of the transportation program. There are two exceptions to this rule, which are discussed in Sidebar 5.1.

The main advantage of this acceptance system is that it provides an equitable order for acceptance of spent fuel. Owners who have allocations near the beginning of the acceptance queue made earlier payments into the Nuclear Waste Fund and have had to bear the costs for on-site spent fuel storage for a longer period of time. These owners are able to ship their spent fuel to the federal repository first, relieving them of further on-site storage costs. Owners who have more recent allocations in the acceptance queue will be required to maintain on-site spent fuel storage until they move to the front of the queue.

This acceptance system has two significant disadvantages, however. First, it will require that DOE make multiple shipments from multiple reactor sites during its planned 24-year transportation program. Second, the NWPA allows owners to ship any spent fuel from any of their sites for each of their allocations in the acceptance queue. Owners are likely to have a strong preference to ship spent fuel that is stored in spent fuel pools to free up space and reduce the need for (and expense of) future movements of spent fuel into dry casks. Some of the fuel offered for shipment could be recently discharged and radiologically active. Both of these factors could greatly complicate planning and execution of the transportation program and increase overall transportation risks.

report to be 2010) in 16 allocations from spent fuel owners (Table 5.1). The acceptance rate ramps up to 3000 MTHM in 39 allocations by 2014.

Some of the allocations (see column 4 of Table 5.1) are not large enough to fill even a single transportation package. Unless multiple allocations are combined,[33] there could be a large number of partially filled packages transported to Yucca Mountain. This could greatly increase the number of total shipments to the repository. For rail shipments, DOE may have to marshal packages from several reactors in rail yards to reduce the total number of trips to Yucca Mountain.

[33]In some cases, a single owner may hold several allocations in a given year. In other cases, allocations can be traded or purchased, subject to DOE review and approval. See Sidebar 5.1.

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TABLE 5.1 Spent Fuel Annual Capacity and Acceptance Priority Ranking

Year of Repository Operation[a]	Quantity of Spent Fuel to Be Shipped to Repository (MTHM)	Number of Allocations in Acceptance Queue[b]	Range of Allocation Quantities[c] (MTHM)
1	400	16	0.1–145
2	600	23	0.1–72
3	1200	26	0.1–251
4	2000	37	0.1–467
5	3000	39	0.1–488
6	3000	39	0.1–452
7	3000	43	0.1–420
8	3000	47	0.1–375
9	3000	50	0.1–524
10	3000	46	0.1–444

[a]After Yucca Mountain is opened.

[b]Number of allocations made to owners of commercial spent fuel. In some cases, owners may have multiple allocations.

[c]Minimum and maximum allocated quantities of spent fuel for the number of allocations listed in column 3.

SOURCE: DOE (2004f).

The term "nominal" is used to describe these acceptances because, as described previously, the owners of the spent fuel will ultimately decide which fuel DOE will be required to transport. Some owners may have multiple allocations in a given year and may own multiple reactors. Under the standard contract, they have the right to designate fuel from any of their reactors for transport up to the combined quantity limits of their annual allocations. Owners are not required to inform DOE of which sites will ship spent fuel until about 5 years prior to the transport date and also are not required to finalize these plans until 12 months in advance of the shipping date. This makes DOE's planning assumptions especially tenuous.

The order for acceptance of spent fuel from commercial owners prescribed by the standard contract could require DOE to initiate its transportation program with movements of spent fuel from multiple, geographically dispersed sites. It gives DOE limited control over the age and radiological content of the fuel that is offered for transport.[34] It provides little opportu-

[34]The lack of DOE control over the age and radiological content of spent fuel offered for transport also has cost and operational implications for the repository receiving facility. DOE is planning to build above-ground spent fuel storage facilities and purchase dry casks so that spent fuel can be aged before being packaged for disposal. Aging is necessary because DOE has limited control over the radiological content of the spent fuel that is shipped for disposal.

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nity for optimizing the transportation program to reduce the total number of shipments or the need for maintaining large numbers of transportation routes and for emergency responder training.

The order in which fuel is shipped to Yucca Mountain has important implications for safety, operational efficiency, and possibly the security of a Yucca Mountain transportation program. For reasons described in more detail below, it would be preferable from a safety standpoint to ship older spent fuel first to the federal repository. Under the current standard contract system, owners of commercial spent fuel are not required to ship older fuel first, however. The oldest fuel at many operating commercial reactors now resides in dry casks.[35] These casks were purchased and loaded by the owners, and some of these casks are licensed only for storage. They represent significant sunk costs,[36] which continue to grow as more plants resort to dry storage. Owners are likely to have a strong preference to give DOE their more recently discharged spent fuel, which is stored in pools at nuclear plant sites. This would free up pool space and reduce the need for (and the expense of) future movements of spent fuel into dry casks.[37]

Under current USNRC regulations, owners are required to store spent fuel in their pools (see Sidebar 1.4) for one year[38] before it can be transported. Owners could in principle designate one-year-old fuel for transport to Yucca Mountain. This could necessitate the purchase by DOE of transport packages with heavy shielding and active cooling systems[39] to maintain adequate cooling and reduce external radiation doses to workers and

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[35]Current industry practice is to store only spent fuel that is older than five years in dry casks. See Sidebar 1.4.

[36]Each dry cask can cost $1 million or more to purchase and load, and the storage facilities can cost several tens of millions of dollars to license, construct, and protect. The federal government may be legally liable for those costs that occurred as the result of the failure of DOE to begin accepting spent fuel from commercial nuclear power plants in 1998.

[37]In December 2005, legislation was introduced into Congress that would require plant operators to move spent fuel from pools to dry casks at their sites within six years of its discharge from the reactor. The legislation would also require DOE to take title to the spent fuel once it is moved to dry casks and full responsibility for maintaining dry storage. The intent of this legislation is to eliminate the short-term need for a federal repository. However, if the legislation were to become law and a federal repository were to be opened, DOE could presumably ship spent fuel in whatever order desired because it would already have title to that fuel.

[38]This requirement dates to the 1970s when industry planned to ship spent fuel for reprocessing within 90–120 days of its discharge from the reactor. This would have required heavily shielded packages with active cooling systems. The requirement was established to provide enough time for iodine-131 (which has an 8-day half-life) in the fuel to decay.

[39]These packages have pumps and heat exchangers to remove decay heat from the spent fuel. Active cooling is generally required for spent fuel that is less than about three years old. Currently, there are no certified spent fuel transportation packages with active cooling systems in the United States.

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the public. Designation of any fuel younger than five years old might require DOE to seek additional transport package approvals from the USNRC and to ship only partially filled packages to meet external dose requirements.

A recent Government Accountability Office study for Congress explores some of these issues (GAO, 2003). The GAO concluded that transport risks would be reduced by moving larger quantities of spent fuel per shipment and by deliberate selection of the order for picking up spent fuel from commercial nuclear plant sites. The report argues that reducing the number of shipments reduces risks because moving spent fuel in fewer, larger shipments would present fewer chances for accidents and fewer targets for terrorists. It would also simplify the problems of tracking and protecting shipments, and it would reduce routine exposure of workers to radiation. GAO found that the standard contracts between DOE and industry constrain DOE's ability to minimize the number of shipments or to control the order in which stocks of spent fuel are picked up.

GAO analyzed DOE's current plans for acceptance of spent fuel from commercial nuclear plant sites. It estimated that the 12 utilities with the largest quantities of spent fuel would make 576 shipments, with each shipment consisting of up to three rail packages, based on this current plan. GAO determined that if each owner consolidated its fuel into shipments of five full rail packages, total shipments would be reduced by roughly half to 287 (GAO, 2003, pp. 18–19).

The GAO study also found that properly selecting the order of shipment of spent fuel could reduce transportation and storage risks in three ways:

1. Early shipments of fuel from shut-down reactors would reduce the number of spent fuel storage sites. GAO found that nine spent fuel storage sites are not accumulating any additional fuel and could be cleared of their stocks, eliminating them as potential terrorist targets.
2. Early shipment of fuel from storage pools would reduce the likelihood of a pool fire, which could result from sustained loss of coolant from a spent fuel storage pool (see NRC, 2005d).
3. Shipping the older fuel first would reduce radiological transportation risks.

Selecting the shipment schedule that minimized risk would require an analysis to find the right balance between the advantages of moving older fuel first and of removing fuel from pool storage. However, GAO observed that under the terms of the standard contract, DOE cannot choose the order and locations of shipments according to age or form of present storage of the spent fuel. Contracts guarantee utilities positions in the queue for

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shipping specified quantities of spent fuel, and each utility can decide which fuel it wishes to ship within each of its allocated slots.

GAO did not recommend that DOE necessarily change the standard contracts. Rather, it noted that the absolute magnitude of risk reduction that could be obtained is unknown; therefore, it is unknown whether the benefits would justify the costs entailed in renegotiating the contracts and changing spent fuel owners' disposal plans. GAO recommended that DOE evaluate the potential benefits of selecting the order of shipments to minimize risk (GAO, 2003, p. 24).

In the committee's judgment, there are substantial transportation safety advantages (and possibly security advantages[40]) to be gained from moving the older fuel first.[41] This fuel has relatively low burn-ups (typically 25,000–30,000 megawatt-days per metric ton) relative to more recently discharged spent fuel (with burn-ups approaching 60,000 megawatt-days per metric ton). The low burn-up fuel emits less decay heat and radiation. Some of the oldest spent fuel has been in storage for several decades, enough time for the shortest-lived radionuclides to decay to background levels (Figure 5.2). Shipping this fuel first would provide an additional margin of safety, especially in reducing the potential hazards to workers and the public during both normal[42] and accident conditions.

The wording of the committee's recommendation was carefully constructed in recognition that there could conceivably be at-plant storage risks that might dictate earlier-than-desirable (from a transportation standpoint) movements of younger spent fuel to a federal repository or federal interim storage. The committee has not examined at-plant storage risks and

[40]As noted in Chapter 1, the committee was unable to perform an assessment of transportation security. If security threats do turn out to be a serious concern for spent fuel transport, then shipping older fuel first could help to reduce those threats by reducing inventories of radioactive materials in transportation packages.

[41]While not the subject of this report, shipping younger spent fuel first is also not optimal from a repository operations standpoint because that fuel may have to be stored for aging in surface facilities before being emplaced underground. This could require the construction of additional above-ground storage pads, the acquisition of additional storage packages, and additional handling steps. See also Footnote 34.

[42]While public exposures from routine transportation are already very low, this is not necessarily the case for transport workers. As shown in Table 3.8, for example, some transport workers involved in the program to ship spent fuel and high-level waste to the federal repository are estimated to receive the maximum doses allowed under DOE administrative guidelines. However, these guidelines also specify that exposures should be as low as reasonably achievable (ALARA). Shipping older fuel could help reduce these exposures.

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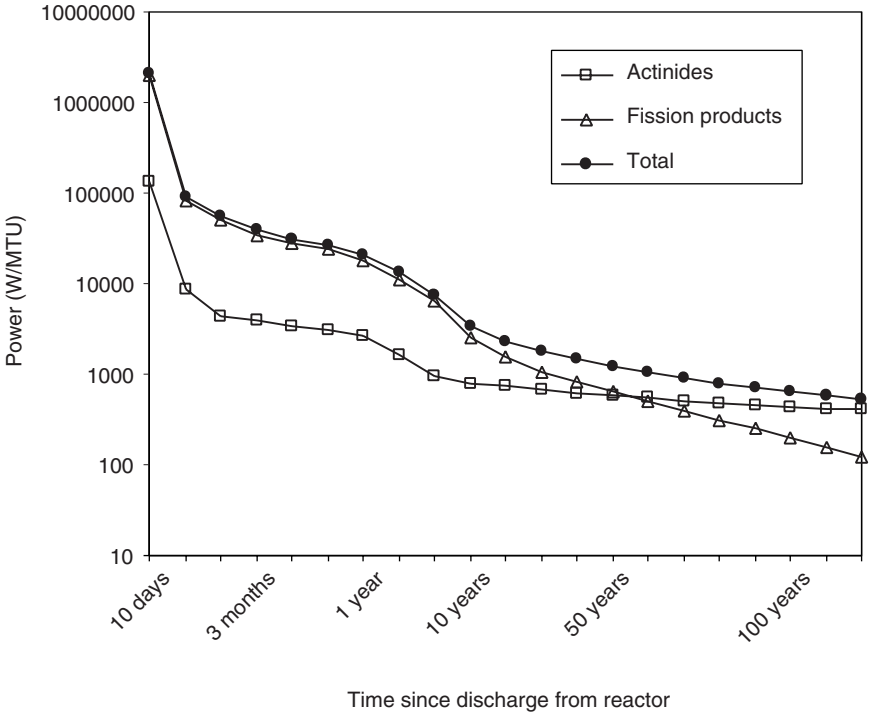

FIGURE 5.2 Plot of decay heat power (watts per metric ton of uranium) as a function of time (on a logarithmic scale) for commercial spent fuel after discharge from a reactor. Decay heat drops by about a factor of 100 during the first year after its removal from a reactor. SOURCE: NRC (2005d).

does not know if they are significant.[43] Nevertheless, the committee sees several practical difficulties in carrying out analyses to identify such risks as part of DOE's acceptance order negotiations with spent fuel owners:

- USNRC regulations require that spent fuel be stored at plant sites in a safe and secure manner, and the Commission and industry have repeatedly asserted that at-plant storage is safe and secure (see NRC, 2005d).
- Consequently, a plant owner could place itself in legal and regula-

[43]A recent National Academies report (NRC, 2005d) examined the safety and security risks of spent fuel storage at commercial power plant sites. That report concluded that immediate steps should be taken to improve the security of pool storage and that additional analyses should be undertaken.

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tory jeopardy if it told DOE that it needed to ship younger spent fuel to reduce on-site storage risks.

- DOE lacks the data or authority to carry out at-plant storage risk analyses.

Moving old fuel first has a collateral benefit: Much of this fuel is in pool or dry storage at 15 of 23 permanently shut-down reactors (Table 5.2). These reactors are located throughout the United States. There would be several benefits of shipping spent fuel from these shut-down sites as early as possible in the transportation program:

- As noted previously, DOE has the authority under its standard contracts with spent fuel owners to choose the time and order in which it will ship from these shut-down sites. This provides operational flexibility during the early years of the transportation program, when DOE needs it most.
- DOE could initiate its transportation program by shipping spent fuel from one or two sites that were located close to main line rail routes, thereby reducing burdens on federal agencies and/or states for route security inspections, emergency responder training, and en route inspections.
- Some of these shut-down sites have enough stored spent fuel to support an extended shipping campaign, which would further reduce burdens for inspections and emergency responder training.
- Some of these shut-down sites have enough stored spent fuel to support greater than three-package rail shipments, which is currently the nominal DOE shipping configuration. Such shipments could help reduce program schedules and costs, reduce the total number of shipments to the federal repository, increase the cost-effectiveness of dedicated trains, and decrease any long-term safety or security concerns from leaving this material at these shut-down sites.
- Some of the spent fuel at these shut-down sites has already been placed into transport-ready form, and most of these sites have rail access.
- Removal of spent fuel from these sites would allow earlier license termination and site closure.

In short, shipping the older fuel first from shut-down plants would give DOE a better ability to optimize routing, scheduling, and emergency responder planning and training, especially during the early phases of its transportation program.[44] As experience is gained, longer movements could

[44]Of course, it might also subject DOE to increased political pressures to accept spent fuel first from certain sites or states, which could result in a suboptimal transportation program.

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TABLE 5.2 Permanently Shut-down Commercial Nuclear Reactors in the United States

Reactor Unit Name	Location	Reactor Type (Thermal Output, MW)
Vallecitos	California	BWR (50)
CVTR	South Carolina	Heavy water (65)
Pathfinder	South Dakota	Superheat BWR (190)
Fermi 1	Michigan	Breeder (200)
Saxton	Pennsylvania	PWR (28)
Indian Point 1	New York	PWR (615)
Peach Bottom 1	Pennsylvania	HTGR (115)
Humbolt Bay 3	California	BWR (200)
Dresden 1	Illinois	BWR (700)
Three Mile Island 2	Pennsylvania	PWR (2772)
Shippingport[b]	Pennsylvania	PWR (~200)
LaCrosse	Wisconsin	BWR (165)
Fort St. Vrain	Colorado	HTGR (842)
Rancho Seco	California	PWR (2772)
Shoreham	New York	BWR (2436)
Yankee Rowe	Massachusetts	PWR (600)
San Onofre 1	California	PWR (1347)
Trojan	Oregon	PWR (3411)
Millstone 1	Connecticut	BWR (2011)
Haddam Neck	Connecticut	PWR (1825)
Maine Yankee	Maine	PWR (2772)
Big Rock Point	Michigan	BWR (67)
Zion 1, 2	Illinois	PWR (3250 each)

NOTE: BWR = boiling water reactor; HTGR = high-temperature gas reactor; PWR = pressurized water reactor.

[a]As of December 31, 2002.

[b]DOE was responsible for decommissioning this reactor and moving spent fuel into off-site storage.

be added. Such an operation could be part of a pilot program by DOE to gain experience and build public confidence[45] by demonstrating an ability to transport spent fuel to Yucca Mountain in a safe, secure, and operationally effective manner. These advantages are further elaborated in another National Research Council report (NRC, 2003).

[45]A University of New Mexico survey suggests that public concerns about the program to transport transuranic waste to the WIPP repository in New Mexico were reduced once the shipping program was under way and waste was being shipped on a routine basis. See Section 3.2.1.

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Shutdown Year	Location of Spent Fuel Storage	Quantity in On-site Storage (MTHM)[a]
1963	Off-site	NA
1967	Off-site	NA
1967	Off-site	NA
1972	Off-site	NA
1972	Off-site	NA
1974	On-site	31
1974	Off-site	NA
1976	On-site	29
1978	On-site	91
1979	Off-site	NA
1982	Off-site	NA
1987	On-site	39
1989	On-site	15[c]
1989	On-site	229
1989	Off-site	NA
1991	On-site	128
1992	On-site	245
1992	On-site	360
1995	On-site	526
1996	On-site	448
1996	On-site	543
1997	On-site	71
1998	On-site	1021

[c]The spent fuel is stored in an on-site ISFSI licensed by the USNRC. DOE took title to the fuel in 1999.

SOURCES: USNRC. 2004. Fact Sheet on Decommissioning Nuclear Power Plants. *http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/decommissioning.html*; DOE (2004f, Appendix A); information on Shippingport and Ft. St. Vrain from various sources.

5.2.5 Emergency Response Planning and Training

FINDING: Emergency responder preparedness is an essential element of safe and effective programs for transporting spent fuel and high-level waste. Emergency responder preparedness has so far received limited attention from DOE, states, and tribes for the planned transportation program to the federal repository. DOE has the opportunity to be innovative in carrying out its responsibilities for emergency responder preparedness. Emergency responders are among the most trusted members of their communities. Well-trained responders can become important emissaries for DOE's trans-

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portation program in local communities and can enhance community preparedness to respond to other kinds of emergencies.

RECOMMENDATION: DOE should begin immediately to execute its emergency responder preparedness responsibilities defined in Section 180(c) of the Nuclear Waste Policy Act. In carrying out these responsibilities, DOE should proceed to (1) establish a cadre of professionals from the emergency responder community who have training and comprehension of emergency response to spent fuel and high-level waste transportation accidents and incidents; (2) work with the Department of Homeland Security to provide consolidated "all hazards" training materials and programs for first responders that build on the existing national emergency response platform; (3) include trained emergency responders on the escort teams that accompany spent fuel and high-level waste shipments; and (4) use emergency responder preparedness programs as an outreach mechanism to communicate broadly about plans and programs for transporting spent fuel and high-level waste to a federal repository with communities along planned shipping routes.

The transportation of spent nuclear fuel to a federal repository would utilize the same state, tribal, and local emergency response capabilities that are in place to deal with existing hazardous materials transport accidents and incidents (see Appendix C). DOE has special responsibilities under the NWPA to ensure that emergency response capabilities and training are adequate to support its repository transportation program. It is responsible under the NWPA for providing technical assistance and funding to states and tribal nations for training on both routine transportation procedures and emergency response. These responsibilities are enumerated in Section 180(c):

> The Secretary shall provide technical assistance and funds to States for training for public safety officials of appropriate units of local government and Indian tribes through whose jurisdiction the Secretary plans to transport spent nuclear fuel or high-level radioactive waste. . . . Training shall cover procedures required for safe routine transportation of these materials, as well as procedures for dealing with emergency response situations. The [Nuclear] Waste Fund shall be the source of funds for work carried out under this subsection.

DOE issued a statement of policies and procedures for providing such assistance in an April 1998 *Federal Register* notice (DOE, 1998b). This statement was the product of more than three years of work by DOE staff and involved several rounds of *Federal Register* notices and public comments. DOE has determined that this latest notice will remain in draft form

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"until program progress or legislation provides definitive guidance as to when shipments will commence. At that time, OCRWM may finalize these policy and procedures or will consider promulgating regulations on Section 180(c) implementation" (DOE, 1998b, p. 27353).

This notice addresses training for both safe routine transportation and emergency response situations. The draft notice states (DOE, 1998b, p. 23754):

> It is OCRWM's policy that, for NWPA shipments, each responsible jurisdiction will have the training necessary for safe routine transportation of spent nuclear fuel or high-level waste and to respond to NWPA transportation incidents or accidents. OCRWM will provide training and technical assistance, subject to annual appropriations, to assist states and tribes to obtain access to the increment of training necessary to prepare for NWPA shipments. . . . If Congress does not fully appropriate the funds requested, the funding to eligible jurisdictions will be decreased proportionately.
>
> For safe routine transportation of spent nuclear fuel and high-level waste, it is OCRWM's policy to provide each eligible state and tribe the funding and technical assistance to prepare for safety and enforcement inspections of NWPA highway shipments, for rail measures that complement FRA inspection procedures, and for access to satellite tracking equipment and training on that equipment in cases where the capability does not already exist.

To carry out this policy, DOE intends to make two types of grants available to eligible states and tribal nations:

1. One-time planning grants of $150,000[46] to help eligible jurisdictions determine their needs for training funds and technical assistance. The amount of the grant is based on DOE's experience with planning for shipments to WIPP in New Mexico.
2. Base grants for safety and enforcement planning and training activities. Such grants will be available on an annual basis for up to five years and will consist of two parts: The first part will be for safety and enforcement inspection training and awareness-level training, awareness-level refresher training, and emergency responder trainer training (see Sidebar 5.3). The second part will be for enhanced emergency responder training such as operations- or technician-level training. The amount of funding available to a particular jurisdiction is based on need as determined by DOE.

States and tribal nations will be eligible to apply for grants approxi-

[46]The committee observes that this is a very small amount of funding to cover an assessment of statewide needs.

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SIDEBAR 5.3 Emergency Responder Training

Emergency responder training requirements are established by federal regulation. Occupational Safety and Health Administration regulations (29 CFR 1910.120) require that emergency responder training for "hazardous substances" (which includes radioactive materials) be based on the duties and function of each person in the emergency response organization. These regulations describe five levels of training proficiency and require that individuals receive sufficient annual refresher training to maintain their competence or else demonstrate competence on at least an annual basis.

1. *First-responder awareness level.* This training is for individuals who are likely to discover the hazardous release and who have been trained to initiate the emergency response by notifying the proper authorities. These individuals would include most public safety personnel, including police officers and firefighters, and possibly highway maintenance workers. Such individuals are required to have training or sufficient experience to demonstrate competence in recognizing the presence of hazardous substances in an emergency; the risks and potential outcomes associated with these substances; and the ability to recognize the need for additional resources and to make appropriate notifications.
2. *First-responder operations level.* This training is for individuals who respond to actual or suspected releases of hazardous substances and are responsible for defensive actions to protect people, property, and the environment. They are responsible for keeping the release from spreading and preventing exposures. These individuals would likely be part of a hazmat team associated, for example, with a fire company. Operations-level responders are required to have at least eight hours of training or sufficient experience to demonstrate competence beyond a basic awareness level in the following: knowledge of basic hazard and risk assessment techniques; selection and use of operational-level protective personnel equipment; basic hazardous material terms; basic containment, confinement, or control operations; basic decontamination techniques; and relevant operating procedures.
3. *Hazardous materials technician.* This training is for individuals who are responsible for stopping hazardous substance releases to the environment. They

mately four years before shipments are scheduled to commence through or along the borders of their jurisdictions. DOE estimates that it will take as long as one year for the application process to be completed, which will leave approximately three years for the assistance program to be implemented. DOE will notify the governor or tribal leader in writing when the jurisdiction becomes eligible to apply for these grants. Jurisdictions will be asked to select an agency or representative to apply for and administer the grants.

Only state and tribal organizations are eligible to apply for these grants. However, states and tribes are required to coordinate their planning with local jurisdictions and indicate in the grant application how the needs of

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take aggressive actions in approaching the points of release to plug or patch them. These individuals are required to have at least 24 hours of training at the operations level and, in addition, to demonstrate competence in the following: ability to implement the emergency response plan; knowledge of the classification and verification of known and unknown materials by using survey instruments; ability to function within an assigned role in the incident command system; ability to select and use chemical personnel protection equipment; understanding of hazard and risk assessment techniques; ability to perform advance control, containment, or confinement operations in the capabilities of available protective equipment and resources; understanding and implementing decontamination procedures; understanding basic chemical toxicological terminology and behavior.

4. *Hazardous materials specialist.* This training is for individuals who have similar responsibilities to a hazardous materials technician but with more directed knowledge of the hazardous substances that they are called upon to contain. They are required to have at least 24 hours of training at the technician level and be able to demonstrate competence in the following: ability to implement the local emergency response plan and knowledge of the state response plan; understanding classification, identification, and verification of known and unknown substances using advanced survey instruments; ability to select and use specialized personnel protective equipment; an in-depth understanding of hazard and risk assessment techniques; ability to perform specialized control, containment or confinement operations; ability to determine and implement decontamination procedures; ability to develop a site safety and control plan; understanding of chemical, radiological, and toxicological terminology and behavior.

5. *On-scene incident commander.* This training is for individuals who will assume control of the incident scene. These individuals must receive at least 24 hours of training at the operations level and demonstrate competence in the following: ability to implement the incident command system and emergency response plan; knowledge of the hazards and risks associated with employees working in chemical protective clothing; knowledge of the state emergency response plan and Federal Regional Response Team; knowledge and understanding of the importance of decontamination procedures.

local safety officials have been considered and how incremental training will be provided. This would include a description of where training would be obtained, what drills and exercises would be included in the training, what equipment and supplies would be purchased, and what other technical assistance would be needed from DOE. DOE anticipates that awareness-level training (see Sidebar 5.3) will be made available to local public safety officials and that enforcement training will be made available to state-level and tribal employees. However, it is largely up to the state or tribal nation to determine, in consultation with local governments and first responders, who receives training and at what frequency such training is provided.

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DOE received 19 sets of comments from states and organizations on its proposed policies and procedures. These are enumerated in a *Federal Register* notice.[47] According to the notice (p. 23757), "the large majority of commenters emphasized that they believe that additional change is still needed in key areas, primarily more cooperative route selection and a more cooperative transportation planning process." Several organizations identified the WIPP transportation planning process as a good example of cooperative planning. Some specific comments addressed the following unmet needs, specifically for:

- Improved communications, including early and substantive public outreach, with DOE taking the responsibility for interacting with states and tribes rather than relegating these responsibilities to private contractors.
- Early selection of routes to allow sufficient time for states to designate alternate routes and assess their planning and training needs.
- Policies on early and cooperative selection of routes, especially to avoid the possibility that the selection of too many routes would dilute planning and training resources.
- Training of emergency responders equivalent to Occupational Safety and Health Administration (OSHA) operations-level training (see Sidebar 5.3).

Concerns about transportation planning and emergency responder training continue to be voiced at DOE-sponsored forums such as the Transportation External Coordination (TEC) Working Group meetings (see Section 3.4). A consistent theme expressed at these meetings is the need for DOE to get on with the process of route selection so that states and tribal nations can begin planning and training activities.

DOE's Office of Environmental Management, which is responsible for cleanup of the nation's nuclear weapons sites, has developed the Transportation Emergency Preparedness Program (TEPP) to support training of federal, state, tribal, and local authorities in emergency preparedness and response to transportation incidents involving DOE radioactive materials shipments. The program has designated coordinators in each of DOE's eight regional offices and has been used extensively for WIPP-related emergency preparedness and response. The TEPP provides a number of planning and training tools for state, tribal, and local governments. The planning tools include models for developing needs assessments, preparedness plan-

[47]Office of Civilian Radioactive Waste Management; Safe Routine Transportation and Emergency Response Training; Technical Assistance and Funding. 63 FR 23757–23766, April 30, 1998.

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ning, and response procedures. They also include a "drill-in-a-box" that provides scenarios and materials for preparing and conducting tabletop exercises and drills for transportation incidents. The program provides technical assistance to state and tribal governments for developing, updating, and testing emergency response plans.

TEPP also provides training materials (Modular Emergency Response Radiological Transportation Training [MERRTT]) for emergency managers and responders, firefighters, law enforcement, and related personnel. These materials provide information on fundamental concepts and procedures for responding to radioactive materials transport incidents. The training is organized into a modular format and includes manuals, instructor guides, and overheads. The program offers several train-the-trainer sessions at various locations across the United States for qualified instructors.

The WIPP emergency responder training program is often cited as a good model for transportation planning and emergency response. WIPP's success was somewhat fortuitous, however. Transportation routes to WIPP were not identified early in the program. When DOE made an initial and ultimately unsuccessful effort to open WIPP in 1988, little planning for transportation had been carried out. It took DOE another 11 years (until 1999) to get the repository open, which gave the agency more time to identify routes and provide the necessary training to emergency responders.

Transportation to WIPP ramped up over a period of five years, which provided DOE with time for planning and training. Initially, only one site shipped waste to WIPP: Rocky Flats, near Denver, Colorado. WIPP has now received waste from eight sites. A relatively small number of routes are used for WIPP shipments (Figure 5.3). This has allowed DOE to keep the demand for emergency responder training and coordination to a manageable level.

The WIPP program was willing to go beyond its legally mandated requirements in planning and implementing its transportation program. For example, DOE executed a memorandum of understanding with the WGA and Southern States Energy Board that included emergency response operations. The WGA, in cooperation with DOE, developed the WIPP *Transportation Safety Program Implementation Guide* (WGA, 2003), which governs the conduct of transuranic waste shipments through the western states, including the conduct of emergency response operations. The Southern States Energy Board (SSEB, 1994) developed the *Transuranic Waste Transportation Handbook*, which serves as a primer for waste transportation through its member states.[48] The Council of State Governments' Midwest-

[48]DOE also provided funding to New Mexico to help construct a highway bypass around Sante Fe for WIPP shipments.

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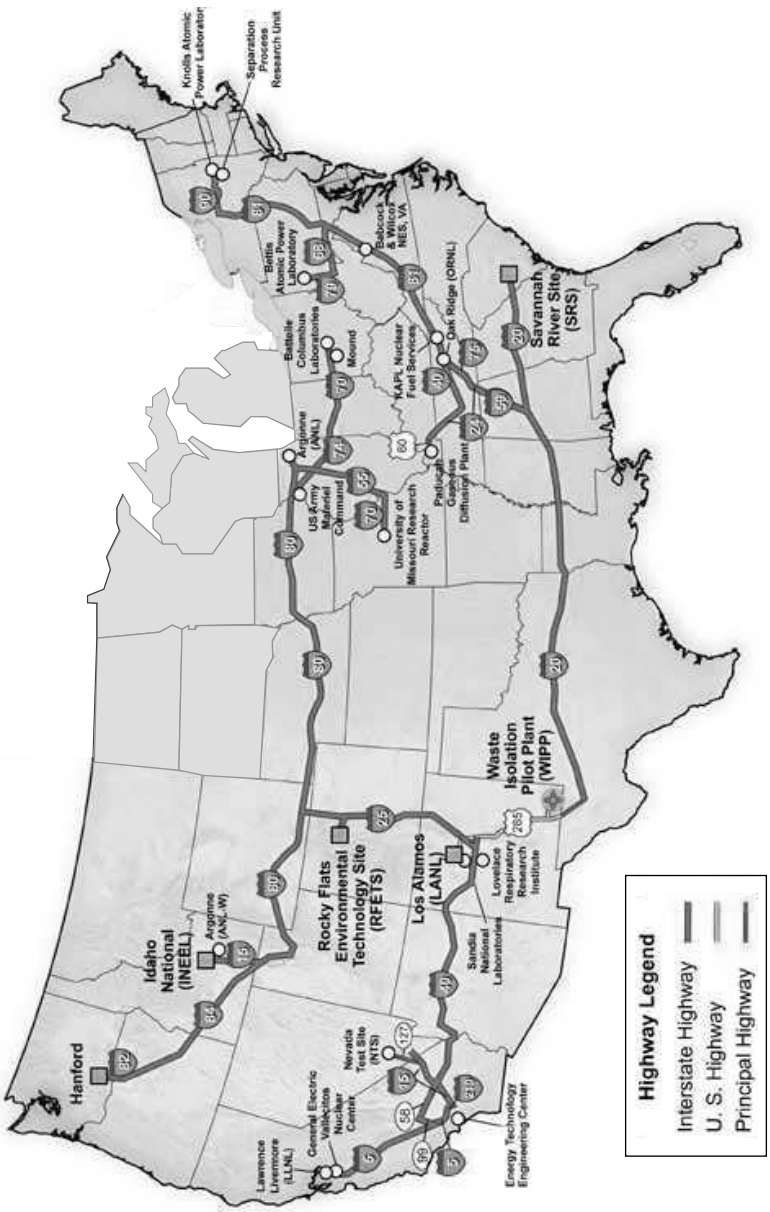

FIGURE 5.3 Routes used for shipping transuranic waste to the Waste Isolation Pilot Plant near Carlsbad, New Mexico. SOURCE: Modified from *http://www.wipp.us/routes.htm*.

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ern Office has also issued guidance for radioactive waste shipments through its member states (CSG, 2004).

WIPP is providing direct training in emergency preparedness and response to first responders along WIPP routes through TEPP. While Section 180(c) of the NWPA requires DOE to provide funds for emergency response training for Yucca Mountain, direct training is not required.

Many lessons from the WIPP transportation program could potentially be applied to Yucca Mountain. DOE's Yucca Mountain Program issued its safe transportation strategic plan in November 2003 (DOE, 2003c). In it, DOE pledged to (p. 2) "approach its transportation planning cooperatively, using a collaborative process that incorporates the successful elements from transportation systems developed for other DOE programs." WIPP is mentioned as such a program.

While the WIPP experience offers some useful lessons, the experience may not be scalable to the Yucca Mountain transportation program. DOE will have to provide training assistance to emergency responders along planned shipping routes in up to 45 states. Even during the early phases of the program, DOE is likely to face demands for training assistance from a dozen or more states along identified transportation routes.

DOE will not begin providing Section 180(c) technical assistance and funding to states until it identifies the routes for shipping spent fuel and high-level waste to Yucca Mountain. The committee sees a clear strategic advantage to DOE in making these decisions and providing at least a base level of assistance at the earliest possible date.

Volunteer and paid emergency responders have been the institutional foundations in many communities since Benjamin Franklin's era and are among their communities' most trusted members. If adequately involved, they can become important emissaries for DOE's program with the local community. When elected officials or members of the public ask "Are these shipments safe?" and "Can our community handle an emergency?" they often look to local emergency response officials for answers. It is in DOE's interests to provide the training and technical assistance necessary for these officials to feel confident that they have the equipment and training needed to respond to any accident or incident involving spent fuel and high-level waste. This training and technical assistance might also help to mitigate some of the social risks described in Chapter 3 (see Section 3.2).

A DOE representative told the committee that training may be ineffective if started too early, given the expected turnover of emergency responder personnel, especially volunteer firefighters, who may experience a 20 percent or higher annual turnover.[49] Although it is true that turnover in some

[49]About 75 percent of the United States is protected by volunteer or only part-paid fire departments. The membership rules for training and proficiency in most volunteer fire depart-

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segments of the emergency responder community is high, especially among volunteers, the committee nevertheless judges that it is never too early to start training. There is a cadre of professionals who will stay in their positions over the long term; they would benefit from early training and they could help DOE with planning for such training. Such early training will be essential for developing appropriate organizational memory and culture and for setting expectations. DOE could focus its early assistance on training-the-trainer and other long-term activities such as planning for equipment procurements, calibrations, upgrades, and replacements of radiation detection instruments used by emergency responders.[50]

There are even benefits, albeit more indirect, to be gained from training volunteer emergency responders who may leave their posts before the transportation program begins operating: these people live in the communities through which these shipments will pass and some are community leaders. They can serve as informal but important sources of information to their communities about DOE's transportation program.

Since DOE's Section 180(c) assistance will reach the majority of states and many tribal nations, the committee sees clear opportunities for innovation. DOE could work with the Department of Homeland Security to provide consolidated all hazards training materials and programs for emergency responders that would provide at least awareness-level training (see Sidebar 5.3). Such programs could reach large numbers of emergency responders well in advance of any route determinations and would help to leverage DOE's limited 180(c) funding. Such training could also help counteract the possible perception among emergency responders, local officials, and members of the public that if special training is needed for spent fuel and high-level waste shipments, transporting such materials must be an especially risky activity.

Another opportunity for innovation involves the deployment of trained emergency responders on the escort teams that accompany spent fuel and high-level waste shipments to Yucca Mountain. These individuals could be given the responsibility for establishing liaisons with tribal and local government emergency responder organizations along transportation routes. Such individuals would provide the first line of emergency response in an

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ments are as rigorous as those for full-time paid fire service, and most volunteer firefighters take enormous pride in their service and competence. While it is true that turnover among volunteers is high, many volunteer departments have a cadre of long-serving members who retain the corporate memory and help to train newcomers.

[50]Some of the nontraining activities could take place under the "technical assistance" clause of the NWPA if sufficient funding is made available by Congress for such purposes. These activities could also be carried out in cooperation with the Department of Homeland Security as part of its activities to upgrade emergency responder preparedness for terrorist attacks.

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accident or incident and would function as a known and trusted resource for local incident commanders. This innovation could be most readily implemented for rail shipments, because these will be fewer in number and will have more space to accommodate escorts.

DOE could also use this state and local interest to communicate more broadly with the public about its transportation program by

- Opening its emergency responder training sessions to selected individuals from local communities, especially opinion leaders,
- Providing emergency responder information through a Web site designed for interested non-experts, and
- Working with local communities and their schools to develop programs to monitor environmental conditions (e.g., radiation levels) along transportation routes.

Although the discussion in this section has focused on the federal repository transportation program operated by DOE, the committee's suggested innovations are also potentially applicable to the transportation program operated by Private Fuel Storage, LLC. This private transportation program has no legal responsibility under the NWPA to support emergency responder preparedness along its shipping routes. To the committee's knowledge, Private Fuel Storage, LLC, has no plans to provide financial aid to communities along its planned transportation routes to support emergency responder training. However, state, tribal, and local communities are likely to take a keen interest in emergency response preparedness in this program. The committee judges that there would be significant benefits to the program in terms of capacity and public confidence building through early and innovative actions to support emergency responder preparedness.

5.2.6 Information Sharing and Openness

FINDING: There is a conflict between the open sharing of information on spent fuel and high-level waste shipments and the security of transportation programs. This conflict is impeding effective risk communication and may reduce public acceptance and confidence. Post–September 11, 2001, efforts by transportation planners, managers, and regulators to further restrict information about spent fuel shipments make it difficult for the public to assess the safety and security of transportation operations.

RECOMMENDATION: The Department of Energy, Department of Homeland Security, Department of Transportation, and Nuclear Regulatory Commission should promptly complete the job of developing, applying, and disclosing consistent, reasonable, and understandable criteria for protecting

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sensitive information about spent fuel and high-level waste transportation. They should also commit to the open sharing of information that does not require such protection and should facilitate timely access to such information: for example, by posting it on readily accessible Web sites.

This finding and recommendation are motivated by several factors. In a representative democracy, citizens have a general right, subject to legitimate privacy and national security restrictions, to obtain information about government programs that affect their communities. Such sharing of information might also help to build community trust and confidence in transportation programs and help implementers to identify and manage the social risks described in Chapter 3 (Section 3.2).

The current study was conceptualized before the September 11, 2001, terrorist attacks on the United States, and its original focus was intended to be on the safety of spent fuel and high-level waste shipments. During the committee's information-gathering meetings, however, several participants expressed concern about the security of spent fuel and high-level waste transport, especially the potential consequences of terrorist attacks on transport packages in highly populated areas. Other participants expressed concerns about the efforts of federal agencies to use the September 11 attacks as a pretext for withholding information that could help the public to evaluate the safety and security of spent fuel and high-level waste shipments. These presenters expressed concern that such withholding could allow the government to operate such programs with little public scrutiny.

The committee itself encountered information restrictions during this study. In compiling historical data on spent fuel shipments in the United States, the committee discovered that the USNRC had removed some of the needed information (USNRC, 1978) from its Web site and document reading room because it was deemed to be too sensitive for public release. The committee saw no reason for withholding this information given that it involved only past shipping campaigns. However, at the committee's request, Commission staff provided the summary data on historical spent fuel shipments for use in this report (Chapter 3). The staff also told the committee that it is now updating and reviewing this historical information to determine what is appropriate for public release.

The committee discussed the possibility of expanding its report to include information on the security of spent fuel and high-level waste transportation. This effort was supported by the federal study sponsors. As noted previously, four members of the committee and one staff member with appropriate security clearances were given a classified briefing by USNRC staff on investigations under way within that agency to assess the security of transportation packages. However, the committee was not able to receive timely written guidance from the study sponsors on what infor-

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mation from these studies and other documents[51] could be released to the public in the committee's final report.

The USNRC has provided guidance to its staff for communicating security risks since the September 11, 2001, terrorist attacks (USNRC, 2004e, f). The guidance notes that "[p]eople who live near power plants and other nuclear facilities have a different sense of the risks they are asked to bear on behalf of the rest of the country" (USNRC, 2004e, p. 54) and recommends that agency officials "clearly establish what information can be shared and what can't" (USNRC, 2004e, p. 52). The guidance notes that information can be shared about additional security personnel, new equipment, and upgraded procedures put in place, but without specifics being disclosed. The guidance also recommends that agency officials clearly state why they cannot share detailed security information. The agency asserts, "Because the public is keenly aware of security concerns most will understand and respect the need to keep certain information classified" (USNRC, 2004e, p. 52).

DOE's transportation program for Yucca Mountain apparently has not yet confronted this issue to the same extent, largely because it is still in the planning stages. However, DOE's Environmental Management program, which is responsible for cleaning up the U.S. nuclear weapons complex, has long grappled with the issue of openness (e.g., Ashford and Rest, 1999; Bradbury et al., 1996a,b, 1997a,b, 2003; Bradbury and Branch, 1999; Drew et al., forthcoming). The TEC Working Group, which advises the Yucca Mountain transportation program, has provided suggestions on best practices to assist DOE program managers "in their efforts to communicate about radioactive materials transportation in a manner that is responsive to the needs and concerns of stakeholders" (TEC, 2002, p. 1). TEC recommends sharing information such as the number of shipments, mode(s), possible route(s), time frame, quantity, type of material being shipped, and reason for making the shipments. Web sites are also considered "good tools for making information available" (TEC, 2002, p. 3).

Some of the information recommended for sharing by TEC is considered by other parts of DOE to be too sensitive to share with the public. For example, the program for transporting transuranic waste to WIPP has restricted information sharing about its shipments. At its Albuquerque meeting, the committee received comments from the representative of a stakeholder group concerning public restrictions on information sharing about these shipments after the terrorist attacks of September 11, 2001 (Hancock, 2004). This representative noted that State of New Mexico officials were no longer allowed to provide shipment schedule information to members of

[51]Some of this information exists in published reports that were removed from public circulation by the government after the September 11 attacks.

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the public, and DOE no longer responded to requests for information about incidents involving these shipments.

Clearly, the public has a right to receive some timely information about the shipments of spent fuel and high-level waste that pass through their communities. The TEC guidance on information sharing described above strikes the committee as a reasonably complete and appropriate guidance for sharing at different times in the life cycle of a shipment or shipping campaign. Some general information is appropriate to share before shipments commence: This includes reasons for making the shipments; general information about the materials to be shipped; possible shipping modes and routes; and general shipping time frames. Appropriate post-shipment information includes more details on the shipments, such as quantities of materials shipped; specific modes and routes used for the shipments; timing of shipments; accidents and incidents during shipments; and any resulting response actions.

Federal agencies need to develop and then abide by clear and consistent guidelines for protecting information about spent fuel and high-level waste transportation activities. The class of information to be protected should be defined clearly and should be small, encompassing only that information that is truly in need of protection. The remaining information should be made freely available to the public through agencies' Web postings and other dissemination channels.

5.3 ORGANIZATIONAL STRUCTURE OF THE FEDERAL TRANSPORTATION PROGRAM

FINDING: Successful execution of DOE's program to transport spent fuel and high-level waste to a federal repository will be difficult given the organizational structure in which it is embedded, despite the high quality of many current program staff. As currently structured, the program has limited flexibility over commercial spent fuel acceptance order (Section 5.2.4); it also has limited control over its budget and is subject to the annual federal appropriations process, both of which affect the program's ability to plan for, procure, and construct the needed transportation infrastructure. Moreover, the current program may have difficulty supporting what appears to be an expanding future mission to transport commercial spent nuclear fuel for interim storage or reprocessing. In the committee's judgment, changing the organizational structure of this program will improve its chances for success.

RECOMMENDATION: The Secretary of Energy and the U.S. Congress should examine options for changing the organizational structure of the Department of Energy's program for transporting spent fuel and high-level

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waste to a federal repository. The following three alternative organizational structures, which are representative of progressively greater organizational change, should be specifically examined: (1) a quasi-independent DOE office reporting directly to upper-level DOE management; (2) a quasi-government corporation; or (3) a fully private organization operated by the commercial nuclear industry. The latter two options would require changes to the Nuclear Waste Policy Act. The primary objectives in modifying the structure should be to give the transportation program greater planning authority; greater budgetary flexibility to make the multiyear commitments needed to plan for, procure, and construct the necessary transportation infrastructure; and greater flexibility to support an expanding future mission to transport spent fuel and high-level waste for interim storage or reprocessing. Whatever structure is selected, the organization should place a strong emphasis on operational safety and reliability and should be responsive to social concerns.

The Yucca Mountain transportation program operates within the larger milieu of the repository development effort (Chapter 1). Consequently, its success will depend to a large degree on the decisions made within DOE, other agencies, and Congress on whether and when to license, construct, and open a federal repository. If completed, the federal repository program will be the most expensive waste disposal effort in U.S. history. Current projected life-cycle costs are $58 billion in 2000 dollars (DOE, 2001d). The transportation program would also be the most expensive effort to ship spent fuel and high-level waste in the nation's history. Its share of the life cycle costs is about $6 billion in 2000 dollars.

Certain characteristics of the Yucca Mountain transportation program will make it exceptionally challenging to carry out successfully: The transportation program

- Will last for more than two decades;
- Is decentralized, encompassing more than 70 sites in 31 states;
- Involves a large number of parties (i.e., industry, regulators, and state, tribal, and local governments) over which it has limited control;
- Must operate with a high degree of consistency and reliability;
- Has limited flexibility over schedules because of the standard contract requirements for acceptance of spent fuel (see Section 5.2.4); and
- Has limited budgetary control within DOE and is subject to the annual congressional appropriations process.

The transportation system is not only physically and logistically complex, but also has a "nested complexity" that derives from the institutional architecture in which it is embedded. The transportation program is embed-

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ded in DOE's OCRWM, which is responsible for constructing and operating a federal repository. The transportation program must compete with the much larger repository development program for personnel, funding, and management attention.

OCRWM has embarked on what some have described (and the committee agrees) is an ambitious schedule to open a Yucca Mountain repository. Its last announced schedule for opening the repository included the following milestones:

- Submission of a repository construction license application to the USNRC in December 2004.
- Approval by the Commission in 2008 to begin construction of the repository and ancillary surface facilities.
- Submission of a license amendment to the USNRC in 2009 to begin receiving waste.
- Approval of this amendment by the USNRC and start-up of repository operations by the end of 2010.

DOE missed the first milestone because of problems with the Environmental Protection Agency Agency's standard for Yucca Mountain and completion of DOE's licensing support network (see Section 1.3.2). A new schedule had not been formally announced by December 2005 when work on this report was being completed, although DOE has stated that Yucca Mountain will not open until 2012 at the earliest.

The transportation program's schedule is linked to the schedule for opening the repository. The last announced schedule for the transportation program included the following milestones:

- Complete work on the Nevada rail EIS and issue a ROD on the specific alignment in early 2006.
- Award the design contract for the rail spur in early 2005 and begin construction of the rail spur in early 2006. According to the final Yucca Mountain EIS (DOE, 2002a), construction is planned to last no more than 46 months at an estimated cost of about $880 million (see Section 5.2.1).[52]
- Issue a request for proposals on rolling stock (i.e., railcars) in early 2005 and begin receiving equipment deliveries in early 2007.
- Undertake an assessment of industry's ability to provide transportation packages of the sizes and quantities needed for the program. Package

[52]As noted previously, DOE acknowledged that the estimated cost for constructing the complete 319-mile (513-kilometer) rail spur had increased to about $2 billion.

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design, certification, and fabrication activities would be carried out in fiscal years 2005 and 2006.

- Complete work on an operational plan and issue a final concept of operations in early fiscal year 2005. This would presumably detail how DOE plans to conduct its transportation operations, including the role of contractors.
- Issue final routing selection criteria in late fiscal year 2005 and its transportation operations plan in late fiscal year 2006.
- Identify a suite of transportation routes in early fiscal year 2006, which will then trigger the awarding of Section 180(c) planning grants (see Section 5.2.5) to states later that fiscal year. Awards of Section 180(c) base grants would be made later in fiscal year 2007.

In October 2005, OCRWM announced that it intended to adopt a standardized package design to transport, store, and dispose of commercial spent fuel. This will require certification of the new package design and modification of the design for the fuel receipt and handling facilities at the federal repository. DOE has not indicated what additional delays may be encountered in the repository program and its associated transportation program to implement these changes.

Funding for the Yucca Mountain Program comes from a combination of direct federal appropriations to cover the costs of disposing of defense spent fuel and high-level waste and the Nuclear Waste Fund (Appendix C) to cover the costs of commercial spent fuel disposal. Both funding sources are controlled by Congress through the annual appropriations process.[53] The transportation program's annual budget request to Congress is submitted as part of the OCRWM budget request based on a target set by the Office of Management and Budget in consultation with DOE management. As shown by Table 5.3, the transportation program's budget has not received high priority within OCRWM, possibly because the overall OCRWM budget has itself been underfunded relative to requested levels during several of the past years. The transportation program will require substantially higher future budgets to construct a Nevada rail line, procure transportation equipment, and make other necessary infrastructure improvements.

While the apparent delay in opening a federal repository would potentially provide more time for the transportation program to attain operational readiness, it introduces other complications. For example, the com-

[53]The Bush administration made an unsuccessful attempt in fiscal year 2005 to exempt the Nuclear Waste Fund from the annual appropriations process. This attempt, which was supported by the nuclear industry, would have provided DOE with a great deal more budgetary discretion.

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TABLE 5.3 Congressional Appropriations for OCRWM and Its Transportation Program

Federal Fiscal Year	OCRWM Request ($ millions)	OCRWM Appropriation ($ millions)	Transportation Program Request ($ millions)	Transportation Program Appropriation ($ millions)
1999	380	353	2	2
2000	409	351	2	2
2001	437	401	3.8	2.7
2002	445	375	5.9	4.6
2003	591	457	30.2	9.4
2004	591	577	73.1	63.6
2005	131[a]	572	186	30.7
2006	651	450[b]	85.4	19.9

[a]DOE requested $880 million, but the Bush administration requested only $131 million for defense waste disposal. The administration intended to obtain the remaining funding from the Nuclear Waste Fund and unsuccessfully attempted to have that fund taken "off budget," which would have freed it from the annual congressional appropriations process.

[b]Does not include the $50 million appropriated by Congress in fiscal year 2006 for initiation of a site selection process for an integrated spent fuel recycling facility.

SOURCE: DOE budget documents and written communications.

mercial nuclear industry could begin shipments of spent fuel to Private Fuel Storage, LLC, in Utah once that facility is constructed and opened.[54] Under current plans, this fuel will be placed in packages (see Sidebar 1.4) for transport and storage. However, unless the industry adopts the new DOE standardized package, which has not yet been designed, licensed, or manufactured, it may be required to repackage the fuel before it can be transported to the federal repository. In the meantime, additional nuclear plants are expected to establish dry-cask storage to relieve growing storage pressures in their pools, and additional plants may be closed and decommissioned. These changes could further affect the transportation program's pickup schedules and require more repackaging of spent fuel for transport to the federal repository.

The recent decision by Congress to promote the development of one or more federal interim storage sites for commercial spent fuel potentially

[54]A license for this facility was submitted to the USNRC in 1997. As noted in Chapter 1, the Commission authorized its staff to issue a license to construct and operate this facility under the conditions in 10 CFR 72.40.

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further complicates DOE's transportation mission. The Energy and Water Development Fiscal Year 2006 report[55] provides the following direction to DOE (italics added):

> Integrated spent fuel recycling.—Given the uncertainties surrounding the Yucca Mountain license application process, the conferees provide $50,000,000, not derived from the Nuclear Waste Fund, for the Department to develop a spent nuclear fuel recycling plan. Under the Nuclear Energy account, the conferees provide additional research funds to select one or more advanced recycling technologies and to complete conceptual design and initiate pre-engineering design of an Engineering Scale Demonstration of advanced recycling technology. Coupled with this technology research and development effort, funds are provided under the Nuclear Waste Disposal account to prepare the overall program plan *and to initiate a competition to select one or more sites suitable for development of integrated recycling facilities (i.e., separation of spent fuel, fabrication of mixed oxide fuel, vitrification of waste products, and process storage) and initiate work on an Environmental Impact Statement. The site competition should not be limited to DOE sites, but should be open to a wide range of other possible federal and non-federal sites on a strictly voluntary basis. The conferees remind the Department that the Nuclear Waste Policy Act prohibits interim storage of nuclear waste in the State of Nevada.* To support the development of detailed site proposals for this competition, the conferees make a total of $20,000,000 available to the site offerors, with a maximum of $5,000,000 available per site. To be eligible to receive these funds, each applicant site must be able to identify all state, regulatory, and environmental permits required for permitting this facility, including identifying any legislative or regulatory prohibitions that might prevent siting such a facility. The conferees direct the Secretary to submit a detailed program plan to the House and Senate Committees on Appropriations not later than March 31, 2006, and to initiate the site selection competition not later than June 30, 2006. The target for site selection is fiscal year 2007, and the target for initiation of construction of one or more integrated spent fuel recycling facilities is fiscal year 2010.

The development of an integrated spent fuel recycling facility will likely require interim storage at the recycling facility as well as additional transportation capacity, possibly involving a different mix of transportation packages, conveyances, and routes than for the federal repository.

Even if Yucca Mountain fails to receive a license and an integrated spent fuel recycling facility is never constructed, the federal government may still require a transportation capability to move commercial spent fuel

[55]House Report 109-275 Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 2006, and for Other Purposes.

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to one or more centralized storage sites to meet its commitments under the NWPA (see Chapter 1 and Appendix C).[56] This fact alone argues for the establishment of a generic federal transportation capability that could service a repository and possibly other government transportation needs. Under the current organizational structure for the transportation program, all of the federal government's transportation "eggs" have been placed in the federal repository basket.

The current transportation program is unusual in another sense: The committee knows of no other federal government-run program that has a mission to take ownership of private-sector waste for the purposes of transport and disposal.[57] Such programs are usually private-sector responsibilities. The government's usual role is to control and regulate such activities.

Several members of the committee have extensive experience with the design and operation of large transportation programs. Their experience suggests that such programs are more likely to be successful when they have the following:

- An appropriately focused mission;
- A systems-driven focus on the mission;
- Authority to carry out the mission and accountability for failure;
- Independent and strong regulatory oversight;
- Continuity and predictability of funding; and
- Alert, flexible, and responsive management.

OCRWM's transportation program lacks some of these attributes. The current program is focused on transport to Yucca Mountain; it is not organized to provide a generic transportation capacity that could serve the government's other transportation needs. The transportation program director's authority for carrying out the mission is limited because priorities

[56]The fiscal year 2006 House Energy and Water Development Appropriations Bill directed DOE to begin accepting commercial spent fuel for interim storage at a government site within 12 months, but this language was not included in the final conference report.

[57]Amtrak, a government-chartered corporation, has carried private-sector freight. The federal government has programs for the shipment of government-owned materials and wastes. For example, the military has transportation programs for moving military materials and wastes. DOE has transportation programs for shipping nuclear weapons and naval spent fuel. It also has transportation programs for shipping the wastes from its environmental cleanup programs at defense sites. Transport of non-DOE domestic and some foreign research reactor spent fuel is the responsibility of reactor operators (see Chapter 4). DOE is responsible for the transport of some foreign research reactor fuel, but this fuel is of U.S. origin and, because it contains HEU (see Chapter 4), is a proliferation concern.

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are set at higher levels in the department. In principle, accountability follows authority. The program is partially self-regulating (see Table 1.3). There is little continuity, predictability, or rationality of funding in the annual appropriations process, as noted previously, and the transportation program has historically received a low priority for funding within OCRWM (see Table 5.3).

The committee judges that there are several options for changing the current organizational structure to improve its chances for success; the principal attributes and advantages of these structures are summarized in Sidebar 5.4. One of these options could be implemented within the current structure of the NWPA, whereas two others would likely require fundamental changes to the NWPA. All of the options involve transferring the transportation program out of OCRWM with the explicit goal of increasing management authority and accountability for executing the program's mission(s). Such a transfer could also be advantageous to OCRWM because it would allow that program to focus its staff and resources on its primary near-term mission, which is to license and construct a federal repository.

There are of course some advantages to the current organizational structure: The transportation and repository development programs are closely coupled. In principle, this promotes coordination, cooperation, and systems-driven integration, helping to ensure a match-up between transportation supply, demand, and schedules. However, the committee has not seen much evidence that these advantages are being realized in the current transportation program. Programmatic decisions appear to be based more on funding availability (Table 5.3) than on technical or schedule considerations.

The committee did not perform an exhaustive analysis of alternative organizational structures for the transportation program. However, based on the expertise and experience of its members, at least three different organizational structures seem feasible. The following paragraphs describe these options and their potential advantages and disadvantages.

First, within the current structure of the NWPA, the transportation program could be organized as the Nuclear Waste Transportation Administration, a quasi-independent DOE office program reporting directly to upper-level DOE management (i.e., the DOE secretary, deputy secretary, or under secretary). The main advantages of this structure are that it would free the transportation program from the budget, personnel, and schedule constraints imposed by OCRWM management and give program staff greater authority to execute its mission. The effectiveness of this structure would be enhanced by giving the program more predictability and continuity of funding so that it could make long-term commitments to

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SIDEBAR 5.4 Principal Attributes of Potential Organizational Structures for the Federal Transportation Program

Nuclear Waste Transportation Administration

- Independent DOE program reporting directly to upper-level DOE management
- Could serve all of the federal government's commercial spent fuel transportation needs
- Permissible under the current NWPA
- Effectiveness of this organizational structure could be enhanced by giving it authority to tap the Nuclear Waste Fund without annual congressional authorizations
- Organizational model: Federal Highway Administration (FHWA) within DOT

Quasi-Government Corporation

- Private-sector organization with partial government ownership
- Would have exclusive authority to take title to commercial spent fuel for the purposes of transport to a federal repository or federal interim storage
- Would be subject to the full regulatory authority of government for corporate finances and governance, worker and public health and safety, and transportation safety and security
- Could be chartered to be responsive to public participation and the social risk concerns (Chapter 3)
- Would require changes to the current NWPA to implement
- Organizational models: British Nuclear Fuels Limited and AREVA

Private Company

- Similar to quasi-government corporation but with full private ownership
- Could be the most effective option for solving the spent fuel acceptance order problem
- Would require changes to the current NWPA to implement
- Organizational model: Private Fuel Storage, LLC

construct the Nevada rail spur[58] and purchase transportation packages and conveyances. This could be accomplished by giving the program more

[58]Under this and the other two organizational options described in this section, the responsibility for constructing the Nevada rail spur and making other transportation-related infrastructure improvements within Nevada could continue to reside within OCRWM following the recommended organizational restructuring. The transportation program could be given the responsibility for purchasing transportation packages and conveyances and making the needed infrastructure improvements at commercial power plant sites (see Appendix C) and on transportation routes outside of Nevada. This could provide a better separation between repository-specific responsibilities and other responsibilities for a generic federal transportation capability.

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direct access to the Nuclear Waste Fund and authority to tap that fund without prior congressional authorization.

A possible model for this arrangement is the Federal Highway Administration (FHWA) within DOT, which reports directly to the Secretary of Transportation. The FHWA is funded mainly from congressional appropriations from the Highway Users Trust Fund, a government account replenished by highway user fees. While FHWA's main mission is to provide programmatic grants to states for highway construction, it also sets selected standards for federally funded roads and provides technical support to state departments of transportation. Additionally, it funds and conducts research to develop and improve relevant technology and enhance the effectiveness of its grant programs.

FHWA oversees a highly decentralized set of activities in which oversight is provided by the federal government but roads are owned by states and local governments, and built and maintained largely by hundreds of private contractors. Some of these activities are also subject to review and approval by other agencies—for example, the Environmental Protection Agency and the Department of Defense. Many of these activities also involve considerable public outreach and participation. The FHWA must operate in a collaborative fashion to execute its missions and has had a long and successful partnerships with state, contractor, material supplier, and academic institutions. The administration has developed a skilled staff with the core competencies required to carry out its missions.

A successful Nuclear Waste Transportation Administration would be similar in many respects to the FHWA. It would be largely dependent on congressional appropriations for its funding and, like FHWA, would rely on a permanent fund (the Nuclear Waste Fund) for most of its budget. It would be involved heavily in cooperative relationships with other federal agencies, states, tribes, local governments, nuclear utilities, contractors, and other nongovernmental organizations. Even though it would likely contract out many of its functions, it would need to have a strong staff with competencies in transportation planning, design, operations, materials handling, and public outreach. However, it would also be different from FHWA in some respects: It would have operational responsibilities and would be much smaller in dollar terms.

The other two organizational models would require changes to the NWPA. The second option would be to reorganize the transportation program as a quasi-government corporation. Such a corporation would operate like a private-sector organization and would be subject to the full regulatory authority of the government for corporate finances and governance, worker and public health and safety, and transportation safety and security. The charter for this corporation would give it exclusive authority to take title to commercial spent fuel for transport to the federal repository or

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federal interim storage.[59] DOE would take title to shipped materials at the gate of the federal repository or interim storage facility.

This quasi-corporate model has two primary advantages. First, it would bring some private-sector efficiencies to the transportation program, which could help the program operate in a more timely and cost-effective manner. The corporation could freely draw upon existing worldwide transportation capabilities, thereby reducing development costs and schedules. Second, this arrangement would get the government out of the business of regulating itself, which creates both real and perceived conflicts of interest. It would also reduce the potential for political pressures on program plans and operations—for example, on the acceptance order for commercial spent fuel. If desired, DOE could also contract with this corporation to transport its defense spent fuel and high-level waste to the repository.

The main potential disadvantages of this model are that a corporation could be perceived to have less accountability to the public and would be freed from many of the public participation processes in which the government is required to engage.[60] If chartered correctly, however, a quasi-government corporation might actually be more accountable than a government agency for meeting legal and regulatory requirements: the corporation could be fined and its staff subject to civil and criminal penalties for violating statutes and regulations. Moreover, in chartering this corporation, Congress could establish requirements for outside consultation and public participation and make it responsive to the social risk concerns described in Chapter 3 (Section 3.2).

There is a precedent for this organizational model in the United Kingdom and France. British Nuclear Fuels Limited (BNFL) and the French company AREVA are private companies with a high level of government ownership.[61] These companies provide a wide range of nuclear services, including spent fuel and high-level waste transportation services. They are subject to the full regulatory authorities in all of the countries in which they operate, including their home countries.

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[59]This take-title provision would be workable only if the corporation were covered by the Price Anderson Act.

[60]For example, Flynn et al. (1998) reported the results of a national survey that asked respondents whether they preferred having the federal government manage nuclear waste transportation directly or contract with private companies to manage it. A majority of respondents (about 52 percent) preferred to have the federal government manage transportation directly. The WGA has also expressed a clear preference that the federal government not delegate key transportation responsibilities to contractors (WGA, 2005).

[61]The committee cites these companies as examples of government-owned organizations that transport commercial spent fuel. The citation is not an endorsement of these companies, their business models, or their performance records.

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A third option for reorganizing the transportation program is to make it a fully private company operated by the commercial nuclear industry. There is already an industry consortium in existence (Private Fuel Storage, LLC; see Chapter 1) that is developing a transportation capability that could serve as a model for such a company. This arrangement would have some of the same advantages and disadvantages of the quasi-government corporation option, although requirements for outside consultations and public participation might be harder to enforce. However, this might be the most effective option for addressing the commercial spent fuel acceptance order issue (Section 5.2.4), especially if owners had collective economic incentives to maximize the efficiency of the transportation program,[62] and individual owner interests did not trump these collective incentives. Under this option, DOE would be responsible for transporting its own spent fuel and high-level waste but could contract this activity out to the private entity if desired.

The selection of a specific organizational model for the federal transportation program is a policy decision that goes well beyond the task for this study. In making this decision, the federal government will have to consider factors beyond Yucca Mountain. The government is encouraging the construction of new nuclear plants in the United States. If such construction occurs on a large scale, the federal repository and the transportation program that supports it will have to be expanded. In this case, it might make sense for the government to turn over the transportation program to a quasi-private or private entity if it does not wish to be in the permanent business of transporting the industry's spent fuel. As noted previously, a generic transportation capability could also be useful if the federal government decides to transport commercial fuel to one or more centralized sites for storage or reprocessing to meet its commitments under the NWPA (see Chapter 1 and Appendix C). This argues for the establishment of a generic transportation capability that could service a range of government transportation needs.

If the federal government decides to maintain the transportation program in its current organizational form, the committee judges that it will at the very least need a greater commitment to continuity in funding and programmatic direction from the Secretary of Energy and Congress to successfully execute its mission. This may not be possible in the current fiscal and political climate, which is why the committee is recommending that other organizational structures be examined.

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[62]For example, Congress could make adjustments to the Nuclear Waste Fund (either by changing the fee structure or by providing negotiated refunds to cover transportation costs) to provide such an incentive.

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Regardless of which option is selected, continuing attention must be paid to ensuring that the transportation program develops and maintains an integrated systems focus. The program is complex from both physical and institutional perspectives: it will involve the movement of large quantities of hazardous materials from multiple locations over long distances for sustained periods of time. It will also involve major construction, equipment acquisition, and training. It must coordinate its activities with a large number of constituencies: Congress; spent fuel owners; state, tribal, and local governments; and other nongovernmental organizations. The successful operation of various components and functions of the transportation system is a necessary but not a sufficient condition for overall system effectiveness. The interconnections among the components must also be explicitly thought through and managed. An integrated systems approach is a proven technique for achieving this goal.

The committee did not review the current OCRWM transportation program to determine if it has an integrated systems focus. The committee did see evidence of integrated systems thinking in one presentation it received from transportation program staff (Lanthrum, 2004). However, the committee also saw clear evidence that the current organizational structure for the transportation program is impeding such an integrated approach because, as noted previously, the program does not have the autonomy and funding necessary to execute its mission.

The industry has developed best practices that could be applied to this program (Meredith et al., 1985; Blanchard and Fabrycky, 2005). One element of such best practices is the development of a continuing review and correction process to ensure that a systems focus is maintained from program conception through operations. The committee strongly encourages the program to seek expert advice (e.g., using consultants and expert advisory groups) to learn about and incorporate best industry practices for designing and operating this transportation system using an integrated systems approach. This encouragement is in addition to the recommendations in Section 3.4 for an expert committee to advise transportation implementers on social risk.

Finally, the committee's comments in this section should not be interpreted to reflect on the quality of the federal staff in OCRWM's Office of National Transportation. The committee has had the opportunity to interact with several of these staff during the course of this study and judges that they are capable and dedicated individuals. However, they are working within a difficult organizational structure and in a political environment that could make success close to impossible.

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APPENDIX A

Biographical Sketches of Committee Members

Neal Lane, *Chair*, is a nationally recognized leader in science and technology policy development and application. He is now a university professor in the Department of Physics and Astronomy and fellow of the James A. Baker III Institute for Public Policy at Rice University, where he previously served as university provost. He also served as assistant to the president for science and technology, director of the White House Office of Science and Technology Policy, director of the National Science Foundation, and chancellor of the University of Colorado at Colorado Springs. Dr. Lane earned his B.S., M.S., and Ph.D. degrees in physics from the University of Oklahoma and is a fellow of the American Physical Society, the American Academy of Arts and Sciences, the American Association for the Advancement of Science, and the Association for Women in Science.

Thomas B. Deen, *Vice-chair*, is a transportation consultant and former executive director of the Transportation Research Board, a position he held from 1980 to 1994. He is former chairman and president of PRC-Voorhees, a transportation engineering and planning consulting firm. During this period, he was in charge of his firm's activities in major urban highway and rail transit projects, both in this country and abroad. Later he was chairman of the national interagency committee that prepared the strategic plan for America's development of intelligent transportation systems. In recent years, the governor of Maryland has appointed him as chair of several blue ribbon committees investigating significant rail and road projects in the state. He also serves on an advisory board for the federal Department of Transportation's Bureau of

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Transportation Statistics. His research interests include intermodal planning of urban transportation systems, integration of transportation and land use in urban areas, national transportation policy, and intelligent transportation systems. He holds a B.S. degree from the University of Kentucky and a certificate from Yale University's Bureau of Highway Traffic; he is a member of the National Academy of Engineering.

Julian Agyeman is currently an assistant professor in the Department of Urban and Environmental Policy and Planning at Tufts University. He also served on the Commonwealth of Massachusetts' Environmental Justice Advisory Committee (MEJAC). He earned a B.Sc. degree in geography and botany from the University of Durham, UK; a postgraduate certificate in geography and environmental studies from the University of Newcastle-on-Tyne, Enfield, UK; an M.A. degree in conservation policy from the Middlesex University, Enfield, UK; and a Ph.D. degree in environmental education from the University of London. He is the editor of *Local Environment*, an international peer-reviewed journal and the author and editor of many books and articles. He is a practitioner and researcher in sustainable development and environmental justice at local, national, and international levels. His practical experience was gained through work in the United Kingdom as a consultant on environmental and sustainable development; environmental education adviser and head of curriculum support for the Education Department in the London Borough of Islington; senior environmental education officer for the Directorate of Environmental Health in the London Borough of Lambeth; and chair and founder of the Black Environment Network.

Lisa M. Bendixen is an expert in hazmat risk and safety and has worked on risk assessment and management problems in numerous industries covering both fixed facilities and transportation systems. She was the project manager and primary author of the *Guidelines for Chemical Transportation Risk Analysis*, published by the American Institute of Chemical Engineers' Center for Chemical Process Safety, and has served on the center's technical steering committee. She is currently a vice president with ICF Consulting, where she provides consulting services to private companies, trade associations, and government organizations on a variety of hazardous materials and transportation safety and security issues. She previously spent 22 years in Arthur D. Little, Inc.'s, environment and risk practice. Ms. Bendixen holds a B.S. degree in applied mathematics and an M.S. degree in operations research, both from the Massachusetts Institute of Technology.

Dennis C. Bley has more than 30 years of experience in applying quantitative risk analysis to engineered facilities. His current research involves

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the application of risk analysis to diverse technological systems, uncertainty modeling, technical risk communication, and human reliability analysis. He is president of Buttonwood Consulting, Inc., and a principal of the WreathWood Group, a joint venture company that supports multidisciplinary research in human performance. He also serves on the board of directors of the International Association for Probabilistic Safety Assessment and Management. His clients include the Department of Energy's (DOE's) Office of Nuclear Energy (for development of risk assessment methods for Generation IV reactors); the Nuclear Regulatory Commission's Office of Nuclear Regulatory Research (also for the development of risk assessment methods); and the Department of Transportation's Volpe Center (for work on human reliability analysis for railroad accidents). Dr. Bley has a Ph.D. degree in nuclear reactor engineering from the Massachusetts Institute of Technology and is a registered professional engineer in the State of California.

Hank Jenkins-Smith is a nationally recognized expert on public perception of environmental and technical risks. His research involves measurement of public and elite risk perceptions of transportation of hazardous and radioactive materials, nuclear waste, and national security issues. He is currently doing research on public perceptions of nuclear security, terrorism, and weapons of mass destruction that is funded through Sandia National Laboratories and the National Science Foundation. His previous research includes public reactions to hazardous facilities, public perceptions of the risks of shipping foreign research reactor spent fuel, and the effects of spent fuel shipments on property values. He is a professor of public policy and holds the Joe R. and Teresa Lozano Long Chair of Business and Government at the George H.W. Bush School of Government and Public Service at Texas A&M University. Previously, he was professor of political science and director of the Institute for Public Policy at the University of New Mexico. Dr. Jenkins-Smith received a B.S. degree in political science and economics from Linfield College and an M.S. and Ph.D. degrees in political science, both from the University of Rochester. Dr. Jenkins-Smith has published several recent peer-reviewed papers of relevance to this committee's work, including "Mitigation and Benefits Measures as Policy Tools for Siting Potentially Hazardous Facilities: Determinants of Effectiveness and Appropriateness" (with Howard Kunreuther. 2001. *Risk Analysis*, 21: 71–382), and "Nuclear Waste Transport and Residential Property Values: Estimating the Effects of Perceived Risks" (with Kishore Gawande. 2001. *Journal of Environmental Economics and Management*, 42:207–233).

Melvin F. Kanninen is internationally recognized for his expertise in fracture mechanics and its applications to structural integrity and durability.

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During his 40-year R&D career he has developed and applied this expertise to a wide range of engineering applications, including aging aircraft, rotorcraft, and spacecraft; nuclear power plant pressure vessel and piping systems; and natural gas transmission and distribution pipelines. Dr. Kanninen is currently the principal of MFK Consulting Services. Previously, he held positions with General Electric at the Hanford Atomic Products Operation, Battelle's Columbus Laboratories, and most recently, the Southwest Research Institute where he served as vice president and director of the structural engineering division. He has published more than 180 technical papers, given more than 100 seminar lectures, and coedited six technical books. He is the coauthor of the well-regarded textbook *Advanced Fracture Mechanics*, published by Oxford Press. Dr. Kanninen, who received his Ph.D. degree in engineering mechanics from Stanford University, is a fellow of the American Society of Mechanical Engineers and a member of the National Academy of Engineering.

Ernest J. Moniz is widely recognized for his work in theoretical nuclear physics and, more recently, science and technology policy formulation. He joined the Massachusetts Institute of Technology (MIT) faculty in 1973 and is currently the Cecil and Ida Green Professor of Physics and co-director of the Laboratory for Energy and the Environment. He previously served as head of the MIT Physics Department; as undersecretary of the U.S. Department of Energy; and as associate director for science in the Office of Science and Technology Policy. His current research-related activities include a foundation-sponsored project on the future of coal, work for Los Alamos National Laboratory on security issues related to weapons of mass destruction, and service on a technical advisory board for EPRI. Dr. Moniz received a B.S. degree in physics from Boston College and a Ph.D. degree in theoretical physics from Stanford University. He received honorary doctorate degrees from the University of Athens, the University of Erlangen-Nurenburg, and Michigan State University. He is a fellow of the American Association for the Advancement of Science, the Humboldt Foundation, and the American Physical Society.

John W. Poston, Sr., is a nationally recognized expert in health physics, occupational dosimetry, and health effects of radiation releases from accidents and terrorist events. He is professor and past chair of the Department of Nuclear Engineering and a consultant at the Veterinary Teaching Hospital at Texas A&M University, where he teaches health physics and conducts research on dosimetry. His dosimetry research is supported by the Department of Energy's Office of Nuclear Energy, Science and Technology, and he consults with Sandia National Laboratories and a Texas nuclear utility on operational safety issues. He chaired the National Council on

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Radiation Protection and Measurements committee that produced the 2001 report *Management of Terrorist Events Involving Radioactive Material*, and he served as a peer reviewer for the American Association of Railroads on a risk assessment for rail transport of spent nuclear fuel. Dr. Poston is president emeritus of the Health Physics Society and received the 2003 Loevinger-Berman Award from the Society of Nuclear Medicine.

Lacy E. Suiter has more than three decades of experience in emergency planning and response at both state and federal levels. He spent 30 years as a career employee of the Tennessee Emergency Management Agency, the last 12 years as that agency's director. He also served as executive associate director for Response and Recovery for the Federal Emergency Management Agency until his retirement in 2002. In that capacity he was responsible for planning and executing the federal government's response to major disasters and emergencies and managing that agency's multibillion-dollar individual and public assistance grant programs. Mr. Suiter earned his B.S. degree in business from Middle Tennessee State University and is the recent recipient of the United States Army Meritorious Civilian Service Award and the United States Army Corps of Engineers D. De Fleury Medal.

Joseph M. Sussman is an internationally recognized transportation operations expert whose research has covered a wide range of transportation issues, including transportation systems and institutions; regional strategic transportation planning; intercity freight and passenger rail; intelligent transportation systems; simulation and risk assessment methods; and complex systems analysis. He is currently the Japan Rail East Professor in the Department of Civil and Environmental Engineering and Engineering Systems Division at the Massachusetts Institute of Technology (MIT) and receives some of his research support through the Department of Transportation's Volpe Center and from the Association of American Railroads. He previously served as director of MIT's Center for Transportation Studies and head of the Department of Civil and Environmental Engineering. Dr. Sussman received a B.C.E. degree from City College of New York; an M.S.C.E. degree from the University of New Hampshire; and a Ph.D. degree in civil engineering systems from MIT.

Elizabeth Q. Ten Eyck is an expert in domestic and international nuclear safeguards and security for government-owned and licensed commercial nuclear facilities. She has more than 30 years of career federal service—first as a security engineer for the U.S. Secret Service; then as director of the Office of Safeguards and Security for the U.S. Department of Energy; and, until she retired in 2000, as director of the Division of Fuel Cycle Safety and Safeguards of the U.S. Nuclear Regulatory Commission (USNRC), where

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she managed the safety and safeguards regulatory program for commercial fuel cycle facilities. During her career at USNRC she also managed transportation activities and the safeguards program for nuclear power reactors. She is currently president of ETE Consulting, Inc., and is involved in consulting work for the Department of Homeland Security on vulnerability assessments through Argonne National Labs. Ms. Ten Eyck received her B.S. degree in electrical engineering from the University of Maryland.

Seth Tuler is an expert in public participation, environmental decision making, and community responses to risk communication. His research, which is funded by the National Science Foundation and private foundations, involves public and worker health risks associated with U.S. nuclear weapons production. He also participates in education and training of community members in public participation mechanisms and public health study methods in association with the Alliance for Nuclear Accountability and its member groups. He is a research fellow in the Center for Technology, Environment, and Development at the George Perkins March Institute at Clark University (Worcester, Massachusetts) and a researcher for the Social and Environmental Research Institute (Leverett, Massachusetts). He received a B.A. degree in mathematics from the University of Chicago; an M.S. degree in technology and policy from the Massachusetts Institute of Technology; and a Ph.D. degree in environmental science and policy from Clark University.

Detlof von Winterfeldt is an internationally recognized expert in applying decision and risk analysis to technology and environmental management problems—both as a researcher and as a practitioner. He is a professor of public policy and management in the School of Policy, Planning, and Development at the University of Southern California (USC). He also is director of USC's Homeland Security Center for Risk and Economic Analysis of Terrorism Events. He currently receives support from the Department of Homeland Security for work on risk and economic analysis of terrorism and from the Lawrence Livermore National Laboratory for a project on living with risk. He is the author and coauthor of several publications related to nuclear safety and nuclear waste issues, including a chapter on DOE's selection of candidate nuclear waste repository sites (Keeney, R.L., and von Winterfeldt, D. 1988. The analysis and its role for selecting nuclear repository sites. In G.K. Rand (Ed.) *Operational Research '87*. Amsterdam: Elsevier Science Publishers, pp. 686–701) and an article comparing strategies of disposing of spent fuel from power plants (Keeney, R.L., and von Winterfeldt, D. 1994. Managing nuclear waste from power plants. *Risk Analysis*, 14:107-130). He received M.A. and B.A. degrees in psychology from the University of Hamburg, Germany, and a Ph.D. degree in math-

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ematical psychology from the University of Michigan. He is the 2000 recipient of the Ramsey Medal for distinguished contributions to decision analysis by the Decision Analysis Society.

Thomas R. Warne is known nationally for his expertise in transportation administration, public policy, and large project and program delivery. He is the founder and president of Tom Warne and Associates, LLC, a management consulting company. His previous positions include executive director of the Utah Department of Transportation and deputy director and chief operating officer of the Arizona Department of Transportation. Mr. Warne holds a bachelor's degree in civil engineering from Brigham Young University and a master's degree in civil engineering from Arizona State University; he is a registered professional engineer in Arizona and Utah.

Clive Young is an internationally recognized expert in safety standards for transport of radioactive materials. He has worked at the Department for Transport of the United Kingdom since 1978 and, since 1996, has been head of the Radioactive Materials Transport Division and transport radiological adviser to the Secretary of State for Transport. In this position he is responsible for carrying out the executive functions of the "competent authority" for the transport of radioactive material in the United Kingdom on behalf of the Secretary of State for Transport. He serves as chairman of the Transport Safety Standards Committee of the International Atomic Energy Agency and chairman of the Radioactive Material Working Group of the International Maritime Organization. He previously held the position of research engineer at the UK Atomic Energy Authority. Mr. Young earned his B.Sc. in mechanical engineering from the University of Leeds. He is a member of the Institution of Mechanical Engineers and is a chartered engineer.

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APPENDIX B

List of Presentations Received at Committee Meetings

Washington, D.C., May 16–17, 2003

- NRC's Transportation Program, E. William Bach, U.S. Nuclear Regulatory Commission (USNRC)
- Transportation of Radioactive Waste, Jeffrey Williams, Department of Energy (DOE), Office of National Transportation
- U.S. Department of Transportation's (DOT's) Role in Transportation of Radioactive Waste, Richard Boyle, DOT
- NAS Used Fuel Transportation Study: Remarks from EPRI, John H. Kessler, EPRI

Las Vegas, Nevada, July 24–26, 2003

- State of Nevada Perspectives on Spent Nuclear Fuel (SNF) and High-Level Radioactive Waste Transportation Issues, Robert Loux, Nevada Agency for Nuclear Projects
- Yucca Mountain Transportation Access Issues, Robert Halstead, Nevada Agency for Nuclear Projects
- Yucca Mountain Transportation Risk and Impact Issues, Robert Halstead, Nevada Agency for Nuclear Projects
- Full-scale Testing of Shipping Casks, Jim Hall, Hall and Associates
- Baltimore Tunnel Fire: Implications for SNF Transportation Safety, Marvin Resnikoff, Radioactive Waste Management Associates

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- Security, Safeguards, and Implications for Emergency Management, James Ballard, California State University, Northridge
- Plans for Developing a National Transportation Plan, Jeffrey Williams, DOE, Office of National Transportation
- Baltimore Tunnel Fire Study and Sandia Vulnerability Studies, Jack Guttmann, USNRC
- Yucca Mountain Impacts, Irene Navis, Clark County Nuclear Waste Division
- Under the Draining End of the Transportation Funnel, Abby Johnson, Eureka County
- Lincoln County and Town of Caliente Perspectives on Spent Fuel and High-Level Radioactive Waste Transportation Issues, Kevin Phillips, City of Caliente
- Nye County's Views on Nuclear Waste Transportation, Les Bradshaw, Nye County Department of Natural Resources and Federal Facilities
- Perspectives of other Nevada-based Organizations:
  - Kalynda Tilges, Shundahai Network
  - Judy Treichel, Nevada Nuclear Waste Task Force
  - Peggy Maze, Citizen Alert

Denver, Colorado, October 29–31, 2003

- Technical Aspects of DOE's Transportation Operations, Robin Sweeney, DOE, Office of National Transportation
- NRC's Role in Transportation of Spent Nuclear Fuel, Earl Easton, USNRC
- Transportation of Radioactive Waste by Highway, James Simmons, USDOT, Federal Motor Carrier Safety Administration (FMCSA)
- Federal Railroad Administration's (FRA) High-Level Radioactive Materials Program, Kevin Blackwell, USDOT, FRA
- Research and Special Programs Administration, Richard Boyle, DOT
- Western States and NWPA (Nuclear Waste Policy Act) Shipments, Doug Larson, Western Interstate Energy Board
- A State Perspective Regarding Transportation of High-Level Radioactive Waste, Bill Sinclair, Utah Department of Environmental Quality
- Transportation of Radioactive Waste Through the Western States, Bill Mackie, Western Governor's Association
- Used Nuclear Fuel Transportation Responsibilities and Operations, John Vincent (deceased), Nuclear Energy Institute (NEI)

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- Trucking Companies Operations Issues, David Bennett, Tri-State Motor Transit
- Rail Perspective on Transportation of SNF, Sandy Covi, Union Pacific Railroad

Chicago, Illinois, February 2–4, 2004

- Federal Role in Responding to Emergencies, Eric Tolbert, Federal Emergency Management Agency (FEMA)
- Department of Energy Role for Emergency Response in the Yucca Mountain Transportation Program, Jozette Booth, DOE
- Corridor States Perspectives in Planning for Spent Nuclear Fuel Shipments, Thor Strong, Michigan Low-Level Radioactive Waste Authority
- Midwestern State's Views on Emergency Preparedness and Response Planning, Tim Runyon, Illinois Emergency Management Agency
- Local Roles for Planning, Training, Response, and Intergovernmental Coordination:
  - Perspectives of a Large City, Chief Gene Ryan, City of Chicago
  - Perspectives of a Small City/County, Ned Wright, Linn County, Iowa, Emergency Management
  - Perspectives of Private Industry, Patrick Brady, Burlington Northern Santa Fe Railway
  - Training Issues, Chief Gordon Vermeer, Argonne National Laboratory and International Association of Fire Chiefs
- Risk Perception, Risk Communication, and Public Response to Emergencies: What Really Happens?
  - Dennis Mileti, University of Colorado
  - Michael Lindell, Texas A&M University

Washington, D.C., May 5–7, 2004

- Used Nuclear Fuel Transportation: Prior Experience Is Valid, Stephen P. Kraft, NEI
- Regulator Perspective on Transportation Safety, E. William Brach, USNRC
- Irradiated Fuel Transport to Yucca Mountain: What History Tells Us, Michele Boyd, Public Citizen
- SNF Cask Crash Tests: What Can They Tell Us About the Safety of the Current Fleet of SNF Shipping Casks? Douglas Ammerman, Sandia National Laboratories

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- Reexamination of Spent Fuel Shipment Risk Estimates, Douglas Ammerman, Sandia National Laboratories
- Transportation Infrastructure Acquisition Update, Ned Larson, DOE, Office of National Transportation
- SNF Transportation Cask Certification Requirements, Earl Easton, USNRC
- Update on the USNRC Package Performance Study, Mike Mayfield, USNRC
- Naval Nuclear Propulsion Program, Barry Miles, DOE, Naval Reactors
- Spent Nuclear Fuel Transportation Experience, Steven Edwards, Progress Energy
- AAR Perspective on the Dedicated Trains and Other Issues, Bob Fronczak, Association of American Railroads (AAR)
- Regional Perspectives on Radioactive Materials Transportation, Christopher Wells, Southern States Energy Board
- Northeast Council of State Governments' Perspectives on SNF Transportation, Edward L. Wilds, Council of State Governments Northeast High-Level Radioactive Waste Transportation Task Force

Albuquerque, New Mexico, July 21–23, 2004

- An Overview of Stigma and Potential Socioeconomic Impacts, James Flynn, Decision Research
- Stigma Studies on Nevada and Yucca Mountain, Bob O'Connor, National Science Foundation
- Environmental Justice Impacts, Veronica Eady, National Environmental Justice Advisory Council
- Information and Involvement for Transportation of Nuclear Waste, Christina Drew, University of Washington
- Stakeholder Involvement Strategies for Highly Technical and Controversial Issues, Janesse Brewer, The Keystone Center
- Key Problem Issues in Risk Communication, James Flynn, Decision Research
- Planning, Decision Making, and Monitoring, Veronica Eady, National Environmental Justice Advisory Council
- Planning, Decision Making, and Monitoring, Mervyn Tano, International Institute for Indigenous Resource Management
- Social Diversity in Framing Risk Problems: Implications for Risk Management and Communication Regarding the Transportation of Radioactive Waste, Elaine Vaughan, University of California, Irvine
- Office of National Transportation Update, Gary Lanthrum, DOE, Office of National Transportation

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- Assessing the Role of Time in Public Perceptions of the Waste Isolation Pilot Plant (WIPP), Amy Goodin, University of New Mexico
- WIPP Transportation Information Issues, Don Hancock, Southwest Research and Information Center
- Collaboration Among States and Agencies in the WIPP Transportation Safety Program, Anne deLain Clark, New Mexico Energy, Minerals and Natural Resources Department
- State Emergency Management Perspective on Lessons Learned from Coordinating with Other Stakeholders and Communicating with the Public, W. Scott Field, New Mexico Office of Emergency Management
- Native American Perspective on Lessons Learned from Coordinating with Other Stakeholders and Communicating with the Public, Sue Loudner, WIPP Transportation Emergency Preparedness Program
- Federal Perspective on Lessons Learned from Coordinating with Other Stakeholders and Communicating with the Public, Paul Detwiler, DOE, Carlsbad Field Office
- Federal Perspective on Involving the Public in Radioactive Materials Transportation Programs, Judith Holm, DOE, Office of Civilian Radioactive Waste Management

Washington, D.C., May 26, 2005

- Research Reactor Spent Fuel Routing Study: Scope and Origin, Richard Boyle, Pipeline and Hazardous Materials Safety Administration, DOT
- Background: History, Scope, and Purpose of Foreign, University, and DOE Research Reactor Spent Fuel Programs, Alex Thrower DOE, Office of Environmental Management
- Department of Transportation Regulations, Michael Conroy, Pipeline and Hazardous Materials Safety Administration, DOT; Ryan Paquet, DOT, FMCSA
- Nuclear Regulatory Commission Regulations, Philip Brochman, Division of Nuclear Security, USNRC
- DOE Foreign Research Reactor Spent Fuel Acceptance Program, Alex Thrower, DOE; James Wade, Idaho National Laboratory, DOE; Charles E. Messick, DOE Nuclear Material Programs Division, Savannah River Site, Aiken, S.C.
- Domestic University and DOE Research Reactors, James Wade, DOE; Christopher Becker, University of Michigan, Ann Arbor
- Collaboration of States with DOE and Licensees on Routing, Chris Wells, Southern States Energy Board; Lisa Sattler, Council of State Governments—Midwest Office, Lombard, Ill.

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Committee Subgroup Visit to Europe (September 2004)

Committee members Dennis Bley, Hank Jenkins-Smith, Mel Kanninen, John Poston, Seth Tuler, Detlof von Winterfeldt, and Clive Young and committee staff Kevin Crowley and Joe Morris participated in all or portions of this visit. Because it involved substantially less than half of the committee, this was not an official information-gathering meeting.

September 24 (Berlin and Environs, Germany)

- Briefing on the AREVA spent fuel transportation program, including transportation operations and communications with the public. Host: Vincent Roland, AREVA
- Tour of the German Federal Institute for Materials Research and Testing (BAM) facility near Horstwalde and attendance at the cask-drop test. Host: Thomas Böllinghaus, BAM

September 27: BNFL Sellafield Site (Seascale, Cumbria, UK, and London)

- Overview of British Nuclear Fuel Limited (BNFL) and the Sellafield Site. Briefers: Colin Boardman, Ben Children, Bob Quinn, and Stephen Stagg, BNFL
- BNFL transportation capabilities, Mark Robinson, BNFL
- Tour of the transportation cask maintenance facility and spent fuel receipt and storage areas of the Thermal Oxide Reprocessing Plant
- Lunch meeting with local government and emergency planning organizations to discuss transportation issues: David Cook (Chairman, Emergency Planning Subcommittee), David Humphreys (Cumbria County Council Emergency Planning Agency), and Mat Fox (Senior Emergency Response Manager, BNFL)

September 28: Visit to Direct Rail Service (DRS) Headquarters in Carlisle, Cumbria

- Presentation and discussion of DRS's UK rail activities, Chris Connelly, General Manager, Commercial and Business Services, DRS
- Tour of DRS Carlisle facilities
- Dinner meeting to discuss BNFL transportation program with London area stakeholders: Roger Evans (London Assembly); Linda Hayes (Cricklewood Against Nuclear Trains); Steve Robinson (Environment Business Management); Patrick van den Bulck (Campaign for Nuclear Disarmament). Dinner hosted by Rupert Wilcox-Baker, Head of Communications, Spent Fuel Services, BNFL

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September 29: London and Environs

- Field trip to a BNFL rail head to observe transportation operations.

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APPENDIX C

Federal Repository Transportation System

This appendix describes the system for transporting spent fuel and high-level radioactive waste to a federal repository at Yucca Mountain, Nevada. It is provided to support the discussions of this transportation system that appear in Chapter 5.

C.1 PRINCIPAL ELEMENTS OF A REPOSITORY TRANSPORTATION SYSTEM

The system for transporting spent fuel and high-level waste to a federal repository at Yucca Mountain will involve train and truck transport from sites across the continental United States (see Figure 1.1). A good deal of the complexity of this system is the unanticipated consequence of the siting process that was established in the Nuclear Waste Policy Act (NWPA).[1] When writing the NWPA, Congress did not consider the availability of transportation routes or the distance of transport from spent fuel and high-level waste storage sites to the repository. The 1987 amendments to the Nuclear Waste Policy Act fixed the end point of the transportation system at Yucca Mountain, Nevada—a state that has no commercial nuclear power plants and is geographically distant from most spent fuel and high-level

[1]The "Nuclear Waste Policy Act of 1982," P.L. 97-425 (January 7, 1983) and amendments (P.L. 100-203, Subtitle A [December 22, 1987]; P.L. 100-507 [October 18, 1988]; and P.L. 102-486 [October 24, 1992]).

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waste storage sites (Figure 1.1). The Yucca Mountain site also lacks good existing transportation access, especially rail access.

The NWPA establishes that the federal government is responsible for developing and operating the transportation and disposal programs, and the owners of spent fuel and high-level waste are financially responsible for covering transport and disposal costs (Table C.1). The NWPA vests authority with the Secretary of Energy for carrying out the federal government's responsibilities and establishes the Nuclear Waste Fund to cover the costs of disposal.

TABLE C.1 Responsibilities Under the Nuclear Waste Policy Act for Storage of Spent Fuel and High-Level Waste and Their Transport to a Federal Repository

	Commercial Spent Fuel	DOE Spent Fuel and High-Level Waste[a]	Naval Spent Fuel
On-site storage	Spent fuel owners	DOE-EM	DOE-NR
Costs of transport and disposal at a federal repository	Spent fuel owners	DOE-EM	DOE-NR
Development of a federal repository	DOE-OCRWM	DOE-OCRWM	DOE-OCRWM
Transportation to a federal repository	DOE-OCRWM	DOE-OCRWM	DOE-NR
Package certification	USNRC	USNRC	DOE-NR, USNRC[b]
Advance shipping notifications of states and tribes required?	Yes	Yes	No
Emergency responder training	DOE supported	DOE supported	DOE supported

NOTE: DOE-EM = Office of Environmental Management; DOE-NR = Naval Reactors Program; DOE-OCRWM = Office of Civilian Radioactive Waste Management.

[a]Includes research reactor spent fuel described in Chapter 4.

[b]DOE seeks USNRC concurrence on package certifications under a cost-reimbursable agreement.

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The NWPA also establishes the authorities of the U.S. Nuclear Regulatory Commission (USNRC) as well as the roles of states and tribal nations. It requires that the U.S. Department of Energy (DOE) transport spent fuel and high-level waste only in packages that have been certified by the USNRC (see Chapter 2). It also requires DOE to follow USNRC regulations for advance notifications of state and local governments prior to transport of these materials. Further, it requires DOE to provide technical assistance and funding to states for training of appropriate units of local government and Indian tribes through whose jurisdictions the Secretary of Energy plans to transport spent nuclear fuel or high-level radioactive waste. This training is to cover procedures for safe routine transportation and emergency response.

The NWPA explicitly recognizes the precedence of existing federal, state, and local transportation laws: "Sec. 9: Nothing in this Act shall be construed to affect Federal, State, or local laws pertaining to the transportation of spent nuclear fuel or high-level radioactive waste." Indeed, as described elsewhere in this appendix, there are many additional laws and regulations that apply to the national transportation program for Yucca Mountain.

Section 304 of the NWPA establishes the Office of Civilian Radioactive Waste Management within the Department of Energy (DOE-OCRWM) to carry out the waste disposal function. Within this office, the Office of National Transportation is taking the lead for developing a national transportation program for Yucca Mountain.[2] The Office of Civilian Radioactive Waste Management will be responsible for transporting both commercial spent fuel and DOE spent fuel (except naval spent fuel) and high-level waste to the repository. The Naval Reactors Program (DOE-NR) will transport its own spent fuel to the repository.

The DOE-OCRWM Office of National Transportation is responsible for performing the following tasks:

- Develop a national transportation plan that specifies schedules, modes, and routes for shipping spent fuel to the repository.
- Build the necessary infrastructure (e.g., a rail line in Nevada; road upgrades as necessary) to support the transportation program.
- Purchase the necessary equipment (e.g., transport packages, tractor-trailers, and railcars) to support the transportation program.
- Hire transportation contractors to operate the transportation program.

[2]DOE-OCRWM was undergoing a reorganization in early 2006. The new office structure had not been announced when the present report was completed.

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- Establish a federal oversight program to ensure that transportation operations comply with all applicable federal, state, and local regulations.

DOE issued the *Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste* (Title 10, Part 961 of the Code of Federal Regulations) that describes how it expects to carry out its responsibilities under the NWPA. These regulations establish a "standard contract" to be signed by the Secretary of Energy and owners of commercial spent fuel, who are referred to as "purchasers" of DOE's services. The standard contract lays out the responsibilities of the purchasers and the DOE in carrying out the provisions under the contract. These responsibilities are summarized in Sidebar 5.1 and are discussed elsewhere in this appendix.

A flowchart for the national transportation system is illustrated schematically in Figure C.1A, and the organizations responsible for the system components are shown in Figure C.1B. Regulatory authorities are shown in Figure C.1C. The components of the system are described below.

C.1.1 System Planning

Three primary planning functions must be completed before the transportation system can be put into operation: procurement of equipment and other needed infrastructure; scheduling the acceptance of spent fuel and high-level waste from its owners; and identifying the routes to be used for shipping this material to the federal repository and undertaking any necessary upgrades to such routes. These planning functions are described in the following subsections.

Procurement

DOE plans to use the nation's existing roads and railways to ship to the repository,[3] but it may be required at its own expense to upgrade roads and rail access to plant sites or to provide heavy-haul or barge access to railheads. There is no rail spur to Yucca Mountain in Nevada, for example, so DOE will have to build one to support its decision to ship by "mostly rail." DOE has selected the location for the rail spur in Nevada (see Chapter 5) but has not yet completed a detailed route survey or the supplemental Environmental Impact Statement (EIS) that is required prior to the initiation of construction. The rail spur is expected to take several years to

[3]As described further in this appendix and in Chapter 5, rail access to the repository does not now exist, so DOE will be required to build a rail spur to the repository in Nevada. DOE may also be required to build a road to the repository from the nearest highway to support truck transport.

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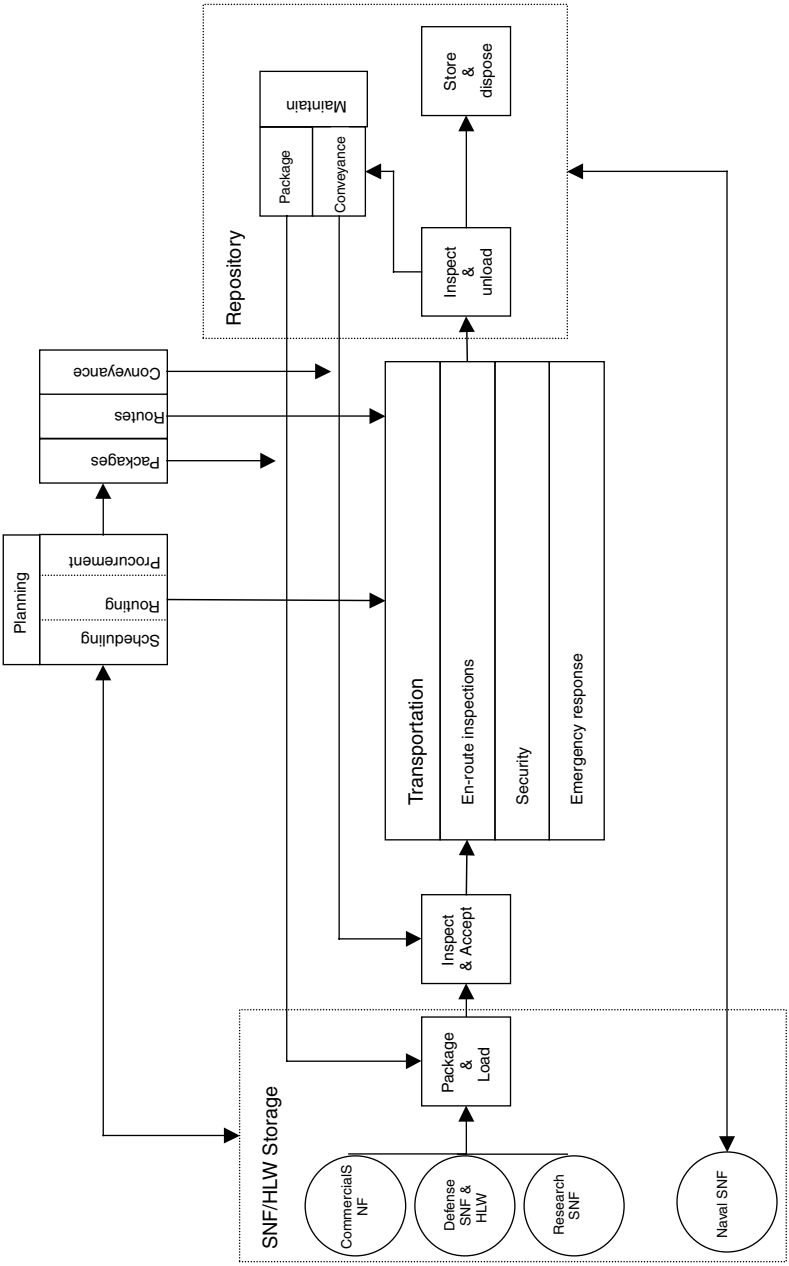

FIGURE C.1A National Transportation System

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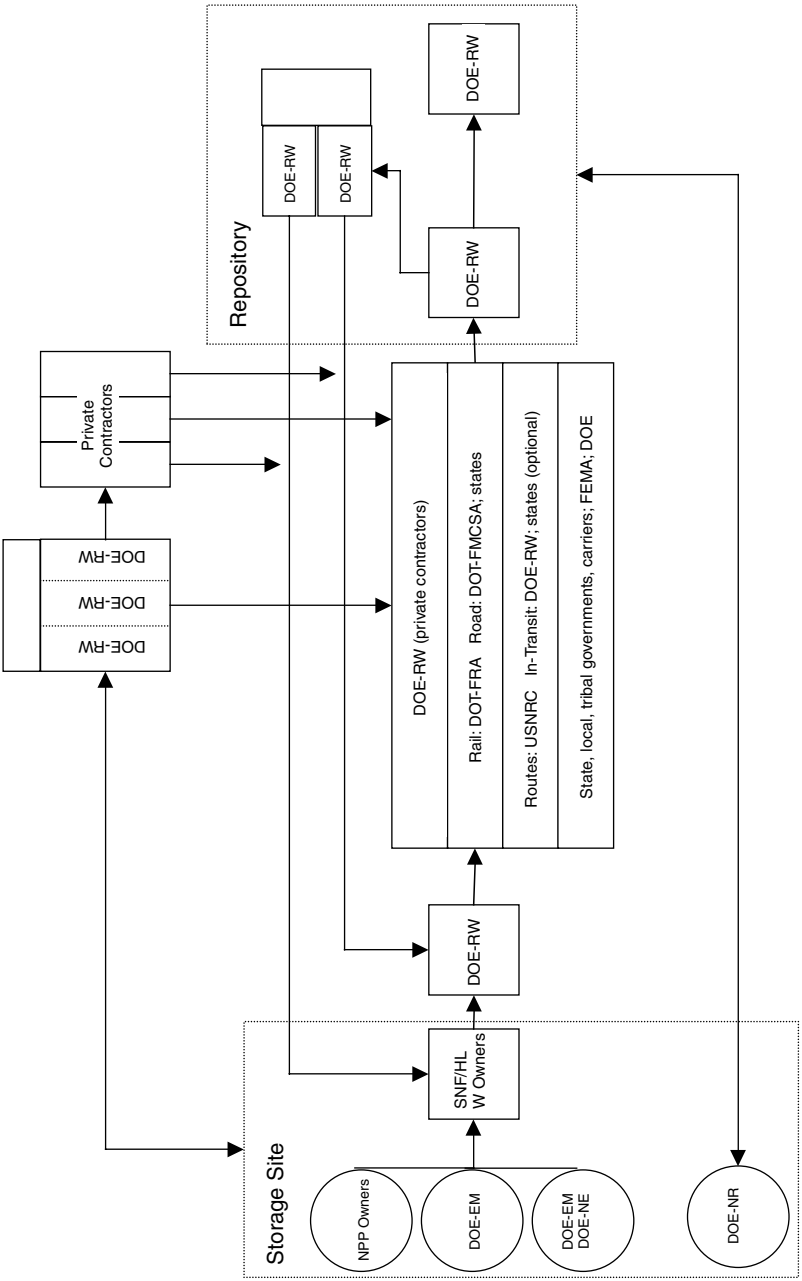

FIGURE C.1B Organizational responsiblilities.

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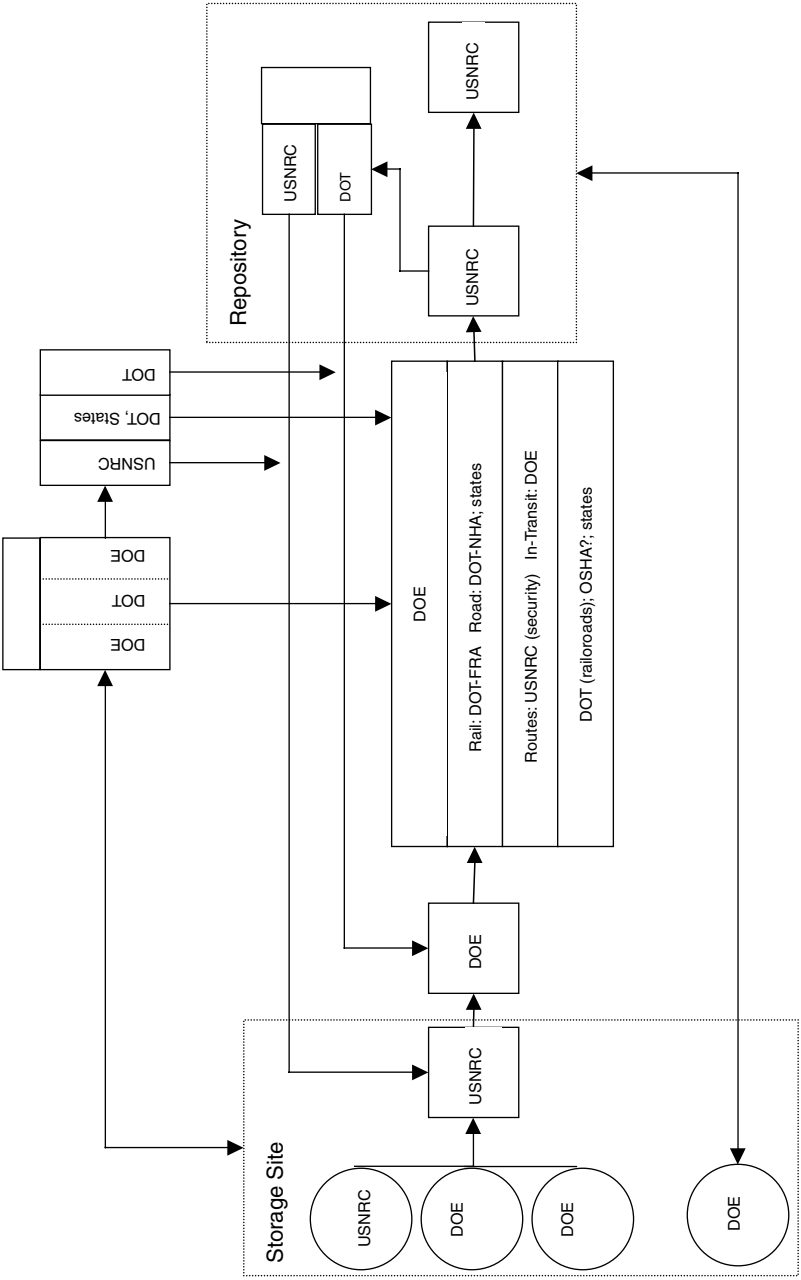

FIGURE C.1C Regulatory authorities.

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construct at a DOE-estimated cost of $2 billion. Congress must appropriate the necessary construction funds to undertake this work.

DOE is also responsible for procuring the reusable transport packages that it will use to ship spent fuel and high-level waste to the repository. A variety of package designs may be needed to accommodate existing spent fuel and high-level waste types. There are certified packages available for commercial spent fuel transport (see Chapter 3) that could be purchased by DOE. In May 2004, DOE issued purchase orders to vendors possessing current USNRC certificates of compliance for transport packages to finance studies on the vendors' capabilities to take possession of spent fuel at nuclear power plant sites and deliver it to Yucca Mountain. However, in late 2005, DOE announced plans to develop a standardized package design for its federal repository transportation program.

The process for procuring transport packages will likely take several years, especially if new package designs are needed. The Nuclear Waste Policy Act requires that new package designs be certified by the USNRC, which will add additional time to the acquisition process. Procurement of waste packages, which will cost on the order of $1 million each, also will require timely appropriations from Congress. A substantial transportation fleet must be acquired to meet DOE's stated intention to ship to the repository at a steady-state rate of 3000 metric tons per year (see Table 5.1).

DOE will also have to procure purpose-built railcars and tractor-trailers (and possibly tractors) to transport these packages. These also will be designed and fabricated by private vendors. As described in Section 5.3, DOE's schedule for these activities is changing because of delays in completing the license application for the federal repository.

The equipment purchase decision is a complex systems problem within the broader transportation system and depends on several factors, for example:

- *Modal decisions*. Fundamentally different kinds and quantities of equipment will be required depending on the number of truck and train shipments to be made. This in turn will depend on the availability of rail access at each of the shipping sites and at Yucca Mountain.
- *Shipping rates*. There must be sufficient equipment to support the envisaged steady-state shipping rate of 3000 metric tons per year within a few years of the start of repository operations. This is equivalent to about 200 to 300 rail package shipments per year or 1500 truck package shipments per year.
- *Contingencies*. Spare equipment will be needed to allow for maintenance, "deadhead" shipments of packages and conveyances from the repository to spent fuel and high-level waste storage sites, and unanticipated equipment failures.

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The Nuclear Waste Policy Act requires that DOE use private contractors "to the extent feasible" for the repository program. Indeed, DOE has announced its intention to use private contractors to run its national transportation program. However, DOE has not yet decided on the structure for contractor operations. In 1998, DOE issued a notice that it intended to divide the country into regions, each serviced by a "Regional Service Contractor." This plan was never implemented. In 2002, DOE issued another notice that it planned to issue a request for proposals for a single management and operating contractor to run the entire transportation program. It retracted this notice after receiving unfavorable comments. DOE has yet to announce what contracting approach it will pursue.

Once DOE decides which approach to use, it could take one or more years to hire a contractor using the usual DOE procurement processes. Once a contractor is selected, additional time will be required to develop the procedures to be used in the transportation program. The contractor will also have to hire and train workers to follow these procedures.

Scheduling

DOE must develop a schedule for accepting spent nuclear fuel and high-level waste from commercial and DOE sites for transportation to the repository. The schedule will based on two factors: (1) the order in which spent fuel or high-level waste is to be accepted from its owners (see Sidebar 5.2); and (2) the rate at which fuel can be shipped to the repository. The shipping rate will be based on several factors, but an important rate-controlling step is likely to be the capacity at the repository for receiving and unloading transportation packages. The availability of packages and other transport equipment also could become a rate-limiting step, especially if unexpected system upsets (e.g., equipment malfunctions) are encountered. There also could be site-specific shipping delays owing to equipment malfunctions and interference with reactor operations.

Routing

Two types of route planning are required to make the transportation system functional. The first is to assess whether the routes at the shipping and receiving ends of the system are adequate to accommodate shipments using trains, the preferred DOE shipping mode. If not, upgrades will be required before shipments can be made. DOE is in the process of planning a Nevada rail route, as noted previously. Road upgrades also may be needed in Nevada to support truck transport to the repository.

A second, more detailed route planning function must be carried out for each shipment of spent fuel and high-level waste. Railroads operate

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almost entirely on private right of way. At present, there are few regulatory restrictions on railroads' freedom to select routes for spent fuel and high-level waste shipments according to their own determinations of operational suitability and safety.[4] Such restrictions might be imposed through contractual or voluntary agreements between DOE and the railroads.

If the shipment is to be made by truck, route selection is based on Department of Transportation (DOT) regulations described in Chapter 2 and Chapter 4. DOE's current plans regarding mode and route selection, legal and regulatory restrictions on those decisions, and the states' concerns regarding routing are examined in Chapter 5.

C.1.2 Package and Load

Spent fuel and high-level waste owners are responsible for loading their waste into transportation packages at their sites. DOE-OCRWM is responsible for delivering empty packages to the sites to be loaded and can, at its option, observe the loading operations. The standard waste contracts require that DOE develop procedures for package loading and also provide the necessary training to sites for such loading and any associated package maintenance. These procedures would presumably be developed by the transportation contractor.

Under the terms of DOE's standard contracts with utilities, each shipment of spent fuel from a generator's site to the repository will involve the mass equivalent of one reactor core "offload," that is, the amount of spent fuel discharged from the reactor each time the core is reloaded with fresh nuclear fuel. Commercial power plants typically discharge about a third of a reactor core during each offload. This amounts to about 30 metric tons (33 short tons) of spent fuel for a typical 100 metric ton (110 short ton) reactor core. These offloads were commonly made on an annual basis, but they are now typically made every two years as technologies have been implemented for increasing fuel utilization.[5]

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[4]This autonomy sometimes causes public controversy. In 2004–2005, for example, the train transport of chlorine tank cars through Washington, D.C., within blocks of the U.S. Capitol building, was the subject of controversy and led to an unsuccessful attempt by city government to restrict such shipments. The railroad announced that it had voluntarily rerouted some of these shipments around the city.

[5]The utilization of nuclear fuel is referred to as "burn-up," usually given in terms of the total amount of electricity (megawatt-days) that is generated from each metric ton of uranium in the fuel. Burn-ups on the order of 25,000 megawatt-days per metric ton were achieved during the early days of nuclear power generation. Today, technology improvements allow burn-ups approaching 60,000 megawatt days per metric ton to be achieved. Because of such increased burn-ups, the nuclear fuel in reactors requires less frequent replacement.

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A single core offload will be transported to the federal repository in several packages. A typical rail package holds about 10 metric tons (11 short tons) of spent fuel, so a 30 metric ton (33 short ton) core offload would fit into two or three packages. A truck package typically holds about 2 metric tons (2.2 short tons) of spent fuel, so a single core offload would fill 15 or more packages. A site must be capable of handling multiple packages and conveyances for each shipping campaign it plans to make. There will be strong pressure from generators to ship full packages for reasons of economic efficiency, but there are likely to be many instances when the spent fuel to be shipped from a site results in less than a full package. DOE and the industry have not yet worked out arrangements for resolving this issue. The industry maintains that it wants the transportation system to run efficiently and will work with DOE to ensure that it does.

Owners are responsible for providing infrastructure for loading transportation packages for shipment to the repository. At operating commercial nuclear power plants, packages would be loaded under water in existing spent fuel pools. The packages would be moved in and out of the pools using existing overhead cranes. The overhead cranes at some plants will have to be upgraded to handle rail packages if the site intends to ship by that mode. Those packages can weigh in excess of 100 metric tons (110 short tons) when fully loaded, versus the 25 metric ton (28 short ton) weight for typical truck packages.

Several nuclear power plants, including decommissioned plants that no longer have operating spent fuel pools, have large quantities of fuel in dry-cask storage. Some of this fuel is stored in single-purpose packages that are not directly suitable for transportation. Special equipment (e.g., package over packs) or one-time variances from the USNRC will be needed to transport these packages to the repository. Otherwise, this fuel will have to be removed from the storage casks and reloaded into a package certified for transport. This will require access to pool space or heavily shielded dry-transfer facilities.

Owners are also responsible for providing access infrastructure within their plant sites so that the transport packages can be delivered and picked up. All commercial nuclear power plants have road access, and most, but not all, have rail access. Some plants may have to upgrade or add rail spurs if they choose to ship by that mode. DOE will have to assess and, where necessary, make improvements to roads and rails outside plant sites so that package deliveries and spent fuel pickups can be made.

The type of access available at each site will help determine what transport mode is selected. Sites that have adequate access to rail lines will likely ship by that mode using packages designed to be transported on railcars. Sites without rail access could ship by truck using packages de-

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signed to be transported on truck trailers. Legal-weight truck[6] shipments could be made over most of the nation's highways. Overweight truck shipments would require special permits issued by states and would be restricted to routes with appropriate load ratings. Alternatively, rail packages could be transported by heavy-haul truck[7] (again with state permits using load-rated highways) or by barge[8] over water to nearby railheads if the necessary infrastructure improvements are in place or can be made. DOE is responsible for the costs of such improvements.

DOE's Office of Environmental Management (DOE-EM) will be responsible for packaging its defense and research reactor spent fuel and high-level waste for shipment to the repository. All of the DOE sites that will ship this waste have rail access, but package-loading facilities may have to be constructed at some of these sites.

C.1.3 Inspect and Accept

Once loaded, the owner must place the spent fuel or high-level waste package onto the DOE-provided conveyance (i.e., typically railcars or trailers). This will be done at the owner's site using the owner's equipment. DOE-OCRWM will then perform an inspection to determine if the shipment is "transport ready." If so, it will accept the package for transport to the repository. Ownership of the spent fuel or high-level waste passes to DOE-OCRWM at the plant gate.

DOE told the committee that its current plans are to transport an average of three packages per rail shipment. This is approximately the number of train packages needed to ship a full core reload. DOE could, however, accept a larger or smaller number of packages in each shipment, or even partially full packages—there is no physical constraint that limits a

[6]A legal-weight truck is a truck that complies with all state and federal truck weight regulations and therefore does not require any special permits to operate. In almost all cases, legal-weight trucks would be limited to 80,000 pounds (about 36 metric tons) gross weight (i.e., the weight of the vehicle and cargo) and could carry a cargo of about 50,000 pounds (about 23 metric tons).

[7]In the context of the Yucca Mountain transportation problem, a heavy-haul truck is a highway vehicle capable of carrying a rail shipping package. Such a truck would weigh in excess of 200,000 pounds (about 90 metric tons) empty, plus the weight of the package when loaded.

[8]Even if barge access is available, DOE may not be able to ship by this mode due to state and public opposition. Such opposition appears to be especially strong in the upper Midwest, particularly for shipments that would utilize the Great Lakes. The committee was told that barge transport appears to be more acceptable in the southeastern United States, where such shipments for the disposal of low-level waste are already being made.

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single train shipment to three packages. DOE could, in principle, combine packages from several sites into a single shipment by moving packages to nearby rail yards for makeup of single trains. There will likely be strong pressure to minimize time in transit, which could encourage shipments from single sites directly to the repository, and to minimize the consolidation of shipments from multiple sites into single trains. On the other hand, there might be pressure from transit states to consolidate shipments to reduce the total number of trips.

C.1.4 Transport

The transport of spent fuel and high-level waste from storage sites to the repository will be a complicated process involving DOE; its contractors; regulatory authorities; and state, tribal, and local authorities. Each shipment or shipping campaign[9] must be planned well in advance; the exact planning requirements will depend to a great extent on the transportation mode selected.

Although DOE has decided on a mostly rail transportation program, the possibility still exists that trucks will play a significant role. For truck shipments, the transportation contractor, in consultation with DOE, would select a route from DOT's approved list of preferred or alternate preferred routes (see Chapter 4). The latter are designated by states. The highway routes selected are most likely to be Interstate System highways and bypasses around cities. The transportation contractor would then pick up the shipment at the owner's site and transport it to Yucca Mountain. The only planned stops during transport would be for inspections, refueling, maintenance, and crew rests and changes.

For train shipments, the railroad will select the route to be used probably in consultation with the contractor and DOE. DOE could impose restrictions on the route—for example, to reduce time in transport, to minimize transport through tunnels or densely populated areas, or to avoid poor-quality tracks—but this might increase shipping costs. There is no state or local control over routing decisions. The Western Interstate Energy Board has examined the possibility of state regulation of routing of spent fuel train shipments, but no state has acted and the limits of state powers to regulate such matters have not been legally determined (WIEB, 1995, Pp. 34–36, Pp. 45–47).

[9]A shipping campaign consists of a number of shipments from a single site to the federal repository over a fixed period of time. Such campaigns are likely for truck transport but less likely for train transport unless a number of core offloads (each of which could be shipped to the repository using a single train) are planned for consecutive shipment.

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Regardless of mode, actual transportation operations would be carried out by private trucking or railroad companies under contract to DOE. In principle, a single trucking firm could handle all truck shipments to the repository, because highways are publicly owned. This would not be the case for train shipments, however, because railroad rights of way are privately owned. DOE would have to contract with the rail operator who owns the tracks with direct access to the shipping site. That operator would pick up the shipment and move it to the end of its line. From there it would be transferred to the rail operator who owns the next segment of track. Several such transfers might take place to move a single shipment from the owner's site to the repository.

DOE has yet to develop procedures or hire contractors for shipping to the repository. These tasks would presumably be handled by the transportation contractor.

En Route Inspections

States have primary responsibility for enforcing highway safety regulations concerning federal motor carrier safety and hazardous materials transportation. Consequently, truck shipments of spent fuel and high-level waste to the repository would be subject to state inspection, and each shipment could potentially receive separate inspections by each state. State enforcement officials can stop and inspect vehicles and inspect the premises of motor carriers to check for compliance with federal and state requirements regarding equipment, documentation, and driver fitness. States can also require carriers to obtain special permits to operate these vehicles and charge fees for such permits.

However, the federal hazardous materials transportation law is explicit that federal rules preempt state rules in cases of conflict (49 USC 5125), consistent with the goal of nationally uniform regulation. DOT has administrative authority to determine when state rules are to be preempted. For example, DOT has determined that state requirements for special permits for radioactive materials highway shipments are preempted if they require documentation or prenotification in excess of federal requirements. DOT also has determined that state fees imposed on hazardous materials transport are preempted if they are excessive or if the revenue is not used for purposes related to hazardous materials transport. Additionally, DOT has determined that state routing requirements for highway radioactive materials transport are preempted if they are not identical with federal requirements (Buren, 1998).

Regulation of the safety and operation of railroads is dominated by the federal government. Railroad shipments of spent fuel and high-level waste are not subject to state regulation, but they are subject to inspection by

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DOT's Federal Railroad Administration (FRA). The FRA is generally responsible for safety regulations governing the design and maintenance of track, signals, and equipment; railroad operating practices; hazardous materials handling; and rail worker safety practices and qualifications.[10] Enforcement is by railroad self-inspections, which are audited by Federal Railroad Administration inspectors with the participation of administration-certified state inspectors.

In 1998, the Federal Railroad Administration published the report *Safety Compliance Oversight Plan for Rail Transportation of High-Level Radioactive Waste and Spent Nuclear Fuel* (FRA, 1998) as a comprehensive definition of FRA activities to ensure the safety of rail transport of these materials. The plan is a statement of policy rather than a regulation. It was developed to guide the FRA's involvement in DOE's Foreign Research Reactor Spent Fuel Program, but it is also intended to be applicable to future shipments to a federal repository or to temporary storage. The plan requires coordination among the Federal Railroad Administration, DOE, utilities, railroads, and the states.

The elements of this plan are grouped in three activity areas: planning, inspections, and training. The planning provisions require the shipper to notify the Federal Railroad Administration with carrier and route information at least 90 days before the initial shipment. The FRA will inspect the track and will consult with DOE and the shipper and carrier on route selection. The plan highlights physical track quality as a route selection criterion. The Federal Railroad Administration will also assist states in estimating highway-rail grade-crossing accident risks along the route. Other provisions of this plan involve inspections by FRA personnel of all equipment, a requirement for administration personnel to be present in the railroad's dispatch center during each movement of spent fuel or high-level waste, and training for railroad personnel and emergency responders.

Security

DOE-OCRWM is responsible for providing security for its shipments of spent fuel and high-level waste. Under the Nuclear Waste Policy Act, DOE is required to follow the U.S. Nuclear Regulatory Commission's regulations in 10 CFR 73.37: *Requirements for the Physical Protection of Irradiated Reactor Fuel in Transport*. These regulations address the establishment of a physical protection system that minimizes the possibility for radiological sabotage of spent fuel shipments, especially within heavily

[10]These regulations are promulgated in Title 49, Parts 200-245 of the Code of Federal Regulations.

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populated regions, and facilitates the location and recovery of spent fuel shipments that come under the control of unauthorized persons. The regulations require that the shipper take the following steps:

- Notify the USNRC in advance of each shipment. Part 73.72 requires that such notifications be received at least 10 days prior to the initiation of such shipments.
- Make arrangements with local law enforcement agencies along the route of each shipment for their response to an emergency or call for assistance.
- Obtain advance approval by the USNRC of the routes to be used. The Commission will physically survey the routes and issue an approval to use them for a fixed time period.
- Plan shipments so that scheduled intermediate stops are avoided to the extent practicable.
- Provide trained escorts for the shipments and require that these escorts make calls to a communications center at least every two hours to provide a shipment status.

Escort requirements are specified according to mode and route. Truck transport within a heavily populated region[11] is required to be occupied by a driver and at least one escort, and to be escorted by an armed member of local law enforcement in a mobile unit. Alternatively, a vehicle occupied only by a driver is required to be escorted by lead and trailing vehicles containing at least one armed escort each. A road transport vehicle not in a heavily populated region is required to have an escort on board or to be escorted by a vehicle that contains at least two escorts. Escorts must be capable of communicating with the communications center, local law enforcement, and each other. The transport vehicle must be equipped with USNRC-approved features that permit immobilization of the cab or cargo-carrying portion of the vehicle. Additional security measures were required by the USNRC after September 11, 2001. These requirements have not been made public.

Shipments by train within heavily populated regions must be accompanied by two armed escorts, at least one of whom is stationed on the train to

[11]The more stringent requirements for transporting spent fuel through heavily populated regions were developed based on the "urban studies" completed by Sandia for the USNRC (DuCharme et al., 1978; Finley et al., 1980; Sandoval et al., 1983; Sandoval, 1987). These studies suggested that sabotage of spent fuel transport packages in urban areas could have significant negative consequences. Consequently, the Commission requires tighter security for spent fuel transport through such areas. The USNRC is undertaking additional vulnerability studies in response to the September 11, 2001, attacks.

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permit direct observation of the package railcar while in motion. Shipments by rail in regions that are not heavily populated must be accompanied by at least one escort stationed on the train to permit such direct observation. These escorts must have the capability to communicate with the communications center and local law enforcement.

Regulations also require that the shipper notify the governor or governor's designee of each state through which the shipment will pass. This notification must be postmarked at least seven days before the shipment reaches the state or be delivered by messenger at least four days in advance. The notification must include a description of the shipment, a listing of the routes to be used within the state, the estimated time of departure from the point of origin of the shipment,[12] and the date and time of entry into the state. Subsequent timely notifications are required if the schedule changes by more than six hours.

All spent fuel and high-level waste shipments to the repository will have DOE- or contractor-provided security escorts and, in addition to the USNRC requirements described previously, will be tracked using a global positioning system (GPS) to provide real-time monitoring of the locations of all shipments. GPS tracking is currently in use for other DOE waste shipments, including shipments to the Waste Isolation Pilot Plant in New Mexico. The information on location and status of shipments is made available to states when shipments are within their geographic boundaries.

Emergency Response

An *emergency responder* is any individual trained to provide assistance at the scene of an accident. The first emergency responder at the scene of a transportation accident might be the transport vehicle driver. The carrier (whether truck or rail) is responsible for providing the first line of emergency response should an accident or terrorist attack occur. This would include preventing the spread of contamination at the site of the accident; preventing individuals from coming into contact with spilled materials; and preventing contaminated vehicles or equipment from being used until they have been surveyed and, if necessary, decontaminated. The carrier also is responsible for notifying local authorities, the shipper, and applicable federal agencies of the accident and providing whatever additional assistance is required.

State, tribal, and local governments play a preeminent role in emergency response and preparedness. They provide the first line of government

[12]The state is to keep this information protected in accordance with 10 CFR 73.21 until at least 10 days after the shipment entered or originated within the state or, for a series of shipments, 10 days after the last shipment.

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response to emergencies involving chemically hazardous and radioactive materials and can call on other levels of government for assistance as circumstances require. Their level of readiness varies nationally. Some require minimal technical assistance, whereas others will act only to secure the accident scene and evacuate endangered populations while awaiting technical assistance.

The first government responder will likely be a member of a public safety department such as sworn police officer or firefighter, or both, from the jurisdiction where the accident is located. Specialized teams (i.e., a "hazmat team") attached to the jurisdiction's emergency services agency, or from neighboring communities when mutual aid agreements are in effect, may be dispatched to the site in the event of an accident involving hazardous cargo.

Except in national defense incidents, the local government and the on-scene commander are responsible for incident command and control. The local authority (usually a government entity such as a city or county) will establish an on-scene "incident commander" to direct the response and ensure that all needed resources are made available. If the emergency needs outstrip the resources of the jurisdiction, the incident commander will work with authorities to summon additional assistance. This could include trained teams from adjacent jurisdictions that are activated through prearranged mutual assistance agreements; state and federal response teams; and private organizations.

The Department of Homeland Security (DHS) is the responsible federal agency for incident response. At the direction of the President of the United States, DHS has instituted the National Incident Management System (NIMS), which is intended to become the national command and control system for responding to incidents of any nature in the homeland. The President has issued a number of Homeland Security Presidential Directives (HSPDs)[13] to implement NIMS, and governors and state legislatures have also been requested to adopt this system. The federal government has established 2006 as the deadline for national compliance.

The NIMS establishes a National Response Plan, which tasks all federal agencies and establishes operational standards and procedures for responding to incidents.[14] Under this plan, the Secretary of Homeland Security, acting as the principal federal official, or a federal official designated by the secretary as a federal coordinating officer, can direct federal assis-

[13]HSPD-5 designates the Secretary of the Department of Homeland Security as the principal federal official for hazards preparedness, response, and recovery anywhere in the United States. HSPD-8 implements NIMS, defines national preparedness goals, and provides a National Uniform Task List for all hazards.

[14]The National Response Plan replaces the Federal Response Plan, which was an agreement among federal agencies on a management process for responding to incidents.

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tance and resources to the on-scene incident commander. The governor of the state in which the incident occurs will appoint a state coordinating officer to direct and control state assets and request federal assistance on behalf of the on-scene commander.

The federal government also is the primary provider of training to the nation's firefighters and emergency management personnel through the National Emergency Training Center in Emmitsburg, Maryland. This center houses the National Fire Academy, which provides training to the nation's firefighters, and the Emergency Management Institute, which serves as the national focal point for executive-level emergency management training. These organizations provide resident and nonresident training; the latter includes Web-based training and other distance training using video tapes and other instructional materials.

The Department of Transportation, in cooperation with Canadian and Mexican transportation organizations, has developed the *Emergency Response Guidebook* (DOT, 2004) for use by emergency responders during the initial phase of a dangerous goods or hazardous materials incident. It was developed to help responders quickly identify actual or potential hazards in an incident and take steps to protect themselves and the public during the initial phases of a response. Federal regulations[15] require that first responders be trained in the use of this guidebook.

The Department of Energy provides technical assistance and training to emergency responders through its Transportation Emergency Preparedness Program (TEPP). Under the Nuclear Waste Policy Act, DOE is responsible for providing emergency responder training assistance along routes that will be used to ship spent fuel and high-level waste to the repository. This program is described in Chapter 5. DOE plans to initiate this training assistance once it identifies transport routes.

The Institute for Nuclear Power Operations (INPO[16]) has established voluntary agreements among the nation's nuclear utilities to provide mutual assistance in the event of a radioactive materials transportation accident involving commercial spent fuel. Through these agreements, nuclear utilities located near the scene of an accident would provide technical advice and assistance to federal, state, and local emergency responders regardless of who owns the spent fuel involved in the accident.

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[15]These are provided in 29 CFR 1910.120 and 40 CFR Part 311.

[16]INPO was formed by the nuclear power industry in 1979 as a result of the Three Mile Island Unit 2 accident near Harrisburg, Pennsylvania. Its purpose is to promote the safety and reliability of nuclear power plant operations. INPO sets performance guidelines and objectives for nuclear power plant operations; conducts evaluations of plant performance; and accredits utility training programs for plant operators and supervisors. All U.S. nuclear power plant operators are members of this organization, and nuclear plant operators in other countries are participants.

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C.1.5 Inspect and Unload

Once the shipment reaches the repository, the package will be removed from its conveyance and unloaded. A surface facility at the repository site will be constructed for this purpose. The package unloading function will be handled by the repository contractor as part of disposal system operations. The rate of unloading will be governed by the availability of surface storage and the rate at which spent fuel and high-level waste can be moved to storage or emplaced underground. This rate will help determine the transport package procurement strategy.

DOE-OCRWM is responsible for constructing facilities for receiving and unloading waste packages at the repository and maintaining the packages and conveyance equipment. DOE will include the design of these facilities in its application to the USNRC for a repository construction license. Construction of these facilities could take several years.

C.1.6 Maintenance

Once the package has been unloaded, it and its conveyance would be inspected for wear and damage, and maintenance would be performed as required. They would then be returned to service. Empty packages and conveyances would be sent to the next site in the waste acceptance queue. While DOE-OCRWM has not yet determined where it will carry out this maintenance activity, it sees advantages in locating this facility at or near the Yucca Mountain site. DOE-OCRWM noted that it also does not yet have a design for such a maintenance facility. The design requirements will depend on the mix of transport modes employed (i.e., train versus truck), because this will affect the size and throughput of transport packages.

DOE-OCRWM may find that it needs more than one facility to service a national transportation program, given the amount of equipment involved and the geographic extent of its planned operations. The transportation program in the United Kingdom, for example, has one maintenance facility for locomotives, two geographically separated facilities for maintaining railcars, and yet another facility for maintaining its transportation packages.

C.2 DISCUSSION

As described in the foregoing sections, the system to transport spent fuel and high-level waste to a federal repository will involve a large number of operations, responsible parties, and interdependencies. Many of the major decisions that have to be made to establish this system are under DOE-OCRWM's direct control, most notably modal and routing decisions, equip-

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ment purchases, and contractor selections. Of course, establishment of this system is dependent on DOE's ability to obtain a license to construct and operate the repository, including surface facilities to handle spent fuel and high-level waste shipments, and to obtain adequate appropriations from Congress for procuring equipment and hiring contractors.

One of the most important decisions in the transportation program—the order for accepting spent fuel from generators—is established by the Nuclear Waste Policy Act (see Sidebar 5.2). It has no geographic coherence, and neither will the transport system developed to accommodate it. Spent fuel is likely to be transported to the repository simultaneously from several parts of the country along several different routes. It could be difficult for DOE to achieve efficiencies with respect to many of its transport operations, most notably route planning and emergency responder training, if it has no legal control of the acceptance order.

The national transportation program was in the early stages of development when this report was being written. Most of the planning and a great deal of the infrastructure will have to be developed from scratch, most notably the following:

- The back-end facilities at the repository for handling the packages and conveyances have not been licensed or constructed.
- A rail route has not been constructed in Nevada.
- The packages and conveyances to move the spent fuel and high-level waste have not yet been ordered. New designs may have to be developed for some of this equipment. New package designs will require certification by the USNRC. DOE will not be able to fully determine its package needs until it has updated data on rail and heavy-haul access to owner's sites (see Chapter 5).
- DOE has not yet decided on contractor roles in the program, nor has it advertised for a transportation contractor.
- Procedures for loading and moving spent fuel and high-level waste have not yet been established.
- DOE has not yet selected routes so that emergency responder training can begin.
- Many states, including Nevada, have yet to specify alternate preferred routes for truck shipments.
- Procedures, facilities, and criteria for inspection and maintenance of packages and conveyances have not been developed.

In short, the national transportation program is very much a work in progress. The committee makes several recommendations in Chapter 5 for improving this transportation program.

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APPENDIX D
Glossary

10 CFR Part 71: Title 10, Part 71 of the Code of Federal Regulations, Packaging and Transportation of Radioactive Material. These regulations were promulgated by the U.S. Nuclear Regulatory Commission.

10 CFR Part 72: Title 10, Part 72 of the Code of Federal Regulations, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste. These regulations were promulgated by the U.S. Nuclear Regulatory Commission.

49 CFR Part 173: Title 49, Part 173 of the Code of Federal Regulations, Shippers—General Requirements for Shipments and Packagings. These regulations were promulgated by the U.S. Department of Transportation.

A_1: The maximum activity of special form radioactive material permitted in a Type A package as provided in Appendix A of 10 CFR Part 71.

A_2: The maximum activity of normal form radioactive material permitted in a Type A package as provided in Appendix A of 10 CFR Part 71.

Absorbed dose: The quantity of ionizing radiation deposited into an organ or tissue, expressed in terms of the energy absorbed per unit mass of tissue. The basic unit of absorbed dose is the rad or its SI equivalent the gray (Gy).

Acceleration: The rate of change of velocity of an object.

Accelerometers: Devices that measure the acceleration of an object.

Accident conditions of transport: Severe conditions that well exceed normal conditions of transport. Such conditions could result in the application

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of thermal and mechanical forces that have the potential to damage the vital containment functions of the package.

Accident consequence value: The estimated collective dose that would be received by a population as a result of an accident scenario.

Accident scenario: A postulated sequence of events during a transportation accident that result in the application of elevated thermal and mechanical loads to a transportation package.

Accident source term: The amount of radioactive material released from a loaded transportation package in an accident.

Actinides: Any of a series of chemically similar radioactive elements with atomic numbers ranging from 89 (actinium) through 103 (lawrencium). This group includes uranium (atomic number 92) and plutonium (atomic number 94).

Activity: The rate of decay of a radioactive isotope.

Acute radiation exposure: A radiation exposure that occurs over a relatively short period of time (e.g., seconds to hours). A chest X-ray is an acute radiation exposure.

Affected communities: Communities that are impacted by a transportation program, for example, communities along a route used to ship spent fuel and high-level waste.

Agreement State: States that have assumed authority under Section 274b of the Atomic Energy Act to license and regulate by-product materials (radioisotopes), source materials (uranium and thorium), and certain quantities of special nuclear materials.

Atoms for Peace Program: A U.S. program begun under the Eisenhower administration to supply research reactor technology and nuclear fuel to foreign nations that agreed to forgo the development of nuclear weapons.

Bare-fuel packages: See *Package*.

Becquerel: A unit of radioactive decay equal to 1 disintegration per second.

Bounding accident scenarios: Physically realistic accident scenarios that would be expected to produce large thermal and mechanical loading conditions.

Burn-up: A measure of the degree to which the uranium-235 in nuclear fuel has been used up (fissioned), which determines the amount of radioactivity and heat generation in the fuel after it has been removed from the reactor.

BWR: Boiling water reactor, a type of nuclear reactor in which the reactor's water coolant is allowed to boil to produce steam. The steam is used to drive a turbine and electrical generator to produce electricity.

Byproduct material: Defined by the Atomic Energy Act as radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or using

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special nuclear material; and tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.

Caliente corridor: A corridor in Nevada that has been selected by the U.S. Department of Energy for the construction of a rail line to Yucca Mountain. The corridor begins near Caliente, Nevada; passes north of the Nevada Test and Training Range; and then runs south to Yucca Mountain.

Cancer incidence: Also known as the *incidence rate*. The rate of occurrence of cancer within a specified period of time per unit of population; for example, the number of cancers per year per 100,000 people.

Cancer mortality: Also known as the *mortality rate*. The rate of death from cancer within a specified period of time per unit of population; for example, number of cancer deaths per year per 100,000 people.

Canister-based packages: See *Package*.

Cask: See *Package*.

Centralized interim storage: See *Interim storage*.

Certification tests: See *Full-scale testing*.

Chronic radiation exposures: Radiation exposures that occur over extended periods of time (e.g., months to years). Exposure to natural background is a chronic radiation exposure.

Closed fuel cycle: A nuclear fuel cycle in which spent fuel is processed to recover its usable contents.

Cloud shine: Radiation exposure from airborne radioactive material.

Collective dose: The sum of all radiation exposures received by all members of a specified population.

Commercial spent fuel: Spent fuel produced from commercial nuclear power plants.

Community: A group of people having similar characteristics, interests, or interactions; for example, people living in a particular geographic region, people with common cultural backgrounds, or people with common professional interests.

Comparative risk: See *Risk*.

Complementary cumulative distribution function (CCDF): Also known as the *risk curve*. A graphical representation of estimates of risk to a population from a particular accident scenario involving spent fuel and high-level waste. The estimate is developed through computer modeling studies.

Compound CCDF: A graphical representation of the statistical properties (e.g., mean, median) of a group of complementary cumulative distribution functions.

Containment effectiveness: The ability of a transportation package to con-

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tain its radioactive contents and maintain its radiation shielding effectiveness during routine use and under severe accident conditions.

Conventional vehicular impact: Health and safety impacts that result from both normal transportation and transportation accidents involving spent fuel and high-level waste. These include the health impacts of transport vehicle exhaust emissions as well as traffic-related fatalities, injuries, and property damage.

Conveyance: Any transport vehicle or vessel used to move spent fuel and high-level waste packages; for example, a truck and trailer or a locomotive and railcar.

Criticality events: Self-sustaining nuclear reactions in spent fuel like those that occur when the fuel is in the reactor.

Crud: Non-fixed radioactive contamination on the external surfaces of spent fuel assemblies.

Curie: A unit of radioactive decay equal to 3.7×10^{10} (37 billion) disintegrations per second.

Dedicated train: A train that transports only spent fuel or high-level waste and no other cargo.

Demonstration tests: See *Full-scale testing*.

Depleted uranium: Uranium from which much of the uranium-235 has been removed.

Direct inhalation: See *Inhalation*.

Direct socioeconomic impact: Loss of economic or social well-being as a direct result of transportation program operations; for example, economic losses from a transportation accident.

DOE spent fuel: Spent fuel that is being managed by the U.S. Department of Energy, including spent fuel from defense reactors, research reactors, naval reactors, and some commercial power plants.

Dose: See *Radiation dose*.

Dose rate: See *Radiation dose rate*.

Dry-cask storage: Packages used to store spent fuel in a dry state.

Effective dose: The equivalent dose averaged over all organs that accounts for the varying sensitivity of different organs and tissues to the biological effects of ionizing radiation. The effective dose has the same units as the equivalent dose.

Elastic limit: The maximum stress that can be applied to an object without causing permanent deformation.

Emergency responder: A individual trained to provide assistance at the scene of an accident.

Environmental justice: The fair treatment and meaningful involvement of people regardless of race, gender, national origin, or level of attained education in the development of laws, regulations, and policies that affect them.

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Equivalent dose: The absorbed dose averaged over the organ or tissue of interest multiplied by a weighting factor that accounts for the differences in the biological effects per unit of absorbed dose for different types of radiation. The basic unit of equivalent dose is the rem or its SI equivalent the sievert (Sv).

Essentially unyielding surface: A surface that, because of its large mass and stiffness, absorbs minimal energy when impacted with other objects.

Event trees: A graphical illustration of the sequence of events leading to an accident along with the probability of occurrence of each event. Each branch of the tree depicts the sequence of events that leads to the accident outcome depicted at the end of the branch. The probability of that accident is equal to the product of the probabilities of each segment along the branch.

Exclusive use: Defined in 10 CFR 71.4 as "sole use by a single consignor of a conveyance for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of the consignor or consignee. The loading and unloading must be carried out by personnel having radiological training and resources appropriate for the safe handling of the consignment."

Extraregulatory conditions: Accidents that impose thermal or mechanical loads on transportation packages that exceed those generated in the hypothetical accident conditions specified in 10 CFR Part 71.

Federal repository: A federally operated underground facility for the permanent disposal of spent fuel and high-level waste.

Fissile: Capable of being fissioned with thermal (low-energy) neutrons, the primary process in most nuclear reactors. The two most important fissile materials in spent fuel are uranium-235 and plutonium-239.

Fission: The splitting of a nucleus into at least two fragments accompanied by the release of neutrons and energy.

Free-drop test: One of the hypothetical accident conditions in 10 CFR Part 71 involving the free fall a transportation package from a height of 9 meters (about 30 feet) onto a flat, essentially unyielding horizontal surface, with the package striking the surface in the position expected to produce maximum damage.

Fuel assembly: A bundle of fuel rods arranged in a square array.

Fuel basket: A latticed container that is inserted into a transportation package or dry-storage cask and is designed to hold spent fuel assemblies in a fixed configuration.

Fuel cladding: The thin-walled metal tube, usually fabricated from a zirconium alloy, that forms the outer jacket of a nuclear fuel rod.

Fuel pellets: Small cylinders of uranium, usually in an oxide form, that provide the fuel for a nuclear reactor.

Fuel rod: Sometimes referred to as a *fuel element* or *fuel pin*. A long, slen-

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der, sealed tube that holds uranium fuel pellets. Fuel rods are bundled in square-arrays bundles called *fuel assemblies*.

Full-scale testing: Tests carried out on full-scale transportation packages or package components. Tests carried out to simulate the hypothetical accident conditions specified in 10 CFR Part 71 are referred to as *certification tests*. Tests carried out to simulate other severe accident conditions are often referred to as *demonstration tests*.

Fully engulfing fire: An optically dense, hydrocarbon-fuel fire that is sufficiently large to completely engulf a transportation package.

***g*:** The acceleration imparted by Earth's gravity field; 1 *g* is equal to 9.8 meters per second squared or 32 feet per second squared.

Galactic cosmic radiation: Radiation originating from distant stars and galaxies.

General trains: Also known as *general service trains*. Trains that carry other freight in addition to spent fuel or high-level waste.

Generic package: A conceptual package design that incorporates the salient features of packages that have been certified for actual service. Generic package designs have been constructed for use in package performance modeling studies.

Gray literature: Foreign or domestic open-source material that usually is available through specialized channels and may not enter normal channels or systems of publication, distribution, bibliographic control, or acquisition by booksellers or subscription agents.

Greater-than-Class-C waste: Radioactive waste that contains concentrations of certain radionuclides above the Class C limits in 10 CFR 61.55.

Ground shine: Radiation exposure from material deposited on the ground.

Hazardous Materials Incident Reporting System: A computerized database maintained by the U.S. Department of Transportation that contains information on incidents involving the interstate transportation of hazardous (including radioactive) materials by air, highway, rail, and water.

Health and safety risks: In the context of this report, risks that arise from exposures of people to radiation as a direct result of spent fuel and high-level waste transport.

Heavy-haul truck: As used by the U.S. Department of Energy, an overweight truck that is capable of transporting a full-size rail package.

High-income economy countries: Defined by the U.S. Department of Energy to include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Israel, Italy, Japan, Netherlands, Spain, Sweden, Switzerland, Taiwan, and the United Kingdom.

High-level radioactive waste (HLW): Defined in Title 42 of the U.S. Code as the highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in repro-

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cessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and other highly radioactive material that the U.S. Nuclear Regulatory Commission, consistent with existing law, determines by rule to require permanent isolation.

Highly enriched uranium (HEU): Uranium enriched in the isotope uranium-235 to concentrations greater than or equal to 20 percent.

HIGHWAY: A U.S. Department of Energy computer model used to route highway shipments of radioactive materials.

Highway route controlled quantity: Defined in 49 CFR 173.403 as a quantity within a single package that exceeds 3000 times the A_1 or A_2 values for special form and normal form radioactive material, respectively, or that contains 1000 terabecquerels (27,000 curies) of radioactivity, whichever is least.

HTGR: High-temperature gas-cooled reactor, a type of nuclear reactor in which helium is used as the coolant instead of water. The helium is used to heat water to generate steam, which in turn drives a turbine and electrical generator to produce electricity.

Hypothetical accident conditions: A series of package tests described in 10 CFR Part 71 that includes a free-drop test, puncture test, thermal test, and immersion test.

Immersion test: One of the hypothetical accident conditions in 10 CFR Part 71 in which an undamaged package is subjected to a pressure head equivalent to immersion in 15 meters (about 50 feet) of water. Additionally, 10 CFR 71.61 specifies that for packages designed for transport of spent fuel with activity exceeding 37 petabecquerels (1 million curies), the undamaged containment system must be able to withstand an external water pressure of 2 megapascals (290 pounds per square inch) for one hour without collapse, buckling, or in-leakage of water.

Impact limiters: Protective coverings attached to the ends of transportation packages that are designed to absorb mechanical forces and provide thermal protection for the package closure system.

Incidents: (1) Any event that involves the actual or suspected release of radioactive material from or surface contamination of a transportation package. (2) An intentional criminal act intended to damage a transportation package or disrupt a shipment.

Independent Spent Fuel Storage Installations (ISFSIs): See *Interim storage*.

Ingestion: Radiation exposures resulting from the uptake of radioactive material into the body via the digestive tract.

Inhalation: Exposures resulting from the uptake of material into the body via the respiratory tract. The exposures of interest in this report are from inhalation of radioactive materials.

Interim storage: The temporary storage of spent fuel and high-level waste,

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either in pools or in dry casks. Facilities designed to store spent fuel or high-level waste from several different sites are also informally referred to as *centralized interim storage facilities*.

INTERLINE: A Department of Energy computer model used to route rail shipments of radioactive materials.

Intermodal transportation: Movement of spent fuel or high-level waste using a combination of rail, highway, and barge.

INTERTRAN 2: An implementation of the RADTRAN code for international applications.

Ionizing radiation: Radiation that is sufficiently energetic to ionize the matter (i.e., remove electrons from the atoms) through which it moves.

Irradiated nuclear fuel: See *Spent nuclear fuel*.

Large-quantity shipping programs: Transportation programs that ship on the order of hundreds to thousands of metric tons of spent fuel or high-level waste.

Latent cancer: Cancerous lesions in a living organism that have not progressed to a stage to be detectable.

Legal-weight truck: A truck having a total gross weight (i.e., including cargo) of 80,000 pounds (about 36 metric tons) or less.

Low enriched uranium (LEU): Uranium enriched in the isotope uranium-235 to concentrations less than 20 percent.

Magnox package: A transportation package used in the United Kingdom to transport spent fuel from Magnox reactors. Also referred to as a *Magnox flask*.

Margin of safety: Also known as a *safety margin*. A philosophy for designing engineering structures that relies on conservative assumptions about the mechanical properties of the materials used in the structure and the applied loads that the structure must resist.

Maximally exposed individual: The individual in a population who is expected to receive the largest radiation dose.

Maximum reasonably foreseeable accident: Defined by the U.S. Department of Energy as an accident characterized by extremes of mechanical and thermal forces, and other conditions not specified, that leads to the "highest reasonably foreseeable consequences." DOE defines any accident that has the chance of occurring more than 1 in 10 million times per year as being reasonably foreseeable.

Mean collective dose risk: The collective dose received by the population from an accident times the probability of occurrence of that accident.

Mixed oxide fuel: Nuclear fuel that contains uranium and plutonium.

Mode: See *Transportation mode*.

Modular Emergency Response Radiological Transportation Training (MERRTT): U.S. Department of Energy-developed training materials

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that provide information on fundamental concepts and procedures for responding to radioactive materials transport incidents.

Mostly rail scenario: U.S. Department of Energy's preferred scenario for using trains to ship spent fuel and high-level waste to a federal repository at Yucca Mountain, Nevada.

Mostly truck scenario: U.S. Department of Energy's alternate scenario for using trucks to ship spent fuel and high-level waste to a federal repository at Yucca Mountain, Nevada.

MTHM: Metric tons of heavy metal, where the heavy metal is usually uranium. This is a commonly used measure of fuel quantity.

Natural background radiation: Radiation that exists naturally in the environment. It includes cosmic and solar radiation, radiation from radioactive materials present in rocks and soil, and radioactivity that is inhaled or ingested.

Naval spent fuel: Spent fuel from nuclear submarines, ships, and training reactors belonging to the U.S. Navy.

Nominal probability coefficient: The slope of the linear no-threshold relationship between radiation dose and effect, the latter usually expressed in terms of fatal cancer.

Non-fixed surface contamination: Contamination that adheres to the outer surfaces of a package and can be detected by wiping.

Normal conditions of transport: Transport conditions in which the package is subjected to minor mishaps due to rough handling or exposure to weather. Such minor mishaps would not be expected to compromise the vital containment functions of the package.

Normal form radioactive material: Defined in 10 CFR Part 71 as radioactive material that is not special form radioactive material.

Nuclear fuel cycle: The cradle-to-grave processes for obtaining, using, recycling, and disposing of uranium for nuclear applications such as electric power generation.

Nuclear Waste Fund: A fund established by the U.S. government and funded through a 1.0 mil (0.1 cents) per kilowatt-hour fee on nuclear-generated electricity to pay for the costs of disposing of commercial spent fuel.

Nuclear Waste Policy Act: A federal law passed in 1982 and amended thereafter that provides for the development of a federal program to develop and operate a federal repository for the disposal of spent fuel and high-level waste.

Open fuel cycle: Also known as the *once-through fuel cycle*. A type of nuclear fuel cycle in which fuel is disposed of after it becomes spent, with no effort made to recover its usable components.

Operational controls: Restrictions placed on individual shipments of spent

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fuel and high-level waste to reduce the likelihood and/or consequences of accidents.

Other than high-income economy countries: Defined by the U.S. Department of Energy to include Argentina, Bangladesh, Brazil, Chile, Colombia, Greece, Indonesia, Iran, Jamaica, Malaysia, Mexico, Pakistan, Peru, Philippines, Portugal, Romania, Slovenia, South Africa, South Korea, Thailand, Turkey, Uruguay, Venezuela, and Zaire.

Overweight truck: A truck exceeding the legal-weight limit of 80,000 pounds (approximately 36 metric tons) but within the range of weights that states approve for operation on public roads after issuance of special permits.

Package: See *Transportation package*.

Package closure system: The system of seals and lids on a transportation package that provides for an airtight closure to prevent the release of radioactive materials to the environment.

Package dose rates: The dose rate on the external surface of the package.

Package performance: The ability of a transportation package to maintain a high level of containment effectiveness in long-term routine use and under extreme mechanical and thermal loading conditions.

Package Performance Study: A U.S. Nuclear Regulatory Commission study of package response to extreme thermal and mechanical loading conditions.

PATRAN/PThermal: A commercial computer code used to model heat convection, conduction, and radiation transport processes.

Perceptions: Defined by *Webster's Third New International Dictionary* as the "integration of sensory impressions of events in the external world . . . as a function of nonconscious expectations derived from past experience."

Physical protection: Security measures to protect spent fuel and high-level waste shipments from malevolent acts.

Plutonium (Pu): A naturally radioactive actinide element with atomic number 94.

Private Fuel Storage, LLC: A private company that is developing a surface facility in Utah for the interim storage of commercial spent fuel.

PRONTO 3D: A computer code developed by Sandia National Laboratories that has been used to model transportation package response to thermal and mechanical loading conditions.

Publics: Groups of people differentiated by both demographic (ethnicity, income) and interest-based criteria.

Puncture test: One of the hypothetical accident conditions in 10 CFR Part 71 in which a package is dropped through a distance of 1 meter (about 40 inches) onto the upper end of a 6-inch (15.2-centimeter) diameter solid, vertical, cylindrical mild steel bar mounted on an essentially unyielding

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horizontal surface. The package is dropped onto the bar in a position that is expected to produce maximum damage.

PWR: Pressurized water reactor, a type of nuclear reactor in which the reactor's water coolant is kept at high pressure to prevent it from boiling. The heat from this water is transferred to a secondary water system that produces steam to drive a turbine and electrical generator to produce electricity.

Quality assurance program: Defined in 10 CFR Part 71 as those planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service.

Radiation dose: The quantity of radiation deposited in an object divided by the mass of the object. The radiation dose of interest in this report is ionizing radiation. Ionizing radiation doses can be expressed as an absorbed dose, equivalent dose, or effective dose.

Radiation dose rate: The quantity of ionizing radiation deposited into an object per mass of the object per unit time.

Radiation exposure: The act of being exposed to radiation. Also referred to as *irradiation*.

Radiation shine: Radiation emitted from a transportation package containing spent fuel or high-level waste.

Radioactive: Elements that are unstable and transform spontaneously (i.e., decay) through the emission of ionizing radiation, a process known as *Radioactive decay*.

Radioactive decay: See *Radioactive*.

Radioactive Material Incident Report Database: A database maintained by Sandia National Laboratories that contains information about radioactive materials transportation incidents that have occurred in the United States since 1971.

RADTRAN: A computer code developed by Sandia National Laboratories that has been used to estimate radiological exposures and consequences under both normal transport conditions and accidents.

Railhead: The terminus of a rail line, usually within easy access of a public roadway or water port.

Rail package: A transportation package designed to be transported by rail.

Repository: See *Federal repository*.

Research reactor: Small nuclear reactor used primarily to conduct research, to develop theoretical practices, and for education or medical purposes. These serve as sources of neutrons for spectrographic and radiographic applications and for the manufacture of radionuclides for medical and other uses.

Research reactor spent fuel: Spent fuel produced from research reactors.

Resuspension inhalation: Inhalation of radioactive materials that were deposited onto the ground and later resuspended in air.

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Risk: As used in this report, the potential for an adverse effect from the transport of spent fuel or high-level waste. This potential can be estimated quantitatively if answers to the following three questions can be obtained: (1) What can go wrong? (2) How likely is it? (3) What are the consequences? Risk can be expressed in absolute terms or in comparison to other types of risks.

Risk curves: See *Complementary cumulative distribution function.*

RISKIND: A computer code developed by Argonne National Laboratory that has been used to estimate local, scenario-specific radiological doses to maximally exposed individuals.

Routine conditions of transport: Transport conditions that are free of minor mishaps (see *Normal conditions of transport*) or accidents (see *Accident conditions of transport*).

Safeguards: Steps taken to ensure that special nuclear material is not stolen or otherwise diverted for possible use in nuclear explosives or for radiological sabotage.

Safe havens: Preplanned locations where a transport vehicle can stop in case of an emergency and receive protection by police or other security forces.

Safety: Measures taken to protect spent fuel and high-level waste during handling and transport from failure, damage, human error, and other inadvertent acts.

Scale model: A dimensionally accurate representation of an object, usually at a reduced size, that is used for design and testing purposes.

Security: In the context of this report, measures taken to protect spent fuel and high-level waste during handling and transport from sabotage, attacks, and theft.

SI: International System of Units (from the French Système International d'Unités), also sometimes referred to as the metric system.

Small-quantity shipping programs: Transportation programs that ship on the order of tens of metric tons of spent fuel or high-level waste.

Social amplification of risk: Social processes that increase the consequences of a particular risk.

Social process: A characteristic mode of social interaction. Such interactions shape the communities in which people live by influencing choices about where to purchase or rent a home, where to work, and where to send children to school.

Social risk: Risks that arise from social processes and human perceptions.

Societal risk: All risks that affect society, including the health and safety risks and social risks discussed in this report.

Source materials: Defined in the Atomic Energy Act to include any combination of uranium and thorium, in any physical or chemical form, or ores that contain at least 0.05 percent by weight of uranium, thorium,

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or any combination thereof. Depleted uranium is considered to be a source material.

Special form radioactive material: Defined in 10 CFR Part 71 as radioactive material that exists as a single solid piece or is encapsulated material that meets certain other requirements.

Special nuclear material: Defined in the Atomic Energy Act as plutonium, uranium-233, or uranium enriched in the isotopes uranium-233 or uranium-235. These isotopes are fissile and can be used in nuclear explosive devices.

Spent fuel: See *Spent nuclear fuel*.

Spent fuel basket: See *Fuel basket*.

Spent fuel pool: A water-filled pool that is used for storage of spent fuel assemblies after their removal from a nuclear reactor.

Spent nuclear fuel: Fuel whose fissile radionuclides have been consumed by fission to a point where it is no longer efficient for its intended purpose (e.g., for producing heat, electricity, or neutrons).

Standard contract: Created by the Nuclear Waste Policy Act, it specifies the responsibilities of the U.S. Department of Energy and owners of commercial spent fuel for handling, receipt, and transportation of spent fuel to a federal repository for permanent disposal.

Stigma: An event or condition that marks a person, place, product, or technology as deviant, flawed, or undesirable. When the particular stigmatizing characteristic is observed, the person, place, product, or technology may be denigrated or avoided.

Strain: The deformation of an object under an applied force.

Thermal creep: Deformation of an object over an extended period of time when subjected to elevated temperatures.

Thermal test: One of the hypothetical accident conditions in 10 CFR Part 71 in which a package is fully engulfed in a hydrocarbon-fuel fire with an average flame temperature of at least 800°C (1472°F) for a period of 30 minutes.

Thermally induced creep: See *Thermal creep*.

Thermomechanical conditions: Describes the mechanical forces and heat loads applied to a transportation package.

Transportation Emergency Preparedness Program: A program developed to support training of federal, state, tribal, and local authorities in emergency preparedness and response to transportation incidents involving DOE radioactive materials shipments.

Transportation mode: Describes the means by which spent fuel and high-level waste is transported, for example, by truck, train, or barge.

Transportation operations: The spectrum of activities associated with the shipment of spent fuel and high-level waste.

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Transportation package: In the context of this report, containers used for the transport of spent fuel or high-level waste, whether loaded or empty. Loaded packages are referred to as *packages* in international standards, whereas the containers themselves without their contents are referred to as *packagings*. The terms *casks* and *flasks* (the latter term is commonly used in the United Kingdom) are sometimes used synonymously with packages. This report distinguished between two types of transportation packages: *bare-fuel packages* in which the spent fuel and the fuel basket are placed directly into the package, and *canister-based packages* in which the spent fuel and fuel basket are placed into a welded steel canister that in turn is placed in the package.

Transuranic waste: Radioactive waste containing long-lived radioactive transuranic elements (elements with atomic numbers greater than 92) such as plutonium in concentrations greater than 100 nanocuries per gram.

Truck package: A transportation package designed to be transported by road.

Type A package: A package designed for the transport of materials of limited radioactivity—for example, uranium hexafluoride and fresh nuclear fuel.

Type B package: A package designed for the transport of larger quantities of material including spent fuel, high-level waste, and mixed oxide fuel.

Type C package: A package designed for the air transport of quantities of radioactive material exceeding a defined threshold including, for example, plutonium and mixed oxide fuel.

Uranium (U): A naturally radioactive actinide element with atomic number 92.

Very long duration fires: Fires that burn for periods of hours (or longer), which can produce thermal loading conditions that exceed those for the regulatory thermal test specified in 10 CFR 71.73.

Vitrification: A process for immobilizing radioactive waste, particularly high-level waste, in glass matrices.

Vulnerable communities: Communities of people who, because of disproportionate exposures to other health-affecting substances, or because of ethnic, linguistic, or socioeconomic issues, may be less able to read or understand information from the authorities, to act in a first-responder role, to exit the area in a timely manner in an emergency, or to otherwise cope with an emergency.

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APPENDIX E
Acronyms

AAR	Association of American Railroads
AEA	Atomic Energy Act
AEC	Atomic Energy Commission
ALARA	as low as reasonably achievable
ASME	American Society for Mechanical Engineers
BAM	German Federal Institute for Materials Research and Testing
BLM	Bureau of Land Management
BNFL	British Nuclear Fuels Limited
BWR	boiling water reactor
CCDF	complementary cumulative distribution function
CEGB	Central Electricity Generating Board
CFR	Code of Federal Regulations
CT	computed tomography
CVTR	Carolinas-Virginia Tube Reactor
DHS	U.S. Department of Homeland Security
DNA	deoxyribonucleic acid
DOE	U.S. Department of Energy
DOE-EM	U.S. Department of Energy, Office of Environmental Management

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DOE-NE	U.S. Department of Energy, Office of Nuclear Energy
DOE-NR	U.S. Department of Energy, Naval Reactors Program
DOE-RW	U.S. Department of Energy. Office of Civilian Radioactive Waste Management
DOT	U.S. Department of Transportation
DOT-FMCSA	U.S. Department of Transportation, Federal Motor Carrier Safety Administration
DOT-FRA	U.S. Department of Transportation, Federal Railroad Administration
DOT-NHA	U.S. Department of Transportation, National Highway Administration
DU	depleted uranium
EIS	Environmental Impact Statement
EJ	Environmental Justice
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
ERDA	Energy Research and Development Administration
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FICA	Facility Interface Capabilities Assessment
FRA	Federal Railroad Administration
FRR	foreign research reactor
GAO	U.S. Government Accountability Office
GPS	global positioning system
HEU	highly enriched uranium
HFIR	High Flux Isotope Reactor
HLW	high-level waste
HMIS	Hazardous Materials Incident Reporting System
HSPD	Homeland Security Presidential Directive
HTGR	high-temperature gas reactor
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IME	Institution of Mechanical Engineers
INEL	Idaho National Engineering Laboratory
INL	Idaho National Laboratory
INPO	Institute for Nuclear Power Operations
ISO	International Organization for Standardization

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LCF	latent cancer fatality
LEU	low enriched uranium
MERRTT	Modular Emergency Response Radiological Transportation Training
MN	meganewton
MOU	memorandum of understanding
MOX	mixed oxide fuel
MRFA	Maximally Reasonably Foreseeable Accident
MTHM	metric tons of heavy metal
NCRP	National Council on Radiation Protection and Measurements
NEPA	National Environmental Policy Act
NIMS	National Incident Management System
NIST	National Institute of Standards and Technology
NPP	nuclear power plant
NRC	National Research Council
NSTI	Near Site Transportation Interface
NWPA	Nuclear Waste Policy Act
NWS	Naval Weapons Station
OCRWM	Office of Civilian Radioactive Waste Management (DOE)
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
PATRAM	International Symposium on Packaging and Transportation of Radioactive Materials
PFS	Private Fuel Storage, LLC
PWR	pressurized water reactor
RITA	Research and Innovative Technology Administration
RMIR	Radioactive Material Incident Report
ROD	Record of Decision
RSPA	Research and Special Programs Administration
SI	International System of Units as defined by the General Conference of Weights and Measures in 1960
SNF	spent nuclear fuel
SRS	Savannah River Site
SSEB	Southern States Energy Board

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TEC	Transportation External Coordination (Working Group)
TEPP	Transportation Emergency Preparedness Program
TRANSSC	Transport Safety Standards Committee
TRUPAC II	Transuranic Waste Transport Package
UER	Urban Environmental Institute, LLC
USNRC	U.S. Nuclear Regulatory Commission
WGA	Western Governors' Association
WIPP	Waste Isolation Pilot Plant
W/MTU	watts per metric ton of heavy metal

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Attachment 10

UER, “Yucca Mountain Impact Assessment Report, Clark County, Nevada”
(Feb 2002)

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Executive Summary

Clark County's opposition to the Yucca Mountain Project has been steadfast for nearly 20 years. Clark County, along with other Affected Units of Local Government (AULG), has spent more than a decade evaluating the potential impacts of the proposed high-level nuclear waste repository at Yucca Mountain in Nye County, Nevada.

Clark County has relied on appropriate procedural, legal, and technical bases in the operation of its Nuclear Waste Program. Since 1987, staff has provided program oversight for site characterization activities, including the review of and comment on various U.S. Department of Energy (DOE) documents; conducted and analyzed impact studies; and, conducted public outreach activities for the benefit of Clark County residents.

Clark County's Impact Assessment Report is also included as part of the State of Nevada's impact report. The report provides Clark County's analysis of the potential impacts resulting from the construction, operation and closure of the proposed repository.

The main purpose of the report is to fill the sizeable gap left in the DOE's analysis and assertions regarding impacts to Clark County. For the most part, the DOE has either underestimated or has completely mischaracterized the likely impacts resulting from the proposed repository. Admittedly, it has been difficult to characterize and assess the full range of impacts in the absence of a Final Environmental Impact Statement (FEIS) by the DOE and a final design for the repository. Further, the DOE has not updated much of the data used in its Draft Environmental Impact Statement (DEIS) (e.g. 1990 population data), which contributes to the inaccuracy of its assessment of the impacts.

It must be made clear that this report is not intended to be a request for impact assistance or to imply consent to the proposed repository. Rather, it is a comprehensive analysis of potential impacts anticipated by Clark County in the event that a positive site recommendation by the Secretary of Energy is accepted by the President of the United States and the United States Congress.

This report contains seven chapters and nine appendices. The report describes the context for Clark County's impact assessment by providing some general information about Clark County and it affirms ample basis for Clark County's opposition to the proposed repository. Three

chapters are devoted to articulating the extent of anticipated impacts. A key aspect of these impacts is that they occur immediately, beginning with the negative effect a site recommendation will have on Clark County's economy. For example, over the duration of shipment campaign, the cost to Clark County for additional personnel, planning, training, and public outreach resulting from the DOE's actions is estimated at over $2.672 billion. Additional capital facilities and equipment costs to Clark County through 2010 have been estimated at $280 million. These costs do not include any upgrades to the existing transportation system that may be needed. In addition, facilities and equipment will also need to be replaced at various points throughout the shipment campaign, although replacement costs have yet to be calculated.

In Chapter 3, the reader is able to quickly reference each of the following impacts covered in Chapters 4 and 5: gaming, property values, transportation, and impacts due to Yucca Mountain operations including environmental impacts, public safety, non-public safety, and Native American concerns.

As additional support for its position, Clark County has included in Chapter 6 a summary of public outreach efforts, including public opinion surveys, public information strategies, and other methods designed to inform Clark County residents about the County's position on the issue. It is important to note that the majority of public responses received indicate opposition to the Yucca Mountain Project. It is also important to note that the issues of highest significance and concern to the majority of residents correlate to those studied by Clark County for over fifteen years.

The public health and safety of Clark County residents are our primary concern, particularly in the area of transportation of nuclear waste. This report provides ample evidence that Clark County's constant opposition over nearly twenty years has not been misplaced.

1.0 Background

Clark County, with a land area of over 7,900 square miles, has been the fastest growing county in the United States for many years. Over 5,000 new residents per month have been arriving here to live, work, and play since the early 1990's, due to the surge in the casino industry beginning with the construction of The Mirage Resort Hotel in 1989. At the time of the decision to narrow the DOE's search for a suitable site to store high level radioactive nuclear waste, Clark County's population was half what it is today, over 1.5 million. Over the next twenty years, the area's population is expected to reach 2.8 million.

Clark County is home to the "Las Vegas Strip" which, along with our world-famous downtown Las Vegas, allows the Southern Nevada area to enjoy a reputation as "The Entertainment Capital of the World." With more than 35 million visitors annually, the primary engine that drives our economic growth is the gaming industry. Also key to Clark County's economic growth are service- and construction-oriented businesses. According to the website for the City of Las Vegas, Lesa Coder, Director of the Office of Business Development for the City of Las Vegas, stated:

> *"We're the premier business center in the Western United States, now and well into the twenty-first century. One major advantage is our location, which gives investors access to over 52 million people within a 1,000-mile radius…"*

While the focus here has historically been on gaming and tourism, in recent years the pro-business climate and diversity of lifestyle choices has produced a shift in public perception. Since the construction boom and influx of new residents in the early 1990's, the image of Southern Nevada has shifted from an entertainment mecca for only the rich and famous to one which strives for a sense of community and high quality of life for all residents. For example, a 1999 Federal Reserve Bank of St. Louis study ranked Las Vegas as "The Most Livable Big City in America." In that study, economist Howard J. Wall ranked 59 metropolitan areas of similar size based on strict criteria which reflects why people relocate to, and stay, in a particular community.

In a region where the concept of "perception is reality" is particularly marked, the stigma and perception of any danger associated with high level radioactive nuclear waste presents a very real and significant threat to Clark County residents, businesses, and visitors.

Clark County's opposition to the Yucca Mountain Project has been steadfast. Over the years, Clark County has been joined by other local governments, agencies and groups in opposition to the DOE'S efforts. (See Appendix A for resolutions in opposition to the proposed repository.)

2.0 Purpose and Basis

Purpose

The purpose of this Impact Assessment Report is to set forth, from Clark County's perspective, the full range of potential impacts anticipated should the proposed high level radioactive waste repository at Yucca Mountain be approved and constructed. The proposed repository site is in Nye County, Nevada, just a few miles from the Clark County border. Clark County is the economic and population base for the State of Nevada. Therefore, it is important to articulate as complete a picture of the impacts as is possible, in light of the limited information and analysis provided by the DOE to date with respect to any such impacts.

The impacts identified as important to Clark County must be seriously considered by the Secretary of Energy, the President and Congress during the federal approval process, as required under the Nuclear Waste Policy Act as amended in 1987 (NWPAA) Section 114(a)(1)(D).

Clark County's large land area encompasses a unique mix of incorporated cities, urban and rural towns, and tribal entities. This Impact Assessment Report is intended to address the interests of not only unincorporated Clark County, but also, wherever possible and appropriate, the interests of the cities of Las Vegas, North Las Vegas, Henderson, Boulder City, and Mesquite, as well as the Las Vegas Band of Paiutes and the Moapa Band of Paiutes. Clark County has entered into interlocal agreements with these entities, affording the opportunity for significant impact assessment of critical areas. The results of those studies are reflected in this Impact Assessment Report.

Basis

Since 1983 Clark County has been recognized as an active participant in monitoring the DOE Yucca Mountain nuclear waste program efforts. In 1988, DOE officially designated Clark County as an "Affected Unit of Local Government (AULG)" under provisions of the NWPAA, when the search for a geologic repository study site was reduced to only one alternative: *Yucca Mountain*. The AULG designation was an acknowledgement by the federal government that activities associated with the Yucca Mountain Project could result in considerable impacts to our residents and community. In fact, the provisions under the Act enable Clark County to determine "any potential economic, social, public health and safety, and environmental impacts of a repository," 42 U.S.C. Section 10135(c)(1)(B)(i).

In addition to the NWPAA, applicable case law supports Clark County's efforts to fully identify potential impacts. In *County of Esmeralda v. Department of Energy*, 925 F.2d 1216 (9th Cir. 1991), the court stated: "Affected unit status is also meant to ensure that all potential harms from repository operation – whatever the current estimate of their probability—are sufficiently studied **before** Yucca Mountain is approved as a repository." (emphasis added)

Further, under the National Environmental Policy Act (NEPA), the DOE is required to follow specific processes for identifying and assessing environmental impacts that may result from the operation of a nuclear waste repository at Yucca Mountain. Clark County officials have always maintained that absent the ability to review the DOE's FEIS, it is not certain whether the full range of impacts has been identified. What is certain is that the DOE's DEIS is woefully inadequate in the area of impact identification and assessment.

In addition to relying on applicable policies, regulations, and procedures, Clark County can support its position by looking to lessons learned from other jurisdictions facing similar challenges. Examples exist from the experiences of other communities as the U.S. Department of Energy attempts to address the problem of nuclear waste disposal. This is especially true in New Mexico where the Waste Isolation Pilot Plant (WIPP), a repository for transuranic waste, has begun operations. These lessons have to do with the way that DOE interacts with local governments with regard to plans, agreements and mandates. These lessons have been instrumental to Clark County in developing and/or modifying county policies and actions regarding Yucca Mountain as the program moves into the federal approval phase in 2001 and the licensing phase thereafter.

For these reasons, the Clark County Board of Commissioners created a framework for constant opposition to the Yucca Mountain Project by unanimously passing resolutions in opposition to the Yucca Mountain Project (Appendix B). This Impact Assessment Report, along with previously submitted comments to the DEIS, Supplemental DEIS (SDEIS), and Preliminary Site Suitability Evaluation (PSSE), provide the substance, detail, and justification for Clark County's long-established opposition. (See Clark County Comments to DEIS, SDEIS and PSSE, Appendix C.) In April 2001, the Board of County Commissioners adopted Strategic Priorities that further solidified its opposition to the Yucca Mountain Project.

In addition to submitting the above-mentioned procedural (response) documentation, Clark County has engaged in site characterization oversight, impact assessment, and public outreach

activities (within the parameters of the NWPAA and DOE appropriations requirements) in order to fully understand and compile a comprehensive, realistic analysis and report of the impacts.

Finally, it must be made very clear that Clark County is merely attempting to comprehensively articulate and to quantify potential impacts. This report should in no way be interpreted as a request for impact assistance, nor should it be construed as implied consent to the siting of the proposed repository at Yucca Mountain.

3.0 Overview of Impacts

This overview chapter provides brief summaries of the impacts more fully described in Chapters 4 and 5 of this Impact Assessment Report. The summaries are intended to provide the reader with a reference point from which to quickly gather the key concerns and findings for each of these impact areas. Likewise Appendices A through I are intended to provide additional background, support and context for the impacts described in the report. The discussion of these impacts is based on the three transportation scenarios listed in Figure 1 (page 15). Scenarios 1 and 2 were derived directly from the Department of Energy's DEIS, and Scenario 3 was developed by a consultant for the State of Nevada and a Clark County transportation planner. These scenarios have been applied uniformly and consistently by both the State of Nevada and Clark County throughout our impact assessment studies for many years.

It should be noted that most of the impact analyses contained in this report are based upon the dates used in the DEIS regarding the anticipated time frame (2007) for shipping high level radioactive waste. Further, several of Clark County's impact studies were completed prior to the release of the SDEIS, where the DOE adjusted the time frame to 2010 for the proposed shipping campaign. Absent a final repository design and transportation plan, it is difficult to predict the start and duration of the shipping campaign. According to the recently released General Accounting Office report, shipment of high level radioactive waste would not begin before 2016**.** Clark County's impact studies have not been updated to reflect this timeframe estimate.

Gaming Impacts

Clark County has identified both the nature and the range of concerns of key tourism leaders as to the potential effects on the tourism industry of the DOE's proposal to ship high-level waste through Clark County to a repository at Yucca Mountain. Focused, confidential interviews were conducted with key tourism industry representatives. According to virtually every gaming industry representative interviewed, the most serious risk is from the stigma that will result if there is any accident of any kind involving the shipment of high level radioactive waste.

A survey of Clark County visitors in the weeks following the September 11, 2001 terrorism attacks indicates that even among those willing to travel, the possibility of a nuclear waste shipment campaign that proceeds even without incident will adversely affect their decision to visit

Las Vegas in the future. The survey also indicates that any type of nuclear waste shipment incident would significantly decrease the number of those willing to visit.

Based upon a recently released report conducted for the State of Nevada, even a small drop in visitation could result in gaming revenues falling by one-half billion dollars. In the event of a high-level waste shipping accident that resulted in a downturn of 10.0% - 15.0%, gaming revenue would drop by $1.1 billion to $1.7 billion. These losses could skyrocket to $2.8 billion to $3.7 billion in the event of a severe, prolonged downturn resulting from a serious high level radioactive waste accident.

Property Value Impacts

Stable property values are a necessary component for the stability of Clark County's tax structure. Any threat to a government entity's ability to rely on property taxes as a stable source of income impacts not only that entity's ability to operate, but has a "domino" effect on all aspects of what people expect and deserve in terms of community livability.

This subchapter includes a comprehensive analysis from a practical and quantifiable point of view. Also included in the discussion is an extensive discussion on stigma and perception.

Depending on the transportation scenario applied, property value decreases directly resulting from transportation of nuclear waste through Clark County range from 2% to 30%, resulting in property value losses up to $8.753 billion. Clark County took the initial property value analysis one step further by requesting a population-based economic analysis by University of Nevada, Las Vegas (UNLV). This analysis estimates potential economic impacts over the course of the DOE's shipping campaign (2010 to 2035) to be in the billions of dollars.

UNLV's Center for Business and Economic Research (CBER) analyzed additional economic impacts property value diminution will have on Clark County. The property value diminution report was prepared by Urban Environmental Research, LLC (UER). Job losses estimated in this analysis range from 11,294 – 90,718. Billions of dollars in revenue and income losses were also estimated in the CBER study.

Transportation Impacts

The impacts addressed in this subchapter include impacts such as routine radiation exposure, accident costs, incident delay, transportation planning impacts, land use impacts, and monitoring impacts.

This subchapter also provides an interim assessment of the transportation system impacts attributable to the Yucca Mountain Project. Transportation system impacts are defined as changes

to the operation, condition, and performance of the County's transportation network. This subchapter addresses direct, indirect, and cumulative impacts of transporting waste through Clark County to Yucca Mountain.

In 1997, the Federal Highway Administration Cost Allocation Study developed a detailed model for calculating accident costs for combination trucks on urban highways. Combination trucks include all multiple axle tractor semi-trailer trucks, truck-trailers, trailer-semi trailer, and triple-trailer trucks as defined by the Federal Highway Administration (FHWA). The trucks proposed for use by DOE for the shipment of high level radioactive nuclear waste fall into the category of combination trucks.

When this model is adjusted to year 2000 dollars, and applied to the rail and heavy haul routes through Clark County, the forecasted accident costs range between $70.7 million - $170.4 million. Since on average, approximately 30% of these costs are not reimbursed to the affected party, Clark County can expect to absorb between $21.2 million to $51.1 million if an accident were to occur along one of these routes.

Impacts Due to Yucca Mountain Operations

This subchapter outlines Clark County's concerns related to the construction, operation and closure of the proposed repository. Absent a final repository design and the issuance of a FEIS, it is impossible to identify the full range of impacts.

However, given the long history of quality assurance problems in the Yucca Mountain program, it can be expected that a future inability to follow quality control procedures during the loading and sealing of casks with high level radioactive nuclear waste could result in the immediate loss of life, exposure to elevated levels of radiation, and premature failure of the disposal casks. Any of these events would result in a severe negative impact to Clark County. In addition, upwards of 1,800 Clark County residents are likely to work at Yucca Mountain under conditions that increase their risk of having negative health effects related to the handling of high level radioactive nuclear waste. Operations at Yucca Mountain could also jeopardize Clark County's compliance with the Endangered Species Act and its Federal Section 10A permit. Finally, as a non-attainment area under the Clean Air Act, Clark County's future economic growth may be restricted because of air pollution resulting from the Yucca Mountain Project.

Public Safety Impacts

This subchapter summarizes the integrated findings of an assessment conducted by UER of Southern Nevada's public safety agencies. This study covered incremental or additional costs to

governmental entities that would be directly attributable to the proposed repository. Combined costs under Scenario 3 would likely approach $360 million. The majority of these costs is attributable to Clark County, with the largest portions designated for facilities, equipment, personnel, and training. Clark County's costs alone would be over $274 million in unfounded government mandates.

Non-Public Safety Impacts

County departments and related agencies were studied to determine impacts that were not specifically related to public safety issues. In order to prepare for the commencement of shipments of high-level waste, Clark County non-public safety agencies identified approximately $40 million in additional costs to Clark County departments and agencies. Over the 24-year shipping campaign described in the DEIS, the projected preparedness costs just for personnel, planning, training and public outreach are expected to reach over $350 million. These costs represent an unfunded federal mandate to Clark County and the other affected entities addressed in this subchapter.

Native American Concerns

A separate chapter is devoted to Native American concerns. While many of the concerns of Native Americans are similar to others potentially affected by the Yucca Mountain Project, it is important to recognize that Native American concerns must be considered in ways that identify and reflect the range of impacts from a tribal perspective. Subchapters 4.2 and 4.5 also address specific potential impacts to the Moapa Band of Paiutes.

The Impact Assessment Report includes Chapter 6.0 that summarizes Public Involvement and Outreach, and Chapter 7.0 that offers a Summary and Recommendations. These chapters provide additional context for Clark County's position with respect to the proposed repository at Yucca Mountain.

Figure 1 Summary of Scenarios

Scenarios	Description
1*	No accident of any kind has occurred. However, anti-nuclear environmental groups and property owners along the route (who claim that their property values will decrease) have generated considerable publicity.
2*	Shipments of nuclear waste to the Yucca Mountain repository site have progressed for several years without incident. Three days after New Year's Day 2010, the driver of a truck transporting nuclear waste loses control of the vehicle and runs into the median of Interstate 15. The cask containing the nuclear waste breaks away from the trailer and skids 50 yards along the median of I-15 in North Las Vegas. The cask remains intact and no radiation is released, but the national media covers the event heavily.
3**	An accident involving a truck carrying spent nuclear fuel and a gasoline tanker on I-15 near the Las Vegas Strip. The accident triggers a chain reaction collision. Twenty-seven civilians, four sheriff's deputies, and seven firefighters are hospitalized after exposure to radiation at the site of accident. Another 1,000 or more persons are exposed to radiation from the fire's radioactive plume. Experts indicate that 5 to 200 latent cancer fatalities may result from the accident. The affected highway and several access ramps are closed for four days. The two drivers of the spent fuel hauler and the gasoline tanker, and one driver-escort, died from head injuries and burns. Six months later, the cleanup effort is still under way, and thousands of lawsuits have been filed. Preliminary reports estimate cleanup costs and economic losses in excess of $1 billion.

*Source: U.S. Department Of Energy, Office of Radioactive Waste Management (July 1999) Draft Environmental Impact Statement (DEIS) for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada.

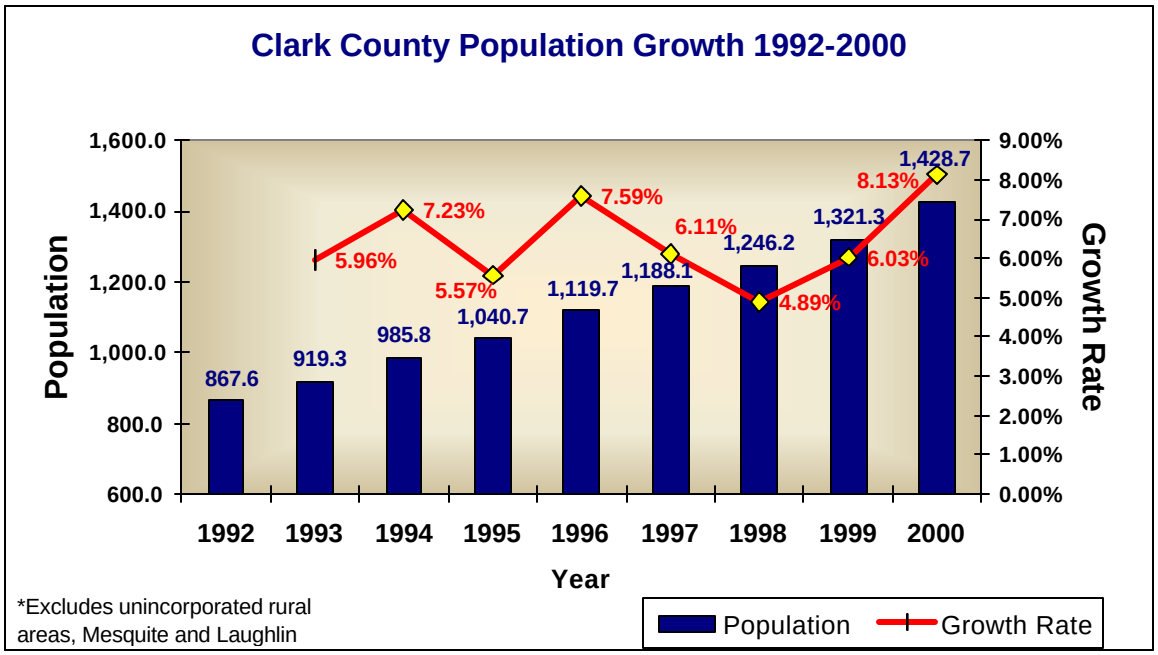
**Source: Robert Halstead, Transportation Advisor, State of Nevada, Nuclear Waste Project Office, and Fred Dilger, Transportation Planner, Clark County, Nevada, Department of Comprehensive Planning, Nuclear Waste Division

4.0 Impact Analyses

4.1 Gaming and Tourism Impacts

Clark County has experienced burgeoning population growth over the last decade from a population of 867.6 thousand in 1992 to over 1.4 million in 2000 (Figure 2). Today, Clark County ranks as the fastest growing county of its size in the nation.

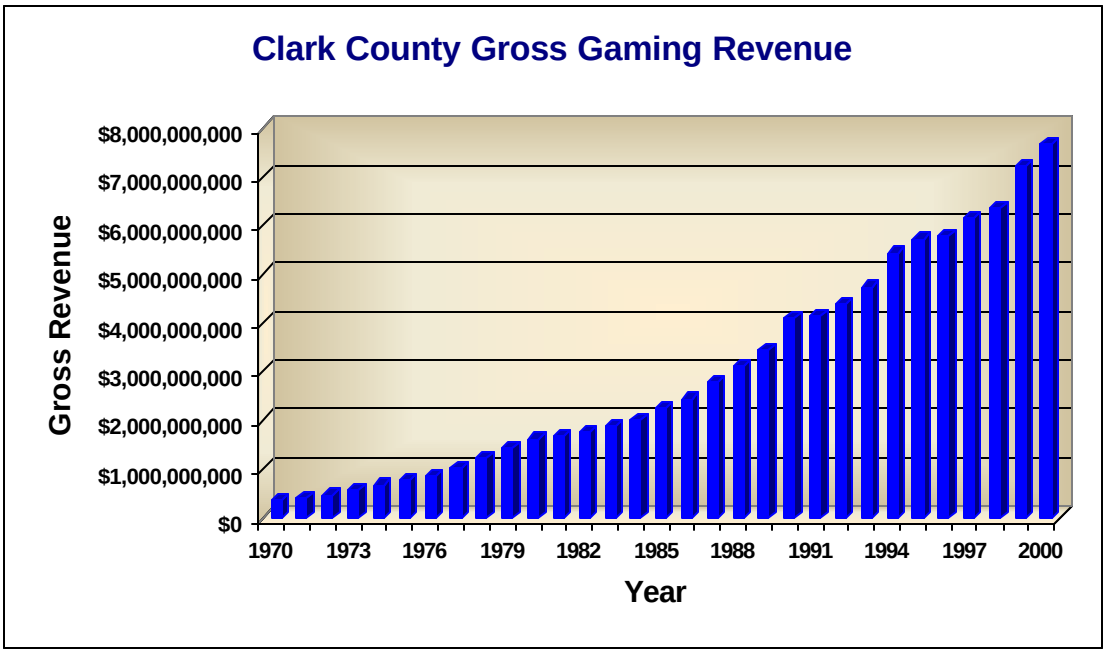
Figure 2 Clark County Population Growth 1992 - 2000



Source: Center for Business and Economic Research, UNLV, 2001

According to the Las Vegas Convention and Visitors Authority, the number of visitors coming to Las Vegas by auto and air exceeded 35.8 million in 2000. The percent of those visiting Las Vegas by air was 46%, while the percentage of those driving in was 54%. Air traffic into Las Vegas has grown at a compounded annual growth rate (CAGR) of 7.35%, while vehicle traffic grew at a 4.15% CAGR between 1970 and 2000. Over the last three decades, gaming revenues have increased from $369 million to $7.67 billion (Figure 3). The overall economic impact from these visitations now exceeds $31.46 billion making it the primary engine of the area's economy.

Figure 3 Clark County Gross Gaming Revenue 1970-2000



Source: Center for Business and Economic Research, UNLV, 2001

In order to identify both the nature and the range of concerns of key tourism leaders as to the potential effects on the tourism industry of the DOE's proposal to ship high level radioactive waste through Clark County, focused, confidential interviews were conducted with gaming executives and a representative of one of their trade associations. The 14 gaming executives represented 10 casinos that generate 95.5% of the *Earnings Before Interest, Taxes, Depreciation, and Amortization* on the "Strip." The gaming executives interviewed included both the largest gaming corporations and representatives of the smaller operations. Gaming executives for the Las Vegas Strip, as well as the downtown casinos were interviewed.

Interviewees were asked what areas, if any, of the visitor economy might be vulnerable to the proposed high level radioactive nuclear waste shipments. Inquiries of respondents were made regarding their organizations and any specific concerns for their own businesses as a result of the DOE's proposal. They were also asked whether the "transportation of nuclear waste near areas of economic activities may create stigma effects resulting in people not wanting to visit such places or buy homes nearby." Gaming executives also were asked to rank the impact of the proposed high level radioactive nuclear waste shipment campaigns on tourism volume, their corporation's credit rating and appraised value.

Another series of questions were asked of the gaming industry executives about the types of activities that the industry and/or their individual organization had undertaken to plan and prepare for the DOE's proposed activities. Specifically, they were asked to discuss "what risk management tools or measures" they might deploy to offset any declines in visitation and to address whether they felt "that any downturn from stigma effects can be overcome by effective marketing." Gaming executives were asked whether they were aware of any coordinated planning activities for evacuating the "Las Vegas Strip" in case of an incident. Finally, responses were obtained to questions about their own organization's evacuation planning activities and whether their insurance covered nuclear related events.

Gaming executives emphasized two other key sub markets that contributed to the growth in revenues that their operations have experienced. Since 1990, the number of convention visitors has grown dramatically as has their economic contribution to Clark County. Since 1990, the number of conventioneers has grown from 1.74 million to 3.86 million in 2000. The economic impact from this component of the market also has experienced phenomenal growth contributing $4.4 billion to the Las Vegas valley's economy in 2000. One gaming executive from a larger destination resort stated that the convention trade is responsible for approximately one-third of its hotel room occupancy.

The current downturn in the U.S. economy was identified as a significant challenge that will likely contribute to slowing growth among this sector in the near term.

In particular, increasing energy costs were identified as a challenge in both minimizing operating expenses, as well as the potentially adverse effect it may have on visitor airline fares. One executive noted that energy costs for his operation had gone up $10,000,000 this past year and that it was now costing about 1½ cents per share of their stock price.

In addition to energy costs, road congestion and air pollution were identified as significant issues that could endanger the longer-term economic health of the gaming industry. In fact, in a filing with the Securities and Exchange Commission, one of the largest companies stated that congestion along the I-15 corridor from California was a potential problem and that "capacity constraints of that highway or any other traffic disruptions may affect the number of customers who visit our facilities." Other challenges faced by these industry representatives include improving Clark County's education system and according to some, ensuring that in-migration continues so that there is a sufficient labor pool. One executive noted that despite all of the

population growth that Clark County had experienced, maintaining an adequate educated labor force remained a significant challenge in the face of a tight labor supply.

Overall, most of the executives believe that despite short-term cyclical responses to national and worldwide economic conditions, the overall trend for the gaming industry in the absence of high level radioactive nuclear waste shipments is positive.

Further, all of the gaming executives interviewed expressed concern that an accident, even a minor one along a route anywhere in Clark County, could have a devastating impact on their business. While some representatives were unsure of the scientific viability of the Yucca Mountain repository, all indicated that under no circumstance should trucks carrying high level radioactive nuclear waste come through Clark County. Several noted that just the transportation of high level radioactive nuclear waste coming from California through Clark County en route to Yucca Mountain, could significantly affect their business in an adverse manner. These industry representatives noted that congestion, particularly on weekends along the California/Nevada transportation corridor, has already proved problematic. They believe the addition of slow moving trucks containing such dangerous wastes will increase the likelihood and severity of an accident, discouraging some Californians from driving to Las Vegas. These representatives stated that Californians make up 30% of the visitors to Clark County. The increase in congestion along the California/Nevada corridor, combined with rising energy costs, is seen as a significant risk to gaming in Southern Nevada, especially for the Las Vegas downtown casinos.

According to virtually every gaming industry representative interviewed, the most serious risk is from the stigma that will result if there is any accident of any kind involving the shipment of high level radioactive nuclear waste. These representatives referenced the media coverage that is likely to accompany any incident involving a vehicle transporting high level radioactive nuclear waste. Several stated that an accident anywhere in Clark County would be reported worldwide and would be linked to Las Vegas because it is the nearest media outlet.

Many of the gaming executives discussed the various ways that stigma could affect their businesses. For example, earlier studies conducted for the State of Nevada indicated that convention planners would be less likely to hold a convention in Las Vegas if there were a nuclear transportation incident. Since 1990, the contribution of convention visitors to the local economy has grown exponentially. Several gaming representatives stated that given the growth in this sector, it is important to investigate what the fiscal implications could be to this subset of the market if the DOE proceeds with its program.

Another concern related to stigma that was frequently cited was the potential loss of attractiveness of Clark County as a place for families to live, especially if an incident were to occur. Some of the casino executives interviewed repeatedly mentioned that the tourism economy is driven by growth and that "population growth begets growth." For these representatives, anything that makes Clark County a less attractive environment for in-migration will have some degree of adverse affect on their businesses. Some noted that this could result in fewer retirees moving into the area. Others felt that younger workers might leave resulting in an aging population that over time would require more services and would contribute fewer resources to the area economy eventually cascading into "urban decay."

Some gaming industry executives were concerned of the possibility that investors might find Clark County a less attractive area for investment because of increased uncertainty related to the effects of the shipment campaign on the visitor economy. These gaming executives linked the high fixed costs associated with the gaming industry, as well as the need to continuously attract investment funds so that the new products can be developed to stimulate the market place. The potential negative impacts resulting from the high level radioactive nuclear waste shipment campaign might make the industry less attractive for investors.

Further, several gaming executives noted that their insurance would not cover the costs associated with a disruption of this type. Many also noted that while each casino has emergency response plans for their own facility(s) that a coordinated "Strip"-wide emergency response plan requiring in-place evacuation did not exist.

Finally, most of the representatives emphasized that the gaming industry is particularly sensitive to downturns in revenues because of the high level of fixed costs associated with this type of business. Thus, for every dollar of gross revenue that is reduced, the impact on the bottom line net income is even greater.

This unique sensitivity and vulnerability to high-profile events was made very clear after the September 11, 2001 terrorism attacks. The combined effects of economic downturn, airline and airport difficulties and the stigma and fear associated with travel safety are still being calculated. In the weeks after the attacks, the Las Vegas area gaming and tourism industries experienced unprecedented revenue and job losses. National media coverage of an in-depth investigation into possible terrorist planning activities in the Las Vegas area has served to heighten and prolong the negative effects of these events.

In order to understand how the Yucca Mountain Project might influence visitation subsequent to the September 11, 2001 terrorism attacks, a survey of 1,013 visitors was conducted in early December 2001, approximately twelve weeks after the attacks. These results reflect the opinions of the least risk adverse visitors to Clark County, that is those who were willing to visit at a time period when the effects of September 11, 2001 were still negatively impacting the area's economy. Among those surveyed, 25% indicated that just the shipment of high level radioactive nuclear waste through Clark County would affect their decision to visit Las Vegas in the future, even if there were no incidents of any type. Among the 25% who indicated that the shipments of high level radioactive nuclear waste would affect their decision to visit, 77% stated that they would reduce their visits and 12% stated that they would never visit Las Vegas again.

If a truck transporting high level radioactive nuclear waste was involved in an accident without a release of radiation, similar to the Scenario 2 event described on page 15, 37% of the visitors surveyed indicated that it would affect their decision to visit Las Vegas. Among these visitors, 49% stated that they would never visit Las Vegas again and 47% said that the frequency of their visits would decrease. If a serious accident resulting in a release of radiation were to occur, those surveyed indicated that the results would be devastating. Almost 80% noted that it would affect their decision and of those who stated that it would affect their decision, 62% stated that they would never visit Las Vegas again and 35% indicated that they would reduce the frequency of their visits.

As September 11, 2001 has already demonstrated, stigma can and has adversely affected Clark County's economy. While the full extent of this impact is still being measured, it is obvious that stigma related impacts have demonstrable adverse impacts on Clark County's sensitive tourism sector. The Las Vegas Sun reported on January 16, 2002, that according to the Las Vegas Convention and Visitors Authority, about 2.65 million people visited Las Vegas in November 2001, a decline of nearly 9% from November 2000. Passenger traffic at McCarran International Airport was down 18% to 2.55 million for the month, and reported vehicle traffic between Los Angeles and Las Vegas on I-15 declined 9% to 479,000. As a result, Las Vegas' average occupancy rate for the month was 76.4%, a 10% decline over November 2000.

This survey indicates that even among those who were willing to visit Las Vegas in the weeks following September 11, 2001, the shipment of high level radioactive nuclear waste will affect their willingness to continue to visit. These survey results highlight the vulnerability of

Clark County's economy to a stigma-related economic downturn as a result of the DOE's proposed shipments of high level radioactive nuclear waste.

The issue of stigma and perception with respect to Yucca Mountain, while minimized by the DOE, arguably poses the most significant threat to the economic well being of Clark County and its incorporated cities.

In a study prepared for the State of Nevada, a scenario-based study of analogous cases examined the potential impact to the gaming industry in Clark County of the of high level radioactive nuclear waste shipment campaign. This study indicates that if only 4.5% - 5.7% of current visitors decide to no longer visit Las Vegas because of these shipments, losses in gaming revenues would fall by more than one-half billion dollars. If 10.0% - 15.0% of the current volume of visitors decided to vacation elsewhere because of the shipment campaign, gaming revenue losses would likely grow to between $1.1 billion to $1.7 billion. Such losses might have been considered unprecedented prior to September 11, 2001. However, the terrorist attacks that occurred over two thousand miles away from Clark County resulted in dramatic drops in revenues for the gaming industry and in gaming tax revenues for state and local governments. If losses of this level were to be sustained for a prolonged period, the effects on the bottom line would be grave for a number of facilities. In the event of a severe, prolonged downturn such as could result from a high level radioactive nuclear waste shipment accident, the gaming revenue losses could reach $2.8 billion to $3.7 billion over one year.

4.2 Property Value Impacts

Two key components of the local government tax structure in Nevada are sales taxes and property values. State and local governments rely heavily on these two sources of income. Obviously, steady increases in property value are desirable for property owners as well as government entities. Any threat to a government entity's ability to rely on property taxes as a stable source of income impacts not only that entity's ability to operate, but has a "domino" affect on all aspects of what people expect and deserve in terms of community livability.

Clark County's research has approached the issue of property values in a comprehensive fashion, analyzing it from a practical and quantifiable point of view, using expert advice and verifiable data through proven methodologies. Public opinion surveys have been conducted which corroborate the findings of technical experts in this area.

Another area that has been studied by both Clark County and the State of Nevada is the issue of stigma. As noted previously, the doctrine of "perception is reality" applies to Las Vegas like no other region in the world. Stigma resulting from an amplified perception of risk has been associated with all aspects of nuclear power plant siting and operations, and stigma has been associated with a decline in property values. Clark County investigated the likelihood and extent of property value diminution that may occur in Clark County, Nevada that is directly attributable to the Yucca Mountain Project. The findings, fully described in the report entitled *Clark County Property Value Report on the Effects of DOE's Proposal to Ship High Level Radioactive Waste to a Repository at Yucca Mountain* (UER, June 2001) are indeed significant.

The research indicates that Clark County would likely experience a loss in fair market property value ranging from $214.7 million to $1.6 billion for three types of properties – residential, commercial, and industrial. Within this range, the projection depends on the route selected and whether the shipment campaign proceeds without incident, or whether an incident occurs but does not result in any release of radioactive material. Further, this projection is based only on the diminution of a limited number of land uses, and thus actual losses are likely to be much higher.

Stigma resulting from amplified perception of risk has been associated with all aspects of nuclear energy including property value diminution (Jenkins-Smith, 1999). Given the amplification of risk that has been associated with all things nuclear and the probability of an incident (even an incident with no release of radioactive material), there is a potential that Clark County may experience significant property value diminution over an extended period resulting from the DOE's proposal to ship and store high level radioactive nuclear waste at Yucca Mountain.

If the proposed Yucca Mountain repository is constructed and primarily truck transport is used to move the waste, the majority of all of the waste will travel through Clark County. In this region of the country, no practical alternatives to I-15 and U.S. 93/95 are available for transit from Los Angeles, California, Salt Lake City, Utah, Phoenix, Arizona, or Reno, Nevada. Thus, while the DOE has not selected the transportation routes it will use, the DEIS for Yucca Mountain does identify these routes among the options under consideration. If the DOE's proposed "mostly highway" scenario is selected, as described in the DEIS, almost 93,000 shipments will traverse through Clark County over 24 years. It must be noted that the exact number and duration of shipments is not known, as the FEIS and the final repository design have not yet been completed.

The property value diminution reported on in this subchapter is not based upon a formal appraisal of specific properties. Instead, it is based on the opinions, perceptions, and beliefs of Clark County residents, lenders, and appraisers as to the effects of the shipment campaign on property values along two routes under consideration.

Over the last 15 years, a number of public opinion surveys addressing the intensity of concerns and public perceptions of the risks of transporting of high level radioactive nuclear waste on nearby routes offer consistent results. These surveys have typically targeted areas or regions containing proposed nuclear waste transportation routes, and the objectives of the surveys were to discern residents' concerns and, in some cases, what their likely behavior might be if these routes were selected.

Property value is directly influenced by the attitudes and behaviors of market participants including real estate appraisers, lenders, and owners. Clark County appraisers and lenders were interviewed to assess their beliefs and perceptions about the extent of property value diminution that could occur under three different transportation scenarios for three different property types, and at distances varying from one mile to three miles along the proposed transportation routes.

Related literature indicates that a wide variety of environmental disamenities from high-voltage transmission lines, Superfund sites, hazardous waste landfills and incinerators can result in stigma-induced property value diminution (Colewell, 1990; McClelland et al., 1990; Greenberg and Hughes, 1991; Kiel and McClain, 1995; Smolen et al., 1992). In a 1978 study, Lindell et al. found that only 29% of the public would be willing to live within 10 miles of a nuclear waste facility and 32% percent stated that they were unwilling to live within 100 miles of a nuclear waste facility. Further, this study found that a nuclear waste repository was the least tolerable of eight industrial facility types including a nuclear power plant (Lindell et al., 1978). A 1997 national survey by Flynn, et al. indicated that 63.6% of the sample agreed or strongly agreed that property values along the transportation corridor for high level radioactive nuclear waste would decline. Similarly, 70% of the respondents to a survey in Santa Fe, New Mexico indicated that property values would fall along a proposed bypass that was proposed for the transportation of radioactive waste to the WIPP near Carlsbad, New Mexico (ZIA Research Associates, 1991). Sixty percent of those respondents also indicated that under *no conditions* would they purchase homes in proximity to the proposed bypass.

The literature also demonstrates that the courts recognize stigma-induced property value diminution as a viable claim. This court recognition is discussed in detail in *Clark County*

Property Value Report on the Effects of DOE's Proposal to Ship High Level Waste to a Repository at Yucca Mountain (UER, 2001).

Formal protocols to measure stigma effects in property values have been developed by experts, such as appraisers. Lenders have developed formal policies for dealing with stigma. The acknowledgement of the effects of stigma on property values by the courts and other experts suggest that it is both reasonable and prudent to consider the potential effects of the proposed Yucca Mountain Project on Clark County's property values.

A survey of 512 Clark County residents was conducted by the Canon Center at UNLV in August 2000. The full findings of the survey are described in detail in the report, *Clark County Residents and Key Informant Surveys: Beliefs, Opinions, and Perceptions about Property Value Impacts from the Shipment of High-Level Nuclear Waste through Clark County, Nevada* (UER, 2001). The results were applied to the fair market valuation data for three groups of land uses within Clark County (residential, commercial, industrial).

The purpose of the survey mentioned above was to identify the attitudes, opinions, and perceptions of Clark County, Nevada residents regarding property values in Clark County, and to characterize their beliefs about the potential impacts of the proposed shipments on property values along the transportation corridor.

Several important findings resulted from this survey:

- Over one-half of the residents of Clark County consider the risk of an accident from the transportation of radioactive wastes to be serious or very serious.
- Clark County residents indicated that having a public school and a shopping center nearby has a positive impact on property values, by 61%, and 52.2%, respectively.
- Respondents stated that a polluting manufacturing plant, a landfill, and a highway or freeway used to ship nuclear waste would have the most negative affect on property values. The findings correlate with a similar survey of Santa Fe, New Mexico residents conducted in 1990.
- Approximately 80% of the respondents indicated that they were familiar with the proposed Yucca Mountain Project, while 75% said that they knew about the DOE's plans to ship high level radioactive nuclear waste through Clark County.
- Respondents were also asked whether a property's location near a high level radioactive waste transportation route would – increase a lot, increase somewhat, neither increase nor decrease, decrease somewhat, or decrease a lot – the likelihood of purchasing property.

- Altogether almost 82% of the respondents stated that a nearby high level radioactive nuclear waste route would either "decrease a lot" or "decrease somewhat" their likelihood of purchasing a residential property.
- Seventy-eight percent of the respondents utilized negative terms to describe the effects of the proposed high level radioactive nuclear waste shipment campaign through Clark County (Figure 4). Among the other terms used to describe the effects of the shipment campaign on property values were a "negative effect," "pretty bad," "upset people," "people would move far away," and "no one will buy houses." In response to a similar closed-ended question, 71% of the Santa Fe, New Mexico residents surveyed indicated that property values would decline from the shipment of radioactive waste.

Figure 4 Perception of Residential Property Value Impacts Located Near Specific Routes in Clark County, Nevada (NV) versus Santa Fe, New Mexico (NM)

Response Category	Nevada	New Mexico*
	Percent (N)	Percent
Danger**	2.4% (12)	NA
Decrease in value	66.1% (327)	71.0%
No effect	12.7% (63)	16.0%
Do not know	3.4% (17)	5.0%
Pretty bad**	2.4% (12)	NA
Negative effect**	5.3% (26)	NA
Upset people**	1.8% (7)	NA
People move**	1.7% (8)	NA
Increase in value	0.6% (3)	5.0%
No one will buy houses**	0.6% (3)	NA
Other	3.0% (15)	3.0%
TOTAL	100% (495)	100% (489)

* All percents are rounded to the nearest whole number and only the total number of respondents (N) was available for comparison.
** NA - Categories not used in the Santa Fe, New Mexico survey

Both the Clark County and New Mexico surveys also questioned respondents about their views concerning potential nuclear waste transportation impacts on nearby commercial or business property (Figure 5). In this case, 40.7% of the Clark County respondents indicated that commercial property would decrease with another 5.8% indicating generally "negative effects" on properties. Interestingly, 6.2% responding to this open-ended question suggested adverse effects on business operations located near these routes. In contrast to the general question on property values, 33.9% of responses to the question on commercial properties indicated that there would be "no effect" on these values. The respondents to a similar closed-ended question in the Santa Fe,

New Mexico survey indicated that 37% of the respondents believed that commercial and business property values would decline along the shipment corridor to WIPP, while 38% stated that the shipment campaign would have "no effect."

Clark County residents were asked under what conditions they would consider purchasing residential properties near high level radioactive nuclear waste transportation routes. Almost three-fourths of the respondents declared that they would not consider purchasing property along the transportation routes under *any conditions* (Figure 6). These responses are more negative than those expressed by respondents in the earlier Santa Fe, New Mexico study.

Figure 5 Perceptions of Property Value Impacts on Commercial or Business Properties

Response Category	Nevada	New Mexico
	Percent (N)	Percent *
Decrease in value	40.7% (231)	37.0%
No effect	33.9% (192)	38.0%
Do not know	7.2% (41)	9.0%
Affect businesses**	6.2% (35)	NA
Negative effect**	5.8% (33)	NA
Increase in value	1.6% (9)	13.0%
Dangerous**	1.6% (9)	NA
Other	3.0% (17)	3.0%
TOTAL	100.0% (567)	100.0% (496)

*All Santa Fe, New Mexico responses are rounded to the nearest whole number and only the total number of respondents (N) was available for comparison.
** NA - Categories not included in the Santa Fe, New Mexico survey.

Figure 6 Conditions Under Which Residents Would Consider Purchasing Residential Property near a Highway to be used for the Shipment of High-Level Radioactive Nuclear Waste in Clark County

Environmental Condition	Nevada	New Mexico
	Percent (N)	Percent *
Under no condition	74.9% (355)	59.0%
Do not know	2.5% (12)	8.0%
Depends on location**	3.2% (15)	NA
Would consider conditions	3.6% (17)	19.0%
Depends on safety measures**	3.2% (15)	NA
Other	6.1% (29)	5.0%
Would Not Affect Decision to Purchase***	NA	9.0%
TOTAL	100.0% (474)	100.0% (489)

* All Santa Fe, New Mexico responses are rounded to the nearest whole number and only the total number of respondents (N) was available for comparison.
** NA - Categories not included in the Santa Fe, New Mexico survey.
*** NA - Category not included in the Clark County, Nevada survey.

Clark County residents were asked whether residential property near a highway used for transporting high level radioactive waste would sell for more, the same, or less, than an identical property that *is not near* such a route (Figure 7). Eighty-two percent of the respondents believe such a property would sell for less; 15% think it would not make a difference; and only the remaining 3% believe it would sell for more. This pattern of response was similar to the earlier Santa Fe County, New Mexico study which found 71% of the respondents indicating that residential property would sell for less (ZIA Research Associates, 1991).

Figure 7 Perceptions of Direction of Impact on Property Values

Residential Property Near Nuclear Waste Shipment Routes would sell for...	Nevada	New Mexico
	Percentage (N)	Percentage (N)*
More money	3.3% (13)	3.0%
Same amount of money	14.5% (57)	20.0%
Less money	82.2% (324)	71.0%
Not Sure**	NA	6.0%
TOTAL	100.0% (394)	100.0% (501)

* All Santa Fe, New Mexico responses are rounded to the nearest whole number and only the total number of respondents (N) was available.
** NA - Categories not included in the Clark County, Nevada survey.

Respondents answering that a residential property would sell for more than or less than a comparable property not near a shipment route were then asked how much more or less they would expect the price to be. Of the 369 Clark County respondents who expect lower selling prices for homes near shipment routes, the mean expected drop in selling price in Clark County is estimated at approximately 25% compared to identical homes not near a highway that transports high-level radioactive nuclear waste (Figure 8).

Figure 8 Percentage of Diminution in Selling Price of Residential Properties Near a High Level Radioactive Nuclear Waste Shipment Route Compared to an Identical Property Not Near Such a Route

Diminution Amount	Nevada		New Mexico	
	Percent (N)	Cumulative Percent*	Percent (N)**	Cumulative Percent**
Less than 1 percent	12.4% (47)			
1-5 percent	6.1% (23)	18.5%		
6-10 percent	10.3% (39)	28.8%	11.0%***	11.0%***
11-20 percent	18.9% (72)	47.7%	22.0%	33.0%
21-30 percent	17.6% (67)	65.3%	19.0%	52.0%
31-40 percent	8.2% (31)	73.5%	13.0%	65.0%
41-50 percent	12.4% (47)	85.9%	10.0%	75.0%
51-60 percent	2.9% (11)	88.8%	5.0%	80.0%
61-75 percent	1.8% (7)	90.6%	2.0%	82.0%
More than 75 percent	6.6% (25)	97.2%	6.0%	88.0%
Not sure/refused	2.9% (11)	100.1%	12.0% (357)	100.0%

* Percents are rounded to the nearest tenth
** All percents are rounded to the nearest whole number and only the total number of respondents (N) is available for comparison.
*** The Santa Fe, New Mexico survey classification was Less Than Ten Percent.

When the 25% mean diminution rate reported by Clark County survey respondents is applied to all residential properties within one mile of the northern and western Beltway routes suggested in the DEIS, the resulting diminution in fair market value utilizing current assessed residential valuations is $1.4 billion (Figure 9). Alternatively, if the Beltway is not expected to be completed before high level radioactive nuclear waste shipments commence, the application of the 25% mean property value diminution along the I-15 transportation corridor in Clark County could result in a loss of $1.7 billion of fair market residential valuation.

Figure 9 Application of Property Value Survey to Clark County Residential Fair Market Value

		Nevada Transportation Corridor	
Clark County Property Value Survey	Rate	Beltway	I-15
Residential at One Mile	25.00%	$1,406,531,814	$1,727,460,214

It is important to note that these ranges represent the application of the mean rate of property value diminution to current residential fair market valuation within one mile of the beltway and I-15 routes through Clark County as reported by those Clark County residents who were surveyed. These rates are based on the respondent's current perception of likely property

value diminution and are based on extrapolating current residential assessed valuation data to fair market value. Obviously, perceptions are dynamic and thus are likely to change over time. In addition, the current assessed residential valuation within Clark County does not account for the significant developments that are proposed over the next decade especially along the northern beltway. Thus, these figures are best understood as representing the intensity of public concern about the effect of DOE's proposal to construct the proposed Yucca Mountain repository and ship high level radioactive nuclear waste through Clark County.

The results of focused interviews with Clark County lenders and appraisers are described in detail in the report, *Clark County Residents and Key Informant Surveys: Beliefs, Opinions, and Perceptions about Property Value Impacts from the Shipment of High-level Nuclear Waste through Clark County, Nevada*. The results are applied to the assessed valuation data for three groups of land uses within Clark County. UER conducted a survey of 18 Clark County lenders and 35 certified appraisers in May 2000.

Under the first scenario, the appraisers and lenders were asked to evaluate whether there would be any changes in property values along the corridor if "no event" occurred, but there was adverse publicity, particularly, at the onset of the shipment campaign. This scenario was assigned to three discreet residential, commercial, and industrial properties that were characterized in terms of size, location, lease fees, and other factors. As noted above, the lenders and appraisers were also asked to differentiate the level of impact, if any, that might be experienced at two varying distances along the corridor (within 1 mile of the shipment route and within 1 to 3 miles of shipment routes).

According to the lenders and appraisers, residential properties would lose the most value in percentage terms. Appraisers indicated that within one mile of a shipment route, residential properties would decline on the average by 3.50%, while lenders indicated the decline would be approximately 2.00% (Figure 10). When these rates of diminution are applied to residential fair market valuation data for these property types within one mile of the beltway route, the potential property value loss for residential property ranges from $112.5 million to $196.9 million (Figure 10). In contrast, if these rates are applied to fair market property value data within one mile of the I-15 route then diminution could range from $138.2 million to $241.8 million (Figure 11).

According to the appraisers and lenders, residential properties at a distance of one to three miles from the routes would continue to experience the greatest decline in value relative to the other two property types. When the rates of property value diminution are applied to residential

fair market value data at a distance of one to three miles from the Beltway route, the diminution ranges from $91 million to $265.6 million. From the I-15 route, the diminution ranges from $105.4 million to $307.7 million. Thus, under Scenario 1, lenders and appraisers indicated that the rate of residential property value diminution when applied to fair market value data along the beltway might be as high as $203.5 million to $462.5 million, while along the I-15 route the diminution could range from $243.6 million to $549.5 million.

Figure 10 Scenario 1 Mean Property Value Diminutions within 1 Mile and at 1 to 3 Miles of the Beltway Route

	Residential Property Value Diminution				
	1 mile		1 - 3 miles		Totals
Lenders (N*)	2.00% (11)	$112,522,546	0.50% (11)	$90,954,074	$203,476,617
Appraisers (N*)	3.50% (13)	$196,914,454	1.46% (12)	$265,585,894	$462,500,346
	Commercial Property Value Diminution				
	1 mile		1 - 3 miles		Totals
Lenders (N*)	0.56% (10)	$447,457	0.56% (10)	$5,167,840	$5,615,300
Appraisers (N*)	3.21% (14)	$2,564,894	1.25% (14)	$11,535,360	$14,100,251
	Industrial Property Value Diminution				
	1 mile		1 - 3 miles		Totals
Lenders (N*)	0.56% (10)	$993,494	0.56% (10)	$4,925,689	$5,919,186
Appraisers (N*)	1.25% (12)	$2,217,623	0.83% (12)	$7,300,577	$9,518,200

* All percents are rounded to the nearest whole number and only the total number of respondents (N) is available for comparison.

Figures 12 and 13 summarize the results of the property value loss under each of the scenarios as estimated by the Clark County bankers and lenders. What these figures suggest is that among those most experienced with estimating Clark County property values, there is a perception that significant adverse impacts will occur along either of the Clark County routes proposed, for all property types examined, even under the most benign scenario.

Figure 11 Scenario 1 Mean Property Value Diminution within 1 Mile and at 1 to 3 Miles of the I-15 Route

	Residential Property Value Diminution				
	1 mile		1 - 3 miles		Totals
Lenders (N*)	2.00% (11)	$138,196,817	0.50% (11)	$105,370,546	$243,567,363
Appraisers (N*)	3.50% (13)	$241,844,431	1.46% (12)	$307,681,997	$549,526,426
	Commercial Property Value Diminution				
	1 mile		1 - 3 miles		Totals
Lenders (N*)	0.56% (10)	$5,478,700	0.56% (10)	$8,625,117	$14,103,817
Appraisers (N*)	3.21% (14)	$12,229,240	1.25% (14)	$12,783,654	$24,498,609
	Industrial Property Value Diminution				
	1 mile		1 - 3 miles		Totals
Lenders (N*)	0.56% (10)	$7,082,897	0.56% (10)	$14,305,271	$21,388,171
Appraisers (N*)	1.25% (12)	$40,600,186	0.83% (12)	$31,931,411	$72,531,594

* All percents are rounded to the nearest whole number and only the total number of respondents (N) is available for comparison.

Figure 12 Property Value Diminutions under Three Scenarios within 3-Mile Distance of the Proposed Beltway Route

	Residential		Commercial		Industrial	
Groups	Lenders	Appraisers	Lenders	Appraisers	Lenders	Appraisers
Scenario 1	$203,219,474	$462,500,346	$5,615,300	$14,100,251	$5,919,186	$9,518,200
Scenario 2	$646,024,023	$1,175,472,314	$12,424,417	$33,873,129	$15,892,269	$27,680,400
Scenario 3	$5,269,739,823	$6,203,196,049	$171,414,257	$189,179,886	$125,658,343	$192,465,463

Figure 13 Property Value Diminutions under Three Scenarios within 3-Miles of the I-15 Shipment Route, by Professional Group (Lenders and Appraisers)

	Residential		Commercial		Industrial	
Groups	Lenders	Appraisers	Lenders	Appraisers	Lenders	Appraisers
Scenario 1	$243,567,363	$549,526,426	$21,388,171	$72,531,494	$14,103,817	$25,012,894
Scenario 2	$772,643,577	$1,392,987,706	$76,137,260	$171,126,151	$54,535,563	$83,790,291
Scenario 3	$6,218,675,720	$7,318,862,089	$704,094,009	$926,894,417	$361,917,017	$507,543,183

The findings also indicate that increasing the severity of events within the scenarios, as illustrated in Scenario 2 and 3, results in significantly larger rates of impact. Under Scenario 3, the most serious accident event evaluated, residential property diminution rises to $5.3 billion - $6.2 billion within 3 miles of the Beltway route and $6.2 billion - $7.3 billion within 3 miles of the I-15 route.

The City of Las Vegas is the largest incorporated city within Clark County. Thus, it is reasonable to expect that the largest potential dollar decrease in property values would be experienced in this jurisdiction (Figure 14). According to the lenders and appraisers, residential properties within the City of Las Vegas, like all other jurisdictions within Clark County, are likely to experience the largest loss in property values along both the I-15 route and the Beltway.

Figure 14 Total Property Value Diminutions by Route, Property Type, Scenario, and Professional Group (Lenders and Appraisers) for Las Vegas

	Beltway Route		I-15 Route	
Residential	Lenders	Appraisers	Lenders	Appraisers
Scenario 1	$90,541,066	$205,191,963	$156,784,337	$340,430,714
Scenario 2	$287,362,977	$520,964,800	$495,190,989	$850,970,611
Scenario 3	$2,331,648,849	$2,744,464,529	$3,713,101,297	$4,365,535,780
Commercial				
Scenario 1	$3,037,806	$6,972,709	$13,237,277	$49,171,100
Scenario 2	$6,004,080	$16,916,829	$53,674,129	$115,411,900
Scenario 3	$90,950,803	$112,319,546	$447,409,589	$598,515,980
Industrial				
Scenario 1	$51,203	$75,889	$2,117,549	$3,789,223
Scenario 2	$91,431	$190,177	$8,429,277	$12,838,477
Scenario 3	$914,320	$1,529,657	$55,243,149	$76,911,223

Lenders and appraisers repeatedly remarked that the future economic growth of the area is inextricably linked to the development of the Northern and Western Beltway, i.e., the Beltway route. Thus, while property value impacts may be lower today along the Beltway, it is expected to play a major role in the Valley's future development (see C*ity of Las Vegas Governmental Fiscal Impact Report*, UER, 2001). If the DOE selects the Beltway as its preferred route, as it has suggested in the DEIS, then the future economic growth of Las Vegas and in fact the entire Valley may be diminished.

In North Las Vegas, the largest property value impacts are estimated for residential properties along the I-15 route (Figure 15). For these properties, the loss in fair market value could reach $521.6 million - $614.8 million. In contrast, residential property value losses along the Beltway could reach $305.8 million - $361.6 million. However, like Las Vegas, North Las Vegas expects its primary future economic growth to occur along the Beltway route.

Figure 15 Total Property Value Diminutions by Route, Property Type, Scenario, and Professional Group (Lenders and Appraisers) for North Las Vegas

	Beltway Route		I-15 Route	
Residential	Lenders	Appraisers	Lenders	Appraisers
Scenario 1	$7,859,509	$22,557,620	$18,084,091	$43,549,057
Scenario 2	$2,572,649	$61,528,697	$57,812,634	$112,868,383
Scenario 3	$305,833,589	$361,564,006	$521,619,643	$614,827,454
Commercial				
Scenario 1	$56,694	$126,551	$883,334	$3,295,426
Scenario 2	$101,243	$307,774	$3,603,451	$7,733,040
Scenario 3	$1,687,703	$2,075,460	$29,894,617	$40,021,897
Industrial				
Scenario 1	$701,063	$1,039,077	$3,837,409	$7,016,377
Scenario 2	$1,251,900	$2,603,951	$16,343,883	$24,408,994
Scenario 3	$12,518,997	$20,944,283	$104,117,777	$142,515,549

Residential properties in unincorporated Clark County vary from the pattern in Las Vegas and Clark County as a whole. In unincorporated Clark County the larger property value losses are found along the Beltway, when one applies the results of the lenders and appraisers survey to fair market residential valuation (Figure 16). Along the Beltway route, the losses could range from $96.7 million - $218 million under Scenario 1 and $306.8 million - $552.6 million under Scenario 2. Along this same route, the losses rise to $2.47 billion to $3 billion, under Scenario 3. In contrast, along I-15, they range from $60.4 - $149 million under Scenario 1; $193.7 million - $389.3 million under Scenario 2; and $1.8 billion - $2.1 billion under Scenario 3.

Figure 16 Total Property Value Diminutions by Route, Property Type, Scenario, and Professional Group (Lenders and Appraisers) for Unincorporated Clark County

	Beltway Route		I-15 Route	
Residential	Lenders	Appraisers	Lenders	Appraisers
Scenario 1	$96,721,051	$218,055,049	$60,411,103	$149,047,049
Scenario 2	$306,791,731	$552,598,249	$193,706,420	$389,305,446
Scenario 3	$2,465,897,000	$3,004,957,211	$1,820,280,886	$2,146,608,183
Commercial				
Scenario 1	$2,255,291	$5,943,709	$7,002,051	$19,007,780
Scenario 2	$3,429,466	$14,261,703	$17,674,380	$45,508,674
Scenario 3	$69,608,637	$87,840,826	$217,622,694	$275,939,337
Industrial				
Scenario 1	$4,725,197	$7,687,794	$7,707,137	$13,491,854
Scenario 2	$13,326,246	$22,781,314	$28,539,711	$44,437,863
Scenario 3	$102,710,006	$155,520,860	$193,041,071	$273,645,749

In Henderson, the primary property value impacts are likely to be felt by industrial properties along the I-15 (Figure 17). These properties could see a drop in fair market value of $279,414 to $414,000 under Scenario 1 and these losses would grow from half a million to 1 million under Scenario 2. In the event of a Scenario 3 accident, these losses could reach $5 million to $8.4 million.

Figure 17 Total Property Value Diminutions by Route, Property Scenario, and Professional Group (Lenders and Appraisers) for Henderson

	I-15 Route	
Residential	Lenders	Appraisers
Scenario 1	$108,483	$297,531
Scenario 2	$352,697	$801,763
Scenario 3	$3,920,037	$4,631,311
Industrial		
Scenario 1	$279,731	$414,603
Scenario 2	$499,520	$1,039,003
Scenario 3	$4,995,209	$8,356,983

Since all of Mesquite lies within three miles of the I-15 corridor, the community would experience significant impacts under all of the scenarios. The most significant impacts are estimated for residential properties (Figure 18). These properties can anticipate losses in fair market value of between $8.2 million - $16.4 million under Scenario 1. If an accident without a release, such as described in Scenario 2 were to occur, the loss to residential property values could grow to $25.8 million - $40 million.

Figure 18 Total Property Value Diminutions by Route, Property Type, Scenario, and Professional Group (Lenders and Appraisers) for Mesquite

	I-15 Route	
Residential	Lenders	Appraisers
Scenario 1	$8,246,511	$16,398,186
Scenario 2	$25,801,111	$39,578,803
Scenario 3	$162,440,351	$190,436,134
Commercial		
Scenario 1	$265,509	$1,057,289
Scenario 2	$1,185,300	$2,472,537
Scenario 3	$9,167,111	$12,417,203
Industrial		
Scenario 1	$161,991	$300,840
Scenario 2	$723,171	$1,065,951
Scenario 3	$3,693,951	$6,113,680

The literature clearly indicates that knowledge of an undesirable environmental condition is closely associated with declines in property values. Surveys of Clark County residents show that 77% of Clark County residents are familiar with the DOE's plans. This finding is consistent with earlier surveys conducted for over a decade. The media attention that is sure to accompany any final decision to construct the repository and the transport of high level radioactive nuclear waste will certainly maintain, if not increase, public awareness of this issue.

Perception, especially the perception of risk, also has been positively correlated with property value diminution. When Clark County residents were asked about their perception of what will happen to residential property values if the DOE proceeds with its plans, over 80% indicated the effects in negative terms and almost two-thirds described the impacts on commercial properties in similar negative terms. Moreover, two expert groups, Clark County lenders and appraisers (with an average of over a decade of experience in Clark County determining property values), also overwhelmingly indicated that property values are likely to suffer as a result of the DOE's proposed actions.

In fact, even under the most benign scenario where no incident of any type occurs, the Clark County lenders and appraisers projected that residential property values would decline by 2.00% - 3.50%, resulting in losses of $243.6 million to $549.5 million along the I-15 route and $203.3 million – $462.5 million along the Beltway route. These experts indicate that if an event

were to occur, even with no release of radioactive material, the rate of residential property value diminution would increase to 6% to 8% within one mile and 1.64% - 4.00% within one to three miles. This also is consistent with actual experience that has demonstrated that distance is associated with the rate of diminution with the largest drops occurring closest to the undesirable environmental condition.

When one considers the findings from the lenders and appraisers for the most severe accident event studies, Scenario 3, the level of diminution indicated is substantially higher than for the other two scenarios. Under this scenario, lenders and appraisers indicate that residential property losses would likely reach approximately 30%. This is consistent with findings in the literature that show that the increasing magnitude of an event influences the degree of property value diminution.

The Clark County residents surveyed indicated on average that they expect a 25% drop in residential property values. This rate of diminution is consistent with an earlier survey of residents in Santa Fe, New Mexico along the transportation corridor for waste shipments to WIPP. This rate of diminution is substantially higher than what has been demonstrated around landfills, and is remarkably close to the level of diminution indicated as likely by the experts under Scenario 3.

The DEIS assumes that there will be no event of any kind during the shipment period. This would be consistent with the level of losses indicated by the experts under Scenario 1. Thus, Scenario 1 appears to be an appropriate lower boundary for the level of impact that may be experienced. Using Scenario 1 as the lower boundary means that at a minimum, property value diminution is likely to range from $214.8 million to $647 million.

Clark County is ranked as the fasted growing county in the nation. This growth has led to increasing congestion along the transportation routes being considered. This in turn increases the likelihood of an incident. While the probability of Scenario 3 may be small, if it were to occur the consequences of such an event would be devastating.

It is important to note that these estimates of potential property value damage are based on "fair market value." From the private property owner's perspective, these projected rates of diminution imply that there will likely be a loss of personal wealth and either increased property tax rates and/or reduced governmental services, even if the shipment of high level radioactive waste occurs without an incident of any type. If an incident occurs and there is a release of radioactive material, the diminution could be devastating.

As this study has shown, the extent of property value diminution varies by land use and route. This has important implications. If the I-15 route were selected, the total impact would likely be highest using the current value of developed land. This is because the area is almost fully developed; however, in unincorporated Clark County there is already a greater impact on residential properties along the Beltway. The Beltway has also been identified as critical to future economic growth within the Las Vegas Valley. The DOE's selection of a route for shipping high level radioactive waste has very significant consequences that vary by land use and jurisdiction.

In conclusion, the Yucca Mountain transportation campaign, even under the DOE's own scenario that postulates no *incidents of any type*, will likely result in significant property value losses within Clark County.

This research supports Clark County's findings that property values are likely to be affected adversely by the DOE's proposed actions. It is impossible to estimate the exact property value reductions as a result of the DOE's proposals for Yucca Mountain absent a FEIS, description of transportation routes throughout the valley, and final repository design. However, there is no doubt that the Yucca Mountain program poses a significant threat to property values in Clark County.

Economic Losses Based Upon Property Values and Population Estimates

As noted previously in this report, the consulting firm of UER interviewed experienced lenders and appraisers within Clark County regarding the effects three transportation scenarios would have on local property values.

UNLV's CBER was requested to utilize these results as input into the Regional Economic Model, Inc. (REMI) and compare these outputs to the normal REMI outputs (Appendix D). CBER was specifically tasked with:

a. Estimating employment, income and expenditure impacts of property value losses under three alternative scenarios; and
b. Estimating lost property taxes.

Within each scenario are both minimum and maximum impacts that can be expected to occur within the community. There are, therefore, six options. However, only two options will be discussed. These options are Scenario 1 (minimum impact) and Scenario 3 (maximum impact). This will allow the reader to gain a sense of economic impacts and provides a potential bounding of economic impacts on Clark County.

Two benchmarks that can be utilized when comparing this study are:

- During the Great Depression one in three persons were unemployed.
- The terrorist attacks of September 11, 2001, resulted in layoffs of over 11,000 Clark County residents.

The REMI model utilizes 1992 dollars. Therefore, all dollars reflected in this section are in 1992 constant dollars. This results in estimates that are extremely conservative.

Impacts Based Upon Scenario 1

The impacts identified as minimum impacts within Scenario 1 (trucks utilizing the Clark County transportation system without incident) are as follows:

a. Employment would be reduced by 5,393 jobs.
b. Gross Regional Product (Spending) would be reduced by $185 million. This is a one-year figure and will be cumulative over the life of the project to $5.6 billion.
c. Real Disposable Income would be reduced by $136 million for one year. Cumulatively, over the life of the project, losses of Real Disposable Income could exceed $4.7 billion.
d. Population would be reduced by 11,294 people. This is an average population loss over the life of the project. Of interest to note is that over this last decade, the population within Clark County has never declined and in fact has grown, on average, 6.27% per year.

Impacts Based Upon Scenario 3

The impacts identified as maximum impacts within Scenario 3 (a serious accident including the release of radioactive materials involving the Clark County transportation system) are as follows:

a. Employment would be reduced by 54,429 jobs. It should be noted that this is equivalent to increasing the current unemployment rate by approximately 6.5% (roughly 10 times the impact under Scenario 1) to more than 13%.
b. Gross Regional Product (Spending) would be reduced by $1.4 billion. This is a one-year figure and will be cumulative over the life of the project to $68.1 billion. This is the equivalent expenditures made by over 30 major hotel properties.
c. Real Disposable Income would be reduced by $686 million for one year. Cumulatively, over the life of the project, this figure rises to $42.1 billion.
d. Population would be reduced by 90,718 people, more than 8 times the loss under Scenario 1. This is an average population loss over the life of the project.

These estimates under Scenario 3 reflect an expected magnitude of impact. However, it is difficult to verify the duration and likelihood of this impact based upon the information provided

by the DOE to date. Unlike most accidents that cause brief disruptions to our every day lives, a nuclear release will result in a much more prolonged disruption than other hazardous incidents or events. Figure 19 below summarizes the minimum and maximum expected economic losses based on the REMI model.

Figure 19 Economic Impacts Based Upon Property Values and Population Estimates from Years 2010 through 2035

Economic Losses	Scenario 1	Scenario 3
	Minimum Impact	Maximum Impact
Population	11,294	90,718
Job	5,393	54,429
Gross Regional Product		
Annual	$182 million*	$1.4 billion*
Cumulative***	$5.6 billion**	$68.1 billion**
Disposable Personal Income		
Annual	$136 million*	$686 million*
Cumulative***	$4.7 billion**	$42.1 billion**

* Projected for 2010 in constant 1992 dollars.
** All dollars are in constant 1992 dollars due to the REMI model. Therefore, all dollars represented are conservative estimates.
*** For period from 2010 through 2035; dollars are in constant 1992 dollars.

4.3 Transportation Impacts

Introduction

This subchapter provides an interim assessment of six of the fourteen transportation route (rail and truck) alternatives that DOE identified in its DEIS. The DEIS, although seriously deficient in its transportation analysis, provided the first indication of how the DOE proposes to move the waste to Yucca Mountain for disposal. The information contained in the DEIS serves as the basis for the following assessment of transportation impacts to Clark County.

The DEIS identified 14 “implementing alternatives” for possible use in transporting high level radioactive waste and spent nuclear fuel from generating sites to the proposed repository at Yucca Mountain, Nevada. These implementing alternatives are potential rail, heavy-haul, or legal-weight truck routes that may be used to transport high level radioactive nuclear waste and spent nuclear fuel. Of these 14 transportation route alternatives, 6 travel through Clark County, Nevada. The impacts addressed in this subchapter include impacts such as routine radiation exposure, accident costs, incident delay, transportation planning impacts, land use impacts, and monitoring impacts. The maps and transportation scenarios used in this report are included in Appendix E.

Although the DEIS provided a cursory examination of 14 "implementing alternatives," it did not identify a best alternative. Consequently, it is difficult to prepare a definitive assessment of the transportation impacts attributable to the Yucca Mountain Project since the DOE failed to provide specific information about its program. The DEIS itself acknowledges this failure when it indicates that additional studies must be completed before transportation system impacts can be assessed.

These impacts, defined as changes to the operation, condition, and performance of the Yucca Mountain Project that adversely affect the transportation network in Clark County, Nevada, are organized to coincide with the Yucca Mountain Project completion phases.

The proposed repository would be completed in three phases: construction, operation, and post-closure. Although this chapter does not examine post-closure transportation system impacts, it does address the cumulative impacts attributable to the additional burden of the DOE's low-level radioactive waste disposal operations at the Nevada Test Site (NTS).

Further, this report does not address the mitigation of the impacts described herein, and should not be used as a "baseline" for impact mitigation. The DOE should use this estimate as a guide for identifying and addressing future issues related to transportation. Future studies will be necessary to identify specific routes and impact assessment should Yucca Mountain be selected as the nation's repository for high level radioactive nuclear waste.

The transportation system impacts fit within the Council on Environmental Quality's (CEQ) interpretation of NEPA as indirect and cumulative. In NEPA, certain standards for evaluating impacts and determining their significance have evolved. These standards were applied here in order to determine probable and significant impacts. Within these limits, Clark County estimated which impacts were reasonably foreseeable based on their probability and significance. Impacts that were not reasonably foreseeable were not considered. Two types of NEPA-defined impacts were examined in this report: indirect and cumulative.

Indirect Impacts

Transportation of high level radioactive nuclear waste to Yucca Mountain is an indirect effect of the Yucca Mountain Project under NEPA because (1) the effects are a consequence of the proposed action (i.e., construction of the proposed Yucca Mountain high level radioactive nuclear waste disposal facility), and (2) the effects of this transportation are removed in time and location from the proposed repository, itself. The impacts assessed in this report were found to meet the

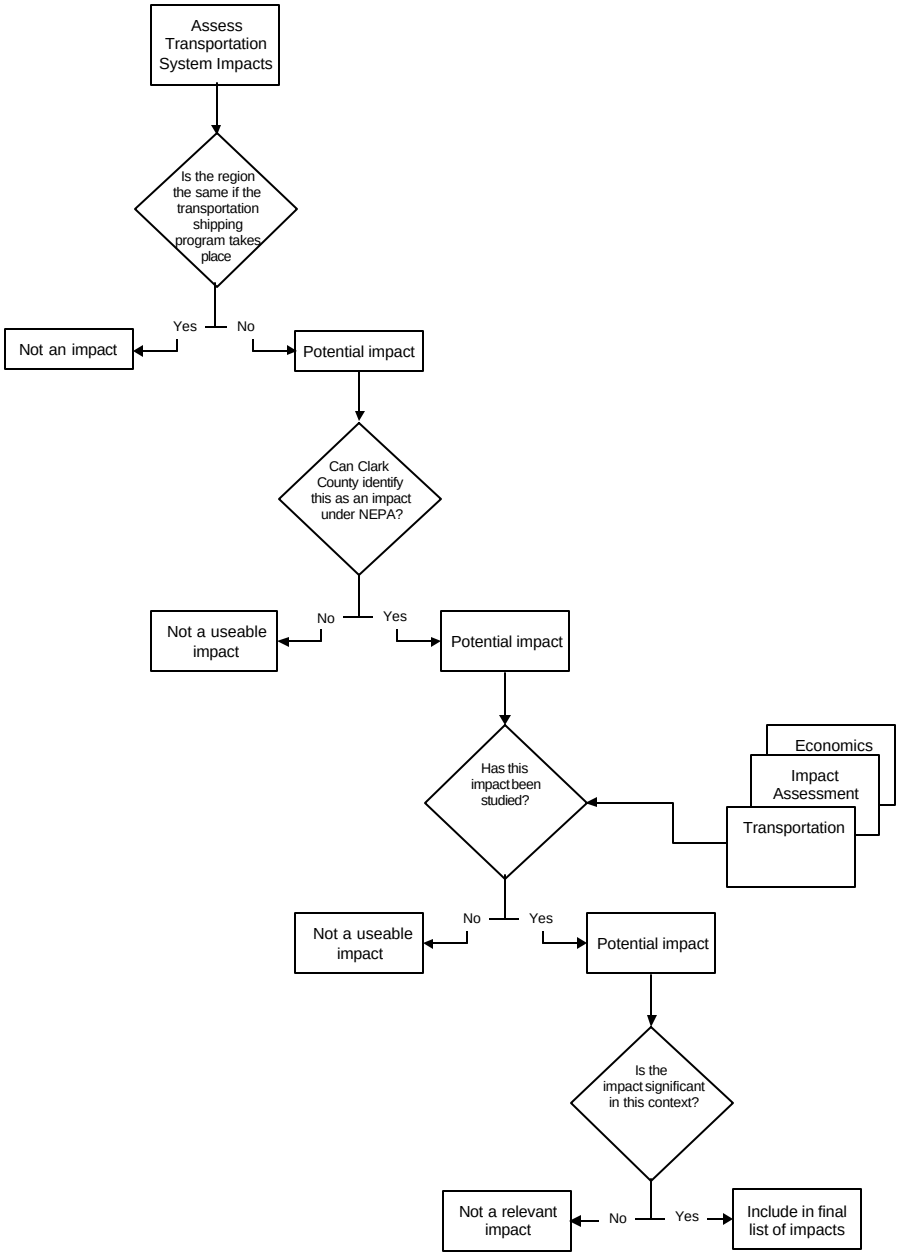
three-step test established for indirect effects in *Sierra Club v. Marsh*, 808 F. Supp. 852, 875 (D. Mass., 1984).

This test is:

1. *Can one say with confidence that the impacts are likely to occur?*
2. *Can one describe them now with sufficient specificity to make their consideration useful?*
3. *Will the decision maker be able to take account of the impacts now, before the agency is so firmly committed to the project that further environmental knowledge, as a practical matter, will prove irrelevant to the government's decision?*

The impacts were identified through literature review, professional judgment, and consultation with other agencies, and chosen based on the logic model presented on page 43:

Figure 20 Logic Model Used to Define Indirect Impacts



The impacts described in this subchapter also satisfy the other requirements of being both probable and significant should the Yucca Mountain Project proceed.

Cumulative Impacts

The cumulative impacts examined in this subchapter are based on the DOE's use of the NTS as a disposal site for the ongoing program to clean up nuclear weapons production facilities through the United States. The CEQ defines cumulative impact as ". . . the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions. . .." The use of the NTS as a low level radioactive waste disposal site fits this definition. Most of the low level radioactive waste from these sites will be shipped to the NTS for permanent disposal. For the foreseeable future, the most likely mode of transport for these wastes is by legal-weight truck on the highway system. However, the use of heavy-haul trucks or rail has not been excluded from consideration by the DOE.

Definition of the Region of Influence

Clark County is within the region of influence of the Yucca Mountain Project for transportation because Congress identified the interstate highway system as the default route for the transportation of high level radioactive nuclear waste. The most direct route from power generating sites to Yucca Mountain is the interstate highway system through Clark County. Therefore most of the transportation routes from shipping sites would likely pass through Clark County.[1]

[1] The State of Nevada does have the ability to designate a preferred route if an analysis done in accordance with the provisions contained in *Guidelines for Selecting Preferred Highway Routes for Highway Route Controlled Quantity Shipments of Radioactive Materials* (August 1992), which demonstrates that the alternate route has no negative effect on public health and safety. Whether or not Nevada will choose to perform such an analysis, or whether or not that analysis will show positive effects on health and safety is not clear. Therefore, it is reasonable to assume that the default route will be used.

Figure 21 Cross-Country High Level Radioactive Nuclear Waste Shipments on the Interstate Highway System

The shortest routes from the waste generating sites to Yucca Mountain pass through Clark County en route to Yucca Mountain. Congress anticipated efforts to avoid transportation of waste through particular areas. In all likelihood, that is why Congress designated, in the NWPAA, the interstate highway system as the default transportation route for the movement of high level radioactive nuclear waste to a repository. If the proposed repository is approved, Clark County would likely request that the shipment be rerouted to avoid populated areas of the county. Other similarly affected entities would also be likely to request that the shipments be rerouted. The likely result of changing the route will be an uneconomical routing process that is both circuitous and expensive.

Because the majority of the truck-transported high level radioactive waste would pass through Clark County en route to Yucca Mountain, the transportation impacts would be concentrated in Clark County. The Nuclear Regulatory Commission identified Clark County as

part of the maximally affected region in the nation in an Environmental Impact Statement (NUREG 1437) because it sought to identify the maximum impact scenario. Following are the areas of impact most significant to the residents and visitors of Clark County.

Routine Radiation

In order to examine the effects of the routine transportation of high level radioactive nuclear waste, the State of Nevada hired M. H. Chew & Associates to examine the health effects of a routine rail shipment of high level radioactive nuclear waste to Yucca Mountain. A portion of the Chew report is excerpted below. The entire report is included as Appendix F.

The Union Pacific Railroad will routinely make extended stops for train assembly, safety inspections, etc. Some of the stops are quite extended. Since the stop doses of radiation will be considerably larger than the passing doses, the latter were not examined. Three locations that are affected by the stopped doses are considered in the impact analysis. Two of the locations are hotel/casinos and the third is the Clark County Government Center.

According to the DEIS, DOE's rail routing analysis for Jean, Nevada indicates that about 87% of all rail shipments to Yucca Mountain would use the Union Pacific mainline through downtown Las Vegas. According to the DOE'S SDEIS, There would be 17,364 rail cask shipments through Las Vegas over 38 years, an average of 457 cask shipments per year.

The DEIS assumes that spent nuclear fuel rail casks will be shipped in general freight service. However, for purposes of evaluating a maximum credible incident-free scenario, this analysis assumes each rail cask is shipped through Las Vegas separately by general freight service in a different train. Thus, there would be 457 rail cask shipments per year through Las Vegas for 38 years. There are a number of locations along the Union Pacific railroad through Las Vegas where entire trains and groups of freight cars are routinely stopped for varying periods of time. For this analysis the state of Nevada selected three such locations.

Stops for carrier interchange or train assembly could require from 2 to 24 hours. Stops for crew changes, car changes, engine refueling, train maintenance, regulatory inspections, and traffic control, could range from 15 minutes to more than 2 hours. In planning for receipt of casks shipped by general freight service, the DOE has indicated its intention to take advantage of U.S. Department of Transportation regulations that allow stoppage of rail cars in transit for periods of up to 48 hours.

A major portion of the analysis finds significant annual doses at the designated locations. The figure below summarizes the findings for the cumulative annual doses (457 hours) at each of three locations.

The M. H. Chew report concludes that the shipment of high level radioactive nuclear waste will impose measurable doses of radiation on people living or employed with one-half mile of any proposed route. These doses are summarized in Figure 22:

Figure 22 Routine Radiation Doses

Building/Maximally Exposed Individual	Distance (meters)	457 hour Dose (mrem)
Casino 1, MEI 1	40	27.6
Casino 1, MEI 2	15	200
Casino 2, MEI 1	35	36.2
Casino 2, MEI 2	160	1.05
Clark County Government Center	20	114
Clark County Government Center	30	49.5
Clark County Government Center	100	3.43

Accident Costs

Vehicular traffic accident costs include deaths, injuries, pain, disabilities, lost productivity, grief, material damage, and crash prevention expenses. Previous studies that evaluate the relationship between financial expenses and safety make it possible to assign a value to marginal changes in traffic risk. The National Highway Traffic Safety Administration estimates traffic accident costs at .065 dollars per mile. This estimate excludes pain and lost quality of life. The Federal Highway Cost Allocation Study performed in 1997 made a more detailed estimate of external costs for combination trucks on urban highways. The external costs are costs not borne by the carrier. By definition then, they are costs imposed on the local community. This analysis uses the more detailed FHWA estimate.

Construction Phase Accident Costs

The construction phase accident costs are calculated for the percentage of the routes that will traverse Clark County. The volumes of shipments are taken from the DEIS and are included for each route. The FHWA estimate of costs for combination trucks on urban highways (adjusted to year 2000 dollars) is $1.24 per vehicle mile. These costs are summarized in Figure 23.

Figure 23 Construction Phase Accident Costs

Alternative	DEIS listed length of the rail corridor	Length of the rail corridor in Clark County	Percent of the Corridor in Clark County	Total Shipping Miles for Construction Projects	Total Shipping Miles in Clark County	Forecasted accident costs
Jean Rail Corridor	112	88	0.79	38,524,940	30,269,596	$102,912,425
Valley Modified Rail Corridor	98	90	0.92	19,262,470	17,690,023	$70,655,344
Apex Dry Lake Heavy Haul Route	114	91	0.80	19,883,840	15,872,188	$134,270,347
Caliente Heavy-Haul Route	234	66	0.71	37,903,570	26,888,857	$170,443,822
Sloan-Jean Heavy-Haul Route	117	66	0.56	19,883,840	11,216,525	$97,891,418

Approximately 30% of these costs would likely not be reimbursed to the affected parties. Using the 30% figure, the amount of unreimbursed accident costs is estimated below.

Operation Phase Accident Costs

The operation phase accident costs are calculated for the heavy-haul and legal weight truck routes that traverse Clark County. Figure 24 below contains unreimbursed accident costs to Clark during the period Yucca Mountain repository would be operational.

Figure 24 Operation Phase Unreimbursed Accident Costs

Operation	Shipments through Clark County	Shipment Miles in Clark County	Accident Costs	Unreimbursed Accident Costs
Apex Dry Lake	10,815	1121948.1	$1,391,216	$417,365
Caliente Heavy-Haul Route	10,815	1670268.6	$2,071,133	$621,340
Sloan-Jean Heavy-Haul Route	10,815	835134.3	$1,035,567	$310,670
Legal-weight truck	49,523	4902777	$6,079,443	$1,823,833

Total unreimbursed accident costs due to the construction and operation of the Yucca Mountain repository are summarized in Figure 25 below.

Figure 25 Unreimbursed Accident Costs in Clark County

Jean Rail Corridor	$30,873,728
Valley Modified Rail Corridor	$21,196,603
Apex Dry Lake Heavy Haul Route	$40,281,104
Caliente Heavy-Haul Route	$51,133,147
Sloan-Jean Heavy-Haul Route	$29,367,425

Cumulative Impact Accident Costs

The cumulative impact of the DOE's shipments to the NTS is also significant. The volumes of shipments are from the DEIS and are included for each route. The FHWA estimate of costs for combination trucks on urban highways (adjusted to year 2000 dollars) is $1.24 per vehicle mile. The numbers presented in Figure 26 represent the unreimbursed costs to Clark County due to low level waste disposal activities at the NTS.

Figure 26 Cumulative Unreimbursed Accident Costs

	Accident Costs	Unreimbursed Accident Costs
Cumulative Impact	$32,899,680	$9,869,904

Incident Delay

Incident delay is the change to traffic system performance due to traffic incidents. This subsection includes delays due to drivers stuck in traffic as well as "gaper-lock" - the tendency for drivers in opposing lanes to slow down to observe the scene of an incident. Two types of incidents are considered: Traffic accidents, and incidents in which radiation contamination is released beyond the vehicle. Clark County's analysis assumes that when radiation is released and is confined to the vehicle, it will be detected at a routine stop instead of "in transit." Clark County's analysis differentiates between two types of delay. The first is incident delay in which the delay associated with specific incidents or a specific type of incident can be assessed. The second type of delay, system delay, is the impact a major incident will have on the function of a regional transportation system. Delay impacts occur when drivers are stuck in traffic immediately behind an incident waiting for it to clear. This section measures the traffic delay costs due to design incidents. The purpose is to establish an upper boundary on the impacts due to delay.

Construction Phase Incident Delay

During the construction phase of the Yucca Mountain Project, various rail and/or heavy-haul routes will be constructed. Accidents that occur during this construction will cause traffic delays. The upper bound of the expenses are calculated for each of the various implementing alternatives the DOE proposes to construct through Clark County. The DEIS anticipates the need for up to 1,800 new jobs.

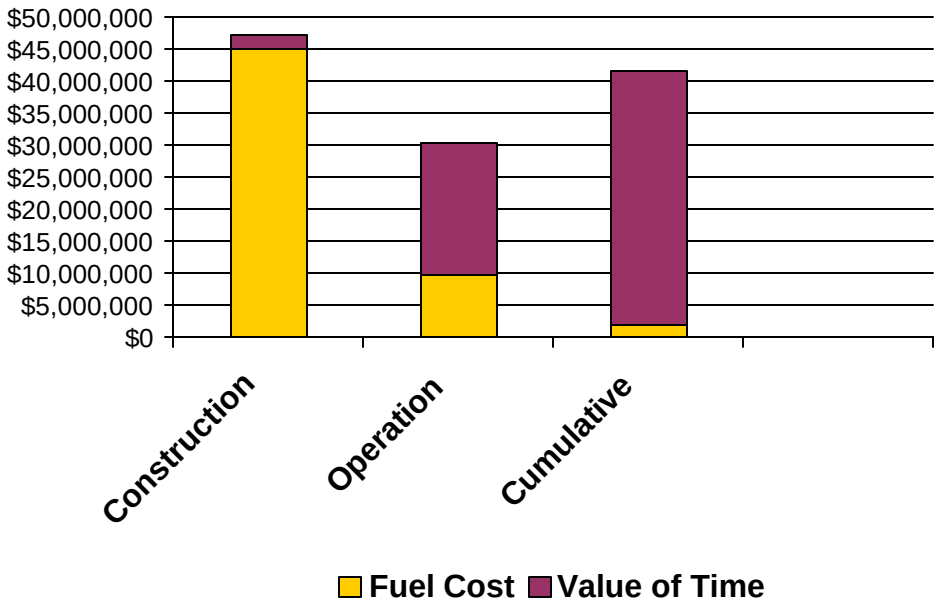
Summary of Incident Delay Impacts

The upper boundary of the delay costs to the residents of Clark County due to traffic delays caused by the Yucca Mountain Project and the disposal of low level waste at the NTS are shown below:

Travel time variability

When travelers are diverted from routes due to accidents and incidents, it reduces the reliability of that route system. For example, travelers to time sensitive events such as meetings or airplane flights may choose a more circuitous route that has a reliable travel time over a more direct or faster route that is less reliable.

Figure 27 Incident Delay Costs to Clark County Residents



Transportation Planning Impacts

The absence of a coherent plan to transport the high level radioactive nuclear waste is a significant impact that is already affecting Clark County. Without definitive knowledge of the DOE's transportation plan, Clark County decision-makers cannot engage in planning practices that will minimize harm in the event of an incident. It is difficult to anticipate, for example, appropriate land uses along possible routes. It is also difficult to plan in advance for emergency evacuation routes and strategic locations for emergency services. This plan should be prepared in accordance with the Statewide Planning/Metropolitan Planning regulation issued by FHWA on Oct 28, 1993. These statutes require a continuing, comprehensive, and coordinated transportation planning process for the metropolitan areas and states. The plan should recognize - as does the Nuclear Regulatory Commission - that Clark County is within the Area of Influence of Yucca Mountain and that its transportation network must be considered in this report.

The plan ultimately produced by the DOE must describe how the following items will affect Clark County's transportation system and how the DOE will provide the following:

- Evacuation Planning Zone Maps
- Logistical Support for shipping operations
- Recovery Operations
- Institutional Commitments
- Incident Management System
- Incident Command system
- Truck and rail (identify) routes by volume, mode, waste type, time of day and date
- Impacts (assessment) caused by the unique configuration of the rail classification yards northeast of Las Vegas to facilitate rail movement
- Hazards (mitigation) along the routes
- Equitable dispersion of radiological risks nationally

Serious land use and transportation planning considerations exist within potential routes. For instance, the following land uses within one-half mile of high level radioactive waste routes would be affected by daily anticipated truck trips along Clark County's highways:

- 37 schools
- 2 major health facilities
- 1 special event center

- 23 hotels

It should be noted that the population sectors such as children and seniors would be most directly affected. As noted in Chapter 4, Section 4.5, public safety and preparedness for potential accidents are primary concerns.

Construction Phase Land Use Impacts

The construction of various routes through Clark County will impose a burden on Clark County's public facilities. The workers and their families will require public services and Clark County will have to pay for these services. Standard impact fee assessment methods were used to determine the following impacts for various categories of public facilities (Figure 28).

Figure 28 Summary of Public Facility Costs

Alternative Public Facility	Jean Rail Corridor	Valley Siding Rail	Apex-Dry Lake Heavy Haul	Caliente Heavy-Haul	Apex Heavy Haul
Parks	$806,380	$368,130	$613,550	$911,560	$262,950
Fire Station	$150,000	$75,000	$50,000	$175,000	$50,000
Police Station	$62,000	$31,000	$31,000	$62,000	$31,000
Traffic Signal	$27,360	$12,730	$20,520	$30,780	$8,740
Elementary School	$4,900,000	$2,300,000	$3,600,000	$5,500,000	$1,600,000
Middle School	$2,200,000	$1,600,000	$1,800,000	$2,600,000	$800,000
High School	$3,200,000	$2,400,000	$2,400,000	$3,600,000	$1,200,000

Construction, Operation, and Cumulative Phase Monitoring Impacts

The transportation of high level radioactive nuclear waste through Clark County will require the county to embark on an extensive program to monitor the impacts the program will have on the transportation system and the community. These costs will vary with the program phase. During the construction phase of the proposed high level radioactive nuclear waste repository, a minimum requirement of two additional staff members will be needed to monitor the transportation aspects of the DOE's program. Additionally, a modest consulting budget is required in order to engage unique, outside technical expertise.

In the operation phase of the repository, staff would be required to monitor compliance with state and federal laws, and guidelines. These costs will be incurred throughout the lifetime of the program. Transportation impacts to Clark County are indeed significant, even considering the limited information provided in the DEIS and SDEIS. Clark County officials would have been better able to estimate and evaluate potential impacts had the DOE completed a transportation plan prior to site recommendation.

4.4 Impacts Due to Yucca Mountain Operations

Sec.116 (b)(B)(ii) of the NWPAA states in part that the Secretary shall make funds available to the Affected Units of Local Government "to develop a request for impact assistance under paragraph (2). Section (B) of paragraph 2 defines the areas of concern for the impacts as "economic, social, public health and safety, and environmental impacts."

The following is a summary of Clark County's concerns related to the construction, operation and closure of the Yucca Mountain repository. Absent a final repository design and FEIS, it is impossible to fully identify all possible impacts in this regard. Clark County's concerns in this area relate to quality assurance, work force health and safety, impacts to species, and air quality impacts.

The construction, operation and eventual closure of a repository could have severe economic consequences on Clark County. The most severe and immediate impacts would likely be due to transportation, either routine or with possible and likely accidents.

Beyond transportation, there are however, construction and operational issues that could also have extremely negative economic effects on the County. Even though the actual operation of the proposed repository will occur in Nye County, the effects of stigma and perceived risk are not that easily separated, and thus must be recognized.

Accidents, whether serious or not, will be portrayed by the press as occurring "in the vicinity of, or near Las Vegas." Considering the known effects of stigma and perceived risk, these accidents may as well occur in downtown Las Vegas. Survey results contained in *Clark County Visitor Survey Report* (UER, 2002) clearly demonstrate the tourists' perception regarding perceived risks.

Quality Assurance Concerns

The Yucca Mountain program has a long history of quality assurance problems, problems that in the past have been a consistent inability to follow their own procedures, and lately (May 17, 2001 letter W. Reamer to S. Brocoum) have included computational errors in critical site suitability documents (*Total System Performance Assessment for Site Recommendation*). In addition to these failures there are also Corrective Action Reports issued that deal with model validation and the control of software. The effects of these have not been fully evaluated.

Inability to follow quality control procedures during site characterization can, and has led to the collection of data that either has to be qualified or that cannot be used at all. Inability to follow quality assurance procedures during the loading and sealing of casks with high level radioactive nuclear waste can lead to immediate loss of life, exposure to elevated levels of radiation, or premature and unanticipated failure of disposal casks. The premature failure of disposal casks will most likely not have immediate effects on Clark County, as even a worst case failure would most likely not occur for hundreds of years. An accident involving the release of radiation or the exposure of individuals to levels of radiation beyond that allowed for in regulations could have severe and negative impacts on Clark County. Here again, the role of the media and the effects of stigma and perceived risk become critical elements in evaluating impacts to Clark County from site operations.

For additional details on discrepancies in the areas of mathematical computations, modeling and quality assurance see the following OCRWM-02-D-016, OQA-01-D-146, OQA-01-D-147, BSC-02-D-008, BSC-01-D-142, LVMO-98-D-038, LVMO-00-D-119, LVMO-00-D-118, LVMO-00-D-007, LVMO-00-D-028, BSC-01-D-050, BSC-01-D-051, BSL-01-C-002, BSC-01-D-078, BSC-01-D-088, BSC-01-C-001, BSC-01-D-063, and BSC-01-D-078 (Appendix G).

All of these discrepancies and incomplete studies amount to an unacceptable level of uncertainty as to the suitability of Yucca Mountain as a high level radioactive nuclear waste repository.

Clark County Workforce Impacts

Negative health impacts on the workers involved with the proposed repository at Yucca Mountain are expected to be much more extensive than the DEIS indicated. With the issuance of the SDEIS and the large proposed fuel blending facility, it is clear that work force exposure during normal operations will increase. It is not possible to fully define this increase as neither the DEIS nor the SDEIS contains a detailed description of the processes involved. Without this information it is impossible to realistically analyze health impacts to the workforce.

The likely employment during the lifecycle of the facility is expected to reach 1,800 persons. Approximately 90% of these workers will, based on historical trends, live in Clark County.

The handling of highly radioactive nuclear waste in the pool storage building will create additional opportunities for accidents. Releases of radioactive materials from accidents may or

may not be contained in the pool storage and blending area. The mixing of spent nuclear fuel assemblies of different sizes and different radiological characteristics from different fuel batches and/or reactors will create numerous opportunities for errors (e.g. insertion of incorrect assembly in disposal canister, insertion of assembly in incorrect disposal canister cell, etc). Deliberate sabotage also becomes easier and more likely with the additional step of fuel handling. Cleanup after accidents will likely increase worker exposures and generate additional health problems.

Impacts to Species

The DOE's assessment of impacts to species in the DEIS is incomplete (see Appendix C). Clark County recently completed a *Multi-Species Habitat Conservation Plan and Environmental Impact Statement* that covers over 80 threatened or endangered species. Further, the county has achieved compliance with the Federal Endangered Species Act. Specifically, Clark County has been able to achieve and maintain a Federal Section 10A Permit as required under the Act. The DOE's activities related to construction, operation, monitoring and closure of a repository could severely compromise Clark County's ability to retain this permit. Loss of this permit, which allows ongoing development and construction activity in Clark County, would severely impact Southern Nevada's economic stability.

Specific concerns about the DOE's proposals in the DEIS and SDEIS are outlined below. These issues are of concern to Clark County because it is engaged in supporting significant conservation actions in areas adjacent to and in the regional vicinity of the repository. For example:

- The regional and range-wide implications of the loss of the unique desert tortoise (*Gopherus agassizii*) populations and the genetic potential of these populations at the northern extremes of this species range, particularly with respect to the implications of increased traffic and habitat disturbance due to construction and operation activities have not been fully considered by the DOE.
- Range-wide implications exist due to increases in raven populations and their increased levels of predation on unique desert tortoise (*Gopherus agassizii*) populations at the northern extremes of this species range due to this activity.
- Discharge of radioactive and toxic effluent would pose a more significant threat than is currently being considered.

- When considering rail corridor routes, particularly in the area of Jean, Nevada, the DOE does not recognize that this corridor would pass through or near the Clark County Desert Tortoise Large-Scale Translocation Study Site (LSTSS) west of Jean. Clark County has invested significant resources in establishing this site and funding studies to investigate the efficacy of translocating displaced desert tortoises. Currently more than 2,000 displaced desert tortoises have been successfully translocated to this site and many more will be translocated over the coming several years. This site is crucial to desert tortoise conservation and management in Clark County. Clark County residents have overwhelmingly supported desert tortoise conservation actions because, in part, displaced tortoises have been humanely provided a wild home at the LSTSS. Threats to the integrity of the LSTSS would jeopardize public support for tortoise conservation efforts.
- The contribution of truck traffic related to this activity and its impact on desert tortoise populations is lacking a consideration of noise and low frequency vibrations.

Air Quality Impacts

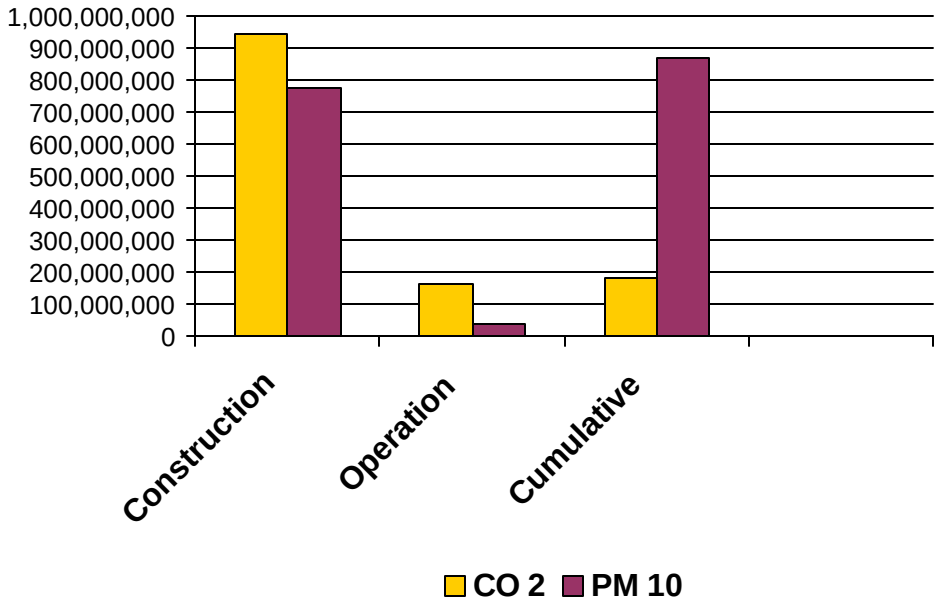
The EPA issued transportation conformity regulations on November 24, 1993 to implement Section 176(c) (4) of the Clean Air Act as amended. The transportation conformity regulations apply to actions of the FHWA and Federal Transit Administration. Actions of other federal agencies, including other transportation agencies are covered by the general conformity regulations issued by the U.S. Environmental Protection Agency (EPA) on November 30, 1993. The DOE is covered by these general conformity regulations.

The Las Vegas valley is classified by the EPA as a serious non-attainment area for carbon monoxide (CO) and particulate matter (PM_{10}). The Clark County Regional Transportation Commission is responsible for establishing CO and PM_{10} emissions and for demonstrating conformity. Because Clark County is in non-attainment for air quality emissions, the pollutants to be generated by the proposed Yucca Mountain repository project are of concern. The DEIS translated some of the air quality impacts into an estimate of the fatalities caused by the pollutants. However, air quality impacts are important to Clark County for regulatory purposes that are not considered in the DEIS. The construction and operation of Yucca Mountain Project transportation facilities impacts the ability of Clark County to meet national air quality standards. Failure to meet these standards will harm Clark County's ability to obtain federal funding for transportation facilities and will generally harm the quality of life in Clark County.

Vehicular emissions are the primary source of CO pollutants, whereas construction activities are the primary source of dust (PM_{10}) in the Las Vegas valley. In addition to vehicle miles of travel, traffic congestion is a significant contributor to increased CO emissions.

The upper boundary of the air quality impacts on the residents of Clark County due to air quality pollution caused by the Yucca Mountain Project and the disposal of low level waste at the Nevada Test Site are shown in Figure 29:

Figure 29 Grams of Air Pollutants Released in Clark County During the Yucca Mountain Project



Proposed Yucca Mountain Project activities will substantially degrade Clark County's air quality. Clark County air quality goals would therefore be difficult to achieve and could cause other federal agencies to take punitive action on Clark County due to violations caused by the actions of the DOE over which Clark County would have no authority.

4.5 Public Safety Impacts

The following fiscal impacts reflect an integrated view of impacts to public safety agencies in Southern Nevada. The agencies represented include Las Vegas Metropolitan Police Department (LVMPD), Clark County Fire Department, Clark County Office of Emergency Management, Clark County Health District, Las Vegas Fire Department, Las Vegas Office of Emergency Management, North Las Vegas Police, North Las Vegas Fire Department, Henderson Police Department, Henderson Fire Department, Henderson Office of Emergency Management, Mesquite Police Department, Mesquite Fire Department, Boulder City Police Department, Boulder City Fire Department, Moapa Fire Department, and Moapa Office of Emergency Management, and seven major Southern Nevada hospitals.

These impacts are more fully addressed by UER in the individual agency reports as well as its report entitled *Impacts to Clark County and Local Governmental Public Safety Agencies Resulting From the Yucca Mountain Project* (UER, 2001).

The integrated impact study does not attempt to estimate the total costs to public safety agencies within Clark County government and its local jurisdictions from the Department of Energy's shipping of high level radioactive nuclear waste. Rather, only the incremental or additional costs to governmental entities that would be directly attributable to the siting of the repository at Yucca Mountain and the subsequent shipping campaign are projected. This fiscal impact study of public safety agencies uses a case study approach that provides each county and local government public safety personnel with the three transportation scenarios described in Chapter 3. Public safety personnel were asked to describe how the events would impact their agency. Public safety personnel were then asked to compile a list of resources, training, personnel, equipment, and capital outlays necessary for them to be able to ensure the public health, safety, and welfare and to carry out their agency's mission for each of the three scenarios.

The integrated impact study demonstrates major negative impacts on the public safety agencies within Clark County and its local jurisdictions. Potential vulnerabilities to these agencies and the hospitals in Southern Nevada as well as the fiscal impacts to the public safety agencies have been evaluated. Because of the length of time between now and when shipments may actually begin, the ambiguities surrounding the actual shipment routes and the modal mix, the estimated fiscal projections are tentative. The potential fiscal impacts and vulnerabilities to Clark

County public safety agencies alone, just to the year 2007 when the shipping is proposed to begin, include over $67.6 million for police services, over $195.8 million for fire services, and over $10.6 million for emergency management.

Despite the high degree of professionalism and organization, none of the public safety agencies are currently adequately prepared, trained, or equipped to respond to any of the three high level radioactive nuclear waste shipping scenarios used in the study. This finding is consistent with the 1995 Public Safety Advisory Committee's report that examined public safety needs in Clark County.

The current County Emergency Operations Center that would be the focal point of the County's response to an incident involving high level radioactive nuclear waste is only adequate for a very short duration event.

Southern Nevada hospitals are not adequately equipped, nor are personnel properly trained to effectively manage a high level radioactive nuclear waste incident like that contained in Scenario 3. The hospital system is already strained under current needs, and the projected hospital needs for the area are daunting. This system will not be adequate to handle the events described in the scenarios in this study.

The total projected cost to just the public safety agencies examined in this study to be adequately prepared for a Scenario 3 event is $359,986,630.

This $359,986,630 projected fiscal cost for public safety agencies includes $274.1 million for Clark County; $45.1 million for the City of Las Vegas; $23.3 million for North Las Vegas; $1.3 million for Henderson; almost $7.0 million for Mesquite; approximately $400,000 for Boulder City; and $8.5 million for the Moapa Band of Paiutes. The estimate for Clark County includes all of the fiscal impacts estimated for the LVMPD have been attributed to the County. However, it should be observed that LVMPD annual operating and capital costs are shared between Clark County and the City of Las Vegas.

The largest projected costs to these public safety agencies fall under the categories of facilities, equipment, personnel, and training. For police services, the projected fiscal cost is over $72.5 million for the communities examined in this study. The Fire Departments' projected fiscal costs total over $275.3 million, and the Offices of Emergency Management fiscal cost projections total over $12 million. These cost projections are for the agencies to be prepared for a Scenario 3 incident beginning in 2010. The projections do not include costs that will be recurring such as vehicle and equipment replacement costs or the dollar costs of training new employees after 2007.

Hence, the fiscal cost projections in the report will tend to underestimate (are conservative) some of the fiscal impacts to the public safety agencies.

Additional Haz/Mat Radiological personnel, training, and equipment are viewed as critical needs among the public safety agencies. The hospitals lack sufficient decontamination facilities, equipment, and trained personnel.

Current planning activities are progressing, regional public safety organizations are beginning to grapple with the problems posed by high level radioactive nuclear waste shipments, and a Southern Nevada hospital system approach is developing with the help of the Clark County Health District. There is a critical need for a strong regional effort to ensure that the County, the municipalities, and the Moapa Band of Paiutes are prepared for high level radioactive nuclear waste shipments. Additional resources for the hospitals and the Health District are not projected in this study, only their training and equipment needs.

Figures 30 through 33 below list additional anticipated public safety costs resulting from the repository. These costs reflect combined estimated personnel, training, and equipment costs for police, fire and emergency management for the Southern Nevada jurisdictions covered by this analysis.

Figure 30 Total Projected Costs by Community/County

	Police	Fire	Emergency Management	Cost
Clark County	$67,686,369	$195,896,055	$10,614,385	$274,196,809
Las Vegas	*	$44,596,793	$561,265	$45,158,058
North Las Vegas	$711,021	$22,421,402	$207,623	$23,340,046
Henderson	$952,427	$285,933	$148,569	$1,386,929
Mesquite	$2,828,960	$4,151,451	***	$6,980,411
Boulder City	$404,880	**	**	$404,880
Moapa	N/A	$8,038,644	$480,853	$8,519,497
Totals	$72,583,657	$275,390,278	$12,012,695	$359,986,630

* Las Vegas Metro provides services to both Clark County and the City of Las Vegas
** Because of the projected distance to the high level radioactive nuclear waste shipment corridor, Boulder City estimated impacts only for the Police Department.
*** In Mesquite, Emergency Management is a function of the Fire Department and thus costs are combined under Fire.

Figure 31 Projected Fiscal Impact Costs on Metro Police Department

	Personnel	Training	Equipment	Cost
Clark County	$17,582,464	$8,080,604	$42,023,301**	$67,686,369
Las Vegas	*	*	*	*
North Las Vegas	0	$711,021	0	$711,021
Henderson	$510,195	0	$442,232	$952,427
Mesquite	$1,876,446	$34,754	$917,760	$2,828,960
Boulder City	$186,000	$18,880	$200,000	$404,880
Moapa	0	0	0	0
Totals	$20,155,105	$8,845,259	$43,583,293	$72,583,657

*Las Vegas Metro Police Department provides services to both Clark County and the City of Las Vegas
** Equipment includes capital costs

Figure 32 Projected Fiscal Impact Costs on Fire Department

	Personnel	Training	Equipment	Cost
Clark County	$25,991,241	$13,615,031	$156,289,783**	$195,896,055
Las Vegas	$5,711,370	$4,044,588	$34,840,835	$44,596,793
North Las Vegas	$3,851,129	$5,121,073	$13,449,200	$22,421,402
Henderson	$140,592	$70,296	$75,045	$285,933
Mesquite	$1,874,429	$333,133	$1,943,889	$4,151,451
Boulder City	0	0	0	0
Moapa	$1,791,292	$94,584	$6,152,768	$8,038,644
Totals	$39,360,053	$23,278,705	$212,751,520	$275,390,278

** Equipment includes capital costs

Figure 33 Projected Fiscal Impact Costs on Offices of Emergency Management

	Personnel	Training	Equipment	Cost
Clark County	$340,340	$9,552	$10,264,493**	$10,614,385
Las Vegas	$561,265	0	0	$561,265
North Las Vegas	0	$207,623	0	$207,623
Henderson	$61,463	$13,401	$73,705	$148,569
Mesquite	0	0	0	0
Boulder City	0	0	0	0
Moapa	$203,353	0	$277,500	$480,853
Totals	$1,166,421	$230,576	$10,615,698	$12,012,695

** Equipment includes capital costs

The health and safety of Clark County residents and visitors are of paramount concern to local elected officials. The analysis contained in this report is conservative and realistic, having been based on the experience and knowledge of public safety professionals. This analysis should be carefully considered by those who are a part of the decision-making process for Yucca Mountain, as it is an integral component to the implementation of the Yucca Mountain Project.

4.6 Non-Public Safety Governmental Impacts

The following Clark County non-public safety governmental departments provided the projections contained in this subchapter: Administrative Services, Assessor, Aviation, Building Department, Business License, Comprehensive Planning, County Clerk, District Attorney, Finance, General Services, Health District, Parks and Recreation, Public Communications, Public Works, Recorder's Office, Social Services, and Treasurer's Office.

In addition, information was provided by the following agencies: Regional Flood Control District, Regional Transportation Commission, Clark County Sanitation District, and Clark County School District. Although these agencies are separate from general Clark County government, it is important to demonstrate the interdependent nature among them. Further, it is important to understand the combined impacts to Clark County as a region.

This study provides a first estimation of the range and magnitude of potential impacts to Clark County non-public safety governmental agencies as a result of the DOE's proposal and compliments an earlier study of potential impacts to the public safety agencies within Clark County and its incorporated jurisdictions, summarized in Chapter 4.5.

This study does not attempt to estimate the total costs to the Clark County government from the DOE's shipping of high level radioactive nuclear waste, but only the incremental or additional costs to governmental entities that would be directly attributable to the siting of the proposed repository at Yucca Mountain and the subsequent shipping campaign. The analysis for this set of impacts used the same case study approach as Clark County's public safety agencies and is similar to the methodology used by the State of Nevada over the last decade to identify impacts to governmental agencies. County agency personnel were presented with the three transportation scenarios described in Chapter 3, and were asked to describe how each of the events would influence their agency. County personnel then provided a first estimation of the additional

resources, training, personnel, equipment, and capital outlays that would be required by their agency to carry out their responsibilities under each of the three scenarios.

The results of the study indicate significant negative impacts on many of Clark County governmental agencies. The potential vulnerabilities, as well as a first estimation of the likely fiscal impacts to these agencies, are described in the report entitled *Non-Public Safety Governmental and Fiscal Impact Report* (UER, 2001). Because of the length of time between now and when shipments may actually begin, the ambiguities surrounding the actual shipment routes, and the modal mix, the results are very tentative.

The potential fiscal impacts to these non-public safety governmental agencies in order to prepare for the commencement of the high level radioactive waste shipments to Yucca Mountain (adjusted to the year 2007 as reflected in the DEIS) are likely to reach almost $40 million. These include almost $6.3 million in additional personnel costs; almost $20 million in expenditures for radiation health and safety, approximately $13 million in equipment and capital expenditures, as well as communication training, changes to various County planning documents, and public outreach.

Over the proposed 24-year duration of the shipment campaign, the cost for personnel would reach $229 million, while the cost for training, plan development and public outreach would reach almost $123 million. Other capital and equipment costs were only estimated through the commencement of the proposed program in 2007 since projecting the diverse nature of these costs were beyond the scope of this report.

In addition, these estimates are quite conservative. Although most agencies indicated that they would likely experience adverse fiscal impacts on their personnel costs in order to prepare for the proposed repository and its related high level radioactive nuclear waste shipment campaign, only eight agencies were able to quantify the potential fiscal impacts to their agencies. Many of the agencies identified additional studies required to forecast the impacts to their agencies.

If a Scenario 2 type of high level radioactive nuclear waste incident were to occur, many of the agencies indicated that they would experience additional impacts. However, only three of the agencies felt that they could quantify these impacts based on the available information. According to the estimates provided by these three agencies, a Scenario 2 event would result in another $1 million in expenditures, primarily for overtime and some additional training. As studies are completed, agencies should be better able to more accurately and completely define vulnerabilities.

The potential magnitude of a Scenario 3 high level radioactive nuclear waste accident was the most troubling to those interviewed. The fiscal impacts within just a one-year period were estimated by twelve non-public safety agencies at almost $122 million. These include an additional $6 million in personnel costs; over $645 thousand in additional training costs; and almost $47 million in equipment and capital costs, a decline in revenues of $7 million and additional medical expenditures of $61.5 million. It should be noted that many of these costs would likely last for well over the year that has been estimated in this report.

Preparedness Impacts

Among the 21 agencies interviewed, only three indicated that they are unlikely to incur impacts as a result of needing to prepare for the DOE's proposed repository and its related shipment campaign. Among the eighteen other agencies, extensive lists of impacts were identified that were likely to occur as a result of their need to prepare for the high level radioactive nuclear waste shipment campaign. Approximately half of these agencies were able to identify at least to a limited extent, the magnitude of potential fiscal impacts to their agency. The nature of the impacts can be grouped into the following categories:

Personnel

Training, Planning, and Public Outreach

County Expenditures and Revenues

Public and Environmental Health

These costs are summarized in Figure 34 below

Figure 34 Summary Preparedness Costs for Non-Public Safety Agencies

AGENCY	PERSONNEL*	EQUIPMENT AND CAPITAL COSTS**	TRAINING AND PLANS*	FISCAL IMPACTS
Administrative Services			$184,481	$184,481
Aviation	$3,137,924	$9,849,703	$1,506,596	$14,494,223
Comprehensive Planning	$882,058		$2,248,560	$3,130,618
District Attorney	$139,406			$139,406
General Services	$143,896			$143,896
Health District	$383,721	$3,000,000	$1,048,083	$4,431,804
Parks and Recreation	$263,808	$112,568	$491,950	$868,326
Public Communications			$368,962	$368,962
Regional Transportation Commission*, **	$455,658		$12,500,000	$12,955,658
School District	$863,371		$1,430,763	$2,294,134
Social Services			$119,913	$119,913
TOTALS*, **	$6,269,842	$12,962,271	$19,899,308	$39,131,421
CUMULATIVE TOTALS 2007 - 2031	$228,593,827		$122,669,481	$351,263,108

***** Personnel, training, information development/distribution, and plan development costs are adjusted using a 3% inflation factor through 2007.

** Equipment, Facilities/Capital costs are adjusted using 5% inflation factor through 2007.

Personnel Impacts

Thirteen agencies indicated that they would experience personnel impacts merely to prepare for the DOE's proposed high level radioactive nuclear waste shipment campaign. Among the eight agencies that estimated the fiscal impacts in the area of personnel, the largest impact was estimated by the Department of Aviation.

- Department of Aviation would require 60 bus drivers and 40 buses to be maintained for evacuation purposes if the DOE proceeds with the high level radioactive waste shipments. The airport's current evacuation plan calls for the use of public buses and school buses and that if a nuclear waste incident were to occur, it would be unlikely that these buses would be available, since the School District would need to prioritize transporting students instead of airport passengers and staff. The personnel costs associated with hiring these drivers would be over $3.1 million.

- Department of Comprehensive Planning would require over $880,000 to maintain program oversight staff through the Yucca Mountain licensing phase. This includes the addition of a regulatory analyst and a geographic information systems technician.
- Department of Parks and Recreation would require four additional police officers and an information management specialist.
- General Services would require additional staff to process contracts and manage purchase and lease agreements from other County agencies affected by the high level radioactive nuclear waste shipment campaign.
- District Attorney's Office needs to provide support for the increased litigation that is expected, particularly along the northern Beltway if that route is selected for the high level radioactive nuclear waste shipment campaign.
- Regional Transportation Commission identified the need for a transportation modeler, engineer, and planner as well as support staff if the DOE proceeds.
- The Clark County School District would require over $860,000 to implement their policy of "shelter in place," if the DOE proceeds with the high level radioactive waste shipments.
- The Clark County Health District would require an additional four staff to conduct the extensive education and public information program that will be needed to inform Clark County residents about the nature and risk associated with high level radioactive nuclear waste shipments.

County departments such as the Assessors Office, the Clerk's Office, Finance, and the Recorder, all indicated that they would also have personnel impacts that would require further study to quantify the magnitude of these impacts.

Among those agencies who did make a first estimation of impacts, the personnel requirements to prepare for the commencement of the program was almost $6.27 million. When these personnel costs are forecast out over the 24 year life cycle of the shipment campaign described in the DEIS, the fiscal cost to Clark County reaches almost $229 million.

Preparedness: Training, Planning, and Public Outreach Impacts

The largest category of fiscal impact for the non-public safety agencies is in the area of training and plan development. The Regional Transportation Commission indicated that they will need upwards of $12.5 million to conduct impact analysis of the alterative routes, as well as to conduct impact studies including pavement, air quality, and land use studies once the DOE has

selected the transportation routes they would use for the high level radioactive nuclear waste shipments.

The Department of Comprehensive Planning will likely need upwards of $2.25 million a year through the site characterization phase in order to perform oversight studies and detailed fiscal impact analysis, develop a monitoring program, and carry out regulatory and policy analysis. If the DOE proceeds with its shipment campaign, Clark County will need to continue to provide monitoring of key indicators in order to identify impacts and to provide policy support as the proposed Yucca Mountain Project evolves. The Department of Comprehensive Planning, as well as the Assessor's Office, Department of Parks and Recreation, Department of Social Services and the School District all commented on the impacts the high level radioactive nuclear waste shipment campaign will have on the planning process. They all noted that current planning activities are largely driven by accessibility. Thus, facilities such as hospitals, intermediate care facilities, child and adult daycare, schools, parks, and other recreational facilities are located in areas that are easily accessible to highways. If the high level radioactive nuclear waste shipment campaign proceeds, the County will likely have to reassess its entire approach to planning to incorporate the additional risk factors associated with high level radioactive nuclear waste transport.

The Department of Aviation noted that they would need to make additions to their emergency response plan and would require a detailed risk assessment in order to update their airport evacuation plan. The current evacuation plan calls for utilizing school buses to evacuate McCarran Airport. In the event of a high level radioactive waste accident, it is unlikely that the Clark County School District would make these busses available, needing instead to provide for the safe transport of their students. The costs for these studies were forecast at over $675,000. The Department of Aviation also noted "Rad 1" training will be needed for the approximately 300-security and traffic control personnel at the airport. This will result in additional costs of $830,000 per year throughout the duration of the shipment campaign.

The Department of Parks and Recreation identified the need to conduct detailed analysis of current and future park and recreation facilities to determine potential visitor impacts, as well as, evacuation and closure strategies. These studies were forecast to cost upwards of $490,000.

The Neighborhood Services Division within Administrative Services and Public Communications also noted the need for ongoing public outreach activities, including outreach through neighborhood groups, and other appropriate education and outreach activities in order to

address residents' concerns about the shipment campaign. The Public Communications staff also noted that all Clark County public information personnel would need risk communication training on an annual basis so that they would be prepared to communicate effectively with the public in case of a high level radioactive waste incident. The additional public information and risk communication costs were forecast at over $550,000 annually throughout the duration of the shipment campaign. These costs are in addition to the four personnel identified by the Health District as needed to provide information and education about the health risks associated with the shipment campaign.

The Clark County School District indicated that they would require approximately $1 million in order to conduct a study detailing the impacts to the school system and to their finances that will result if the DOE proceeds with the high level radioactive nuclear waste shipment campaign. In addition, they believe that training costs and annual training exercises will result in another $430,000 in expenses for the District. The Department of Social Services also indicated that their 65 social workers would also need "Rad 1" training at a cost of almost $120,000 per year.

Among the nine agencies that were able to provide first cut cost estimations for training, planning, and public outreach, the fiscal impacts just to prepare for commencement of the program is almost $20 million. Over the 24-year lifecycle of the shipment campaign discussed in the DEIS, these additional costs to Clark County will grow to almost $123 million.

Preparedness: Clark County Expenditures and Revenues

The Department of Aviation indicated that in order to develop an effective evacuation plan for the airport to respond to a high level radioactive nuclear waste accident event, if it occurred in proximity to the McCarran Airport, would require the acquisition of 40 buses at a cost of over $2.8 million. As noted previously, currently the Department is dependent on the Clark County School District to supply buses for an airport evacuation. This would not be a viable alternative in the event of a high level radioactive waste incident. The Department of Aviation also indicated that they would need 50 early warning monitoring instruments in order to protect the airport if the DOE proceeds with the high level radioactive nuclear waste shipment campaign along I-15 adjacent to the McCarran Airport. The cost for these monitors would be approximately $7 million.

The Department of Parks and Recreation noted that they would need 4 vehicles for the additional Parks Police that will be required at a cost of approximately $113,000.

The Health District indicated that they would need a computer system for environmental health inspection data and enhancements to the Emergency Management System communication system currently being deployed at costs of upwards of $3 million.

It was also noted that Clark County pays for additional services through the additional funds that are generated from growth in the local economy. Based on current growth rates, it was estimated that it would take 50 years for the County to be able to provide the additional $275 million identified in the *Review of Impacts to Clark County Public Safety Agencies Resulting from the Yucca Mountain Project* (UER, 2001).

It was further pointed out that the County would need to determine whether insurance rates would go up on County facilities and for employee health insurance because of the DOE's proposed high level radioactive nuclear waste shipment campaign. There could be an increase in residential property insurance rates that could make living in the County less attractive.

A direct link exists between revenues and the level of County services that can be provided. If the high level radioactive nuclear waste shipment campaign results in a reduction in revenues from property value diminution and stigma related reductions in visitor generated taxes, staffing levels would be reduced and the quality of County services would subsequently decline. The debt rating for the County could suffer, leading to an increase in the cost of capital.

Preparedness: Clark County Public and Environmental Health

In order to establish a baseline for monitoring radiation relaxed health impacts, the Health District might consider testing all school children. Air Quality State Implementation Plans may require adjustment in the future to account for air quality issues associated with the high level radioactive nuclear waste shipments.

Scenario 2: Additional Personnel Impacts

While many of the agencies interviewed indicated that they would experience personnel impacts from a Scenario 2 high level radioactive nuclear waste shipment event, only General Services and the Recorder's Office felt that they could provide a first cut estimation of the fiscal level of impacts (Figure 35). Under this scenario, General Services indicated that they would likely need another $50,000 to support temporary overtime costs related to contract management activities associated with an incident. The Recorder's Office indicated that they would likely experience a 10% increase in personnel costs during the period immediately following the incident as a result of the transference of property from County residents migrating from the area.

Scenario 2: Additional Training, Planning, and Public Outreach Impacts

The Public Communications office noted that there would need to be additional public outreach activities if a Scenario 2 high level radioactive nuclear waste shipment incident occurred. They estimated that the costs of such activities would be greater than $600,000 (Figure 35).

Figure 35 Summary of Scenario 2 Additional Needs, Vulnerabilities, and Impacts

AGENCY	PERSONNEL*	TRAINING AND PLANS*	FISCAL IMPACTS
General Services	$50,000		$50,000
Public Communications		$614,937	$614,937
Recorder	$284,984		$284,984
Social Services			
TOTALS*, **	$334,984	$614,937	$949,921

* Personnel, training, information development/distribution, and plan development costs are adjusted using a 3% inflation factor through 2007.
** Equipment, Facilities/Capital costs are adjusted using 5% inflation factor through 2007.

Based on the available data, Clark County agencies identified almost another $1 million in impacts above those costs associated with preparedness if a Scenario 2 type event occurred during the shipment campaign.

Scenario 3: Additional Personnel Impacts

If a Scenario 3 level event were to occur, virtually all of the County departments and agencies interviewed would experience adverse personnel impacts:

- The Business License Department indicated that they would require 15 additional auditors, 7 investigators, and support staff to handle the larger number of audits that would result as tourism downturns resulted in turnover in business ownership and the termination of business operations. Associated personnel costs for these activities could reach almost $1.7 million.
- The Department of General Services estimated that they would need another 18 staff to handle all of the purchasing and contract activities that would result from this type of event costing upwards of $1.3 million.
- The District Attorney's Office stated that a Scenario 3 event would significantly increase the level of litigation likely requiring three additional civil attorneys and one criminal attorney, as well as support staff. The cost for these services would run approximately $578,000 per year for two years.

- The Department of Administrative Services noted that they would likely need four analysts within the Center for Strategic Management to deal with policy related issues and 6 additional public outreach personnel to work with the plethora of community issues that would arise from an event of this type. The Administrative Services personnel costs associated with these activities could be $575,000 or more per year.

Similarly, other agencies including the Health District, the County Clerk, the Treasurer, the Recorder, the Department of Parks and Recreation, and Public Communications identified significant fiscal impacts on their personnel costs. In total, those agencies that were able to provide a first estimation of impacts forecast additional personnel costs of nearly $6 million above those previously identified related to preparedness.

Scenario 3: Additional Training, Planning, and Public Outreach Impacts

The Department of Administrative Services emphasized that if a Scenario 3 event were to occur, the magnitude and type of public outreach efforts that would be required would grow dramatically. While it is very difficult to estimate costs for an event of this type, the first cut estimation for only the Neighborhood Services needs were for an additional $370,000 above those costs identified for preparedness. As noted above, Public Communications also identified additional public outreach needs that they would address through the hiring of two additional staff.

Scenario 3: Clark County Expenditures and Revenues

The Department of Social Services estimated that their entire Medical Assistance budget would be exhausted in a few days if a Scenario 3 event occurred. It was noted that the demand for medical services to address both accident and stress related injuries would far exceed resources. This could result in expenditures in the period immediately following the accident of over $61.5 million. Further, it was noted only Social Services is authorized to write County checks without prior Board of Commissioner's authorization and thus, would likely be called on to make expenditures for other critical services. The County Clerk indicated that her office generates significant revenues from issuing marriage licenses and from deputy clerks solemnizing marriages. A great deal of this revenue is generated from tourists who come to Las Vegas to get married. If a Scenario 3 event were to occur, the number of tourists requesting marriage licenses will drop substantially. The County Clerk estimates that this could reduce revenues by almost $7 million a year. Figure 36 summarizes these impacts.

Figure 36 Summary of Scenario 3 Additional Needs, Vulnerabilities, and Impacts

AGENCY	PERSONNEL *	EQUIPMENT AND CAPITAL COSTS**	TRAINING AND PLANS*	REVENUE ***	RANGE OF FISCAL IMPACTS
Administrative Services	$575,580		$368,962		$944,542
Aviation			$276,722		$276,722
Business License	$1,678,778	$422,130			$2,100,908
County Clerk	$383,721			$6,946,328	$7,330,049
District Attorney	$578,041				$578,041
General Services	$1,295,057				$1,295,057
Health District	$503,633	$307,468			$811,101
Parks and Recreation	$191,860	$46,073,792			$46,265,652
Public Communications	$167,878				$167,878
Recorder	$284,984				$284,984
Social Services				$61,493,693	$61,493,693
Treasurer	$287,790				$287,790
TOTALS*, **	$5,947,322	$46,803,390	$645,684	$68,440,021	$121,836,417

* Personnel, training, information development/distribution, and plan development costs are adjusted using a 3% inflation factor through 2007.
** Equipment, Facilities/Capital costs are adjusted using 5% inflation factor through 2007.
*** Shown as a positive number to identify the total impacts to Clark County

This non-public safety impact analysis is, as noted, of a preliminary nature. As more is discovered about the DOE's final program proposal these figures would likely require modification.

5.0 Native American Concerns

To provide a complete understanding of impacts to all communities addressed in the Clark County Impact Assessment Report, the effects on Native American communities must be considered in ways that identify and reflect the range of impacts from a tribal perspective.

From a tribal perspective, the Yucca Mountain area holds special significance to the Native Americans most likely to be impacted by the project. The mountain itself is a very old border between the Western Shoshone and the Southern Paiute. Yucca Mountain is considered sacred, holy ground by the Western Shoshone, Southern Paiute, and Owens Valley tribes. This area is home to many traditional plant and animal species, rock art, and burial sites. Beyond the spiritual significance of Yucca Mountain, the Native Americans place historical and political significance to the area as well, especially with respect to the Treaty of Ruby Valley, established in 1863. Many legal and political battles have been fought over the issues stemming from this treaty over the years.

Federal guidelines CEQ define "adverse effects" for minority populations as follows:

> ". . . the totality of significant individual or cumulative human health or environmental effects, including interrelated social and economic effects, which may include, but are not limited to, bodily impairment; infirmity; illness or death; air, noise, and water pollution and soil contamination; destruction or diminution of aesthetic values; destruction or disruption of community cohesion or a community's economic vitality."

Considering this definition, then, it is not surprising that the DOE fails to recognize impacts to minority populations, including Native Americans.

Arguably, minority populations in Southern Nevada would be most negatively affected by transportation of high level radioactive nuclear waste. For example, both Native American communities located within Clark County, the Moapa Band of Southern Paiutes (the Moapa) and the Las Vegas Paiutes, are located adjacent to highway and rail routes for the transport of high level radioactive nuclear waste to Yucca Mountain. Beyond the potential for adverse socioeconomic consequences to the tribes due to the transportation of nuclear waste common to all communities, it is appropriate to consider impacts related to the cultural and spiritual aspects specific to Native Americans.

In the Las Vegas urbanized area, a large percentage of minority and low-income residents live near truck and rail transportation routes. It is estimated, therefore, that these communities

would also be further negatively influenced by decreases in property values, the defection of local banks and businesses, as well as being subject to a disincentive to invest in these communities. A negative effect on the economy could result in job losses, especially at entry-level and low-level positions, which would most quickly and severely affect low-income and minority individuals.

Clark County has, for several years, entered into interlocal agreements with both the Las Vegas and Moapa Paiute bands in order to facilitate program oversight, information sharing, and impact assessment. This has resulted in the opportunity for the affected Native American communities to participate in the impact assessment process. For example, Clark County's consultants, UER, helped the Moapa to prepare an extensive public safety report to assess their preparedness and response requirements (see Chapter 4, Subchapter 4.5). Negative impacts to Native American populations can also be derived from the property value report prepared by UER (see Chapter 4, Subchapter 4.2).

The assessment of impacts on the Moapa shows that shipments of nuclear waste through or near the Moapa Reservation will have adverse impacts on the tribe's culture and spiritual traditions as well as social well being. Some of these concerns focus on the possible loss of tribal farms which are not only important economically but also culturally as it represents renewed economic independence, a return to farming and a possible return of tribal members who have previously left the reservation. There is concern that because of the small population and earlier displacements, that a transportation accident near the community may result in permanent displacement from their traditional lands and restricting access to traditional areas for food gathering and other activities.

Because there is minimal public safety capacity on tribal lands today, basic capacity building to prepare for a possible accident will require major investments in equipment, facilities, planning, and training. In addition, the Moapa are dependent on revenues from their gaming center/store that is located along I-15. If the spent fuel shipments result in fewer customers, especially in the event of an accident, then the financial well being of the Moapa could be adversely impacted.

Further, documented evidence of past practice indicates that the DOE has had difficulty providing financial support through new jobs, highway funding, or the impacts caused by emergency conditions in related nuclear waste projects such as the WIPP site in New Mexico. Understandably, the Native American communities of Southern Nevada do not have much confidence their needs would be considered any differently.

6.0 Public Involvement and Outreach

Introduction

Clark County's Nuclear Waste Program began in earnest in 1988 after Clark County was designated as an Affected Unit of Local Government. The provision of public information and outreach are approved activities under the federal appropriation that funds the County's program.

Clark County can point to many examples of effective public involvement over the course of its Nuclear Waste Program. For example, in 1999 and 2000, the Nuclear Waste Division conducted an extensive outreach effort focused on the release of the DOE's DEIS and Clark County's response to the DEIS. Town advisory boards, citizens advisory councils, city councils, and community groups all had opportunities to receive information and to submit their comments for consideration by the DOE. As a matter of interest, Clark County has received no response from the DOE to any of the comments submitted on the DEIS.

In January 2001, Clark County launched a program known as "INFORM." This program was designed and implemented to establish and maintain an informative, proactive community relations effort directed to all residents of Clark County. Key objectives of the program included raising the level of knowledge and awareness of the proposed Yucca Mountain Project. Equally important has been the notion of providing a means for meaningful public involvement and opportunities to comment on not only various aspects of the DOE's program, but Clark County's efforts as well. Clark County officials recognized the need for public participation and actively sought to improve public involvement, as well as provide opportunities for residents to make their opinions known.

Based on a public perception analysis conducted at the beginning of the INFORM program, key issues were identified, and tactics were employed to establish a dialogue with the public, with emphasis on public participation.

The INFORM program presented timely and accurate information that was accomplished through a strategic plan, and tactics that included the following: informational presentations, public response mediums, mass media, and the mailing and distribution of fact sheets and other information.

Clark County's public outreach efforts have achieved the desired results. One key result is heightened awareness of Yucca Mountain issues and concerns (Appendix H). Another is the growing list of resolutions in opposition to the project (Appendix A).

Public Response

Public response was gathered in several ways, including testimony during County-sponsored public meetings, e-mail, hotline calls, and questionnaires available at public meetings. Additionally, two community-wide surveys were conducted. The complete results of these surveys are included in Appendix H.

Seventy-three percent of these overall responses reflect opposition to the proposed Yucca Mountain Project. Nine percent of the overall responses were in favor of the project, and the remaining 18% are undecided. Eighty-seven percent of Clark County's residents are extremely concerned about transporting high-level nuclear waste through the County. Approximately 92% indicated concern about emergency response in case of a nuclear waste transportation accident. Financial impact of a potential transportation accident is of extreme importance to 88.5% of respondents. A vast majority, 91%, rated potential exposure to radiation along the transportation route as "extremely important."

Seventy-one percent of the hotline responses accounted for those who oppose the project. Reasons for opposition included fears of transportation accidents, radiation leakage, health risks, safety and overall quality of life in Nevada for present and future generations.

Community Opinion Surveys

In December 2000 a research team from UNLV was used to obtain a random sample of public opinion by Clark County residents from the Las Vegas valley. The survey goals were to determine the level of awareness about the Yucca Mountain Project, determine the public's perception of Clark County's position on the Yucca Mountain Project, and obtain comments from the general public about the Yucca Mountain Project.

A total of 1,018 responses were obtained from the 2000 survey. In face-to-face interviews based on a standard set of questions, surveys were conducted in English, Spanish, and Mandarin Chinese. Nearly 80% of the respondents were aware of the Yucca Mountain Project. Most (632) want more information. While the majority of residents did not know what Clark County's position on Yucca Mountain Project is, most (606) wanted to know where Clark County Commissioners stand on this issue. More than half of the respondents consider the transportation of nuclear waste unsafe or very unsafe. Of those interviewed, 304, or approximately 30% of the

total offered comments. Opinions ranged from "Don't bring it here," to "It's good for the economy." A significant number expressed the need for more and better information. Several suggested nuclear waste be stored where it is currently generated. When given an opportunity to make a comment, opinions against the project outnumbered those in favor of it by 10 to 1. Approximately 100 responses were either neutral or not applicable in terms of a position about the Yucca Mountain Project.

The 2000 survey was a benchmark survey. In November 2001, another survey under identical conditions using a similar team of UNLV students, surveyed 1,018 residents in similar locations. Comparatively, public awareness about the Yucca Mountain Project rose 4% over the one-year period. Public concerns about transportation of high-level nuclear waste was down by 5%; however, the public's desire for additional information was up by 7% on transportation issues and 9% on Clark County's position. Public awareness of the County's position on the project rose by 8%. Both surveys indicated a clear desire for more and better information. For example, in the November 2001 survey, more than 55% asked for additional public information.

Responses from the 2001 survey were again varied. Of the 1,018 total respondents interviewed, 31% volunteered additional comments. Among those, only 5% (15 of 314 comments) were clearly in favor of the project, with the overwhelming majority against the project. Comments ranged from "Not in Nevada," to "OK if made safe." Many people requested additional information. There seems to be a perception that the Board of County Commissioners has the decision-making authority to allow or reject the Yucca Mountain Project. It is also clear from the results that the public is unsure about the County's role and responsibility in the Yucca Mountain Project.

Public comments obtained in the surveys are significant because they were taken randomly, rather than from individuals motivated to attend a public meeting and express a view for or against the project. A complete transcript of public comments received through both surveys as well as survey statistical summaries are included in Appendix H. Other feedback mechanisms should be conducted in 2002 to measure the INFORM program effectiveness.

Clark County will continue its outreach efforts to ensure public participation, and to disseminate information on the County's position roles and findings related to the proposed Yucca Mountain Project. Significantly, the impacts over which the public has continually expressed concern correspond to those focused on for many years by Clark County, and are addressed in this Impact Assessment Report.

7.0 Summary and Recommendations

7.1 Summary

Clark County, home of "The Entertainment Capital of the World," has enjoyed many years of economic growth. The continued economic vitality of the Southern Nevada region depends on an intricate balance of factors all coming together to achieve a strong sense of community and high quality of life for all residents. Any significant threat to that balance could topple the region's economy.

It is hoped that the decision makers who will act on the proposed high level radioactive nuclear waste repository at Yucca Mountain over the next several years will consider the following as outlined in the Impact Assessment Report:

Gaming Impacts

According to virtually every gaming industry representative interviewed for the County's gaming impacts study, the most serious risk is from the stigma that will result if there is any accident of any kind involving the shipment of high level radioactive nuclear waste. Transportation of high level radioactive nuclear waste along Clark County's roadways, even without a serious accident, could seriously compromise Clark County's tourism based economy.

Property Value Impacts

Stable property values are a necessary component for the stability of Clark County's tax structure. Any threat to a government entity's ability to rely on property taxes as a stable source of income impacts not only that entity's ability to operate, but has a "domino" effect on all aspects of what people expect and deserve in terms of community livability.

Depending on the transportation scenario applied, property value decreases directly resulting from transportation of nuclear waste through Clark County range from 2% to 30%, resulting in property value losses up to $1 billion. An additional economic analysis by UNLV estimates potential economic impacts over the course of the DOE's proposed shipping campaign to be in the billions of dollars.

Transportation Impacts

Transportation system impacts are defined as changes to the operation, condition, and performance of the County's transportation network. The DOE must address the direct, indirect,

and cumulative impacts of transporting waste through Clark County to Yucca Mountain. Several impacts addressed in this report dovetail from the issues surrounding the transportation of high level waste through Clark County.

Impacts Due to Yucca Mountain Operations

Although several impacts addressed in this report relate to transportation, impacts due to Yucca Mountain operations also pose significant risk. Absent a final repository design and the issuance of a FEIS, it is impossible to identify the full range of impacts. Concerns over quality assurance issues, workforce impacts, impacts to species, and air quality impacts are substantial.

Public Safety Impacts

This assessment of these impacts includes the incremental or additional costs to governmental entities that would be directly attributable to the proposed repository. Under Scenario 3, costs would likely approach $360 million. The majority of these costs are attributable to Clark County, with the largest portions designated for facilities, equipment, personnel, and training. Clark County's costs alone would be over $274 million.

Non-Public Safety Impacts

Most county departments and related agencies interviewed expressed concern over the magnitude of the impacts they each anticipate. These impacts, calculated in the millions of dollars for most agencies, are attributed to preparedness, personnel, equipment, planning, training, and public outreach.

Native American Concerns

While many of the concerns of Native Americans are similar to others potentially affected by the Yucca Mountain Project, it is important to recognize that Native American concerns must be considered in ways that identify and reflect the range of impacts from a tribal perspective.

7.2 Recommendations

The large number of unanswered questions, inadequacies, inaccuracies, and findings related to impacts call into question the appropriateness of Yucca Mountain as a suitable repository site. Therefore, the site should be disqualified in compliance with the NWPAA. However, in light of the Secretary of Energy's intent to move forward with a positive site recommendation, Clark County recommends the DOE do the following:

- Complete an EIS process which ensures compliance with NEPA and other federal regulations, and which is based on a final repository design. This could include withdrawal

of the current DEIS and SDEIS, and a new EIS process which includes the preparation of an FEIS with full hearings prior to further action by the U. S. Secretary of Energy.

- Conduct a national transportation study and develop a plan to address concerns of all affected jurisdictions nationwide. This plan should ensure coordination of roles and responsibilities among government entities, and sufficiently address public safety issues such as radiation exposure and terrorism.
- Acknowledge the nature and extent of the impacts to all local, state, and tribal governments nationwide before making a final decision to approve a high level radioactive nuclear waste repository at Yucca Mountain.

Acknowledgements

This report was written and produced by the staff of the Nuclear Waste Division of the Comprehensive Planning Department, at the direction of the Board of County Commissioners:

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The Board of County Commissioners is especially grateful to all those individuals who contributed their time and knowledge to this program, including: Dennis A. Bechtel, former Clark County Nuclear Waste Division Planning Manager, for his dedication to Clark County and nuclear waste issues over the past 18 years, former Senator Richard H. Bryan, for his unique insights concerning Yucca Mountain issues, and Stephen Cloobeck, the leader of the SAVENEVADA effort, in assisting with the *Gaming Industry Revenue Impacts Resulting from the DOE's Yucca Mountain Project* and in working with Clark County to achieve its public outreach objectives.

Appendices

Appendix A	Resolutions in Opposition to Yucca Mountain by Groups Other Than Clark County, Nevada
Appendix B	Clark County, Nevada's Resolutions in Opposition to Yucca Mountain
Appendix C	Clark County, Nevada's Comments to U.S. Department of Energy's Draft Environmental Impact Statement (DEIS), Formal Response to Supplemental Draft Environmental Impact Statement (SDEIS), and Formal Response to Preliminary Site Suitability Evaluation (PSSE)
Appendix D	University of Nevada, Las Vegas, The Center for Business and Economic Research Report (December 26, 2001): *Regional Economic Model, Inc. (REMI) Analysis Utilizing Urban Environmental Research, L.L.C. (UER) Property Losses to Determine Economic Impacts on Clark County's Scenarios*
Appendix E	Maps and Descriptions of Transportation Scenarios 1, 2 and 3
Appendix F	G. Roger Gathers, M. H. Chew & Associates Report (July 16, 2001 Revision A): *Calculations with RISKIND for Rail Transport of Spent Nuclear Fuel Casks Via Las Vegas, Nevada*
Appendix G	U.S. Department of Energy Deficiency/Corrective Action Reports
Appendix H	Public Involvement, Outreach and Comments
Appendix I	References

Appendix A – Resolutions in Opposition to Yucca Mountain by Groups other than Clark County, Nevada

Appendix A

RESOLUTION OF
THE SOUTHERN NEVADA REGIONAL PLANNING COALITION
TO COORDINATE STRATEGIES ON YUCCA MOUNTAIN

This Resolution is made and entered into this 22nd day of March 2001 by the Southern Nevada Regional Planning Coalition (SNRPC).

WITNESSETH:

WHEREAS, the Department of Energy (DOE) is evaluating Yucca Mountain in Nye County as a potential site for the permanent storage of 70,000 metric tons of commercial spent nuclear fuel and high-level radioactive defense waste; and

WHEREAS, the opening of a repository at Yucca Mountain could result in as many as 70-90,000 shipments of nuclear waste to Yucca Mountain, mostly through Southern Nevada, over a twenty four year shipping campaign; and

WHEREAS, the Department of Energy (DOE) prepared a draft Environmental Impact Statement (EIS) which will accompany the Secretary of Energy's decision on the potential recommendation of Yucca Mountain to the President later this year; and,

WHEREAS, the draft EIS lists the planned western and northern "Beltways," and Interstate 15 and U.S. Route 95 through the "Spaghetti bowl," all in the Las Vegas Valley, as potential truck routes for the transport of nuclear waste to Yucca Mountain; and

WHEREAS, the draft EIS also lists the Union Pacific Railroad, which traverses urbanized metropolitan Las Vegas, as a potential rail option for the shipment of waste; and

WHEREAS, recent Clark County studies and information, including legal case law from other communities, provide compelling evidence that such shipments could result in negative effects to the health and safety of residents, and impacts to property values, Las Vegas' tourist-based economy and cost of government services; and

WHEREAS, Southern Nevada continues to be one of the nation's fastest growing region and is experiencing significant construction and traffic congestion, inconsistent with the transportation of nuclear waste through the Las Vegas Valley; and

WHEREAS, the governments representing the Southern Nevada Regional Planning Coalition (SNRPC) together constitute almost 70 percent of Nevada's population and economic revenue and negative effects to the economy of Clark County would also impact State of Nevada revenues; and

WHEREAS, it is of utmost importance to preserve and enhance the quality of life for the citizens and the future generations of Southern Nevada; and

WHEREAS, intergovernmental collaboration has proven to be an efficient and effective approach to address many of these challenges; and

WHEREAS, there is a need for collaboration and regional recommendations to address the challenges facing Southern Nevada, on the Yucca Mountain issues enumerated above; and

WHEREAS, the Southern Nevada Regional Planning Coalition can provide regional strength in addressing these potentially significant Yucca Mountain issues.

NOW, THEREFORE, be it resolved by the Southern Nevada Regional Planning Coalition that the Coalition opposes the location of a high-level nuclear waste repository in Southern Nevada.

And be it further resolved by the Southern Nevada Regional Planning Coalition that:

1. The SNRPC serve as a forum to develop and coordinate strategies on regional Yucca Mountain Program issues.

2. The Coalition provide regional guidance on policy issues affecting the area and ensure that constant opposition will be maintained among governmental units in Clark County and with the State of Nevada.

3. The staff of the Clark County Comprehensive Planning Department, Nuclear Waste Division, and incorporated city representatives of the Clark County Yucca Mountain Advisory meet periodically and develop and present issues and recommendations to the SNPRC.

4. The incorporated City of Mesquite be invited to participate in the discussions because of potentially significant impacts to that Clark County community.

IN WITNESS WHEREOF, the Southern Nevada Regional Planning Coalition endorses this resolution.

Oscar Goodman, Chairman
Southern Nevada Regional Planning Coalition

Approved as to form:

Robert Warhola, Deputy District

RESOLUTION NO. 2001-4

A RESOLUTION OF THE LAS VEGAS CONVENTION AND VISITORS AUTHORITY FOR SUPPORT OF OPPOSITION TO THE USE OF YUCCA MOUNTAIN AS A NUCLEAR WASTE REPOSITORY

WHEREAS, the Las Vegas Convention and Visitors Authority, in Clark County, State of Nevada (the "Authority") is duly organized, existing and operating as a fair and recreation board under the laws of the State;

WHEREAS, the Nevada Resort Association has adopted a resolution opposing the use of Yucca Mountain as a Nuclear Waste Repository;

WHEREAS, the Greater Las Vegas Chamber of Commerce has adopted a resolution opposing the use of Yucca Mountain as a Nuclear Waste Repository;

NOW THEREFORE, be it resolved that the Las Vegas Convention and Visitors Authority hereby supports the above referenced positions opposing the use of Yucca Mountain as a nuclear waste repository.

PASSED and ADOPTED on this 13th day of February, 2001.

(SEAL)
Attest:

Mary Kincaid, Chair
LVCVA Board of Directors

Secretary
Las Vegas Convention and Visitors Authority

RESOLUTION

WHEREAS, visitors from outside the State of Nevada constitute the economic life blood for this state's continued prosperity with their expenditures directly and indirectly accounting for more than half of the state's economic activity; and

WHEREAS, the emergence of gaming in new jurisdictions throughout the United States and the rest of the world has intensified the competition for tourists who seek to make gaming a part of their leisure experiences; and

WHEREAS, any diminution in the image that Nevada now conveys to the prospective visitor as an exciting, attractive, healthy and safe destination would reduce tourism and severely damage the welfare of Nevada's citizens; and

WHEREAS, the establishment of a high-level, nuclear waste repository in Nevada is inconsistent with the positive image the state seeks to present to the world; and

WHEREAS, because Las Vegas, the principal resource in Nevada's tourism product, has earned international recognition as the recreation capital of the world and would be the closest population center to the proposed nuclear waste repository, any news story about the repository and the associated transportation of radioactive materials to it could cause special damage to the reputation enjoyed by Las Vegas and the success of its tourism promotion efforts; now, therefore, be it

2300 West Sahara #440 Box 32, Las Vegas, Nevada 89102
Phone (702) 362-2472, Fax (702) 362-9273

RESOLVED, by its Board of Directors this 11th day of September, 1991, that the Nevada Resort Association objects to the establishment of a high-level, nuclear waste repository in the State of Nevada; and be it further

RESOLVED, that copies of this Resolution be transmitted to Nevada's Congressional delegation.

Robert H. Baldwin
Chairman of the Board

Richard W. Bunker
President

DRAFT

Resolution Stating Opposition to Storage of Nuclear Waste In Nevada

Whereas Nevada has been identified as the most favored site for relocation of the nation's nuclear waste;

Whereas the vast majority of nuclear waste is generated thousands of miles from Nevada by non-Nevadans and would have to be transported great distances to reach our state;

Whereas Southern Nevada is the fastest growing community in the United States according to the past three censuses and is now home to well over one million men, women and children;

Whereas the livelihood of the majority of Southern Nevadans is dependent on the health of the tourism industry and the continued growth in visitor volume and increased popularity of Las Vegas as a destination;

Whereas Southern Nevada is one of the world's leading tourist destinations attracting more than 33 million visitors a year who may elect to choose elsewhere for their vacations if even the perception that the valley is unsafe exists;

Whereas one accident involving the transportation of nuclear waste, no matter how minor, could create fears and hysteria among the general public and cause fewer tourists to travel to Southern Nevada, even if scientists determine these fears are unfounded;

Whereas the resort-hotel industry of Southern Nevada has invested tens of billions of dollars in infrastructure and capital improvements to build the world's most incredible resorts with the expectation that visitor volume will continue to increase;

Whereas the corporations that have made these investments are publicly traded entities whose securities are held by thousands of Americans who depend upon the financial success of these properties for their own financial security;

Whereas the mere threat of a nuclear waste accident could have a significant adverse impact on the property values of Las Vegas residents;

Whereas there is no clear scientific consensus that storage of nuclear waste less than 100 miles from Las Vegas will not result in any adverse health impacts to the region in the long-term;

Now, therefore be it resolved, The Las Vegas Chamber of Commerce expresses its strong opposition to the storage of nuclear waste in Nevada.

Approved,

Board of Trustees
January 31, 2001

Statement by Gary Coles, President of the Greater Las Vegas Association of REALTORS®

A statement of the Greater Las Vegas Association of REALTORS® in opposition to the use of Yucca Mountain as a repository for high-level nuclear waste and the proposed transportation of that waste through Clark County and surrounding areas.

The Greater Las Vegas Association of REALTORS® joins with other government, business and civic organizations in general objection to the use of Yucca Mountain as a nuclear waste site and specific objection to the validity of the Department of Energy's Impact Statement (DEIS) concerning transportation routes of nuclear waste through and around Clark County.

Since its inception in 1947, the Association of REALTORS® has been a prime proponent of private property rights, quality of living, respect of the environment and issues such as education, safety and community planning.

The 1,400 page Department of Energy's Impact Statement contains many sections that can be considered either inadequate or incomplete.

Specfically:

1. Use of 1990 population figures result in gross underestimation of people that maybe put at risk by nuclear waste transport.

2. Land use and strategic plans that guide area development have not been considered in the DOE program. Some routes actually dissect large planned developments.

3. There is evidence in other areas of the country that property and business values may be reduced severely just by the designations of nuclear waste routes.

In specific reference to the proposed routes of transportation, present and future homeowners face the problem of:

- The lack of proper equipment and training for the control of spilled or leaked nuclear waste in a community neighborhood.

- Residential/neighborhood panic following the report of a nuclear waste accident near a school where their children attend.

- Effective loss of the use of major arterials because of the congestion caused by slow moving overdimensional vehicles.

- Lack of a federal facility or program to protect or compensate communities and individuals in case of a nuclear waste accident.

In addition to these safety aspects of a nuclear waste incident you also have an economic impact of waste being routed by established residential areas.

- A route near an established neighborhood will immediately devalue the price of the home.
- Projected services for that area such as additional schools, medical and commercial services would be of questionable value.
- Resale value of residences along a nuclear route will plummet.
- Desirability of a home in the Greater Las Vegas valley will drop to a new low.
- Construction of new homes will also drop drastically.
- Businesses that considered Southern Nevada as a possible site for production and employment will reconsider due to the negative perceptions of the area.
- The gaming, tourist and convention interests that employ so many homeowners would see a definite decline in visitors at the perceived risk or report of even a minor nuclear waste accident.

Homeowners are the one stable force in any community, city or county. Homeowners are the tax base; they provide the need of many services, water, power, food, medical, home insurance, repair services.

As REALTORS® we are very much aware that if you disrupt the option and opportunity of a family to have their most serious investment in a safe and secure home threatened you will find that the Greater Las Vegas valley area will rapidly become a depressed area.

REALTORS® OPPOSE NUCLEAR WASTE IN NEVADA!

2/24/00

Wendy Dixon, EIS Manager
Yucca Mountain Site Characterization Office
Office of Civilian Radioactive Waste Management
U.S. Department of Energy M/S 010
P.O. Box 30307
North Las Vegas, NV 89036-0307

Dear Ms. Dixon:

This letter is a response to the draft Environmental Impact Statement for the proposed nuclear waste repository at Yucca Mountain. The Southern Nevada Home Builders Association consists of 750 member companies involved in the residential building industry and is an affiliate of the National Home Builders Association. These companies employ thousands of Southern Nevada residents and are truly community stakeholders. Our comments will address the industry concerns of nuclear waste transportation and storage within Southern Nevada.

It is clear that while transportation of nuclear waste to Yucca Mountain remains an uncertainty, nuclear power industry executives are fixated on pushing the process forward with little or no concern for the residents of Southern Nevada. This point is displayed by Rod McCullum of the Nuclear Energy Institute when stating the process should move forward recognizing there is an "involuntary risk" in disposing of nuclear waste. The transportation of nuclear waste poses a clear and undeniable risk to the residents and economy of Southern Nevada. Furthermore, such comments undermine and trivialize the very real concerns we have about the impacts on our communities for years to come.

Given Clark County's potential role in the transportation of nuclear waste, adverse impacts to property values and tourism have not been adequately addressed. As demonstrated in New Mexico, perceived risk can lead to a decrease in property values. With that in mind, we can be reasonably assured that additional health consequences or a nuclear waste-related accident along the transportation corridor would have severe ramifications on public health, safety and property values in Southern Nevada. The DEIS does not include current populations figures or future projections along the proposed routes. Without question significant growth along the corridor, in a County that holds 70% of the state's residents, will have very serious implications for future generations of Southern Nevadans.

The population element in the DEIS should also include visitors to our county. More than 32 million tourists annually augment the population of the metro Las Vegas area, situated directly along the proposed truck route. This is not to be overshadowed by the fact that tourism as a whole is the lifeblood of Southern Nevada. The economy of our region and state depends on these visitors, visitors who may choose not to come if nuclear waste is transported through the Las Vegas Valley.

3685 PECOS McLEOD - LAS VEGAS, NEVADA 89121-3805 • (702) 794-0117 • FAX 794-2439

In the view of many thousands of residents and visitors who use the local roadways, driving alongside shipments of nuclear waste is unacceptable. These routes are essential to both commerce and residents in the valley. Should either highway be compromised by an accident involving the shipment of nuclear waste, impacts to the community would be devastating.

In economic terms, the construction of a repository in our region can only be viewed in a negative light. Job creation at the proposed repository, even at periods of peak employment, is greatly outweighed by the negative impacts of nuclear waste transportation and storage. Additionally, we enjoy very robust economic conditions in the region. Our unemployment figures are some of the lowest in the country and future projections are very positive. Quite simply, any job creation at the proposed repository is easily mitigated by current and future growth in the regional economy.

Many concerns relative to public health have not been adequately investigated. The DOE's projections for latent cancer fatalities are only estimations and cannot provide accurate assessments of the long-term health consequences. And as we know, the aftereffects of a nuclear waste-related accident would have far-reaching impacts for the current and future citizens of Southern Nevada.

As home builders, it is imperative that we remain sensitive to the needs and interests of current and future residents of Southern Nevada. Some would say that this effort is made merely to enhance the position of our industry. But it is much more than strategic planning. It is our obligation as community stakeholders and a duty that we hold in very high regard. The time has come for our voices to be heard in this debate. Decisions made today will touch the hearts, minds, and lives of Southern Nevadans for many years to come.

Sincerely,

Irene Porter

Irene Porter
Executive Director

Clark County
Comprehensive Plan Steering Committee

January 10, 2000

Clark County
Board of County Commissioners
500 S. Grand Central Parkway, 6th Floor
Las Vegas, NV 89155-1601

Dear Board of County Commissioners;

We, the Clark County Comprehensive Plan Steering Committee, want to express our concern about the inadequacy of the recently released Yucca Mountain Draft Environmental Impact Statement (DEIS). Among other concerns, some of the key items we don't believe are adequately addressed are the following:

- The majority of the transportation options would affect Clark County (Interstate-15, the Beltway, a rail line in the northern part of the Las Vegas Valley and, possibly the Spaghetti Bowl). Despite this, no analyses are performed of potential impacts to our economy and quality of life from these transportation options.

- The NEPA process requires that "reasonable" impacts from the project be recognized. Although Clark County could experience a large number of shipments there is no recognition of potential impacts from these shipments. Potential impacts to our tourist-based economy, for example, are not even considered.

- The Department of Energy was one of the first federal agencies to develop an *Environmental Justice* policy. It is unfortunate, then, that the evaluation of effects on minority, low-income and Native-American groups is totally ignored in the *DEIS*. For example, U.S. 95, a major proposed routing option bisects the Las Vegas Paiute reservation. No statement is made of potential impacts. Other routes through the Las Vegas metropolitan area are adjacent to minority and low-income populations. However, there is no recognition of potential impacts to these populations in the *DEIS*.

In addition, we have receive reports from DOE staff and contractors, and from Clark County staff about the Yucca Mountain program. We support the Clark County Board of Commissioners in their efforts and the detailed comments they will submit.

Member Organizations
Clark County Planning Commission
Enterprise Town Advisory Board
Paradise Town Advisory Board
Winchester Town Advisory Board
Sunrise Manor Town Advisory Board
Whitney Town Advisory board
Spring Valley Town Advisory Board
Lone Mountain Citizen Advisory Council
Las Vegas League of Women Voters
Greater Las Vegas Chamber of Commerce
Henderson Chamber of Commerce
North Las Vegas Chamber of Commerce
Las Vegas Board of Realtors
Southern Nevada Homebuilders Association
Commissioner Woodbury - General Public
Commissioner Williams - General Public
Commissioner Gates - General Public
Commissioner Kenny - General Public
Commissioner Malone - General Public
Commissioner Kincaid - General Public
Commissioner Herrera - General Public

Staff
Jon Wardlaw, AICP
Assistant Planning Manager
Kim Bush
Administrative Secretary

The DEIS does not meet the letter or the spirit of NEPA. It does not provide the information that is needed to be able to assess the real impacts, not only to the citizens of Clark County, but to the nation as a whole. For example, no national transportation routes are suggested - how can an assessment of the environmental impacts be made? Likewise, in Nevada, so many routes and modes of transportation are made - time and resources do not allow an adequate assessment of environmental impacts along the routes.

We would strongly suggest that at a minimum, a supplemental document is needed to address the concerns that we have raised. We also know that other people and groups are concerned because of the inadequacy of the document. The spirit of NEPA requires that all environmental impacts be addressed. We are hopeful that DOE can meet that objective, in creating a document that fulfills the spirit and technical challenges of NEPA.

Sincerely,

Michael Dias
Chair
Clark County Comprehensive Plan Steering Committee

CPSC BCC ltr.wpd

Laughlin Town Advisory Board

REGIONAL GOVERNMENT CENTER
101 CIVIC WAY
LAUGHLIN, NV 89029
(702) 298-0828
FAX (702) 298-6132

January 11, 2000

Wendy R. Dixon, EIS Project Manager
Yucca Mountain Site Characterization Office
Office of Civilian Radioactive Waste Management
U.S. Department of Energy
P.O. Box 30307, M/S 010
North Las Vegas, NV 89036-0307

Dear Ms. Dixon:

The Laughlin Town Advisory Board met on November 9, 1999, and voted to voice its numerous concerns regarding the proposed Yucca Mountain nuclear waste storage site and accompanying transportation dangers.

In spite of the opinions of many easterners and a long-standing myth, Nevada is not a wasteland that everyone with unwanted, radioactive and nuclear waste should use as their out-of-sight-out-of mind dump. As the fastest growing state, and with Clark County being the fastest growing county, we have a proven record that spans decades: Southern Nevada is attractive to thousands of new residents monthly and many millions of visitors from around the world annually.

By opening Yucca Mountain and transporting nuclear waste to this site, you not only could adversely affect the groundwater in our state, but our citizens will have to be exposed daily on our highways to slow, escorted transport vehicles that could have and cause accidents. Although the studies and estimates thus far indicate such accidents would likely be rare, it only takes one real disaster to ruin for the rest of our lifetimes the place we call "home."

We realize Yucca Mountain has been the subject of numerous studies and discussions for more than a decade but apparently there have not been honest and forthright answers given to the American people, Congress and, specifically, Nevada citizens by the scientific community and the Department of Energy on the nature and extent of the impacts that Yucca Mountain could have on the long- and short-term.

BOARD OF COUNTY COMMISSIONERS
BRUCE L. WOODBURY, Chair • ERIN KENNY, Vice-Chair
YVONNE ATKINSON-GATES • DARIO HERRERA • MARY KINCAID • LANCE M. MALONE • MYRNA WILLIAMS
DALE W. ASKEW, County Manager

Therefore, the Laughlin Town Advisory Board can in no way support the opening of Yucca Mountain as a nuclear waste repository and urge more in-depth study be given to alternatives.

Sincerely,

LAUGHLIN TOWN ADVISORY BOARD

Lorraine Haywood

LORRAINE HAYWOOD
Chair

JAB:/rmr

cc: Laughlin Town Advisory Board members
County Commissioner Bruce Woodbury
Jacquelyne A. Brady, Town Manager
Kevin Smedley, Current Planning
U.S. Senator Harry Reid
U.S. Senator Richard Bryan
U.S. Congressman Jim Gibbons

BOARD OF COUNTY COMMISSIONERS
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DALE W. ASKEW, County Manager

Winchester Town Advisory Board

The Winchester Town Board meets twice a monthly and these meetings include business owners, students, grandparents, and young families. The topics are numerous dealing from zoning to community to quality of life. We have heard many different views on the subject of Nuclear Waste / Yucca Mountain.

We have reviewed the Environmental Impact Draft Study (EIDS), and have found many areas have been completely over looked.

There were no studies or surveys done in the following areas:

Economic Effects –
Special Taxing Districts & Special Taxes - that are collected from Auto Rental, Trucking, Amb[illegible] fees, just to name a few.
Tax Base - over 50 % of our tax base comes from gaming revenues.
Visitor Volume - the reduction of a world wide visitor volume based on a by country by region or state.
Property Taxes and Property Values

Cost Effectiveness
Existing Storage -versus - the cost of encasement, trucking, roadway repair, etc.

General and Emergency Health and Safety Issues
At any given time our population can double. If a minor or major accident occurs are the Emergency Medical, Fire and Police more than adequately equipped and trained to handle the situation. Are the Hospitals equipped, adequately staffed, and are there enough rooms to care for injured whether or not our population is inflated?

Faults, Possible Earthquakes, Underground Water
" The builders of the Titanic believed it was unsinkable, so did those who purchased tickets, so did the press." Now, we know different. Several months ago we experienced an earthquake. It took place at an unnamed fault, unnamed because it was believed by "authorities" in the field to be inactive. Now, we know different.

We would ask that you complete the proper research of the above concerns. We also asked that other sites, including those already in existence be evaluated.

Sincerely

Kristine Makowsky
Vice Chairperson

COMMISSIONERS
YVONNE ATKINSON GATES, Chair • LORRAINE T. HUNT, Vice-Chair
ERIN KENNY • MARY J. KINCAID • LANCE M. MALONE • MYRNA WILLIAMS • BRUCE L. WOODBURY
DALE W. ASKEW, County Manager

RESOLUTION OF THE CLARK COUNTY, NEVADA BOARD OF COMMISSIONERS REGARDING THE DRAFT DEPARTMENT OF ENERGY ENVIRONMENTAL IMPACT STATEMENT FOR A GEOLOGIC REPOSITORY AT YUCCA MOUNTAIN, NYE COUNTY, NEVADA

WITNESSETH:

WHEREAS, the Department of Energy (DOE) in August 1999 released a Draft Environmental Impact Statement (DEIS) intended to provide information on potential environmental impacts that could result from the proposed action to construct, operate and monitor, and close a geologic repository at Yucca Mountain, Nevada, and

WHEREAS, Clark County is specified in the DEIS as being in the *Region of Influence,* defined as the specific area of study for each of the resource areas that DOE assessed for the EIS analyses, and

WHEREAS, DOE in 1988 designated Clark County as an "affected unit of local government," under provisions of the Nuclear Waste Policy Act, as amended, in further recognition of the potential impacts to Clark County, its citizens and economy, and

WHEREAS, Clark County, which includes the incorporated cities of Las Vegas, Boulder City, Henderson, North Las Vegas and Mesquite, is one of the fastest growing counties in the nation with 1.3 million residents, and 32 million visitors, is experiencing severe traffic congestion, and extensive construction activities, and

WHEREAS, the DEIS lists potential options in Clark County for the transportation of commercial spent nuclear fuel and high-level radioactive waste including Interstate 15, the Las Vegas Valley Beltway transportation alignment, currently under construction, rail lines connecting to the Union Pacific Railroad at Valley modified and Jean, and sidings at Apex/Dry Lake and Sloan/Jean, and

WHEREAS, the DEIS fails to consider potential public health and safety effects from the transportation of nuclear waste through Clark County, in particular the Las Vegas Valley, and

WHEREAS, despite the dependence of Clark County on the volatile economic sector of tourism, the DEIS fails to evaluate impacts to Clark County's economy due to repository operation and transportation, and

WHEREAS, notwithstanding the potential impacts that could occur from the transportation of the nuclear waste, other socioeconomic issues such as impact on quality of life and stigma affects are also not evaluated in the DEIS, and

WHEREAS, DOE failed to interact appropriately with Clark County government to receive accurate and complete local information during the preparation of the DEIS, and

WHEREAS, DOE effectively excluded members of minority and low-income groups from the public information process, and

WHEREAS, The failure of the DEIS to adequately consider the potential impacts to Clark County's economy, public health and safety and quality of life to its citizens is not in the spirit and intent of national environmental policy and requirements.

NOW, THEREFORE, BE IT RESOLVED THAT

1. Since Clark County and other issues, appropriately required by the National Environmental Policy Act, are not adequately addressed in the DEIS, a new DEIS or a supplemental EIS for Yucca Mountain must be prepared by DOE to address failures in the current draft DEIS.

2. Clark County's written comments and concerns regarding the DEIS shall be transmitted to the President, Nevada's Congressional delegation, the Council on Environmental Quality, and the leadership of the Senate and House of Representatives.

PASSED, ADOPTED AND APPROVED this 15th Day of February 2000

CLARK COUNTY BOARD OF COMMISSIONERS

By: Bruce Woodbury

BRUCE L. WOODBURY
Chairman

ATTEST:

Shirley B. Parraguirre

SHIRLEY B. PARRAGUIRRE, County Clerk

RESOLUTION NO. 1506

A RESOLUTION OF THE CITY OF HENDERSON CITY COUNCIL OPPOSING THE PROPOSED NEW NATIONAL ENERGY POLICY THAT WOULD ELIMINATE STATE ENFORCEMENT OF ENVIRONMENTAL LAWS WHICH CONTROL ACTIVITIES OF THE DEPARTMENT OF ENERGY, INCLUDING STUDIES OF YUCCA MOUNTAIN AS A HIGH-LEVEL NUCLEAR WASTE REPOSITORY; AND OTHER MATTERS RELATING THERETO.

WHEREAS, Public Laws have been enacted to protect public health, property, and environmental quality, including laws relating to clean air, clean water, safe drinking water, and solid waste management; and

WHEREAS, these Public Laws provide for the delegation to states of certain permitting and enforcement authority; and

WHEREAS, the State of Nevada has accepted this delegated authority and is responsible for a broad scope of environmental regulation, including review and consideration of environmental permits requested by the Department of Energy for site characterization of Yucca Mountain as a high-level nuclear waste repository; and

WHEREAS, the Department of Energy, through a proposed new National Energy Policy, now seeks to eliminate the State of Nevada's environmental oversight of Department of Energy activities, particularly those at Yucca Mountain; and

WHEREAS, the City of Henderson, an active anti-repository jurisdiction within a designated local government, opposes the Administrations' proposal to preempt the State of Nevada's right to issue permits relating to site characterization.

NOW, THEREFORE, BE IT RESOLVED that the Henderson City Council opposes the proposed new National Energy Policy that would eliminate State enforcement of environmental laws which control activities of the Department of Energy, including studies of Yucca Mountain as a high-level nuclear waste repository.

PASSED, ADOPTED, AND APPROVED this 21st day of May, 1991 by the following vote:

Those voting Aye: Mayor Lorna Kesterson
Councilmembers Andy Hafen, Michael Harris, and Larry Scheffler

Those voting Nay: None

Those Absent: Lorin L. Williams

Lorin L. Williams

LORNA KESTERSON, MAYOR

ATTEST:

Dorothy A. Vondenbrink

DOROTHY A. VONDENBRINK, CMC, CITY CLERK

RESOLUTION NO. 2257
(Transportation of Radioactive/Hazardous Waste)

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF HENDERSON, NEVADA, REQUESTING THE DEPARTMENT OF ENERGY TO AVOID TRANSPORTING RADIOACTIVE AND/OR HAZARDOUS WASTE THROUGH CLARK COUNTY USING INTERSTATE HIGHWAY 15 (I-15) US HIGHWAY 95 (95), STATE ROUTE 146 (LAKE MEAD DRIVE), OR STATE ROUTE 160 (BLUE DIAMOND HIGHWAY).

WHEREAS, the Nevada Test Site is currently used by the Department of Energy as a site for the final disposal of low-level radioactive waste, and is being considered for use as a site for the disposal of low-level radioactive waste and mixed low-level radioactive and hazardous waste from the cleanup of the Department of Energy Weapons Complex; and

WHEREAS, the Department of Energy Fernald Environmental Management Project curtailed shipments of radioactive waste from the Fernald Environmental Management Project subsequent to the December 1997 incident in Kingman, Arizona; and

WHEREAS the Department of Energy Fernald Environmental Management Project located in Ohio proposes resuming shipments of low-level radioactive waste to the Nevada Test Site; and

WHEREAS, the Department of Energy Fernald Environmental Management Project has solicited bids from trucking companies to transport the waste, and these bids propose routes through Nevada to the Nevada Test Site; and

WHEREAS, some of the bids include routes that traverse Clark County that avoid using Hoover Dam and the interchange at US Highway 95 and Interstate Highway 15; and

WHEREAS, some of the proposed routes would use State Route 146 (Lake Mead Drive) and State Route 160 (Blue Diamond Highway); and

WHEREAS, these routes will be undergoing construction for the next several years and currently carry high volumes of traffic; and

WHEREAS, the recent radioactive waste incident at Kingman, Arizona involving radioactive wastes destined for final disposal at the Nevada Test Site illustrate the potential for accidents that could result in the release of radioactive waste, a problem that could be exacerbated by the high speeds and traffic volumes on State Route 146 and State Route 160.

THEREFORE, BE IT RESOLVED that the City Council of the City of Henderson, Nevada, urges the Department of Transportation to select a carrier who does not propose routes that traverse Clark County using Interstate Highway 15 (I-15) US Highway 95 (95), State Route 146 (Lake Mead Drive), or State Route 160 (Blue Diamond Highway); and

BE IT FURTHER RESOLVED that the City Council of the City of Henderson, Nevada, encourages the Department of Energy to specify highway routes for the transport of radioactive and mixed radioactive and hazardous waste that avoid these high-speed, high-volume, high-accident routes.

PASSED, ADOPTED, AND APPROVED THIS 11TH DAY OF MAY 1999, BY THE FOLLOWING ROLL-CALL VOTE OF COUNCIL:

Those voting aye: James B. Gibson, Mayor

Councilmembers:
Jack Clark
Amanda M. Cyphers
Arthur "Andy" Hafen
David A. Wood

Those voting nay: None
Those abstaining: None
Those absent: None

James B. Gibson, Mayor

ATTEST:

Monica M. Simmons, City Clerk

RESOLUTION NUMBER 224

A RESOLUTION OF THE CITY OF MESQUITE, NEVADA REGARDING THE TRANSPORTATION OF NUCLEAR WASTE, RADIOACTIVE MATERIAL AND NUCLEAR SPENT FUEL THROUGH THE CITY OF MESQUITE

WHEREAS, the United States Department of Energy has attempted for over two decades to store nuclear waste, radioactive material and nuclear spent fuel in the State of Nevada at Yucca Mountain which is located less than 100 miles north of Las Vegas, Nevada; and

WHEREAS, if the Department of Energy ultimately prevails in its efforts to make Yucca Mountain a nuclear storage facility, one likely route for the transportation of nuclear waste, radioactive material and nuclear spent fuel on its way to Yucca Mountain, per documents prepared by the Department of Energy, would be on Interstate 15 through the City of Mesquite; and

WHEREAS, if the route for the transportation of nuclear waste, radioactive material and nuclear spent fuel does go through the City of Mesquite via Interstate 15, that route would also be through the Virgin River Gorge via Interstate 15 which is in the State of Arizona is only ten miles north of the City of Mesquite; and

WHEREAS, the path of Interstate 15 through the Virgin River Gorge is an extremely narrow passage, barely wide enough to accommodate the lanes of Interstate 15 at several points; and

WHEREAS, Interstate 15 is a major traffic artery through Utah, Arizona, Nevada and California, a spill of nuclear waste, radioactive material or nuclear spent fuel in the Virgin River Gorge on Interstate 15 could have catastrophic effects on the environment of the Virgin River which travels through the Virgin River Gorge along Interstate 15 and on interstate travel and commerce, perhaps for decades; and

WHEREAS, the Virgin River may be the home of certain endangered species of fish, other wildlife and fauna; and

WHEREAS, the City of Mesquite is the fastest growing community in the United States of America by percentage of growth and currently is home to 15,000 residents and will double in size within the next four years if the current growth rate continues as is expected; and

WHEREAS, the City of Mesquite has experienced $700 million in new home construction in the past decade and has become a favored residential destination for golf enthusiasts and senior citizens; and

WHEREAS, if an accident occurred on Interstate 15 at Nevada Exit 122 which caused Pioneer Boulevard to be blocked at Interstate 15, an accident such as occurred in Kingman, Arizona in 1997, approximately seven thousand citizens of Mesquite would be stranded for an indefinite

period of time since Pioneer Boulevard is the only road from Interstate 15 and the City of Mesquite to approximately 7,000 residents living above Pioneer Boulevard; and

WHEREAS, Interstate 15 goes through the center of the population of the City of Mesquite and many businesses and homes are adjacent or in close proximity to Interstate 15; and

WHEREAS, the undeclared transportation routes planned by the Department of Energy are of particular concern to the City of Mesquite since the Department of Energy does not even acknowledge the existence of the City of Mesquite on its official maps of the area; and

WHEREAS, Nuclear Regulatory Commission Regulation 1437, dated February of 1999, does not acknowledge or recognize the City of Mesquite in its discussion of a proposed route through our City and the stated proposed route mistakenly states it would go through the unincorporated Township of Overton, Nevada which is over ten miles off Interstate 15 in a rural farm community on an extremely dangerous and narrow road system; and

WHEREAS, the actions of the Department of Energy to date show a complete ignorance of the location of the City of Mesquite and a total lack of concern about what an accident involving the spilling of nuclear waste, radioactive material or nuclear spent fuel in the City of Mesquite or the Virgin River Gorge would have on the City of Mesquite, its citizens, its commerce and its environment.

NOW, THEREFORE, the Mesquite City Council declares by Resolution the following:

1. The City of Mesquite opposes the establishment of a storage facility at Yucca Mountain for nuclear waste, radioactive material and nuclear spent fuel.

2. The City of Mesquite opposes the transportation of any nuclear waste, radioactive material and nuclear spent fuel through the Virgin River Gorge or the City of Mesquite.

3. The City of Mesquite resolves to resist the storage of nuclear waste, radioactive materials and spent nuclear fuel at Yucca Mountain and the transportation of the same through the State of Nevada generally and the City of Mesquite specifically and to lend its support toward efforts to oppose said project by all lawful means.

Passed and Adopted this 14th day of September, 1999.

THE CITY OF MESQUITE

By: Charles Horne

Charles Horne, Mayor

ATTEST:

By: Carol Woods

Carol Woods, City Clerk

City of North Las Vegas

2200 Civic Center Drive
North Las Vegas, Nv 89030
633-1033
FAX: 702-649-3846

RESOLUTION NO7 2019

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF NORTH LAS VEGAS REQUESTING THE DEPARTMENT Of ENERGY TO EXCLUDE THE USE OF HIGHWAY ROUTES THROUGH NORTH LAS VEGAS AND THE METROPOLITAN LAS VEGAS VALLEY FOR THE TRANSPORT OF OF LOW-LEVEL RADIOACTIVE WASTE TO THE NEVADA TEST SITE.

WHEREAS, the Department of Energy has made a formal determination to prepare an Environmental Assessment for intermodal transportation of low-level radioactive waste the Nevada Test Site; and

WHEREAS, according to this determination, the Department of Energy is proposing to institutionalize and encourage intermodal transportation of Department of Energy complex-wide generated low- level nuclear waste to the Nevada Test Site; and

WHEREAS, the Environmental Assessment will not, as it is currency planned, result in a decision by the Department of Energy to require all shipments of low-level radioactive waste destiny for the Nevada Test Site to avoid North Las Vegas and the metropolitan Las Vegas Valley; and

WHEREAS, Sate and local officials in Nevada contend that the continued transportation of these wastes not only poses risks to public health and safety, but could also adversely affect the State's tourist- based economy; and

WHEREAS, if a transportation accident involving radioactive waste were to occur, it could have a devastating impact on our community as well as a devastating socioeconomic impact on the State's economy.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of North Las Vegas, Nevada, that the City supports the position that the Environmental Assessment must address the use of intermodal transportation in combination with highway routes that avoid entirely North Las Vegas and the Las Vegas Metropolitan area; and

BE IT FURTHER RESOLVED that any transport of low-level radioactive waste using trucks only must avoid transport of waste through North Las Vegas and the Las Vegas Valley; and

IT IS FURTHER RESOLVED that nay transport of low-level radioactive waste by the department of Energy or their contractors or trucks to the Nevada Test Site must avoid routes through North Las Vegas and the Las Vegas Valley.

PASSED, ADOPTED AND APPROVED THIS 1st day of April, 1998

/s/ Michael L. Montandon, Mayor

ATTEST:
/s/ Eileen M. Sevigny, CMC City Clerk

...

Return to the
Nuclear Waste Project Office
Home Page

State of Nevada
Nuclear Waste Project Office
Capitol Complex
Carson City, NV 89710
(702) 687-3744 voice
(702) 687-5277 fax
nwpo@govmail.state.nv.us e-mail

*

RESOLUTION NO. 2182

A RESOLUTION BY THE CITY COUNCIL OF NORTH LAS VEGAS OBJECTING TO THE DEPARTMENT OF ENERGY SHIPPERS USING SURFACE ARTERIAL STREETS FOR SHIPPING LOW-LEVEL RADIOACTIVE WASTE THROUGH NORTH LAS VEGAS TO THE NEVADA TEST SITE, OBJECTING TO THE DEPARTMENT OF ENERGY'S UNILATERAL DECISION TO CEASE NOTIFYING THE CITY OF NORTH LAS VEGAS PRIOR TO TRANSPORTING LOW-LEVEL RADIOACTIVE WASTE THROUGH NORTH LAS VEGAS, AND AGAIN REQUESTING THAT THE DEPARTMENT OF ENERGY EXCLUDE THE USE OF HIGHWAY ROUTES THROUGH NORTH LAS VEGAS AND THE METROPOLITAN LAS VEGAS VALLEY FOR THE TRANSPORT OF LOW-LEVEL RADIOACTIVE WASTE TO THE NEVADA TEST SITE.

WHEREAS, the Department of Energy is responsible for the environmental cleanup of its various sites around the country which involves shipping low-level radioactive waste from those sites to the Nevada Test Site; and,

WHEREAS, the Department of Energy contracts with shippers, who are required by federal regulation to use the route with the lowest risk, to move the low-level radioactive waste; and

WHEREAS, all of the shipments to the Nevada Test Site must use routes to and through Nevada; and

WHEREAS, several years ago the Department of Energy met with the City Council representatives and agreed to direct their shippers to avoid non-Interstate routes through North Las Vegas; and

WHEREAS, after that meeting the Department of Energy created the Transportation Protocol Working Group to address low-level radioactive waste transportation through Nevada; and

WHEREAS, a cooperative relationship based on information sharing and open discussion was established between the Department of Energy and the local entities, including Department of Energy notification to the local entities of low-level radioactive waste shipments through the area; and

WHEREAS, the Transportation Protocol Working Group, which included representatives from the City of North Las Vegas, was instrumental in defining alternate routes and the risks and hazards associated with transporting low-level radioactive waste on those routes, which was to be part of an environmental assessment but which the Department of Energy published as a study titled *Intermodal and Highway Transportation of Low-level Radioactive Waste to the Nevada Test Site*; and

WHEREAS, the risk associated with using Craig Road and Cheyenne Avenue was not evaluated as those streets were not included in the published study as potential routes; and

WHEREAS, the Department of Energy through unilateral action has chosen to ignore long-standing agreements for notification by directing their shippers to avoid the Spaghetti Bowl (Interstate 15/US 95 interchange) through Las Vegas without notifying the affected entities; and

WHEREAS, at the February 17, 2000, meeting of the Transportation Protocol Working Group the Department of Energy admitted that they had told their shippers to avoid the Spaghetti Bowl which resulted in the shippers diverting those shipments to the surface arterial streets of Craig Road or Cheyenne Avenue as alternates, and that they had deliberately failed to notify the local entities based on the year 2006 deadline for cleaning up the Rocky Flats Plant site in Colorado; and

WHEREAS, it has long been the position of the City of North Las Vegas that no radioactive waste shipments should use North Las Vegas streets, and

WHEREAS, on April 1, 1998, the City of North Las Vegas City Council adopted a resolution requesting the Department of Energy to exclude the use of highway routes through North Las Vegas and the metropolitan Las Vegas Valley for the transport of low-level radioactive waste to the Nevada

Test Site.

NOW, THEREFORE, BE IT RESOLVED that the City of North Las Vegas emphatically objects to the use of surface arterial streets for shipments of low-level nuclear waste through North Las Vegas to the Nevada Test Site; and

BE IT FURTHER RESOLVED that the City of North Las Vegas strongly objects to the Department of Energy's decision to avoid notifying the affected entities about the low-level radioactive shipments through their borders, which has jeopardized the cooperative atmosphere that has slowly developed over the past few years; and

BE IT FURTHER RESOLVED that the City of Las Vegas again requests the Department of Energy to exclude the use of highway routes through North Las Vegas and the metropolitan Las Vegas Valley for the transport of low-level radioactive waste to the Nevada Test Site.

PASSED, ADOPTED AND APPROVED this _____ day of _____, 2000

_____
Michael L. Montandon, Mayor
North Las Vegas

ATTEST:

_____
Eileen M. Sevigny

RA-5-2000

RESOLUTION

RESOLUTION TO DESIGNATE LAS VEGAS A NUCLEAR-FREE ZONE

WHEREAS, Congress has designated Yucca Mountain, Nevada, the only site to be studied for a high-level nuclear waste repository; and

WHEREAS, the proposed Yucca Mountain site should be disqualified from consideration due to scientifically proven geologic and technical factors; and

WHEREAS, billions of taxpayer dollars have already been spent on the Yucca Mountain project; and

WHEREAS, the governments of the State of Nevada and the City of Las Vegas are opposed to Yucca Mountain; and

WHEREAS, the State of Nevada has already made countless sacrifices for the nation's nuclear programs; and

WHEREAS, the Nevada Test Site is currently used by the Department of Energy as a site for the final disposal of low-level radioactive waste from the cleanup of the Department of Energy's weapons complex; and

WHEREAS, high-level nuclear waste, as well as some low-level nuclear waste, is extremely dangerous, containing long-lived radioactive isotopes; and

WHEREAS, this high-level nuclear waste would consist of irradiated nuclear fuel rods and other radioactive waste; and

WHEREAS, legislation is introduced each year and is currently being debated which, if adopted by Congress and signed into law by the President of the United States, will allow for the transport of radioactive waste through the City of Las Vegas and other towns in Nevada; and

WHEREAS, this legislation would create an above-ground interim storage facility for high-level nuclear waste at the Nevada Test Site; and

WHEREAS, this legislation would begin the largest nuclear waste transportation campaign in history, possibly endangering residents in 43 states and thousands of towns and cities; and

WHEREAS, the Department of Energy predicts that there will be nuclear waste accidents occurring during this transportation campaign; and

WHEREAS, lives, health, and properties of Las Vegas residents living and working along transportation routes will be unnecessarily endangered by accidents or incidents; and

WHEREAS, the City of Las Vegas will have limited funding for training of emergency response personnel and for purchase of necessary equipment to cope with a radiological emergency; and

WHEREAS, the City of Las Vegas does not have the independent resources required to effectively cope with a radiological disaster that could occur as a result of radioactive waste transported through Las Vegas; and

WHEREAS, tourism has long been the life-blood of Nevada's economy with over half of the state's economic activity resulting directly or indirectly from tourism related expenditures; and

WHEREAS, the transportation of nuclear waste through Las Vegas would diminish the safe and attractive image the city now conveys, poses a possible health risk to potential visitors, and would damage the city and state's economy; and

WHEREAS, since the production of both high- and low-level waste continues, transportation to either an interim or permanent repository does nothing to solve the nuclear waste problem in our country; and

WHEREAS, the City of Las Vegas supports basing nuclear waste disposal decisions that will impact future generations on sound science, long-term safety considerations, and a thorough evaluation of all possible options; and

WHEREAS, at or near reactor above-ground monitored retrievable dry cask storage technology can be used to safely and economically store high-level radioactive wastes on site for at least 100 years; and

NOW THEREFORE, BE IT RESOLVED by the Mayor and Council of the City of Las Vegas as follows:

SECTION 1: That the Mayor and City Council of Las Vegas oppose all legislation that would require or allow transportation of radioactive waste near or through the City of Las Vegas;

SECTION 2: That the Mayor and City Council of Las Vegas support at reactor, on-site storage of spent nuclear fuel and high-level nuclear waste and a shift in funding to find a scientifically defensible and publicly acceptable method of disposal;

SECTION 3: That the Mayor and City Council of Las Vegas support the research and use of alternative renewable energy sources;

SECTION 4: That radioactive waste and nuclear waste, as referred to in this Resolution, is principally intended to include fuel materials utilized in nuclear power production. This Resolution does not relate to radioactive materials used, in the City of Las Vegas, for medical applications, industrial radiography and personal purposes such as time pieces or smoke detectors;

SECTION 5: That in opposition to legislation that would allow the transportation, storage or production of spent nuclear fuel, high-level nuclear waste, and low-level radioactive waste within the City of Las Vegas, the Mayor and City Council of Las Vegas designate the City of Las Vegas as a Nuclear Free Zone;

PASSED, ADOPTED, and APPROVED this 6 day of SEPTEMBER, 2000.

CITY OF LAS VEGAS

By_____
OSCAR B. GOODMAN, Mayor

ATTEST:

_____
BARBARA JO RONEMUS, City Clerk

APPROVED AS TO FORM:

Valdtech 8-28-00
Date

1 **BILL NO. 2000-4**

2 **ORDINANCE NO. 5196**

3 **AN ORDINANCE TO PROHIBIT THE TRANSPORTATION OF HIGH-LEVEL NUCLEAR WASTE WITHIN THE CITY LIMITS, AND TO PROVIDE FOR OTHER RELATED MATTERS.**

4

Sponsored by:
5 Mayor Oscar B. Goodman

Summary: Prohibits the transportation of high-level nuclear waste within the City limits.

6

7 THE CITY COUNCIL OF THE CITY OF LAS VEGAS DOES HEREBY ORDAIN

8 AS FOLLOWS:

9 SECTION 1: Title 9 of the Municipal Code of the City of Las Vegas, Nevada, 1983

10 Edition, is hereby amended by adding thereto a new chapter, designated as Chapter 37, consisting of

11 Sections 10 and 20, reading as follows:

12 **9.37.010:** For purposes of this Chapter, the following terms have the meanings ascribed to them:

13 "High-level nuclear waste" means highly radioactive material:

14 (A) That results from the reprocessing of spent nuclear fuel, including liquid waste

15 produced directly in reprocessing, and any solid material derived from such liquid waste that contains

16 fission products in sufficient concentrations; or

17 (B) That the Nuclear Regulatory Commission, consistent with existing law,

18 determines by rule requires permanent isolation.

19 "Spent nuclear fuel" means fuel that has been withdrawn from a nuclear reactor

20 following irradiation, the constituent elements of which have not been separated by reprocessing.

21 **9.37.020:** It is unlawful for any person to transport, within or through the corporate boundaries

22 of the City, any high-level nuclear waste for delivery to a repository for nuclear waste.

23 SECTION 2: If any section, subsection, subdivision, paragraph, sentence, clause or

24 phrase in this ordinance or any part thereof, is for any reason held to be unconstitutional, or invalid

25 or ineffective by any court of competent jurisdiction, such decision shall not affect the validity or

26 effectiveness of the remaining portions of this ordinance or any part thereof. The City Council of the

27 City of Las Vegas hereby declares that it would have passed each section, subsection, subdivision,

28 paragraph, sentence, clause or phrase thereof irrespective of the fact that any one or more sections,

subsections, subdivisions, paragraphs, sentences, clauses or phrases be declared unconstitutional, invalid or ineffective.

SECTION 3: Whenever in this ordinance any act is prohibited or is made or declared to be unlawful or an offense or a misdemeanor, or whenever in this ordinance the doing of any act is required or the failure to do any act is made or declared to be unlawful or an offense or a misdemeanor, the doing of such prohibited act or the failure to do any such required act shall constitute a misdemeanor and upon conviction thereof, shall be punished by a fine of not more than $1,000.00 or by imprisonment for a term of not more than six months, or by any combination of such fine and imprisonment. Any day of any violation of this ordinance shall constitute a separate offense.

SECTION 4: All ordinances or parts of ordinances or sections, subsections, phrases, sentences, clauses or paragraphs contained in the Municipal Code of the City of Las Vegas, Nevada, 1983 Edition, in conflict herewith are hereby repealed.

PASSED, ADOPTED and APPROVED this 2nd day of February, 2000.

APPROVED:

By _____
OSCAR B. GOODMAN, Mayor

ATTEST:

_____
BARBARA JO RONEMUS, City Clerk

APPROVED AS TO FORM:

_____ 12-21-99
Date

The above and foregoing ordinance was first proposed and read by title to the City Council on the 5th day of January, 2000 and referred to the following committee composed of the Full Council for recommendation; thereafter the said committee reported favorably on said ordinance on the 2nd day of February, 2000 which was a regular meeting of said Council; that at said regular meeting, the proposed ordinance was read by title to the City Council as introduced and adopted by the following vote:

VOTING "AYE": Mayor Goodman and Councilmembers Reese, Brown, L. McDonald, Weekly and Mack

VOTING "NAY": NONE

EXCUSED: Councilmember M. McDonald

APPROVED:

OSCAR B. GOODMAN, Mayor

ATTEST:

BARBARA JO RONEMUS, City Clerk

RESOLUTION R-40-98

A RESOLUTION REQUESTING THE DEPARTMENT OF ENERGY TO EXCLUDE THE USE OF HIGHWAY ROUTES OVER HOOVER DAM AND THROUGH THE METROPOLITAN LAS VEGAS VALLEY FOR THE TRANSPORT OF LOW-LEVEL RADIOACTIVE WASTE TO THE NEVADA TEST SITE.

WHEREAS, the Nevada Test Site (The Site) is currently used as a site for the final disposal of low-level radioactive waste and is being considered as a Regional or Centralized site for the disposal of low-level radioactive waste from the cleanup of the Department of Energy Weapons Complex; and

WHEREAS, the naming of the Nevada Test Site as a Regional or Centralized disposal site for low-level radioactive waste could increase the number of shipments of low-level radioactive waste into Southern Nevada considerably; and

WHEREAS, The Department of Energy is proposing to transport much of the waste by rail; and

WHEREAS, The Department of Energy is currently preparing an Environmental Assessment to evaluate sites outside the Las Vegas Valley for the transfer of low-level radioactive waste from rail to truck for shipment to the Nevada Test Site; and

WHEREAS, according to this determination, the Department of Energy is proposing to institutionalize and encourage the use of the intermodal transfer facility and highway routes outside the Las Vegas Metropolitan Area for the transport of the low-level nuclear waste to the Nevada Test Site; and

WHEREAS, the Environmental Assessment will not result in a decision by the Department of Energy to require all shipments of low-level radioactive waste destined for the Nevada Test Site to avoid Metropolitan Las Vegas; and

WHEREAS, State and local officials in Nevada contend that the continued transportation of these wastes, particularly over Hoover Dam and through the rapidly growing Las Vegas Metropolitan area, provides a greater opportunity for accidents which not only pose risks to the public health and safety of our citizens, but could also adversely affect the State's tourist-based economy; and

WHEREAS, the recent incident in Kingman, Arizona, among others, illustrates that the potential exists for the release of potentially dangerous material, a problem that could be exacerbated if it occurred on Hoover Dam or in Metropolitan Las Vegas.

A RESOLUTION REQUESTING THE DEPARTMENT OF ENERGY TO EXCLUDE THE USE OF HIGHWAY ROUTES OVER HOOVER DAM AND THROUGH THE METROPOLITAN LAS VEGAS VALLEY FOR THE TRANSPORT OF LOW-LEVEL RADIOACTIVE WASTE TO THE NEVADA TEST SITE.

NOW, THEREFORE, BE IT RESOLVED by the City of Las Vegas, Nevada, that the City supports the position that the Environmental Assessment must address the use of intermodal transportation in combination with highway routes that avoid entirely Hoover Dam and the Las Vegas Metropolitan area; and

BE IT FURTHER RESOLVED that any transport of low-level nuclear waste by the Department of Energy or their contractors or trucks to the Nevada Test Site must avoid routes over Hoover Dam and through the Las Vegas Valley.

PASSED, ADOPTED AND APPROVED on this 13th day of APRIL, 1998.

BY_____

MICHAEL J. MCDONALD, MAYOR PRO-TEM

ATTEST:

BARBARA JO RONEMUS, CITY CLERK

APPROVED AS TO FORM:

DEPUTY CITY ATTORNEY

Res04-13-98

RESOLUTION

RESOLUTION SUPPORTING THE CREATION OF A CITY OF LAS VEGAS YUCCA MOUNTAIN NUCLEAR REPOSITORY COMMITTEE

WHEREAS, in 1987 Congress amended the Nuclear Waste Policy Act and selected Yucca Mountain as the only site to be studied as a potential geologic repository for high level nuclear waste; and

WHEREAS, the City of Las Vegas has been involved in oversite of the Department of Energy activities since 1984 and has played an active and visible role in that oversight; and

WHEREAS, the City of Las Vegas desires to continue its active role of oversight as the studies of Yucca Mountain continue and work level by the Department of Energy expands; and

WHEREAS, the City Council of the City of Las Vegas desires to provide more formalized policy guidance, advice and direction and assist staff in performing the City's oversite role;

NOW, THEREFORE, BE IT RESOLVED that the City Council of the City of Las Vegas affirms the creation of a City of Las Vegas Yucca Mountain Repository Committee to provide policy guidance and direction to staff and assist in planning the City's oversight activities.

PASSED, ADOPTED, AND APPROVED this 16 day of DECEMBER, 1992.

JAN LAVERTY JONES, Mayor

ATTEST:

KATHLEEN M. TIGHE, City Clerk

R-59-95

RESOLUTION

RESOLUTION OPPOSING THE RAIL SPUR ALIGNMENT THROUGH THE LAS VEGAS VALLEY AS PROPOSED IN SENATE BILL (S-167) AND HOUSE BILL (HR-1020)

WHEREAS, the Congress of the United States is attempting to site a high level waste repository at Yucca Mountain and an interim storage facility at the Nevada Test Site against the will of the majority of Nevadans; and

WHEREAS, the development of the Yucca Mountain repository and the interim storage facility, as mandated in these two bills, would require the transportation of such waste through Las Vegas and Clark County; and

WHEREAS, transportation of such waste by rail would require the construction of a rail spur through the Las Vegas valley to the interim storage facility and the repository; and

WHEREAS, our quality of life in the fastest growing city in America and our tourism-based economy could be seriously harmed by any accident involving high level nuclear waste and the resulting media coverage; and

WHEREAS, Nevada is not a generator of high level nuclear waste products and has done its fair share by contributing substantially to the United States by providing the nation's site for nuclear weapons testings; and

NOW THEREFORE, BE IT RESOLVED by the Las Vegas City Council that we affirm our strong opposition to the forced siting of an interim storage facility and geologic repository in Nevada and to the alignment and construction of a rail spur in the Las Vegas valley from existing rail systems to any interim storage facility or repository.

BE IT FURTHER RESOLVED that we adamantly oppose, as well, the transportation of nuclear waste by truck through our streets, past our homes, schools, and businesses.

BE IT FURTHER RESOLVED that we remain strongly opposed to the transportation of high level radioactive waste anywhere in Clark County and attempts by the Congress of the United States to force the siting of the Yucca Mountain repository or an interim storage facility at the Nevada Test Site.

PASSED, ADOPTED AND APPROVED this 17th day of MAY, 1995.

CITY OF LAS VEGAS NEVADA

BY Jan Laverty Jones
JAN LAVERTY JONES, MAYOR

ATTEST:

Kathleen M. Tighe
KATHLEEN M. TIGHE, CITY CLERK

RESOLUTION RESTATING THE CITY'S OPPOSITION TO THE LOCATION OF A HIGH LEVEL NUCLEAR WASTE REPOSITORY AT YUCCA MOUNTAIN

WHEREAS, the Nuclear Waste Policy Act of 1982 established a process for the establishment of the nation's first geologic repository for the storage of high level nuclear waste; and

WHEREAS, in December 1987, the Congress of the United States amended the Nuclear Waste Policy Act and unfairly selected Yucca Mountain as the only site to be characterized as a potential high level nuclear waste repository; and

WHEREAS, on April 20, 1983, and January 2, 1985, the Las Vegas City Council unanimously adopted a resolution opposing the location of a high level nuclear waste repository in Southern Nevada and the transportation of high level nuclear waste anywhere in Southern Nevada; and

WHEREAS, the Congress of the United States is attempting to pre-empt the legitimate rights of the State of Nevada to issue environmental permits needed to construct a high level nuclear waste repository at Yucca Mountain; and

WHEREAS, the development of Yucca Mountain as a high level nuclear waste repository would require the transportation of such waste through Las Vegas and Clark County; and

WHEREAS, our tourism based economy could be seriously harmed by an accident involving high level nuclear waste and the resulting media coverage; and

WHEREAS, Nevada is not a generator of high level nuclear waste products and has done its fair share by contributing substantially to the United States by providing the nation's site for nuclear weapons testing.

NOW, THEREFORE, BE IT RESOLVED by the Las Vegas City Council that we reaffirm our strong opposition to the location of a high level nuclear waste repository in Southern Nevada at Yucca Mountain.

BE IT FURTHER RESOLVED that we remain strongly opposed to the transportation of high level radioactive waste anywhere in Clark County and attempts by the Congress of the United States to pre-empt Nevada's legitimate permitting authority for Yucca Mountain.

PASSED, ADOPTED, AND APPROVED this 21st day of August, 1991.

JAN LAVERTY JONES, Mayor

ATTEST:

KATHLEEN M. TIGHE, City Clerk

file - w 1791

RESOLUTION RECONFIRMING OPPOSITION TO LOCATION
OF A NUCLEAR WASTE DEPOSIT FACILITY IN SOUTHERN NEVADA

WHEREAS, the United States Department of Energy has tentatively identified Yucca Mountain, located in Southern Nevada, as one of three possible sites for the establishment of a National Nuclear Waste Deposit Facility; and

WHEREAS, on April 20, 1983 the Las Vegas City Council unanimously adopted a resolution opposing the construction of a high-level radioactive waste storage in Southern Nevada and the transportation of high-level radioactive waste anywhere in Southern Nevada; and

WHEREAS, the development of Yucca Mountain as a radioactive waste dump would require the transportation of such waste through Las Vegas and Clark County; and

WHEREAS, a tourist-recreation based economy could be seriously harmed by an accident involving high-level radioactive material and the resulting media coverage; and

WHEREAS, Nevada is not a generator of nuclear waste products and has contributed substantially to the United States nuclear program by providing the nation's site for nuclear weapons testing.

NOW, THEREFORE, BE IT RESOLVED by the Las Vegas City Council that we reaffirm our opposition to the location of a high-level nuclear waste deposit facility in Southern Nevada.

BE IT FURTHER RESOLVED that we remain opposed to the transportation of high-level radioactive waste anywhere in Clark County.

PASSED, ADOPTED AND APPROVED THIS 2nd day of January 1985.

William H. Briare
WILLIAM H. BRIARE, MAYOR

ATTEST:

Carol A. Hawley
Carol Ann Hawley, City Clerk

RESOLUTION REGARDING THE POSSIBLE
LOCATION OF A NUCLEAR WASTE DEPOSIT
FACILITY IN SOUTHERN NEVADA

WHEREAS, the United States Department of Energy has been examining locations on the Nevada Test Site in Southern Nevada for storing high-level radioactive waste; and

WHEREAS, Southern Nevada has contributed substantially to the nation's nuclear program by providing a site for above and below ground nuclear weapons testing and also a site for the disposal of low-level nuclear waste; and

WHEREAS, Nevada is not a generator of nuclear waste products; and

WHEREAS, the possibility of an accident involving nuclear waste would be significantly more probable in Las Vegas if the Nevada Test Site is chosen as the nation's high-level radioactive waste dump; and

WHEREAS, Southern Nevada's economy is based upon tourism and the possibility of an accident and media coverage thereof could seriously affect the economic vitality of Las Vegas residents not to mention their very lives.

NOW THEREFORE BE IT RESOLVED by the Las Vegas Board of Commissioners that we oppose the construction of a storage site for high-level radioactive waste in Southern Nevada.

BE IT FURTHER RESOLVED that we oppose the transportation of nuclear waste on our streets, past our homes, schools and businesses.

BE IT FURTHER RESOLVED that we oppose the transportation of high-level radioactive waste anywhere in Clark County or Southern Nevada.

Dated this 20th day of April, 1983.

William H. Briare, Mayor

ATTEST:

City Clerk

PROCLAMATION

WHEREAS; Yucca Mountain, Nevada has been designated by the U.S. Congress as the only site to be studied as a potential high-level nuclear waste repository in the United States; and

WHEREAS; numerous geologic and technical factors make Yucca Mountain a poor candidate for such a repository and should disqualify it as such; and

WHEREAS; the creation of a high-level nuclear waste repository at Yucca Mountain would pose a deadly risk to millions of people along waste shipment routes across the country and would directly threaten the health and safety of hundreds of generations of Nevadans; and

WHEREAS; tourism has long been the life-blood of Nevada's economy, with over half of the state's economic activity resulting directly or indirectly from tourism-related expenditures; and

WHEREAS; the establishment of a high-level nuclear waste repository in Nevada would diminish the safe and attractive image the state now conveys to potential visitors worldwide; and

WHEREAS; Citizen Alert has been the primary source of grassroots opposition to the siting of high-level nuclear waste in the State of Nevada since the project's inception; and

WHEREAS; the Shundahai Network, Nevada Nuclear Waste Task Force, and the Nevada Desert Experience have worked closely with Citizen Alert in the fight to keep Nevada from becoming the nation's nuclear garbage dump; now

THEREFORE; We, the Mayor and City Council of Las Vegas, do hereby proclaim Saturday, September 30, 2000, and annually thereafter until such time as the Yucca Mountain high-level nuclear waste repository project is defeated, as:

Nevada is Not a Wasteland Day

Oscar B. Goodman
Mayor of Las Vegas

Michael J. McDonald, Mayor Pro-Tem

Gary Reese, Councilman

Larry Brown, Councilman

Lynette B. McDonald, Councilwoman

c/c

RESOLUTION NO. 738

RESOLUTION OF THE CITY COUNCIL OF BOULDER CITY, NEVADA OPPOSING THE TRANSPORTING AND DUMPING OF NUCLEAR AND OTHER HAZARDOUS WASTE AT THE BEATTY DUMPSITE

WHEREAS, the State of Nevada is one of only three states which allow the disposal of commercial radioactive and other hazardous waste within their boundaries and is rapidly becoming the nuclear dumping ground for the entire nation; and

WHEREAS, leaks in shipments arriving at the dumpsite and the transportation of these radioactive wastes and materials through the cities and towns of our State pose a serious threat to the health, safety and welfare of our residents and visitors; and

WHEREAS, those federal agencies responsible for the regulation of interstate transport of nuclear and other hazardous waste have given a low priority to enforcement of the regulations governing the safety of the transportation of radioactive materials;

NOW, THEREFORE, BE IT RESOLVED, that the City Council call upon the Governor of the State of Nevada and the State Board of Health to close the Beatty dumpsite and to refuse to allow the transportation of nuclear and other hazardous waste on any road or highway in our State until we can be assured that the shippers of such waste will be forced to comply with strict safety standards and inspections.

DATED this 11th day of November, 1980.

/s/ Robert S. Ferraro

Robert S. Ferraro, Mayor

ATTEST:

/s/ Delia H. Estes

Delia H. Estes, City Clerk

(City Seal)

11/12 D
11/13 To Governor: John H Carr, M.D., State Health Officer, 505 E. King St., (Rm 201) Carson C NV. 8971

AMENDED 2-12-85

C/C

RESOLUTION NO. 1187

RESOLUTION OF THE CITY COUNCIL OF BOULDER CITY, NEVADA REFLECTING BOULDER CITY'S POSITION WITH REGARD TO PROPOSED NUCLEAR WASTE SITE ON YUCCA MT.

WHEREAS, the Nuclear Waste Policy Act of 1982 delineates a procedure and time schedule for the establishment of the nation's first geologic repository for the storage of high level nuclear waste; and

WHEREAS, one of three sites under final consideration for siting of the repository is Yucca Mountain adjacent to the Nevada Test Site; and

WHEREAS, as a result of the location of Yucca Mountain and the limited transportation network in the southwest United States and into Nevada, two of the major accesses to Yucca Mountain will be Highways 93 and 95, potentially over Hoover Dam and through Boulder City; and

WHEREAS, an accident on the site of Hoover Dam and the heavily traveled U.S. Highways 93 and 95 through Southern Nevada, which carry millions of tourists each year, would create a direct physical and economic risk for residents as well as travelers alike; and

WHEREAS, Nevada already has contributed substantially to the United States nuclear program in the form of the nation's nuclear weapons testing center;

NOW, THEREFORE, BE IT RESOLVED by the City Council of Boulder City, Nevada, that it opposes the location of a high-level nuclear waste repository in Southern Nevada.

APPROVED AND ADOPTED this 12th day of February, 1985.

/s/ Robert S. Ferraro

Robert S. Ferraro, Mayor

ATTEST:

/s/ Delia H. Estes

Delia H. Estes, City Clerk

D 2-19-85 + Nuclear Waste Project, Carson City

CIC

RESOLUTION NO. 1655

RESOLUTION OF THE CITY COUNCIL OF BOULDER CITY, NEVADA
FOR APPROVAL OF AMENDED MAP OF A PORTION OF VILLA DEL PRADO
UNIT 7 (A PORTION OF BOULDER CITY SUBDIVISION NO. 33)

WHEREAS, On November 11, 1982, by Resolution No. 907, City Council approved the Tentative Map, and;

WHEREAS, On January 26, 1988, by Resolution No. 1525, City Council approved the Final map, and;

WHEREAS, DDL, the Developer, through VTN of Nevada, Consulting Engineers has submitted to the City, an Amended Map of a portion of Villa Del Prado, Unit 7, which is a portion of Boulder City Subdivision No. 33 and;

WHEREAS, The Amended Map shows a property line relocation between Lots 10 and 11, and ;

WHEREAS, said Amended Map is in compliance with Title 11, Chapter 39 of the City Code and the Subdivision Act of the State of Nevada,

NOW, THEREFORE BE IT RESOLVED that the City Council approve the submitted Amended Map.

DATED and APPROVED this 11th day of April, 1989.

/s/ Jon C. Porter

Jon C. Porter, Mayor

ATTEST:

/s/ Delia H. Estes

Delia H. Estes, City Clerk

D 4/12/89 + marti

RESOLUTION NO. 1724

AGREEMENT WITH THE BOARD OF COUNTY COMMISSIONERS OF CLARK COUNTY AND THE CITY OF BOULDER CITY FOR CARRYOVER RESEARCH GRANT FUNDS FOR THE YUCCA MOUNTAIN NUCLEAR WASTE REPOSITORY

WHEREAS, The Federal Government has selected Yucca Mountain, Nevada, for site characterization for the location of a high level nuclear waste repository; and

WHEREAS, The Yucca Mountain Nuclear Waste Repository has the potential to impact the social and economic characteristic of southern Nevada; and

WHEREAS, The location of the Repository at Yucca Mountain has the potential to adversely impact the City of Boulder City; and

WHEREAS, The City of Boulder City needs to determine the present capabilities and evaluate the future needs for concentrated emergency management and develop a plan to acquire up-to-date equipment and material to enhance the level of these capabilities; and

WHEREAS, The City of Boulder City needs to be able to participate in the determination of the potential impact of the Yucca Mountain Repository along with other units of local government; and

WHEREAS, The City of Boulder City has received FY 89 funding from Clark County and has demonstrated a definite need for pass through funding; and

WHEREAS, Due to the timeframe from the expenditure of the FY 89 funds, carryover of a portion of these funds into FY 90 is necessary; and

WHEREAS, This Agreement will authorize the expenditure of FY 89 funds in FY 90;

NOW, THEREFORE, BE IT RESOLVED that the appropriate officers of the City are hereby authorized and directed to take the necessary and appropriate action to execute an agreement for the carryover of funds from Clark County for the Yucca Mountain Nuclear Waste Repository.

DATED and APPROVED this 26th day of September, 1989.

/s/ Jon C. Porter

Jon C. Porter, Mayor

ATTEST:

/s/ Delia H. Estes

Delia H. Estes, City Clerk
(SEAL)

D 9/20/89

C/C

RESOLUTION NO. 1908

AGREEMENT WITH THE BOARD OF COUNTY COMMISSIONERS OF CLARK COUNTY AND THE CITY OF BOULDER CITY FOR RESEARCH GRANT FUNDS FOR THE YUCCA MOUNTAIN NUCLEAR WASTE REPOSITORY

WHEREAS, The Federal Government has selected Yucca Mountain, Nevada, for site characterization for the location of a high level nuclear waste repository; and

WHEREAS, The Yucca Mountain Nuclear Waste Repository has the potential to impact the social and economic characteristic of the City of Boulder City and southern Nevada; and

WHEREAS, The City of Boulder City needs to participate in the review of the Depart of Energy's activities and proposals and to provide more detailed information regarding existing local conditions; and

WHEREAS, The City of Boulder City needs to be able to participate in the determination of the potential impact of the Yucca Mountain Repository along with other units of local government;

NOW, THEREFORE, BE IT RESOLVED that the appropriate officers of the City are hereby authorized and directed to take the necessary and appropriate action to make application of funds from Clark County for the Yucca Mountain Nuclear Waste Repository.

DATED and APPROVED this 11th day of December, 1990.

/s/ Jon C. Porter

Jon C. Porter, Mayor

ATTEST:

/s/ Delia H. Estes

Delia H. Estes, City Clerk

(SEAL)

D 12/12/90

C/C

RESOLUTION NO. 1930

A RESOLUTION OF THE CITY COUNCIL OF BOULDER CITY, NEVADA, APPROVING AGREEMENT NO. 91-A143 WITH CAD SCAN, INC., FOR CONVERSION OF THE CITY'S BASE MAPS TO DIGITIZED FORM FOR THE CLARK COUNTY NUCLEAR WASTE REPOSITORY PROGRAM, AS A SOLE SOURCE PURCHASE

WHEREAS, The City and Clark County entered into an agreement on January 22, 1991 in regards to grant funds for the Yucca Mountain Nuclear Waste Repository Program; and

WHEREAS, In preparing and submitting the grant request, the only CAD Scan, Inc., was identified as being able to provide the requested work; and

WHEREAS, As a result, the approved grant agreement identifies CAD Scan Inc., of Rio Rancho, New Mexico, as a sole source purchase to perform the requested work task;

NOW THEREFORE, BE IT RESOLVED that the City Council approve Agreement No. 91-A143 with CAD Scan, Inc., as a sole source purchase to perform the specified work task in an amount not to exceed $128,500.00;

BE IT FURTHER RESOLVED that the City Manager be authorized to sign the agreement with CAD Scan, Inc.

DATED and APPROVED this 12th day of February, 1991.

/s/ Jon C. Porter

Jon C. Porter, Mayor

ATTEST:

/s/ Sarah Forrest

Sarah Forrest, Deputy City Clerk

(SEAL)

D & M 2/14/91

RESOLUTION NO. 2049

AGREEMENT WITH THE BOARD OF COUNTY COMMISSIONERS OF CLARK COUNTY AND THE CITY OF BOULDER CITY FOR RESEARCH GRANT FUNDS FOR THE YUCCA MOUNTAIN NUCLEAR WASTE REPOSITORY

WHEREAS, The Federal Government has selected Yucca Mountain, Nevada, for site characterization for the location of a high level nuclear waste repository; and

WHEREAS, The Yucca Mountain Nuclear Waste Repository has the potential to impact the social and economic characteristic of the City of Boulder City and southern Nevada; and

WHEREAS, The City of Boulder City needs to participate in the review of the Department of Energy's activities and proposals and to provide more detailed information regarding existing local conditions; and

WHEREAS, The City of Boulder City needs to be able to participate in the determination of the potential impact of the Yucca Mountain Repository along with other units of local government;

NOW, THEREFORE, BE IT RESOLVED that the Mayor is hereby authorized and directed to sign Agreement No. 91-A184, an agreement for funds from Clark County for the Yucca Mountain Nuclear Waste Repository for Fiscal Year 1991.

DATED and APPROVED this 22nd day of October, 1991.

Eric L. Lundgaard, Mayor

ATTEST:

Carol Ann Hawley, City Clerk

(SEAL)

Amended 5-12-92

c/c

RESOLUTION NO. 2117

AGREEMENT WITH THE BOARD OF COUNTY COMMISSIONERS OF CLARK COUNTY AND THE CITY OF BOULDER CITY FOR RESEARCH GRANT FUNDS FOR THE YUCCA MOUNTAIN NUCLEAR WASTE REPOSITORY

WHEREAS, The Federal Government has selected Yucca Mountain, Nevada, for site characterization for the location of a high level nuclear waste repository; and

WHEREAS, The Yucca Mountain Nuclear Waste Repository has the potential to impact the social and economic characteristics of the City of Boulder City and southern Nevada; and

WHEREAS, The City of Boulder City needs to participate in the review of the Department of Energy's activities and proposals and to provide more detailed information regarding existing local conditions; and

WHEREAS, The City of Boulder City needs to be able to participate in the determination of the potential impact of the Yucca Mountain Repository along with other units of local government; and

WHEREAS, On October 22, 1991, the City Council passed resolution No. 2049, entering into an agreement with Clark County for research grant funds for Fiscal Year 1991. The City and Clark County have agreed that it is in the best interest of both parties to enter into a revised agreement for the remainder of FY91 to allow:

1. The City to enter into a separate agreement with Planning Information Corporation (PIC) in an amount of $20,000.00 to develop Boulder City's PEDaL (Parcel-based Database of Local Economic, Demographic and Land Use information) System.

2. The City to continue to use a local consultant for Data Base Management in an amount of $4,500.00 from FY91 funds.

NOW, THEREFORE, BE IT RESOLVED that the Mayor is hereby authorized and directed to sign Agreement No. 92-A210, a revised agreement for funds from Clark County for the Yucca Mountain Nuclear Waste Repository for Fiscal Year 1991.

5/18/92 D

DATED and APPROVED this 12th day of May, 1992.

/s/ Eric L. Lundgaard
Eric L. Lundgaard, Mayor

ATTEST:

/s/ Sarah Forrest
Sarah Forrest, Deputy City Clerk

(SEAL)

RESOLUTION NO. 2118

AGREEMENT WITH PLANNING INFORMATION CORPORATION AND THE CITY OF BOULDER CITY FOR DEVELOPMENT OF THE CITY'S DATABASE FOR THE YUCCA MOUNTAIN NUCLEAR WASTE REPOSITORY PROGRAM

WHEREAS, The Federal Government has selected Yucca Mountain, Nevada, for site characterization for the location of a high level nuclear waste repository; and

WHEREAS, The Yucca Mountain Nuclear Waste Repository has the potential to impact the social and economic characteristics of the City of Boulder City and southern Nevada; and

WHEREAS, The City of Boulder City needs to participate in the review of the Department of Energy's activities and proposals and to provide more detailed information regarding existing local conditions; and

WHEREAS, The City of Boulder City needs to be able to participate in the determination of the potential impact of the Yucca Mountain Repository along with other units of local government; and

WHEREAS, On October 22, 1991, the City Council passed Resolution No. 2049, entering into an agreement with Clark County for research grant funds for Fiscal Year 1991. The City and Clark County have agreed that it is in the best interest of both parties to enter into a revised agreement for the remainder of FY91 to allow, in part, the City to enter into a separate agreement with Planning Information Corporation (PIC) in an amount of $20,000.00 to develop Boulder City's PEDaL (Parcel-based Database of Local Economic, Demographic and Land Use information) System.

NOW, THEREFORE, BE IT RESOLVED that the Mayor is hereby authorized and directed to sign Agreement No. 92-A211, an agreement with Planning Information Corporation for development of the City's database for the Yucca Mountain Nuclear Waste Repository for Fiscal Year 1991 in an amount of $20,000.00.

DATED and APPROVED this 12th day of May, 1992.

/s/ Eric L. Lundgaard
Eric L. Lundgaard, Mayor

ATTEST:

/s/ Sarah Forrest
Sarah Forrest, Deputy City Clerk
(SEAL)

5/18/92 D

C/C

RESOLUTION NO. 2125

AGREEMENT WITH THE BOARD OF COUNTY COMMISSIONERS OF CLARK COUNTY AND THE CITY OF BOULDER CITY FOR RESEARCH GRANT FUNDS FOR THE YUCCA MOUNTAIN NUCLEAR WASTE REPOSITORY

WHEREAS, The Federal Government has selected Yucca Mountain, Nevada, for site characterization for the location of a high level nuclear waste repository; and

WHEREAS, The Yucca Mountain Nuclear Waste Repository has the potential to impact the social and economic characteristic of the City of Boulder City and southern Nevada; and

WHEREAS, The City of Boulder City needs to participate in the review of the Department of Energy's activities and proposals and to provide more detailed information regarding existing local conditions; and

WHEREAS, The City of Boulder City needs to be able to participate in the determination of the potential impact of the Yucca Mountain Repository along with other units of local government;

NOW, THEREFORE, BE IT RESOLVED that the Mayor is hereby authorized and directed to sign Agreement No. 92-A213, an agreement for funds from Clark County for the Yucca Mountain Nuclear Waste Repository for Fiscal Year 1992.

DATED and APPROVED this 9th day of June, 1992.

/s/ Eric L. Lundgaard
Eric L. Lundgaard, Mayor

ATTEST:

/s/ Sarah Forrest
Sarah Forrest, Deputy City Clerk

(SEAL)

D 6/22/92

RESOLUTION NO. 2208

AGREEMENT WITH THE BOARD OF COUNTY COMMISSIONERS OF CLARK COUNTY AND THE CITY OF BOULDER CITY FOR RESEARCH GRANT FUNDS FOR THE YUCCA MOUNTAIN NUCLEAR WASTE REPOSITORY

WHEREAS, The Federal Government has selected Yucca Mountain, Nevada, for site characterization for the location of a high level nuclear waste repository; and

WHEREAS, The Yucca Mountain Nuclear Waste Repository has the potential to impact the social and economic characteristic of the City of Boulder City and southern Nevada; and

WHEREAS, The City of Boulder City needs to participate in the review of the Department of Energy's activities and proposals and to provide more detailed information regarding existing local conditions; and

WHEREAS, The City of Boulder City needs to be able to participate in the determination of the potential impact of the Yucca Mountain Repository along with other units of local government;

NOW, THEREFORE, BE IT RESOLVED that the Mayor is hereby authorized and directed to sign Agreement No. 92-A235, an agreement for funds from Clark County for the Yucca Mountain Nuclear Waste Repository for Fiscal Year 1992.

DATED and APPROVED this 8th day of December, 1992.

John F. Pilgrim, Assistant Mayor

ATTEST:

Vicki G. Bergdale, City Clerk

(SEAL)

RESOLUTION NO. 3364

A RESOLUTION REQUESTING THE DEPARTMENT OF ENERGY TO REQUIRE SHIPPERS AND CARRIERS OF LOW LEVEL RADIOACTIVE WASTE TO THE NEVADA TEST SITE TO USE ROUTES THAT DO NOT INCLUDE U.S. 93 AND THE TRANSPORT OF WASTE OVER HOOVER DAM AND THROUGH BOULDER CITY

WHEREAS, the Department of Energy's (DOE) Fernald Environmental Management Project (FEMP) anticipates resuming shipments of low level radioactive waste (LLW) to the Nevada Test Site (NTS) at the end of April, 1999, and it is anticipated that other carriers will be added as low-level radioactive waste contractors in the near future; and

WHEREAS, FEMP has solicited bids from carriers to transport the waste and are considering five of the bids, some of which include routes that avoid Hoover Dam and the City of Boulder City; and

WHEREAS, it is likely that other future carriers who transport low-level radioactive waste will likely select the same routes that are selected as a result of the current bid process; and

WHEREAS, the City Council of Boulder City had previously approved Resolution No. 3117 on March 24, 1998, requesting that the routes for transport of such waste avoid Hoover Dam and the City of Boulder City; and

WHEREAS, State and local officials in Nevada contend that the continued transportation of these wastes not only poses risks to public health and safety, but could also adversely affect the State's tourist-based economy; and

WHEREAS, if a transportation accident involving radioactive waste were to occur at Hoover Dam, it could have a devastating impact on the State's water supply and the Colorado River; and

NOW, THEREFORE BE IT RESOLVED by the City Council of Boulder City, Nevada, that supports the position that under no circumstances should U.S. 93 be utilized for transport of low level radioactive waste into the State of Nevada.

APPROVED on this 27th day of April, 1999.

Robert S. Ferraro, Mayor

ATTEST:

Vicki G. Mayes, City Clerk

RESOLUTION NO. 3622

RESOLUTION APPROVING AGREEMENT NO. 00-662 BETWEEN THE CITY OF BOULDER CITY AND CLARK COUNTY FOR NUCLEAR WASTE REPOSITORY PROGRAM PARTICIPATION FROM AUGUST, 2000, THROUGH THE COMPLETION OF THE SCOPE OF WORK

WHEREAS, The Federal Government has selected Yucca Mountain, Nevada, for site characterization for the location of a high level nuclear waste repository; and

WHEREAS, The Yucca Mountain Nuclear Waste Repository has the potential to impact the social and economic characteristic of the City of Boulder City and Southern Nevada; and

WHEREAS, The City of Boulder City needs to participate in the review of the Department of Energy's activities and proposals and to provide more detailed information regarding existing local conditions; and

WHEREAS, The City of Boulder City needs to be able to participate in the determination of the potential impact of the Yucca Mountain Repository along with other units of local government;

NOW, THEREFORE, BE IT RESOLVED that the Mayor is hereby authorized and directed to sign Agreement No. 00-662, an agreement for funds from Clark County for participation in the Yucca Mountain Nuclear Waste Repository Program for a period beginning August 1, 2000 in an amount not to exceed $3,500.00.

DATED and APPROVED this 8th day of August, 2000.

Robert S. Ferraro

Robert Ferraro, Mayor

ATTEST:

Vicki G. Mayes

Vicki G. Mayes, City Clerk

(SEAL)

Appendix B – Clark County, Nevada's Resolutions in Opposition to Yucca Mountain

Appendix B

CLARK COUNTY BOARD OF COMMISSIONERS
AGENDA ITEM

Issue:	**Yucca Mountain Nuclear Waste Repository**	**Back-up:**
Petitioner:	John L. Schlegel, Director, Comprehensive Planning	**Clerk Ref.#**

Recommendation:

That the Board of County Commissioners approve, adopt, and authorize the Chairman to sign a resolution reaffirming its opposition to the siting of a Nuclear Waste Repository at Yucca Mountain, Nye County, Nevada.

FISCAL IMPACT:

None by this action.

BACKGROUND:

Goal A. Create partnerships with common interest groups and the people within our community.

In January 1983 the President signed into law the Nuclear Waste Policy Act of 1982 (NWPA), which established a process and time schedule for developing the nation's first high level nuclear waste geologic repository. Yucca Mountain in Nye County was, subsequently, named as one of nine sites to be evaluated to determine its suitability for the permanent isolation of the highly toxic nuclear waste. In reacting to the Yucca Mountain designation, the Commission on January 8, 1985, adopted a resolution opposing the siting of a nuclear waste repository at Yucca Mountain.

On December 22, 1987, Congress enacted the Nuclear Waste Policy Amendments Act (NWPAA), which designated Yucca Mountain as the sole site to be characterized for permanent nuclear waste storage. The NWPAA also abandoned the important original objectives of the NWPA to establish and utilize a process that would equitably site a facility of this danger and controversy. Given these circumstances, on April 5, 1988, the Board of County Commissioners, by resolution, further reaffirmed its opposition to the siting of a repository at Yucca Mountain.

Recent actions by the Department of Energy (DOE) warrant Clark County's reconfirmation of its opposition to the Yucca Mountain site. It is apparent, for example, in the Yucca Mountain Draft Environmental Impact Statement (DEIS) that a major objective of the DEIS is to minimize the description and consideration of any potential impacts resulting from Yucca Mountain Program activities. It is also evident that a major component of the Yucca Mountain Program is the transportation of the nuclear waste. Despite the huge volume of shipments that are projected to occur and the listing of numerous rail and highway routing options in Clark County, potential impacts in Clark County are ignored. It is almost impossible to separate the transportation of the nuclear waste, which creates substantial potential risks to Clark County, from the siting of a repository at Yucca Mountain. It is, therefore, not in the public interest of the citizens of Clark County to have a repository constructed in Southern Nevada.

Respectfully submitted,

APPROVED/ADOPTED/AUTHORIZED AS RECOMMENDED

Cleared for Agenda

3/7/00 DU

JOHN L. SCHLEGEL
Director, Comprehensive Planning

JLS/DB/jt

Agenda Item # 73

RESOLUTION
OF THE
CLARK COUNTY BOARD OF COMMISSIONERS
REAFFIRMING ITS OPPOSITION TO THE SITING OF A NUCLEAR WASTE REPOSITORY AT YUCCA MOUNTAIN, NYE COUNTY, NEVADA

WHEREAS, the Nuclear Waste Policy Act of 1982 established a process and time schedule for the establishment of the nation's first geologic repository for the permanent disposal of spent commercial nuclear fuel and high-level nuclear waste; and

WHEREAS, on December 22, 1987, the Congress of the United States amended the Nuclear Waste Policy Act of 1982, identifying Yucca Mountain in Nye County, Nevada as the sole site to be characterized as a permanent repository for the storage of spent commercial nuclear fuel and high-level nuclear waste; and

WHEREAS, because of these actions by Congress the Clark County Board of Commissioners approved resolutions on January 8, 1985, and April 5, 1988, opposing the location of a repository in Southern Nevada; and

WHEREAS, the transportation of nuclear waste is a major component of the Yucca Mountain Program; and

WHEREAS, the Department of Energy, in the draft *Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada (DEIS)*, lists numerous potential truck and rail routing alternatives in Clark County, and the Las Vegas Valley; and

WHEREAS, if Yucca Mountain is developed as a repository, the listing of these transportation alternatives in the DEIS would result in the Las Vegas Valley, with over 1.3 million residents and 33 million annual visitors and considerable congestion, becoming a major access point to Yucca Mountain; and

WHEREAS, the transportation of nuclear waste in the highly developed Las Vegas Valley would create a direct and significant risk to the health, safety and quality of life of both residents and visitors, as well as a substantial economic risk to Clark County's tourist-based economy, the major revenue source to Clark County and the State of Nevada; and

WHEREAS, because of the integration of the transportation of the nuclear waste with the development of the Yucca Mountain repository site, and the impossibility of separating these activities it is, therefore, not in the public interest of the citizens of Clark County to have a repository located at Yucca Mountain in Southern Nevada.

NOW, THEREFORE, BE IT RESOLVED, by the Clark County Board of County Commissioners that

1. The Clark County Board of Commissioners reaffirms its opposition to the siting of a high-level nuclear waste repository at Yucca Mountain in Nye County in Southern Nevada.

2. The signed resolution be transmitted to the President of the United States, the Nevada Congressional representatives, and the Governor of the State of Nevada.

PASSED, ADOPTED, AND APPROVED this 7TH day of MARCH, 2000.

CLARK COUNTY, NEVADA

By: B L Woodbury

BRUCE L. WOODBURY, CHAIRMAN
BOARD OF COUNTY COMMISSIONERS

ATTEST:

Shirley B Parraguirre

SHIRLEY B. PARRAGUIRRE, COUNTY CLERK

BOARD OF COUNTY COMMISSIONERS
AGENDA ITEM

CLARK COUNTY
NUCLEAR WASTE DIVISION
LIBRARY

SUBJECT: ☐ Public Hearing ☒ Resolution ☐ Agreement ☐ Information ☐ Other ☐ Proceedings NUCLEAR WASTE POLICY AMENDMENTS ACT OF 1987.	Clerk Ref. # XIII 03
PETITIONER: DONALD L. SHALMY, COUNTY MANAGER	Commission Backup

RECOMMENDATION:

THAT THE BOARD OF COUNTY COMMISSIONERS ADOPT THE ATTACHED RESOLUTION REAFFIRMING ITS OPPOSITION TO THE NUCLEAR WASTE REPOSITORY AT YUCCA MOUNTAIN, DECLARING CLARK COUNTY AS AN "AFFECTED UNIT OF LOCAL GOVERNMENT" PURSUANT TO THE NUCLEAR WASTE POLICY AMENDMENTS ACT OF 1987 AND DIRECTING THE COUNTY MANAGER TO PURSUE WITH THE DEPARTMENT OF ENERGY (DOE), THE CERTIFICATION OF CLARK COUNTY AS AN AFFECTED UNIT OF LOCAL GOVERNMENT, FOR GRANTS, FINANCIAL AND TECHNICAL ASSISTANCE, AND AN IMPACT REPORT UNDER THE PROVISIONS OF THE NUCLEAR WASTE AMENDMENTS ACT OF 1987.

FISCAL IMPACT:

Not applicable.

BACKGROUND:

In January 1983 the President signed into law the Nuclear Waste Policy Act which provided a process and time schedule for establishing the nation's first high level nuclear waste geologic repository. Yucca Mountain, adjacent to the Nevada Test Site, was one of nine sites chosen for initial screening assessments.

In a reaction opposing the Yucca Mountain designation, the Clark County Board of Commissioners officially adopted a resolution opposing the siting of a nuclear waste repository at Yucca Mountain in January of 1985.

In May 1986, the President approved the Secretary of Energy's recommendation that Yucca Mountain and two other western sites be characterized as a potential repository.

On December 22, 1987, the Congress passed, and the President signed the Nuclear Waste Policy Amendments Act of 1987, defining certain grants, impact assistance, and payments-equal-to-taxes funds available to contiguous, affected counties. Clark County became a contiguous affected county to the Yucca Mountain site in Nye County when the formation of a new Nevada county (Bullfrog) was ruled unconstitutional by a District Court in early 1988, and the State Legislative Committee determined not to appeal this decision.

In March 1988, the DOE's Nevada Nuclear Waste Storage Investigations Project identified six potential railway transportation routes for hazardous material to the proposed Yucca Mountain repository site. Five of the six routes pass through Clark County.

CLEARED FOR AGENDA

4-5-88 JAB

County Manager

ADOPTED AS RECOMMENDED

The Clark County Board of Commissioners has affirmed its opposition to a nuclear waste repository at Yucca Mountain. With presidential approval of characterization and with identification of nuclear waste rail routes through Clark County, it is imperative that the Board undertake every available means to protect the interests of Clark County residents.

Pursuit of the guaranteed provisions of the Nuclear Waste Amendments Act of 1987 will ensure the County an active role in the characterization process and adequate information to determine potential future impacts. In the event a repository is indeed developed at Yucca Mountain, Clark County will receive grants and financial aid to mitigate these impacts on local residents and interests.

The Nuclear Waste Amendment Act of 1987 requires Department of Energy certification of Clark County as an affected unit of local government and the filing of an impact report. With this certification Clark County would become eligible for grants to:

1. Review DOE activities to determine economic, social, public health and safety, and environmental impacts of a repository or site characterization.

2. Develop a request for impact mitigation assistance.

3. Engage in monitoring, testing, or evaluation of site characterization activities.

4. Provide information to residents on program activities.

5. Request information from and make comments and recommendations to DOE.

6. Prepare and file an application for a grant for payment-equal-to-taxes for site characterization and repository development activities and operations by DOE in Clark County.

The Nuclear Waste Policy Amendments Act allows Clark County to ensure maximum protection for its residents without acceptance or implied agreement to the location of a nuclear repository at the Yucca Mountain site.

The attached resolution suggests an evolved policy stance by the Board of County Commissioners which recognizes the amendments to the Nuclear Waste Policy Act. The policy represents a strong reaffirmation of the Board's opposition to the nuclear waste repository. It also deals pragmatically with the political realities of congressional action in amending the Nuclear Waste Policy Act, by directing the pursuit of all supplemental financial assistance available as a means of protecting Clark County residents and interests.

Respectfully submitted,

DONALD L. SHALMY
County Manager

CLARK COUNTY, NEVADA

DONALD L. "PAT" SHALMY
County Manager

DALE W. ASKEW, CPA
Assistant County Manager

MICHAEL P. COOL
Assistant County Manager

AGENDA ITEM DEVELOPMENT REPORT

NO. 1379

DATE: March 22, 1988

Subject: NUCLEAR WASTE POLICY AMENDMENTS ACT OF 1987

Federal action on siting a high level nuclear waste repository has escalated with passage of the Nuclear Waste Policy Amendments Act of 1987 (NWPAA) last year. Through this act, siting of a nuclear waste repository was focused on Yucca Mountain. Further, in February the Legislative Commission decided not to appeal a District Court ruling that the formation of Bullfrog County was unconstitutional. Clark County then became a contiguous, affected county to the Yucca Mountain site in Nye County. This has opened up financial assistance opportunities provided by the NWPAA.

The Board has long expressed a unified stance in opposition to the repository. But, with changes in the federal law focusing attention on Yucca Mountain, it is now appropriate and indeed prudent for the Board to consider all options necessary to protect the residents and business interests of Clark County.

Background:

In January 1983 the President signed into law the Nuclear Waste Policy Act. The Act provided a process and time schedule for establishing the nation's first high level nuclear waste repository. Yucca Mountain, adjacent to the Nevada Test Site, was one of the nine sites chosen for initial screening as a repository. The Clark County Board of Commissioners adopted a resolution in January of 1985 opposing the siting of a nuclear waste repository at Yucca Mountain.

In May of 1986, the President approved the Secretary of Energy's recommendation that Yucca Mountain and two other Western sites be characterized as a potential repository.

On December 12, 1987, the Congress passed, and the President signed the Nuclear Waste Policy Amendments Act (NWPAA) of 1987. This law identified Yucca Mountain as the prime site for locating a repository.

In February of this year the Legislative Commission chose not to appeal a District Court ruling that the formation of Bullfrog County was unconstitutional.

-contined-

Impacts to Clark County:

Clark County may experience a number of impacts from the proposed Yucca Mountain repository. Among these are risk to the health and safety of our citizens from transportation impacts, demands on services from the influx of thousands of workers and their families, and the allocation of scarce financial resources for emergency preparedness. If Yucca Mountain is selected, current plans would permit thousands of truck loads and rail ship ments of high level nuclear waste to traverse Las Vegas. For example, in March of 1988, the Department of Energy's Nevada Nuclear Waste Storage Investigations Project identified six potential railway transportation routes for hazardous material to the proposed Yucca Mountain repository site. Five of the six routes pass through Clark County.

Affected Local Governments/Financial Assistance

The NWPAA provides for the characterization of the Yucca Mountain site, through a process anticipated to require five to seven years. The NWPAA also provides for certain grant monies, impact assistance and involvement in the process for "affected units of local government."

An affected local government is defined as "the unit of local government with jurisdiction over the site of a repository ..." or, "may, at the discretion of the Secretary of the Department of Energy, include units of local government that are contiguous with such unit." With the ruling on Bullfrog County, Clark County is in a position to be identified as an affected local government.

Impact assistance is authorized to affected local governments during site characterization and repository development. An impact report must be submitted to the Department of Energy (DOE) to request such assistance.

Under the NWPAA, affected local governments are guaranteed the following financial assistance considerations:

1) Grants and PETT (payments equal to taxes)

DOE is required to grant to the State of Nevada and any affected unit of local government an amount, each year, equal to the amount the state or local government would receive if they were authorized to tax site characterization activities and repository development and operation as they would tax non-federal real property and industrial actitivies with the state or unit of local government. The assistance amounts are as yet undefined.

-continued-

2) Negotiations

Local governments are also included in negotiations for a negotiator's agreement. A federal negotiator will be appointed to consult with affected units of local government. The negotiated agreement would specify the terms and conditions under which a local government would agree to host a repository, including financial and institutional arrangements. The agreement may include terms and conditions related to the affected unit of local government's interests. Under a benefits agreement, affected units of local government must also be consulted in negotiations, and must receive at least one-third of the benefits. Total benefits are limited to $10 million per year.

3) Impact Assistance

Affected units of local government can develop impact assistance reports and request financial and technical assistance to address those impacts. The assistance amounts available are as yet undefined.

It is important to note that the NWPAA states clearly that acceptance of grants and PETT does not imply acceptance of the program and that "the submittal of an impact assistance report to DOE in no way implies that the state (local government) agrees with the program or is volunteering to host the repository."

Current Program:

Clark County has worked closely over the past several years with the State of Nevada and local governments in Clark, Lincoln and Nye counties to monitor DOE's activities and to determine impacts from the program. Clark County has received annual grants from the State and participated in the development and implementation of a program to evaluate impacts. Preliminary results from these studies will be available in the near future.

Recommendation:

The Clark County Board of Commissioners has affirmed its opposition to a nuclear waste repository at Yucca Mountain. Nonetheless, with the changes contained in the NWPAA which focus investigation on one repository site at Yucca Mountain, it is only prudent that the Board consider the options available to protect the interests of Clark County residents.

-continued-

Pursuit of the guaranteed financial assistance provided in the Nuclear Waste Policy Amendments Act of 1987 will provide the County with the opportunity to chart an independent course of action to determine potential future impacts without depleting limited local tax dollars. In the event a repository is developed at Yucca Mountain, Clark County has several options by which to receive grants and financial aid to mitigate these impacts on local residents and interests. Documentation of reports and needs will be necessary to support impact assistance requests.

Staff is preparing an agenda item seeking Board approval to file a request with the Department of Energy for Clark County certification as an "affected unit of local government."

With the Board's direction staff can develop an operational plan to pursue the funding options available. Pursuit and acceptance of assistance does not imply acceptance of a repository at Yucca Mountain. Nonetheless, given the amendments to the Nuclear Waste Policy Act it is only prudent that Clark County pursue the supplemental assistance available to ensure maximum protection for its residents and interests. Richard Holmes and Robert Broadbent will be available to brief the Board on the program and issues.

DONALD L. SHALMY
County Manager

jbn
A-5

RESOLUTION

(OF THE CLARK COUNTY BOARD OF COMMISSIONERS)

WHEREAS, the Nuclear Waste Policy Act of 1982 delineated a procedure and time schedule for the establishment of the nation's first geologic repository for the storage of high level nuclear waste; and

WHEREAS, on January 8, 1985, the Clark County Board of Commissioners adopted a resolution opposing the location of a high-level nuclear waste repository in Southern Nevada; and

WHEREAS, Yucca Mountain in Nye County was selected in May of 1986 to be one of three sites to be considered for placement of the repository; and

WHEREAS, in December 1987, the Congress of the United States amended the Nuclear Waste Policy Act identifying Yucca Mountain as the preferred site for a high-level nuclear waste repository; and

WHEREAS, the amendments defined "affected units of local government", which could include Clark County; and

WHEREAS, the amendments established a procedure whereby such local governments could receive grants and impact mitigation assistance and could become directly involved in decision-making for the high level nuclear waste program; and

WHEREAS, designation as an affected unit of local government and acceptance of grant assistance in no way implies or requires acceptance of the placement of a high-level nuclear waste repository in Southern Nevada.

NOW, THEREFORE, BE IT RESOLVED by the Clark County Board of Commissioners that:

1. The Board continues to oppose the location of a high-level nuclear waste repository in Southern Nevada; and

-continued-

2. Pursuant to this opposition, and because Congress has directed the Department of Energy to apply its repository resources towards site characterization at Yucca Mountain, it is prudent and responsible for the Board to seek all supplemental financial assistance available to undertake the studies necessary to support impact assistance requests, to support a staff and program to monitor Department of Energy activities, and to provide a negotiating presence so that potential impacts on local residents and business interests can be mitigated.

AND BE IT FURTHER RESOLVED THAT the Board hereby declares Clark County to be an "affected unit of local government" pursuant to the Nuclear Waste Policy Act Amendments of 1987 and directs the County Manager to pursue such certification from the Department of Energy and to pursue all financial or other assistance available to Clark County under the high-level nuclear waste program.

PASSED, ADOPTED, AND APPROVED this 5th day of April, 1988.

CLARK COUNTY, Nevada

By: Paul J. Christensen
PAUL J. CHRISTENSEN, Chairman
Board of County Commissioners

ATTEST:

Loretta Bowman
LORETTA BOWMAN, County Clerk

BOARD OF COUNTY COMMISSIONERS
AGENDA ITEM

Subject:	Clerk Ref.#
YUCCA MOUNTAIN NUCLEAR WASTE REPOSITORY	IV C.2
Petitioner: DONALD L. SHALMY COUNTY MANAGER	Commission Backup

Recommendation:

THAT THE BOARD OF COUNTY COMMISSIONERS CONSIDER A RESOLUTION STATING THE BOARD'S POSITION ON THE POTENTIAL SITING OF A NUCLEAR WASTE REPOSITORY AT YUCCA MOUNTAIN, ADJACENT TO THE NEVADA TEST SITE.

Fiscal Impact:

NONE

Background:

In January 1983 the President signed into law the Nuclear Waste Policy Act. The Act set up a process and time schedule for establishing the nation's first high level nuclear waste geologic repository. Yucca Mountain, adjacent to the Nevada Test Site, was one of nine sites chosen for initial screening assessments. MIR #1351 details the process and the original time schedule.

As a result of federal legislation identifying a potential site in Nevada, the 1983 legislature established a subcommittee to track federal efforts and to consider a policy stance for Nevada. Also, the Nuclear Waste Project Office was established within the Office of the Governor. The Nuclear Waste Project Office is responsible for technical review of federal studies and liaison with local governments. The Nuclear Waste Project Office is funded by a federal grant and passes a portion of that funding through to various local governments so that they too may track federal proposals.

In late December 1984, the Department of Energy issued the environmental assessments for each of the nine candidate sites and suggested three of those nine for a four or five year detailed geologic investigation called a site characterization study. Yucca Mountain was one of the three selected for final consideration. MIR #1500 provides further detail on this proposed decision and its time frame.

Attached is a proposed resolution which highlights the concerns of the Board regarding this matter.

Respectfully submitted,

ADOPTED RESOLUTION

Cleared for Agenda

1-8-85 CJ

mp Cook for
DONALD L. SHALMY
COUNTY MANAGER

DLS:sg

OFFICE OF THE COUNTY MANAGER

CLARK COUNTY NEVADA

BRUCE W. SPAULDING
County Manager

JOSEPH C. DENNY
Assistant County Manager

MANAGER'S INFORMATION REPORT

NO. 1351

DATE: DECEMBER 30, 1983

SUBJECT: HIGH LEVEL NUCLEAR WASTE REPOSITORY
ISSUES AFFECTING CLARK COUNTY

The State of Nevada was notified in February of 1983 that Yucca Mountain, North of Las Vegas in Nye County, was being considered for nomination as one of five candidate sites* for a high-level nuclear waste repository. Formal nomination of the five sites will occur by summer 1984. The list of five sites will be further reduced to three by mid-1985, with the recommended site being presented to Congress in April of 1987. Nevada appears to be a strong candidate for the repository given its low population density, high percentage of federal land ownership, favorable hydrogeologic setting, and history of prior nuclear activity. Given the likelihood of Nevada's selection, a number of issues become evident:

1) Does Nevada have to accept the nuclear waste?

2) What is the relationship between state and federal law on nuclear waste siting and transport?

3) What sort of flexibility is present in federal regulations to address local concerns?

4) What issues are important to consider locally?

5) What role should Clark County play with the state and federal governments to ensure that local issues are considered?

These issues are discussed briefly in the remainder of this report. Comprehensive Planning will provide a more detailed briefing at your convenience.

*Other areas of the country being considered are Utah, West Texas, Louisiana and Mississippi.

1) Does Nevada have to accept the nuclear waste?

The Federal government appears to be preeminent in matters dealing with nuclear waste. The Atomic Energy Act of 1954 and amendments, and the Energy Reorganization Act of 1974 all specify federal authority. The Nuclear Waste Policy Act of 1982 further centers this responsibility in the Department of Energy. In litigation the "Commerce Clause" and "Supremacy Clause" are cited in providing evidence that the United States has licensing authority and regulatory power over the transfer, storage or disposal of radioactive waste material. The several states that have attempted to prevent or restrict the movement or storage of nuclear waste into or through their jurisdictions (Washington State Building and Construction Trades Council vs. Spellman and Illinois vs. General Electric) have had these clauses cited by courts to prevent state intervention actions.

Perhaps for cosmetic purposes, the Nuclear Waste Policy Act of 1982 provides a method by which a state could conceivably reject its selection as a waste repository. The process begins by a state governor vetoing his state's selection as a repository site. If both houses of Congress can override this veto by a simple majority, however, the state nonetheless becomes a repository state, despite the gubernatorial veto. Once selected, it seems unlikely that a state will be able to overturn the process.

2) What is the relationship between state and federal law on nuclear waste siting and transport?

This is a relatively complicated issue because there are both federal and state laws which regulate nuclear waste. Chapter 459 of the Nevada Revised Statutes (NRS) regulates nuclear affairs, with regulations cited in the Nevada Administrative Code. NRS 706.441 regulates the transport of radioactive waste in Nevada and NRS 408.125 enables the state to designate routes for the transport of hazardous materials.

On the other hand, the Atomic Energy Act (AEA) of 1954 and amendments grant specific powers to the federal government to license and regulate all facets of nuclear waste. These regulations are specified in 10 CFR Parts 1 to 199 (Energy). Section 274(b) of the AEA permits "Agreements with states." The Nuclear Regulatory Commission can "enter into agreements with the Governor of any State providing for discontinuance of the regulatory authority of the Commission under Subchapters V, VI, VII and Section 2201 of Title 42 (Public Health and Welfare)." Such an agreement permits a state to regulate byproduct materials, source materials and special nuclear materials (plutonium, uranium 233, etc.). Nevada has signed such an agreement with the federal government and it forms the basis for NRS 459 and other related statutes. Section 274(b), however, appears to be more concerned with nuclear waste generated and transported within the state rather than between states as envisioned in the Yucca Mountain project.

In answering Washington and Illinois' attempt to limit out-of-state deliveries for storage (see cases cited on Page 2), the courts have specifically noted that regulating nuclear waste is a federal decision and federal licensing requirements would apply.

In one area, namely the selection of routes for the conveyance of nuclear waste, the federal government appears to allow states some flexibility. For example, the federal government consulted with several states closely this past year on route selection in the shipment of high-level wastes to interim sites in Wisconsin and Illinois.

Part 397.9(a) of the Nuclear Regulatory Commission regulations also notes that "unless there is no practicable alternative, a motor vehicle which contains hazardous material must be operated over routes which do not go through or near heavily populated areas, places where crowds are assembled: tunnels, narrow streets [Hoover Dam?]. Operating convenience is not a basis for determining whether it is practicable to operate a motor vehicle." This regulation would appear to provide the state some flexibility in addressing intrastate transport matters.

In general, however federal law appears to have precedence over State of Nevada law.

3) What sort of flexibility is present in federal regulations to address local concerns?

The Nuclear Waste Policy Act of 1982 (97-425) (particularly Section 215(a)), defines interaction with local governments as that which occurs at the state level and affected Indian Tribes. Local involvement will also consist of a series of public hearings to be sponsored by the Department of Energy, at which time the public will be afforded opportunity for comment. The first public hearing in Las Vegas took place in March 1983.

A more substantive process through which local concerns can be addressed is available from the state.

Section 215(b) of the Nuclear Waste Policy Act of 1982 specifies that the Secretary (of the Department of Energy) and Governor of a state shall enter into a written agreement which can specify "procedures by which such Governor or governing body may study, determine, comment or make recommendation with regard to the possible health, safety and economic impacts of the test and evaluation facility." The Nevada Department of Minerals, which is coordinating the Nevada response to the federal government, feels that local entities can be included in the substantive review process vis-a-vis the written agreement.

Federal monies funneled through the State of Nevada Department of Energy would likewise be available for Clark County to investigate potential local impacts. The State of Nevada received $350,000 for FY 1983 for investigative studies and $1.9 million for FY 1984, $1.1 million of which is slated for an analysis of the Department of Energy site plan for Yucca Mountain. It is anticipated that some monies from the $700,000 remaining will be available for local impact analysis.

4) What issues are important to consider locally?

It is important that issues pertinent to Clark County and local entities are considered at the earliest date. In addition to ensuring that impacts are minimized, it is also important to make the federal government aware of the degree of local concern about: a) the project, and b) the fact that Clark County and its citizens would be the best judge on determining what local impacts would result (as opposed to the state making those decisions).

Among the issues which should be considered in Clark County are:

A. Emergency response issues in the event of an accident (security, clean-up, evacuation of people, financial responsibility, etc.).

B. The transportation of the nuclear waste through the County (mode, routes and magnitude of the shipments).

C. Socioeconomic considerations (employment impacts associated with construction and operations, demographics, facilities needs, service requirements, security, and financial considerations).

D. Perceptual issues (influence on tourism, quality of life, general hazard).

E. Environmental impact (impact on the environment because of an accident, for example).

F. Mitigation funds to minimize impacts if the Yucca Mountain site is selected (how much, availability prior to site construction, funds for impact analysis).

5) What role should Clark County play with the state and federal governments to ensure that local issues are considered?

The nuclear waste issue is largely a no-win proposition. If we assume that the Yucca Mountain site is to be selected and plan accordingly we may run the risk of having the public feel that we approve of the project and are tacitly working with the federal government to bring the project to Nevada. If we ignore the project and let the state do our planning for us we face the equally untenable position of having the state specify impacts and

solutions. While this is a difficult question to answer and one that could be delayed because of the long time frame of the project (commencement of operations is not scheduled until 1997) we should recognize that either stance will be criticized.

Nonetheless, because of the significance of the issue, it is important that we determine what influence the project would have on Clark County. At a minimum we could be a coordinative vehicle for citizens and groups in Clark County to ensure that all concerns are noted; at the other end of the spectrum staff could provide substantive technical input similar to that provided by the County in its evaluation of the M-X project. Whatever the role, it is important that the County determine which course of action it will pursue in a relatively timely manner.

Bruce W. Spaulding
County Manager

BWS:sg

REPORT #1351

OFFICE OF THE COUNTY MANAGER

CLARK COUNTY, NEVADA

DONALD L. "PAT" SHALMY
County Manager

DALE W. ASKEW, CPA
Assistant County Manager

MICHAEL P. COOL
Assistant County Manager

MANAGER'S INFORMATION REPORT

NO. 1500

DATE: JANUARY 4, 1985

SUBJECT: HIGH-LEVEL NUCLEAR WASTE REPOSITORY

Recently, the Department of Energy (DOE) released a series of evironmental assessments for each of the nine sites being considered to establish the nation's first high-level radioactive waste repository. Of these nine, the DOE has recommended three for detailed investigations called site characterizations. These three are Yucca Mountain adjacent to the Nevada Test Site, Hanford, Washington, and the Deaf Smith site in Texas. The selection of those three sites is subject to public review and comment received over a period ending on March 20, 1985. DOE will hold a public briefing on the Yucca Mountain assessment on January 22, 1985 in Las Vegas. A public hearing will be held in Las Vegas on February 26, 1985. Time and locations have not been announced.

The site characterization studies will involve construction of deep shafts 1,000 to 4,000 feet below ground to further study the geology of each site on a hands on basis. From these studies, one site will be recommended for the repository.

The schedule and process of selection for these sites is governed by the Nuclear Waste Policy Act of 1982. The site characterization will take four to five years at which time the DOE will recommend one site to the President for approval. A decision will probably not occur before 1990.

The Governor of the selected state may reject a selection. This rejection may be overriden by a resolution of both Houses of Congress.

Comprehensive Planning has been tracking and will continue to track this process very closely. Comprehensive Planning's staff is currently reviewing the 1,500 page Yucca Mountain draft assessment and will be preparing comments on the report for those aspects which influence Clark County. Transportation and tourism related issues will be their prime focus.

Donald L. Shalmy
County Manager

DLS:ll
Attachment

RESOLUTION

(of the Clark County Board of Commissioners)

WHEREAS, the Nuclear Waste Policy Act of 1982 delineates a procedure and time schedule for the establishment of the nation's first geologic repository for the storage of high level nuclear waste; and

WHEREAS, one of three sites under final consideration for siting of the repository is Yucca Mountain adjacent to the Nevada Test Site; and

WHEREAS, as a result of the location of Yucca Mountain and the limited transportation network in the southwest United States, major access to Yucca Mountain will be through the heavily populated Las Vegas Valley, which will be home to approximately one million people and a destination for 25 million visitors by the year 2000; and

WHEREAS, an accident within the highly developed Las Vegas Valley would create a direct physical and economic risk for residents and visitors alike; and

WHEREAS, Nevada already has contributed substantially to the United States nuclear program in the form of the nation's nuclear weapons testing center.

NOW, THEREFORE, BE IT RESOLVED by the Clark County Board of Commissioners that the Board opposes the location of a high-level nuclear waste repository in Southern Nevada.

PASSED, ADOPTED, AND APPROVED this 8th day of January, 1985.

CLARK COUNTY, NEVADA

By: Thalia M. Dondero

Thalia M. Dondero, Chairman
Board of County Commissioners

ATTEST:

Loretta Bowman

LORETTA BOWMAN, County Clerk

/sg

Appendix C – Clark County Comments to Draft Environmental Impact Statement (DEIS), Formal Response to Supplemental Draft Environmental Impact Statement (SDEIS) and Formal Response to Preliminary Site Suitability Evaluation (PSSE)

Appendix C

Clark County, Nevada

Executive Summary Comments

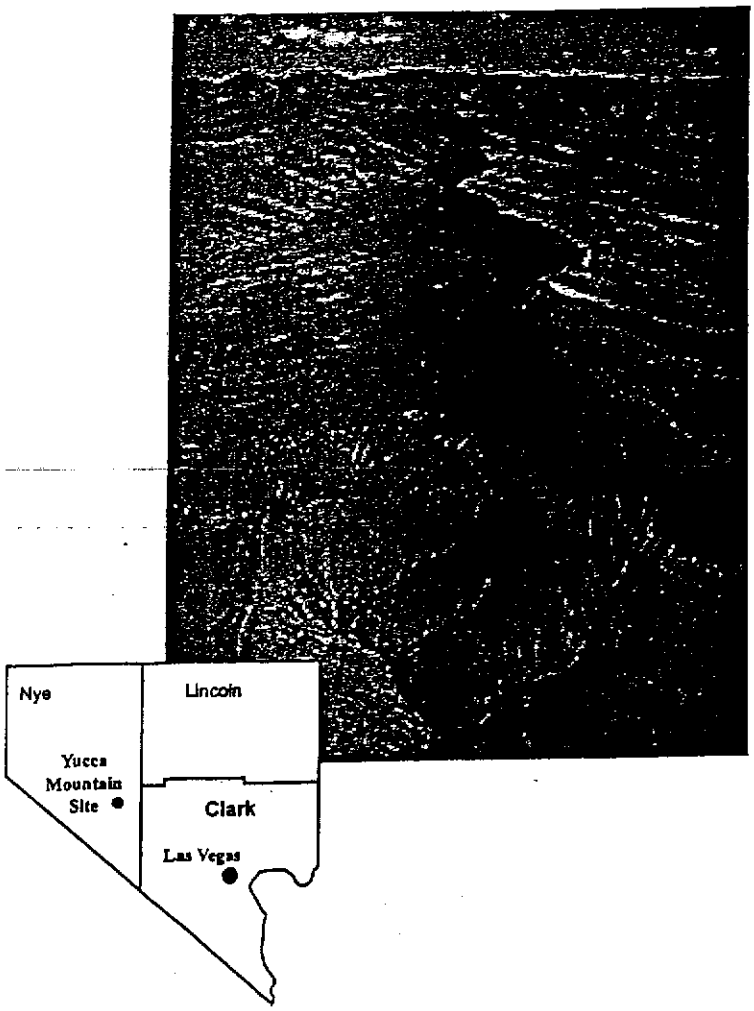
Dated February 25, 2000

to

DOE's Draft Environmental Impact Statement (DEIS)

Clark County Comments

U.S. Department of Energy's Draft Environmental Impact Statement for a Geologic Repostitory for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada



Executive Summary

Department of Comprehensive Planning
Nuclear Waste Division

CLARK COUNTY NEVADA

BRUCE L. WOODBURY
Chairman

Board of County Commissioners

CLARK COUNTY GOVERNMENT CENTER
500 S GRAND CENTRAL PKY
PO BOX 551601
LAS VEGAS NV 89155-1601
(702) 455-3500 FAX: (702) 383-6041

February 25, 2000

Wendy R. Dixon, EIS Project Manager
Yucca Mountain Site Characterization Office
Office of Civilian Radioactive Waste Management
U.S. Department of Energy
P.O. Box 30307, Mail Stop 010
North Las Vegas, Nevada 89036-0307

Clark County, Nevada Comments on the Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada

Dear Ms. Dixon:

Attached are comments by Clark County, Nevada to the *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada (DEIS)*. The comments are the culmination of an extensive review of the DEIS by staff from the Department of Comprehensive Planning, Nuclear Waste Division, supported by outside expertise from other County departments and organizations, and consultants. Clark County also received considerable input from citizens, from nineteen Clark County Town Advisory Boards and Citizen Councils, as well as the incorporated cities, other citizens and advisory committees, and private organizations.

Clark County has, of course, been an active participant since 1983 in monitoring the high-level nuclear waste program. In 1988, Clark County was designated as an "affected unit of local government," under provisions of the Nuclear Waste Policy Act of 1987, in full recognition by DOE that impacts could occur to our citizens and community from activities associated with the Yucca Mountain Program. The concern about potential impacts was manifested in the Board approval of resolutions opposing the siting of a repository in Southern Nevada on January 8, 1985 and April 5, 1988.

As the attached comments will fully attest, the Board of Commissioners of Clark County has considerable substantive concerns with the Yucca Mountain DEIS. The deficiencies range from a lack of adherence to the spirit and principles of the National Environmental Policy Act (NEPA) to, specifically, an insufficiency in analysis of potentially significant Clark County impact areas including adverse affects on public health and safety and tourism, among others.

The avoidance of these important Clark County issues in the DEIS is especially perplexing. For almost two decades Clark County has interacted closely with DOE to ensure that the agency was aware of the many issues and concerns that Clark County has had with a project of this scope and controversy. Clark County staff has provided substantial evidence over the years that certain aspects of the project, notably associated with the transportation of the nuclear waste, could have, among other potential impacts, substantial negative consequences to Clark County's tourist-based economy. It is difficult, therefore, to understand why these issues were virtually ignored in the DEIS.

RESOLUTION OF THE
CLARK COUNTY, NEVADA BOARD OF COMMISSIONERS
REGARDING THE DRAFT DEPARTMENT OF ENERGY
ENVIRONMENTAL IMPACT STATEMENT FOR A GEOLOGIC REPOSITORY
AT YUCCA MOUNTAIN, NYE COUNTY, NEVADA

WITNESSETH:

WHEREAS, the Department of Energy (DOE) in August 1999 released a Draft Environmental Impact Statement (DEIS) intended to provide information on potential environmental impacts that could result from the proposed action to construct, operate and monitor, and close a geologic repository at Yucca Mountain, Nevada, and

WHEREAS, Clark County is specified in the DEIS as being in the *Region of Influence,* defined as the specific area of study for each of the resource areas that DOE assessed for the EIS analyses, and

WHEREAS, DOE in 1988 designated Clark County as an "affected unit of local-government," under provisions of the Nuclear Waste Policy Act, as amended, in further recognition of the potential impacts to Clark County, its citizens and economy, and

WHEREAS, Clark County, which includes the incorporated cities of Las Vegas, Boulder City, Henderson, North Las Vegas and Mesquite, is one of the fastest growing counties in the nation with 1.3 million residents, and 32 million visitors, is experiencing severe traffic congestion, and extensive construction activities, and

WHEREAS, the DEIS lists potential options in Clark County for the transportation of commercial spent nuclear fuel and high-level radioactive waste including Interstate 15, the Las Vegas Valley Beltway transportation alignment, currently under construction, rail lines connecting to the Union Pacific Railroad at Valley modified and Jean, and sidings at Apex/Dry Lake and Sloan/Jean, and

WHEREAS, the DEIS fails to consider potential public health and safety effects from the transportation of nuclear waste through Clark County, in particular the Las Vegas Valley, and

WHEREAS, despite the dependence of Clark County on the volatile economic sector of tourism, the DEIS fails to evaluate impacts to Clark County's economy due to repository operation and transportation, and

WHEREAS, notwithstanding the potential impacts that could occur from the transportation of the nuclear waste, other socioeconomic issues such as impact on quality of life and stigma affects are also not evaluated in the DEIS, and

WHEREAS, DOE failed to interact appropriately with Clark County government to receive accurate and complete local information during the preparation of the DEIS, and

EXECUTIVE SUMMARY

Introduction

In its capacity as an affected unit of local government under the Nuclear Waste Policy Act, As Amended, Clark County, Nevada, has completed an extensive review of the *Draft EIS*. This document was published in August 1999 and is available for public comment until February 28, 2000. After all comments are reviewed, DOE staff will prepare a final EIS that should reflect consideration of all relevant issues.

The Final EIS will be a key document in the federal approval and licensing process for the proposed repository at Yucca Mountain. Therefore it is of utmost importance that *all* potential impacts of the repository on Clark County are identified and analyzed in the EIS since it will be used by DOE, Congress, DOE and other federal entities to recommend, plan and implement mitigation strategies and programs.

As a result of this review and other interactions with the U.S. Department of Energy [the "DOE"], the Clark County Board of County Commissioners recently passed a resolution requesting that the DOE prepare a new *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada [the Draft EIS]*. This action was taken because of a number of major insufficiencies that were identified during the county's review of the Draft EIS.

In preparing the Draft EIS, DOE has virtually ignored the standing of Clark County and other affected units of local government. Not only did they fail to acknowledge the comments provided by Clark County, the State of Nevada and other AULGs in 1995 during the scoping phase of DEIS development, they have also disregarded more accurate local information (e.g., demographics, development and strategic plans, transportation system) that was readily available for use in the DEIS

In addition, DOE did not make a diligent effort to involve the public and implement NEPA procedures. In particular, no substantial effort was made by DOE to involve groups that would be affected by the Yucca Mountain Program, especially low-income and minority populations. DOE failed to comply with Executive Order 12898 that directs the agency to consult with states, Native American tribes and local governments to assist in identifying minority and low-income groups so that they may have significant input.

Because of the lack of compliance with NEPA requirements, consideration of important individual and cumulative impacts, and inclusion of affected groups in the process, the DEIS is inadequate and incomplete. Therefore, the DEIS does not provide enough scope and detail to allow for meaningful mitigation planning.

The rationale for this statement takes into account the following points. The Draft EIS:

- does not comply with the letter and intent of NEPA since it did not provide a realistic alternative that allows for consideration of a No Action Alternative,
- provided insufficient scope and detail to allow for impact determination that could result in the planning and implementation of mitigation and management plans,
- narrowly defined the scope and nature of impacts, thus assuring that few impacts of significance would be identified. For example, the DEIS ignored potential impact categories important to Clark County's economy and (e.g., stigma effects on tourism, land use conflicts, property diminution and unfunded mandates on local government) although there is credible evidence that shows that these may occur, and,
- failed to include minorities and low-income groups in the scoping, interactive and hearing processes related to the EIS.

- There were no estimates of the costs necessary to mitigate the impacts of emergency planning, response, evacuation and cleanup. This approach does not conform to best practice in the field of impact assessment.
- The DEIS used outdated databases, geographic data files, and inaccurate or misleading maps to support the conclusions of the transportation, health effects and public safety analyses.

- ***Impacts of Importance to Clark County Not Considered in the DEIS***

This section addresses a number of impact areas of importance to Clark County not considered by DOE. If these areas are not addressed in sufficient detail and scope, a meaningful understanding of potential impacts may not take place, and effective mitigation planning and negotiation strategies could not occur. A number of examples are provided to illustrate potential impacts from Yucca Mountain activities.

- There are a number of potential impacts that could be adverse to Clark County residents, visitors, and businesses, harm the quality of life of residents and adversely affect the economic well-being of the County and State.
- In view of Clark County government's objective to sustain the vibrancy of our area, we must take steps to maintain the economic base for its residents, managing its rapid growth, assuring healthy communities and opportunities for its residents, and preserving the natural environment.
- The DEIS does not consider "stigma induced" impacts. As an example, there exists substantial evidence that demonstrates the real potential for serious property value declines and disinvestment from similar programs. Data indicate that stigma induced changes can occur even under incident-free transportation conditions. At a minimum, stigma-induced impacts if present can result in diminution of property values and business performance, development and investment along routes, and decreases in tourism. The importance of this is underscored by the fact that a number of organizations whose constituencies may be adversely affected have expressed their deep concerns. These organizations include the Southern Nevada Home Builders Association, the Greater Las Vegas Association of Realtors®, the Howard Hughes Corporation, and others.

Public Participation in the Draft EIS Review Process

Clark County staff met with 19 Town Advisory Boards / Citizens' Advisory Councils, representatives from local jurisdictions and other groups to exchange information and receive comments on the Draft EIS. It is clear from the comments recorded that not only county officials, but also citizens, are very concerned about the negative impacts that the Yucca Mountain Program may have on Southern Nevada.

- Specific issues raised in the comments include the need to acknowledge and assess the impacts on Native Americans, and more fully consider public safety, environmental impacts, environmental justice, funding to local governments, effects on land use, perception-based impacts of DOE activities, performance assessment, interaction of the repository program of local and regional plans, public participation, regulatory standards, schedule & licensing, socio-economic impacts, storage, and transportation issues.

DARIO HERRERA
Chairman

Board of County Commissioners

CLARK COUNTY GOVERNMENT CENTER
500 S GRAND CENTRAL PKY
PO BOX 551601
LAS VEGAS NV 89155-1601
(702) 455-3500 FAX: (702) 383-6041

July 5, 2001

Jane R. Summerson, EIS Document Manager
Yucca Mountain Site Characterization Office
Office of Civilian Radioactive Waste Management
U.S. Department of Energy
P.O. Box 30307, M/S 010
North Las Vegas, NV 89036-0307

RE: Supplement to the Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada

Dear Ms. Summerson:

Clark County has been designated an "affected unit of local government" under the 1987 amendments to the Nuclear Waste Policy Act. The attached comments to the Department of Energy's Supplement to the Draft Environmental Impact Statement (SDEIS) are hereby submitted as formal comments on behalf of the Clark County Board of Commissioners. The comments, as prepared by our staff, focus on both general and specific issues related to the new proposed action described in the SDEIS. Our most serious concerns relate to the new proposed repository design, the fuel blending proposal, transportation impacts, environmental impacts, and concerns over public input and other procedural issues.

We request that the Department of Energy consider and formally respond to our comments, as well as the comments we previously submitted in response to the Draft Environmental Impact Statement.

Sincerely,

Dario Herrera
Chairman

Clark County, Nevada

Formal Response

Dated July 5, 2001

to

DOE's Supplement to

Draft Environmental Impact Statement (SDEIS)

SUPPLEMENT TO THE DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR A GEOLOGIC REPOSITORY FOR THE DISPOSAL OF SPENT NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE AT YUCCA MOUNTAIN, NYE COUNTY, NEVADA (DOE/EIS-0250D-S)

FORMAL RESPONSE SUBMITTED BY
CLARK COUNTY, NEVADA
July 5, 2001

FORMAL RESPONSE SUBMITTED BY
CLARK COUNTY, NEVADA
July 5, 2001

Background

This formal response is submitted on behalf of the Clark County Board of Commissioners. It should be considered in addition to previously submitted formal responses to previous Department of Energy (DOE) documents, including the Environmental Assessment (1985), Scoping Document (1994) and the Draft Environmental Impact Statement (DEIS). All previous comments made by Clark County are hereby incorporated by reference.

Since 1983 Clark County has been an active participant in monitoring the DOE Yucca Mountain nuclear waste program efforts. In 1988, DOE designated Clark County as an *"affected unit of local government* (AULG)" under provisions of the Nuclear Waste Policy Act of 1987. The designation was an acknowledgement that activities associated with the Yucca Mountain Program could result in considerable impacts to our citizens and community. The concern about potential impacts was further emphasized by the Clark County Board of Commissioners' (the Board) approval of resolutions on January 8, 1985, April 5, 1988 and March 7, 2000 opposing the siting of a repository at Yucca Mountain. The Department of Comprehensive Planning has been designated by the Board to monitor Yucca Mountain Program activities.

On February 15, 2000 Clark County submitted to DOE an extensive document detailing comments associated with the DEIS. The Board also approved a resolution expressing concerns about the inadequacies of the DEIS in describing and analyzing potential impacts to our community. Of primary concern was the identification of a number of transportation routing and rail options in Clark County and Southern Nevada without a commensurate evaluation of the potential impacts to our tourist-based economy and quality of life.

Subsequently, the Board requested in its February 15, 2000 resolution that *"Since Clark County and other issues, appropriately required by the National Environmental Policy Act, are not adequately addressed in the DEIS, a new DEIS or a supplemental EIS for Yucca Mountain must be prepared by DOE to address failures in the current DEIS."*

General Comments

Clark County officials continue to be concerned that the DOE has failed to formally respond to any of the concerns raised in the past, in particular the formal response by Clark County to the DEIS. There was an expectation on behalf of commentors to previous documents that the SDEIS would attempt to address these concerns. Instead, the SDEIS is focused on a new proposal for repository design, and at best inadequately addresses, or at worst ignores, the issues that have been identified as problematic in previous formal responses and comments. In our opinion, the SDEIS is an inappropriate vehicle to introduce a "*new proposed action*" such as the flexible repository design described in the SDEIS.

Further, the new design seems to violate the terms of the Nuclear Waste Policy Act in two key areas. One area is the fact that the new design heavily relies on engineered barriers, and not on the geology of the mountain itself, as required under the Act. The fuel blending and

cooling facilities referred to in the SDEIS are *de facto* interim storage. The Act prohibits operating of an interim storage facility and a permanent repository on the same site. Another glaring omission that flies in the face of both NEPA and the NWPA is the lack of consideration of a programmatic EIS process, particularly for construction of the required infrastructure to support the project. Similarly, life cycle cost estimates for should have been included to reflect this *new proposed action.*

Clark County concurs with the Nuclear Regulatory Commission (NRC) and the Nuclear Waste Technical Review Board (NWTRB) that the introduction of a flexible design at this stage of the site characterization process offers nothing more than a moving target. This forces oversight agencies and the public to continually reevaluate data and reassess impacts that many times are vaguely addressed, or not at all addressed, by the DOE.

The SDEIS once again fails to address a multitude of issues of concern to the public elected officials and others in Clark County. Given that the DEIS listed a number of potential transportation routing options in Nevada, and in particular the Las Vegas Valley (e.g., the Beltway), it is unconscionable that these issues and related potential primary and secondary socioeconomic impacts have not yet been evaluated.

Clark County, the State of Nevada and the other affected governments are currently in the process of developing "Impact Assessment Reports" (IAR) that are intended to substantively address a host of significant community impact not evaluated in the DEIS. Affected government IAR information will accompany the *Site Recommendation.* As part of the National Environmental Policy Act (NEPA) DOE is preparing a *Public Response Document* (PRD) to inform the public and others on how comments to the DEIS were addressed. It is our understanding that current plans are to release the PRD at the same time as the Final Environmental Impact Statement (FEIS.) Clark County, however, has requested that DOE release the PRD well in advance of the FEIS release date to enable IAR preparation efforts to be more focused.

The Yucca Mountain Project is national in scope. It creates the potential for impacts in much of the United States, largely with respect to the transportation of the waste. By limiting the scope of inquiry, however, the SDEIS perpetuates an incomplete and inadequate understanding of the potential effects of a project of this magnitude and complexity. Moreover, it discounts the views expressed by a large number of concerned citizens throughout the nation who participated in last year's DEIS public meetings. Similarly, it conveys the message that these issues are not important.

Since the SDEIS does not describe a specific design for the repository, the information provides nothing to increase the public's knowledge of potential environmental impacts. Also uncertain is how DOE can provide a "site recommendation" when the SDEIS and Science and Engineering Report (S&ER) are still examining "flexible" repository concepts. Absent a specific design, it is also unclear how the site can be evaluated against a specific Environmental Protection Agency exposure standard siting guidelines.

Current TSPA analysis, as communicated to the Nuclear Waste Technical Review Board, during their June meeting showed that the DOE is now using an analysis that includes early waste canister failures. This means that the base case scenario, not including disruptive events, now shows releases during the expected compliance period. This is an outcome that has not been included in either the DEIS or the SDEIS. This is a major change in the long-term performance of the proposed repository and should be open for public comment prior to the release of the final EIS.

The following comments related to specific concerns with respect to those issues that have not been adequately addressed in the SDEIS, and that are of the most critical concern to Clark County.

Repository Engineering/Design

The site suitability decision on Yucca Mountain should be made with the confidence that the researchers building the predictive tools are adhering to high professional standards. Likewise, there should be strong assurances that the tools employed in the decision-making process have some validity. Reliance on these basic issues, however, is also questionable. The DOE Office of Quality Assurance, for example, issued a corrective action report on May 3, 2001, which, under the description of Condition #6 noted that *"Yucca Mountain personnel failed to consistently implement . . . requirements (AP-3.10Q) for model validation. Based on the lack of progress to resolve this deficient area through various deficiency reports the area of model validation is considered to be a significant condition adverse to quality."* Based on these deficiencies, both of which impact the TSPA-SR, it is imperative that the SDEIS and the Science and Engineering Report (S&ER) be reissued after the full impact of these conditions on the TSPA-SR and supporting documentation have been evaluated.

Page 3-19, Section 3.2. *Total System Performance Assessment* (TSPA-SR) will be the vehicle that is used to predict the long-term performance of the proposed repository. It is, therefore, one of the more critical elements in a Site Recommendation decision. On May 17, 2001 the NRC, in correspondence to the DOE, noted calculation errors and inconsistencies during a review of TSPA-SR documentation. The errors and inconsistencies in the TSPA-SR and the model validation issues, however, basically will cast a doubt on any conclusions reached using the TSPA-SR. With no confidence in the calculations it places the data in Table 3-14 in question, and makes statements such as the "*waste packages would remain intact for as long as or longer than for the higher temperature mode"* suspect.

Page 2-8 (Lower-Temperature Repository Operating Mode), notes that "placing younger fuel in surface aging facility" could vary thermal outputs. In essence this is recommending the development of an interim storage facility at the Yucca Mountain site. Construction of such a facility, of course, violates the provisions of the 1987 Amendments to the Nuclear Waste Policy Act (NWPAA), which prohibits the siting of a repository and an interim storage facility in the same state. In addition to its illegality, the construction of such a facility would require a separate EIS process. Certainly, it must be acknowledged that any additional surface facilities necessary to implement the *new proposed action* would require a separate EIS process. Indeed, as is the case with the Private Storage Facility in Utah, proposed for the Skull Valley Goshute

Reservation, it would require a separate EIS. Ideally, the EIS processes for the DEIS and the SDEIS would have been programmatic in nature, and more comprehensively addressed all of the environmental issues inherent in what the DOE recognizes as "the largest public works project in history."

Page 2-20 illustrates a number of repository layouts. The "Flexible Design" and "Low Thermal Load" layout options extend further north than the proposed design. These, therefore, appear to extend closer to a location where, in previous analyses, the groundwater level would be closer to the repository horizon. This is not discussed or described, however, in the SDEIS.

One of the primary reasons for issuing the SDEIS would appear to be to evaluate the performance of a lower temperature repository option. It is not clear to Clark County how this evaluation can be made when some of the near field models used are not coupled and do not consider the critical temperature dependence of coupled chemical hydrological processes and their subsequent effect on corrosion.

On Page 3-20 Section 3.2.2 the DOE indicates that the software for the integration of the TSPA has been changed. Even though this is an important and major change from the DEIS no analyses were shown that would indicate the scope and effect of this change on the TSPA.

Fuel Blending Proposal

The Fuel Blending process mentioned in the SDEIS is not discussed in detail in either the DEIS nor in the SDEIS. The SDEIS should contain a full description of the proposed fuel blending process. This description should include a complete estimate of the NEPA cognizable impacts that will occur as a result of the proposal. This information is not contained in the SDEIS. Clark County has two specific concerns with regard to the fuel blending facility. The first is impact related. The second is perceptual.

The fuel handling facility necessary to implement the action proposed by the SDEIS is itself a significant impact that is not assessed in the SDEIS. There are numerous unanswered questions about the facility. These questions should have been addressed in the SDEIS.

- How many rods will the facility handle at a time?
- What operations are performed on the rods?
    - Inspection
    - Removal from packaging
    - Characterization
- Replacement into packaging
- How many people are employed?
- What is the size of the budget for the facility?
- How long did it take to construct? License? Etc…
- What special emergency management precautions are provided to surrounding communities?

Employment at the facility is expected to reach 2000 persons. Approximately ninety percent of the 2000 persons expected to be employed at the fuel handling facility will live in Clark

County. Based on traditional planning calculations the following impacts on municipal services are likely to be experienced.

$1,972,125	Park Cost
$375,000	Fire Station Costs
$155,000	Police Station Costs
$68,400	Traffic Signal Costs
$12,236,574	Elementary School Cost
$5,760,000	Middle School Cost
$7,860,262	High School Cost
$28,427,361	Total Direct Costs to Clark County

Figure 1 Direct Costs to Governments in Clark County due to Fuel Blending

Clark County is also concerned about the increased likelihood of stigma associated with the fuel blending proposal. The SDEIS proposes to construct a vast, complex nuclear fuel handling facility unlike any other in the world. The nearest similar type of facility is the controversial B-205 plant at Sellafield, England. The B-205 facility has a capacity of 1,500 tons per year. The fuel blending facility proposed in the SEIS will require handling 3,000 tons per year.

The handling of highly radioactive HLW in the pool building will create additional opportunities for accidents. Releases of radioactive materials from accidents may or may not be contained in the pool storage and blending area. The mixing of SNF assemblies of different sizes and different radiological characteristics, from different fuel batches and/or reactors, will create numerous opportunities for errors (e.g. insertion of incorrect assembly in disposal canister, insertion of assembly in incorrect disposal canister cell, etc). Deliberate sabotage also becomes easier and more likely with the additional step of fuel handling. Cleanup after accidents will likely increase worker exposures and generate additional streams of LLW, Mixed Wastes, and possibly HLW.

Publicity about these errors will naturally draw public scrutiny to Las Vegas and to the program itself. Nevada will continue to be stigmatized as a "garbage state." Clark County will naturally be harmed by this activity. The SDEIS does not examine this problem. It does not state how the DOE proposes to mitigate these stigma effects and it does not provide persuasive evidence that they do not exist.

Transportation Impacts

Transportation system impacts are defined as: changes to the operation, condition, and performance of the transportation network in Clark County, Nevada that are attributable to the Yucca Mountain Project or the Department of Energy's (DOE) Environmental Management operations. These comments are organized as a discussion of significant issues. After a brief introduction each issue area is discussed.

Unfortunately, it is impossible to prepare definitive comments on the impacts attributable to the *new proposed action* (NPA) due to the DOE's failure to provide specific information about its program. The SDEIS fails to respond to criticism leveled at the DEIS's transportation

analysis. For example the SDEIS fails to describe the mix of modes (i.e. rail and truck) necessary to implement the NPA. Another qualification is necessary. The drastic changes to the proposed action contained in the SDEIS invalidate any conclusions contained in the DEIS. To avoid confusion, the Proposed Action described by the DEIS is abbreviated as the PA and the *New proposed action* described by the SDEIS is abbreviated as NPA. Clark County has provided extensive comments about the inadequacies of the DEIS in our comments on that document. These comments will not be repeated here. The salient point is that not enough is known about the DOE's transportation program to adequately assess it. The SDEIS is deficient because it fails to rectify the shortcomings identified in the DEIS.

Transportation of HLW to Yucca Mountain is an indirect effect of the NPA under NEPA because 1) the effects are a consequence of the proposed action (i.e. construction of the Yucca Mountain HLW disposal facility) 2) the effects of this transportation are removed in time and location from the repository itself. The Council on Environmental Quality defines cumulative impact as "...the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions..." The use of NTS as a Low Level Waste (LLW) disposal site fit this definition. The Waste Management Programmatic EIS (WMPEIS) made it clear that most of the LLW from these sites will be shipped to the NTS for permanent disposal. For the foreseeable future, the most likely mode of transport for these wastes is by legal-weight truck on the highway system. Although the DOE has engaged in a cooperative effort with Clark County to avoid transporting LLW over the Hoover Dam and through downtown Las Vegas, it is clear that if HLW is transported through Las Vegas, the DOE will have little incentive to incur extra expense shipping LLW away from Clark County. Therefore the cumulative impact examined in this report is the effect an 268,000 shipments of LLW from DOE nuclear weapons production sites to the Nevada Test Site (NTS) will have on the transportation system that will be used to transport HLW to Yucca Mountain.

Clark County is within the region of influence of Yucca Mountain Program (YMP) for transportation because Congress identified the interstate highway system as the default route for the transportation of HLW. The most direct route from power generating sites to Yucca Mountain is the interstate highway system through Clark County. Therefore most of the truck trips from shipping sites will pass through Clark County.

The shortest routes from the waste generating sites to Yucca Mountain pass through Clark County en route to Yucca Mountain. Congress anticipated efforts to avoid transportation of waste through particular areas. That is why they designated the Interstate highway system as the default transportation route for the movement of HLW to a repository in the NWPAA. Therefore, any effort to avoid shipping any of these waste streams through Clark County will be met with requests from other similarly affected areas. The result of these requests will be an uneconomical routing process that will be both circuitous and expensive. Clark County assumes that the interstate highway system through Clark County will be the primary route used to transport waste to Yucca Mountain.

Because the majority of the truck-transported HLW will pass through the county en route to Yucca Mountain, the transportation impacts will be concentrated in Clark County. The

Nuclear Regulatory Commission identified Clark County as part of the maximally affected region in the nation in an Environmental Impact Statement.

The DEIS assumed that DOE would be able to ship HLW using Clark County's planned northern and western beltways. However, these "beltways" are unlike beltways in other communities in several important respects. First, Clark County's beltway system is entirely paid for with local tax dollars and is not part of the Federal Highway System. As a result, Clark County's beltway is ineligible as a HLW route under Appendix A of HM 164. Another concern is that the beltway is being constructed as a frontage road rather than as a typical beltway facility. This is another reason Clark County's beltway system is ineligible as a transportation route. This means the primary route used for the truck transportation of HLW is likely to be Interstate 15 and US Highway 95 through Las Vegas. The SDEIS did not consider our comments in this area. However, the assumption that DOE cannot use the Clark County beltway system was used in this assessment.

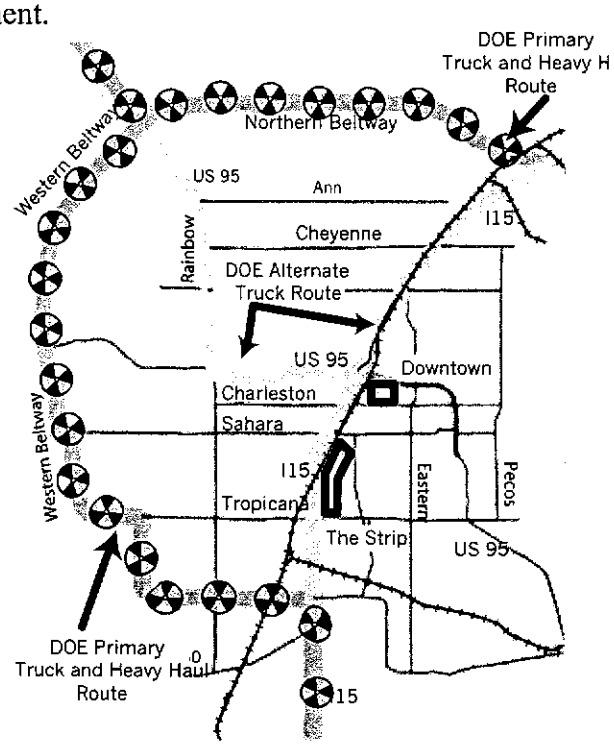


Figure 2 Truck Transportation Routes Through Urban Clark County

The SDEIS fails to examine the consequences of the fuel-blending proposal that is the heart of the NPA. In order to implement fuel-blending, younger, hotter spent fuel will have to be transported to mix with older, cooler fuel. The addition of hotter fuel has enormous impacts on the transportation system that were not considered in the SDEIS.

Truck transportation casks are licensed to transport five-year old fuel. Rail casks are licensed to transport ten year-old fuel. As a result, the fuel-blending proposal in the NPA requires truck transportation and may eliminate the justification for rail transportation entirely. It is likely that constructing a rail line for a relatively modest number of shipments will be uneconomical. Additionally, moving hotter, younger fuel will prevent the maximum number of

fuel assemblies from being transported in each waste package. The likely increase in truck trips cascades through the transportation system. A conservative estimate suggests that the number of truck shipments will double from 2100 shipments per year to 4200 shipments per year. A total of 100,000 truck shipments for the NPA is a reasonable estimate.

The DEIS estimated the consequences of the maximum reasonably foreseeable accident (MRFA) based on 26 year-old spent fuel. The change to shipping younger fuel invalidates the risk assessment provided in the DEIS. The SDEIS should have contained a risk assessment based on the types of fuel that will be shipped. A better analytical approach would establish boundaries of the worst case. That is, the SDEIS should have provided a risk assessment of the MRFA with five-year old fuel and twenty-six year old fuel to describe the effects of both the best and worst cases. The SDEIS fails to describe the fuel shipping campaign. The SDEIS should have contained specific information about the timing and composition of the shipments. The SDEIS fails to provide a description of the national routes that will be used to transport the waste from the reactors to Yucca Mountain.

The fuel-blending proposal may not be feasible because of the standard contracts with utilities that describe the order in which the DOE must accept the SNF from the utilities. It is entirely possible that the fuel-handling facilities will have to be significantly different than described in the SDEIS in order to accommodate a wide range of significantly different types of fuel necessary to make fuel-blending possible. The SDEIS should have carefully described how the NPA will avoid these problems.

The changed numbers of truck shipments increases the number of traffic accidents that can be expected to take place in Clark County. The Bureau of Transportation Statistics accident rate for legal-weight trucks is 233 accidents for every 100,000,000 shipping miles. Therefore, a forecasted number of accidents that will take place in Clark County due to the NPA is approximately 23. None of the costs or transportation system effects due to the NPA are assessed by the SDEIS. These accidents are directly attributable to the NPA. The cumulative impact of the NPA and the shipment of LLW to the Nevada Test also increases.

The number of accidents due to the transportation of LLW to the Nevada Test Site (NTS) for disposal is estimated at 72. Based on historical accident rates, up to eighty-five accidents involving DOE radioactive materials shipments will take place in Clark County. Approximately 3 accidents involving DOE radioactive materials will take place in Clark County each year. The DEIS does not discuss the consequences of these accidents anywhere.

The EPA issued transportation conformity regulations on Nov 24, 1993 to implement section 176(c) (4) of the Clean Air Act as amended. The transportation conformity regulations apply to actions of the FHWA and FTA. Actions of other federal agencies, including other transportation agencies are covered by the general conformity regulations issued by the EPA on November 30, 1993. The DOE is covered by these general conformity regulations.

The Las Vegas Valley is classified by the U.S. Environmental Protection Agency as a serious non-attainment area for carbon monoxide (CO) and particulate matter (PM_{10}). The Clark County Regional Transportation Commission is responsible for establishing CO and PM_{10}

emissions and for demonstrating conformity. Because Clark County is a non-attainment area for air quality emissions, the pollutants generated by the NPA are of concern. Air quality impacts are important to Clark County for regulatory purposes that are not considered in the SDEIS. The construction and operation of NPA transportation facilities effects the ability of Clark County to meet national air quality standards. Failure to meet these standards will harm Clark County's ability to obtain Federal funding for transportation facilities and will generally harm the quality of life in Clark County.

Vehicular emissions are the primary source of CO pollutants, whereas construction activities are the primary source of dust (PM_{10}) in the Valley. In addition to vehicle miles of travel, congestion is a significant contributor to increased CO emissions.

Projected carbon monoxide emissions calculated by the Regional Transportation Commission for the projected roadway types, travel speed characteristics, and emission factors using the Mobile 5b model are:

Facility Type	Major Arterial (four lane)
Posted Speed	45 mph
Free Flow Speed	45 mph
Average Travel Speed	35 mph
Congested Speed	20 mph

Figure 3 Uncongested Travel Speed Characteristics and Carbon Monoxide Emissions

45 mph	4.87 grams/mile
35 mph	6.82 grams/mile
20 mph	13.51 grams/mile

Figure 2 Emission Factors and carbon dioxide emission factors

These emission factors are used to calculate the amount of air quality impact on Clark County attributable to the YMP.

The emissions for the construction phase air quality impact cannot be calculated because not enough information is provided by the SDEIS on the vehicle trips required to construct and operate the facility. During the operational phase of the NPA there will be significant air quality problems. The impacts on air quality due to legal-weight truck shipments will be very substantial. The results of the analysis are presented below.

Pollutants	Truck Air Quality Impacts
CO2	48,213,000
PM10	47,223,000

Figure 3 Total Grams of Air Pollutants During the Operational Phase

The cumulative impacts due to the shipment of LLW to the NTS are assumed to be the emissions from the legal-weight trucks that will traverse the valley en route to the NTS. Because these shipments take place on the region's freeways, the emission factors for higher speeds are used. The cumulative impacts of LLW transportation are below.

Air Quality Impact	Cumulative Impacts
CO2	182,274,840
PM10	869,450,987

Figure 4 Cumulative Air Quality Impacts

The upper boundary of the air quality impacts on the residents of Clark County due to air quality pollution caused by the NPA and the disposal of LLW at the NTS are:

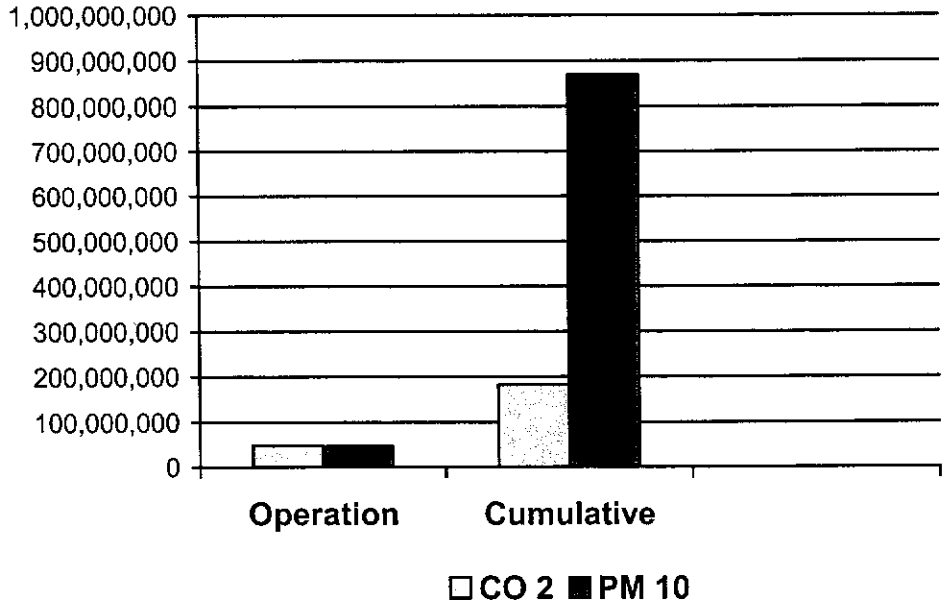


Figure 5 Air Quality Impacts on Clark County

The air quality impacts due to the YMP will substantially degrade Clark County's air quality. They will make it increasingly difficult for local government to meet air quality goals and could cause other Federal agencies to take punitive action on Clark County due to the YMP. The NPA should have been prepared to accommodate the regional transportation plans and conform to the FHWA's regulations for statewide planning.

Public Involvement/Procedure

Clark County's comments to the DEIS were submitted to DOE on February 15, 2000, well over a year ago. The DOE has not responded to the issues raised in our review. In fact, the DOE asserts that they will not be making any formal response back to any of the comments, and have stated that they intend to merely append the public comments to the Final Environmental Impact Statement (FEIS) that will be submitted to the Secretary of Energy. The DOE's failure to respond to the public comments could suggest a lack of recognition of public concern.

Finally, it is interesting to note that national stakeholders do not appear to have an opportunity to express their views on the SDEIS at public hearings. In the original review of the DEIS, citizens in venues throughout the nation, appropriately, had opportunities to offer public comments. Hearings held in other parts of the nation will enable others to consider the SDEIS, important since its treatment or non-treatment of issues will affect them as well. Furthermore, since there are ten affected units of local government in Nevada and California, DOE should hold also hearings in other areas of Nevada, or in Inyo County in California.

Conclusion

The SDEIS lacks sufficient verifiable data to be relied upon, properly analyzed, or even commented on in a comprehensive manner. The SDEIS lacks sufficient analysis and full consideration with respect to repository engineering/design, transportation impacts, environmental impacts, and public involvement and procedural considerations. There is serious doubt as to compliance with both NEPA and the NWPA with respect to the proposed "flexible" repository design. Clark County's position is that sufficient unanswered questions exist to call into question the accuracy, adequacy and appropriateness of the SDEIS. The DOE is therefore urged to withdraw the SDEIS until such time as the DOE is prepared to submit a SDEIS that adequately address both the concerns raised in the DEIS process and the gaps and errors found in the SDEIS in its present form. Further, we urge the DOE to republish the SDEIS incorporating the S&ER to ensure compliance with NEPA regulations.

Clark County, Nevada

Formal Response

Dated October 19, 2001

to

DOE's Preliminary Site Suitability Evaluation (PSSE)

PRELIMINARY SITE SUITABILITY EVALUATION FOR A GEOLOGIC REPOSITORY FOR THE DISPOSAL OF SPENT NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE AT YUCCA MOUNTAIN, NYE COUNTY, NEVADA

FORMAL RESPONSE SUBMITTED BY
CLARK COUNTY, NEVADA
October 19, 2001

FORMAL RESPONSE SUBMITTED BY CLARK COUNTY, NEVADA October 19, 2001

Background

This formal response to the Department of Energy's (DOE) Preliminary Site Suitability Evaluation (PSSE) is submitted on behalf of the Clark County Board of Commissioners. It should be considered in addition to previously submitted formal responses to previous Department of Energy documents, including the Environmental Assessment (1985), Scoping Document (1994), the Draft Environmental Impact Statement (DEIS), and the Supplemental Draft Environmental Impact Statement (SDEIS). All previous comments made by Clark County are hereby incorporated by reference.

Since 1983 Clark County has been an active participant in monitoring the DOE Yucca Mountain nuclear waste program efforts. In 1988, DOE designated Clark County as an *"affected unit of local government* (AULG)" under provisions of the Nuclear Waste Policy Act of 1987. The designation was an acknowledgement that activities associated with the Yucca Mountain Program could result in considerable impacts to our citizens and community. The concern about potential impacts was further emphasized by the Clark County Board of Commissioners' approval of resolutions on January 8, 1985, April 5, 1988 and March 7, 2000 opposing the siting of a repository at Yucca Mountain. The Department of Comprehensive Planning has been designated by the Board to monitor Yucca Mountain Program activities.

General Comments

Prior to outlining specific comments on the PSSE, it should be noted that Clark County has joined the other affected units of local government in requesting a minimum sixty day extension of time for the public comment period, originally scheduled to close on September 20, 2001. As it stands now, the response time was only extended to October 19, 2001, less than one week after the conclusion of hearings scheduled at various locations in Nevada. Only one formal hearing was scheduled in Clark County, on September 5, 2001.

The PSSE is premature and incomplete. It does not provide an adequate basis for consideration of the site recommendation by the Secretary of Energy, the President of the United States, or Congress. Further, absent the existence of a Final Environmental Impact Statement and final siting guidelines, it is inappropriate for these public hearings to go forward at this time.

Too many unanswered questions remain. Heavy reliance on engineered barriers and the absence of adequately tested, full-scale waste packages creates an unacceptable level of uncertainty where there is the greatest level of performance expectation.

The PSSE fails to address a multitude of issues of concern to the public, elected officials, and others in Clark County. Given that the DEIS listed a number of potential transportation routing options in Nevada, and in particular the Las Vegas Valley (e.g., the Beltway), it is

unconscionable that these issues and related potential primary and secondary socioeconomic impacts have not yet been evaluated.

Clark County's comments to the DEIS were submitted to DOE on February 15, 2000, well over a year ago. Clark County, along with the City of Las Vegas, and the State of Nevada, submitted comments to the SDEIS on July 5, 2001. It is still uncertain, however, how (or whether) DOE has considered the issues raised in our reviews of these documents. The DOE's plan to merely categorize and append the thousands of comments received to the DEIS and SDEIS in response to our concerns is an unacceptable procedure under the requirements for the Final Environmental Impact Statement.

The DOE continues to disregard the notion that the Yucca Mountain Program is national in scope. The magnitude of this program creates the potential for impacts in much of the United States, largely with respect to the protection of public health and safety of over 50 million United States residents affected by the transportation of high-level nuclear waste through at least 43 states. The DOE continues to discount the views expressed by a large number of concerned citizens throughout the nation who participated in last year's DEIS public meetings. By its own actions it conveys the message that these issues are not important.

Since the PSSE does not describe a specific design for the repository, the information provides nothing to increase the public's knowledge of potential environmental impacts. Also uncertain is how DOE can provide a "site recommendation" when "flexible" repository concepts are still in the planning and design phases. Absent a specific design, it is also unclear how the site can be evaluated against DOE's siting guidelines.

Specific Comments

Repository Design

Attached as Appendix A is a report dated October 4, 2001. This report, prepared by SC&A, Inc., is entitled "Final Report on Review of the U.S. Department of Energy Yucca Mountain Preliminary Site Suitability Evaluation and Supporting Documents." This review resulted in the following key technical findings:

- ***The regulatory framework for site suitability findings is incomplete and the validity of DOE findings is therefore uncertain.***

- ***The PSSE and its principal supporting documents do not describe a specific engineered system design to serve as basis for the performance evaluations. A specific basis for performance expectations has therefore not been provided.***

- ***Repository system performance factors depend strongly on temperature, but DOE's evaluations show no significant dependence of performance on temperature. The validity of DOE's performance assessment models and results is therefore highly uncertain.***

- ***Performance of the repository during the regulatory period is, under DOE analyses, totally dependent on the performance of the Alloy 22 outer wall of the waste package, but the technical basis for confidence in performance of Alloy 22 is weak and will remain uncertain.***

- ***DOE's performance assessment results to assess compliance with radiation protection standards show great variations which depend on modeling methods and assumptions. The reliability of the models, and of the results as a measure of performance, is therefore suspect.***

- ***DOE uses "one-off" analyses to assess the contributions of individual performance factors to overall system performance, but has not reported an analysis in which the contribution of the most important performance barrier, the Alloy 22 wall on the waste packages, is clearly evaluated.***

- ***Interactions between thermal, hydrologic, chemical, and mechanical phenomena may control repository performance and performance-evaluation uncertainty, but DOE's models for these phenomena cannot be confirmed.***

- ***Comprehensive, independent peer technical review of all aspects of DOE's analyses and results is needed in order to have a defensible scientific basis for the site suitability evaluation.***

Transportation Impacts

This section contains Clark County's comments on PSSE as they relate to transportation system impacts. Transportation system impacts are defined as: changes to the operation, condition, and performance of the transportation network in Clark County, Nevada that are attributable to the Yucca Mountain Project or the Department of Energy's (DOE) Environmental Management operations. These comments are organized as a discussion of significant issues. After a brief introduction each issue area is discussed.

The PSSE reveals a critical flaw in the DOE's site characterization strategy. The DOE has proceeded from the assumption that transporting waste to Yucca Mountain is not an inherently difficult or expensive problem and that characterization of the site is possible without considering the difficulties of transporting the waste to a remote site without rail access. This approach deemphasizes critical components of the overall program (transportation, cask fabrication, etc.). Instead, it focuses primarily on geology and the engineered barriers related to the mountain itself. This failure to provide a systematic evaluation of important characteristics of the site will ultimately increase the risks and costs and, at the same time, further decrease public confidence in the feasibility of the program. This gap in DOE's site characterization strategy ensures that the PSSE is an incomplete document and that the public does not possess a realistic assessment of the suitability of the site.

Environmental Concerns

Another issue the PSSE did not address is the suitability of the site for a massive "fuel blending" facility that will be required due to the changes in the Yucca Mountain Program described by the Supplemental EIS. It is clear that the facility required will be substantial. It will require, at a minimum, a fuel handling facility capable of handling three times the capacity of fuel as any currently existing facility. A huge spent fuel pool will also be required to cool fuel rods prior to emplacement in the mountain. Because of the remoteness of the site, the support facilities for thousands of employees will also be necessary. The ability and location of these facilities is nowhere described in the PSSE.

The analysis for this proposed "fuel blending facility" is not adequate, because it fails to adequately address impacts related to air quality, water quality and supply, sanitation, and the consequences of interference with multiple species habitat conservation.

Public Involvement/Procedure

In addition to the hearings held throughout Nevada and Inyo County, California, we urge the DOE and the Secretary of Energy to include stakeholders throughout the United States, and allow them to have an opportunity to express their views on the PSSE at public hearings. Hearings held in other parts of the nation will enable others to express their opinions on the PSSE. This is important since the DOE's consideration of these issues affects them as well.

Conclusion

The significant changes included in the Supplement to the Yucca Mountain Draft EIS fundamentally change the impacts and characteristics of the program. These changes invalidate the conclusions in the *Report on Assessment of Fee Adequacy Based on FY 1999 TSLCC of December 1999 and the Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program* (May 2001). The failure to consider the site in a systematic way in the PSSE and by the Yucca Mountain Program guarantee that elected officials will receive an incomplete and misleading assessment of the feasibility and impacts of the Yucca Mountain Program. Clark County believes the PSSE should be withdrawn until an integrated analysis of the site's suitability can be conducted. An assessment of this type should examine both the effects on lifecycle costs and on the potentially difficult interactions between the new surface facilities and the disposal site itself. This assessment should also be part of a document that falls within the NEPA framework with the necessary public access and review.

Final Report on Review of the U.S. Department of Energy
Yucca Mountain Preliminary Site Suitability Evaluation
and Supporting Documents

Prepared by:

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McLean, Virginia 22101

Under

P.O. Number 156281

Prepared for:

Nuclear Waste Division
Clark County, Nevada

October 4, 2001

APPENDIX A
CLARK COUNTY PSSE COMMENTS
OCTOBER 15, 2001

Final Report on Review of the U.S. Department of Energy
Yucca Mountain Preliminary Site Suitability Evaluation
and Supporting Documents
for
Clark County, Nevada

October 4, 2001

S. Cohen & Associates, Inc. (SC&A) has reviewed, for Clark County, Nevada, the Yucca Mountain Preliminary Site Suitability Evaluation (PSSE; released by the U.S. Department of Energy (DOE) in August 2001) and numerous documents previously issued and stated by DOE to support the PSSE. This report presents the principal results of the reviews.

I. SYNOPSIS OF PRINCIPAL FINDINGS

The regulatory framework is currently incomplete, and the proposed repository can meet regulatory requirements only if the DOE siting guidelines are revised to make total system performance assessment (TSPA) the basis for site suitability evaluation.

DOE has not provided a specific repository design to serve as the basis for site suitability evaluation.

The validity of DOE's performance assessment models and results that support the PSSE is uncertain. Results do not show expected dependence on temperature, and available information does not permit determination of the validity of the models.

A high temperature repository may be unacceptable because of uncertainty issues associated with the effects of temperature on the physical features of the repository, and a low-temperature repository may be unacceptable because of site characterization uncertainty issues associated with need to expand the repository footprint.

Performance of the proposed repository during the regulatory period is directly dependent on the performance of the Alloy 22 outer wall of the waste package. An independent peer review panel has determined that: the data base for Alloy 22 performance is currently weak; current corrosion models are inadequate to support the necessary extrapolations of performance; and there are three sources of potential for changes in the passive film that provides corrosion resistance, but potential for film changes is currently unknown.

Performance assessment results to assess compliance with radiation protection standards show variations for alternative models which suggest that the results are more an artifact of the models used than a realistic reflection of actual performance.

Although performance of the proposed repository depends on the Alloy 22 performance during the regulatory period, DOE has not clearly and singularly characterized the role of the Alloy 22 in overall system performance.

Models that describe the effects of temperature on the physical features of the repository cannot be validated.

Because all program technologies are on the cutting edge of knowledge and understanding, independent peer review of all aspects of DOE's analyses and results is needed in order to have confidence in the scientific basis for site suitability evaluation. Peer review of the supplemental TSPA models and results is especially needed in order to assess the scientific basis for the site suitability evaluation.

II. PRINCIPAL REVIEW FINDINGS

1. The regulatory framework for site suitability findings is incomplete and the validity of DOE findings is therefore uncertain.

The Nuclear Waste Policy Act of 1982 assigned responsibility for generally applicable environmental protection standards for radioactive waste disposal to the U.S. Environmental Protection Agency (EPA). The U.S. Nuclear Regulatory Commission (NRC) was assigned responsibility for regulations to implement the EPA standards and for licensing of disposal facilities, and DOE was given authority to develop regulatory guidelines for determining the suitability of candidate disposal locations. The Nuclear Waste Policy Amendments Act of 1987 directed that only the Yucca Mountain site be initially characterized, and the Energy Policy Act of 1992 (EnPA) directed EPA to develop site-specific radiation protection standards for Yucca Mountain.

The EPA radiation protection standards for Yucca Mountain, 40 CFR Part 197, were made final in June 2001. These standards will be implemented by the NRC regulations, 10 CFR Part 63, and DOE's site suitability guidelines, 10 CFR Part 963. These NRC and DOE regulations will be revisions of previous NRC and DOE regulations (10 CFR Part 60 and 10 CFR Part 960, respectively) that were established prior to enactment of the EnPA; the revisions will be intended to conform to the EPA standards.

At the time the PSSE was issued, neither the NRC nor the DOE regulations had been made final. This is particularly important because DOE's original, and currently effective, siting guidelines, 10 CFR Part 960, state that natural features of the repository system should be the principal basis for performance of the repository system. In contrast, the proposed 10 CFR Part 963 guidelines

call for use of total system performance assessments (TSPA) to evaluate performance and do not favor natural barriers over engineered barriers in achieving compliance with the radiation protection standards.

The TSPA approach is essential to the validity of DOE's suitability findings reported in the PSSE because, with the current engineered design, performance of the proposed Yucca Mountain repository is totally dependent on performance of the engineered barriers, rather than the natural barriers, during the 10,000-year regulatory period. Only if the DOE regulations are revised can the proposed repository meet regulatory requirements.

2. The PSSE and its principal supporting documents do not describe a specific engineered system design to serve as basis for the performance evaluations. A specific basis for performance expectations has therefore not been provided.

In response to comments on the Viability Assessment (VA), issued in December 1998, DOE devised and characterized five alternative repository designs for future consideration. The design option selected from this suite to be the basis for subsequent studies had, as its principal features, an areal thermal loading of 85 metric tons of uranium (MTU) per acre; spacing between parallel drifts of 81 meters; end-to-end horizontal emplacment of waste packages, each approximately six feet in diameter and 18 feet long, in the drifts; and waste-package designs involving an outer wall of Alloy 22 (a highly-corrosion-resistant nickel-based alloy), an inner wall of stainless steel, and a surface temperature limit of 160 degrees Centigrade. This is a "hot" repository for which water in the pore spaces and fractures in the geologic medium surrounding the drifts would boil and be driven away from the repository horizon.

Reviewers of the Yucca Mountain program (e.g., the Nuclear Waste Technical Review Board, NWTRB) expressed concern that the temperatures associated with the hot repository could cause coupling of thermal, chemical, hydrologic, and mechanical effects, and that this coupling could produce significant uncertainty in performance-assessment results because it is poorly understood and cannot be modeled with confidence. Consideration of a low temperature repository was recommended to DOE.

In response to these recommendations, DOE examined means to achieve a cool repository using the hot repository design. The PSSE states that DOE "...has developed a flexible design..." that permits operation over a range of thermal modes. The thermal mode can be selected by adjustment of factors such as ventilation rates and distance between waste packages in the

excavated drifts. The actual performance of the repository system may depend strongly on which operating factors are selected.

DOE performed analyses in support of the PSSE using the hot repository design and conditions that were termed the "high-temperature operating mode" (HTOM) and the "low-temperature operating mode" (LTOM). The basic difference between the two modes was the waste package surface temperature limit of 160 and 85 degrees Centigrade, respectively, for the HTOM and the LTOM.

The temperature limits could be met by various means, including alternative designs and alternative operating conditions. One major option would be to vary the spacing between drifts, but all HTOM and LTOM analyses were done for a drift spacing of 81 meters, i.e., the design parameter previously established by DOE for analysis of post-VA design options. Preservation of the 81-meter spacing simplified DOE's analysis of options; i.e., it enabled use of the same basic design to investigate alternative operating conditions. In adopting this approach, DOE did not consider a design specifically selected for a low temperature repository.

As suggested by the NWTRB, it could be advantageous to select the LTOM option in order to reduce performance uncertainties associated with coupled effects. Operating characteristics to achieve this objective with what is basically a high temperature design (e.g., use of the HTOM design with high ventilation rates) could, however, be impractical and unacceptable.

An alternative, designed-to-the-purpose way to achieve a low temperature repository would be to increase the drift spacing beyond 81 meters. This strategy could, however, require DOE to increase the repository footprint beyond the site area that has been characterized to date as the basis for TSPA evaluations.

Expansion of the repository footprint would necessitate investment of an extended schedule and expanded fiscal resources for site characterization. Additional area would have to be characterized at least to the same extent as has been accomplished for the current repository footprint. Because of the characteristics of the geologic features in the vicinity of Yucca Mountain, it would be necessary to characterize and use, for a low-temperature repository, the area to the north of the current repository footprint. This is the location of a large ground-water hydraulic gradient and is a region of high geologic complexity. The uncertainties in repository performance introduced by having to include this region in the repository footprint could more than offset the uncertainty reduction associated with avoiding the coupled effect issues.

In sum, a high temperature repository at the Yucca Mountain site may be unacceptable because of the coupled effect uncertainty issues and a low-temperature repository may be unacceptable because of site characterization uncertainty issues.

DOE's analyses to date have not, however, been based on a specific design for either the HTOM or the LTOM. A specific basis for obtaining performance assessment results and characterizing their uncertainties for HTOM and LTOM repositories has therefore not been provided.

3. Repository system performance factors depend strongly on temperature, but DOE's evaluations show no significant dependence of performance on temperature. The validity of DOE's performance assessment models and results is therefore highly uncertain.

All of the processes and phenomena important to repository system performance are temperature- dependent. For example, chemical reaction-rate processes, such as corrosion, typically double in rate for every 10 degrees Centigrade increase in temperature. For the temperature range considered in DOE's HTOM and LTOM analyses, it would therefore be expected that, from 85 degrees Centigrade to 160 degrees Centigrade, the corrosion rate of the waste package outer wall, Alloy 22, would double by seven-fold, or approximately a factor of 125. DOE's analyses show however, that overall system performance is virtually independent of temperature. The analyses also showed that system performance during the regulatory period is essentially totally dependent on the Alloy 22 performance and that performance of some sub-system elements is dependent on temperature.

DOE 's performance assessments showed a small difference between HTOM and LTOM performance in the first few thousand years, which was attributed to differences in Alloy 22 corrosion rates at HTOM and LTOM temperature conditions. Beyond about 8,000 years, overall performance for the HTOM and LTOM systems was essentially the same.

One possible explanation for the inconsistency between expectation of repository performance on temperature and DOE's finding that performance is essentially independent of temperature is that, because so many factors are involved in total system performance (on the order of 2,000), the effect of changes in Alloy 22 corrosion rate are masked by the combined effect of other factors and the complexity of the integrated and interactive performance models for the various elements of the repository system. If this is the case, DOE's models and results do not distinguish and identify the relevant factors. The compensating effect of each of the factors should be assessed so that there is confidence that the effects of temperature have been adequately considered in the analyses.

DOE has developed a temperature-dependent model for Alloy 22 corrosion and stated that it is a key factor in the performance-assessment results supporting the PSSE. However, as discussed in Section 4 below, available data are not sufficient to serve as a reliable basis for the model or to confirm that the model is realistic. It is possible that corrosion of Alloy 22 does not follow the usual rules for chemical reaction phenomena because it forms a highly passive corrosion film that inhibits "normal" corrosion processes; a model based on conventional corrosion phenomena would then be incorrect. As has been noted by the NWTRB, a fundamental understanding of the mechanisms of formation and stability of the Alloy 22 passive film is essential for reliability in extrapolation of its presence and effectiveness for long periods of time. To date, the essential understanding has not been achieved.

The temperature-dependent Alloy 22 corrosion model may have had a profound impact on DOE's performance assessment results. In the TSPA for the Site Recommendation, which was published by DOE in December 2000 and did not use the temperature-dependent model, the projected annual radiation dose rate at 100,000 years was 10 mrem/yr. In the supplemental TSPA, which was published in July 2001 and did use the temperature-dependent corrosion model, the projected dose rate at 100,000 years was a factor of one million less, i.e., 0.0001 mrem/yr. The basis for the difference in these results may lie in the temperature-dependent corrosion model, but it has not been explicitly addressed by DOE.

Another possible explanation for the lack of difference in HTOM and LTOM results is that use of the same repository design for both types of analyses, with emphasis on differences in operating conditions, did not capture the different effects of temperature that would exist in repositories specifically designed for the different temperature limits. A low-temperature repository, with drift spacings greater than 81 meters, could, for example, have coupled effects impacts on the hydrogeologic regime around the drifts that are significantly different from those for the high-temperature repository.

After about 10,000 years, when the shorter-lived radionuclides have decayed away, the temperature regimes for alternative repository designs would be similar. For performance assessment results for periods beyond 10,000 years to be similar, it would be necessary for there to be no long-term effects of short-term temperature differences, or for performance models to not adequately capture the long-term effects of short-term differences. Available information does not permit determination of the validity of DOE's models with respect to long-term temperature effects.

4. Performance of the repository during the regulatory period is, under DOE analyses, totally dependent on the performance of the Alloy 22 outer wall of the waste package, but the technical basis for confidence in performance of Alloy 22 is and weak and will remain uncertain.

DOE has only recently initiated a comprehensive program for testing the corrosion performance of Alloy 22. Available experience indicates that the alloy is highly corrosion resistant under service conditions that have been experienced to date (e.g., in the chemical industry), but past experience is limited in comparison with the data base for other alloys, and the service conditions have not been comparable to those that might be experienced for disposal in Yucca Mountain.

The EPA standards for Yucca Mountain specify a 10,000-year regulatory time period, for which confidence in understanding of the performance of the engineered and natural barriers (especially the single most important barrier in the repository system, Alloy 22) is required. The DOE testing program has to date developed only about a three-year data base for performance of Alloy 22, and, under present program schedules, the time period for development of the data base could only be extended for a few more years before a license application is to be submitted to the NRC.
Moreover, the service conditions in the repository, in terms of temperatures, ground-water contaminations conditions, and changes in repository conditions with time, are uncertain, and the basis for testing conditions is therefore also uncertain. The basis for expectations for Alloy 22 performance in the repository during the regulatory period is therefore uncertain and, as discussed below, will remain so.

A core technical issue for Alloy 22 performance is the long-term stability of the protective surface film that provides the corrosion resistance that has been observed in service conditions and durations to date. It will never be possible to experimentally demonstrate performance of the corrosion film for the regulatory period and repository service conditions; it will be necessary to use judgment to extrapolate data by a factor of 1,000 or more. This is an highly fragile basis for asserting performance expectations for the barrier that is singularly responsible for repository performance and compliance with the radiation protection standards.

DOE established an independent Waste Package Materials Performance Peer Review Panel which issued an Interim Report on September 4, 2001. The Panel report stated that "...significant technical issues remain to be settled; the Project staff needs to enhance the technical basis for assessing the long-term performance of the proposed waste packages at this

site". The Panel report also "...identifies specific areas worthy of attention or increased emphasis".

The Panel report noted that whether or not the waste package will resist significant general corrosion for 10,000 years depends on what changes take place in the passive films. The report described three potential causes for changes in the passive film: changes in the intrinsic nature of the film; changes that result from changes in the environment, and changes that result from changes in the alloy. DOE is planning experimental work and development of models to address these potential causes of change in the protective film. The Panel report notes that extrapolation of data over three orders of magnitude will be greatly aided by models, but the report states that the Project has not clearly identified experiments that will test the validity of particular models.

The Panel report also addresses issues of localized corrosion, such as pitting or crevice corrosion, and stress corrosion cracking. These types of corrosion can occur as a result of factors such as surface roughness or weld-related stresses. The report identified issues related to localized corrosion that have not been addressed sufficiently, and also identifies deficiencies in the current program concerning stress corrosion cracking.

Overall, the Panel's Interim Report confirmed that the current basis for projecting the future performance of Alloy 22 is weak; that there are deficiencies in the current DOE program; that extrapolation over three orders of magnitude of time will be necessary; and that reliable models will be needed to justify and defend the extrapolations. The fundamental issue at present is whether or not the present data base and models are sufficient to make and defend a site suitability evaluation, especially when the performance of the repository system depends critically on the performance factor, Alloy 22, for which the information base is weak and uncertain.

5. DOE's performance assessment results to assess compliance with radiation protection standards show great variations which depend on modeling methods and assumptions. The reliability of the models, and of the results as a measure of performance, is therefore suspect.

DOE has issued six comprehensive TSPA reports since 1991. DOE intended early reports to be guides for efforts such as site characterization and engineered design selection. The TSPA for the Viability Assessment (TSPA-VA), issued in December 1998, provided the basis for determining, at that time, that work to evaluate the Yucca Mountain site should go forward. Critiques of the TSPA-VA led to major revisions of the repository engineered design concept; the design concept that emerged, which had as a principal feature the design parameter of 81-

meter spacing between excavated drifts, has been the basis for the TSPA evaluations associated with the Site Recommendation.

The TSPA to support the Site Recommendation, TSPA-SR, was issued in December 2000. In response to criticisms of major weaknesses in the technical basis for the TSPA-SR (e.g., comments from the NWTRB), DOE made major revisions to the models and assumptions used in the TSPA-SR, and also updated the scientific basis for the analyses by incorporating recent data additions. DOE also quantified uncertainties that had not been quantified in the TSPA-SR. Results of these efforts were described in the "supplemental TSPA", herein termed the S-TSPA, which was issued in July 2001 and supported by the "FY01 Supplemental Science and Performance Analyses (SSPA), Volume 1". The S-TSPA is Volume 2 of the SSPA.

The technical differences between the TSPA-SR and the S-TSPA models are extremely difficult to identify and characterize on the basis of the DOE documentation. Technical factors are described only in overview in the documents supporting the PSSE and are referred downward through as many as four tiers of documentation. Many of the documents in the tiers are not available for public review.

The effects of the changes between the TSPA-SR and the S-TSPA are most evident in the results of the TSPA evaluations. DOE states, in the PSSE, that the principal difference in the models is in adoption of a temperature-dependent model for Alloy 22 corrosion and revision of solubility parameters for radionuclides such as Neptunium 237 in the S-TSPA evaluations. "Other model changes" are also noted but not specifically identified.

There are large differences in the performance evaluation results for the TSPA-SR and the S-TSPA. For example:

> The TSPA-SR results show no doses until after 20,000 years; the S-TSPA shows doses on the order of 0.0001 mrem/yr for periods from about 2,000 years all the way out to 100,000 years. The S-TSPA doses for time periods less than 10,000 years are the result of assumed waste package weld failures.
>
> In the TSPA-SR analyses, projected dose levels rise by a factor of one million in the time interval from 10,000 to 100,000 years, i.e., from 0.0001 to 100 mrem/yr. As noted above, the S-TSPA analyses show constant dose levels of about 0.0001 mrem/yr during this period.

The cause for the difference between TSPA-SR and S-TSPA dose results for the 10,000 to 100,000-year time frame is not stated and cannot readily be inferred from the documentation. However, information presented in Figure 4.1-8 of the S-TSPA document (Volume 2 of the SSPA) can be interpreted to show that the contribution of Np-237 to the dose at 100,000 years is a factor of about 2 million less for the S-TSPA results in comparison with the TSPA-SR results. This finding would suggest that the solubility of neptunium was revised downward by about a factor of one million for the S-TSPA evaluations.

As noted earlier, the S-TSPA found dose evaluation results to be virtually independent of temperature, even though the processes and phenomena important to performance are temperature-dependent.

These findings suggest that DOE's TSPA results are much more an artifact of the models used than a realistic reflection of actual performance. For example, the S-TSPA dose history results are virtually totally dependent on highly contrived assumptions concerning waste-package weld failures, and they suggest that values for Np-237 solubilities used in prior TSPA evaluations must have been in error by about a factor of one million.

The comparisons of the TSPA-SR and S-TSPA results, and recognition of the factors and assumptions that give rise to the results, reduce confidence in the results. Better explanation and justification of the performance models, data, and assumptions are needed in order to have confidence that the TSPA evaluations provide a realistic evaluation of repository performance and that the S-TSPA results provide a reliable basis for the PSSE.

6. DOE uses "one-off" analyses to assess the contributions of individual performance factors to overall system performance, but has not reported an analysis in which the contribution of the most important performance barrier, the Alloy 22 wall on the waste packages, is clearly evaluated.

The "one-off" analyses involve one-at-a-time removal of models for individual performance factors from the total system performance model in order to assess the contribution of that factor to overall performance. DOE has performed these analyses for a large number of repository system performance factors. Results for many of the analyses are reported graphically, in terms of the effect of removal of the performance factor on mean annual dose, in Section 3 of the S-TSPA document (Volume 2 of the SSPA).

The results of the one-off analyses vary widely in terms of their indication of the effects of the individual performance factors on mean annual dose. For example, removal of the performance factor termed "in-drift chemistry" had no effect on mean annual dose. This result indicates that this barrier does not contribute to system performance.

In contrast, accounting for the temperature dependence of Alloy 22 corrosion has a dramatic effect on mean annual dose (Figure 3.2.5.3-2, page 3F-28, of the S-TSPA document). These results show that accounting for the temperature dependence of Alloy 22 corrosion changed the time at which mean annual dose is initiated at the 0.001 level from about 16,000 years to about 26,000 years, and the predicted dose at 100,000 years decreased from about 70 mrem/yr to 0.1 mrem/yr. Without accounting for the temperature dependence of Alloy 22, the EPA individual protection standard of 15 mrem/yr is exceeded at about 60,000 years; with temperature dependence accounted for, the dose at this time is about 0.03 mrem/yr. Overall, therefore, these results indicate that accounting for the temperature dependence of Alloy 22 corrosion in the general corrosion models greatly decreased the predicted radiation doses.

DOE has also performed one-off analyses for "sub-system" Alloy 22 performance factors such as localized corrosion and stress-corrosion cracking. DOE has not, however, reported S-TSPA results for total removal of the Alloy 22 barrier from the repository. In view of the importance of this barrier to system performance during the compliance period, it is important to know what the performance of the repository system would be in comparison with radiation standards, using the S-TSPA model, if the Alloy 22 barrier were assumed not to be present at all. Only this analysis would give a true picture of the effect of the Alloy 22 on overall system performance under present modeling assumptions that provide the basis for the PSSE.

7. Interactions between thermal, hydrologic, chemical, and mechanical phenomena may control repository performance and performance-evaluation uncertainty, but DOE's models for these phenomena cannot be confirmed.

Temperature-driven hydrologic, chemical and mechanical phenomena and interactions (so-called "coupled effects") are expected in the geologic formations around the repository. Such interactions are, for example, the basis for DOE's high-temperature repository concept, in which high temperatures within the repository would drive water in the rocks away from the repository until temperatures are low. Water might then flow back to, and into, the repository under low-temperature conditions, which would be attained after about 10,000 years. Thermal driving forces for corrosion and radionuclide release would be reduced at that time and beyond, but mechanical and chemical alterations might have occurred at the high temperatures so that flow

paths for water in the rocks have been altered and the contaminant characteristics of the water, which affect its capacity to corrode engineered materials in the repository, are changed.

DOE has developed performance models for coupled effects, but their validity is highly uncertain. Because of the heterogeneity and variability of the geologic formations and flow paths, a reliable model of the physical system and its potential for alteration, e.g., by chemical mineralization in fractures, cannot be established and tested experimentally. Similarly, the theoretical and experimental data bases for alterations to contaminant characteristics of water that can enter the repository and would corrode the engineered materials, such as the drip shields and the Alloy 22 outer wall of the waste packages, are weak, cannot be experimentally verified, and cannot be extrapolated reliably, especially for long periods of time.

Therefore, the effects of temperature on the physical characteristics of the natural system, their variation with time, and their effects on repository system performance cannot be reliably assessed. As a result, the reliability of DOE models addressing these performance factors cannot be assessed. Moreover, the reliability of models and assessment results cannot be significantly improved through experimental programs. "Residual uncertainty" factors associated with these coupled phenomena can be identified, and they may dominate the uncertainty in predictions of repository performance, but this uncertainty also cannot be assessed.

As noted and discussed in Section 3 above, results of DOE's HTOM and LTOM analyses show no difference in repository-system performance for the high- and low-temperature repositories after about 10,000 years. These results imply that coupled effects during the period up to 10,000 years, when repository temperatures differ significantly, either had no significance or no persistent consequences, e.g., no permanent changes in the geohydrologic flow paths. DOE's coupled effect models were used to produce these results; as stated above, the reliability of the DOE models cannot be assessed.

8. Comprehensive, independent peer technical review of all aspects of DOE's analyses and results is needed in order to have a defensible scientific basis for the site suitability evaluation.

DOE's technical work for the Yucca Mountain program involves unprecedented model development, data extrapolation, application of assumptions, and use of judgment. Independent assessment of these efforts is essential in order to establish a measure of confidence in the methods used and the results obtained.

The DOE program has made use of peer reviews in selected areas (e.g., the Waste Package Materials Performance Peer Review Panel cited above). Because all program technologies are on the cutting edge of knowledge and understanding, similar efforts are needed in each of the technical areas important to the scientific basis for site-suitability evaluation.

Accomplishment of independent peer review will require expert personnel and a significant investment of time and fiscal resources. The information to be addressed will be difficult to extract and assess because of the way it is scattered throughout the DOE documents and tiers of documents. Use of information and concepts by DOE has evolved with the sequence of documents as they have been issued, and substantive information that is the basis for what was done (which is only described in overview in documents such as the PSSE) can only be obtained by tracing back through the time sequence of documents.

Much of the substantive information is contained in the Analysis Model Reports (AMRs), the Process Model Reports (PMRs), and topical technical reports that underlie the AMRs and PMRs. There are nearly 200 AMRs and PMRs, and apparently there are several thousand topical reports. The topical reports are referenced in the AMRs and PMRs and are not generally available.

In order to assure that the peer reviews themselves are effective and defensible, DOE will have to make all essential documents available. DOE will also have to expect and plan that the scientific basis for site-suitability evaluation is not adequate until all essential peer reviews are completed. In particular, because the S-TSPA methods and results, which are the basis for the PSSE, differ significantly from those for the TSPA-SR, DOE must accomplish a comprehensive, independent peer review for the S-TSPA.

Appendix D – University of Nevada, Las Vegas, The Center for Business and Economic Research Report (December 26, 2001): Regional Economic Model, Inc. (REMI) Analysis Utilizing Urban Environmental Research, L.L.C. (UER) Property Losses to Determine Economic Impacts on Clark County's Scenarios

Appendix D

REMI Analysis Utilizing UER Property Losses to Determine Economic Impacts on Clark County's Scenarios

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Economic impacts work through backward and forward linkages. Backward linkages have been referred to as indirect effects and follow from the basics of production activities. For example, an expansionary change calls for increased inputs, thereby adding additional activity to the original direct change. On the other hand, the indirect effects associated with an initial adversity will further affect conditions negatively. In short, initial effects do not fully reflect final economic impacts. Forward linkages also may create effects. For example, the sale of goods and services increases incomes, thereby inducing additional expenditures. Rising employment and wages create opportunities for additional consumer spending, thus, measuring the full impacts of an event calls for an accounting of direct, indirect, and induced effects.

A full accounting of economic impacts can be reached through modeling forward and backward linkage, the degree of respending of dollars within an economy, and spending leakages. Input-output and econometric models have proved useful in accomplishing this task for studying the full impacts of changes in regional economies.

Clark County asked the Center for Business and Economic Research (CBER) at UNLV to estimate the full-employment, income, and expenditure effects resulting from estimated direct effects for three scenarios associated with the transportation of nuclear waste through Clark County. This report details estimates of these alternative scenarios using a modeling scheme developed by Regional Economic Models, Inc (REMI) and calibrated to local conditions by CBER. The initial impacts, reductions to specific property values, used in this analysis were developed and estimated by Urban Environmental Resource, LLC (UER) in conjunction with lenders and appraisers within Clark County. We have taken these estimates as prepared by UER and developed estimates for leading economic indicators.

Each of the three scenarios have possible outcomes, ranging from a minimum to a maximum, altogether resulting in six separate direct impacts that we modeled. The three scenarios are as follows:

1. Scenario I -- The identification of nuclear waste transported through Clark County.
2. Scenario II -- The occurrence of an accident without a nuclear spill within Clark County.
3. Scenario III-- The occurrence of an accident with a nuclear spill in Clark County.

The minimum and maximum estimates reflect separate valuation efforts from lenders and appraisers. The valuations comprise estimates associated with residential property losses, commercial and industrial property losses, and the permanent loss in gaming revenue (revenue from the region's major industry).

These initial impacts were transformed for estimation with the REMI model. The loss of residential property values is transformed to an economic flow through consumer spending. A loss of wealth (residential property) is estimated to cut the level of spending by 4 percent per year. This wealth-to-spending adjustment follows a long-established relationship associated with the wealth impact on consumer spending. The loss of business activity from a loss of commercial and industrial property and gaming revenue is estimated from ratios of the number of employees per dollar of property value (estimated from the historical data associated with the REMI model) and the number of employees in hotel and gaming (as reported by the Nevada state government) and gaming revenue for Clark County reported by Nevada's Gaming Control Board.

The full impacts are measured by the differences in the level of employment, income, population, and expenditures without the identified options (identified as the baseline) and with

the impacts of an option (identified as a simulation). The specifics associated with this analysis as they relate to the use of the REMI model are specified in George Treyz's book, Regional Economic Modeling: A Systematic Approach to Economic Forecasting and Policy Analysis. The relationship between impact analysis with REMI and the other two major model schemes (identified as IMPLAN and RIMS) as they relate to Clark County has been discussed in a series of academic publications by Rickman and Schwer. A summary of the key issues relating to impact analysis for Clark County, Nevada, is in Rickman and Schwer's paper, "A Comparison of the Multipliers of IMPLAN, REMI, and RIMSII: Benchmarking Ready-made Models for Comparison," The Annals of Regional Science, (1995) 29: 363-374.

Model Inputs

The model inputs, the loss of consumer spending and the loss of jobs, were introduced in six separate sets of estimates, that is, six separate simulations (three scenarios with two sets of estimates). The job and spending losses were introduced beginning in 2010 and additionally for each year until 2035. Consumer-spending estimates were introduced in terms of inflation-adjusted dollar amounts, what economists refer to as constant dollars. In measuring income and expenditure impacts the distinction between current-dollar measures (unadjusted for inflation) and constant dollars (adjusted for inflation) is important. In addition, the adjustment for inflation can be made with a number of deflators, for example, the GDP deflator or CPI deflator. Deflators were also developed for local areas. The model estimates values in constant 1992 dollars. Values in current dollars will be greater; therefore, these estimates are extremely conservative.

Estimates for lenders and appraisers were made for these options and are shown in Table 1.

Table 1

Property Impacts on Clark County in 2001$

Scenario 1

	Appraisers	Lenders
Residential	$161,875,121	$85,248,577
Commercial	4,935,088	4,936,336
Industrial	3,331,370	7,485,860
Sub-total	170,141,579	97,670,773
Gaming Revenue	172,106,274	136,300,947
TOTAL	342,247,853	233,971,720

Scenario 2

	Appraisers	Lenders
Residential	$411,415,310	$270,425,245
Commercial	11,885,595	26,648,041
Industrial	9,688,140	19,087,447
Sub-total	432,989,045	316,160,733
Gaming Revenue	451,327,642	300,885,093
TOTAL	884,316,687	617,045,826

Scenario 3

	Appraisers	Lenders
Residential	$2,171,118,617	$2,176,536,502
Commercial	75,128,562	246,432,903
Industrial	67,362,912	126,670,956
Sub-total	2,313,610.091	2,549,640,361
Gaming Revenue	992,920,810	752,212,735
TOTAL	$3,306,530,901	$3,301,853,096

Source: UER

An increasing number of possible scenarios also brings a range of additional estimates. Whereas these additional options are of note, their introduction does not appreciably help policy makers understand the impacts better. As a result, the redundancy of alternative options was reduced to selecting the largest and smallest initial impacts for each scenario. In so doing, each scenario has only one estimate by lenders (minimum estimate) and one estimate by appraisers (maximum estimate). The direct impacts provided by UER, shown in Table 1, were translated into impacts described above, and for purposes of analysis are shown in Table 2 on an annual basis.

Table 2

Model Inputs

Scenario 1		
Lender	Translation Ratio	Annual Impact in Lost Spending in Current Dollars or Number of Job Losses
Consumer Spending	4% of loss	$2,848,672.64
Jobs Lost	1 job/$36,323	111.1436280043
Gaming Jobs Lost	1 job/$40,606	3356.670122642
Appraiser		
Consumer Spending	4% of loss	$7,693,369.96
Jobs Lost	1 job/$36,323	934.9605208821
Gaming Jobs Lost	1 job/$40,606	4238.444417081
Scenario 2		
Lender		
Consumer Spending	4% of loss	$9,044,336.32
Jobs Lost	1 job/$36,323	272.8530132423
Gaming Jobs Lost	1 job/$40,606	7409.867827415
Appraiser		
Consumer Spending	4% of loss	$19,501,827.88
Jobs Lost	1 job/$36,323	2462.484958048
Gaming Jobs Lost	1 job/$40,606	11114.80180269
Scenario 3		
Lender		
Consumer Spending	4% of loss	$73,776,357.52
Jobs Lost	1 job/$36,323	2862.522644055
Gaming Jobs Lost	1 job/$40,606	18524.6696301
Appraiser		
Consumer Spending	4% of loss	$102,464,069.24
Jobs Lost	1 job/$36,323	13821.90785453
Gaming Jobs Lost	1 job/$40,606	24452.56390681

The information provided by UER does not directly relate to the set of variables of the model which we may change.

As such, we translated the loss of residential property value to reduced consumer spending through the wealth effect. The lost commercial and industrial property translated to job losses using a fixed ratio between capital and labor through production, one job loss per $36,223 of property value lost. In addition, we distributed the jobs losses proportional to the percentage of jobs in each two digit industry. Lastly, we estimated the impact of the losses to hotels and casinos using a fixed ratio of gaming revenue per worker. Using gaming revenue and employment data, we estimate the ratio as one job for each $40,606 of gaming revenue.

Model Outputs

REMI, an eclectic model combining an input-output structure and econometric relationships, enables the estimation of a long list of impacts. Again, wishing to focus on the most important impacts, we have limited our output evaluation to the four most often used measures—employment, income, expenditures, and population. With respect to income and expenditures, however, we show cumulative effects. We show both the short-term effects (the losses for a given year) and longer-term effects (the cumulative impacts over 25 years). Employment impacts can be cumulated and shown on a job-year basis; but, we did not do so, thereby avoiding possible confusion of interpretation between jobs and job-years measures. The detailed output from the models (which could be used to measure impacts across a host of measures) is appended. The output for the select measures is shown in Table 3.

Table 3

Economic Impacts on Clark County's Scenarios

	Job Losses(1)	Population Losses (1)	Cumulative Economic Losses: 2010-2035 (in 1992 Dollars) Spending (2)	Income (3)
Scenario 1				
Lender	5,393	11,294	$5,663,400,000	$4,700,200.000
Appraiser	7,426	12,707	$8,490,300,000	$5,819,100,000
Scenario 2				
Lender	11,193	19,573	$11,852,400,000	$8,856,500,000
Appraiser	19,522	33,419	$22,333,300,000	$15,300,400,000
Scenario 3				
Lender	31,305	53,984	$35,131,000,000	$24,611,600,000
Appraiser	54,429	90,718	$68,116,000,000	$42,128,000,000

Notes (1). (Average Annual)
(2). (Gross Regional Product)
(3). (Disposable Personal Income)

Findings

The minimum impacts are associated with the lender estimates of Scenario I (trucks utilizing the transportation system of Clark County) and are as follows:

1. Job loss of 5,393 jobs.
2. Expenditure loss of $185 million per year, on average, in 1992 dollars and a cumulation loss of $5.6 billion in1992 dollars.
3. Personal income loss of $282 million per year, on average, in 1992 dollars.
4. Real disposable income loss (accounting for taxes and inflation) of $136 million per year, on average, in 1992 dollars and a cumulative 25-year loss of $4.7 billion in constant 1992 dollars.
5. A population loss of 11,294 persons.

The minimum impact estimates are decidedly less onerous than the impacts expected under Scenario 3 (an accident occurs involving the release of radioactive materials along Clark County roads). The maximum impacts are as follows:

1. Employment loss of 54,429 jobs.
2. Average annual expenditure loss of $1.4 billion and a 25-year cumulative loss of $68.1 billion.
3. Personal income loss of $776 million per year.
4. Real disposable income loss of $686 million per year and a 25-year cumulative loss of $42.1 billion in constant dollars.
5. A population loss of 90,718 persons.

Conclusion

The transportation of nuclear waste without an accident of spillage of radioactive material through a large urban community will have adverse impacts on a community such as Las Vegas which depends on travel and tourism for its economic livelihood. The maximum economic impact of a transportation accident, based upon current available information is devastating to any community, especially one which depends upon travel and tourism as its economic engine. The loss of 54,429 jobs and 90,718 people is of grave concern to this community and greatly exceeds the adverse, but temporary impacts of the September 11, 2001 terrorist attacks on travel and tourism..

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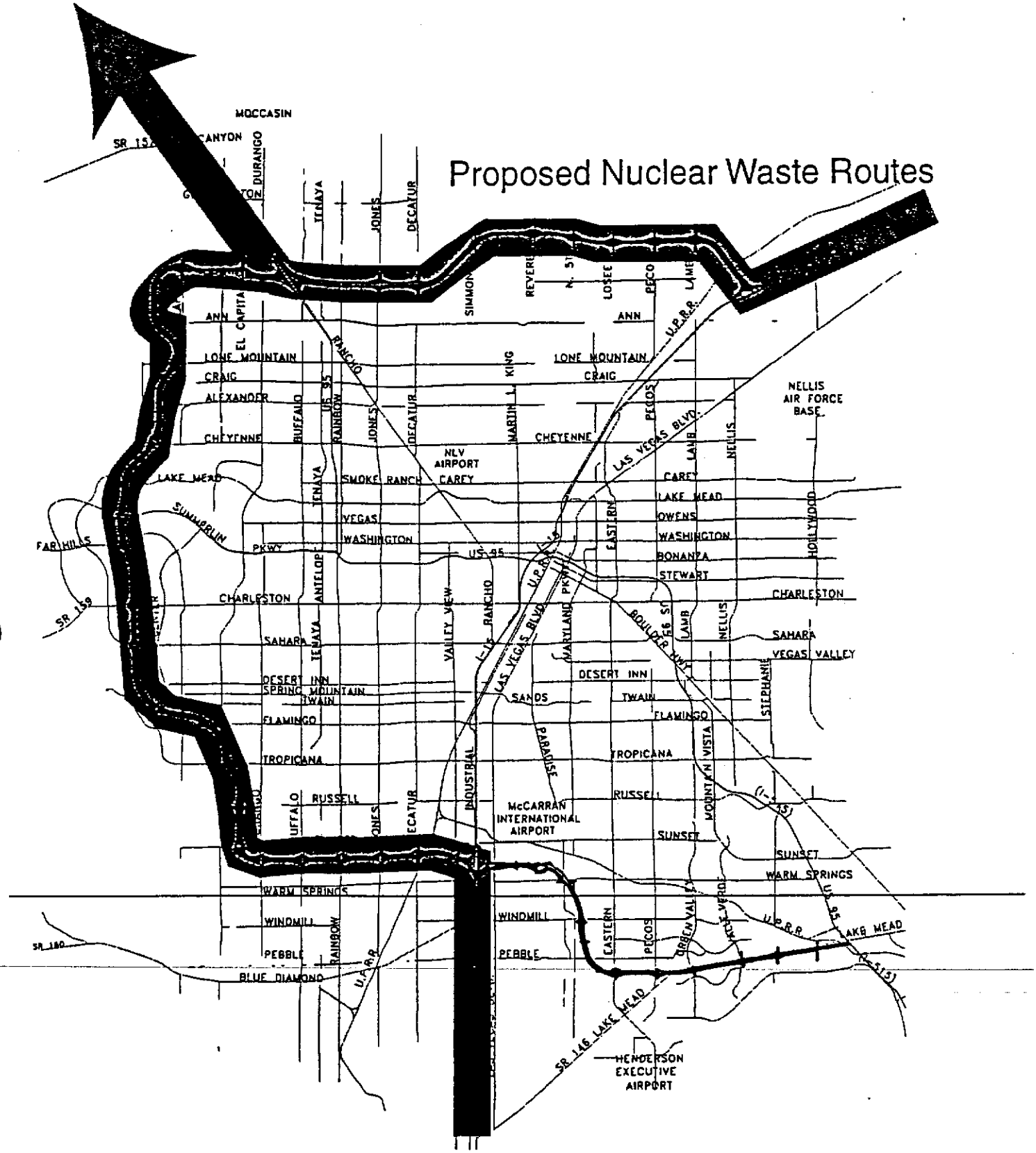
Appendix E – Maps and Descriptions of Transportation Scenarios 1, 2, and 3

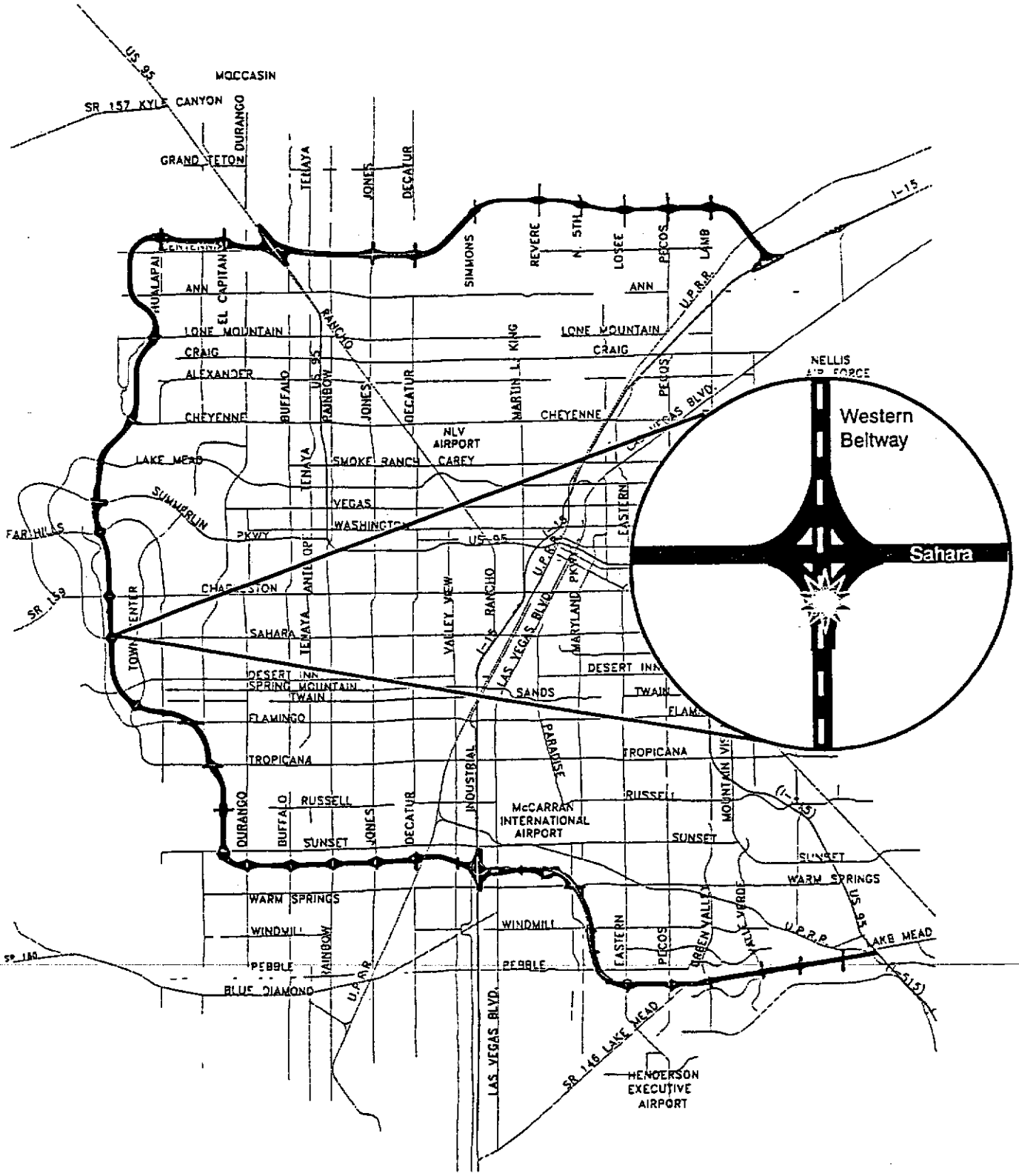
Appendix E

Nuclear Waste Scenario Map



Nuclear Waste Scenario Map

Clark County



Scenario 1 – All Communities

Over the next 24 years, beginning July 2007, the U.S. Department of Energy plans to ship high-level nuclear waste through Clark County to a repository to be built at Yucca Mountain, Nevada. The U.S.DOE plans to ship:

Number of Highway Shipments Expected - All Truck Scenario

Total number of truck shipments projected over a 24 year shipping period:	**49,500**
Number of shipments per year:	**2,063**
Number of shipments per week:	**40**
Number of shipments per day:	**5.7**

The shipment routes are as follows: (See attached map for route depictions)

- **I-15 south from the Utah border to U.S. 95 north**
- **I-15 south from the Utah border to the northern Las Vegas Beltway to U.S. 95 north**
- **I-15 north from the California border to U.S. 95 north**
- **I-15 north from the California border to the southern Las Vegas Beltway to U.S. 95 north**

At the end of the third year of shipments, no accident of any kind has occurred and the probability of an accident is remote. However, interested parties have generated considerable adverse publicity. Residential property values have declined an average of 3.5% within one mile of the transportation corridor, while commercial properties have declined an average of 3.2% and industrial properties have declined an average of 1.25% within one mile of the transportation corridor.

Scenario 2 – Clark County

Over the next 24 years, beginning July 2007, the U.S. Department of Energy plans to ship high-level nuclear waste through Clark County to a repository to be built at Yucca Mountain, Nevada. The U.S.DOE plans to ship:

Number of Highway Shipments Expected - All Truck Scenario

Total number of truck shipments projected over a 24 year shipping period:	**49,500**
Number of shipments per year:	**2,063**
Number of shipments per week:	**40**
Number of shipments per day:	**5.7**

The shipment routes are as follows: (See attached map for route depictions)

- **I-15 south from the Utah border to U.S. 95 north**
- **I-15 south from the Utah border to the northern Las Vegas Beltway to U.S. 95 north**
- **I-15 north from the California border to U.S. 95 north**
- **I-15 north from the California border to the southern Las Vegas Beltway to U.S. 95 north**

Shipments of nuclear waste to the Yucca Mountain repository site progress for three years without incident. Three days after New Year's Day 2010, the driver of a truck transporting nuclear waste loses control of the vehicle and overturns at the Sahara exit of the Western Beltway. The cask containing the nuclear waste breaks away from the trailer and skids 50 yards. **The cask remains intact and no radiation is released,** but the local and national media cover the event heavily. Emergency management personnel respond effectively to the incident and redirect traffic until it is determined that no radiation was released. Within one day traffic resumed on the Western Beltway.

Residential property values decline an average of 7.96% within one mile and an average of 4% between 1 and 3 miles of the transportation corridor; commercial property values decline an average of 7.4% within one mile and an average of 3% between 1 and 3 miles of the transportation corridor. Finally, industrial property values decline an average of 5.3% within one mile and an average of 2% between 1 and 3 miles of the transportation corridor.

Scenario 3 – Clark County

Over the next 24 years, beginning July 2007, the U.S. Department of Energy plans to ship high-level nuclear waste through Clark County to a repository to be built at Yucca Mountain, Nevada. The U.S.DOE plans to ship:

Number of Highway Shipments Expected - All Truck Scenario

Total number of truck shipments projected over a 24 year shipping period:	**49,500**
Number of shipments per year:	**2,063**
Number of shipments per week:	**40**
Number of shipments per day:	**5.7**

The shipment routes are as follows: (See attached map for route depictions)

- **I-15 south from the Utah border to U.S. 95 north**
- **I-15 south from the Utah border to the northern Las Vegas Beltway to U.S. 95 north**
- **I-15 north from the California border to U.S. 95 north**
- **I-15 north from the California border to the southern Las Vegas Beltway to U.S. 95 north**

In the third year of the shipping campaign, a truck carrying one cask of nuclear waste from a reactor destined for the Yucca Mountain high-level radioactive waste repository is involved in a major accident on the Western Beltway at the Sahara exit. The spent fuel truck overturns at 60 mph. Seconds later, a fully loaded gasoline tanker crashes into the wreckage and bursts into flames. The fire burns for more than two hours.

Winds carry the fire plume towards populated areas, dispersing radioactive materials over a wide area. Five persons receive doses of radiation at levels that result in cancer fatalities.

The affected highway is closed for seven days. The two drivers of the spent fuel hauler and the gasoline tanker, and one driver-escort, die from head injuries and burns. Six months later the cleanup effort is still under way and is completed within one year. The accident receives repeated worldwide news coverage.

Residential property values decline an average of 33.8% within one mile and an average of 23.6% between 1 and 3 miles of the transportation corridor; commercial property values decline and average of 31.9% within one mile and an average of 20% between 1 and 3 miles of the transportation corridor. Finally, industrial property values decline an average of 25.5% within one mile and an average of 16.7% between 1 and 3 miles of the transportation corridor.

Appendix F – G. Roger Gathers, M. H. Chew & Associates Report (July 16, 2001 Revision A): *Calculations with RISKIND for Rail Transport of Spent Nuclear Fuel Casks via Las Vegas, Nevada*

Appendix F

Calculations with RISKIND for Rail Transport of Spent Nuclear Fuel Casks Via Las Vegas, Nevada

G. Roger Gathers, M. H. Chew & Associates

July 16, 2001

Revision A

Calculations with RISKIND[1] for Rail Transport of Spent Nuclear Fuel Casks Via Las Vegas, Nevada

Introduction

This report describes calculations for the routine exposure of individuals located at several locations in Las Vegas, Nevada. The calculations were made using the code RISKIND 1.11. The Union Pacific Rail Road (UPRR) trains will routinely make extended stops for train assembly, safety inspections, etc. Some of the stops are quite extended. The cases of 48 hr and 457 hr stops will be examined. Since the stop doses will be considerably larger than passing doses, the latter were not examined. Three locations are considered. Two of them are Hotel-Casinos and the third is the Clark County Government Center. Two or more positions for individuals are considered. The cask is assumed to be the (21 PWR) MPC. Table G.4 in the RISKIND users manual gives a length of 5.29 meters and a radius of 1.086 meters. No gamma fraction was listed, so the value of 0.83 was taken. The loading is assumed to give 10 mrem/hr at a distance of 2 meters from the cask surface.

Under the mostly rail transportation scenario in the Draft Environmental Impact Statement (DEIS) for Yucca Mountain, the Department of Energy (DOE) evaluated the impacts of 19,800 rail cask-shipments to four potential rail spur originations and three potential intermodal transfer stations. The heaviest routine rail transportation impacts on downtown Las Vegas would likely occur if DOE proceeds with the Jean rail spur or Sloan/Jean intermodal transfer options. DOE's rail routing analysis for Jean indicates that about 87% of all rail shipments to Yucca Mountain would use the Union Pacific mainline through downtown Las Vegas. There would be 17,364 rail cask-shipments through Las Vegas over 38 years, an average of 457 cask-shipments per year.

The DEIS assumes that SNF rail casks will be shipped in general freight service, although the railroads and many stakeholders believe that all SNF shipments should be made by dedicated train. Indeed, many experts believe DOE will be forced to use dedicated trains. However, for purposes of evaluating a credible maximum incident-free scenario, this analysis assumes each rail cask is shipped through Las Vegas separately by general service in a different train. Thus there are 457 rail cask-shipments per year through Las Vegas over 38 years.

There are a number of locations along the Union Pacific through Las Vegas where entire trains and groups of freight cars are routinely stopped for varying periods of time. For this analysis, the State of Nevada Agency for Nuclear Projects selected three such locations near large commercial and government buildings.

The DEIS provides few details about expected rail operations, other than the decision that dedicated trains will not be required. Train stops occur for many reasons. Stops for carrier interchange or train assembly could require from 2 to 24 hours. Stops for crew changes, car changes, engine refueling, train maintenance, regulatory inspections, and traffic control, could range from 15 minutes to more than 2 hours. In planning for receipt of

casks shipped by general freight service, DOE has indicated its intention to take advantage of USDOT regulations that allow stoppage of SNF cars in transit for periods of up to 48 hours (DEIS, p. 2-50).

This analysis evaluates exposures under to two rail-stop scenarios: (1) a one time cask-car stoppage at the designated location for 48 hours, the regulatory maximum; and (2) the cumulative annual exposure assuming that each cask-shipment stops at the designated location one time for one-hour only (a total of 457 hours per year). We assume in all cases that the cask involved is the large DOE MPC containing 21 PWR assemblies (RISKIND, p. G-30) or a similar large rail cask as described in the DEIS.

Locations

LV#1: Hotel-Casino #1

This is an older, downtown hotel-casino. Numerous locations in the ground-level parking lot are less than 20 meters from the side of the stopped rail cask. We calculate the 48 hr dose and the 457 hr dose for MEI#1 located 40 m from the cask wall at the exterior wall of the first floor of the hotel-casino, and for MEI#2 located 15 m from the cask wall. Figure 1 shows a diagram of the location. MEI#2 is in the parking lot.

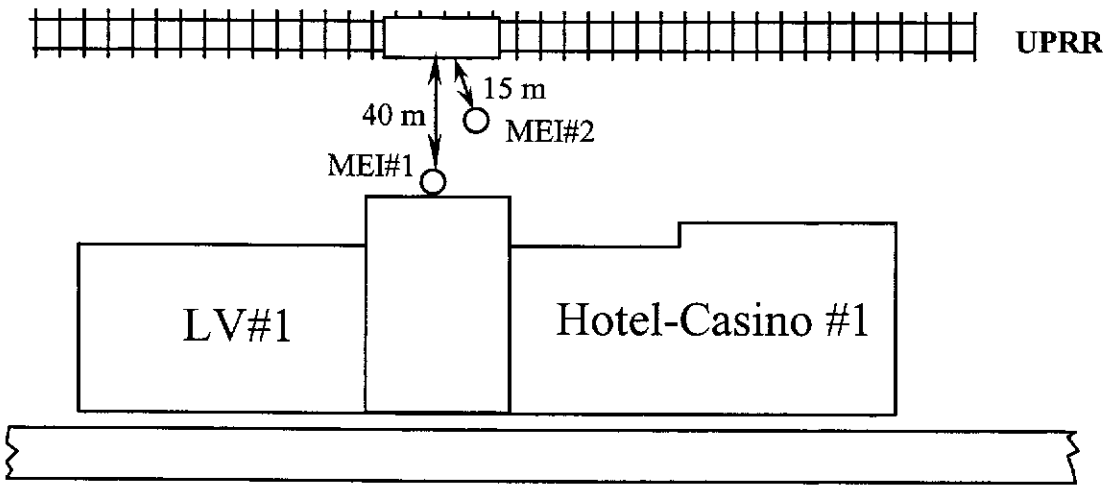


Fig. 1 Diagram of location #1. MEI#1 is located 40 m from the side of the cask. MEI#2 is 15 m from the side of the cask. and is located in the hotel parking lot.

LV#2: Hotel-Casino #2

This is a newer, off-strip hotel-casino with nearly 3000 rooms in multiple high-rise towers. Some locations in the ground level parking lot east of the parking building are less than 20 m from the nearest track of the Union Pacific Rail Road (UPRR). We calculate the 48 hr dose and the 457 hr dose for MEI#1 located 35 m from the stopped rail cask wall at the interior corner of the first floor of the self-service parking building (it has four or five stories). We also calculate the 48 hr dose and the 457 hr dose for MEI#2 located 160 m from the stopped rail cask wall at an exterior first floor entrance to the hotel casino. Figure 2 shows a diagram of the location.

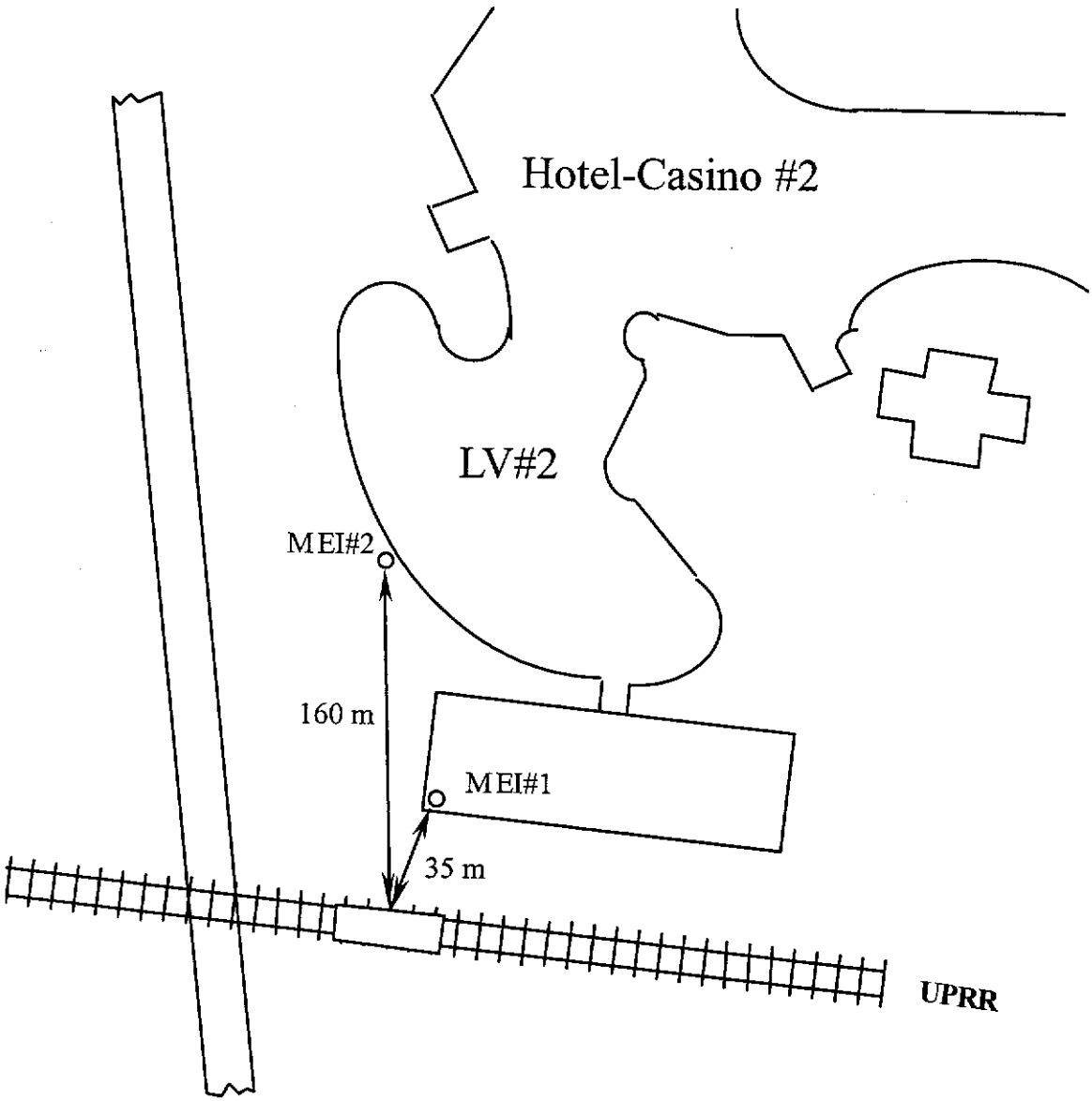


Fig. 2 Diagram of location #2. The two individuals are located as shown.

LV#3: Clark County Government Center

This is the Clark County Government Center in downtown Las Vegas. We calculate the 48 hr dose and the 457 hr dose for MEI#1 located 20 m from the stopped rail cask wall at the extreme southern end of the southern parking lot. We also calculate the 48 hr dose and the 457 hr dose for MEI#2, located about 30 m from the stopped rail cask wall at the exterior of the southern first floor entrance. We also calculate the 48 hr dose and the 457 hr dose for MEI#3, located 100 m from the stopped rail cask wall at the exterior of the first floor entrance to the County Commission Chambers. Figure 3 shows a diagram of the location. Figure 4 shows a view of the center.

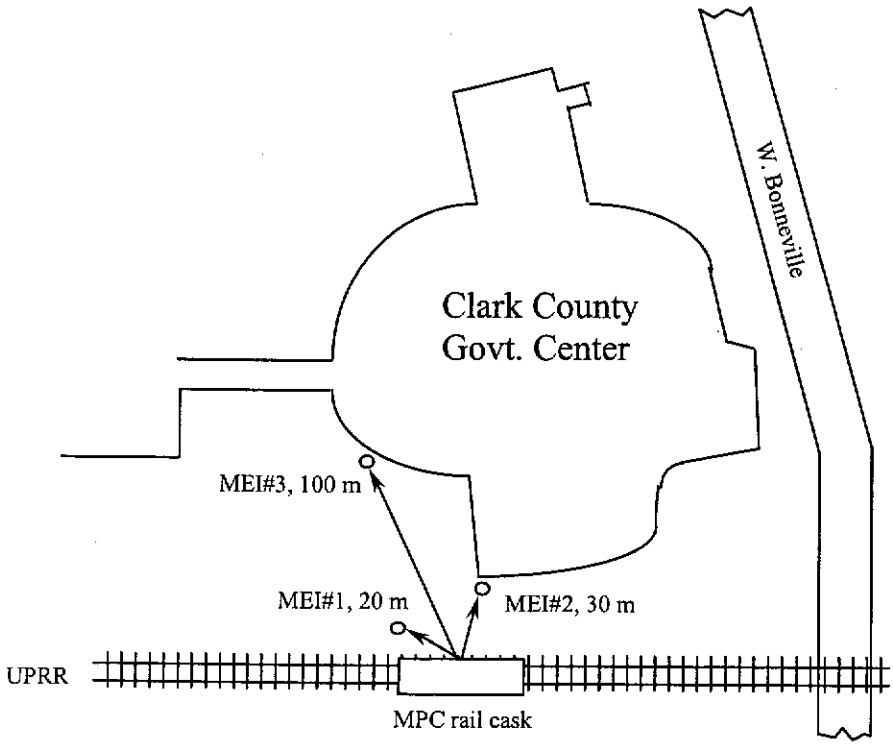


Fig. 3 Diagram of location #3. The three individuals are located as shown.

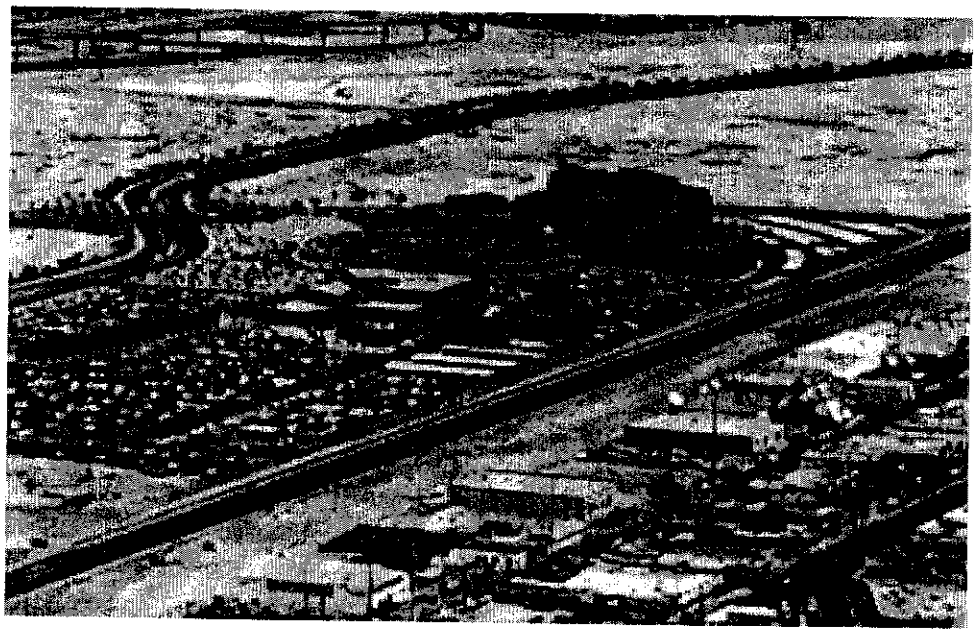


Fig. 4 Clark County Government Center. The railroad crosses diagonally from the lower left-hand side of the picture, and passes adjacent to the parking lot area.

Calculations

RISKIND does not allow calculations for stop times greater than 100 hr, so the 48 hr doses will be multiplied by (457/48) to give the doses for the longer time. Since the doses are only reported to two significant figures, this may slightly degrade the accuracy of the results for 457 hr due to round-off problems. Only three problems need to be run since multiple individuals can be considered for a given shipment in RISKIND.

Run#1 considers Hotel-Casino #1 for MEI#1 and MEI#2.

Run #2 considers Hotel-Casino #2 for MEI#1 and MEI#2.

Run#3 considers the Clark County Government Center (CCGC) for MEI#1, MEI#2, and MEI#3.

The calculations will assume the RISKIND default dose curve for the GA-4 cask, with 10 mrem/hr at 2 m from the cask surface. The gamma fraction is taken as 0.83 and the cask dimensions are length 5.29 m , radius 1.09 m. Only the *Stop* calculations will be used. The speed of 64 km/hr is set so that the code will calculate a *Passing* calculation which shows that the passing dose is trivial by comparison. Table 1 shows the results.

Table 1. 48 hr and 457 hr doses for three locations with various MEIs. The doses are in mrem. The 457 hr dose is calculated form (457/48)*48 hr dose. CCGC is the Clark County Government Center.

Bulding/MEI	Distance (m)	48 hr dose (mrem)	457 hr dose (mrem)
Casino#1, MEI#1	40	2.9	27.6
Casino#1, MEI#2	15	21	200
Casino #2, MEI#1	35	3.8	36.2
Casino #2, MEI#2	160	0.11	1.05
CCGC, MEI#1	20	12	114
CCGC, MEI#2	30	5.2	49.5
CCGC, MEI#3	100	0.36	3.43

Appendix A shows the results of the RISKIND calculations. Note that the doses listed in the RISKIND output files are in rem. Appendix B lists the input files for the three runs.

References

1. Y. C. Yuan, S. Y. Chen, B. M. Biwer, and D. J. LePoire, "*RISKIND – A Computer Program for Calculating Radiological Consequences and Health Risks from Transportation of Spent Nuclear Fuel*", ANL/EAD-1 (1995), Argonne National Laboratory

Appendix A: Calculation Results

Run #1

Title : Hotel-Casino#1, MEI#1-2, 48 hour dose

Shipment Parameters

Transport Mode [IMOD]:	Rail	
Population Zone [IZONE]:	Urban	
Dose at 2 m [TD2M]:	10.00	mrem/hr
Measurement Offset [TIOFF]:	0.00	m
Gamma Fraction [FRAD(1)]:	0.83	
Neutron Fraction [FRAD(2)]:	0.17	
Cask Length [HSIZE]*:	5.29	m
Cask Radius [RSIZE]*:	1.09	m
Traveling speed [SPEED]:	64.00	km/hr
Individual type [INDTYPE]:	Public	

Risk Conversion Factors

Non-Fatal Cancers/rem:	1.0E-04
Fatal Cancers/rem:	5.0E-04
Genetic Effects/rem:	1.3E-04

#	Individual Name	Stop Distance [DISTSTOP] [km]	Stop Time [TSTP] [hr]	Passing Distance [DISTPASS] [km]
1	MEI#1	4.0E-02	48.00	4.0E-02
2	MEI#2	1.5E-02	48.00	1.5E-02

		========== Stop ==========		
#	Individual Name	Dose (rem)	Expected Non-Fatal Cancers	Expected Cancer Fatalities	Expected Genetic Effects
1	MEI#1	2.9E-03	2.9E-07	1.4E-06	3.7E-07
2	MEI#2	2.1E-02	2.1E-06	1.0E-05	2.7E-06

		========== Passing ==========		
#	Individual Name	Dose (rem)	Expected Non-Fatal Cancers	Expected Cancer Fatalities	Expected Genetic Effects
1	MEI#1	9.5E-08	9.5E-12	4.7E-11	1.2E-11
2	MEI#2	3.0E-07	3.0E-11	1.5E-10	3.9E-11

Run #2

Title : Hotel-Casino#2, MEI#1, MEI#2, 48 hour dose

Shipment Parameters

Transport Mode [IMOD]:	Rail	
Population Zone [IZONE]:	Urban	
Dose at 2 m [TD2M]:	10.00	mrem/hr
Measurement Offset [TIOFF]:	0.00	m
Gamma Fraction [FRAD(1)]:	0.83	
Neutron Fraction [FRAD(2)]:	0.17	
Cask Length [HSIZE]*:	5.29	m
Cask Radius [RSIZE]*:	1.09	m
Traveling speed [SPEED]:	64.00	km/hr
Individual type [INDTYPE]:	Public	
Risk Conversion Factors		
Non-Fatal Cancers/rem:	1.0E-04	
Fatal Cancers/rem:	5.0E-04	
Genetic Effects/rem:	1.3E-04	

#	Individual Name	Stop Distance [DISTSTOP] [km]	Stop Time [TSTP] [hr]	Passing Distance [DISTPASS] [km]
1	MEI#1	3.5E-02	48.00	3.5E-02
2	MEI#2	1.6E-01	48.00	1.6E-01

		========== Stop ==========		
#	Individual Name	Dose (rem)	Expected Non-Fatal Cancers	Expected Cancer Fatalities	Expected Genetic Effects
1	MEI#1	3.8E-03	3.8E-07	1.9E-06	4.9E-07
2	MEI#2	1.1E-04	1.1E-08	5.3E-08	1.4E-08

		========== Passing ==========		
#	Individual Name	Dose (rem)	Expected Non-Fatal Cancers	Expected Cancer Fatalities	Expected Genetic Effects
1	MEI#1	1.1E-07	1.1E-11	5.6E-11	1.5E-11
2	MEI#2	1.0E-08	1.0E-12	5.2E-12	1.4E-12

Run #3

Title : Clark Cty Gov. Ctr, MEI#1, 2 & 3, 48 hour dose

Shipment Parameters

Transport Mode [IMOD]:	Rail	
Population Zone [IZONE]:	Urban	
Dose at 2 m [TD2M]:	10.00	mrem/hr
Measurement Offset [TIOFF]:	0.00	m
Gamma Fraction [FRAD(1)]:	0.83	
Neutron Fraction [FRAD(2)]:	0.17	
Cask Length [HSIZE]*:	5.29	m
Cask Radius [RSIZE]*:	1.09	m
Traveling speed [SPEED]:	64.00	km/hr
Individual type [INDTYPE]:	Public	
Risk Conversion Factors		
Non-Fatal Cancers/rem:	1.0E-04	
Fatal Cancers/rem:	5.0E-04	
Genetic Effects/rem:	1.3E-04	

#	Individual Name	Stop Distance [DISTSTOP] [km]	Stop Time [TSTP] [hr]	Passing Distance [DISTPASS] [km]
1	MEI#1	2.0E-02	48.00	2.0E-02
2	MEI#2	3.0E-02	48.00	3.0E-02
3	MEI#3	1.0E-01	48.00	1.0E-01

========== Stop ==========

#	Individual Name	Dose (rem)	Expected Non-Fatal Cancers	Expected Cancer Fatalities	Expected Genetic Effects
1	MEI#1	1.2E-02	1.2E-06	5.9E-06	1.5E-06
2	MEI#2	5.2E-03	5.2E-07	2.6E-06	6.8E-07
3	MEI#3	3.6E-04	3.6E-08	1.8E-07	4.6E-08

========== Passing ==========

#	Individual Name	Dose (rem)	Expected Non-Fatal Cancers	Expected Cancer Fatalities	Expected Genetic Effects
1	MEI#1	2.2E-07	2.2E-11	1.1E-10	2.8E-11
2	MEI#2	1.4E-07	1.4E-11	6.8E-11	1.8E-11
3	MEI#3	2.5E-08	2.5E-12	1.2E-11	3.2E-12

Appendix B: Problem Input Files

Run #1

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 METFREQ =     1            ,
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 TRAF_DEN =   -1            ,
 PAG =         5            ,
 QA =          50           ,
 STATEN = '',
 HS =          1            ,
 HZLM =        .01          ,
 IACDT =       0            ,
 IACFOD =      0            ,
 IBOUND =      2            ,
 IMOD =        2            ,
 IRDTY =       1            ,
 IRUTIN =      1            ,
 ICONSQ =      0            ,
 NISOPL =      10           ,
 IACOEF =      0            ,
 ISPENT =      1            ,
 ITREAT =      1            ,
 ISTATE =      26           ,
 IZONE =       3            ,
 WDTHMED =    -1            ,
 NUMLANES =   -1            ,
 OUTFIL ='output\laveg1.out',
 EFF_SURF_DEN =              240          ,
 PHALF =       50           ,
 RSALF =       .137         ,
 UF =  3*1,
 SEXT =  40*1,
 IDISPMOD =    0            ,
 SPEED =      64            ,
 SHIPDIST =    1            ,
 BRTPOP =      8000         ,
 SUFI =        .00001       ,
 SUFF =        .000000001   ,
 TD2M =        10           ,
 TIDX =                     ,
 TIOFF =       0            ,
 VDEP =        .01          ,
 VDEPNUC =  4*.01, 0 ,
 YEVD =        50           ,
 BURNUP =      35000        ,
 CACTD =      -1            ,
 CAREA =      -1            ,
 FRAD = 0.83, .17 ,
 HSIZE =      5.29          ,
 RSIZE =      1.09          ,
 RTYPE ='PWR',
```

```
 TFUEL =        10            ,
 TYPCSK ='Modal Rail',
 UMT =         -1             ,
 IADD =         2             ,
 POPTYPE =      1             ,
 DECAY_WEATHER =              .0495        ,
 F_RETAIN =     .2            ,
 F_EDBL_COW =   1             ,
 F_EDBL_HUM =   1             ,
 T_HARVEST_COW =              15           ,
 T_HARVEST_HUM =              30           ,
 YIELD_COW =    .7            ,
 YIELD_HUM =    2             ,
 T_GROW_COW =   30            ,
 T_GROW_HUM =   60            ,
 IDFOOD =  2*0, 18*1,
 IDPG =  1 , 5 , 3*1, 5*5, 6*1, 2*5, 16*1, 2*5, 6*1, 3*2, 7*1, 4 , 5 ,
3 , 30*1, 5 , 14*1, 10*0,
 IRTP =  20*1,
 ISHLT =  20*0,
 LSHLT =  20*0,
 INDTYPE =  20*1,
 WSHLT =  .36 , .38 , .21 , .05 , 0 ,
 SHLDVAL =  .36 , .38 , .21 ,
 IWATER =  20*0,
 OCUPF =  20*.62, 20*.02,
 POPW =  20*1,
 TEXT =  20*2,
 TSTP =  2*48, 18*1,
 BRTIND =  20*8000,
 DISTSTOP = .04,.015, 18*1,
 DISTPASS = .04,.015, 18*1,
 WBDYD =  20*2,
 WBDYW =  20*50,
 WEXCG =  20*1,
 XRECEP =  1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 ,
2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 ,
2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0,
 XNAME =    'MEI#1',
   'MEI#2',
    18*'',

 NUTYPE =    'Particulate',
   'Ru',
   'Cs',
   'I',
   'Gas',

 ANH =          10            ,
 TABK =         283           ,
 IYOURW =       1             ,
 DMIX =         1000          ,
 ITYPE =        4             ,
 RAIN =         0             ,
 WSM =          4             ,
 AMIX =         400           ,
 PMIX =         1600          ,
 DFREQ =  36*.0278,
```

```
 WS =  .89 , 2.46 , 4.47 , 6.93 , 9.61 , 12.52 ,
 DFACT =       .5            ,
 PFIN =  5*1,
 TREATM =      0             ,
 XIN =  .3 , .85 , 1.6 , 0 , 2 ,
 IYOURS =     -1             ,
 VCASK =       65            ,
 ALPHA =       90            ,
 BETA =        90            ,
 IHARD =       1             ,
 TFLAME =      1350          ,
 DFIRE =       .75           ,
 FLOCA =       0             ,
 DSTP =  2 , 90 , 2 , 90 , 2 , 90 , 2 , 90 , 2 , 90 , 2 , 90 , 2 , 90 ,
2 , 90 , 2 , 90 , 2 , 90 ,
 FARM =       -1             ,
 GMEAT =      -1             ,
 GMILK =      -1             ,
 GVEGE =      -1             ,
 HSTP =  10*1,
 HTEXP =       2             ,
 IPFOD =       1             ,
 IPWATR =      0             ,
 NSTP =  10*1,
 NSTY =        0             ,
 POPD =        6             ,
 PSTP =  10*50,
 RDWTH =      -1             ,
 RFIE =        0             ,
 XING =  .26 , .3 , .52 , 0 , 1 ,
 XPZ =  .05 , 80 ,
 NSV =         20            ,
 FRELS =  3*.000002, .00002 , 3*.000002, .00002 , 3*.000002, .00002 ,
3*.000002, 5*.00002, 3*.000027, .00027 , 3*.000027, .00027 , 3*.000027,
.00027 , 3*.000048, 5*.00048, 3*.0002, .002 , 3*.0002, .002 , 3*.0002,
.002 , 3*.0002, 5*.002, 3*.0025, .043 , 3*.0025, .043 , 3*.0025, .043 ,
3*.0043, 5*.043, 3*.33, .63 , 3*.33, .63 , 3*.33, .63 , 3*.39, 5*.63,
 FDISP =  0 , 19*1, 0 , 19*1, 0 , 19*1, 0 , 19*1, 0 , 19*1,
 FSEV =  .994316 , .0038192 , .0017984 , .0000001532 , .00001687 ,
.000000233 , .0000001574 , 3.926E-14 , .00002362 , .0000003008 ,
.0000002034 , 1.495E-14 , .00001525 , .0000001592 , .0000001076 ,
7.681E-16 , .00000957 , .00000007201 , .00000004873 , 1E-16 , .993962 ,
.0027204 , .0005545 , .000000001786 , .0012275 , .0000005011 ,
.0000001021 , .000000000000329 , .00079511 , .0000003255 , .00000006634
, 2.137E-13 , .000614 , .0000002531 , .00000005162 , 1.644E-13 ,
.0001249 , .00000001075 , .00000005296 , 3.459E-14 , 20*.0000000001,
 FAILS =  .03 , .1 , 2*1, .03 , .1 , 2*1, .03 , .1 , 10*1,
 FSPAL =  0 , 3*1, .15 , 3*1, .15 , 3*1, .15 , 3*1, .15 , 3*1,
 FRCRUD =  20*1,
 HEATF =  500 , 19*2000000,
&END
```

Run #2

```
&INDATA
 VERSION = '1.11R'
 TITLE = 'Hotel-Casino#2, MEI#1,MEI#2, 48 hour dose',
 ACTA =        1            ,
 METFREQ =     1            ,
 PPVH =       -1            ,
 TRAF_DEN =   -1            ,
 PAG =         5            ,
 QA =          50           ,
 STATEN = '',
 HS =          1            ,
 HZLM =        .01          ,
 IACDT =       0            ,
 IACFOD =      0            ,
 IBOUND =      2            ,
 IMOD =        2            ,
 IRDTY =       1            ,
 IRUTIN =      1            ,
 ICONSQ =      0            ,
 NISOPL =      10           ,
 IACOEF =      0            ,
 ISPENT =      1            ,
 ITREAT =      1            ,
 ISTATE =      26           ,
 IZONE =       3            ,
 WDTHMED =    -1            ,
 NUMLANES =   -1            ,
 OUTFIL ='output\laveg2.out',
 EFF_SURF_DEN =              240          ,
 PHALF =       50           ,
 RSALF =       .137         ,
 UF =  3*1,
 SEXT =  40*1,
 IDISPMOD =    0            ,
 SPEED =      64            ,
 SHIPDIST =    1            ,
 BRTPOP =      8000         ,
 SUFI =        .00001       ,
 SUFF =        .000000001   ,
 TD2M =        10           ,
 TIDX =                     ,
 TIOFF =       0            ,
 VDEP =        .01          ,
 VDEPNUC =  4*.01, 0 ,
 YEVD =        50           ,
 BURNUP =      35000        ,
 CACTD =      -1            ,
 CAREA =      -1            ,
 FRAD = 0.83, .17 ,
 HSIZE =      5.29          ,
 RSIZE =      1.09          ,
 RTYPE ='PWR',
 TFUEL =       10           ,
 TYPCSK ='Modal Rail',
 UMT =        -1            ,
```

```
 IADD =          2              ,
 POPTYPE =       1              ,
 DECAY_WEATHER =                .0495          ,
 F_RETAIN =      .2             ,
 F_EDBL_COW =    1              ,
 F_EDBL_HUM =    1              ,
 T_HARVEST_COW =                15             ,
 T_HARVEST_HUM =                30             ,
 YIELD_COW =     .7             ,
 YIELD_HUM =     2              ,
 T_GROW_COW =    30             ,
 T_GROW_HUM =    60             ,
 IDFOOD =  2*0, 18*1,
 IDPG =  1 , 5 , 3*1, 5*5, 6*1, 2*5, 16*1, 2*5, 6*1, 3*2, 7*1, 4 , 5 ,
3 , 30*1, 5 , 14*1, 10*0,
 IRTP =  20*1,
 ISHLT =  20*0,
 LSHLT =  20*0,
 INDTYPE =  20*1,
 WSHLT =  .36 , .38 , .21 , .05 , 0 ,
 SHLDVAL =  .36 , .38 , .21 ,
 IWATER =  20*0,
 OCUPF =  20*.62, 20*.02,
 POPW =  20*1,
 TEXT =  20*2,
 TSTP =  2*48, 18*1,
 BRTIND =  20*8000,
 DISTSTOP = 0.035,0.160, 18*1,
 DISTPASS = 0.035,0.160, 18*1,
 WBDYD =  20*2,
 WBDYW =  20*50,
 WEXCG =  20*1,
 XRECEP =  1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 ,
2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 ,
2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0,
 XNAME =    'MEI#1',
   'MEI#2',
    18*'',

 NUTYPE =    'Particulate',
   'Ru',
   'Cs',
   'I',
   'Gas',

 ANH =           10             ,
 TABK =          283            ,
 IYOURW =        1              ,
 DMIX =          1000           ,
 ITYPE =         4              ,
 RAIN =          0              ,
 WSM =           4              ,
 AMIX =          400            ,
 PMIX =          1600           ,
 DFREQ =  36*.0278,
 WS =  .89 , 2.46 , 4.47 , 6.93 , 9.61 , 12.52 ,
 DFACT =         .5             ,
 PFIN =  5*1,
```

```
 TREATM =      0              ,
 XIN =  .3 , .85 , 1.6 , 0 , 2 ,
 IYOURS =     -1              ,
 VCASK =       65             ,
 ALPHA =       90             ,
 BETA =        90             ,
 IHARD =       1              ,
 TFLAME =      1350           ,
 DFIRE =       .75            ,
 FLOCA =       0              ,
 DSTP =  2 , 90 , 2 , 90 , 2 , 90 , 2 , 90 , 2 , 90 , 2 , 90 , 2 , 90 ,
2 , 90 , 2 , 90 , 2 , 90 ,
 FARM =       -1              ,
 GMEAT =      -1              ,
 GMILK =      -1              ,
 GVEGE =      -1              ,
 HSTP =  10*1,
 HTEXP =       2              ,
 IPFOD =       1              ,
 IPWATR =      0              ,
 NSTP =  10*1,
 NSTY =        0              ,
 POPD =        6              ,
 PSTP =  10*50,
 RDWTH =      -1              ,
 RFIE =        0              ,
 XING =  .26 , .3 , .52 , 0 , 1 ,
 XPZ =  .05 , 80 ,
 NSV =         20             ,
 FRELS =  3*.000002, .00002 , 3*.000002, .00002 , 3*.000002, .00002 ,
3*.000002, 5*.00002, 3*.000027, .00027 , 3*.000027, .00027 , 3*.000027,
.00027 , 3*.000048, 5*.00048, 3*.0002, .002 , 3*.0002, .002 , 3*.0002,
.002 , 3*.0002, 5*.002, 3*.0025, .043 , 3*.0025, .043 , 3*.0025, .043 ,
3*.0043, 5*.043, 3*.33, .63 , 3*.33, .63 , 3*.33, .63 , 3*.39, 5*.63,
 FDISP =  0 , 19*1, 0 , 19*1, 0 , 19*1, 0 , 19*1, 0 , 19*1,
 FSEV =  .994316 , .0038192 , .0017984 , .0000001532 , .00001687 ,
.000000233 , .0000001574 , 3.926E-14 , .00002362 , .0000003008 ,
.0000002034 , 1.495E-14 , .00001525 , .0000001592 , .0000001076 ,
7.681E-16 , .00000957 , .00000007201 , .00000004873 , 1E-16 , .993962 ,
.0027204 , .0005545 , .000000001786 , .0012275 , .0000005011 ,
.0000001021 , .00000000000329 , .00079511 , .0000003255 , .00000006634
, 2.137E-13 , .000614 , .0000002531 , .00000005162 , 1.644E-13 ,
.0001249 , .00000001075 , .00000005296 , 3.459E-14 , 20*.0000000001,
 FAILS =  .03 , .1 , 2*1, .03 , .1 , 2*1, .03 , .1 , 10*1,
 FSPAL =  0 , 3*1, .15 , 3*1, .15 , 3*1, .15 , 3*1, .15 , 3*1,
 FRCRUD =  20*1,
 HEATF =  500 , 19*2000000,
&END
```

Run #3

```
&INDATA
 VERSION = '1.11R'
 TITLE = 'Clark Cty. Gov. Ctr., MEI#1, 2 & 3, 48 hour dose',
 ACTA =          1              ,
 METFREQ =       1              ,
 PPVH =         -1              ,
 TRAF_DEN =     -1              ,
 PAG =           5              ,
 QA =            50             ,
 STATEN = '',
 HS =            1              ,
 HZLM =          .01            ,
 IACDT =         0              ,
 IACFOD =        0              ,
 IBOUND =        2              ,
 IMOD =          2              ,
 IRDTY =         1              ,
 IRUTIN =        1              ,
 ICONSQ =        0              ,
 NISOPL =        10             ,
 IACOEF =        0              ,
 ISPENT =        1              ,
 ITREAT =        1              ,
 ISTATE =        26             ,
 IZONE =         3              ,
 WDTHMED =      -1              ,
 NUMLANES =     -1              ,
 OUTFIL ='output\laveg3.out',
 EFF_SURF_DEN =                 240            ,
 PHALF =         50             ,
 RSALF =         .137           ,
 UF =  3*1,
 SEXT =  40*1,
 IDISPMOD =      0              ,
 SPEED =        64              ,
 SHIPDIST =      1              ,
 BRTPOP =        8000           ,
 SUFI =          .00001         ,
 SUFF =          .000000001     ,
 TD2M =          10             ,
 TIDX =                         ,
 TIOFF =         0              ,
 VDEP =          .01            ,
 VDEPNUC =  4*.01, 0 ,
 YEVD =          50             ,
 BURNUP =        35000          ,
 CACTD =        -1              ,
 CAREA =        -1              ,
 FRAD = 0.83, .17 ,
 HSIZE =        5.29            ,
 RSIZE =        1.09            ,
 RTYPE ='PWR',
 TFUEL =         10             ,
 TYPCSK ='Modal Rail',
 UMT =          -1              ,
```

```
 IADD =         3              ,
 POPTYPE =      1              ,
 DECAY_WEATHER =               .0495         ,
 F_RETAIN =     .2             ,
 F_EDBL_COW =   1              ,
 F_EDBL_HUM =   1              ,
 T_HARVEST_COW =               15            ,
 T_HARVEST_HUM =               30            ,
 YIELD_COW =    .7             ,
 YIELD_HUM =    2              ,
 T_GROW_COW =   30             ,
 T_GROW_HUM =   60             ,
 IDFOOD =  3*0, 17*1,
 IDPG =  1 , 5 , 3*1, 5*5, 6*1, 2*5, 16*1, 2*5, 6*1, 3*2, 7*1, 4 , 5 ,
3 , 30*1, 5 , 14*1, 10*0,
 IRTP =  20*1,
 ISHLT =  20*0,
 LSHLT =  20*0,
 INDTYPE =  20*1,
 WSHLT =  .36 , .38 , .21 , .05 , 0 ,
 SHLDVAL =  .36 , .38 , .21 ,
 IWATER =  20*0,
 OCUPF =  20*.62, 20*.02,
 POPW =  20*1,
 TEXT =  20*2,
 TSTP =  3*48, 17*1,
 BRTIND =  20*8000,
 DISTSTOP = 0.02,0.03,0.100, 17*1,
 DISTPASS = 0.02,0.03,0.100, 17*1,
 WBDYD =  20*2,
 WBDYW =  20*50,
 WEXCG =  20*1,
 XRECEP =  1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 ,
2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 ,
2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0, 1 , 2*0,
 XNAME =    'MEI#1',
   'MEI#2',
   'MEI#3',
    17*'',

 NUTYPE =    'Particulate',
   'Ru',
   'Cs',
   'I',
   'Gas',

 ANH =          10            ,
 TABK =         283           ,
 IYOURW =       1             ,
 DMIX =         1000          ,
 ITYPE =        4             ,
 RAIN =         0             ,
 WSM =          4             ,
 AMIX =         400           ,
 PMIX =         1600          ,
 DFREQ =  36*.0278,
 WS =  .89 , 2.46 , 4.47 , 6.93 , 9.61 , 12.52 ,
 DFACT =        .5            ,
```

```
 PFIN =  5*1,
 TREATM =      0              ,
 XIN =  .3 , .85 , 1.6 , 0 , 2 ,
 IYOURS =     -1              ,
 VCASK =       65             ,
 ALPHA =       90             ,
 BETA =        90             ,
 IHARD =       1              ,
 TFLAME =      1350           ,
 DFIRE =       .75            ,
 FLOCA =       0              ,
 DSTP =  2 , 90 , 2 , 90 , 2 , 90 , 2 , 90 , 2 , 90 , 2 , 90 , 2 , 90 ,
2 , 90 , 2 , 90 , 2 , 90 ,
 FARM =       -1              ,
 GMEAT =      -1              ,
 GMILK =      -1              ,
 GVEGE =      -1              ,
 HSTP =  10*1,
 HTEXP =       2              ,
 IPFOD =       1              ,
 IPWATR =      0              ,
 NSTP =  10*1,
 NSTY =        0              ,
 POPD =        6              ,
 PSTP =  10*50,
 RDWTH =      -1              ,
 RFIE =        0              ,
 XING =  .26 , .3 , .52 , 0 , 1 ,
 XPZ =  .05 , 80 ,
 NSV =         20             ,
 FRELS =  3*.000002, .00002 , 3*.000002, .00002 , 3*.000002, .00002 ,
3*.000002, 5*.00002, 3*.000027, .00027 , 3*.000027, .00027 , 3*.000027,
.00027 , 3*.000048, 5*.00048, 3*.0002, .002 , 3*.0002, .002 , 3*.0002,
.002 , 3*.0002, 5*.002, 3*.0025, .043 , 3*.0025, .043 , 3*.0025, .043 ,
3*.0043, 5*.043, 3*.33, .63 , 3*.33, .63 , 3*.33, .63 , 3*.39, 5*.63,
 FDISP =  0 , 19*1, 0 , 19*1, 0 , 19*1, 0 , 19*1, 0 , 19*1,
 FSEV =  .994316 , .0038192 , .0017984 , .0000001532 , .00001687 ,
.000000233 , .0000001574 , 3.926E-14 , .00002362 , .0000003008 ,
.0000002034 , 1.495E-14 , .00001525 , .0000001592 , .0000001076 ,
7.681E-16 , .00000957 , .00000007201 , .00000004873 , 1E-16 , .993962 ,
.0027204 , .0005545 , .000000001786 , .0012275 , .0000005011 ,
.0000001021 , .000000000000329 , .00079511 , .0000003255 , .00000006634
, 2.137E-13 , .000614 , .0000002531 , .00000005162 , 1.644E-13 ,
.0001249 , .00000001075 , .00000005296 , 3.459E-14 , 20*.0000000001,
 FAILS =  .03 , .1 , 2*1, .03 , .1 , 2*1, .03 , .1 , 10*1,
 FSPAL =  0 , 3*1, .15 , 3*1, .15 , 3*1, .15 , 3*1, .15 , 3*1,
 FRCRUD =  20*1,
 HEATF =  500 , 19*2000000,
&END
```

Appendix G – U.S. Department of Energy Deficiency/Corrective Action Reports

Appendix G

Department of Energy
Washington, DC 20585

QA: QA

NOV 19 2001

J. A. McNeish
Bechtel SAIC Company, LLC
1180 Town Center Drive, M/S 423
Las Vegas, NV 89144

ISSUANCE OF DEFICIENCY REPORT (DR) BSC-02-D-022 RESULTING FROM THE OFFICE OF QUALITY ASSURANCE (OQA) SURVEILLANCE BSC-SR-02-03

Enclosed is DR BSC-02-D-022 generated as a result of OQA Surveillance BSC-SR-02-03.

Please provide a response to this deficiency that meets the applicable requirements of Administrative Procedure (AP) 16.1Q, *Management of Conditions Adverse to Quality*. Send the original of your responses to Deborah G. Opielowski, NQS, P.O. Box 364629, Mail Stop 455, North Las Vegas, Nevada 89036-8629. Initial response to the DR is due ten working days from the date of this letter. Any extensions to this due date must be requested in accordance with AP-16.1Q.

The Responsible Individual for this Condition Adverse to Quality (CAQ) should sign below and return to Ms. Opielowski within five working days.

If you have any questions, please contact either James Blaylock at (702) 794-1420 or Samuel E. Archuleta at (702) 794-1476.

James Blaylock for
Robert D. Davis, Acting Director
Office of Quality Assurance

OQA:JB-0280

Enclosure:
DR BSC-02-D-022

Printed with soy ink on recycled paper

ORIGINAL
IS IS A RED STAMP

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
U.S. DEPARTMENT OF ENERGY
WASHINGTON, D.C.

8. ☒ DEFICIENCY REPORT
☐ CORRECTIVE ACTION REPORT

NO. BSC-02-D-022

PAGE 1 OF

QA: QA

DEFICIENCY/CORRECTIVE ACTION REPORT

1. Controlling Document:
AP-SI.1Q, Rev 3, ICN 1, ECN 1

2. Related Report No.:
BSC-SR-02-03

3. Responsible Organization:
BSC

4. Discussed With: Jerry McNeish, Stephen Splawn, William Watson, Judy Gebhart

5. Requirement:

1. AP-SI.1Q, Section 5.10 establishes controls for the interim use of unqualified software.

2 AP-SI.1Q, Section 5.10.1c) refers users of the procedure to Sections 5.4 or 5.5 for the preparation and processing of a Software Activity Plan (SAP), Section 5.10.1c) also includes a requirement that the SAP shall include "special consideration and discussion on how the unqualified software will be used, a schedule for qualification, and comparison confirmation methodologies, including acceptance criteria to be used to determine the extent of impact evaluations that may be applicable once the software is qualified." Sections 5.4.1.2.1 or 5.5.1.2.1 further refer users of the procedure to Section 5.2.1 for requirements for developing the SAP.

3. AP-SI.1Q, Section 5.2.1 establishes the requirements for documentation of software activity planning.

4. AP-SI.1Q, Section 5.4.1.2.2 or 5.5.1.2.2 require that the Responsible Manager's Supervisor review the SAP and concur or resolve issues with the Responsible Manager.

5. Technical Work Plan (TWP) TWP-MGR-MD-000014, Rev 01, Section 13.0 states in part: "...Unqualified software, or software that has been modified as a result of executing work contained in this TWP, will be submitted to Software Configuration Management in accordance with AP-SI.1Q, Section 5.10, Interim Use...."

6. Description of Condition:
During Surveillance BSC-DR-02-03, the Configuration Control Documents for the following software codes were reviewed: (a). ANCpHMIX.BAS V1.0; (b) BATH_10 V1.0; (c) PATCH_FAIL_LAG V1.0; (d) PDFCDF V1.0; (e) SEEPAGEDLLMK2_UU V1.0; (f) SEEPAGEDLLV2UU V1.0; and (g) GoldSim V7.17-200; and (h) LAG_WPFAILURE_T1 V1.0

1. Contrary to requirement 1, the Software Activity Plans for software codes (b) through (h) referenced above were deficient in that, contrary to requirement 2, the SAPs did not effectively address the schedule for qualification, nor did they describe the confirmation methodologies and acceptance criteria.

Continued on Page 2, Continuation Page

7. Initiator:
Sam E. Archuleta Date 11-5-01

9. Does a stop work condition exist? (Not required for a DR)
☐ Yes ☒ No
If Yes, Check One: ☐ A ☐ B ☐ C ☐ D

10. Recommended Actions:
None

11. QA Review:
QAR Sam E. Archuleta Date 11-5-01

12. Response Due Date:
10 Working Days From Issuance

13. DOQA Issuance Approval:
Printed Name Robert D. Davis Signature [signature] Date 11/19/01

22. Corrective Actions Verified:
QAR Date

23. Closure Approved by:
DOQA Date

ENCLOSURE

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT U.S. DEPARTMENT OF ENERGY WASHINGTON, D.C.	8. ☑ DR/CAR ☐ Stop Work Order NO. BSC-02-D-022 PAGE OF QA: QA

DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

Block 6 - Description of Condition: Continued

2. Contrary to requirement 3, the Work Scope statements in all seven SAPs (b through h) are inaccurate in that they state that the non-qualified code will be utilized in non-quality affecting activities until final decisions on the modeling approach for LA are made, yet all seven codes (b through h) were already used in the FY01 Supplemental Science and Performance Analyses (SSPA), Vol 2, which is a "QA: QA " designated document, and therefore represents quality affecting work. In addition, this use of software conflicts with the planned course of action. that is documented in Section 13 of the TWP, requirement 5.

3. Contrary to requirement 4, the review of the SAPs by the Responsible Manager was ineffective in that it failed to detect the deficiencies cited in number 1, above.

Acknowledgement of Understanding of the CAQ (DR BSC-02-D-022) by the Responsible Individual:

_____ _____
Responsible Individual Date

cc w/encl:
W. L. Belke, NRC, Las Vegas, NV
N. K. Stablein, NRC, Rockville, MD
S. W. Lynch, State of Nevada, Carson City, NV
Engelbrecht von Tiesenhausen, Clark County, Las Vegas, NV
R. W. Andrews, BSC, Las Vegas, NV
G. K. Beall, BSC, Las Vegas, NV
J. E. Gebhart, BSC, Las Vegas, NV
Norman Graves, BSC, Las Vegas, NV
S. H. Horton, BSC, Las Vegas, NV
R. P. Keele, BSC, Las Vegas, NV, M/S 280
D. T. Krisha, BSC, Las Vegas, NV
D. M. Kunihiro, BSC, Las Vegas, NV
N. H. Williams, BSC, Las Vegas, NV
S. E. Archuleta, NQS, Las Vegas, NV
W. J. Glasser, NQS, Las Vegas, NV
K. A. Hodges, NQS, Las Vegas, NV
D. G. Opielowski, NQS, Las Vegas, NV
J. R. Dyer, DOE/YMSCO, Las Vegas, NV
C. E. Hampton, DOE/YMSCO, Las Vegas, NV
D. G. Horton, DOE/YMSCO, Las Vegas, NV
J. M. Replogle, DOE/YMSCO, Las Vegas, NV
B. M. Terrell, DOE/YMSCO, Las Vegas, NV
R. N. Wells, DOE/YMSCO (RW-60), Las Vegas, NV

DOE F1325.8
(08-89)
EFG (07-90)

United States Government | Department of Energy

Memorandum

QA: QA

DATE: OCT 30 2001

REPLY TO:
ATTN OF: RW-3 (R. D. Davis/4-1460)

SUBJECT: ISSUANCE OF DEFICIENCY REPORT (DR) OCRWM-02-D-016 RESULTING FROM AN OBSERVATION BY ROCHELLE RUCINSKI

TO: YMSCO/OIM (R. N. Wells)

Enclosed is DR OCRWM-02-D-016 generated as a result of an observation.

Please provide a response to this deficiency that meets the applicable requirements of Administrative Procedure (AP) 16.1Q, *Management of Conditions Adverse to Quality.* Send the original of your responses to Deborah G. Opielowski, NQS, P.O. Box 364629, Mail Stop 455, North Las Vegas, Nevada 89036-8629. Initial response to the DR is due ten working days from the date of this letter. Any extensions to the due date must be requested in accordance with AP-16.1Q.

The Responsible Individual for this Condition Adverse to Quality (CAQ) should sign below and return to Ms. Opielowski within five working days.

If you have any questions, please contact either James Blaylock at (702) 794-1420 or Samuel E. Archuleta at (702) 794-1476.

James Blaylock for
Robert D. Davis, Acting Director
Office of Quality Assurance

OQA:JB-0168

Enclosure:
DR OCRWM-02-D-016

ORIGINAL

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
U.S. DEPARTMENT OF ENERGY
WASHINGTON, D.C.

8. [X] DEFICIENCY REPORT
[ ] CORRECTIVE ACTION REPORT

NO. OCRWM-02-D-016

PAGE 1 OF

QA: QA

DEFICIENCY/CORRECTIVE ACTION REPORT

1. Controlling Document: QARD, Rev. 10

2. Related Report No.: N/A

3. Responsible Organization: OCRWM OIM

4. Discussed With: Sam Archuleta, Lyle Southworth, ALESIA BOOVE SA 10-25-01

5. Requirement:

1) QARD, Rev. 10, Section I.2.1.A.1, requires that "A defined software life cycle methodology shall address the following phases: requirements, design, implementation, testing installation and checkout, operations and maintenance, and retirement."

2) QARD, Rev. 10, Section I.2.1.A, requires that "Software acquisition, development, and maintenance shall proceed in a planned, traceable, and orderly manner utilizing a defined software life cycle methodology."

6. Description of Condition:

1) Contrary to the requirement above, software developed and qualified in accordance with Section 5.3 ("Level 3 software") of the QARD Supplement I implementing procedure, AP-SI.1Q, Rev. 3, ICN 1, is not subjected to the requirements and design phases of software life cycle development. Although the QARD allows for variations of the number of phases and relative emphasis placed on each of the phases, it does not appear to allow for elimination of life cycle methodology phases for different types of software. AP-SI.1Q, Rev. 3, ICN 1, Section 5.3, states no requirement for developing requirements or design documents, nor is there any requirement to document these phases.

2) Contrary to the requirement above, software developed and qualified in accordance with the Section 5.3 ("Level 3 software") of the QARD Supplement I implementing procedure, AP-SI.1Q, Rev. 3, ICN 1, is not subjected to requirements mandating that software development be planned. AP-SI.1Q, Rev. 3, ICN 1, Section 5.3, states no requirement for planning documents, nor is there any requirement to document the planning phase of the life cycle.

7. Initiator: Rochelle Rucinski 10/24/01
Rochelle Rucinski — Date

9. Does a stop work condition exist? (Not required for a DR)
[ ] Yes [ ] No
If Yes, Check One: [ ] A [ ] B [ ] C [ ] D

10. Recommended Actions: NONE

11. QA Review: Samuel E. Archuleta
QAR — Date 10-25-01

12. Response Due Date: 10 Working Days From Issuance

13. DOQA Issuance Approval:
Printed Name R. D. Davis Signature James B. Blaylock, Jr. Date 10/29/01

22. Corrective Actions Verified:
QAR — Date

23. Closure Approved by:
DOQA — Date

Exhibit AP-16.1Q.1

Rev. 12/20/1999

Enclosure

Acknowledgement of Understanding of the CAQ (DR OCRWM-02-D-016) by the Responsible Individual:

_____ _____
Responsible Individual Date

cc w/encl:
N. K. Stablein, NRC, Rockville, MD
W. L. Belke, NRC, Las Vegas, NV
S. W. Lynch, State of Nevada, Carson City, NV
Engelbrecht von Tiesenhausen, Clark County, Las Vegas, NV
W. J. Wooley, MTS, Las Vegas, NV
J. F. Pelletier, BSC/SNL, Las Vegas, NV
S. H. Horton, BSC, Las Vegas, NV
R. P. Keele, BSC, Las Vegas, NV, M/S 280
D. T. Krisha, BSC, Las Vegas, NV
D. M. Kunihiro, BSC, Las Vegas, NV
R. E. Rucinski, BSC, Las Vegas, NV
L. C. Southworth, BSC, Las Vegas, NV
S. E. Archuleta, NQS, Las Vegas, NV
W. J. Glasser, NQS, Las Vegas, NV
K. A. Hodges, NQS, Las Vegas, NV
D. G. Opielowski, NQS, Las Vegas, NV
Alesia Boone, DOE/YMSCO, Las Vegas, NV
J. R. Dyer, DOE/YMSCO, Las Vegas, NV
C. E. Hampton, DOE/YMSCO, Las Vegas, NV
D. G. Horton, DOE/YMSCO, Las Vegas, NV
J. M. Replogle, DOE/YMSCO, Las Vegas, NV
B. M. Terrell, DOE/YMSCO, Las Vegas, NV

DOE F1325.8
(08-89)
EFG (07-90)

United States Government — Department of Energy

Memorandum

QA: QA

DATE: OCT 25 2001

REPLY TO:
ATTN OF: RW-3 (James Blaylock/4-1420)

SUBJECT: ISSUANCE OF DEFICIENCY REPORTS (DR) OQA-01-D-146 AND OQA-01-D-147 RESULTING FROM THE OFFICE OF QUALITY ASSURANCE (OQA) AUDIT OQA-ARC-01-015

TO: RW-3 (R. D. Davis)

Enclosed are DRs OQA-01-D-146 and OQA-01-D-147 generated as a result of OQA Audit OQA-ARC-01-015.

Please provide responses to these deficiencies that meet the applicable requirements of Administrative Procedure (AP) 16.1Q, *Management of Conditions Adverse to Quality*. Send the original of your responses to Deborah G. Opielowski, NQS, P.O. Box 364629, Mail Stop 455, North Las Vegas, Nevada 89036-8629. Initial responses to the DRs are due ten working days from the date of this letter. Any extension to the due dates must be requested in accordance with AP-16.1Q.

The Responsible Individual for these Conditions Adverse to Quality (CAQ) should sign below and return to Ms. Opielowski within five working days.

If you have any questions, please contact James Blaylock at (702) 794-1420.

James Blaylock
James Blaylock
Office of Quality Assurance

OQA:JB-0145

Enclosure:
DRs OQA-01-D-146 and
OQA-01-D-147

ORIGINAL
THIS IS A RED STAMP

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT U.S. DEPARTMENT OF ENERGY WASHINGTON, D.C.	8. ☒ DEFICIENCY REPORT ☐ CORRECTIVE ACTION REPORT NO. OQA-01-D-146 PAGE 1 OF 2 QA: QA

DEFICIENCY/CORRECTIVE ACTION REPORT

1. Controlling Document:	2. Related Report No.:
• QARD Rev 10 Eff Date 04/28/00 • AP-2.1Q Revision 1, ICN 0 Eff Date 06/30/00	OQA-ARC-01-015
3. Responsible Organization: Office of Quality Assurance (OQA)	4. Discussed With: R. D. Davis, J. Blaylock, R. Hasson

5. Requirement:

- Quality Assurance Requirements and Description QARD Rev 10 Eff Date 04/28/00
- Procedure Indoctrination and Training of Personnel AP-2.1Q Revision 1, ICN 0 Eff Date 06/30/00

(Continued on page 2)

6. Description of Condition:

Contrary to the above, complete individual training requirements and history were not retrievable from record storage and the training organization does not reflect the status of training for OQA.

- Individual training requirements could not be determined for five personnel in OQA (DOE personnel)
- DOE Individual Development Plans (IDPs) have not been submitted to the Training Organization (TO)
- Current training matrices could not be retrieved from the records organization or the training organization for three (of three sampled) OQA (Navarro) personnel

(Continued on page 2)

7. Initiator: T. L. Morgan T. L. Morgan Date 10/01/01	9. Does a stop work condition exist? (Not required for a DR) ☐ Yes ☒ No If Yes, Check One: ☐ A ☐ B ☐ C ☐ D

10. Recommended Actions:

None Identified.

11. QA Review: Pamela R. West-Thompson QAR Date 10/24/01	12. Response Due Date: 10 Working Days From Issuance

13. DOQA Issuance Approval:

Printed Name Robert D Davis Signature James Blaylock for Date 10/25/01

22. Corrective Actions Verified: QAR Date	23. Closure Approved by: DOE/OQA Date

Exhibit AP-16.1Q.1 Rev. 12/20/1999

ENCLOSURE

DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

5. Requirement: (continued)

QARD Subsection 2.2.13 *Qualification of Personnel Who Perform Inspection, Nondestructive Examination, Testing, and Auditing* states "Personnel who perform inspection, nondestructive examination, testing, and auditing shall be qualified in accordance with the requirements of the applicable QARD section covering the activity and QARD Subsection 2.2.12, Personnel Qualification"

Subsection 2.2.12.A. states "Each Affected Organization shall indoctrinate and train personnel as follows:

1. Determine required indoctrination and training."
4. "Ensure indoctrination and training are completed prior to performing the work."

17.2.1 Classifying Quality Assurance Records

Subsection 17.2.1.A states "Documents that meet the following requirements shall be classified as lifetime QA records:

7. "Personnel training and qualification documents for individuals executing QA program requirements."

AP-2.1Q Section5.2 *Training Requirements Documentation*

5.4.1 Manager:

a) Ensure that indoctrination and training requirements, including those indoctrination and training requirements for ES&H and work subject to the QARD as determined in Subsection 5.1, are documented for each Employee or the Employee's job function. Document training requirements on an IDP or on a matrix that indicates Training Requirements against job functions, or employee.
c) Submit a copy of the IDP or Training Requirements Matrix to the TO.

5.4.2 Employee

b) Document completed indoctrination and training.... and ensure a copy is provided to the TO.

5.4.3 TO:

b) Submit completed training records and training exemption records in accordance with Section 6.0. [Records].

6. Description of Condition (continued):

- The training organization records do not show completion of required training for three (of three sampled) OQA (Navarro) personnel

QAS 1 (3590)

- Working File showed training matrix requirements for Manager should have been for a QAS
- TO showed two classes as having expired and retraining required.
- TO did not show two classes as being required that management had indicated as being required for initial job qualification.
- Records storage only showed a few completed classes, no matrix on file.

QAS 2 (2526)

- TO showed two classes as having expired and retraining required.
- TO did not show six classes as being required that management had indicated as being required for initial job qualification.
- TO showed one job function related/QA training requirement class as not having been completed
- Records storage only showed a few completed classes, no matrix on file.

QAS 3 (6989)

- TO showed one classes as having expired and retraining required.
- TO did not show fourteen classes as being required that management had indicated as being required for initial job qualification.
- TO showed three job function related/QA training requirement class as not having been completed
- Records storage only showed a few completed classes, no matrix on file.

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
U.S. DEPARTMENT OF ENERGY
WASHINGTON, D.C.

8. ☒ DEFICIENCY REPORT ☐ CORRECTIVE ACTION REPORT

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NO. OQA-01-D-147

PAGE 1 OF
QA: QA

DEFICIENCY/CORRECTIVE ACTION REPORT

1. Controlling Document:
AP-16.1Q, Rev. 4, ICN 1

2. Related Report No.:
OQA-ARC-01-15

3. Responsible Organization:
Office of Quality Assurance (OQA)

4. Discussed With:
R. D. Davis, J. Blaylock, W. Glasser

5. Requirement:
Paragraph 5.2.4.e states: "Identify the results of the Stop Work evaluation in Block 9."

"Attachment 4, Instructions For Completing The Office Of civilian Radioactive Waste Management Deficiency/Corrective Action Report" states in step 9: "Check 'Yes' or 'No' as applicable indicating whether a stop work condition exists."

6. Description of Condition:
Contrary to the above requirement, DR/CAR form Block 9 is not filled in for the following Deficiency Reports:

BSC-01-D-071
OQA—01-D-001
BSC-01-D-082
USSGS-01-D-004

7. Initiator:
R. W. Hendrickson [signature] Date 10/03/01

9. Does a stop work condition exist? (Not required for a DR)
☐ Yes ☒ No
If Yes, Check One: ☐ A ☐ B ☐ C ☐ D

10. Recommended Actions:
Revise existing paragrah 5.2.4 e) and step 9 of Attachment 4 of AP-16.1Q to make stop work considerations applicable only to Corrective Action Reports

11. QA Review:
QAR Sam Horton Date 10/23/01

12. Response Due Date:
10 Working Days From Issuance

13. DOQA Issuance Approval:
Printed Name Robert D. Davis Signature James Blaylock for Date 10/25/01

22. Corrective Actions Verified:
QAR Date

23. Closure Approved by:
DOE/OQA Date

Department of Energy
Washington, DC 20585

QA: QA

OCT 25 2001

G. S. Bodvarsson, Laboratory Lead
Lawrence Berkeley National Laboratory
University of California
One Cyclotron Road, Building 50E
Berkeley, CA 94720

ISSUANCE OF DEFICIENCY REPORT (DR) BSC-02-D-008 RESULTING FROM AN OBSERVATION BY MICHELLE PRATER AND KENNETH O. GILKERSON

Enclosed is DR BSC-02-D-008 generated as a result of an observation.

Please provide a response to this deficiency that meets the applicable requirements of Administrative Procedure (AP) 16.1Q, *Management of Conditions Adverse to Quality*. Send the original of your responses to Deborah G. Opielowski, NQS, P.O. Box 364629, Mail Stop 455, North Las Vegas, Nevada 89036-8629. Initial response to the DR is due ten working days from the date of this letter. Any extensions to this due date must be requested in accordance with AP-16.1Q.

The Responsible Individual for this Condition Adverse to Quality (CAQ) should sign below and return to Ms. Opielowski within five working days.

If you have any questions, please contact either James Blaylock at (702) 794-1420 or Christian M. Palay at (702) 794-1486.

James Blaylock for
Robert D. Davis, Acting Director
Office of Quality Assurance

OQA:JB-0146

Enclosure:
DR BSC-02-D-008

Printed with soy ink on recycled paper

Acknowledgement of Understanding of the CAQ (DR BSC-02-D-008) by the Responsible Individual:

_____ _____
Responsible Individual Date

cc w/encl:
N. K. Stablein, NRC, Rockville, MD
W. L. Belke, NRC, Las Vegas, NV
S. W. Lynch, State of Nevada, Carson City, NV
Engelbrecht von Tiesenhausen, Clark County, Las Vegas, NV
Nancy Aden-Gleason, BSC/LBNL, Berkeley, CA
J. A. Blink, BSC/LLNL, Las Vegas, NV
R. W. Andrews, BSC, Las Vegas, NV
G. K. Beall, BSC, Las Vegas, NV
David Dobson, BSC, Las Vegas, NV
K. O. Gilkerson, BSC, Las Vegas, NV
H. T. Greene, BSC, Las Vegas, NV
S. H. Horton, BSC, Las Vegas, NV
C. A. Humphries-Alder, BSC, Las Vegas, NV, M/S 280
R. P. Keele, BSC, Las Vegas, NV, M/S 280
D. T. Krisha, BSC, Las Vegas, NV
D. M. Kunihiro, BSC, Las Vegas, NV
W. W. Watson, BSC, Las Vegas, NV
N. H. Williams, BSC, Las Vegas, NV
W. J. Glasser, NQS, Las Vegas, NV
K. A. Hodges, NQS, Las Vegas, NV
D. G. Opielowski, NQS, Las Vegas, NV
C. M. Palay, NQS, Las Vegas, NV
J. R. Dyer, DOE/YMSCO, Las Vegas, NV
C. E. Hampton, DOE/YMSCO, Las Vegas, NV
D. G. Horton, DOE/YMSCO, Las Vegas, NV
S. P. Mellington, DOE/YMSCO, Las Vegas, NV
J. M. Replogle, DOE/YMSCO, Las Vegas, NV
B. M. Terrell, DOE/YMSCO, Las Vegas, NV

OFFICE OF CIVILIAN
RADIOACTIVE WASTE MANAGEMENT
U.S. DEPARTMENT OF ENERGY
WASHINGTON, D.C.

8. ☒ DEFICIENCY REPORT
☐ CORRECTIVE ACTION REPORT

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NO. BSC-02-D-008

PAGE 1 OF

QA: QA

DEFICIENCY/CORRECTIVE ACTION REPORT

1. Controlling Document:
AP-2.21Q, Revision 0; AP-2.21Q Revision 1, BSCN 1

2. Related Report No.:
CIRS Item # 1982

3. Responsible Organization:
Science & Analyses

4. Discussed With:
Jim Blink, Hank Greene, Bill Watson, Cindy Humphries-Alder, Dave Dobson

5. Requirement:
1) AP-2.21Q, R-1, BSCN1 Section 5.6 a) states: "For existing Work Packages being modified (e.g., by a Change Request, Baseline Change Proposal, etc.) with work scope changes, determine if the current TWP is consistent with the work package."
2) AP-2.21Q, R-1, BSCN1 Section 5.6 b) states: "When a revision to the TWP is necessary, develop the revised TWP in accordance with Subsections 5.2 through 5.5 and 5.8."
3) AP-2.21Q, R-1, BSCN1 Section 5.5.2.e states: "Conduct a review of the TWP including any addenda (i.e., Activity Evaluation, etc.). Review of the TWP may be accomplished via hard copy or electronically, at the discretion of the TWP Manager or Designee. Comments and resolution may be accomplished via electronic mail or by using a Review Record and Comment Sheet, such as the forms in AP-5.1Q, *Plan and Procedure Preparation, Review, and Approval.* Reviews conducted via electronic mail require a signed hard copy." Section 6.0 requires these reviews to be submitted to records. (NOTE: AP-2.21Q R-0 required that a AP-6.28Q review be performed.)
4) AP-2.21Q, R-1, BSCN1 Section 5.8a) states: "Upon completion of the TWP, TWP Manager or Designee: a) Forward the TWP to Document Control for issuance in accordance with AP-6.1Q."

6. Description of Condition:
TWP-NBS-TH-000001, R-0, ICN 1, "Technical Work Plan for Nearfield Environment Thermal Analyses and Testing" was not prepared and processed in accordance the requirements of AP-2.21Q.

1) Subject TWP was modified to add a scope of work not authorized (funded) by Work Package #4301213NML. This WP only lists 6 approved activities. The addition of the 7th activity to prepare and complete the Large Block Final Report (TDR-NBS-HS-000012) is not part of subject work package and thus an improper modification to subject TWP. This report was however prepared in FY 01 with LLNL funding (not YMP). NOTE: There is no FY 02 funding for this product either.

2) The modification to subject TWP was accomplished by an "ICN". The AP-2.21Q process for revising TWP's does not allow for revising with "ICNs".

3) An extensive review of the RISWEB does not disclose any objective evidence that subject TWP (nor Revision 0 of subject TWP) were reviewed in accordance with AP-2.21Q. No comment sheets or associated resolution of comments could be located in any record package associated with TWP-NBS-TH-000001 Revision 0 or Revision 0, ICN 1.

4) TWP-NBS-TH-000001, R-0, ICN 1 was approved on 2/12/01. The document was never submitted to Document Control as required.

7. Initiator:
Michelle Prater/K. O. Gilkerson Date 10/19/01
M. Prater K. Gilkerson

9. Does a stop work condition exist? (Not required for a DR)
☐ Yes ☒ No
If Yes, Check One: ☐ A ☐ B ☐ C ☐ D

10. Recommended Actions:
None.

11. QA Review: Christian Palay
QAR Chris Palay Date 10/19/01

12. Response Due Date:
10 Working Days From Issuance

13. DOQA Issuance Approval:
Printed Name Robert D. Davis Signature James Blaylock for Date 10/25/01

22. Corrective Actions Verified:
QAR Date

23. Closure Approved by:
DOQA Date

Exhibit AP-16.1Q.1

Rev. 12/20/1999

ENCLOSURE

Department of Energy
Washington, DC 20585

QA: QA

OCT 04 2001

R. L. Howard
Manager of Projects
Bechtel SAIC Company, LLC
1180 Town Center Drive, M/S 423
Las Vegas, NV 89144

ISSUANCE OF DEFICIENCY REPORT (DR) BSC-01-D-142 RESULTING FROM AN OBSERVATION BY ROCHELLE RUCINSKI

Enclosed is DR BSC-01-D-142 generated as a result of an observation.

Please provide a response to this deficiency that meets the applicable requirements of Administrative Procedure (AP) 16.1Q, *Management of Conditions Adverse to Quality*. Send the original of your responses to Deborah G. Opielowski, OQA/NQS, P.O. Box 364629, Mail Stop 455, North Las Vegas, Nevada 89036-8629. Initial response to the DR is due ten working days from the date of this letter. Any extensions to this due date must be requested in accordance with AP-16.1Q.

The Responsible Individual for this Condition Adverse to Quality (CAQ) should sign below and return to Ms. Opielowski within five working days.

If you have any questions, please contact either James Blaylock at (702) 794-1420 or Christian M. Palay at (702) 794-1486.

James Blaylock for
Robert D. Davis, Acting Director
Office of Quality Assurance

OQA:JB-0034

Enclosure:
DR BSC-01-D-142

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D60 10/4/01

DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

8) On page II-6, the 4th paragraph, discusses 150 random samples of a lognormal distribution and Table II-4 is referenced. Table II-4 is for a shifted lognormal test.

9) The last paragraph on page II-6 discusses 2 distributions (not all three) and states that "As expected, both distributions provide acceptable fits to the random data (Section 6.1.3)". In sections 6.1.3 and 6.2.6, the accept/reject cutoff for chi squared is 12 for the normal and lognormal distributions and 10.6 for the shifted lognormal distribution. Looking at the chi squared values in table II-5 it appears that only the shifted lognormal distribution with a value of 9.1604 is acceptable. The other 2 chi squared values are 14.6770 (lognormal), and 25.0131 (normal). The conclusion has to change to state that only the shifted lognormal distribution provides an acceptable fit.

10) In the same paragraph discussed in 9 above, a shift of 0.32 is noted. The shift on Table II-5 is actually 4.9968.

11) On page II-7, only 2 distributions are mentioned, the normal distribution is missing ~~form~~ from the discussion.
c.f. 10/04/01

12) On page IV-2, 2nd to the last line of the 1st paragraph, B4:B154 should be B4:B153.

ANL-EBS-MD-000029 Rev 00 ICN 01 (E0070)

1) The reference in attachment II to the source code listing for *chim_wt_TP.f* (attachment VI) is incorrect. The routine *chim_wt_TP.f* is not listed in attachment VI.

2) Essentially all of the cross-references to figures in the AMR are incorrect. There are two "Figure 1" figures. The first is on pages 13 and 14, and the second is on page 29. The numerous figure references on pages 25, 26, 31, 32 (in Table 7), and 36 are all incorrect.

3) On Table III-1, the Northing and Easting coordinates are reversed.

ANL-EBS-MD-000033 Rev 01 (E0100)

1) Table 3-1, the first routine listed has an incorrect name, there should be a "12" after Sd.

2) Page 22, first line, "Attachment IV" should be "Attachment II".

3) Page II-1, section II.3.1, a DTN is referenced for the "Groundwater Flow Model (GFM) V3.0". The DTN referenced is in support of the Geologic Framework Model V3.0.

Page III-2, second line, "tree" should be "three", and line 6, "as positive" should be "is positive".

5) Page IX-1, the use of "routines" (plural) appears to be incorrect since the attachment only discusses one routine.

DGO 10/4/01

DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

ANL-EBS-HS-000003 Rev 00 ICN 02 (E0130)

1) Page II-1, in the code listing, under "Nomenclature for this processor", the line starting "temp (8)", 3emps should be Temps. In the same section, the last entry in the line starting "time23" should be 22.64 meters instead of 22.14 meters.

2) Page II-10, 2nd line from the top should read " for use with the no-backfill SR base case high (not low) infiltration flux -----"; also on the 5th line, "csnflow" should be csnfhigh since this version is for the high infiltration flux case.

3) Page III-1, the first line of the 2nd paragraph states that three versions of the routine maxtwp are used in the AMR. This should be six versions as six versions are documented in attachment III. The last line of the paragraph should read that all 6 routines are presented on the next 15 pages.

4) Page III-8, the text paragraph at the bottom of the page, 2nd sentence, there are not seven data columns, there are five.

5) Page III-11, the text paragraph near the middle of the page, 2nd sentence, there are not seven data columns, there are five, and the headers are shifted such that "time" is above temperature values and there is no information in the temperature column.

6) Page III-13, top of the page, 2nd sentence, the statement is made that this routine is for the high infiltration flux case. This is not correct; version 1.05 is for the low infiltration case.

7) Page III-14, the text paragraph near the middle of the page, 2nd sentence, there are not seven data columns, there are five.

8) Page IV-21, first line of text, computed should be computer.

9) Page VII-1, last paragraph, 2nd sentence, there is a reference to input files for six routines, it should be for three routines.

10) Page VIII-25, last paragraph, the second line reads "-----for both input and input files", it should indicate input and output files.

ANL-NBS-HS-000022 Rev 00 ICN 01 (S0015)

1) On the Revision Record (page 2 of the AMR), opposite "REV 00 ICN 01", it states "Initial issue: 7/26/00". It should indicate that ICN 01 was issued sometime after 8/30/00 when the document was approved.

10/4/01

DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

ANL-WER-ME-000001 Rev 01

1) The hand calculations on Page II-7 show that 1237.87*4.448222= 55506.32 (0.00% error), but it actually equals 5506.32. Further, the spreadsheet (for Scenario 1, delta h = 3.3) uses different inputs and shows that the result is 1222.56*4.448222=5438.24.

ANL-WIS-MD-000017 Rev 00 ICN 01 (T0070)

1) Page 11, section 4, 3rd paragraph, end of the 3rd line, the period should be after "events", "and receives in" should be deleted.

2) Page 17, section 5.1.2, 4th line of "rationale", "wind speed" should be wind direction.

3) Page 22, section 5.3.5, there is no "Use in Analysis" section for this assumption.

4) Page 30, section 6.1.1, first line, "represented" should be deleted.

5) Page 33; first line after equation 5, the "is" in the middle of the line should be deleted.

6) Page 51, Table 4, 4th entry (down) on the table, "x-axis" should be y-axis.

7) Page 55, Table 5, the same mistake noted in 6 above is repeated.

8) On DTN SN0010T0502900.003, the same mistake noted in 6 and 7 above is repeated.

9) On DTN SN0010T0502900.003, the DTN indicates that it is for Rev 01 of the AMR, it should indicate Rev 00 ICN 01.

ANL-NBS-HS-000032 Rev 00 ICN 01 (U0010)

1) On page V-4, the descriptions for the files DAILY09.CTL, DAILY09.FOR, and DAILY09.EXE have been incorrectly replaced by descriptions of BLOCKR7 files.

2) On page VI-20 is an example listing of the file "30MSOIL.ASC", or so states the text at the top of the page. However, this exact same text describing the file "30MSOIL.ASC", is repeated on page VI-21 but a different file is presented below the text.

3) On page VII-12 an excerpt of the file "GEOMAP7.INP" is provided. This is the output file of GEOMAP7 that is to include updated bedrock geology. However the output file is identical to the input file "30MSITE.INP" provided on page VII-9 and no explanation is provided.

DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

4) Similar to item 3 above, it is unclear whether the input and output files on pages VIII-7 and VIII-9 are correct file excerpts. All of the rock-type designations are "201" or "202", while a quick look at tables VII-4, VII-6, VIII-2, and VIII-4 indicates that the majority of rock-type designations are in the expected 301 to 345 range. Also, the input (GEOMAP7.INP on page VIII-7) and output (GEOMOD4.INP on page VIII-9) files are again identical, indicating that there were no modifications to the soil depth class by the routine. As it is, given the routine functions that are being documented, the excerpts provide no indication of routine function and no explanation is provided.

5) On page XII-2, the description of what the routine VEGCOV01 does (item 4) is surprising given the name of the routine and a reading of the code. Item 4 indicates that the only purpose of the routine is to change the saturated hydraulic conductivity of the Yucca Mountain Tuff, there is no mention of vegetation cover or type. It appears that what is actually changed is the rock type designation of the tuff to account for the change in welding from welded in the northern part of the area to non-welded in the south. More parameters than just hydraulic conductivity will change with the rock type, but table XII-1 demonstrates that the rock type was changed correctly. Though not mentioned at all in the attachment text, the routine also does add terms for vegetation cover and type. The input file (30MGRD01.SR1 on page XII-3 contains "-99" placeholders for vegetation, and the output file (30MGRD04.SR1 on page XII-4) shows these placeholders replaced with integers (4 and 30 in several cases). The auxiliary input file "vegtyp01.xyz" listed at the top of page XII-3 is neither described nor provided in the attachment yet it apparently was used by the routine. The full functionality of the routine needs to be described and demonstrated in the attachment, and it is not.

6) On page XIII-4, item 6, the perimeter cell identifier should always be -3.

7) On page XIII-7, top of the page, third line, Attachment VII should be Attachment XII.

8) On page XIII-8, second paragraph, third line, "WATSHD20.INP" should probably be "WATSHD20.CTL".

9) On page XIII-8 an example input file (30MGRD04.SR1) is provided. This file is said to be from VEGCOV01. However the output file from VEGCOV01 (30MGRD04.SR1 on page XII-4) does not match the file on page XIII-8. The "-99" placeholder values that were changed to integers by VEGCOV01 (see comment 5 above) are here in part placeholders. The 4 and 30 in the first line for example, is now -99 and 30. An explanation as to why these file excerpts which should match but do not needs to be provided, or a correct excerpt needs to be provided if that is the problem.

10) On page XIII-9 the reference to Attachment XII in bold text should be to Attachment XI.

11) On page XV-5, the listing of electronic files at the top of the page is not complete. Files such as MAPSUM01.EXE, MAPSUM01.CTL and perhaps others need to be added to the list.

D60 10/4/01

DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

CAL-WIS-TH-000001 Rev 01

1) The text of attachment I on page I-26 states that for the no-backfill case "response surfaces are provide only for relatively short ventilation periods". Yet two tables are provided, Table I-5 (Response Surface Coefficients for No Backfill (long term)), and Table I-7 (Response Surface Coefficients for No Backfill (short term)). Inspection reveals that the contents of the two tables are identical.

2) Figure I-5 is indicated to be for the no backfill case according to the text on page I-31 yet the figure itself clearly indicates that backfill with a thermal conductivity of 0.20 W/m k is included.

3) The density of the backfill is assumed to be essentially the same as the intact welded tuff of the repository horizon. This is a high value for a granular material and no explanation is provided.

4) The density of the invert ballast is indicated to be much less than that of the backfill; yet the effective thermal conductivity of these materials are stated to be identical (Table I-9) and no explanation is provided.

5) Table I-3 provides design basis and average factors for heat generation, drift wall temperatures, and WP temperatures. As expected the design basis is equal to or higher than the average in all cases, with the notable exception of heat generation for 24-BWR waste packages. In that case the design basis is less than one tenth of the average and no explanation is provided.

DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

(Continued from Block 5 – Requirement)

Additional applicable requirements:

AP-3.12Q Rev. 0 ICN 3, Attachment 2, Section 5, requires that "The calculation shall be presented such that any qualified individual could review the calculation without recourse to the Originator."

AP-3.12Q Rev. 0 ICN 3, Section 5.2.3.a.1, requires that the checker "Check for completeness, mathematical correctness, and technical adequacy of the calculation method used."

Initiator: Rochelle Rucinski 10/3/01

Rochelle Rucinski Date

DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

Recommendations for BSC-01-D-142:

1. Evaluate adequacy of checkers with regards to their qualifications for technical and compliance checking.
2. Given the frequency of "editorial" errors in the description of condition for this deficiency report, BSC should consider the incorporation of a more rigorous technical editing process being made available for all future mission critical technical documents.
3. Given that an AP-3.10Q revision is currently underway , BSC should coordinate this corrective action with the revision of that procedure
4. Evaluate the errors for technical impact.

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U.S. DEPARTMENT OF ENERGY
WASHINGTON, D.C.

8 ☐ Performance Report
☑ Deficiency Report

NO. LVMO-98-D-038

PAGE 1 OF 3
QA: L DS

PERFORMANCE/DEFICIENCY REPORT

6/19/98

1 Controlling Document:
Geokon Quality Assurance (QA) Manual, Revision 08/07/97

2 Related Report No.
OQA-SA-98-005

3 Responsible Organization:
CRWMS M&O/Geokon, Inc.

4 Discussed With:
Marty Gibson

5 Requirement/Measurement Criteria:

A. QA Manual, Section 1.1, states in part, "All employees are required to read and understand Geokon's Quality Policy and Manual."

B. QA Manual, Section 15.0, states in part, "It is the company's policy to hire and/or to ensure that all personnel are suitably educated, professionally qualified or experienced, or suitably skilled or experienced to fulfill responsibilities of the position that they occupy or are hired for."

Continued on Page 3

6 Description of Condition:

A. No objective evidence could be provided to support that Geokon's employees have read and understand the Geokon Quality Policy and Manual.

B. No objective evidence could be provided to reflect that personnel performing the calibrations of ambient/low temperature MPBXs and SPBXs are qualified to fulfill the responsibilities and position they occupy.

Continued on Page 3

7 Initiator Richard L. Maudlin Date 02/04/98

9 Is condition an isolated occurrence?
☐ Yes ☐ No ☑ Unknown; Must be Yes if PR

10 Recommended Actions: (Not required for PR)

A. Take the necessary action to have all Geokon personnel read and understand the Geokon Quality Policy and Manual. Document this training. As an alternative, consider development of a training class which summarizes the QA program and indoctrinate all personnel. Document this training. Revise the QA Manual accordingly.

B. Take immediate action to train and qualify personnel, if not presently qualified, to perform calibrations of the MPBX and SPBX. Assure that documented qualifications satisfy minimum requirement as defined in the Position Description for the assigned position that the individual occupies.

Continued on Page 3

11 QA Review: Richard L. Maudlin
QAR Richard L. Maudlin Date 02/04/98

12 Response Due Date
20 days from issuance

13 Director, OQA Issuance Approval: (QAR for PR)
Printed Name Catherine Hampton Signature Catherine Hampton Date 2/11/98

22 Corrective Actions Verified
QAR Richard L. Maudlin Date 05/19/98

23 Closure Approved by: (N/A for PR)
OQA Catherine Hampton Date 5/29/98

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WASHINGTON, D.C.

PR/DR NO. LVMO-98-D-038
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FJS 3/6/98 QA: L
DS 6/19/98

PERFORMANCE/DEFICIENCY REPORT RESPONSE

14 Remedial Actions:

See continuation page

15 Extent of Condition: (Not required for PR)

See continuation page

16 Root Cause Determination: (Not required for PR) Required: ☐ Yes ☒ No

17 Action to Preclude Recurrence: (Not required for PR) Required: ☐ Yes ☒ No

18 Corrective Action Completion Due Date:	19 Response by:
4/30/98	F. J. Schelling Date 3/6/98 Phone (505) 848-0643

20 Response Accepted	21 Response Accepted (N/A for PR)
QAR N/A Date	DOQA N/A Date

Exhibit AP-16.10.2 Rev. 06/02/97

3/10/98 Schelling to Horton

PR/DR CONTINUATION PAGE

5 Requirement/Measurement Criteria: (Continued)

C. Quality Assurance Operating Procedure (QAOP) 430, Revision A, Section 6.2.10, states in part: "The document owner will assign a sequential DCR number from the DCR Logbook using the next available number, utilizing the last two digits of the calendar year .... "

D. QA Manual, Section 10.0, states in part, "The company operates a program that controls, calibrates, and maintains M&TE which can effect product quality, in compliance with the United States of America, Department of Defense, MIL-STD-45662A." MIL-STD-45662A, Section 5.9, Records, states in part, "... The records shall include an individual record of calibration or other means of control for each item of M&TE and measurement standard, providing a description or identification of the item, calibration interval, date calibrated, identification of the calibration source, calibration procedures used, calibration results, and calibration actions taken."

E. QA Manual, Section 14.0, states in part, "The company performs planned and documented Internal QA audits to verify compliance with the QA Program and Quality System ... Normal time periods for a complete program audit are not to exceed one year."

6 Description of Condition: (Continued)

C. To date, Geokon has not instituted a DCR Logbook for tracking changes to documents other than drawings or sketches.

D. QAOP 1100, Revision: Initial, does not address requirements for the contents of Certificates of Calibration or calibration data when documenting internal Geokon calibrations.

E. To date, no documented evidence could be provided to reflect a complete program audit of the Geokon QA Program has been performed.

10 Recommended Actions: (Continued)

C. Take action to develop a DCR Logbook and implement this log in tracking changes to documents other than drawings and sketches. An alternative may be to just use the Engineering Change Notice system for documenting all changes to all documents, including procedures.

D. Revise QAOP 1100 to address content of Certificates of Calibration or calibration data, which consist of MIL-STD-45662A or ANSI/NCSL Z540-1, 1994.

E. Implement your documented audit plan to assure that the entire QA Program is audited in FY98.

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WASHINGTON, D.C.

8 ☐ Performance Report
☑ Deficiency Report

NO. LVMO-98-D-038
PAGE 4 OF 4.9 pg
FPS 3/6/98 QA: L

PR/DR CONTINUATION PAGE

6/15/98

14 Remedial Action (Continued)

1. A revision to the Geokon Quality Policy and Manual is being processed to replace the "read and understand" requirement with new employee training, which is implemented by QAOP1800. The revised manual is expected to be released by mid-April 1998. A training plan was prepared and all employees hired since June, 1996 were trained to it, as documented by training records.

2. A position description has been developed to establish minimum qualifications for any new hires for this type of work and documentation of calibration personnel being trained and qualified to perform the task is maintained. At the present time, an extensive "hands-on" training program has been completed by the individual calibrating vibrating wire transducers for YMP SPBX and MPBX instrumentation. This individual was hired prior to the establishment of qualifications for new hires, but has considerable experience in performing this work and is considered qualified for the position.

3. QAOP430 is being revised to eliminate the DCR Logbook and document changes using the Engineering Change Notice system. This revision should be completed by mid-April 1998.

4. QAOP1100 has been revised to reflect the calibration documentation requirements and is presently in review for an expected release by mid-April 1998.

5. The documented audit plan is being implemented and is being performed as scheduled. To date, one internal audit has been done and is being closed, and two are scheduled to be performed in February, 1998.

15 Extent of Condition (Continued)

1. The draft Geokon Quality Policy and Manual which contained the "read and understand" requirement has been replaced by one that requires personnel to be aware of and work to the quality program. An implementing document, QAOP 1800, has been released which implements training and includes using the Quality Manual as a guide.

2. The qualification and training status of the four technicians was evaluated, and it has been determined that these individuals are adequately qualified on the basis of their experience and/or education, and trained for their assignments. The qualifications of the individual performing the YMP calibrations, for example, include a Bachelor degree, ten years of related experience, and several years of on-the-job training and experience in calibration. The Job descriptions maintained by the Geokon Human Resources organization are used as a guide for posting openings, but should not be interpreted as minimum standards to perform the work.

3. It was determined that an Engineering Change Notice (ECN) is the standard practice at Geokon for tracking document changes. QAOP 430 is therefore being revised to replace the DCR Log with ECNs.

4. Geokon is in the process of finalizing their implementation of an ANSI Z540 program. With respect to the content of calibration certificates, their intention is to solicit feedback on content requirements from known customers and develop an updated standard certificate for the purposes of efficiency and cost savings.

5. An investigation showed that the lack of internal audits also results from Geokon being in the final stages of implementing the ANSI Z 540 program; audit procedures have been written, audit personnel qualified, and the first program audit is currently in process.

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PERFORMANCE/DEFICIENCY REPORT RESPONSE

14 Remedial Actions:

See continuation page

15 Extent of Condition: (Not required for PR)

See continuation page

16 Root Cause Determination: (Not required for PR) Required: ☐ Yes ☒ No

17 Action to Preclude Recurrence: (Not required for PR) Required: ☐ Yes ☒ No

18 Corrective Action Completion Due Date:	19 Response by:
4/30/98	F.J. Schelly Date 3/6/98 Phone (505) 848-0693

20 Response Accepted	21 Response Accepted (N/A for PR)
QAR [signature] Date 04/07/98	DOQA R.W. Cap Date 4/7/98

5 Requirement/Measurement Criteria: (Continued)

C. Quality Assurance Operating Procedure (QAOP) 430, Revision A, Section 6.2.10, states in part: "The document owner will assign a sequential DCR number from the DCR Logbook using the next available number, utilizing the last two digits of the calendar year .... "

D. QA Manual, Section 10.0, states in part, "The company operates a program that controls, calibrates, and maintains M&TE which can effect product quality, in compliance with the United States of America, Department of Defense, MIL-STD-45662A." MIL-STD-45662A, Section 5.9, Records, states in part, "... The records shall include an individual record of calibration or other means of control for each item of M&TE and measurement standard, providing a description or identification of the item, calibration interval, date calibrated, identification of the calibration source, calibration procedures used, calibration results, and calibration actions taken."

E. QA Manual, Section 14.0, states in part, "The company performs planned and documented Internal QA audits to verify compliance with the QA Program and Quality System ... Normal time periods for a complete program audit are not to exceed one year."

6 Description of Condition: (Continued)

C. To date, Geokon has not instituted a DCR Logbook for tracking changes to documents other than drawings or sketches.

D. QAOP 1100, Revision: Initial, does not address requirements for the contents of Certificates of Calibration or calibration data when documenting internal Geokon calibrations.

E. To date, no documented evidence could be provided to reflect a complete program audit of the Geokon QA Program has been performed.

10 Recommended Actions: (Continued)

C. Take action to develop a DCR Logbook and implement this log in tracking changes to documents other than drawings and sketches. An alternative may be to just use the Engineering Change Notice system for documenting all changes to all documents, including procedures.

D. Revise QAOP 1100 to address content of Certificates of Calibration or calibration data, which consist of MIL-STD-45662A or ANSI/NCSL Z540-1, 1994.

E. Implement your documented audit plan to assure that the entire QA Program is audited in FY98.

PR/DR CONTINUATION PAGE

14 Remedial Action (Continued)

1. A revision to the Geokon Quality Policy and Manual is being processed to replace the "read and understand" requirement with new employee training, which is implemented by QAOP1800. The revised manual is expected to be released by mid-April 1998. A training plan was prepared and all employees hired since June, 1996 were trained to it, as documented by training records.
2. A position description has been developed to establish minimum qualifications for any new hires for this type of work and documentation of calibration personnel being trained and qualified to perform the task is maintained. At the present time, an extensive "hands-on" training program has been completed by the individual calibrating vibrating wire transducers for YMP SPBX and MPBX instrumentation. This individual was hired prior to the establishment of qualifications for new hires, but has considerable experience in performing this work and is considered qualified for the position.
3. QAOP430 is being revised to eliminate the DCR Logbook and document changes using the Engineering Change Notice system. This revision should be completed by mid-April 1998.
4. QAOP1100 has been revised to reflect the calibration documentation requirements and is presently in review for an expected release by mid-April 1998.
5. The documented audit plan is being implemented and is being performed as scheduled. To date, one internal audit has been done and is being closed, and two are scheduled to be performed in February, 1998.

15 Extent of Condition (Continued)

1. The draft Geokon Quality Policy and Manual which contained the "read and understand" requirement has been replaced by one that requires personnel to be aware of and work to the quality program. An implementing document, QAOP 1800, has been released which implements training and includes using the Quality Manual as a guide.
2. The qualification and training status of the four technicians was evaluated, and it has been determined that these individuals are adequately qualified on the basis of their experience and/or education, and trained for their assignments. The qualifications of the individual performing the YMP calibrations, for example, include a Bachelor degree, ten years of related experience, and several years of on-the-job training and experience in calibration. The Job descriptions maintained by the Geokon Human Resources organization are used as a guide for posting openings, but should not be interpreted as minimum standards to perform the work.
3. It was determined that an Engineering Change Notice (ECN) is the standard practice at Geokon for tracking document changes. QAOP 430 is therefore being revised to replace the DCR Log with ECNs.
4. Geokon is in the process of finalizing their implementation of an ANSI Z540 program. With respect to the content of calibration certificates, their intention is to solicit feedback on content requirements from known customers and develop an updated standard certificate for the purposes of efficiency and cost savings.
5. An investigation showed that the lack of internal audits also results from Geokon being in the final stages of implementing the ANSI Z 540 program; audit procedures have been written, audit personnel qualified, and the first program audit is currently in process.

PR/DR CONTINUATION PAGE

VERIFICATION OF CORRECTIVE ACTION AND CLOSURE OF DEFICIENCY REPORT (DR) LVMO-98-D-038

On May 19, 1998, a follow-up verification was performed to verify implementation of corrective action to DR LVMO-98-D-038. This follow-up verification is based on a review of documentation provided by Geokon, Inc. as follows:

A. A review the current approved Geokon Quality Assurance Manual, Training Plan for New Hires (TP-QAPROG) and Geokon Memorandum dated 02/04/98 revealed that training to the QA Program for Geokon personnel involved in Yucca Mountain Site Characterization Project activities has been completed and documentation supports compliance with the Geokon Quality Assurance Manual. Implementation of corrective action is considered satisfactory.

B. Reviewed documentation, (i.e.; Employee Training Record dated 02/05/98, Employee Qualification Investigation dated 04/07/98, Geokon, Inc. Job Description for Calibration Technician, and the Summary of Qualifications) supporting the qualification of the Geokon individual responsible for the calibration of the Vibrating Wire Transducers for the Model 4400. The results of the review, along with the on-the-job training indicate that the responsible calibration technician satisfies the Job Description requirements. Implementation of corrective action is considered satisfactory.

C. A review of Geokon procedure QAOP 430, "Document Change Request/Order Procedure", Revision A, approved 04/07/98, revealed that the requirement for the maintenance of a Document Change Request (DCR) Log has been deleted. Changes to both engineering and non-engineering documents will be maintained through the Engineering Change Request (ECR) logbook. Implementation of corrective action is considered satisfactory.

D. A review of Geokon procedure QAOP 1100, "Control of Inspection, Measuring, and Test Equipment", Revision B, approved 02/24/98, identified requirements for the content of Certificates of Calibration. Implementation of corrective action is considered satisfactory.

E. A review of the Geokon FY1998 Internal Audit Schedule and two internal audit reports, (I-1980306 and I-2980313), support that Geokon is implementing its internal audit program as required by the Geokon QA Manual. Future audits/surveillances of Geokon will monitor continued compliance with the Geokon internal audit schedule.

Based on the documented evidence provided by Geokon and the above verification results, this DR is considered closed.

Richard L. Maudlin 05/19/98
Richard L. Maudlin, QAR

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DEFICIENCY DOCUMENT SUMMARY SHEET

	Date	Letter Reference
Issuance Letter/Memo	2/11/98	OQA:JB-0919
Response Extension Request	N/A	N/A
Acceptance	↓	↓
Response Received	3/16/98	Schellingto Horton
Acceptance	~~3/23/98~~ DB 4/14/98 4/8/98	OQA-JB-1382
Request Amended Response	N/A	N/A
Response		
Acceptance		
C/A Extension Request		
Acceptance		
C/A Extension Request		
Acceptance		
Unsatisfactory Verification		
Response		
Acceptance	↓	↓
Closure Letter	6/2/98	OQA:JB-1858

Other N/A

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8. ☑ DEFICIENCY REPORT
☐ CORRECTIVE ACTION REPORT
NO. LVMO-00-D-119
PAGE 1 OF 3 KAH 8/3/00
QA: ☒ QA

DEFICIENCY/CORRECTIVE ACTION REPORT

1. Controlling Document:	2. Related Report No.:
AP-3.10Q, Rev. 2, ICN 2	Audit Report M&O-ARP-00-13
3. Responsible Organization:	**4. Discussed With:**
CRWMS M&O	Robert Andrews, Rob Howard

5. Requirement:
AP-3.10Q, Rev. 2, ICN 2, Para. 5.3 a) states in part, "The appropriate level of confidence for a model shall be determined based on the intended use of the model and the importance of the model for assessing post-closure system performance."
AP-3.10Q, Rev. 2, ICN 2, Para. 5.3 b) states in part, "The criteria used to evaluate the appropriateness and adequacy of the model for its intended use may be qualitative or quantitative but must be justified in the model documentation."
AP-3.10Q, Rev. 2, ICN 2, Attachment 1, Section 6, states in part ," For model validation, include the validation criteria and methods for conducting model validation, the specific tests to be conducted, and the results of those tests (or results of alternative validation method)."
AP-3.10Q, Rev. 2, ICN 2, Para 5.3 c), states in part, "If data from sources such as those identified in Paragraph 5.3b) are not available to support validation of the model, utilize or document an alternative approach."

6. Description of Condition:
The TSPA-SR Model is supported by twenty-six (26) abstraction-level Analysis and Model Reports (AMR). A sampling of the AMRs shows that validation (confidence building) is not in all cases documented in accordance with AP-3.10Q. The following are examples of AMRs that do not address/adequately address model validation/confidence building; i.e., validation criteria and methods, tests conducted, and results are not documented within the AMRs; nor is an alternative approach suggested when validation is impractical based on lack of available data to support validation.

a) ANL-EBS-PA-000001, Rev. 00, "WAPDEG Analysis of Waste Package and Drip Shield Degradation" (W0050) (Validation criteria were not documented. Model validation is not addressed. Based on discussion with the AMR author, this model may require an alternative approach to validation ; e.g., peer review.)
b) ANL-WIS-MD-000010, Rev. 00, "Summary of Dissolved Concentration Limits" (F0095) (Validation criteria were not documented. Model validation is not addressed. Based on discussion with the author, progress is being made toward validation in Rev. 01.)
c) ANL-NBS-HS-000026, Rev. 00, "Particle tracking Model and Abstraction of Transport Processes" (U0065) (Validation criteria were not documented. The AMR discussed verification but not validation.) (Continued on P.3)

7. Initiator:	9. Does a stop work condition exist? (Not required for a DR)
Kristi A. Hodges / F. Harvey Dove Kristi A. Hodges/Harvey Dove Date 8/3/00	☐ Yes ☑ No If Yes, Check One: ☐ A ☐ B ☐ C ☐ D

10. Recommended Actions:
Review the 26 abstraction-level AMRs to identify additional AMRs that do not address/adequately address model validation requirements.
Determine which AMRs are currently being revised, or are prioritized for revision.
Ensure that the AMR revision includes or enhances the model validation section (Section 6).
Review the various punchlists to determine the status of the process-level AMRs that were identified as requiring revision/ICN per CAR-010.
For models that are deemed problematic/difficult to validate, consider alternative methods as indicated in Para. 5.3c).

11. QA Review: Kristi A. Hodges 8/8/00	12. Response Due Date:
QAR Kristi A. Hodges Date	10 working days from issuance

13. DOQA Issuance Approval:
Printed Name Robert W. Clark Signature R.W. Clark Date 8/21/00

22. Corrective Actions Verified	23. Closure Approved by:
QAR Date	DOQA Date

Exhibit AP-16.1Q.1 Rev. 12/20/1999

DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

Block 6 (Continued)

In addition, the approach to building confidence in the TSPA-SR model (in draft) is to rely upon the validation of the supporting process and/or abstraction-level AMRs. Because the TSPA-SR model is an AMR, and validation of the process/abstraction-level models does not address validation as a system, the requirements of AP-3.10Q for validation also apply to that system-level model. Appropriate confidence based on documented qualitative/quantitative criteria, validation methods, specific tests, and results of those tests, or an alternative validation approach when sufficient data are not available is required . There are differing perceptions of what constitutes model validation, and validation at all levels (process/abstraction/system) can be problematic; however, AP-3.10Q requires validation to be addressed prior to document approval, regardless of model level and/or complexity of the validation.

Corrective Action Report (CAR) LVMO-98-C-010 (CAR-010) addressed inadequate procedure for model/analysis development and documentation, however, it was expanded to address model validation. The CAR was closed when AP-3.10Q was revised, training occurred, and impacted AMRs, developed prior to February 25, 2000, were identified and evaluated. Based on the evaluation, 19 process-level AMRs were determined to require revision/ICN to address model validation issues. These AMRs are being tracked on a punchlist pending AMR revision/ICN. Corrective action for this DR should include an evaluation of the status of the 19 AMRs and a path forward for removing them from the punchlist status. Note that CAR-010 focused on establishing a process for model/analysis development however, this DR documents deficiencies in implementation of the AP-3.10Q process.

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT U.S. DEPARTMENT OF ENERGY WASHINGTON, D.C.	DIR 00-21 PAGE 1 OF 1 QA: QA

DEFICIENCY IDENTIFICATION AND REFERRAL

Date: 9/6/00	DR/CAR Referred to: DR LVMO-00-D-119

Description of Deficiency:

AMR U0100 (Unsaturated Zone and Saturated Zone Transport Properties) is used to predict the transport of radionuclides through the unsaturated zone (UZ). A UZ Transport Test will confirm the predictions using field measurements. The model validation section confuses code qualification with model validation, and the existing text is inadequate in the following areas:

1. The text of Section 6.6.8 is directed towards code qualification and not model validation. Model validation should demonstrate that the model is appropriate and adequate for its intended use. This demonstration is not obtained by pointing to the qualification of individual parts. The demonstration that the model is appropriate and adequate for its intended use is to exercise the model (make predictions) and show that the predictions agree (within specified tolerances) with measured values.

2. While briefly referring to Phase-1A predictions and a Phase-2 model, the author does not present any staged plan over time for model validation in sufficient detail to build any confidence in the intended validation process. Because there appears to be a timed process associated with validating this model, a validation plan needs to be presented that clearly defines the phases, objectives of the phases, and specific model evaluation criteria.

3. Criteria are not established to compare the predictions with the measured data in terms of concentration tolerances, breakthrough-time intervals, and tracer-recovery percentages. For model credibility purposes, the criteria used to evaluate the appropriateness and adequacy of the model need to be established, up front, before the comparisons between predictions and measured data are performed.

Note that F. Harvey Dove assisted in the technical evaluation of this AMR.

How Identified:

During verification of DR LVMO-00-D-046, it was determined that the completed corrective action was not adequate to address model validation requirements. DR LVMO-00-D-119 applies to model validation (confidence building) in all AMRs; therefore, it was determined that this deficiency document, which addresses one AMR (U0100), should be closed and referred to LVMO-00-D-119 for resolution.

Existing Open DR/CAR:
DR LVMO-00-D-119

Open DR/CAR QAR's Concurrence	Date: 9/18/00
Kristi A. Hodges Kristi A. Hodges	
Initiator: Kristi A. Hodges Kristi A. Hodges	Date: 9/18/00

Exhibit AP-16.1Q.5 Rev. 06/01/1999

TYPE RESPONSE:
☐ Initial
☑ Complete
☐ Amended

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QA: QA

DEFICIENCY/CORRECTIVE ACTION REPORT (RESPONSE)

14a. Immediate Actions: All PAD AMRs, including the 26 listed as feeding the TSPA model and those AMRs belonging to PA that were associated with the CAR-10 closure, will be reviewed with respect to the completeness of the documentation related to model validation and confidence building. Additionally, guidance on best business practices related to the documentation of model validation will be communicated to all PAD staff.

Compliance Date: November 15, 2000.

14. Remedial Actions: This DR and DIR 00-21, identifies four AMRs (W0050, F0095, U0100 and U0065) that fall short of adequate model validation (confidence building). These AMRs will be updated, as appropriate to include/enhance text addressing model validation (per AP-3.10Q, Section 5.3).

15. Extent of Condition: Many of PAD's AMRs are currently being revised to incorporate design changes and to address data qualification issues and as much as possible, address the issues listed in internal self-assessments (SA-PA-2000-005). Below is a list of AMRs that are not undergoing revision that have been identified as having potential validation issues.

ANL-NBS-MD-000006 Groundwater Usage by the Proposed Farming Community

ANL-EBS-MD-000039 Seepage Backfill Interactions

ANL-EBS-MD-000040 In-Drift Gas Flux & Composition

ANL-EBS-MD-000044 Seepage Invert Interactions

ANL-NBS-HS-000022 Modeling Sub Gridlock Scale Dispersion in Three Dimensional Heterogeneous Fractured Media

ANL-EBS-MD-000028 Water Diversion Model

ANL-EBS-MD-000029 Water Drainage (see continuation page).

Cause: (Attach results of root cause determination prepared in accordance with AP-16.4Q for a significant deficiency.) AP-3.10Q does not clearly describe a process for validating models at the various model levels; i.e., conceptual, process, abstraction, and system). In addition, in some instances AMR authors are confusing software code qualification with model validation; in other instances, the model is considered too difficult and/or problematic to validate with the current requirements. .

17. Action to Preclude Recurrence: For AMRs prepared by the Performance Assessment Department that are undergoing ICN or revision, the AMRs will be subjected to an AP-2.14Q review that includes an OQA (QATSS) reviewer. For the AMRs identified above that are not being changed in the current budget cycle, there are no impacts to TSPA.

AP-3.10Q will be revised to facilitate the model validation process so that it includes modifications for conceptual models, abstraction models, and system- and subsystem-level models. Some possible actions to accomplish the development and implementation of a defensible and reasonable procedure revision include a) creating a small working group with representatives from the interested parties, b) reviewing defensible validation efforts of system and subsystem models and c) discussing the issue with NRC during the upcoming technical exchange on the TSPAI IRSR (Currently planned for February 2001).

Closure of this DR will be complete upon revision/change of PA AMRs (ETC December 14, 2000), QA verification of adequate model validation in the currently planned revisions/changes and a revision to AP-3.10Q to add additional model validation criteria (ETC April 15, 2001).

18. Due Date: April 30 , 2001 ☐ For submittal of complete response ☑ For completion of corrective action	19. Response by: Robert W. Andrews Date Oct 20, 2000 Phone 295-5549
20. Evaluation: ☑ Accept ☐ Partially Accept ☐ Reject QAR Kristi A. Hodges Date 10/25/00	21. Concurrence: DOQA James Blaylock Date 11/2/00

10/23/00 LV.PA.RWA.10/00-180

DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

15. Extent of Condition: Continuation

There is no impact to TSPA-SR from any potential model validation issues associated with these seven AMRs based on the following:

The Groundwater Usage by the Proposed Farming Community AMR is not a model and does not need to be revised. It has used parameters and assumptions consistent with guidance provided in the proposed 10 CFR Part 63.

The Seepage Backfill Interactions AMR is no longer relevant based on current design requirements which do not include backfill.

The appropriateness of the In-Drift Gas Flux & Composition and Seepage Invert Interactions AMRs will either be addressed in the next ICN or revision or they will be eventually merged with the Physical and Chemical Environment Abstraction Model as they are not directly used in TSPA.

The three last AMRs identified above were part of the CAR 10 closure activity and are not being revised. There is no impact to TSPA as the TSPA model does not use these 3 AMRs as input.

In light of the recommended actions, a review of the current requirements for model validation in AP-3.10Q limits alternative methodologies for model validation. For example, system- and subsystem-level models are difficult to validate using the comparative requirements (e.g. comparison to lab, *in situ*, field, or natural analog data) that are applied to process models. Other alternatives need to be considered in order to take credit for the extent of technical review that goes along with the development and implementation of integrating models such as the TSPA model. Subjecting system-level models to such reviews enhances the validity or confidence of these models.

In addition to the issues associated with integrating models (such as system- or subsystem-level models), other issues deal with how conceptual models are validated. Appropriate alternatives for validating conceptual models are not present in AP-3.10Q.

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Request for Extended Processing

A significant integration is required to assure appropriate procedure changes to address the model validation issue on integrated models and system models as well as conceptual models

The immediate actions is expected to be completed on schedule.
The remedial actions are underway and are expected to be completed by the end of November depending on Volume 3 of the SRCR actions.
The first action to preclude will occur as part of the ongoing revisions of AMR products in the coming weeks. The second, and most significant action to preclude will occupy most of the time and energy and require the integration mentioned above.

There is no impact of the added time, as this issue is viewed as a licensing issue, not an SR issue.

R. W. Andrews

Robert Andrews

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APPROVAL SIGNATURES FOR REQUEST FOR EXTENDED PROCESSING FOR LVMO-00-D-119

DOE Project Manager for — Date 1/25/01

Director, Office of Quality Assurance — Date 12/14/00

APPROVAL SIGNATURE FOR REQUEST FOR EXTENDED PROCESSING GREATER THAN 365 DAYS FOR N/A

Director of OCRWM — Date N/A

TYPE RESPONSE:

- [ ] Initial
- [ ] Complete
- [x] Amended

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RWA 5/1/01

DEFICIENCY/CORRECTIVE ACTION REPORT (RESPONSE)

14a. Immediate Actions:
Same as 10/20/2000 Response

Compliance Date:

14. Remedial Actions:
Same as 10/20/2000 Response

15. Extent of Condition:
A recently completed Suspect Trend Investigation has resulted in the issue of model validation being raised to the level of a CAR. A pending CAR (BSC-01-C-001) is being reviewed by the Office of Quality Assurance. Assuming this CAR is approved, the BSC intent is to consolidate all open model validation related DRs into the CAR, necessitating a more thorough review of the extent of condition in accordance with the CAR response.

16. Cause: (Attach results of root cause detemination prepared in accordance with AP-16.4Q for a significant deficiency.)
Same as 10/20/2000 Response

17. Action to Preclude Recurrence:
Same as 10/20/2000 Response. Note that additional actions to preclude may result due to the actions associated with the pending CAR BSC-01-C-001, which may also include an evaluation of the requiements for model validation in the QA Requirements and Description Document.

18. Due Date: July 31, 2001
- [ ] For submittal of complete response
- [x] For completion of corrective action

19. Response by: KO RWAlls
Robert Andrews Date 5/1/01 Phone 5-5549

20. Evaluation: [x] Accept [ ] Partially Accept [ ] Reject
QAR Kristen A. Hodges Date 5/4/01

21. Concurrence:
DOQA James Blaylock for Date 5/8/01

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Request for Extended Processing

Developing the licensing-based definitions and appropriate implementation process for "model validation" by BSC for application in scientific investigations documentation involves coordination between numerous affected organizations. In addition, a Pending Corrective Action Request (BSC-01-C-001) is expected to significantly modify the scope of the actions to preclude recurrence for this deficiency. Once BSC management receives and has reviewed the above referenced CAR on this subject, a position as to the disposition of this deficiency and associated actions will be developed. This is expected to require a different approach than the original activity planned by the previous M&O contractor.

There is no impact of the added time required for closure, as this issue is viewed as involving the documentation to be submitted as part of the License Application, not a Site Recommendation issue.

Robert W. Andrews

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APPROVAL SIGNATURES FOR REQUEST FOR EXTENDED PROCESSING FOR LVMO-00-D-119

DOE Project Manager — Date: 5/30/01

Director, Office of Quality Assurance — Date: 5/14/01

APPROVAL SIGNATURE FOR REQUEST FOR EXTENDED PROCESSING GREATER THAN 365 DAYS FOR N/A

Director of OCRWM — Date: N/A

TYPE RESPONSE:
☐ Initial
☒ Complete
☒ Amended

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DEFICIENCY/CORRECTIVE ACTION REPORT (RESPONSE)

14a. Immediate Actions:

The following supercedes the 1 May 2001 response in entirety.

The Extent of Condition investigation discussed in Block 15 below will be performed in lieu of any previously planned reviews.

Completion Date: 8 August 2001

14. Remedial Actions:

The following supercedes the 1 May 2001 response in entirety.

Following identification of the models where the existing documentation does not establish sufficient confidence with the suitability of the model (Bin 3 in the Extent of Condition review below), either an impact assessment will be performed or model validation/confidence building documentation will be prepared and issued.

15. Extent of Condition:

The following supercedes the 1 May 2001 response in entirety.

A systematic review will be performed of all Analysis and Model Reports (AMRs) by an independent team under the direction of a senior scientist with oversight by the BSC Chief Science Officer. The review will include the following actions:

- Identification of all AMRs, including analyses, that contain models

See Continuation Page

16. Cause: (Attach results of root cause determination prepared in accordance with AP-16.4Q for a significant deficiency.)

Same as 20 October 2000 response.

17. Action to Preclude Recurrence:

The following supercedes the 1 May 2001 response in entirety.

AP-3.10Q – *Analyses and Models* will be revised to make the procedure specific to scientific modeling. The procedure will be revised to include the following:

- Simplification/clarification of the model validation requirements and techniques, including removal of any overly prescriptive requirements

See Continuation Page

18. Due Date: 10 October 2001
☐ For submittal of complete response
☒ For completion of corrective action (all actions are complete)

19. Response by: William W. Watson
William W. Watson
Date: June 12, 2001 Phone: 5-5550

20. Evaluation: ☐Accept ☒ Partially Accept ☐ Reject
QAR J. Harvey Dove Date 06/28/01

21. Concurrence:
DOQA James Blaylock Jr Date 9/7/01

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Block 15 (cont.) Extent of Condition

- Assignment of a unique identification (short text description) for each model identified
- Determination of which models were adequately validated in accordance with the AP-3.10Q, Rev. 2, ICN 3 (Bin 1)
- Determination of models where existing documentation, although not necessarily within the AMR, results in adequate confidence of the suitability of the model per the intent of AP-3.10Q (Bin 2)
- Determination of models for which existing documentation does not provide sufficient confidence of the suitability of the model per the intent of AP-3.10Q (Bin 3)

This review will be completed by 8 August 2001.

Work was initiated by BSC Science & Analysis Project and Quality Engineering personnel to identify all AMRs, including analyses AMRs, that contain models, and determine which models were adequately validated in accordance with the current version of AP-3.10Q. This effort was completed on 5 June 2001 and is being incorporated into the above review.

Following identification of the models where the existing documentation does not establish sufficient confidence in the adequacy of the model (Bin 3), either an impact assessment will be performed or model validation/confidence building documentation will be prepared and issued.

Block 17 (cont.) Action to Preclude Recurrence

- Requirement for a stand-alone section in the AMR as the sole place model validation is documented
- Requirement that, for any AMR containing a model, BSC QE must be a mandatory AP-2.14Q reviewer

Concurrent with the AP-3.10Q revision, the Chief Science Office has initiated the development of the Scientific Processes Guidance Manual to be used by all project staff performing scientific activities. The Guidance Manual will provide additional clarification and guidance on model validation techniques to model developers and AMR authors to ensure that the requirements of AP-3.10Q will be met.

Following completion of the revision of AP-3.10Q and the issue of the Guidance Manual, training in model validation techniques will be given to all personnel performing scientific activities involving model development and validation. The training will include the availability of assistance in model validation methods and techniques to be provided by the Chief Science Office as noted below.

As a further enhancement of the model validation effort, the BSC Chief Science Office will provide assistance in model validation to personnel performing scientific activities involving model development and validation. This assistance will be provided by senior scientists, with expertise in model validation methods and techniques, who are not involved with the development of the subject model(s). The assistance will include, as appropriate, meetings with AMR authors to assist in planning model validation and review of in-process work on model validation.

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Request for Extended Processing

Reason:
The revision of AP-3.10Q specific to scientific activities and the development of the Scientific Processes Guidance Manual has been initiated by the Chief Science Office. A detailed schedule of activities has been developed to ensure that numerous interviews with personnel involved in preparation of AMR documentation are completed as part of this work. The schedule includes time for the development of the procedure revision and the guidance manual such that internal consistency is assured. In addition, sufficient time has been allowed for development of the combined training, as well as the training itself. The scheduled activities result in the date of 10 October 2001 for completion of the corrective action.

Impact:
There is no impact as a result of the extended processing time since the review and impact assessment/additional validation documentation effort discussed in Block 15 will assure that any inadequate model validation documentation is corrected. During the period between completion of the review and completion of training, any new models documented in an AMR will be validated to the existing version of AP-3.10Q.

Dr. Robert W. Andrews, Science and Analysis Project Manager

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APPROVAL SIGNATURES FOR REQUEST FOR EXTENDED PROCESSING FOR DR LVMO-00-D-119

DOE Project Manager for — Date 7/19/01

Director, Office of Quality Assurance — Date 7/10/01

APPROVAL SIGNATURE FOR REQUEST FOR EXTENDED PROCESSING GREATER THAN 365 DAYS FOR DR LVMO-00-D-119

Director of OCRWM — Date

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Block 20 (Cont'd) Evaluation

Accept amended response (dated June 12) with the following condition noted:

1. In Block 15, first paragraph, bullet four:

   The inadequate documentation identified in Bin 2 will be brought into conformance with the validation requirements of AP-3.10Q during the next scheduled revision to each AMR.

F. Harvey Dove 06-27-01

TYPE RESPONSE:
- ☐ Initial
- ☒ Complete
- ☒ Amended

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DEFICIENCY/CORRECTIVE ACTION REPORT (RESPONSE)

14a. Immediate Actions:

Same as 12 June 2001 response.

14. Remedial Actions:

Same as 12 June 2001 response.

15. Extent of Condition:

Same as 12 June 2001 response.

16. Cause: (Attach results of root cause determination prepared in accordance with AP-16.4Q for a significant deficiency.)

Same as 12 June 2001 response.

17. Action to Preclude Recurrence:

The following revises the 12 June 2001 response.

Revise the last paragraph to read as follows:

As a further enhancement of the model validation effort, the BSC Chief Science Office (CSO) will identify CSO staff scientist(s) that will provide assistance in model validation to personnel performing scientific activities involving model development and validation. The CSO staff senior scientist(s) will have expertise in model validation methods and techniques. The assistance will include, as appropriate, meetings with AMR authors to assist in planning model validation and review of in-process work on model validation.

December 10/10/01

18. Due Date: 30 ~~November~~ 2001
- ☐ For submittal of complete response
- ☒ For completion of corrective action (all actions are complete)

19. Response by: William W. Watson
Date: 5 October 2001 Phone: 5-5550

20. Evaluation: ☒ Accept ☐ Partially Accept ☐ Reject
QAR J. Harvey Dove Date 10/17/01

21. Concurrence:
DOQA James Blaylock Date 10/18/01

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REQUEST FOR EXTENDED PROCESSING

Extended Actions: (Identify those corrective actions planned for completion beyond 100 days from issuance of the deficiency)

The following actions will require additional time to complete:

1. Completion of the new procedure AP-SIII.10Q that replaces AP-3.10Q
2. Development of the training program & actual training (requires #1 above)
3. Finalization of the Guidance Manual (also requires #1 above)

Expected Completion Date: 30 November 2001

Justification: (Provide an explanation as to why the required actions can not be completed within 100 days)

The mandatory comment resolution process involved a number of comments that required dispute resolution to proceed. The extent and nature of the comments lead to the decision to require a tabletop walk-through of the procedure before finalization. This walk-through will enhance the model validation process by identifying any procedural steps that are subject to differing interpretations.

Impact: (Provide an impact statement to indicate what affect not completing within 100 days will have relative to waste isolation and safety, and impact on other work, if any)

There will be no impact to waste isolation and safety since the models that will be used for a potential future license application will comply with the revised procedure. No impact on other work exists since no final license application AMRs are scheduled to be completed by 30 November 2001.

Approvals Manager [illegible] 10/9/01

Responsible ~~Individual~~:			Senior Management:		
Robert W. Andrews	[signature]	10/9/01	Nancy Williams	[signature]	10/10/01
Printed Name	Signature	Date	Printed Name	Signature	Date
DOE Project Management:			Director, OQA:		
Printed Name	Signature	Date	Printed Name	Signature	Date

Director, OCRWM (required for scheduled completion dates one year or more from initial issue)

Printed Name	Signature	Date

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~~THIS IS A RED STAMP~~

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QA: ☑ QA

DEFICIENCY/CORRECTIVE ACTION REPORT

1. Controlling Document:	2. Related Report No.:
QARD, DOE/RW-0333P, Rev. 10	M&O-ARP-00-13
3. Responsible Organization:	**4. Discussed With:**
CRWMS M&O	Robert Andrews, Rob Howard

5. Requirement:
QARD, Rev. 10, Supplement III.2.6B. states, "Documentation shall be transparent and identify principal lines of investigation considered."

6. Description of Condition:
The rational for exclusion (documentation of consideration) of uncertainties, assumptions, and alternative conceptual models contained in the process-level Analysis and Model Reports (AMR) is not being documented. Therefore, it is not transparent in the documentation whether these uncertainties, assumptions, and/or alternative conceptual models were considered while developing the abstraction-level AMRs that directly feed the TSPA-SR model.

There is no established project approach to "roll up" relevant assumptions, uncertainties, and alternative conceptual models to higher-level documents; i.e., abstraction-level AMRs; nor is there an established approach for dispositioning assumptions, uncertainties, and alternative conceptual models contained within process-level AMRs that were considered but not used for the TSPA-SR. Project requirement documents and procedures do not specify this level of detail; however, it is imperative that there be an integrated approach that ensures defensibility of decisions made during the abstraction process; one that ensures consistency within/between AMR families (e.g., WP, UZ), and an overall approach that ensures consistency within/between the abstraction-level AMRs that are direct inputs to the TSPA-SR model.

(Continued on Page 3)

7. Initiator:	9. Does a stop work condition exist? (Not required for a DR)
Kristi A. Hodges F. Harvey Dove Kristi A. Hodges/Harvey Dove Date 8/3/00	☐ Yes ☑ No If Yes, Check One: ☐ A ☐ B ☐ C ☐ D

10. Recommended Actions:
Revise AP-3.10Q to establish an integrated/transparent approach to addressing IRSRs and documenting decisions regarding assumptions, and uncertainties, alternative conceptual models. The revision should consider the use of summary tables for assumptions and alternative conceptual models drawn from supporting AMRs, particularly those associated with developed data from another model or analysis. The summary tables should also include the rationale for exclusion of less significant assumptions and less favorable conceptual models.
AP-3.10Q should be revised to include the requirement to discuss the effects of alternative conceptual models, assumptions, and uncertainties in the AMR results when the analysis or model uses associated TBVdata as input.

11. QA Review:	12. Response Due Date:
Kristi A. Hodges for QAR F. Harvey Dove Date 8/8/00	10 working days from issuance

. DOQA Issuance Approval:
Printed Name Robert W. Clark Signature R.W. Clark Date 8/21/00

22. Corrective Actions Verified	23. Closure Approved by:
QAR Date	DOQA Date

DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

Examples of documentation that is not transparent/does not identify principal lines of investigation considered:

Uncertainty/variability: Recommended uncertainty and variability values that are specified in process-level AMRs were not used in abstraction-level AMR ANL-EBS-PA-000001, "WAPDEG Analysis of Waste Package and Drip Shield Degradation," Rev. 00 (W0050). Regardless of the appropriateness of selected values, the evidence of consideration and/or rational for deviating from the recommended uncertainty/variability values was not documented within W0050. A rationale for the change is needed for traceability and transparency. Examples are included in the attached table (Uncertainty & Variability Values).

Note that this AMR was not subjected to an AP-2.14Q technical review because it did not impact another organization; i.e., the AMR was developed by the PA organization for the PA organization. This exception afforded by AP-3.10Q allowed a change of uncertainty/variability values to be made without recourse to the supporting AMR author.

Assumptions: Lack of transparency of assumptions can be seen in abstraction-level AMR ANL-NBS-MD-000005 "Abstraction of Drift Seepage," Rev. 00 (U0120). The seven assumptions included in U0120 are stated to be based on the results and the six assumptions contained in process-level AMR ANL-NBS-HS-000002, "Seepage Model for PA Including Drift Collapse," Rev. 00 (U0075). The six assumptions documented in U0075 are not discussed/detailed in U0120; therefore, it is difficult to determine how the six assumptions evolved into the seven assumptions that are included in the U0120. In addition, the DTNs used in U0120 are also developed data obtained from five other process-level AMRs: U0035 (contains eight assumptions), U0080 (contains eight assumptions, U0050 (contains eleven assumptions), U0170 (contains four assumptions) & U0000 (contains six assumptions). AP-3.10Q, "Analyses and Models" does not require a roll-up or summary roll-up of assumptions; therefore, the forty-three assumptions under pinning U0120 were not acknowledged/discussed within that abstraction-level AMR.

For example, U0035, assumption eight, states, "Because of data limitations and the way data are interpreted, estimates of uncertainty cannot be directly calculated for some of the data. In these cases, an appropriate uncertainty is selected (assumed) based on the uncertainties of similar data. The specific values and the rationale for each value are documented in Sections 6.1.2." Thus, in order to determine if developed data; i.e., DTNs LB997141233129.001, LB997141233129.002, & LB997141233129.003, are carrying calculated or assumed uncertainties, one must pursue the issue in an AMR below U0120. Three of the five AMRs (U0000, U0050, and U0170) from which developed data were obtained were not referenced in U0120; therefore, it is difficult to defend that all relevant assumptions were even considered at the abstraction level. Note that transparency could be obtained if relevant assumptions were listed in a table that references the supporting AMRs and reasons for exclusion of the less significant assumptions.

Alternative Conceptual Models: Lack of transparency of alternative conceptual models can be seen in AMR ANL-NBS-MD-000005, "Abstraction of Drift Seepage," Rev. 00 (U0120). This abstraction assumes (in assumption No. 2) that the "active fracture" conceptual flow model (discussed in a professional journal) is the applicable conceptual model for purposes of the drift seepage abstraction. The reader is directed to AMR ANL-NBS-HS-000002, "Seepage Model for PA Including Drift Collapse," Rev. 00 (U0075), Section 6.7 for discussion of other "possible alternative conceptual models." In Section 6.7 of U0075, the reader is introduced to the "discrete fracture-network model (DFNM)" as the main alternative conceptual model and is directed to Section 6.7 of AMR MDL-NBS-HS-000004, "Seepage Calibration Model and Seepage Testing Data," Rev. 00 (U0080) for a thorough discussion of the DFNM. Section 6.7 of U0075 introduces new nomenclature beyond the DFNM and concentrates the AMR discussion on the "fracture continuum model (FCM)." The reader must then proceed to Section 5.3 of U0080 for an understanding of the appropriateness of using the FCM and then to Section 6.7 of U0080 to establish the reasons for not using the DFNM.

The Project must demonstrate that alternative modeling approaches consistent with available data and current scientific understanding were investigated and the results and limitations appropriately considered in the abstractions (IRSR TSPAI). The task will be hindered if the AMR documentation is not transparent and does not identify principal lines of investigation that were considered (QARD, Supplement III.2.6B). This transparency is currently not available at the abstraction level for drift seepage.

(Continued on Page 4)

DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

Three conceptual models have been introduced in the three AMRs listed above; they are: (1) the active fracture conceptual model, (2) the discrete fracture-network model, (3) the fracture continuum model. Other alternative conceptual models (not listed in U0120) such as the equivalent continuum, dual permeability, and dual continuum are listed in other AMRs related to flow in unsaturated rock of Yucca Mountain. Note that transparency could be obtained if the alternative conceptual models were all listed in a table in the "Abstraction of Drift Seepage" (U0120) that references the supporting AMRs and reasons for exclusion of the less favorable alternatives.

NRC IRSRs: In addition to weaknesses in the transparency of decisions made regarding uncertainties, assumptions, and alternative conceptual models, transparency/integration of Nuclear Regulatory Commission Issue Resolution Status Reports (IRSR) issues/subissues within the AMRs, particularly at the abstraction-level, is minimal. IRSR, Key Technical Issue: Total System Performance Assessment and Integration (TSPAI), Revision 2 establishes acceptance criteria and review methods, which will be used by the NRC to review DOE's TSPA. Although this TSPAI revision was not issued in sufficient time to incorporate several of its criteria into Revision 00 AMRs, it is evident that the current approach to addressing IRSR acceptance criteria is not entirely comprehensive. Note that some AMRs include IRSR criteria by citation and others by reiteration; however, few AMRs address relevant IRSRs with the intent of resolving an open key technical issue/subissue. Although the Process Model Reports do address IRSRs, it is not clear which criteria are being addressed (or should be addressed) within the TSPA-SR model abstractions.

The following are excerpts from the TSPAI IRSR that suggest a transparent/integrated PA approach:

"Resolution of Subissue 3, model abstraction, ensures that the assumptions, conceptual approaches, data, models and abstractions used in DOE's TSPA are appropriately integrated and technically defensible." (Section 3.2)

"The levels and method(s) of abstraction are described starting from assumptions defining the scope of the assessment down to assumptions concerning specific processes and the validity of given data." (Section 4.1.1.3, Criterion T1)

"The staff will determine that sufficient basis for all information is available that allows an adequate understanding of the basis for all decisions and assumptions made during the abstraction process." (Section 4.1.1.3, Criterion T2)

"The staff will determine that sufficient information is available to allow an adequate understanding of how problems, limitations, and uncertainties are identified and isolated . . . " (Section 4.1.1.3, Criterion T3)

"The NRC staff will evaluate DOE's model and data justification and associated uncertainty to ensure that the degree of technical support for models and data abstractions is commensurate with contribution to risk. The entire abstraction process, from fundamental source information (e.g., FEPs, field data, laboratory results, and others) needs to be recorded, together with uncertainties and biases accumulated and resolved at each stage of the process, and evidence used, for example expert elicitation." (Section 4.1.1.3, Technical Basis)

"PA results can be traced back to applicable analyses that identify the FEPs, assumptions, input parameters and models in the PA. The staff will determine that sufficient documentation is available to trace back to the origin of important assumptions and decisions and verify that the results obtained can be clearly linked to these decisions and assumptions." (Section 4.1.1.5, Criterion T1)

". . . enough information should be presented for reviewers to be able to understand why the results came out as they did. It should be clear which assumptions and subsystems are driving system performance so that staff can focus their review in these areas." Section 4.1.1.5, Technical Basis)

ATTACHMENT TO DR LVMO-00-D-118
UNCERTAINTY & VARIABILITY VALUES

Model	AMR Recommends	WAPDEG Uses
Aging/Phase Stability AMR W0035 (Section 6.7.3)	Uncertainty = 50% Variability = 50%	Uncertainty = 0% Variability = 100%
MIC AMR W0035 (Section 6.8)	Uncertainty = 50% Variability = 50%	Uncertainty = 0% Variability = 100%
General Corrosion AMR W0035 (Section 6.5.3)	Uncertainty = 4-sigma	Uncertainty = 0% Variability = 100%
SCC AMR W0095 (Section 6.2.2.5)	Uncertainty = 100% Variability = 0% Mitigated Residual Stress Range Uncertainty = ±5%	Uncertainty = 100% Variability = 0% Mitigated Residual Stress Range Uncertainty = ±30%

AMR W0035: (ANL-EBS-MD-000003)

AMR W0095: (AMR ANL-EBS-MD-000005)

TYPE RESPONSE:
☐ Initial
☑ Complete
☐ Amended

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DR/CAR NO. LVMO-00-D-118
PAGE 2 OF 4

QA: QA

DEFICIENCY/CORRECTIVE ACTION REPORT (RESPONSE)

14a. Immediate Actions: Develop a plan that provides a path forward to resolving the issues and concerns associated with the need for and implementation of the requirements for "transparent documentation" specified in the QARD Rev 10, Supplement III.2.6B. This plan should include, at a minimum a schedule of activities such as: (1) an evaluation of the requirement (its genesis in the QARD), (2) the traceability of this requirement to any and all applicable procedures, (3) the definition of the term "transparent" or "transparency", (4) a review of regulatory guidance contained in IRSR acceptance criteria, (5) a legal review of the interpretation of the term transparency in related regulatory uses, (6) the revision (if necessary) of the requirements in the QARD and/or the applicable implementing procedure(s) (in particular AP-3.10Q, but also AP-3.11Q and AP-3.12Q), and (7) any required training to assure consistent interpretation of the requirements. This plan should be reviewed by a small working group with representatives from OQA, QATSS, M&O R&L, and M&O PAD.

Compliance Date: November 15, 2000

14. Remedial Actions: Two AMRs have been identified that could be improved in the "transparency" of their documentation. These two AMRs are ANL-EBS-PA-000001, Rev 00 "WAPDEG Analysis of Waste Package and Drip Shield Degradation" and ANL-NMS-MD-00005, Rev 00 "Abstraction of Drift Seepage". Although both of these products were found to be technically adequate, they both contain instances where the documentation could be improved to provide evidence of (a) how uncertainty/variability were evaluated, (b) how assumptions of supporting AMRs were evaluated as to their relevance and/or impact, and (c) how alternative models were evaluated and dispositioned.

These two AMRs are being revised to support the SR. Improving the transparency of these documents will be added to the scope of the revisions of these 2 documents. In addition, both documents will be subject to AP-2.14Q reviews, including a review from QATSS, to assure the documentation is adequate to address the concern raised.

15. Extent of Condition: Various reviews of different AMR products, including those conducted during the audit of the Performance Assessment Department, as well as (a) legal reviews of FEPs AMRs, (b) product enhancement reviews by QATSS of different AMRs, (c) internal AP-2.14Q reviews of technical products, and (d) preliminary NRC reviews of AMRs have indicated that "transparency" has been unevenly treated in most if not all of the products reviewed. Although these reviews have found that the technical results and conclusions are adequate, appropriate and defensible; the issue identified is that the technical basis for assumptions, the selection of alternative models and the treatment of uncertainty and variability has not been adequately or consistently documented. As the result of the lack of documentation, it is difficult for reviewers to ascertain how these issues have been considered and addressed by the authors. This condition is believed to be widespread across all technical products and an area for improvement in all products used to support the License Application.

16. Cause: (Attach results of root cause determination prepared in accordance with AP-16.4Q for a significant deficiency.) Inadequate definition of the requirement for "transparency" in the QARD and therefore difficulty in defining the process steps necessary to effectively and consistently implement this requirement in applicable administrative procedures. Given the difficulty in defining the term and process steps, the products produced have a varying level of "transparency".

17. Action to Preclude Recurrence: Develop a project-wide definition of the term transparency that addresses NRC expectations as defined in the TSPAI IRSR. Include this definition in (or, if necessary, appropriately revise) the QARD. Conduct a survey (utilizing ongoing efforts by QATSS on product enhancement, by MTS on evaluating unquantified uncertainty, by the M&O on documenting major assumptions in TSPA-SR models, by legal reviews of FEPs AMRs and PMRs, and the NRC comments in IRSR TE's) to identify good examples of "transparent" documentation and best business practices in developing "transparent" documentation. Present proposed definition and approach to satisfying "transparency" acceptance criteria within TSPAI IRSR to NRC staff and management at the TSPAI IRSR TE (currently planned for February 2001) [Goal is to gain NRC approval of process/approach.] Revise AP-3.10Q to more clearly and transparently define process for implementing the "transparency" requirement. [NOTE: Training and Implementation of the revised procedure is outside the scope of the actions required.]

18. Due Date: April 30, 2001
☐ For submittal of complete response
☑ For completion of corrective action

19. Response by:
Robert W. Andrews
Robert W. Andrews
Date Oct 20, 2000
Phone 295-5549

20. Evaluation: ☒ Accept ☐ Partially Accept ☐ Reject
QAR F. Harvey Dove Date 10/25/00

21. Concurrence:
DOQA James Blaylock Date 11/2/00

Exhibit AP-16.1Q.1 Rev. 12/20/1999

10/20/00 LVPA RWA 10/00-179

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8. ☐ DR/CAR
☐ Stop Work Order

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QA: QA

DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

Request for Extended Processing

Request for extended processing of subject DR. Developing a project-wide definition of "transparency" that is suitable for appropriate implementation in subject documents is a major task that requires coordination between DOE, OQA, the M&O and NRC. The later is important because the acceptance criteria for the TSPAI IRSR subissue on model abstraction is the only place where this requirement is explicitly raised, with the exception of the QARD. This integration will take significantly longer than the normal 100 days.

The immediate actions is expected to be completed on schedule.
The remedial actions are underway and are expected to be completed by the end of November depending on Volume 3 of the SRCR actions.
The actions to preclude will occupy most of the time and energy and require the integration mentioned above.

There is no impact of the added time, as this issue is viewed as a licensing issue, not an SR issue.

Robert Andrews

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DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

APPROVAL SIGNATURES FOR REQUEST FOR EXTENDED PROCESSING FOR LVMO-00-D-118

DOE Project Manager for — Date 1/25/01

Director, Office of Quality Assurance — Date 12/14/00

APPROVAL SIGNATURE FOR REQUEST FOR EXTENDED PROCESSING GREATER THAN 365 DAYS FOR N/A

Director of OCRWM — Date N/A

TYPE RESPONSE:
☐ Initial
☒ Complete
☒ Amended

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DR/CAR NO. LVMO-00-D-118
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QA: QA

DEFICIENCY/CORRECTIVE ACTION REPORT (RESPONSE)

14a. Immediate Action:
BSC Licensing Application Project will develop the proposed project-wide definition of the term "transparency" and "transparent" as it relates to documentation of scientific investigations. The definition will be based on NRC regulatory guidance and past nuclear industry practice. The definition will be submitted to the DOE Office of Licensing and Regulatory Compliance, Office of Project Execution and Office of Quality Assurance for their concurrence. After approval for issue, the definition will be provided to each member of the BSC Science and Analysis Project for use in preparation of future documentation.

Compliance Date: May 28, 2001

14. Remedial Actions:

Same as 10/20/2000 response.

15. Extent of Condition:

Same as 10/20/2000 response.

Cause: (Attach results of root cause determination prepared in accordance with AP-16.4Q for a significant deficiency.)

Same as 10/20/2000 response.

17. Action to Preclude Recurrence:

Revise AP-3.10Q to make the procedure specific to Scientific Investigations performed by BSC and clarify the requirement for transparent documentation by including the definition(s) developed as described in Block 14a. Concurrent with the revision, develop a guidelines manual for Scientific Investigations (comparable to the Design Guidelines Manual for Engineering) that provides additional guidance to individuals documenting scientific investigations to assist in preparing transparent documentation.

Note: training and implementation of the revised AP-3.10Q and guidelines manual is outside of the scope of the actions required under this DR.

Activities performed (revision of AP-3.10Q and the development of the guidelines manual) shall be concurrent with the Action to Preclude Recurrence for DR LVMO-00-D-119.

18. Due Date: July 27, 2001
☐ For submittal of complete response
☒ For completion of corrective action

19. Response by: Robert Andrews KQ
Date 4/26/01 Phone (702) 295-5549

20. Evaluation: ☒ Accept ☐ Partially Accept ☐ Reject
QAR Donald J. Harris Date 5-1-01

21. Concurrence:
DOQA James B. Blaylock for Date 5/3/01

DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

Request for Extended Processing

Developing the licensing-based project-wide definition of "transparency" and "transparent" by BSC for implementation in scientific investigation documentation involves research and coordination between numerous affected parties. This coordination involves a different approach than the original activity planned by the previous M&O contractor.

There is no impact of the added time, as this issue is viewed as involving the documentation to be submitted as part of the License Application, not an SR issue.

Robert W. Andrews

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NO. LVMO-00-D-118

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DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

APPROVAL SIGNATURES FOR REQUEST FOR EXTENDED PROCESSING FOR LVMO-00-D-118

DOE Project Manager — Date 5/30/01

Director, Office of Quality Assurance — Date 5/8/01

APPROVAL SIGNATURE FOR REQUEST FOR EXTENDED PROCESSING GREATER THAN 365 DAYS FOR N/A

Director of OCRWM — Date N/A

TYPE RESPONSE:
☐ Initial
☒ Complete
☒ Amended

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DR/CAR NO. LVMO-00-D-118
PAGE OF
QA: QA

DEFICIENCY/CORRECTIVE ACTION REPORT (RESPONSE)

14a. Immediate Action:
BSC Licensing Application Project developed the proposed project-wide definition of the term "transparency" and "transparent" as it relates to documentation of scientific investigations. The definition is based on NRC regulatory guidance and past nuclear industry practice. The definition was submitted to the DOE Office of Licensing and Regulatory Compliance, Office of Project Execution and Office of Quality Assurance with their concurrence received in a letter dated June 11, 2001 (OL&RC:CMN-1265. To ensure that the definition is considered by AMR authors in proper context, the definition will be incorporated into the general revision of AP-3.10Q discussed in block 17.

Compliance Date: October 31, 2001

14. Remedial Actions:

Same as 10/20/2000 response.

15. Extent of Condition:

Same as 10/20/2000 response.

[illegible]. Cause: (Attach results of root cause determination prepared in accordance with AP-16.4Q for a significant deficiency.)

Same as 10/20/2000 response.

17. Action to Preclude Recurrence:

Revise AP-3.10Q to make the procedure specific to Scientific Investigations performed by BSC and clarify the requirement for transparent documentation by including the definition(s) developed as described in Block 14a. Concurrent with the revision, develop a guidelines manual for Scientific Investigations (comparable to the Design Guidelines Manual for Engineering) that provides additional guidance to individuals documenting scientific investigations to assist in preparing transparent documentation.

Note: training and implementation of the revised AP-3.10Q and guidelines manual is outside of the scope of the actions required under this DR.

Activities performed (revision of AP-3.10Q and the development of the guidelines manual) shall be concurrent with the Action to Preclude Recurrence for DR LVMO-00-D-119.

18. Due Date: October 31, 2001
☐ For submittal of complete response
☒ For completion of corrective action

19. Response by: William W. Watson [signature] SDC for N. Williams
[signature]
Date 7/31//01 KB Phone (702) 295-5550

[illegible]. Evaluation: ☒ Accept ☐ Partially Accept ☐ Reject
QAR F. Harvey Dove Date 08/03/01

21. Concurrence:
DOQA James Blaylock Date 8/7/01

Exhibit AP-16.1Q.1 Rev. 12/20/1999

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NO. LVMO-00-D-118

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QA: QA

DEFICIENCY/CORRECTIVE ACTION REPORT/STOP WORK ORDER CONTINUATION PAGE

Request for Extended Processing

As noted in the 26 April 2001 response to DR LVMO-00-D-118, the corrective action associated with the revision of AP-3.10Q and the development of the guidelines manual are to be performed in conjunction with the corrective action for DR LVMO-00-D-119. The need to ensure that the definition of transparency is understood in context with the DR 119 changes to procedure AP-3.10Q precludes issuing a procedure change for the sole reason of including the definition of transparency. Therefore the corrective action completion date for DR 118 has been changed to 31 October 2001.

There is no impact of the added time, as this issue is viewed as involving the documentation to be submitted as part of the License Application, not an SR issue.

Robert W. Andrews

Attachment 11

UER, “Sustainable Indicators Report”

(Jan 2001)

FINAL January 30, 2001

PROJECT 2 – TASK 3
SUSTAINABLE INDICATORS REPORT

Prepared for the
Clark County Department of Comprehensive Planning
Nuclear Waste Division

URBAN
ENVIRONMENTAL
RESEARCH, LLC

8687 East Via de Ventura Dr., Suite 211
Scottsdale, AZ 85258

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1.0 INTRODUCTION

This report is the second step toward preparing a Sustainability Impact Assessment and developing a monitoring program to assess and mitigate impacts resulting from the U.S. Department of Energy's (DOE) proposal to construct the Yucca Mountain Repository and transport High Level Nuclear Waste and Spent Nuclear Fuel (HLW) through Clark County. This report builds on an earlier report, *Project 1 – Task 1 Baseline Information and Community Perspective on Potential Repository Impacts on Clark County.* This earlier report summarized over a decade of work by Clark County's Nuclear Waste Division, the State of Nevada, and numerous contractors who have analyzed the vulnerabilities and adverse impacts faced by communities along the shipment corridor within Nevada, To date, the impacts have not been systematically prioritized, placed into a sustainability framework, evaluated in terms of indicators or measures that can be monitored. For Clark County it is critical to identify the set of impacts that are likely to significantly affect the county's economy, environment and community well-being because the Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada (DEIS) did not adequately address many of the issues that are most important to Clark County residents and that will require preventative and mitigative policies to be implemented.

The *Project 1 – Task 1 Baseline Information and Community Perspective on Potential Repository Impacts on Clark County* report indicated that "even without accidental radioactive events from transporting nuclear waste, Clark County would likely experience declines in residential and commercial property values along shipment routes; a decline in investments in such things as second home development; significant costs in governmental services to manage the program; potential losses in the visitor tourist sector; and perhaps significant declines in

many aspects of community well-being and satisfaction with living in the Las Vegas area and other municipalities."

Since Clark County is charged with protecting the public health and safety of its citizens as acknowledged in Section 116C of the Nuclear Waste Policy Act (NWPA), the purpose of this report is to assist Clark County in developing a program to identify and monitor adverse impacts resulting from the DOE's proposed shipment campaign. The program's goal will be to monitor key impact indicators that can provide an early warning to decision makers if Clark County's economy, environment, or community well-being is adversely affected so that appropriate mitigation cam be implemented.

The monitoring program will be designed to be responsive not only to the full array of issues that have been identified by the residents of Clark County as important to their well-being, but also those identified in the *Project 1 - Task 1 Baseline Information and Community Perspective on Potential Repository Impacts on Clark County* report and summarized in Section 3.0 of this report. As a first step, this report summarizes the indicators that have been legally recognized (Section 2.0); identifies the key impact areas that have been identified by Clark County and the State of Nevada (Section 3.0); discusses the purposes for indicator programs (Section 4.0); summarizes a preliminary list of indicators that are either already monitored within Clark County or that have been identified by Clark County personnel as indicators that should be monitored if the U.S. DOE's shipment campaign goes forward (Section 5.0); and prioritizes the indicators identified to date within a sustainability framework (Section 6.0).

Since Clark County recognizes that the DOE's program is still evolving and that the environment in Clark County is dynamic, the selection of impact indicators will be an iterative process that will incorporate new information as it becomes available. The indicators that are

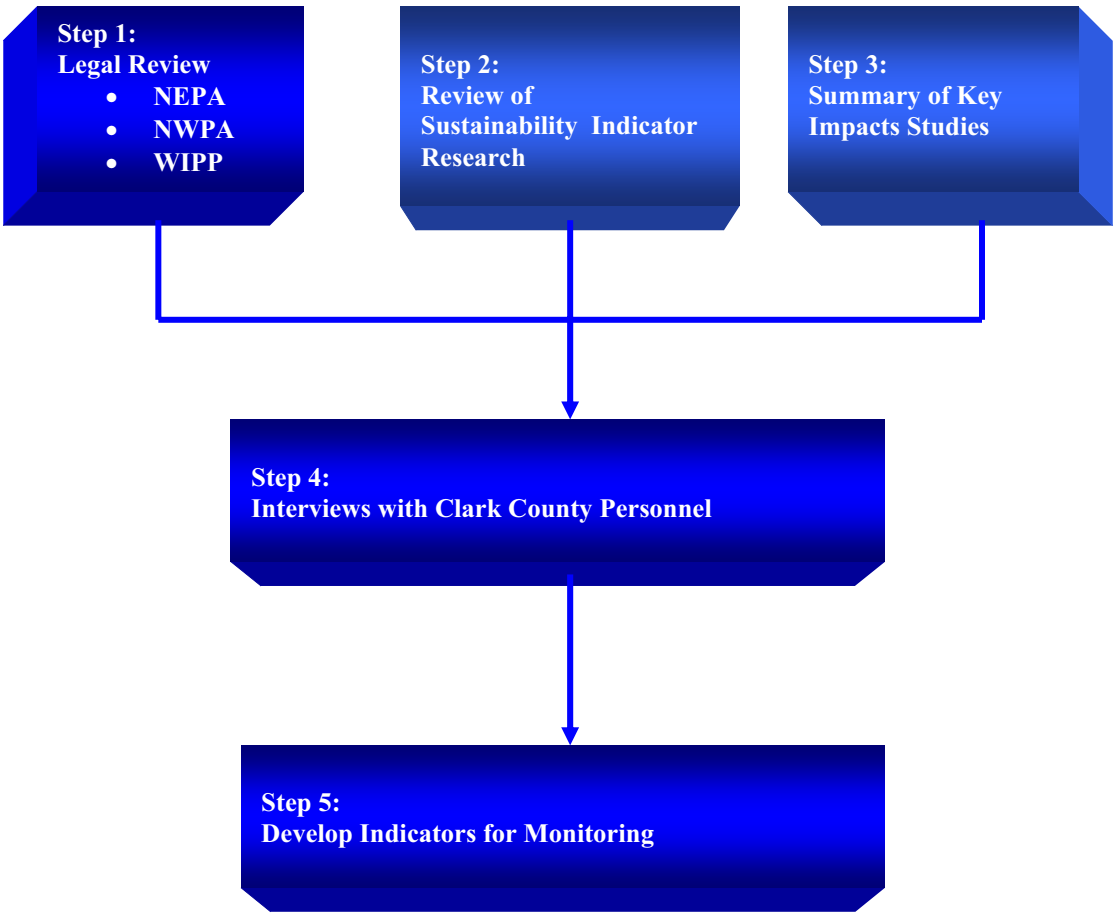
selected, however, will be drawn from those previously identified as meaningful for measuring community sustainability and that have been recognized as legally cognizable and/or have been recognized as important by Clark County personnel. For purposes of this report, legally cognizable indicators are those standards that have been codified in law, such as the National Ambient Air Quality Standards (NAAQS) of the Clean Air Act, and those standards that have been recognized by the courts in their interpretation of Federal and State law.

1.1 Approach

In order to identify indicators that would be appropriate for Clark County's Nuclear Waste Division to monitor and evaluate the potential impacts of the DOE's proposal to transport HLNW and SNF through Clark County, a Five-step research approach was implemented (Figure 1). These steps included the following components:

1. A review of the relevant legal framework that governs impact assessment and mitigation both for the proposed Yucca Mountain repository and for the Waste Isolation Pilot Project (WIPP). The legislation governing WIPP, the Waste Isolation Pilot Plant Land Withdrawal Act of 1992, was reviewed since it is the only one managed by the DOE that is receiving large shipments of radioactive waste. The National Environmental Policy Act of 1969 (NEPA) was selected because it establishes the nation's environmental compliance policy for all major Federal projects including the DOE's proposal to construct the Yucca Mountain Repository and the related shipment campaign of HLW. The NWPA and its amendments was analyzed because it details the specific standards that the U.S. Congress has determined governs the DOE's plans to construct a repository at Yucca Mountain and to ship HLW to that repository.

Figure 1 Approach to Identification of Impact Areas and Indicators



2. A review of the sustainability indicator research to identify the key indicators that have been used for early identification of adverse impacts from large-scale federal projects or to identify the direction and magnitude of changes in communities.
3. A summarization of the key impacts and issues identified by Clark County, the State of Nevada and local jurisdictions related to the DOE's plan to construct the Yucca Mountain Repository and to ship HLW through Clark County; and
4. Interviews with key Clark County governmental personnel to identify indicators that are currently measured as part of the County's activities to protect the public health and safety. (Figure 1).

1.1.1 Step 1: Legal Review

Legislation that governs the DOE's responsibilities toward communities that are adversely impacted by shipment campaigns of radioactive wastes was studied to identify indicators that are legally cognizable. These include the National Environmental Policy Act of 1969, as amended; the Nuclear Waste Policy Act of 1982,as amended by the Nuclear Waste Policy Amendments Act (NWPAA) of 1987; and the Waste Isolation Pilot Plant Land Withdrawal Act of 1992.

NEPA was selected because it provides the framework for making all environmental decisions on major projects within the United States, including the DOE's proposal to construct the Yucca Mountain Repository and to transport HLW through Clark County. The NWPA was selected because it identifies both exemptions to federal and State laws that Congress has authorized related to the construction of a permanent repository at Yucca Mountain, as well as specific requirements that the DOE must comply with if a decision to construct a permanent repository at Yucca Mountain is made. The NWPAA and the Energy Act of 1992 contain amendments to the NWPA. The WIPP Land Withdrawal Act was selected because it provides a framework for how the DOE monitors and mitigates the impacts from the only existing nationwide program to transport transuranic radioactive wastes to the WIPP facility at Carlsbad, New Mexico. It provides an opportunity to evaluate the impacts that were recognized and mitigated by this legislation.

1.1.2 Step 2: Review of Sustainability Research

A growing number of communities have established indicator programs to monitor whether they are growing their economies; managing their environmental resources; and contributing to the community's well-being in a sustainable manner. These indicator programs

have proven to be useful measures of overall community well being. These programs have been designed to provide policy makers and citizens with the information necessary to make informed decisions about the use and allocation of resources. For example, a community that relies heavily on tourism might use their hotel occupancy rate as a measure of economic well-being. If the hotel occupancy rate begins to decline then community leaders would be alerted to identify the causes and to the need to consider mitigation measures to boost the occupancy rate or make other adjustments to lessen the impact of declining tourism on the economy.

By reviewing successful indicator programs and their indicators, it allows Clark County to select the most appropriate indicators for monitoring the potential impacts from the DOE's proposed shipment campaign.

1.1.3 Step: 3 Summary of Key Impact Studies

In response to the release of the Draft Environmental Impact Statement (DEIS) for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada in August of 1999, Clark County and the State of Nevada prepared extensive comments documenting the areas that would be most impacted as a result of the DOE's plans. These summaries were reviewed in order to identify the effected areas and issues for which relevant indicators need to be constructed. In addition, a number of surveys have been conducted within Clark County that illustrates the community well-being factors considered most important by the residents of Clark County. These surveys were also reviewed in order to identify important community well-being factors for which indicators could be constructed.

1.1.4 Step 4: Interviews

A series of interviews were conducted with Clark County governmental personnel to identify the existing indicators used to monitor current conditions by their agencies (in many cases these consisted of regulatory standards for environmental factors). In addition, these personnel were asked to identify specific indicators that they believed would be important to monitor if the DOE proceeds with their proposal to construct the Yucca Mountain Repository and to transport HLW through Clark County. These indicators are discussed in Section 5.0 of this report.

Personnel were selected to be interviewed because of their management responsibilities in areas that have previously been identified as potentially impacted by the proposed shipment campaign. Representatives from the following agencies were contacted (Appendix A):

- Department of Administrative Services
  - Emergency Management Division
- Clark County Assessors Office
- Department of Comprehensive Planning
  - Current Planning Division
  - Major Projects
  - Current Planning
- Environmental Planning Division
  - Air Division
  - Natural Resources
  - Advanced Planning Division
  - Community Planning

- Department of Finance
  - Community Resources Management

In addition key representatives of the Clark County School District were interviewed and their concerns were recorded and translated into indicators.

1.2 Key Terms

Four of the key terms used throughout this report, impacts, indicators, monitoring, and community well-being have been defined in various ways. For purposes of this report, impacts are any positive or adverse change to the environment, community well being, or economy resulting from any external change agent such as the DOE's proposed shipment campaign of HLW through Clark County. Indicators are those factors or conditions that will be routinely measured to determine whether positive or adverse changes are occurring to the environment, community well being, or economy, as a result of the shipment campaign. Measures or indicators will permit assessments of the direction and magnitude of change from baseline conditions or from articulated goals or standards. Monitoring is the formal measurement and evaluation of key indicators over time to determine if changes are occurring to the environment, community well being, or economy as a result of the shipment campaign. Community well being, also frequently referred to as quality of life alludes to Athe state of social well-being of an individual or group, either as perceived or as identified by observable indicators@ (Johnston et al 1994).

The monitoring of key indicators to identify any changes that occur to the environment, community well being, or economy of an area resulting from a major initiative is a well established practice used world-wide. The problem of selecting indicators to monitor and effectively measure change resulting from a shipment campaign is complicated because of the nature of the waste being shipped. In numerous studies, citizens have indicated that nuclear

wastes are among the most feared hazards or disamenities, and that people are reluctant to live or work near these wastes and routes used to transport these wastes. Repeated surveys in Clark County indicate that 75% are unwilling to purchase homes near the transportation corridor. In fact, almost 80% of residents surveyed believe that property values along the transportation corridor will decline if the DOE proceeds with its shipment campaign, even without incidents.

Further, several courts have legally recognized property value loss resulting from the stigma associated with the shipment of radioactive wastes. In a case brought in Santa, Fe, New Mexico, the State of New Mexico was found liable for damages associated with the loss of property value for a property adjacent to a bypass that was constructed for the shipment of radioactive wastes to the WIPP facility in Carlsbad, New Mexico (ZIA Associates 1997). The court found that if a property's value declined as a result of the perceived risk associated with the transportation of radioactive wastes, even if the perception was unfounded, then the property value loss needed to be compensated.

The challenge for Clark County is to design a monitoring program of impacts that can proactively identify changes to the environment, community well-being, and economy that may be triggered not by population changes alone but by the stigma associated with the perceived risk of transporting radioactive waste. A survey of Clark County bankers and appraisers for the State of Nevada found that stigma-induced property value diminution can be anticipated from the DOE's shipment campaign even if no incident occurs (Conway et al 2000). Potential property value diminution was found to exist for all types of properties including residential, commercial, and industrial. The magnitude of property value losses was found to increase substantially if a transportation accident was to occur. The ambiguity and uncertainty associated with the DOE's proposal argues for a monitoring program that is comprehensive and dynamic. Accurate, readily

available information presented in a framework that can be easily understood and utilized to identify mitigative actions will be vital to maintain the communities' well-being.

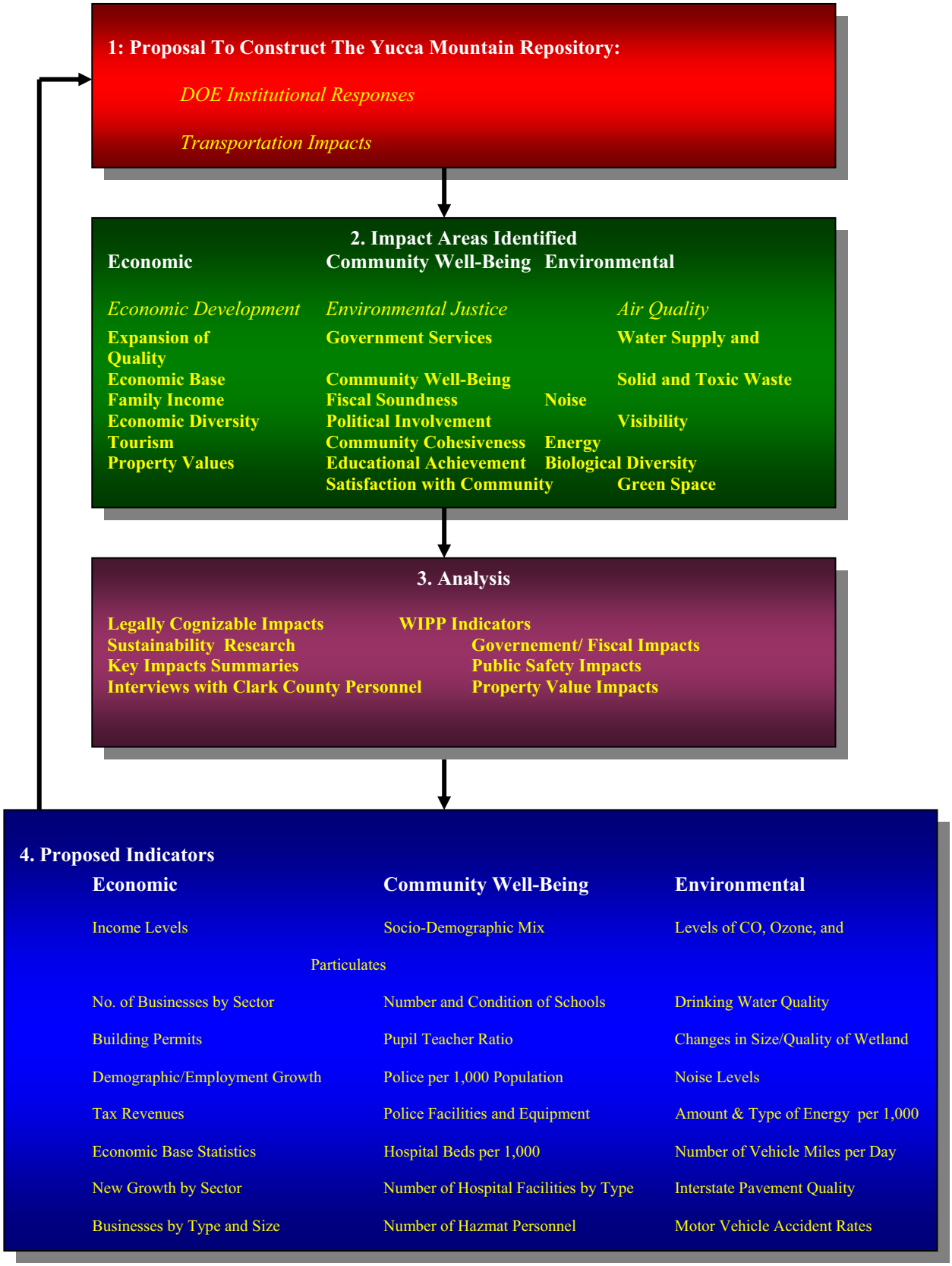
1.3 The Process for Identifying Impact Indicators

As noted in Section 1.0, Clark County is responsible for protecting the public health and safety of its citizens. Toward this end the county provides governmental services and monitors a number of indicators to ensure the well being of its citizens. These indicators include standards promulgated by the federal government and monitored by the County. Air quality and water quality monitoring is an example of routine monitoring by the County to ensure that contaminant concentrations in air and water comply with federal environmental regulations. The County has also identified other indicators it deems important to monitor including school enrollments and measures of economic development.

DOE's proposal to develop a high-level nuclear waste repository and attendant transportation systems may adversely impact public health and safety, local economies, and quality of life. It is vital that Clark County be able to monitor a set of indicators that can provide an early warning to decisionmakers if DOE's proposed shipment campaign adversely impacts Clark County. The monitoring of these indicators will also provide information of the magnitude of the effects from established existing conditions or projected goals. The purpose of the report is to develop a list of priority indicators that can be monitored by Clark County and local jurisdictions as a basis of measuring changes that may result from the repository and its related transportation of high-level nuclear waste.

Figure 2 provides an illustration of the process of identifying impact indicators found in this analysis.

Figure 1 Process of Identifying Impact Indicators for Monitoring



Step 1 is not explicitly developed in this report because it is dealt with elsewhere in Clark County and the State of Nevada's research on Yucca Mountain. Step 1 involves the characterization and understanding of the source of the potential changes to the proposed Yucca Mountain repository. The construction and operation of the repository and the shipment campaign can be viewed as the drivers of the impacts to the County. It will be important to know the exact routes over which the wastes will be transported, the number of shipments and mode, the inspection and safety systems that will have to be in place, the population at risk, among a larger set of data requirements that define and characterize the repository program. Any changes in the repository program including regulatory and institutional changes would obviously result in changes in the type and magnitude of impacts that may be experienced in Clark County. The identification of the impact areas to be evaluated by the County is directly linked to the repository and its associated transportation programs.

Step 2 in our analysis identifies and reviews the impact areas that have previously been recognized by Clark County's Nuclear Waste Division and the State of Nevada as being potentially adverse to public health, well being and the economy of Clark County. Based on 15 years of impact assessment studies specific areas that are likely to be impacted were identified. These impact areas found in Step 2 provide a base framework from which specific indicators can be derived and monitored and that are directly linked to the repository program. Step 2 also categorizes the impact areas into three broad groupings—economic impacts, community well being impacts and environmental impacts. These broad categories provide a framework to examine the impacts of the repository from a "sustainability" perspective. This concept and how it is applicable to potential repository impacts is discussed in the report.

Step 3 describes the process and key components of the analysis that was taken in order to determine and identify the impact indicators. First, the key legislation that was designed to protect the environment from adverse impacts of major federal initiatives and the laws governing radioactive waste disposal facilities were analyzed to provide insights as to the types of indicators that have been legally recognized. Thus, federal laws and the federal agency guidance documents on the implementation of these laws was one approach for prioritizing the indicators to be monitored.

Secondly, we carefully reviewed the key impact assessments related to the proposed repository with the intent to discern from them precise measures characterizing the impacts. This was another approach to identify and prioritize impact indicators. The third analysis completed to meet our objectives in this study was to interview personnel from County departments that are mandated to monitor repository-related impacts. The interviews asked questions about departmental responsibilities, the legal basis for monitoring change and reporting requirements, as well as estimating expected impacts from the repository and related transportation programs. A set of indicators were therefore identified through these interviews either because these are mandated and could be associated with the transportation of high-level nuclear waste through Clark County or can be anticipated as a result of possible risk events. Lastly, indicators were also derived from current studies by Clark County's Nuclear Waste Division including studies examining fiscal impacts, public safety, and property value effects. In addition, a report examining lessons learned from the WIPP experience, also informed this study with respect to the indicators that were utilized for impact assessments, monitoring, and those that perhaps should have been utilized in New Mexico.

Step 4 provides a summary of the prioritized indicators or measures recommended to by utilized by Clark County in any impact monitoring program related to the transportation of nuclear waste through Clark County. These indicators result from examining the full array of indicators from the various analyses described above.

The resulting indicators were based on the data derived from the other steps and analyzed in order to establish an efficient monitoring program that maximizes the use of current and available data sources.

2.0 LEGALLY COGNIZABLE IMPACTS

2.1 The National Environmental Policy Act of 1969 (NEPA, 42 USC 4321)

In 1969, the United States Congress (Congress) adopted the NEPA with an implementation date of January 1, 1970. The purpose of the act was to "declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality" (NEPA, 42 USC ' 4321).

The language of the statute is brief and general. It was originally comprised of a declaration of Congressional purpose and two subchapters. The first subchapter described the policies and goals of NEPA, while the second established the Council on Environmental Quality (CEQ) and delineated its responsibilities.

When NEPA was initially authorized, the Congress did not empower CEQ to promulgate regulations resulting in inconsistent responses from the various federal agencies. To address the inconsistencies, President Carter approved Executive Order No. 11991, which directed CEQ to

disseminate mandatory regulations. These regulations were codified in 40 C.F.R. (Part 1500, et Seq.) and compel federal agencies to abide by the purpose, policy, and mandates of NEPA in their planning processes. Included is a requirement to prepare an Environmental Impact Statements for all major decisions that utilize federal funds.

The *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act* (40 C.F.R. Parts 1500, et Seq.) briefly references methodology in Section 1502.24, which states:

> "*Agencies shall insure the professional integrity, including scientific integrity, of the discussions and analyses in environmental impact statements. They shall identify any methodologies used and shall make explicit reference by footnote to the scientific and other sources relied upon for conclusions in the statement. An agency may place discussion of the methodology in the appendix*."

Guidance detailing the methods and standards to be considered within an EIS can be found in the various memoranda, checklists, and guidance documents that have been developed by the federal agencies in response to NEPA. This guidance establishes the factors that have been legally recognized as appropriate for mitigation. Relative to the DOE's proposal to construct the Yucca Mountain Repository and to ship HLW through Clark County, these memoranda, checklists, and guidance documents are particularly informative for identifying the range of issues that Clark County can appropriately seek mitigative relief from the DOE, if they proceed with the shipment campaign.

One of the initial guidance documents prepared by CEQ was *Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations*. Like NEPA, this document does not specifically address the methods or standards to be used in preparing and evaluating an

EIS. Instead, this guidance primarily addresses procedural issues related to the implementation of NEPA. Two of the questions addressed in this document however are relevant to the issue of standards. Question 19 addresses the Ascope of mitigation measures that must be addressed.@ It states:

> "*The mitigation measures discussed in an EIS must cover the range of impacts of the proposal. The measures must include such things as design alternatives that would decrease pollution emissions, construction impacts, aesthetic intrusion, as well as, relocation assistance, possible land use controls that could be enacted, and other possible efforts. Mitigation measures must be considered even for impacts that by themselves would not be considered 'significant'." Once the proposal itself is considered as a whole to have significant effects, all of its specific effects on the environment (whether or not 'significant') must be considered, and mitigation measures must be developed where it is feasible to do so*."

This discussion implies that the proposed action within the EIS will adversely affect some environmental standard. Question 23, specifically references an obligation to acknowledge "conflicts with land use plans, policies, or controls." And further details that these include those policies promulgated by local, regional, and State executive and/or legislative bodies.

In 1983, CEQ linked the NEPA process with the obligation of federal agencies to comply with other federal laws and Executive Orders (CEQ 1983). The *Memorandum Guidance Regarding NEPA Regulation* states that an EIS should include "issues which originate from separate legislation, regulation, or Executive Order (e.g., historic preservation or endangered species concerns); and identify State and local agency requirements which must be addressed."

(Reinke and Swartz 1999, pg. G 66) This memorandum goes on to state that an EIS should encompass "to the maximum extent possible all of the environmental and public involvement requirements of State and Federal laws, Executive Orders, and administrative policies of the involved agencies. Examples of these requirements include the Fish and Wildlife Coordination Act, the Clean Air Act, the Endangered Species Act, the National Historic Preservation Act, the Wild and Scenic Rivers Act, the Farmland Protection Policy Act, Executive Order 11990 (Protection of Wetlands), and Executive Order 11998 (Floodplain Management)"(Reinke and Swartz 1999, pg. G 67).

The linkages between NEPA and existing federal law, regulation, and Executive Order has subsequently been broadened to incorporate pollution prevention, transboundary impacts, and Executive Order 12898 on Environmental Justice Consideration (Reinke and Swartz 1999, pgs. P-89, T-95, and J-99). Taken as a whole, NEPA, the *Memorandum Guidance Regarding NEPA Regulation* and the subsequent Executive Orders promulgated by CEQ establish Federal and State law and regulatory requirements as the *recognized standards* for measuring impacts under NEPA.

More recently, CEQ developed guidance addressing methodological approaches that are acceptable for measuring cumulative impacts in their 1997-guidance document, *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997). This document lays out a series of methodological approaches that can be combined to evaluate cumulative effects. NEPA defines cumulative effects as "*the impacts on the environment, which results from the incremental impact of the action when added to other past, present, and future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions"* (40 CFR 1508.7). The guidance specifically argues that "analyzing cumulative effects ultimately

depends on the careful application of individual methods, techniques, and tools to the environmental impact assessment at hand." Specifically, the guidance encourages the use of a suite of primary methods that includes:

- Questionnaires, interviews and panels;
- Checklists;
- Matrices;
- Networks and system diagrams;
- Modeling;
- Trend analysis; and
- Overlay mapping and GIS (CEQ 1997, pg vi).

This guidance document also encourages the use of special methods to identify cumulative impacts such as carrying capacity analysis, ecosystem analysis, economic impact analysis, and social impact analysis. (CEQ 1997, pg vi). Further, this document argues that the purpose for using any of these analytical techniques should be the design of mitigation strategies (CEQ 1997, pg vii).

In addition to CEQ another key player in the review of EISs under the NEPA is the U.S. Environmental Protection Agency (USEPA). Since 1970, the USEPA has reviewed virtually all of the roughly 25,000 EISs that have been prepared (USEPA 1999). This is the result of a Congressional effort to address an ambiguity in NEPA, through an amendment to the Clean Air Act of 1997 that delegates the requirement to review EISs prepared in response to NEPA to USEPA. Section 309 of the Clean Air Act of 1997 states that NEPA Adoes not assure that Federal environmental agencies will effectively participate in the decision-making process. It is essential that mission-oriented Federal agencies have access to environmental expertise in order

to give adequate consideration to environmental factors@ (Senate Report No. 91-1196, 91st Congress, 2nd Session 43, 1970; 40 CFR Part 6; Subpart A).

The USEPA guidance document, *Cross-Cutting Environmental Laws: A Guide for Federal/State Project Officers*, parallels the CEQ's *Memorandum Guidance Regarding NEPA Regulation* in stressing the integration of Federal environmental laws into the NEPA process (USEPA 1991). Similarly, another USEPA guidance document, *Consideration of Cumulative Impacts in EPA Review of NEPA Documents*, references the CEQ's handbook, *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997), as the "most comprehensive and useful information to date on practical methods for addressing cumulative effects in NEPA" (USEPA 1999).

The DOE after much resistance adopted NEPA Implementing Procedures in code 10 C.F.R. Part 1021. These Implementing Procedures adopt by reference the CEQ regulations. The DOE has developed an EIS checklist as part of their NEPA implementation guidance (DOE 1997). This DOE NEPA guidance document also emphasizes the use of federal standards, as well as, state, and local government regulations as appropriate guideposts for measuring impacts.

2.2 Draft Environmental Impact Statement (DEIS)

As required by NEPA, the DOE released the Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada (DEIS) in July of 1999. The Proposed Action in the DEIS includes the shipment of spent nuclear fuel and other high-level radioactive waste that is currently stored at 72 civilian and commercial facilities and 5 DOE facilities to a permanent storage repository at Yucca Mountain, Nye County, Nevada approximately 90 miles northwest of Clark County, Nevada.

The DEIS identified the following as "statutes and regulations establishing or affecting authority to propose, license, and develop a monitored geologic repository" (DEIS 1999; pgs. 11-1 to 11-5):

- Nuclear Waste Policy Act of 1982, as amended (42 USC ‘ 10101-10270)
- Energy Policy Act of 1992 (42 USC ‘ 10101 et seq.)
- National Environmental Policy Act of 1969, as amended (42 USC ‘ 4321 et seq.)
- Atomic Energy Act of 1954, as amended (42 USC ‘ 2011 et seq.)
- Federal Land Policy and Management Act of 1976 (43 USC ‘ 1701 et seq.)
- Executive Order 11514, National Environmental Policy Act, Protection and Enhancement of Environmental Quality.

The DEIS also describes over forty statutes, regulations, and orders regarding environmental protection requirements that are also applicable to the Yucca Mountain project [Appendix B (DEIS 1999; pgs. 11-5 to 11-17)]. Compliance with these statutes and regulations provide the basis for many of the indicators that are suggested for monitoring in Section 6.0.

These Federal laws and Executive Orders govern primarily environmental factors that the DOE said were considered in the DEIS. To describe the affected environment relative to socio-economic factors, the DOE used the Regional Economic Models, Inc. (REMI) to estimate baseline socio-economic conditions. The DEIS compared Nevada's 1990 B to 1997 growth rate with the national average. Similarly, the DOE used national averages to compare the employment rate, pupil B teacher ratios, officer to B population ratios, and firefighters per 1,000 population within Clark County. The DOE forecast the number of households based on the assumption that the persons per household and occupancy rates remain static. Recent data indicate that the rate of persons per household and occupancy rates are decreasing. This means

that the method used by the DOE in the DEIS may undercount the impact of the shipment campaign on the housing stock in Clark County. The DOE also measured the number of beds per 1,000 and patient days by holding the usage rate constant with those identified in 1996 (Roderfer et al. 1996, pgs 214 - 216).

2.3 Nuclear Waste Policy Act

In 1982, the United States Congress passed the NWPA, which was amended in 1987. The NWPA and its amendments established the process that is to be used by the DOE in the site selection, site characterization, EIS preparation, and decision to recommend to the President the development of a geologic repository for the disposal of spent nuclear fuel and other high-level radioactive waste at Yucca Mountain, Nevada.

The NWPA states that *"any recommendation made by the Secretary under this section shall be considered a major Federal action significantly affecting quality of the human environment for purposes of the National Environmental Policy Act of 1962* [42 U.S.C. 4321 et seq.]. *A final environmental impact statement prepared by the Secretary under such Act shall accompany any recommendations to the President to approve a site for a repository."*

Section 113d of the NWPA specifically groups all activities during the site characterization phase into what is designated as a "preliminary activity" that is to be addressed in only one EIS.

The NWPA also limits the alternative sites to be considered under NEPA to the Yucca Mountain site (section 114F) and instructs the Nuclear Regulatory commission that *"to the extent such statement is adopted by the Commission, such adoption shall be deemed to also satisfy the responsibilities of the Commission under the National Environmental Policy Act of 1969* [42 U.S.C. 4321 et seq.] *and no further consideration shall be required, except that nothing*

in this subsection shall affect any independent responsibilities of the Commission to protect the public health and safety under the Atomic Energy Act of 1954" [42 USC 2011 et seq.].

The NWPA also lays out the process for States and Indian tribes to indicate their disapproval of a Presidential recommendation to Congress of the Yucca Mountain site. Within 60 days of a Presidential recommendation, either the Governor, legislature, or governing body of a tribe on whose reservation the site is located, may submit a notice of disapproval to Congress under section 116 or 118 [U.S.C. 10136 and 10138]. Upon submittal of a notice of disapproval, Congress must respond with a passage of a resolution of site approval within the first 90 calendar days of continuous session or the site is disapproved (Section 115C).

The NWPA also provides for consultation with the State (Section 117C) particularly as it relates to off site concerns *"including but not limited to, questions of State liability arising from accidents, necessary road upgrading and access to the site, ongoing emergency preparedness and emergency response, monitoring of transportation of high-level radioactive waste and spent nuclear fuel through such State, conduct of baseline health studies of inhabitants in neighboring communities near the repository site and reasonable periodic monitoring thereafter, and monitoring of the repository site upon any decommissioning and decontamination."* Consultation and financial assistance to Indian Tribes is provided for in Section 118.

The NWPA also provides for the development of "standards for the protection of the general environment from radioactive material in repositories," and by the EPA and excludes this activity from the NEPA requirement to prepare an EIS [Section 121 A and C].

Subtitle G specifies which impact areas are to be considered for mitigation (Section 175). These include:

(1) education, including facilities and personnel for elementary and secondary schools, community colleges, vocational and technical schools and universities;

(2) public health, including the facilities and personnel for treatment and distribution of water, the treatment of sewage, the control of pests and the disposal of solid waste;

(3) law enforcement, including facilities and personnel for the courts, police and sheriff's departments, district attorneys and public defenders and prisons;

(4) fire protection, including personnel, the construction of fire stations, and the acquisition of equipment;

(5) medical care, including emergency services and hospitals;

(6) cultural and recreational needs, including facilities and personnel for libraries and museums and the acquisition and expansion of parks;

(7) distribution of public lands to allow for the timely expansion of existing, or creation of new, communities and the construction of necessary residential and commercial facilities;

(8) vocational training and employment services;

(9) social services, including public assistance programs, vocational and physical rehabilitation programs, mental health services, and programs relating to the abuse of alcohol and controlled substances;

(10) transportation, including any roads, terminals, airports, bridges, or railways associated with the facility and the repair and maintenance of roads, terminals, airports, bridges, or railways damaged as a result of the construction, operation, and closure of the facility;

(11) equipment training for State and local personnel in the management of accidents involving high-level radioactive waste;

(12) availability of energy;

(13) tourism and economic development, including the potential loss of revenue and future economic growth; and

(14) other needs of the State and local governments that would not have arisen but for the characterization of the site and the construction, operation, and eventual closure of the facility. [42 USC 10174(a)]

Subtitle H Section 180C also requires the DOE to *"provide technical assistance and funds to States for training for public safety officials of appropriate units of government and Indian tribes through whose jurisdiction the Secretary plans to transport spent nuclear fuel or high-level radioactive waste under subtitle A or under subtitle C. Training shall cover procedures required for safe routine transportation of these materials, as well as procedures for dealing with emergency response situations. The Waste Fund shall be the source of funds for work carried out under this subsection."* [42 USC 10175]

2.4 Waste Isolation Pilot Plant Land Withdrawal Act 0f 1992

The Waste Isolation Pilot Plant Land Withdrawal Act provides the regulatory framework for the operations and decommissioning activities to be conducted at the WIPP facility in Carlsbad, New Mexico. The WIPP facility is designed to receive approximately 38,000 shipments of transuranic radioactive waste over 35 years. The WIPP Land Withdrawal Act states that the facility and shipment campaign must comply with all provisions of the Clean Air Act (42 USC 7401 et Seq.) and the Solid Waste disposal Act (42 USC 6901 et Seq.) with the exception of the land disposal restrictions described in section 9(a)(1), as well as, "any other applicable

clean air or hazardous waste law" (Section 14). The WIPP bill also provides economic assistance of $20,000,000 per year for the fourteen-year period of waste transport and a commitment that the DOE will provide assistance to the State of New Mexico to support the acquisition of public safety equipment and training. The WIPP Land Withdrawal Act indicates that the $20,000,000 of economic assistance "shall be made available to units of local government in Lea and Eddy counties in the State; and may also be provided for independent environmental assessment and economic studies associated with WIPP." These funds are currently being used to improve road quality along the transport corridor. Beyond a general statement that the Congress will appropriate funds for public safety training and equipment, the WIPP Land Withdrawal Act does not identify how much funding will be made available or any criteria for determining what equipment and activities are appropriate for mitigation assistance.

3.0 REVIEW OF SUSTAINABILITY INDICATOR PROGRAMS

In order to improve the community well being, cities, and counties around the country are starting to define a vision for their future that balances economic, environment and social well-being of their communities. These "sustainable" cities have developed specific goals and strategies to guide programs and governmental services to achieve this balance and quality of life for the long-term. The goals and visions of these local areas are based on the *values* and *priorities* of residents who live there.

The 1999 report by the White House on *Building Livable Communities* argues that the real challenge that the nation faces in the 21st Century is to build "livable cities" and involves enhancing economic growth, public safety, environmental quality, well being of families, and sense of community. As part of a national initiative, 70 percent of over 200 communities in the U.S. adopted policies to pursue "livable cities." Building on the work of the Community

Empowerment Board and the President's Council on Sustainable Development, the Livable Communities Initiative mobilized 12 federal agencies to provide information, tools and monitoring support for community targeted assistance.

From the Federal perspective, the initiative is to broaden choices available to communities in order to:

- Sustain prosperity and expand economic opportunity;
- Ensure equal access and participation by all stakeholders to community resources,
- Manage environmental resources in a manner that is sustainable,
- Enhance community well-being, and;
- Build a strong sense of community.

These initiatives base their efforts on earlier goals of sustainable development: environmental protection (reduce environmental threats); economic security (build on past investment in communities and broaden the economic base); and community well-being (encourage opportunities for all segments of society). The report on *Building Livable Communities* found commonalties in diverse local initiatives for developing livable communities. These common characteristics for developing livable communities are important because the development of Clark County and its municipalities as "Livable Communities" may be incongruent or incompatible with the process, approaches, and impacts of DOE's proposed repository program of transporting, managing and disposing of nuclear waste through and near Clark County.

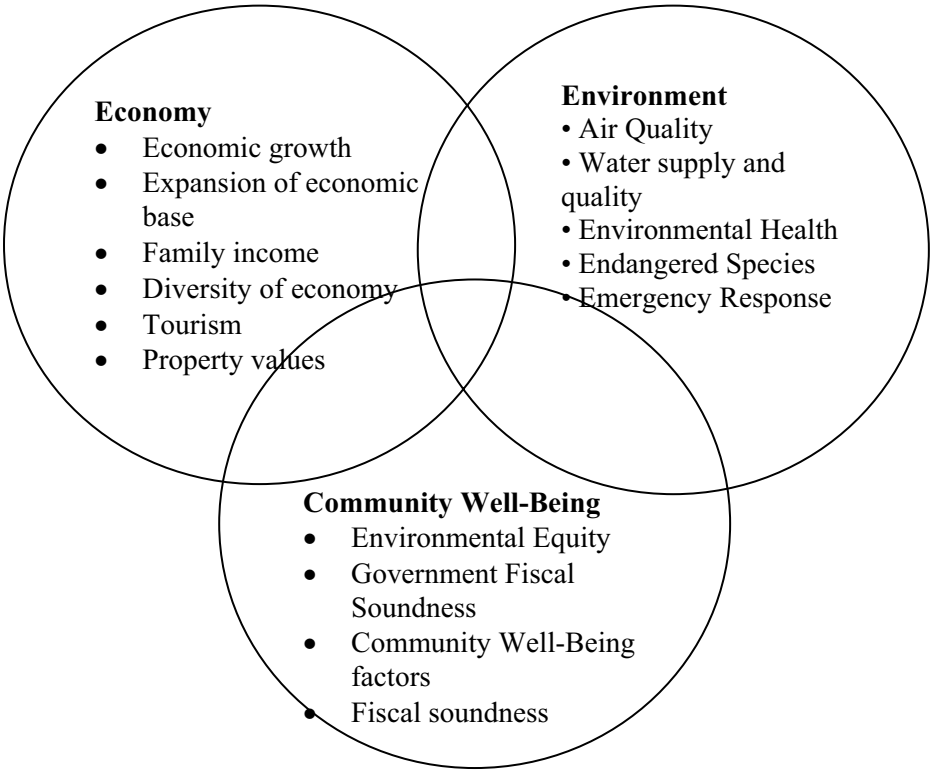
The commonalties in the local initiatives for Livable Communities are as follows:

- Locally Driven–the efforts/initiatives are by local people, a bottom up approach that is not federal directed.

- Inclusive Partnership–opportunities for collaborative public input and goal setting that is open to all stakeholders.
- Broad Scope–successful efforts to create or maintain livable communities and achieve lasting solutions occur when economic, social and environmental challenges are pursued simultaneously.
- Resilient Local Economies–growing interest in economic development strategies that maintain local assets as a source of competitive advantage in the regional, national, and global economy.
- Smart Growth–supports the kind of growth that builds on existing investments and quality of life and redresses environmental damages associated with current patterns of development.

Ideally, there are three elements inherent in developing livable communities (Building Livable Communities 1999) (Figure 3). First a consensus on a vision of what the community strives to be. Some of the elements of the vision are found in comprehensive plans and quality of life reports. Second, it is important that visioning and goal setting in the three linked areas–economy, environment, and community well-being be developed. Third, establish a set of indicators to measure to ensure that the strategies/programs are moving toward the goals. Figure 3 illustrates the range of indicators that can be developed for each of the three key elements of sustainability.

Figure 3 Community Livability Indicators



3.1 Level of Community Livability

Community livability indicators are generally developed as outcomes or output measures that can describe whether a community is utilizing its resources in a manner that is sustainable. These indicators can be monitored over time. The outcomes or outputs from these monitoring efforts can be discussed at meetings between the public and government. If there is slippage in one or more indicators, then the program or strategy can be altered to mitigate the problem. For example, if an indicator program is established in Clark County and as a result of the DOE's nuclear waste program, and there is an adverse impact that causes one of the indicators to drop, Clark County would have an early warning and may be able to develop appropriate mitigation. Given the fact that previous research has indicated that the construction of the Yucca Mountain Repository and the shipment of HLW will adversely impact elements of a livable community, the development of a monitoring program plan that will measure an array of economic,

environmental, and community well-being indicators over time is a prudent approach to protect the public health, safety, and quality of life of Clark County residents.

4.0 SUMMARY OF IMPACTS RESULTING FROM NUCLEAR WASTE TRANSPORTATION THROUGH CLARK COUNTY

4.1 Introduction

Over the last decade, several efforts have been undertaken by both Clark County and the State of Nevada to identify and examine impacts that may result from the activities surrounding the siting of a high-level nuclear waste repository at Yucca Mountain. In addition to repository-specific effects, studies have also addressed the impacts of transporting nuclear waste through Clark County. Among the impact areas identified by these studies are: environmental quality and health, socioeconomic effects to various business sectors including tourism, the convention industry and visitation patterns, property value losses, behavioral effects in home and business investments, social well-being, political activism, and public perceptions and concerns.

In addition to these effects, the establishment of a nuclear waste disposal program will likely result in significant fiscal costs to state and local governments. These costs have and will continue to accrue as a result of their efforts to manage and mitigate repository-related effects, and to build state and local capacity in planning and in providing for public safety. Both the State of Nevada and Clark County continue to examine the nature and magnitude of governmental fiscal costs that will result from the DOE's repository program. A number of impact reports have been compiled by the County (Yucca Mountain Nuclear Waste Repository Program B Baseline Information and Community Perspective on Potential Repository Impacts on Clark County, December 13, 1999) and the State of Nevada (State of Nevada Comments on the U.S. Department of Energy's Draft Environmental Impact Report for a Geological repository for the

Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada, Volume 1 and 2, February 28, 2000) in response to the DOE's DEIS.

From these local and state studies it is clear that adverse impacts to the well-being of Clark County and other communities in Nevada will result from the shipment of nuclear waste in the state. These quality of life effects can result from possible increased costs for governmental services, declines in property values, decreasing desire to live in communities near nuclear waste transportation routes, heightened concerns over public safety, and other problems emanating from the repository program.

In response to the DOE's DEIS both Clark County and the State of Nevada identified potential vulnerabilities and impacts with respect to their direction, likelihood, and magnitude. In this section of this report these areas of vulnerability and potential negative impacts are identified and summarized.

It is important to note that both Clark County and the State of Nevada have indicated that DOE's DEIS is inadequate. In many cases, specific impacts are not discussed in the DEIS despite the fact that they are mandated by NEPA and the NWPA. Many of the impacts viewed as significant by the County and the State to the well being of the economy and state are not adequately considered. The following represents impacts considered to be significant that have not been fully addressed in the DEIS.

4.2 Property Value Impacts

Numerous studies at the national level, as well as those focusing on Clark County, have documented very high levels of public concern over the risks of transporting nuclear waste; the potential for decline in investments in areas near shipment routes, and the subsequent potential for diminution in property values near such routes. Even without accidents, stigma-type effects

are now acknowledged to adversely affect property values. Property value declines can result from several factors including buyer reluctance to purchase homes in these areas, or from the increased desire of residents to sell and leave areas near shipment routes. Moreover, at least one study has shown the influence of lenders' preferences to deny loans on a property contiguous to a parcel that is environmentally contaminated. In their 1991 study Hanford/Healy report that 66% of the banks would require additional indemnification, 44% would consider adjusting the loan-to-value ratio, and 60% would require personal liability, with the overwhelming majority indicating higher interest for loans on property contiguous to environmentally contaminated parcels.

In an important state judicial case, *Santa Fe versus Komis*, compensation to owners of property was deemed necessary to counteract property value losses resulting from negative public perceptions of shipping nuclear waste along a constructed bypass in Santa Fe County, New Mexico. The results of a recent public survey of Clark County residents show very similar public beliefs in property value declines when compared to the results of the Santa Fe survey used in the Komis case. For example, the survey found that fifty-nine percent of Santa Fe residents would "under no condition" purchase residential property near nuclear waste shipment routes. In the case of Clark County, that figure was 75%. Moreover, while 71% of Santa Fe residents believe that residential property would sell for less near shipment routes, compared to similar properties not located near the routes, 82% of Clark County residents indicated similar beliefs.

\When interviewed bankers and appraisers in Clark County indicated, that based on their experience, residential properties along nuclear waste routes would decline by an average of 5% in value without any transportation incidents, and over 20% under a severe accident event. The

same study of lenders and appraisers discovered that both commercial and industrial properties also were projected to decline in value but not to the degree expected in the residential sector.

The above studies are based on responses to future hypothetical scenarios, but there also is confirmation of property value effects from *actual* shipments of nuclear waste. In examining property value effects of transporting nuclear waste by rail in South Carolina, Gawande and Jenkins-Smith (1999) found the value of homes diminished by $840 for every mile closer to the rail line transporting the waste. Property value diminution as a result of shipping waste through Clark County is a compelling and serious impact area. The economy of the Las Vegas Valley under the severe accident scenario should anticipate serious negative consequences. The case for property value diminution is built on four research pillars: (1) analogous case experience shows diminution effects in home and land values as a result of risk perceptions of hazardous facilities; (2) case law demonstrating compensation of damages resulting from stigma; (3) surveys of residents demonstrating expectations of property value losses, and an unwillingness to purchase properties near routes used for shipping nuclear wastes; and (4) the losses in a case of actual shipments. In summary, serious property value effects near nuclear waste shipment routes in Clark County can be expected and may occur for a distance of up to 3 miles from routes used to transport nuclear waste.

4.3 Impacts on the Tourism Sector

While the tourism industry is the dominant economic sector in Clark County, and the State fueling economic development, it is also a very vulnerable sector. Tourism is most vulnerable to adverse impacts resulting from the high-level nuclear waste program in general, and in specific the transportation of nuclear waste through the County and State. In order to understand the ways tourism can be impacted, and the magnitude of these impacts on the County

and State economies, a number of studies have been undertaken by the State of Nevada and Clark County.

These studies have demonstrated the sensitivity of the tourism industry to changes in image, and that nuclear waste and its transportation evoke very strong negative images tied to health and safety risks. These images are known to influence tourist behavior, especially if alternative resort and convention destinations are available. Adverse publicity resulting from stigma-type events has had serious impacts on tourism in several places. Several events/mishaps involving nuclear facilities or accidental radioactive materials have had adverse effects on the local tourism industry.

In the late 1980s, two surveys discovered that the repository would have an adverse impact on the attraction of Nevada as a place to retire, raise a family, or vacation. Close to 50% of those surveyed in one study indicated that the location of the repository would affect their decisions to attend a convention in Nevada. A 1988 survey targeted convention planners concluded that even without an incident for ten years, 30% of convention planners would lower their ranking of Nevada as a place to hold conventions.

A 1993 survey of previous convention attendees indicated that the location of a nuclear waste repository within 100 miles would negatively affect decisions to attend a convention by 25% of the respondents. Studies also suggest that if Las Vegas becomes associated in the public's mind with a repository and the associated transportation of nuclear waste, that any negative incident could adversely influence tourism rates. Based on "no incident" scenarios, two studies concluded that the impacts to Las Vegas tourism still would be moderately to significantly adverse.

To date, none of the studies firmly establishes the specific magnitude of the adverse impacts that are likely to occur. However, the combination of studies using different methodologies, all indicate that adverse impacts to the tourism sector of the economy should be anticipated. This tourism sector is the dominant economic driver in Clark County. Hence, any repository-related impacts to this sector must be carefully considered when making decisions concerning whether to construct the repository, and/or the designation of transportation routes for the shipment of nuclear waste.

4.4 Impacts on Public Safety

One potential area of impact for Clark County from the proposed repository is in public safety (police, fire, and emergency medical services) and emergency management including planning and response. Studies in these areas have estimated resources needed for emergency management and public safety needs for state and local agencies. Some of these studies have provided cost estimates for needed training, planning, equipment, and other resources necessary to carry out public safety functions in the event the repository is sited at Yucca Mountain. DOE's DEIS explicitly identified one emergency management function (training) that needed to be strengthened. Preliminary data from an on-going assessment of public safety needs resulting from the siting of a repository and subsequent transportation of nuclear waste through Clark County indicates that serious capacity shortfalls exist in this area for most communities in Clark County.

One of the key areas in the public safety area that needs to be assessed, especially in the case of serious transportation incident involving nuclear waste, is the multi-jurisdictional and multilevel response capability. The demands on coordination and inter-jurisdictional response following any event is critical because an incident involving the release of radioactive material

will quickly overwhelm local jurisdictional resources. Research efforts to date, both at the State level and Clark County, demonstrate that neither is currently prepared for a serious high-level nuclear waste incident. In addition, the fiscal costs necessary to be able to adequately have confidence in the agencies providing public safety is very large.

The 1995 Public Safety Advisory Group study found that Clark County public safety personnel were not adequately trained for responding to transportation accidents involving nuclear materials. According to the 1995 study, training is needed in the following areas: response procedures, incident command, radiological monitoring, emergency medical procedures, use of communication systems, transportation safety, and practice, as well as evacuation, coordination and communication planning.

In addition to training needs, several other areas of public safety needs must be considered. These include emergency planning, response (including requisite equipment and facilities), impacts of re-routing and evacuation, communications, emergency medical services and decontamination facilities, and information management needs. Current studies sponsored by Clark County are in the process of estimating the cost of the necessary training, additional personnel, plans, and equipment and coordination exercises.

Several studies at the state level have identified public safety and emergency management needs. These are referenced in the Clark County (Yucca Mountain Nuclear Waste Repository Program B Baseline Information and Community Perspective on Potential Repository Impacts on Clark County, December 13, 1999) summary of impacts related to the Yucca Mountain program. In addition to the costs of emergency response planning, equipment/facilities requirements, and training, the area of information management has been found to be very important. Emergency management information systems at different levels of

government, and among local entities need to be compatible and comprehensive. Information management needs fall into the following areas: databases; geographical information systems (GIS); response tools (plume modeling capabilities, hazard zones, and evacuation information), training aids, planning and analysis tools and monitoring capabilities, coordination of data, exercising and information sharing.

4.5 Impacts on County and Local Fiscal Resources

Based on several State of Nevada studies and the on-going research on communities in Clark County, it is apparent that additional fiscal costs to government will result from the shipment of nuclear waste through Clark County and several of the local jurisdictions. Additional fiscal expenses to municipalities and Clark County governmental agencies will result from mandate-driven requirements for personnel, planning, monitoring, regulatory responses, and citizen participation and communications. These do not include the costs needed in the public safety areas identified above.

Fiscal costs fall into two categories, programmatic and procedural. Procedural requirements for many local governmental agencies will result from added reporting, monitoring of environmental and socioeconomic conditions, planning/evaluation, record-keeping, specialized services due to the nuclear waste disposal program, and public communications. The sources of such requirements will be local, county, and regional policy organizations, state advisory boards, local and state governmental/legislative entities, federal regulatory agencies, and congressional oversight activities among others. In 1995, one study concluded that 38 state government departments had already incurred fiscal costs associated with the repository. Programmatic costs can accrue to an agency as a result of a mandate or the mission of an agency and entail answers to the question of what should be done? For example, various air, water and

other permits may be necessary during the repository siting and operation that require local agency time and effort. Additionally, the County is a major actor in the planning and operation of the inner and outer beltways that may be deeply impacted by DOE's transportation plans.

4.6 Environmental Justice Impacts

Environmental justice concerns have been identified in the DOE's DEIS. However, a systematic analysis of environmental and socioeconomic impacts on lower income, minority, and Native American populations has not been undertaken. In Clark County, the health, environmental, socioeconomic, quality of life consequences and barriers to economic opportunities may *disproportionately affect* lower income areas and communities of color.

Such differential effects need to be examined and identified by group and or geographic area, and the nature of the impact measured. *All* potential impacts need to be addressed on the basis of inequitable distribution spatially, demographically, and by magnitude of risk. Previous studies have identified environmental justice issues that need to be addressed along the following factors in order to determine what impacts may exist:

- Are there existing areas, populations, cultures, currently experiencing disproportionately greater environmental and health risks, economic hardships, and other problems?
- To what extent are the current planning/program activities by DOE amplifying and exacerbating these problems?
- To what extent will the transportation of nuclear waste further deteriorate the quality of life and economic opportunities of already overburdened and vulnerable populations?

- What is the level of added/cumulative effects of vulnerable populations resulting from the nuclear waste program, and what are the consequences in terms of health impacts, loss of cultural resources, and economic hardships?
- What will be the short and long-term impacts of a nuclear waste transportation accident on an area, community, or population already experiencing inequities or vulnerabilities?
- What will be the costs of *preventing* further vulnerability and/or mitigating future adverse impacts?
- How can the nuclear waste program be utilized to redress existing and potential future problems of vulnerable communities in Clark County?

4.7 <u>4.7 Business and Economic Development Impacts</u>

On-going studies of municipalities in Clark County have encountered serious concerns regarding the potential impacts that nuclear waste transportation may have on economic development. The DOE's DEIS is inadequate in its treatment of this important impact area. Several studies point out the likely impact of transporting nuclear waste will have on the imagery of Las Vegas as a place to visit and recreate. In addition, the potentially negative impacts on the convention visitor economy resulting from these shipments have already been discussed above.

The impacts on business investment in Clark County resulting from the repository program are unclear because of the lack of systematic forecasts and studies of this sector to date. Several scenario-based studies targeting Clark County residents have found that a diminution of investments near transportation routes is likely. These scenario-based studies also suggest that out-migration rates from Southern Nevada may increase as a result of potential transportation mishaps. Another study focusing on possible property value changes, suggests financial

institutions will make likely adjustments to loan terms for firms wanting to locate in shipment corridors when the DOE program is under way. Hence, the presence of shipments may impact investment decisions in the commercial office distribution sectors along transportation corridors.

Concerns about development along or near potential shipment routes have been raised in terms of possible disruption of on-going development plans. The stigma associated these transportation corridors may result in property value losses and/or increased reluctance to invest or purchase homes near them (see above). Three factors require investigation: how the repository program will effect economic development decisions; the nature of any lost opportunity costs due to the repository (for example in diversification of the local economic base), and the likely economic consequences of a "reasonably foreseeable" transportation accident involving nuclear waste. To date, the DOE has refused to address this impact area.

One recent survey of Las Vegas businesses provides information on the perceived impacts that transportation of nuclear waste will have. Almost 54% of the businesses surveyed indicated that either moderate or significant adverse impacts on their business (or the economy in general) would result from even a non-incident transportation program involving nuclear waste. In this survey, the tourism and professional services industries responding expressed the highest levels of concern about adverse impacts on business. The concerns expressed by the business community in this survey are:

- Loss in business activity
- Stigma effects
- Negative publicity
- Decreased property values
- Decreased quality of life

- Health and safety concerns
- Increased out migration rate
- Group and individual discomfort

4.8 Cumulative Impacts from Transportation

Under NEPA (42 U.S.C. 4321, et. Seq.), cumulative impacts are identified as: the impact on the environment that results from the impact of the action when added to the other past, present and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. The DEIS inadequately approaches cumulative impacts of transporting nuclear waste because it has not delineated transportation routes. Without designated routes, it is impossible to determine the full range of impacts on transportation, transportation development, and air quality. Moreover, the "reasonably foreseeable future" criteria to measure cumulative impacts is not detailed in the DEIS. The impacts to Nevada from currently transporting hazardous materials, low-level radioactive waste, mixed wastes, requires attention to the risks of cumulative impacts. Moreover, possible cumulative impacts for unforeseen accident events on the local economy are an impact area that must be addressed in terms of cumulative impacts. Baseline equity considerations, accident rates on various routes, and economic plans along existing routes need to be evaluated from a cumulative impact perspective, in addition to individual approaches. Such analysis and discussion was absent from the DEIS, although it is warranted under the NEPA guidelines.

4.9 Quality of Life Impacts

Quality of life measures are important in evaluating impacts to a community in order to determine the direction, magnitude, and significance of community changes resulting from a program. The strength of a quality of life impact assessment is in part a result of the community

identifying those factors it considers vital for its well-being. Measures of these factors (indicators) can then be developed and monitored in terms of degree of change from a baseline condition or an established norm. Technically, these quality of life indicators can be either objective or subjective, and include, for example, the level of community satisfaction.

Lessening perceptions of their current and future quality of life by county residents due to the repository can result in behaviors that would be detrimental to the overall well being of the County. For example, if well-being declines it may result in reduced in-migration, increase out migration rates, declines in personal investments, and increased stress and worry over repository related risks by residents.

There is support from several studies that show that the transportation of nuclear waste through Clark County will diminish several quality of life measures including "satisfaction with life"; satisfaction with the community as a "place to live"; economic opportunities, and environmental quality. Although quality of life impacts are difficult to forecast, it will be necessary to identify the key measures that constitute quality of life; determine those that may be impacted by the repository program; monitor these measures; and quantify these changes resulting from the repository. At some point the County may develop mitigation programs to prevent quality of life deterioration and/or mitigate their impacts. It is vital to determine the specific areas of quality of life that are important to Clark County residents, as well as those that the repository program is especially capable of harming. Quality of life is an area of vulnerability that needs to be carefully and fully addressed in the impact assessment.

5.0 CLARK COUNTY PERSONNEL INTERVIEWS

On November 26 and 27, 2000, interviews were conducted with key Clark County personnel identified by the Nuclear Waste Division as having responsibilities for programs

within Clark County (Appendix B). As noted is Section 1.1.4, interviewees were asked to describe the mission of their departments; the types of data that they currently maintain to accomplish their normal responsibilities; the key standards or measures their department monitors; issues that they may confront as a result of the nuclear waste shipment program; and indicators that they consider important to monitor as a result of the DOE's proposal to construct the Yucca Mountain Repository and to ship HLW through Clark County. The interviewees were also asked to describe the type of data their departments would need to be able to attribute any impacts resulting from the DOE's proposed plans.

In general, the interviewees indicated that current data collection efforts focus on maintaining data that measures compliance with a broad array of existing federal environmental regulations. The interviewees also observed that for the most part, they believed that any special or new indicators that they would need to measure impacts from the DOE's proposed shipment campaign would be linked to an incident event rather than from routine shipments. This suggests that it is feasible to design a monitoring program that can efficiently build off of the existing data that is collected by Clark County personnel. This should facilitate the rapid development and deployment of a monitoring system. A summary of the interviews follows.

5.1 Current Planning

Major projects is responsible for facilitating the review of major development projects throughout Clark County from the beginning planning stages, through the zoning process and up through the permitting phase. Major projects are defined as those that are at least 700 acres. Currently, Major Projects is working on developments in Apex (21,000 acres), Summerlin Park (22,000 acres), South Highlands, Pinnacle Peak, and Rhodes Ranch. On average, 4 or 5 major development projects have been ongoing at all times over the last five years. Additionally, there

are generally 5 to 10 midsize projects (100 to 650 acres) ongoing at any one time. Staff from Major Projects indicated that they are aware of at least six major developments that are scheduled for the next decade. These include a 7,500-acre development in North Las Vegas; another development project in Summerlin; two others in the Valley; and two in the Prim/Jean area. They also noted that the Coyote Springs project on the Clark County/Lincoln County line near Alamo is designed to be a 22,000-acre self-contained community. These projects are viewed as critical due to the rapid growth of population in the Las Vegas area and the demand for housing; the fact that land for larger master planned communities is in short supply; and that some projects (North Las Vegas) are considered vital for the economic development of the community.

The staff indicated that the Las Vegas Chamber of Commerce produces the *Las Vegas Perspective* on an annual basis and that this document provides a good review of current and future development trends. The staff also noted that currently Clark County does not provide economic development incentives. They noted that if the DOE moved forward with the proposed shipment campaign that there might be a need for economic development incentives to stimulate the market in Clark County in the future. The projected need for incentives would be a consequence of buyer reluctance; issues of liability; and possible changes in loan adjustments.

Currently, the key indicator for development is the rate at which people move into the metropolitan area. For example, in 1989 the growth rate was 2,000 B 3,000 persons per month. By 1999, the rate increased to 4,000 persons per month. Other indicators of development trends are housing units built and occupied; housing mix by area; and housing starts.

Specific indicators that were suggested to monitor impacts from the DOE's proposed shipment campaign included:

- Monitoring the build out rates. Developers currently provide a schedule for build out during the planning process. If build out rates slow from those projected by the developer, it may be an indication that the DOE's shipment campaign is negatively effecting the market.
- Number of building permits as a measure of housing starts
- Number of home sales

They noted that during the last downturn in Clark County's economy that home sales dropped from 4,000 per month to 2,000 B 3,000 per month. Thus, the number of home sales provides a good barometer of the economic health of the building sector.

5.2 Community Planning

Community Planning is responsible for updating and maintaining Clark County's Land Use Plan. The staff interviewed indicated that Clark County would be completely built out over the next 20 years. Currently, development continues to focus on the fringe areas of the valley, for example, Blue Mountain. Infill development within the urban area is still limited but as the valley becomes built out, there will inevitably be changes in the type off land use in the urban area as residential areas transition to commercial and retail development.

Those interviewed indicated that to date they have not incorporated the DOE's proposed shipment campaign into their planning activities since no routes have been officially designated. However, all agreed that if there were an accident it would have a significant adverse impact on development activities. They also suggested that changes in the current land use resulting from the DOE's proposed shipment campaign could best be measured by tracking the following indicators:

- Number of land use applications;

- Zoning change requests; special use permits;
- Plan amendments;
- Building permits; and
- Variance requests.

While changes in the indicators suggested are expected to occur as the valley is built out, any dramatic shift, particularly, along the shipment corridors could be linked to the shipment campaign and should be monitored and evaluated.

5.3 Community Resources Management

The representative from Community Resources Management stated that adverse changes to a community as a result of a major project usually result from increases in population requiring additional homes, schools, and other community services. While there may be some additional demand for services resulting from the DOE's shipment campaign, Community Resource Management staff thought that any additional demand would be minimal given the rapid growth already occurring in the Valley. Instead, personnel indicated that the transportation of nuclear waste through Clark County is primarily a psychological issue and that if there was an accident during the shipment campaign that it would hurt tourism. This would have a devastating effect since in the 1980's the state increased taxes on gaming to offset a reduction in the property tax. From the perspective of Community Resources Management the key indicators to monitor in order to determine whether Clark County's economy is being damaged by the DOE's shipment of HLW through the area are the number of visitor days and building permits.

5.4 Finance

Clark County operating funds for governmental agencies (such as public works) are generated from two primary sources: intergovernmental revenues and property taxes.

Approximately 25% of the total tax revenue comes from property tax. The intergovernmental revenue flows from sales tax, motor vehicle privilege tax, cigarette tax, and other supplemental taxes. In 1997, these taxes were aggregated from five dedicated sources into a consolidated tax distribution formula.

According to personnel in the Finance Department, the DOE's proposal to construct the Yucca Mountain Repository and the related shipment campaign of HLW could result in adverse impacts on Clark County revenues. These adverse impacts would emanate from: losses in property values; declines in sales tax revenues from decreased spending rates and visitation days by tourists; declines in sales tax revenues from a slow down in building activity; and declines in intergovernmental revenue allocations due to economic changes.

5.5 County Assessors Office

A senior appraiser from the County Assessor's Office revealed that Clark County has already experienced property value diminution in the northern part of the valley for a one to two year period following the construction of a gas pipeline, as well as, in the area near the Pepcon explosion in Henderson. The appraiser acknowledged that these area have rebounded, but the rate at which an area rebounds is dependent on a number of factors making it difficult to predict what will happen if the DOE precedes with its plans to ship HLW through Clark County. Initially, there is likely to be some downturn, but if there are no incidents, then property values may rebound overtime. If there is an accident, however, the downturn in property values could be significant and long lasting, according to the interviewee.

The appraiser noted that a reduction in property values would adversely affect assessed valuation since the land component of the assessed value of a property is linked to market value. An earlier survey of Clark County lenders and appraisers indicates that a reduction in property

values in Clark County is likely even under a no incident scenario, if the DOE proceeds with the HLW shipment campaign (Conway et al 2000). He also noted that for the last several years that the assessed valuation has been going up but that when there is a downturn in the economy assessed value does decrease although there is a lag in time from when the property value declines to the time the Board of Equalization adjusts the assessed value. If there were a significant drop resulting from an accident event associated with the DOE's shipment campaign of SNF and HLNW then the Board of Equalization could reduce this lag time. Normally, however, the Board of Equalization tries to minimize fluctuations in assessed valuation. The link between property value diminution and assessed value is an indirect link. If there is a downturn in property values over time then assessed values will also decline most negatively affecting revenues for costs such as fire and police services, and schools.

The appraiser suggested that changes in property values over time, particularly, significant losses in property values is an indicator that assessed valuations will eventually be affected and in turn could adversely impact the level of fire and police services, and school funding. Additionally, the appraiser suggested that changes in the migration patterns within the Valley would be another excellent indicator that the transportation of HLW is adversely affecting the area.

5.6 Administrative Services: Emergency Management

The representative from Emergency Management noted that his agency is already being impacted by the DOE's proposed shipment campaign of HLW. In order to protect the public health and safety, training exercises have already begun to prepare for a potential incident event if the DOE proceeds with its proposed shipment campaign of HLW through Clark County. In order to prepare for any incident event, Emergency Management will need to add equipment,

personnel, and training to respond to all four stages of an event; mitigation, preparedness, response, and recovery planning. This will have significant a budgetary impact on the department.

Preparing for an incident event requires coordination between the Highway Patrol, Public Works, Department of Transportation, Police, Fire, and Finance as well as others. The Emergency Management representative stated that since preparedness planning already has begun that it is important to begin to establish a baseline measurement of current service levels and to begin monitoring the number of personnel; additional training (needs); and equipment that will be required to adequately protect the public health and safety.

5.7 Environmental Planning Division

The Environmental Planning Division is primarily responsible for Clean Air Act Planning and the development of the State Implementation Plan (SIP). The representative from the Environmental Planning Division noted that Clark County has a non-attainment status for CO, ozone, and particulates< 10 microns. Significant efforts have been made to improve air quality but that growth in the Valley and the proposed stricter standards for particulates continues to be a challenge for the County. Based on the number of truck shipments proposed in the DEIS, the representative interviewed did not expect that the DOE's proposed shipment campaign of HLW would have a significant impact on air quality relative to CO, ozone, and particulates. Because of the rapid growth in the Valley, however, there is increasing congestion problem that raises the potential for excessive exposure to radiation for those who might be caught in traffic next to a truck carrying HLW.

The representative suggested that adherence with the Clean Air Act (CAA) and its amendments would be appropriate indicators to monitor to ensure that the DOE's proposed

shipment campaign doe not adversely affect air quality along the transportation routes. In addition, a program to inspect the trucks for radiation levels would be important to protect the public's health and safety, as well as, monitoring for compliance with the USEPA's radiation standards.

5.8 Natural Resources

Two representatives from Natural Resource Planning discussed potential impacts in the areas of water quality, solid waste, conservation, and endangered species. One of the representatives indicated that there would likely be minimal impact from the DOE's proposal to ship HLW through Clark County on the areas water quality short of a major accident event resulting in a cask being dropped directly into the water supply. This representative considered that outcome unlikely and indicated that the primary issue is *"public perception."* This person noted that the transportation of HLW would require changes in the County's Contingency Plan. Appropriate indicators that currently are measured and should continue to be measured to ensure that there are no adverse effects to water quality are compliance with regulatory standards, especially the Clean Water Act (CWA).

The other Natural Resource representative indicated that the transportation routes might adversely affect the habitat for the 80 species that are now monitored under the Endangered Species Act (ESA) within Clark County. Continued compliance with the ESA would be a good indicator that the shipment campaign is not negatively impacting the habitat for endangered species.

Table 1 provides a summary of the indicators recommended by Clark County personnel during the interviews.

TABLE 1
SUMMARY OF INDICATORS FOR MONITORING FROM INTERVIEWS WITH CLARK COUNTY PERSONNEL

Division	Recommended Impact Indicators for Monitoring
Major Projects	Number of building permits Occupancy rates Number of home sales Build-out rates for development projects
Community Planning	Number of land development applications Zoning change requests Special use permits Plan amendments Building permits Corridor versus general valley statistics
Community Resources Management	Tourist visitor days Convention trade attendees Building permits
County Assessors Office	Property value changes over time Changes in migration patterns Absorption rates of planned communities
Emergency Management	Capacity evaluations for the four areas in emergency management - Mitigation - Preparedness - Response - Recovery
Environmental Planning Division	Continued monitoring of Clean Air Act pollutants NPDES and SWDA compliance for water quality Endangered Species Act continued monitoring Inspection of trucks for radiation levels

6.0 PRELIMINARY INDICATORS IDENTIFIED FOR MONITORING

The preliminary set of indicators suggested for monitoring are primarily derived from existing federal legislation and are in response to the impacts that have been previously identified by Clark County residents, Clark County public officials, and the State of Nevada in studies and comments to the DEIS, as well as, those suggested during interviews with key Clark County personnel. These include an array of impacts that can be grouped into three categories; economic concerns, environmental protection, and community well-being. For purposes of this report, the discussion of suggested indicators will be grouped according to these impact areas. These impact areas also fall within the framework that has been recognized as appropriate for mitigation under the NEPA and Section 175 of the NWPA as discussed above.

6.1 Economic Impacts and Indicators

Economic impacts can be aggregated into four general areas: economic development; economic diversification; tourism and convention trade; and property values (Table 2). Continued economic growth and increasing expansion of Clark County's economic base is one of the primary impact concerns that have been identified repeatedly by the public and government officials. The concern for the economic well being of Clark County residents needs also be monitored at the level of the family. This will require monitoring demographic growth and rate of change in income levels among the various demographic groups within Clark County to ensure that the proposed shipment campaign does not unduly burden one or more groups within the community.

TABLE 2
SUMMARY OF ECONOMIC INDICATORS RECOMMENDED FOR MONITORING

Impact Areas	Recommended Impact Indicators for Monitoring
Economic Development	Income Levels Number of Business by Sector Building Permits Demographic and Employment Growth Tax Revenues
Economic Diversification	Economic Base Statistics New Growth by Sector Business by Type and Size Corridor Land Use Changes
Tourism and Convention Trade	Visitor Days Occupancy Rates Gaming Revenues Average Daily Visitor Expenditure
Property Values	Corridor Land Use Changes Average Home Prices Assessed Valuation Property sales/rental rates per square foot

Indicators that can monitor ***economic development*** include: income levels; number of business by sector; number of building permits; demographics and employment growth; and tax revenues by type.

As communities grow, ***economic diversification*** is also an important consideration since it contributes to economic stability. Indicators that have been identified for measuring economic diversification include: economic base statistics; new growth by sector; business by types and size; and land use changes along the transportation routes.

Of particular concern has been protection of the ***tourism industry***, which is the primary economic engine for Clark County, as well as, the State of Nevada. Previous studies have indicated that this sector of the economy may be particularly vulnerable as a result of the DOE's proposed shipment campaign of radioactive wastes through Clark County. These studies indicate that tourists may decide to spend their discretionary vacation dollars elsewhere, particularly, if an incident was to occur with the shipment of radioactive waste. Indicators to measure potential impacts to this vital part of Clark County's economy include: average visitor days; occupancy rates; number of convention visitors; average daily visitor expenditures; and gaming revenues.

Property values are another area of significant concern. A study in South Carolina found that the transportation of spent nuclear fuel in an urban area could result in property value diminutia (Gawande and Jenkins-Smith 1999). Additionally, there are numerous court cases that have found that when the perception of risk from a disamenity results in stigma induced property value diminution, that parties can be found responsible for this loss. In fact, in New Mexico, the State was found liable for the loss of value of a property that was adjacent to land used for the shipment of radioactive waste, even though it was the DOE who was responsible for the shipment of the waste. Given these facts, it is critical that at a minimum the following indicators be monitored: land use changes along the proposed transportation routes; average home price; assessed valuation; and rental rates or sales costs per square foot for commercial and industrial property.

6.2 Environmental Impact Areas and Indicators

Many of the environmental indicators that are being suggested to monitor impacts from the DOE's proposal to construct the Yucca Mountain Repository and to ship HLW through Clark County are based on standards codified within Federal and State law (Table 3). For example, *air quality* and *visibility* is currently monitored under the CAA and CAAA (42 USC ' 7401 et seq.) for compliance with ***National Ambient Air Quality Standards*** (NAAQS) and under ***Nevada Revised Statutes: Air Emissions Controls, Chapter 445B***. Currently, Nevada is in a non-attainment status with NAAQS requirements. Under existing NAAQS requirements, any additional decrease in air quality resulting from the proposed shipment campaign could limit economic development projects including the construction of new highways and the expansion of existing transportation corridors. Thus, monitoring for compliance with NAAQSs is a critical indicator.

TABLE 3
SUMMARY OF ENVIRONMENTAL INDICATORS RECOMMENDED FOR MONITORING

Impact Areas	Recommended Impact Indicators for Monitoring
Air Quality	CO, Ozone, Pariculates
Water Quality	Drinking Water Quality
Wetlands	Changes in Size/Quality of Wetlands
Noise	Noise Levels
Energy	Amount and Type of Energy Use per 1,000
Transportation	Vehicle Miles Traveled per Day Interstate Pavement Quality Motor Vehicle Accident Rates
Environmental Quality	Perception of Environmentl Quality
Waste	Radiation Levels Number of HLW Trucks Number of LLW Trucks Number of Toxic Waste Trucks Number of Hazmat Incidents
Biodiversity	Size and Quality of Habitat Species Mix and Population

Similarly, monitoring of the *water supply and water quality* for compliance with the ***Safe Drinking Water Act*** (SDWA) (42 USC ' 300 (f) et seq.); the ***Clean Water Act of 1977***, as

amended (CWA)(33 USC ‘ 1251 et Seq.); ***Nevada Revised Statutes: Water Controls 445A*** and ***Underground Water and Wells, Chapter 534***; as well as***, Executive Order 11990, Protection of Wetlands*** and ***Executive Order 11988 Floodplain Management*** and compliance with ***Floodplains/Wetlands Environmental Review Requirements*** (10 CFR Part 1022) are valuable environmental indicators.

Indicators that can be used to measure changes in *noise* levels as the result of the truck shipments of SNF and HLNW through Clark County can be monitored through compliance with standards in the ***Noise Control Act of 1972***, as amended (42 USC ‘ 4901 et seq.). Measuring the amounts and types of *energy* used per 1,000 population can monitor energy use. Additionally, monitoring the number of *vehicles miles traveled* per day can be used as an indicator to measure whether energy use, air quality, and congestion levels. Motor vehicle *accident rates* and *Interstate pavement quality* in selected areas where waste is transported are also measures of whether the transportation of radioactive waste through Clark County is being adversely impacted as a result of the DOE’s shipment campaign.

Of primary concern to Clark County is the protection of the *public’s health and safety*. A number of federal and State laws provide standards that can be effectively used as indicators for protecting the public’s health and safety. These include the ***Hazardous Materials Transportation Act*** (49 USC ‘ 1801); ***Emergency Planning and Community Right to Know Act of 1986*** (42 USC ‘ 1001 et seq.); ***Nevada Revised Statutes: Hazardous Materials, Chapter 459***; ***Nuclear Regulatory Commission Radioactive Materials Packaging and Transportation Regulations*** (10 CRF Parts 71 and 73); Department of Transportation ***Hazardous Materials Packaging and Transportation Regulations*** (49 CRF Subchapter C B Hazardous Materials Regulations, Parts 171 through 180); ***Pollution Prevention Act of 1990*** (42 USC ‘ 13101 et seq.); ***Comprehensive,***

Environmental Response, Compensation, and Liability Act, as amended (42 USC ‘ 9601 et seq.); ***Standards for Protection Against Radiation*** (10 CFR Part 20); ***Resource Conservation and Recovery Act***, as amended (42 USC ‘ 6901 et seq.); ***Executive Order 12088, Federal Compliance with Pollution Control Standards***; ***Executive Order 12856, Right to Know Laws and Pollution Prevention Requirements*** and the ***Nevada Revised Statutes: Sanitation, Chapter 444***. Additionally, the number of trucks transporting SNF, HLNW, LLRW, and other hazardous waste through Clark County should be monitored to assess cumulative impacts.

Biological diversity can also be monitored through measuring the *species mix*, *population levels*, and *changes in habitat acreage*, as well as, by using the standards in Federal and State law as indicators. The Federal and State laws that probed standards that can be used as indicators of biological diversity include the ***Endangered Species Act,*** as amended (16 USC ‘ 1531 et seq.); ***Fish and Wildlife Coordination Act***, as amended (16 USC ‘ 661, 48 Stat. 401); ***Nevada Revised Statutes: Protection and Preservation of Timbered lands, Trees, and Flora, Chapter 527***; ***Nevada Revised Statutes: Hunting, Fishing, and Trapping: Miscellaneous Protective Measures, Chapter 503***; and ***Executive Order 13112, Invasive Species***.

6.3 Community Well-Being Impacts and Indicators

Indicators measuring community well-being can include both “objective” indicators about community conditions such as pupil-teacher ratios and “subjective” indictors, such as “satisfaction with the quality of life.” Both types of community well-being indicators are important measures and are included as suggested indicators (Table 4).

TABLE 4 SUMMARY OF COMMUNITY WELL-BEING INDICATORS RECOMMENDED FOR MONITORING	
Impact Area	**Suggested Indicator**
Environmental Equity	Socio-demographic distribution of population Income distribution Spatial population distribution Distribution of costs and benefits by group
Governmental Fiscal	Tax revenues to Local jurisdictions Number and conditions of schools Pupil teacher ratio
Public Safety	Police per 1,000 population Police facilities and equipment Hospital beds per 1,000 Number of hospital facilities by type Number of hazmat personnel Level of hazmat training by type Hazmat facilities and equipment Number and type of radiation detection equipment Number and type of decontamination equipment Firefighters per 1,000 population Fire facilities and equipment.
Quality of Life	Family income levels Employment rates Satisfaction with quality of life Satisfaction with level of governmental services Level of Concern over public health and safety

Environmental equity refers to evaluating whether the DOE's proposal to construct the Yucca Mountain Repository and the related shipment campaign of HLW results in an unfair distribution of impacts on communities of color, the low income, the elderly, and children. This can be monitored through tracking changes in the *demographic mix* along the transportation corridor to assess for compliance with ***Executive Order 12898, Environmental Justice.*** One population within Clark County that may be particularly impacted is Native Americans. Several pieces of Federal legislation provide effective standards that can be used as indicators to measure potential impacts on Clark County's Native American population. These include the standards within the following legislation: ***Archeological Resources Protection Act***, as amended (16 USC 470aa et seq.); ***American Indian Religious Freedom Act of 1978*** (42 USC 1996); ***Native American Graves Protection and Repatriation Act of 1990*** (25 USC 3001); ***Antiquities Act*** (16

USC 431 et seq.); ***Executive Order 13007, Indian Sacred Sites***; and ***Executive Order 13094, Consultation and Coordination with Indian Tribal Governments***.

The **fiscal soundness of government services** is another area that could be affected, particularly, in the case of an accident event that results in property value diminution and subsequent loss of tax revenues. Public services that may be impacted if tax revenues decline as a result of stigma-induced property value diminution include the quality of Clark County schools. Indicators that can be monitored to provide an early warning of such impacts include:

- Change in tax revenues
- Pupil teacher ratio
- Number and conditions of schools

In addition, service levels for a variety of government services designed to protect the ***public health and safety*** should be monitored as indicators of community well-being. Among the levels of government services that can be used as indicators are:

- Police per 1,000 population
- Police facilities and equipment
- Hospital beds per 1,000
- Number of hospital facilities by type
- Number of hazmat personnel
- Level of hazmat training by type
- Hazmat facilities and equipment
- Number and type of radiation detection equipment
- Number and type of decontamination equipment
- Firefighters per 1,000 population, and

- Fire facilities and equipment.

Additionally, changes in income levels and employment rates can be used as indicators of how the DOE's proposed shipment campaign is impacting the ***quality of life*** of Clark County residents. Satisfaction with the quality of life in the area and the level of concern about the health and safety risks associated with the DOE's proposal to construct the Yucca Mountain Repository and the related shipment campaign of HLW are other measures that can be evaluated.

While changes in the indicators suggested may not be attributable to the DOE's proposal to construct the Yucca Mountain Repository and the related shipment of HLW, they can be effective as an early warning that changes are occurring that require additional investigation. In the next section of this report, the next steps that should be considered to build a monitoring program, including the design of a model to differentiate changes in indicators that are attributable to the DOE's shipment campaign from those that may occur because of organic growth within Clark County will be discussed.

7.0 DISCUSSION

Our preliminary analysis indicates that the range of potential impacts to Clark County resulting from the DOE's proposal to construct the Yucca Mountain Repository and to ship HLW to Yucca Mountain is broad and the possible magnitude is substantial. Adding to the complexity posed by the broad range and substantial magnitude of impacts that may be experienced, is the uncertainty and unpredictability associated with the DOE's plans. For example, to date neither the routes nor the mode of transportation has been specified. Further, the DOE has provided only cursory information about how it intends to manage the full array of impacts that are likely to be experienced by Clark County and its residents because of the DOE's shipment campaign.

It is within this uncertain and unpredictable environment that Clark County is challenged to design and build a monitoring program that can effectively and efficiently measure any adverse impacts resulting from the DOE's activities. Thus, it is vital that the monitoring program design be flexible, dynamic, and responsive to accommodate new information as it is ascertained. Toward this end, the preliminary indicators that have been identified within this report are based largely on impact indicators that have been legally recognized for mitigation purposes; through the extensive literature on sustainable indicators that have developed over the last decade; by earlier studies that have identified potential impact areas; and through preliminary interviews with Clark County governmental personnel. It is expected that these indicators will be refined in an iterative fashion over time as additional studies such as the recently begun Governmental Fiscal Impact Study and Public Safety Impact Study are completed as well as any additional studies and as the new information from the DOE evolves.

Our initial efforts indicate that Clark County governmental personnel in the normal administration of their duties already gather much valuable data but that their data collection activities are very fragmented and uneven. Further, some of the data that will be vital to an ongoing monitoring effort is either not collected or it is maintained by non-governmental entities. The current data collection efforts cannot meet the critical challenge faced by Clark County to provide an ongoing monitoring program that can provide an early warning system for decisionmakers to alert them to any adverse impacts to the economy, environment, or community well-being resulting from the DOE's proposal to construct the Yucca Mountain Repository and the related shipment campaign of HLW.

Thus, the next step in the development of a monitoring program is to: refine the indicators in consultation with Clark County's Nuclear Waste Division; inventory, define, and

characterize the sources, reliability, and frequency of currently available data; evaluate all data sources and identify gaps; and then design a centralized system for collating, analyzing, and maintaining the data, as well as, for reporting the data to Clark County decisionmakers and residents. Subsequent phases will include working with Clark County decision makers to establish a process for assessing which impacts are attributable to the DOE's proposal to construct the Yucca Mountain Repository and the related shipment campaign of HLW.

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APPENDIX A

Clark County Personnel Interviewed

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Department of Comprehensive Planning - Environmental Planning Division
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APPENDIX B

Laws, Regulations, Statutes, and Orders Governing the Proposed Yucca Mountain Repository

- Clean Air Act, as amended (42 USC 7401 et seq.)
- Nevada Revised Statutes: Air Emission Controls, Chapter 445B
- Safe Drinking Water Act, as amended (42 USC 300(f) et seq.)
- Clean Water Act of 1977, as amended (33 USC 1251 et seq.)
- Nevada Revised Statutes: Water Controls, Chapter 445A
- Nevada Revised Statutes: Underground Water and Wells, Chapter 534
- Executive Order 11988 Floodplain Management
- Compliance with Floodplains/Wetlands Environmental Review Requirements (10 CFR Part 1022).
- Hazardous Materials Transportation Act (49 USC 1801)
- Emergency Planning and Community Right-to-Know Act of 9866 (42 USC 1001 et seq.)
- Nevada Revised Statutes: Hazardous Materials, Chapter 459
- Nuclear Regulatory Commission Radioactive Materials Packaging and Transportation Regulations (10 CRF Parts 71 and 73) Department of Transportation hazardous Materials Packaging and Transportation Regulations 49 CRF Subchapter C B Hazardous Materials Regulations, Parts 171 through 180)
- Pollution Prevention Act of 1990 (42 USC 13101 et seq.)
- Comprehensive, Environmental Response, Compensation, and Liability Act, as amended (42 USC 9601 et seq.)
- Standards for Protection Against Radiation (10 CFR Part 20)
- Resource Conservation and Recovery Act, as amended (42 USC 6901 et seq.)
- Noise Control ct of 1972, as amended (42 USC 4901 et seq.)
- Nevada Revised Statutes: Sanitation, Chapter 444
- Executive Order 12088, Federal Compliance with Pollution Control Standards
- Executive Order 12856, Right to Know Laws and Pollution Prevention Requirements
- National Historic Preservation Act, as amended (16 USC 470 et seq.)
- Archeological Resources Protection Act, as amended (16 USC 470aa et seq.)
- American Indian Religious Freedom Act of 1978 (42 USC 1996)
- Native American Graves Protection and Repatriation Act of 1990 (25 USC 3001)
- Antiquities Act (16 USC 431 et seq.)
- Executive Order 11593, National Historic Preservation
- Executive Order 13007, Indian Sacred Sites
- Executive Order 13094, Consultation and Coordination with Indian Tribal Governments
- Executive Order 12898, Environmental Justice
- Endangered Species Act, as amended (16 USC 1531 et seq.)
- Fish and Wildlife Coordination Act, as amended (16 USC 661, 48 Stat. 401)
- Migratory Bird Treaty Act, as amended (16 USC 703 et seq.)
- Bald and Golden Eagle Protection Act, as amended (16 USC 668-668d)
- Nevada Revised Statutes: Protection and Preservation of Timbered lands, Trees, and Flora, Chapter 527
- Nevada Revised Statutes: Hunting, Fishing, and Trapping: Miscellaneous Protective Measures, Chapter 503; Nevada Administrative Code: Sections 010 B 1-4
- Executive Order 11990, Protection of Wetlands
- Executive Order 13112, Invasive Species
- Rivers and Harbors Act (33 USC 301 et seq.)
- National Forest Organic Administrative Act (16 USC 521)

- Materials Act of 1947 (30 USC 601 B 603)
- Taylor Grazing Act (43 USC 315 B 316)
- Farmland Protection Policy Act (7 USC 4201 et seq.)

Attachment 12

UER “Community visioning report on behalf of the town of Indian Springs, Clark County, Nevada” (Feb 2004)

Community Visioning Report on behalf of The Town of Indian Springs Clark County, Nevada

January 2004

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INTRODUCTION

During the course of the Indian Springs Town Advisory Board meeting in August 2000, board members shared a general sense of frustration over the lack of community direction. At that time the community was faced with a number of challenges, and the Town Advisory Board did not have a clear vision of what the community wanted to be. Clark County staff suggested the community might benefit from a formal visioning and strategic planning process, similar to one that was underway in Moapa Valley.

At the September 2000 Town Advisory Board meeting, staff presented an overview of visioning and strategic planning. At the core of the process was to identify what the community envisioned for its future. Staff indicated that the Department of Administrative Services had a strategic plan, and one of the components was assisting rural communities in just such an exercise.

In December 2000, staff provided a presentation to the Town Advisory Board on the subject of community visioning and strategic planning efforts with a focus on the accomplishments and challenges that had been identified. She also discussed the role of the Town Advisory Board in the community planning process.

In January 2001, staff participated in a three-day community development training program that provided techniques for successful community visioning and strategic planning. Based on staff's advice, the Indian Springs Town Advisory Board voted unanimously to recommend Clark County offer a visioning and strategic planning exercise in their community.

During a February 20, 2003 meeting, staff discussed the proposed visioning and strategic planning exercise and the challenge of the facilitation process. Staff discussed alternatives for providing resources for the project, and decided to use existing contract services with the required experience. The outline of a plan was formulated with the assistance of the contractor to assist the Indian Springs community with the visioning and strategic planning process.

In April 2003 at the Town Advisory Board meeting staff advised that the County resources were now in place and ready to move forward. Final agreement was subsequently reached with the Indian Springs Town Advisory Board to meet with the appropriate County staff and consultants to discuss in detail the full scope of the program.

A six-month process was designed that would include four, two-hour visioning sessions involving the Town Advisory Board and all interested residents of Indian Springs. The planning discussions included initiating an extensive community outreach effort to encourage public participation. The community outreach efforts would extend to include County staff discussions with various community leaders and a meeting with local public school administrators to solicit student/teacher support for the project.

A joint consultant/staff team was designated as follows:

- Sheila Conway, Urban Environmental Research, LLC
- Cindy Gates, Graphic Artist
- Babs McGehee, Management Analyst II
- Erik Muller, Public Information Officer
- Chris Munhall, Rural Towns Liaison, Clark County
- Irene Navis, Planning Manager

- George Ormiston, Urban Environmental Research, LLC, Facilitator

UER was designated to lead the program implementation process and to facilitate conduct of the program. In the following months, several UER staff members and consultants contributed to the original program design.

In summary, the defining approach for implementation was that the community visioning process would rely on Indian Springs community leaders and volunteers to deliberate and agree on a compelling community vision. Then those leaders would share the vision with others, both inside and outside the community, and sustain the vision over time.

METHODOLOGY

Prior to implementation of the program a variety of instructional materials related to the community visioning process were reviewed. As most of the County staff and consultants had extensive experience in visioning related exercises, a variety of published materials and plans were reviewed and integrated into the ultimate presentation approach at the discretion of the Team members.

In this regard, substantial reliance was placed on the "Community Visioning and Charting" work of Pennsylvania State University's College of Agricultural Sciences as well as the "Mapping the Future of Your Community" which was developed by the Illinois Institute for Rural Affairs.

The initial mission statement for the Team effort was set forth and described as follows:

> *"The principal intent of the project is to inform and educate the participants regarding community planning and related quality of life*

issues. Thus, community leaders will be better prepared to plan and decide growth or development questions as they may arise in the future."

The final pre-planning discussion with the Indian Springs Town Advisory Board included ratification of the proposed program outline as follows:

- Agreement as to program emphasis and approach to be utilized.
- Preparation of a project milestone chart and implementation schedule (Appendix II).
- Format for the community notification and outreach process:
  - Targeting process for community leaders
  - General public notices
  - Notification letters
  - Design of flyers
  - Posting process / locations
  - Local address mailing lists
- Determination of who prepares content of public notices, location, and logistics.
- The initial two-hour visioning session to be conducted at the Indian Springs Community Center on October 23 at 7:30 p.m. The three additional sessions were set for the same time on the evenings of November 6, November 20, and December 4, 2003.
- Staff to meet with community leaders and personally discuss the project and potential value to Indian Springs.

- Staff to prepare a summary report of meeting conclusions for review at each subsequent session.
- Second session and succeeding agendas to be modified as necessary based on community input and experience.
- Additional notices of succeeding sessions to be mailed prior to each meeting.
- Fourth session to be modified based on prior session experience and conclusions.
- A Program Report to be prepared.
- Upon receiving Team concurrence on the final report, print and distribute to Indian Springs Town Advisory Board.
- Clark County to continue work with the Town Advisory Board on a community indicator measurement and analysis process as part of the long term Visioning process.

PUBLIC INFORMATION PROCESS

Early in the program planning discussions it was agreed an aggressive community awareness/outreach effort was critical to the success of the project. As a result, several public information tools were distributed (Appendix V) and used by the community, including:

- Coloring contest for local children in which they depicted what Indian Springs should look like;
- Tee shirt promotion upon which the winner's drawing was lithographed on the shirts and distributed to residents;

- Posters, flyers and mailers sent to residents and posted in the Indian Springs area advising dates and times of meetings;
- Meeting notes were placed on the Clark County Comprehensive Planning website; and
- Suggestion box was placed in the Indian Springs Library

MODEL FOR REPLICATION / PROGRAM CONTENT

Session 1 – "Setting the Course"

This Session began with a PowerPoint overview presentation (see Appendix I) of the strategic planning visioning process and proposed the basic ground rules for participation and discussion.

An open "Town Hall" type of meeting format was utilized. An overview of the process was provided to the audience as follows:

- The final vision narrative of priorities are to be built through careful dialogue and thought, which incorporates the varied perspectives within the community.
- Vision narrative will be drafted based upon a consensus understanding of current conditions during Session 3.
- A draft final vision statement for Indian Springs will be compiled during the implementation of Session 4.
- The final vision statement will need follow-through and nurturing, which includes a necessary action plan for achieving the agreed vision.

The facilitators led the discussion as commentary was solicited or evolved from the audience, including a facilitated discussion of community strengths. Questions included:

- What do you like best about Indian Springs?

- What might others perceive as advantageous to:
  - Families?
  - Elderly?
  - Businesses?
- A list was created as the session progressed
- Summary review of session by facilitators
- Overview of anticipated Session 2 process

Session 2 – "Where We Are"

This session was designed to help residents look at what may be their challenges to improving the quality of life for the residents in their community. It also helped examine the forces that might affect the community's choices in the future. Questions and observations included:

- Who are we? (Community demographics).
- Where do we work?
- How is our population changing?
- What skills, talents, and resources do we have in our community?
- What do we like about our community?
- What do the family income numbers tell you?

Other Issues and Facilitators Questions Included:

- What have been our major accomplishments over the past five years? What action can we take to leverage these accomplishments?
- What have been our major challenges over the last five years?

- What are the major external forces – [*economic, political, regulatory, market, demographic, and competitive]* – that will affect us over the next five to ten years?
- Given the above discussion, what are the major opportunities that lie before us in the next five to ten years? What can we do to capitalize on these opportunities?
- What are the major threats or risks to our continued quality of life over the next five to ten years? What can we do to resolve them or contain their impact?
- The answers to these and many other facilitated questions formed the basis upon which the ultimate decisions about Indian Springs' future could be made.

The open discussion addressed a variety of family and children, employment, and local governance issues. Cultural and environmental issues were also discussed and an inventory of current "assets" in the community was developed.

Session 3 – "Where We Want To Be"

After taking a realistic look at the community in Session 2, this session specifically focused on the issue of what the participants want the community to achieve and how they want the community to be described or portrayed in the future.

The steps utilized for determining "Where You Want Your Community To Be" were as follows:

- The PowerPoint visioning diagrams were reviewed.
- The goals for improving the quality of life and what residents would specifically like to see included in the community vision were listed.

- The facilitators created a rough draft of a vision statement and goals were listed.
- Open discussion of the draft statement and additional draft text revisions were again made based on consensus of the participants.

This session then proceeded with the group developing a set of tentative priorities and goals designed to improve the community's future quality of life.

Session 4 – "Making the Trip"

Clark County Commissioner Chip Maxwell opened the session and provided various salient comments regarding the importance of community visioning, volunteerism, and goal setting. The Commissioner congratulated the assembled residents on their success to date.

The facilitated session proceeded as follows:

- It was reiterated, the community visioning concept is based upon a proven process designed to help communities plan for and control their future. Facilitators then solicited a broad diversity of viewpoints to finalize a consensus vision for the future.
- The four specific thematic areas for action were set forth and discussed.
- During the course of the session the participants utilized and prioritized the various community goals and initiatives through an interactive discussion and vote on the (subcategories) as grouped into the four themes identified in Session 3.
- During a 15-minute break the group participated in voting to prioritize each goal.

Following the break and vote, it was emphasized a plan of action will have to be implemented by the Town Advisory Board. It was noted the ultimate implementation plan will need to include a timeline and a consensus determination as to who will take responsibility for the various implementation steps.

The previously discussed draft Vision Statement was reviewed, amended and then deemed approved by consensus of the participants. The final session was concluded with open comments about the process by the participants and each Town Advisory Board member.

This session then concentrated on helping move the community toward fulfilling the goals and draft vision through identifying and outlining specific community-level projects.

Follow up

In the course of the following year, staff committed to continue to support the community's efforts with information, education, and technical assistance as may be available.

RESULTS AND CONCLUSIONS

The Vision Statement (desired description of the future in Indian Springs) was ratified as follows:

> ***"Indian Springs provides a clean, safe, healthy and sustainable environment for residents of all ages. We are recognized and respected for our unique rural character and place in Clark County. We provide a diverse, viable, attractive alternative to the urban lifestyle of Las Vegas. Through effective planning, education, partnerships and volunteerism,***

we provide a place for all to live, learn, play, work and contribute now, and for generations to come."

Indian Springs Priorities are enumerated in Appendix III.

Conclusions

The resident participation helped to build a much improved overview and understanding of the total Indian Springs community. Ideas and concepts regarding growth and quality of life were identified and/or clarified. Priorities for community action were achieved through a community discussion process. Both constraints and opportunities open to residents were made self-evident. Town Advisory Board members were given a much improved perspective of citizen needs and wants.

FOLLOW-UP STEPS AND IMPLEMENTATION PLAN

Upon examination it will become apparent that the process to achieve the priorities will require various degrees of effort through a broad range of community, county, state, and federal entities.

Key Town Advisory Board responsibilities will include the following:

- Maintain continuing public involvement
- Convene as necessary strategic plan review and amendment process
- Prepare annual progress reports

Proactive visioning-related efforts by the Town Advisory Board involve the following steps:

- Determination of what action steps need to be initiated to accomplish priorities.

- Completion of each action step by identifying "Who in the Community Will Do It?" and "By When?"
- List the names of individuals and organizations outside the community that can help achieve the project.
- As the year progresses, the action team members are expected to use this information to meet independently and recruit additional townspeople to help with the project and secure appropriate resources.

Also, many of the priorities may only take a few months to achieve (short term). Others will have an intermediate term of 12-18 months. Long term will involve two plus years and will be an on-going activity for the Town Advisory Board to support. Key individuals and organizations in the community will need to participate in the development and implementation of the "Community Action Plan" to ensure its success.

It is recommended that implementation teams comprised of members of the community be formed to accomplish the priorities listed in the action plan and to monitor progress of the team. A sample plan format is included in Appendix III.

After the initial enthusiasm of developing a community vision and action plans, many communities find it difficult to maintain continued public interest and involvement. This drop-off is normal. Over the long term, the potential benefits of the visioning program will be greatly diminished if the action plan devolves to participation by a small number of people. A strategy should be developed to regularly promote the vision and action plans to the entire community in order to keep people involved.

Strategic Vision and Action Review and Amendment

How and when will the community review its strategic vision and action plans? The community team will find unexpected circumstances and thus a need to scan the environment for both shortfalls and opportunities. The review team should include some of the people that developed the plans as well as other members of the public. A successful strategy used in many communities is to solicit public commitment at a special town meeting to explain the status of the process. Some communities have sponsored abbreviated "Visioning Update Programs" as a technique to review and amend the strategic vision.

Interim Review

Did people complete their tasks on time and within budget? Are partnerships succeeding? A process review helps answer questions such as "What changes are needed in how we are carrying out our plan?" and "How can we do it better?" A process evaluation at the end of the first year is important to maintaining momentum and direction.

As the action plan is being implemented, it is important to have constant communications with the public and agencies that have provided resources to the community. It is easy to forget to tell everyone what you are doing when you are so busy doing the work. However, the individuals and agencies that support the visioning program need to know that their time and money are being well spent. Progress reports to the public and other partners will help maintain volunteer activity and promote continued support from inside and outside the community.

Long Term Outcomes / Evaluation

In evaluating the end results of implementing a strategic vision, ask "How successful were we in tackling the long-term problems in our community?" or "How successful were we in achieving our long-term goals?" Outcomes are usually long-term (for instance, fewer people living in poverty) and linked to challenges and goals. The long-term outcome evaluation will be best evaluated after the action plan has been in effect for 36 to 60 months.

County staff and the Town Advisory Board will work to accomplish the priorities identified by the residents of Indian Springs. Regular progress updates can be provided at Town Advisory Board meetings and Board of County Commissioners meetings.

APPENDICES

Appendix I

During the initial sessions, in order to clarify and illustrate visioning issues, the various elements related to the community visioning process were collaboratively designed and displayed via a PowerPoint presentation.

Appendix II

UER and County staff prepared a list of steps to complete a successful visioning exercise together with a relevant timeline

Appendix III

Indian Springs Vision Statement, Priorities and Sample Community Action Plan

Appendix IV

Public Outreach

APPENDIX I
PowerPoint Presentation

AGENDA

- Introductions
- What is Visioning?
- Overview of Visioning Process
- Options, Logistics, and Next Steps
- Round Table on Community Strengths and Challenges

WHAT IS VISIONING?

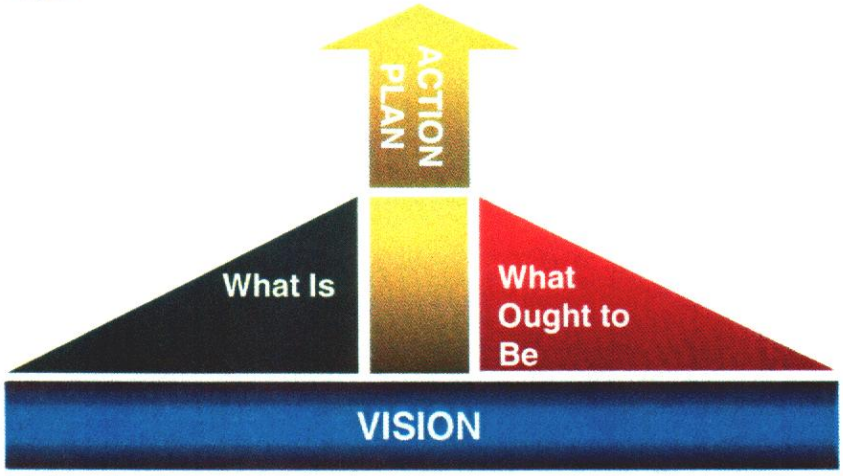
"Visioning is a process by which a community envisions the future it wants, and plans how to achieve it. It brings people together to develop a shared image of what they want their community to become. Once a community has envisioned where it wants to go, it can begin to consciously work toward that goal."

(Steve Ames, American Planning Association)

ADVANTAGES OF A GROUP PROCESS

- Varied viewpoints and expertise
- Tested, discussed and refined
- Gain commitment for implementation
- Broaden everyone's understanding
- Helps community get past limitations

TWO CONDITIONS NEEDED FOR CREATING A VISION



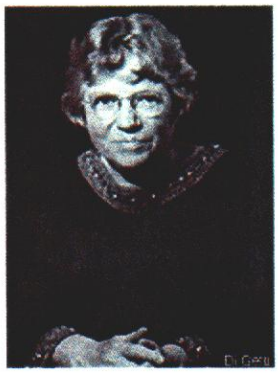
INGREDIENTS FOR A SUCCESSFUL VISIONING PROCESS

- Shared and supported
- Comprehensive and detailed
- Positive and inspiring

Or as Margaret Meade Said:

INGREDIENTS FOR A SUCCESSFUL VISIONING PROCESS

"Never doubt that a small group of thoughtful, committed citizens can Change the world. In fact it is the only thing that ever has."



MOVING FORWARD

- Why?
- What?
- How?

FOUR STEP APPROACH

- Setting our course
- Where we are
- Where we want to be
- Making the trip

VISIONING PROCESS

SESSION 1: SETTING OUR COURSE

- Overview of Visioning Process
- Roundtable on Community Strengths

VISIONING PROCESS

SESSION 2: WHERE WE ARE

- Current Conditions Discussed
- Inventory of Community Assets Developed

VISIONING PROCESS

SESSION 3: WHERE WE WANT TO BE

- Vision And Goals Developed

VISIONING PROCESS

SESSION 4: MAKING THE TRIP

- Goals Refined
- Strategies Developed

PULLING OUR THOUGHTS TOGETHER

- What do people like best about Indian Springs?
- In what ways does Indian Springs provide a positive environment for families, children, businesses, and others?
- What trends/activities have an influence in Indian Springs?
- What would you like for the future of Indian Springs?

OPTIONS, LOGISTICS, AND NEXT STEPS

- Visioning format
- Schedule - dates, time, & location
- Identify and recruit participants
- Publicize the visioning process
- Community Contact(s)
- Resources, experts, and other info needed

APPENDIX II
VISIONING PROGRAM TIMELINE

Pursuant to the scope and contract implementation process the Final Visioning Plan including the implementation steps and proposed timeline is as follows:

Approximate Timeline for Completion	Activity
July 1	Structure and direct various meetings between relevant Clark County staff and Indian Springs Town Advisory Board to discuss and develop the initial project plan.
July 15	Prepare and/or secure relevant public information briefing and educational materials as "hand-outs" and background documents to facilitate community organization.
July 30	Present draft plan to Indian Springs Town Advisory Board for discussion and concurrence.
August 1	Following appropriate advice and review by all parties, set Community Meeting dates.
August 15	▪ Identify the key local stakeholders / community leaders ▪ Prepare address list ▪ Determine information materials to be mailed or delivered ▪ Develop Letter of Invitation

Approximate Timeline for Completion	Activity
September 15	Convene relevant Clark County staff and consultants to organize initial Community Meeting Agenda and clearly define via consensus agreement the anticipated Community Visioning / Planning process to be utilized.
October 1	▪ Initiate pro-active public notice, review, and discussion process at various sites. ▪ Determine community organizational and visioning educational techniques to be utilized. ▪ Penn State model is to be followed ▪ Public information/outreach process to be managed by Clark County Parks and Community Services with support of Comprehensive Planning consultants Program will discuss at a minimum: 1) Anticipated Cark County development impacts 2) Role of U.S. Military/Federal government in community planning 3) Relevance and use of planning/zoning issues 4) Core values 5) Future infrastructure needs 6) Community profiles if available 7) Long range goals 8) Clark County monitoring systems to be integrated into process
October 13 – Ongoing	Follow-up meeting with consultants/staff. Meet with County participants prior to each session as may be required for meeting organization/critique.

Approximate Timeline for Completion	Activity
October 15 – Ongoing	Distribute public notices/information. Develop: ▪ Visual display ▪ Teaching materials ▪ Presentation for public meetings
October 23	Conduct initial public visioning exercise. Consultants/County to attend session.
On-going	Brief County Commissioners as may be necessary.
November 6	Convene 2nd public Visioning exercise
November 20	Convene 3rd public Visioning exercise
December 4	Convene 4th public Visioning exercise
December 15	Complete final report
January 15	Present final report/conclusions to Town Advisory Board at regularly called meeting.
February 1	Consultants and Clark County staff: ▪ Convene and critique the process, ▪ Determine next town for initiating the process, and ▪ Prepare new action steps, etc., as determined based on Indian Springs process.
February 15	Complete County Monitoring Systems Report

APPENDIX III
Indian Springs Vision Statement, Priorities and Sample Community Action Plan

INDIAN SPRINGS VISION STATEMENT

"INDIAN SPRINGS PROVIDES A CLEAN, SAFE, HEALTHY, SUSTAINABLE ENVIRONMENT FOR RESIDENTS OF ALL AGES. WE ARE RECOGNIZED AND RESPECTED FOR OUR UNIQUE, RURAL CHARACTER AND PLACE IN CLARK COUNTY. WE PROVIDE A DIVERSE, VIABLE, ATTRACTIVE ALTERNATIVE TO THE URBAN LIFESTYLE OF LAS VEGAS. THROUGH EFFECTIVE PLANNING, EDUCATION, PARTNERSHIPS AND VOLUNTEERISM, WE PROVIDE A PLACE FOR ALL TO LIVE, LEARN, PLAY, WORK AND CONTRIBUTE NOW, AND FOR GENERATIONS TO COME."

FOR MORE INFORMATION CONTACT SHEILA CONWAY AT PWASHEBA@COX.NET, BABS MCGEHEE AT BMG@CO.CLARK.NV.US, CHRIS MUNHALL AT CHRISMUN@CO.CLARK.NV.US OR VISIT THE INDIAN SPRINGS WEBSITE AT WWW.ACCESSCLARKCOUNTY.COM/COMPREHENSIVE_PLANNING/INDIANSPRINGS/INDIANSPRINGSVISION.HTM

Clark County
Comprehensive Planning & Administrative Services

Board of County Commissioners
Chip Maxfield, Chair • Myrna Williams, Vice Chair • Yvonne Atkinson Gates • Mark James • Mary Kincaid-Chauncey • Rory Reid • Bruce Woodbury
Thom Reilly, County Manager

Indian Springs Visioning
Goal #1

1. Partnership and volunteers

- Improved communications/information included/input in decisions with NAFB, Bureau of Land Management (BLM) and Clark County (12)
- Community cleanup programs (7)
- Teacher involvement in community (5)
- After school programs (4)
- Use of Nevada Test Site (NTS) and NAFB for kids' programs, job training and trade schools (4)
- Joint use of school facilities (0)

Indian Springs Visioning
Goal #2

2. Community development/infrastructure

- Limit high density - place in appropriate location (22)
- Improve visual impact, appearance of overall community (10)
- New business opportunities (8)
- Improve utilities: new (e.g. trash); and enhance maintenance of existing utilities (5)
- Address impacts of NAFB operations on future developments (4)
- Focus efforts on funding strategies (3)
- Protect low density (1)

Indian Springs Visioning
Goal #3

3. Future/Children

- Increase parent involvement/social programs/parent support programs (13)
- Day care (11)
- Teen work program (5)
- Organized activities (Boy Scouts, Girl Scouts, 4-H Programs) (3)
- School curriculum (1)
- Parks and recreation (1)
- Community scholarships (0)
- "SCORE" program (0)

Indian Springs Visioning
Goal #4

4. Health, Safety, etc.

- Medical care, clinic (10)
- More fire hydrants/maintained and fully operational (7)
- Water and septic system (6)
- Fire and EMT: equipment, personnel, expanded coverage, improved response time (1)
- NAFB information on medical resources (1)
- Assisted living for seniors (0)
- NAFB noise (0)

SAMPLE
COMMUNITY ACTION PLAN

Goal: Community Development/Infrastructure
Priority: Improve visual impact, appearance of overall community

Target Date	Project/Task Description	Action Required	Assigned Person/Group	Resources Needed	Contact Information
	Initiate community clean up program	TAB approval		Funding, Republic Services, volunteers, community service organizations	
	Conduct "visual preference" survey	TAB approval		Funding, consultant services, community meeting space	

APPENDIX IV
Public Outreach

THIS IS AN EXCITING TIME FOR INDIAN SPRINGS!

HELP SHAPE OUR COMMUNITY'S FUTURE!

This is an exciting time for Indian Springs! Clark County Parks and Community Services has partnered with Comprehensive Planning to explore your vision for Indian Springs in a four-part series of community planning sessions.

Place: Indian Springs Community Center

When:

OCTOBER						
S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

NOVEMBER						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

DECEMBER						
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Time: 7:30 P.M.

This is an opportunity for you to participate in discussions to help shape your community's future:

- What do residents like best about Indian Springs?
- What challenges face our community?
- How do we want our community to grow and how do we get there?

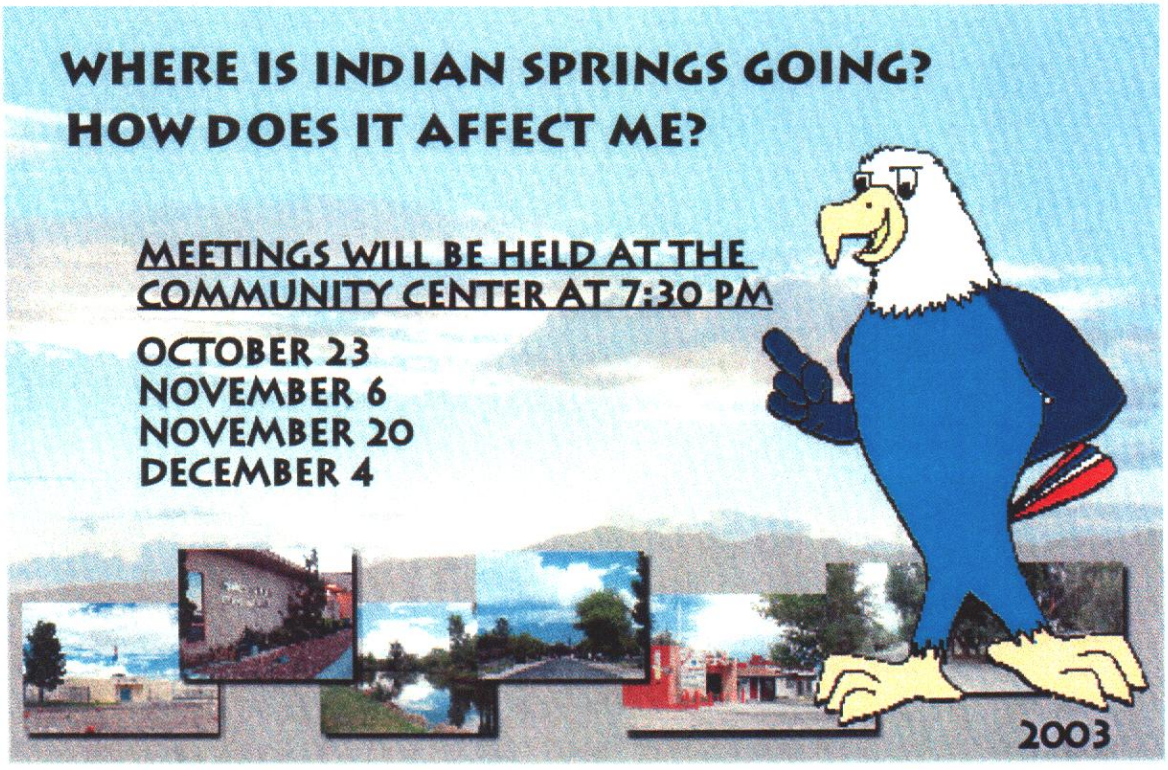
For more information contact Sheila Conway at pwasheba@cox.net, Babs McGehee at bmg@co.clark.nv.us, Chris Munhall at chrismun@co.clark.nv.us or you can drop off comments in the suggestion box at the Indian Springs Library. For events and information visit: www.accessclarkcounty.com/comprehensive_planning/indianspringsvision.htm

Please join us - We look forward to seeing you there!

Clark County
Comprehensive Planning &
Parks & Community Services

Board of County Commissioners
Mary Kincaid-Chauncey, Chair • Chip Maxfield, Vice Chair • Bruce Woodbury • Mark James • Myrna Williams • Rory Reid • Yvonne Atkinson Gates
Thom Reilly, County Manager

THIS IS AN EXCITING TIME FOR INDIAN SPRINGS!
HELP SHAPE OUR COMMUNITY'S FUTURE
MEETINGS WILL BE HELD AT THE COMMUNITY CENTER AT 7:30 P.M.
OCTOBER 23
NOVEMBER 6
NOVEMBER 20
DECEMBER 4
2003


WHERE IS INDIAN SPRINGS GOING?
HOW DOES IT AFFECT ME?
MEETINGS WILL BE HELD AT THE COMMUNITY CENTER AT 7:30 PM
OCTOBER 23
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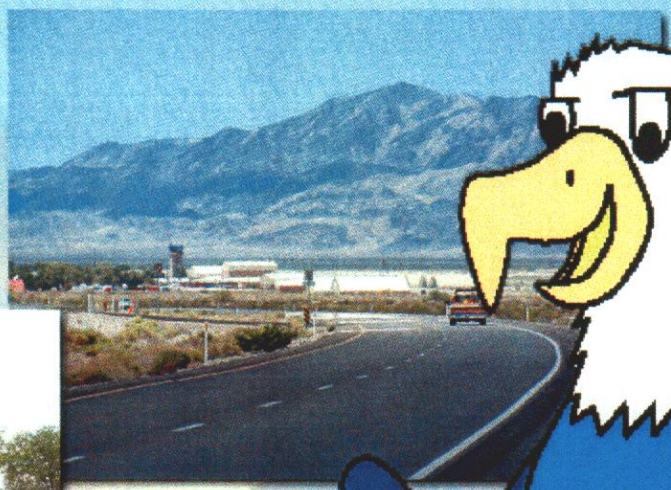
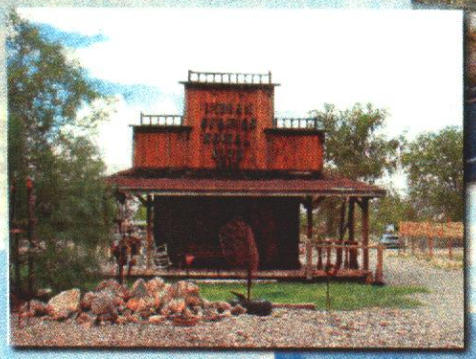
DECEMBER 4
2003

WHERE IS INDIAN SPRINGS GOING?

HOW DOES IT AFFECT ME?





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CLARK COUNTY NEVADA

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INDIAN SPRINGS

MEETINGS WILL BE HELD AT THE COMMUNITY CENTER AT 7:30 PM

OCTOBER 23
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FOR MORE INFORMATION CONTACT SHEILA CONWAY AT PWASHEBA@COX.NET, BABS MCGEHEE AT BMG@COX.NET, CHRIS MUNHALL AT CHRISMIN@CO.CLARK.NV.US OR VISIT THE INDIAN SPRINGS WEBSITE AT WWW.ACCESSCLARKCOUNTY.COM/COMPREHENSIVE_PLANNING/INDIANSPRINGS/INDIANSPRINGSVISION.HTM

Clark County
Comprehensive Planning & Parks & Community Services

Board of County Commissioners
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Thom Reilly, County Manager

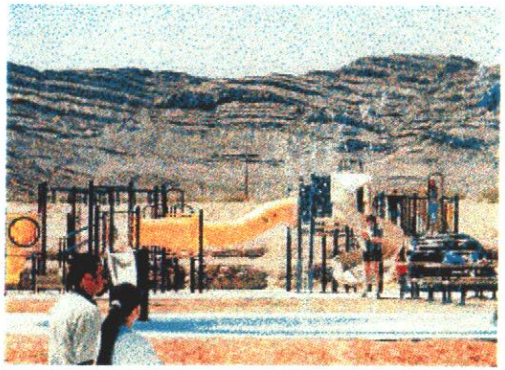
THE FUTURE OF INDIAN SPRINGS!

WHAT DO YOU THINK INDIAN SPRINGS WILL LOOK LIKE IN THE FUTURE? COLOR YOUR VISION OF WHAT INDIAN SPRINGS WILL LOOK LIKE IN THE FUTURE!

RULES:

PARTICIPANTS MUST BE UP TO AND INCLUDING THE 5TH GRADE. SUBMIT YOUR DRAWING AT THE OCTOBER 16TH MEETING OR TO THE LIBRARIAN DODIE PATRICKBY OCTOBER 16, 2003, THERE WILL BE A 1ST, 2ND AND 3RD PRIZES! THE BESTDESIGN WILL BE PRINTED ON TEE SHIRTS FOR ALL VISIONING PARTICIPANTS. THE WINNING DESIGN WILL BE UNVEILED AT THE SECOND VISIONING SESSION ON NOVEMBER 6TH.

INDIAN SPRINGS VISIONING



WHAT IS VISIONING

- *"Visioning is a process by which a community envisions the future it wants, and plans how to achieve it. It brings people together to develop a shared image of what they want their community to become. Once a community has envisioned where it wants to go, it can begin to consciously work toward that goal." (Steve Ames, American Planning Association)*

ADVANTAGES OF A GROUP PROCESS

- Varied viewpoints and expertise
- Tested, discussed and refined by diverse perspectives
- Easier to gain commitment for implementing goals and strategies
- Broaden everyone's understanding of strengths, issues, challenges, and opportunities
- Helps community get past limitations

INGREDIENTS FOR A SUCCESSFUL VISIONING PROCESS

- Shared and supported
- Comprehensive and detailed
- Positive and inspiring

INDIAN SPRINGS VISIONING PROCESS

SESSION 1: SETTING OUR COURSE

- Overview of Visioning Process
- Roundtable on Community Strengths

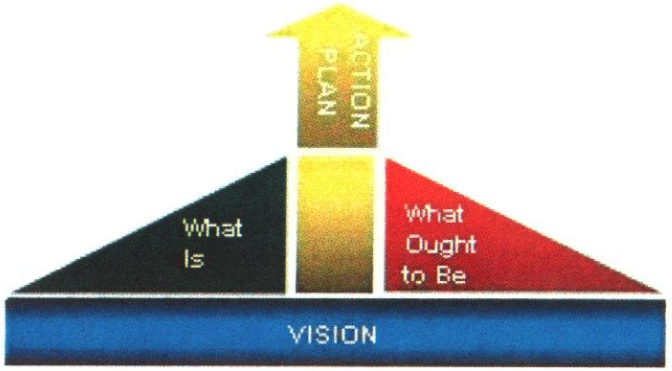
SESSION 2: WHERE WE ARE

- Current Conditions
- Inventory of Community Assets

SESSION 3: WHERE WE WANT TO BE

- Vision & Goals Developed

TWO CONDITIONS NEEDED FOR CREATING A VISION



SESSION 4: MAKING THE TRIP

- Goals Refined
- Strategies Developed

Board of County Commissioners
Chip Maxfield, Chair • Myrna Williams, Vice Chair • Bruce Woodbury • Mark James • Mary Kincaid-Chauncey • Rory Reid • Yvonne Atkinson Gates
Thom Reilly, County Manager

Attachment 13

UER, “Clark County Monitoring Program: Community Survey”

(Apr 2008)

Clark County Monitoring Program

APRIL 2008

APPLIED ANALYSIS

strategic solutions

UER
Urban Environmental Research, LLC

Clark County Monitoring Program: Community Survey
April 2008

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TO: MS. IRENE NAVIS, AICP
FROM: DR. SHEILA CONWAY/UER; DR. ALVIN MUSHKATEL/UER
SUBJECT: CLARK COUNTY MONITORING PROGRAM | April 2008 COMMUNITY SURVEY
DATE: April 29, 2008
CC: JASON GRAY/STRATEGIC SOLUTIONS; BABS McGEHEE/CLARK COUNTY

This memorandum summarizes the key findings of the bi-annual April 2008 Clark County Monitoring Program Survey conducted by Urban Environmental Research and Strategic Solutions on behalf of the Nuclear Waste Division. A more detailed statistical assessment of our findings is available in the accompanying comprehensive assessment binder and will be posted to the Clark County Monitoring Program's website (www.monitoringprogram.com) upon your approval of this deliverable. As with previous cycles of the Clark County Monitoring Program Survey, the intent of this memorandum is to provide an executive level overview of our salient findings.

A. GENERAL OVERVIEW

During the month of February 2008, Strategic Solutions, in coordination with Urban Environmental Research, administered a 156-question telephone survey to 600 Southern Nevada households. The survey, which touches on a broad number of topics, has a margin of error of ±4 percent at the 95 percent confidence level. The principal purpose of the Clark County Monitoring Program, including this survey series, is to establish an analysis baseline from which the impacts of transporting high-level nuclear waste through the Las Vegas Valley, and ultimately storing the radioactive material at the proposed Yucca Mountain Nuclear Waste Repository, can be monitored, measured and assessed.

Generally speaking, the survey is segmented into seven areas of inquiry: 1) public service importance; 2) public service performance; 3) quality-of-life considerations; 4) general economic considerations; 5) property value impact considerations; 6) environmental considerations; and 7) local government interaction. In addition to these general areas of inquiry, information on the demographic and socio-economic profile of respondents is also routinely gathered.

It is easy to conceptualize how the transportation of high-level nuclear waste through a community might negatively impact property values. It is a bit more difficult to identify the nexus to child welfare programs, homelessness, flood protection or crime enforcement. In absence of mitigating funds, it is likely that Nevada's state and local

governments will be required to shift resources away from existing programs and into efforts aimed at ensuring threats, patent and latent, sourced to storage and transportation of high-level nuclear waste are addressed. Shifts away from existing public services would be expected to reduce the quality of life within the community and may also have far-reaching economic, fiscal and social implications. Analyzing these questions requires not only an understanding of resource allocation to specific programs but also the relative importance and effectiveness of those programs. The Clark County Monitoring Program Survey series is designed to provide analysts with a more comprehensive framework from which impact assessments can be appropriately derived.

It is important to mention here that several study instrument modifications were implemented prior to data collection activities for the April 2008 cycle of the Clark County Monitoring Program Survey. The modifications were limited to two sections of the survey instrument: Yucca Mountain Considerations (APPENDIX VII) and Local Government Interactions (APPENDIX IX). Furthermore, these changes will not affect operations of longitudinal analysis applied to the importance and performance of public services matrices.

B. KEY FINDINGS

- Strong public service importance and performance scores for fire and emergency medical services continue from Summer 2006 and Winter 2007.
- Notable trend in importance ratings for traffic service areas as reducing traffic congestion, improving road conditions, and access to freeways all increase in importance relative to Winter 2007.
- Concerns with regard to crime continue to show signs of stabilization among residents.
- Drought continues to be a pressing environmental concern.
- Notable increase in importance of increasing job opportunities continues from Winter 2007.
- Nearly seven of ten respondents (68.9%) felt that now was a good time to buy a home, a significant increase from Winter 2007 (57.7%).

C. YUCCA MOUNTAIN QUESTIONS

- Opposition to the Yucca Mountain project remains stable with 75% indicating they would vote against the nuclear waste repository; 76% said the same in Winter 2007. 68.1% percent of respondents report that the storage site would have a negative impact on their quality of life, up from a low of 59% in 2005.
- Trust regarding the Yucca Mountain project remains a key concern. Roughly 68.4% of all respondents indicate that they “disagree” or “strongly disagree” that the U.S. Department of Energy can be trusted to ensure the public’s safety as it relates to transportation and storage of high-level nuclear waste. 74% of respondents indicated the same in Winter 2007.

- Approximately 87% percent of respondents indicated an expectation that having a high-level nuclear waste transportation route near residential housing would have a negative impact on property values. This figure remained unchanged from Winter 2007.
- In terms of public service importance measures, Yucca Mountain-related considerations, including those related to preparing for man-made accidents or terrorist events; those examining potential impacts from Yucca Mountain nuclear waste shipments; and those relating to the communication of Clark County's views about Yucca Mountain to Federal decision makers all increased, in relation to other pubic services measured, since Winter 2007.
- As an urgent environmental concern, the Yucca Mountain facility's placement among major issues was materially unchanged. Approximately .9 percent of respondents identified the Yucca Mountain project as Southern Nevada's most pressing environmental concern; this was 0.7 percent lower than reported in the Winter 2007 series.
- Concerns about the repository are measurably higher than reported during the Winter 2007 cycle-as mean importance scores for all questions pertaining to Yucca Mountain increased during the current survey period. These importance rating increases continue the trend from Summer 2006 to Winter 2007.

D. PUBLIC SERVICE IMPORTANCE CONSIDERATIONS (FIGURES 1 & 2)

- Public service importance continued to be dominated by public safety considerations, which accounted for the top five and eight out of the top ten most highly-rated services. Traffic-related services also remained high on the list, increasing in terms of importance from Winter 2007.
- On a relative scale, only modest movement was noted in the majority of services. The data demonstrate, however, that "increasing job opportunities" tracked up four places overall (tracking up eight places since Summer 2006). This finding, combined with an increased importance rating for "improving the business climate" (up four places since Winter 2007 and four places since Summer 2006) suggest an overall continued increase in concern about the economic climate.
- The data suggest relative stabilization in the level of concern with youth/juvenile social service provision: "providing child protection services" (-2), "providing child welfare services" (+3) and "providing juvenile justice services" (+/-0).

E. YUCCA MOUNTAIN WILLINGNESS TO PAY

- In response to participating in the license application hearing, 45% of respondents indicated they "agree/strongly agree" if participation were to be funded only by dollars provided to local and/or state government specifically for Yucca Mountain oversight activities, while 29.2% indicated they "disagree/strongly disagree."
  .
- Regarding participation funded only by local taxpayer dollars, 44.6% of the

respondents indicated they “disagree/strongly disagree”, while 35.4% indicated they “agree/strongly agree.”

- Regarding participation funded partially by local taxpayer dollars, 36% of respondents indicated they “disagree/strongly disagree,” while 35.4% indicated they agree/strongly agree.”
- 46.1% of respondents indicated they “agree/strongly agree” with not supporting the use of any local taxpayer dollars to participate in hearings, while 36.3% indicated they “disagree/strongly disagree”.

F. LOCAL GOVERNMENT INTERACTIONS

- 36.3% of respondents indicated they had inquired about or accessed services from Clark County while 63% indicated they had not.
- When compared with their previous local government interactions in other communities, 39.4% of respondents reported their interactions with Clark County as good or excellent.
- The overall customer experience with Clark County for 41.3% of respondents was good or excellent.
- 63 – 64.3 % of respondents indicated Clark County government’s performance met or exceeded their expectations in the following: “employee cared about and understood my needs,” “service delivery was timely and responsive,” and “policies and processes were easy to follow and/or clearly explained.”
- 70.5 – 74.9 % of respondents indicated performance met or exceeded expectations in the following: “employee was able to assist or direct me to an appropriate source,” “employee was qualified, knowledgeable, and well informed,” and “transaction was handled in an appropriate manner.”
- 80.6% of respondents indicated performance on “accessibility (i.e. facility, staff, hours of operation)” met or exceeded expectations.
- The most common way for respondents to hear about Clark County services for both news (47.5%) and advertising (39.9%) was through television. The second most common way for both news (25.2%) and advertising (32.9%) was through newspaper.

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SCALE:

Importance Scale	Performance Scale
Very Important (4.0 -5.0)	Excellent (4.0 – 4.99)
Important (3.0 – 3.99)	Good (3.0 – 3.99)
Neither Important or Not Important (2.0 – 2.99)	Average (2.0 – 2.99)
Not Very Important (1.0 – 1.99)	Fair (1.0 – 1.99)
Not Important At All (< 1.0)	Poor (<1.0)

FIGURE 1 PUBLIC SERVICE IMPORTANCE SCORE SUMMARY

Public Service Importance Score Summary										
		Mean					Mean Change			
Service Category	**Descriptive Statistics**	**Summer '05**	**Winter '06**	**Summer '06**	**Winter '07**	**Winter '08**	**From Summer '05**	**From Winter '06**	**From Summer '06**	**From Winter '07**
General Government	Road Maintenance	4.21	4.05	4.04	4.09	4.13	-.08	.08	.09	.04
	Revitalizing older neighborhoods	3.59	3.41	3.52	3.36	3.57	-.02	.16	.05	.21
	Flood control	4.09	3.88	3.86	3.7	4.01	-.08	.16	.05	.21
	Budget management	4.29	3.99	4.23	4.11	4.41	.12	.42	.18	.30
	Communicate Clark County's local government views about Yucca Mountain to federal decision makers	3.86	3.67	3.58	3.63	3.83	-.03	.16	.25	.20
	Monitor and report to the public on how well government services are being performed	3.9	3.72	3.75	3.87	4.09	1	.37	.34	.20
	Water conservation programs	n/a	n/a	4.12	4.22	4.48	n/a	n/a	.36	.36
Social and Judicial Services	Providing child protection services	4.27	4.06	4.11	4.17	4.30	.03	.24	.19	.13
	Providing child welfare services	4.15	3.98	3.98	3.99	4.21	.06	.23	.23	.22
	Providing juvenile justice services	4.08	3.93	3.87	3.98	4.15	.07	.22	.28	.17
	Providing attainable housing for working class families	n/a	3.72	3.77	3.76	3.96	n/a	.24	.19	.20
	Providing affordable housing for low income families	3.7	3.56	3.64	3.67	3.83	.13	.27	.19	.16
	Providing shelter for the homeless	3.38	3.33	3.54	3.53	3.78	.40	.45	.24	.25
	Providing affordable housing for seniors	4.12	3.92	3.91	4.02	4.18	.06	.26	.27	.16
	Providing medical care for the poor	3.94	3.74	3.74	3.75	4.00	.06	.26	.26	.25

	Providing 24 hour emergency trauma care	4.6	4.38	4.29	4.42	4.58	-.02	.20	.29	.16
Public Safety	Providing crime prevention programs	4.27	3.99	4.09	4.04	4.24	-.03	.25	.15	.20
	Enforcing traffic laws	4.25	3.91	4.07	4.09	4.10	-.15	.19	.03	.01
	Maintaining a low crime rate	4.49	4.14	4.28	4.24	4.58	.09	.44	.30	.34
	Maintaining neighborhood police patrols	4.3	3.97	4.08	4.06	4.38	.08	.42	.30	.32
	Keeping police response times low	4.45	4.24	4.6	4.34	4.59	.14	.35	-.01	.25
	Keeping fire department response times low	4.45	4.54	4.47	4.59	4.73	.28	.19	.26	.14
	Keeping paramedic and emergency medical response times low	4.45	4.56	4.54	4.61	4.79	.34	.23	.25	.18
	Well trained paramedic and emergency medical response personnel	n/a	4.64	4.57	4.67	4.79	n/a	.15	.22	.12
	Facilitate neighborhood watch programs	4.05	3.69	3.79	3.79	4.05	0	.36	.26	.26
	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	4.04	3.75	3.87	3.84	4.10	.06	.35	.23	.26
	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	4.18	3.92	4.01	4.03	4.29	.11	.37	.28	.26
	Investigating criminal activity	4.47	4.03	4.24	4.18	4.46	-.01	.43	.22	.28
	Providing fire protection & prevention services	4.59	4.32	4.26	4.33	4.53	-.06	.21	.27	.20
	Providing emergency medical services	4.66	4.44	4.43	4.51	4.70	.04	.26	.27	.19
	Providing for neighborhood code enforcement services	3.81	3.54	3.58	3.51	3.70	-.11	.16	.12	.19
	Examining potential impacts from Yucca Mountain nuclear waste shipments	3.88	3.68	3.65	3.66	3.99	.11	.31	.34	.33
	Regional justice services and facilities	n/a	n/a	3.6	3.69	3.93	n/a	n/a	.33	.24
Community Development	Providing affordable housing	n/a	n/a	3.68	3.64	3.86	n/a	n/a	.18	.22
	Managing growth	4.07	3.83	3.87	3.83	4.10	.03	.27	.23	.27
	Increasing job opportunities	4.07	3.95	3.82	3.84	4.13	.06	.18	.31	.29
	Improving the business climate	4.08	3.86	3.75	3.76	4.01	-.07	.15	.26	.25
	Planning for commercial development	3.82	3.7	3.56	3.55	3.72	-.10	.02	.16	.17

	Reducing traffic congestion	4.37	4.02	4.06	3.97	4.30	-.07	.28	.24	.33
	Access to freeways	4.12	3.83	3.92	3.83	4.11	-.01	.28	.19	.28
	Improving road conditions	4.29	3.97	4.04	3.95	4.18	-.11	.21	.14	.23
	Reducing travel time	4.01	3.77	3.83	3.82	3.96	-.05	.19	.13	.14
	Providing mass public transit	3.86	3.67	3.64	3.69	3.77	-.09	.10	.13	.08
	Adequate airport facilities	n/a	n/a	3.91	3.87	3.96	n/a	n/a	.05	.09
	Parks and recreation programs	n/a	n/a	4.02	4.04	4.18	n/a	n/a	.16	.14

FIGURE 2 PUBLIC SERVICE IMPORTANCE SCORE RANKING

	Ranking			Change	
Descriptive Statistics	**Winter '08**	**Winter '07**	**Summer '06**	**From Winter '07**	**From Summer '06**
Well trained paramedic and emergency medical response personnel	1	1	2	0	+1
Keeping paramedic and emergency medical response times low	1	2	3	+1	+2
Keeping fire department response times low	3	3	4	0	+1
Providing emergency medical services	4	4	5	0	+1
Keeping police response times low	5	6	1	+1	-4
Providing 24 hour emergency trauma care	6	5	6	-1	0
Maintaining a low crime rate	6	8	7	+2	+1
Providing fire protection & prevention services	8	7	8	-1	0
Water conservation programs	9	9	11	0	+2
Investigating criminal activity	10	10	9	0	-1
Budget management	11	12	10	-1	-1
Maintaining neighborhood police patrols	12	15	14	+3	+2
Providing child protection services	13	11	12	-2	-1
Reducing traffic congestion	13	22	16	+9	+3
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	15	18	20	+3	+5
Providing crime prevention programs	16	17	13	+1	-3
Providing child welfare services	17	20	21	+3	+4
Parks and recreation programs	18	16	19	-2	+1
Providing affordable housing for seniors	18	19	23	+1	+5
Improving road conditions	18	23	18	+5	0
Providing juvenile justice services	21	21	25	0	+4
Road Maintenance	22	14	17	-8	-5
Increasing job opportunities	22	26	30	+4	+8
Access to freeways	24	28	22	+4	-2
Enforcing traffic laws	25	13	15	-12	-10
Preparing for natural disasters (i.e. floods, earthquakes, etc.)	25	27	26	+2	+1
Managing growth	25	29	27	+4	+2
Monitor and report to the public on how well government services are being performed	28	25	33	-3	-5
Facilitate neighborhood watch programs	29	31	31	+2	+2

Improving the business climate	30	32	34	+2	+4
Flood control	30	35	28	+5	-2
Providing medical care for the poor	32	34	35	+2	+3
Examining potential impacts from Yucca Mountain nuclear waste shipments	33	39	37	+6	+4
Adequate airport facilities	34	24	24	-10	-10
Reducing travel time	34	30	29	-4	-5
Providing attainable housing for working class families	34	33	32	-1	-2
Regional justice services and facilities	37	37	40	0	+3
Providing affordable housing	38	40	36	+2	-2
Providing affordable housing for low income families	39	38	38	-1	-1
Communicate Clark County's local government views about Yucca Mountain to federal decision makers	39	41	41	+2	+2
Providing shelter for the homeless	41	43	44	+2	+3
Providing mass public transit	42	36	39	-6	-3
Planning for commercial development	43	42	43	-1	0
Providing for neighborhood code enforcement services	44	44	42	0	-2
Revitalizing older neighborhoods	45	45	45	0	0

SCALE:

Importance Scale	Performance Scale
Very Important (4.0 -5.0)	Excellent (4.0 – 4.99)
Important (3.0 – 3.99)	Good (3.0 – 3.99)
Neither Important or Not Important (2.0 – 2.99)	Average (2.0 – 2.99)
Not Very Important (1.0 – 1.99)	Fair (1.0 – 1.99)
Not Important At All (< 1.0)	Poor (<1.0)

FIGURE 3 GOVERNMENT SERVICE PERFORMANCE SCORE

Government Service Performance Rating					
		Mean		Disparity between Importance and Performance (Performance-Importance)	
Service Category	**Descriptive Statistics**	**Importance**	**Performance**	**Current Disparity**	**Winter '07 Disparity**
General Government	Road maintenance	4.13	3.14	-.99	-1.15
	Revitalizing older neighborhoods	3.57	2.59	-.98	-0.79
	Flood control	4.01	3.60	-.41	-0.22
	Budget management	4.41	2.72	-1.69	-1.55
	Communicate Clark County's local government views about Yucca Mountain to federal decision makers	3.86	3.01	-.85	-0.81
	Monitor and report to the public on how well government services are being performed	4.09	2.60	-1.49	-1.37
	Water conservation programs	4.48	3.44	-1.04	-1.00
Social and Judicial Services	Providing child protection services	4.30	3.03	-1.27	-1.33
	Providing welfare services	4.21	3.03	-1.18	-1.20
	Providing juvenile justice services	4.15	2.96	-1.19	-1.15
	Provide attainable housing for working class families	3.96	2.59	-1.37	-1.24
	Providing affordable housing for low income families	3.83	2.52	-1.31	-1.26
	Providing shelter for the homeless	3.78	2.22	-1.56	-1.34
	Providing affordable housing for seniors	4.18	2.76	-1.46	-1.40
	Providing medical care for the poor	4.00	2.58	-1.42	-1.16
	Providing 24 hour emergency trauma care	4.58	3.42	-1.16	-1.16
Public Safety	Providing crime prevention programs	4.24	3.19	-1.05	-1.00
	Enforcing traffic laws	4.10	3.24	-.86	-1.10
	Maintaining a low crime rate	4.58	3.00	-1.58	-1.42
	Maintaining neighborhood police patrols	4.38	2.82	-1.56	-1.33
	Keeping police response times low	4.59	3.16	-1.43	-1.25
	Keeping fire department response times low	4.73	3.92	-.81	-0.86
	Keeping paramedic and emergency medical response times low	4.79	3.94	-.85	-0.78
	Well trained paramedic and emergency medical response personnel	4.79	4.11	-.68	-0.74
	Facilitate neighborhood watch programs	4.05	2.87	-1.18	-0.99

	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	4.10	3.01	-1.09	-0.85
	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	4.29	3.05	-1.24	-1.08
	Investigating criminal activity	4.46	3.13	-1.33	-1.04
	Providing fire protection & prevention services	4.53	3.73	-.80	-0.68
	Providing emergency medical services	4.70	3.84	-.86	-0.74
	Providing for neighborhood code enforcement services	3.70	3.03	-.67	-0.50
	Examining potential impacts from Yucca Mountain nuclear waste shipments	3.99	2.98	-1.01	-0.87
	Regional justice services and facilities	3.93	3.22	-.71	-0.62
Community Development	Providing affordable housing	3.86	2.62	-1.24	-1.09
	Managing growth	4.10	2.53	-1.57	-1.36
	Increasing job opportunities	4.13	2.84	-1.29	-0.93
	Improving the business climate	4.01	3.00	-1.01	-0.60
	Planning for commercial development	3.72	3.14	-.58	-0.33
	Reducing traffic congestion	4.30	2.59	-1.71	-1.54
	Access to freeways	4.11	3.28	-.83	-0.74
	Improving road conditions	4.18	3.12	-1.06	-1.05
	Reducing travel time	3.96	2.75	-1.21	-1.25
	Providing mass public transit	3.77	2.81	-.96	-0.99
	Adequate airport facilities	3.96	3.56	-.40	-0.49
	Parks and recreation programs	4.18	3.51	-.67	-0.52

SCALE:

Importance Scale	Performance Scale
Very Important (4.0 -5.0)	Excellent (4.0 – 4.99)
Important (3.0 – 3.99)	Good (3.0 – 3.99)
Neither Important or Not Important (2.0 – 2.99)	Average (2.0 – 2.99)
Not Very Important (1.0 – 1.99)	Fair (1.0 – 1.99)
Not Important At All (< 1.0)	Poor (<1.0)

FIGURE 4 YUCCA MOUNTAIN SERVICE IMPORTANCE SCORE SUMMARY

Yucca Mountain Service Importance Score Summary			
Descriptive Statistics	**Public Service Importance Winter**	**Public Service Importance Winter**	**Public Service Importance Summer**
	'08	**'07**	**'06**
Keeping local decision makers up to date on Yucca Mountain	4.26	3.94	3.89
Keeping the public up to date about Yucca Mountain	4.32	3.98	3.93
Reviewing technical, scientific studies about seismic, vulcanology, geology and hydrology	4.12	3.87	3.84
Identify public safety needs and impacts	4.28	4.04	3.96
Assess other government impacts	3.89	3.72	3.66
Assess impacts on the tourist sector	3.85	3.83	3.61
Assess impacts on the building, construction, and development sectors	3.85	3.79	3.57
Identify transportation impacts	3.99	3.85	3.68
Provide information to the public on all facts of Yucca Mountain	4.22	3.96	3.91

Appendix I

Importance Score for Selected Service

Appendix I
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)

Importance Variable	Valid	Missing	Mean	Std. Error of Mean	Median	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
General Government Services												
Road maintenance	600	0	4.13	0.04	4	0.99	-0.987	0.1	0.391	0.199	1	5
Revitalizing older neighborhoods	591	9	3.57	0.05	4	1.222	-0.432	0.101	-0.791	0.201	1	5
Flood control	599	1	4.01	0.048	4	1.168	-0.951	0.1	-0.072	0.199	1	5
Budget management	590	10	4.41	0.038	5	0.918	-1.707	0.101	2.708	0.201	1	5
Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	582	18	3.86	0.056	4	1.344	-0.903	0.101	-0.426	0.202	1	5
Monitor and report to the public on how well government services are being performed	595	5	4.09	0.043	4	1.04	-1.072	0.1	0.569	0.2	1	
Water conservation programs	597	2	4.48	0.036	5	0.884	-1.868	0.1	3.176	0.2	1	5
Social & Judicial Services												
Providing child protection services	595	5	4.3	0.044	5	1.065	-1.485	0.1	1.39	0.2	1	5
Providing child welfare services	595	5	4.21	0.044	5	1.071	-1.282	0.1	0.819	0.2	1	5
Providing juvenile justice services	591	9	4.15	0.043	5	1.052	-1.119	0.101	0.521	0.201	1	5
Provide attainable housing for working class families	594	6	3.96	0.05	4	1.229	-0.993	0.1	-0.065	0.2	1	5
Providing affordable housing for low income families	592	8	3.83	0.053	4	1.28	-0.837	0.1	-0.442	0.201	1	5
Providing shelter for the homeless	596	4	3.78	0.056	4	1.356	-0.791	0.1	-0.639	0.2	1	5
Providing affordable housing for seniors	596	3	4.18	0.045	5	1.105	-1.318	0.1	0.894	0.2	1	5
Providing medical care for the poor	596	3	4	0.051	4.86	1.245	-1.065	0.1	0.026	0.2	1	5
Providing 24 hour emergency trauma care	594	5	4.58	0.033	5	0.813	-2.173	0.1	4.639	0.2	1	5

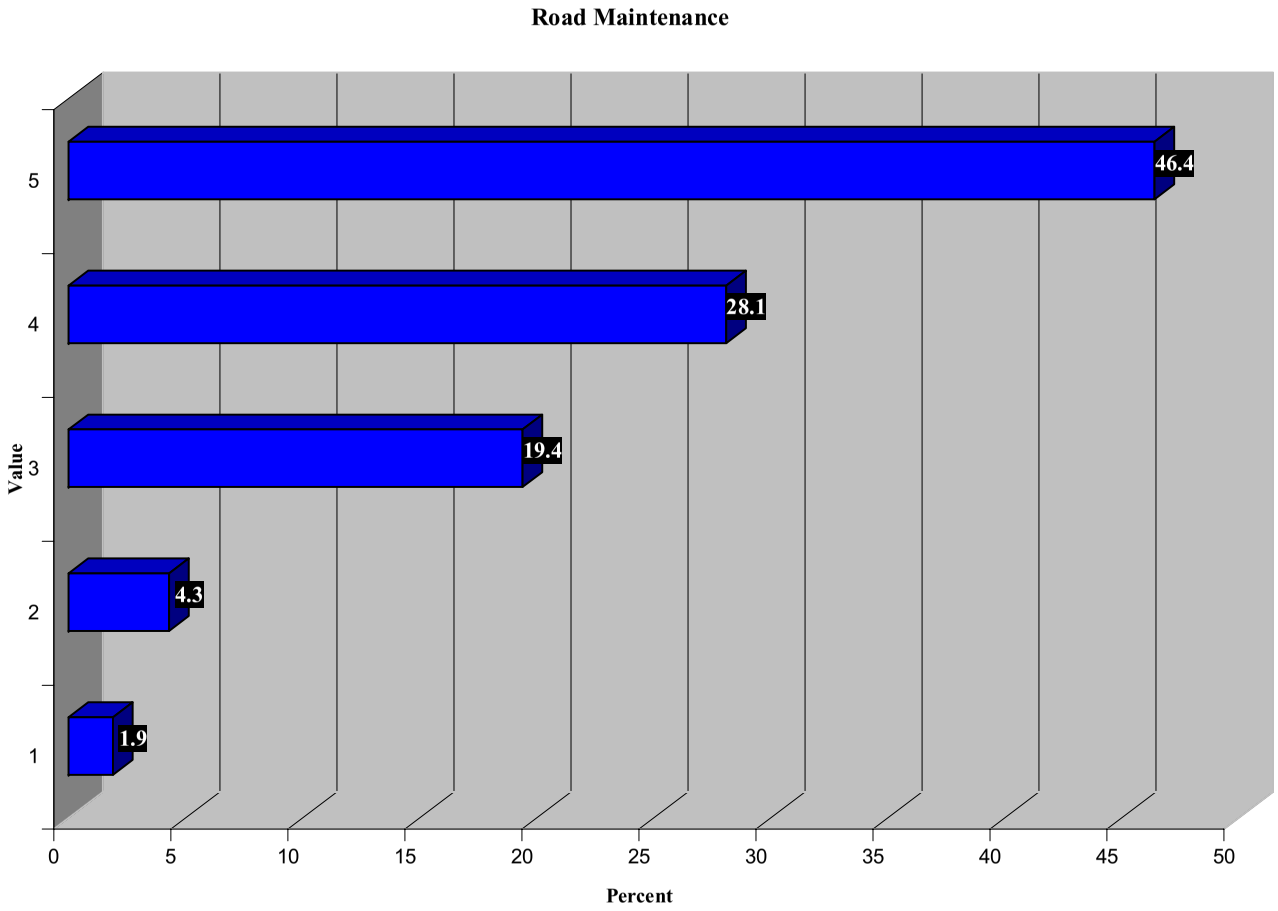
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)

Importance Variable	N Valid	N Missing	Mean	Std. Error of Mean	Median	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
Public Safety Services												
Providing crime prevention programs	597	3	4.24	0.041	5	0.998	-1.293	0.1	1.11	0.2	1	5
Enforcing traffic laws	599	0	4.1	0.045	4	1.094	-1.072	0.1	0.344	0.199	1	5
Maintaining a low crime rate	598	2	4.58	0.034	5	0.842	-2.381	0.1	5.779	0.2	1	5
Maintaining neighborhood police patrols	598	1	4.38	0.037	5	0.91	-1.531	0.1	1.977	0.199	1	5
Keeping police response times low	594	5	4.59	0.031	5	0.753	-2.206	0.1	5.359	0.2	1	5
Keeping fire department response times low	599	1	4.73	0.023	5	0.555	-2.38	0.1	7.215	0.199	1	5
Keeping paramedic and emergency medical response times low	597	2	4.79	0.02	5	0.493	-2.587	0.1	7.06	0.2	2	5
Well trained paramedic and emergency medical response personnel	594	5	4.79	0.022	5	0.538	-3.042	0.1	11.194	0.2	1	5
Facilitate neighborhood watch programs	598	2	4.05	0.043	4	1.048	-0.954	0.1	0.28	0.2	1	5
Preparing for natural disasters, (i.e. floods, earthquakes, etc.)	598	1	4.1	0.043	4	1.06	-1.005	0.1	0.211	0.199	1	5
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	597	2	4.29	0.042	5	1.036	-1.449	0.1	1.377	0.2	1	5
Investigating criminal activity	596	3	4.46	0.035	5	0.848	-1.614	0.1	2.395	0.2	1	5
Providing fire protection & prevention services	596	4	4.53	0.03	5	0.728	-1.46	0.1	1.441	0.2	1	5
Providing emergency medical services	599	1	4.7	0.026	5	0.642	-2.337	0.1	5.516	0.199	1	5
Providing for neighborhood code enforcement services	576	24	3.7	0.049	4	1.172	-0.595	0.102	-0.434	0.203	1	5

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)

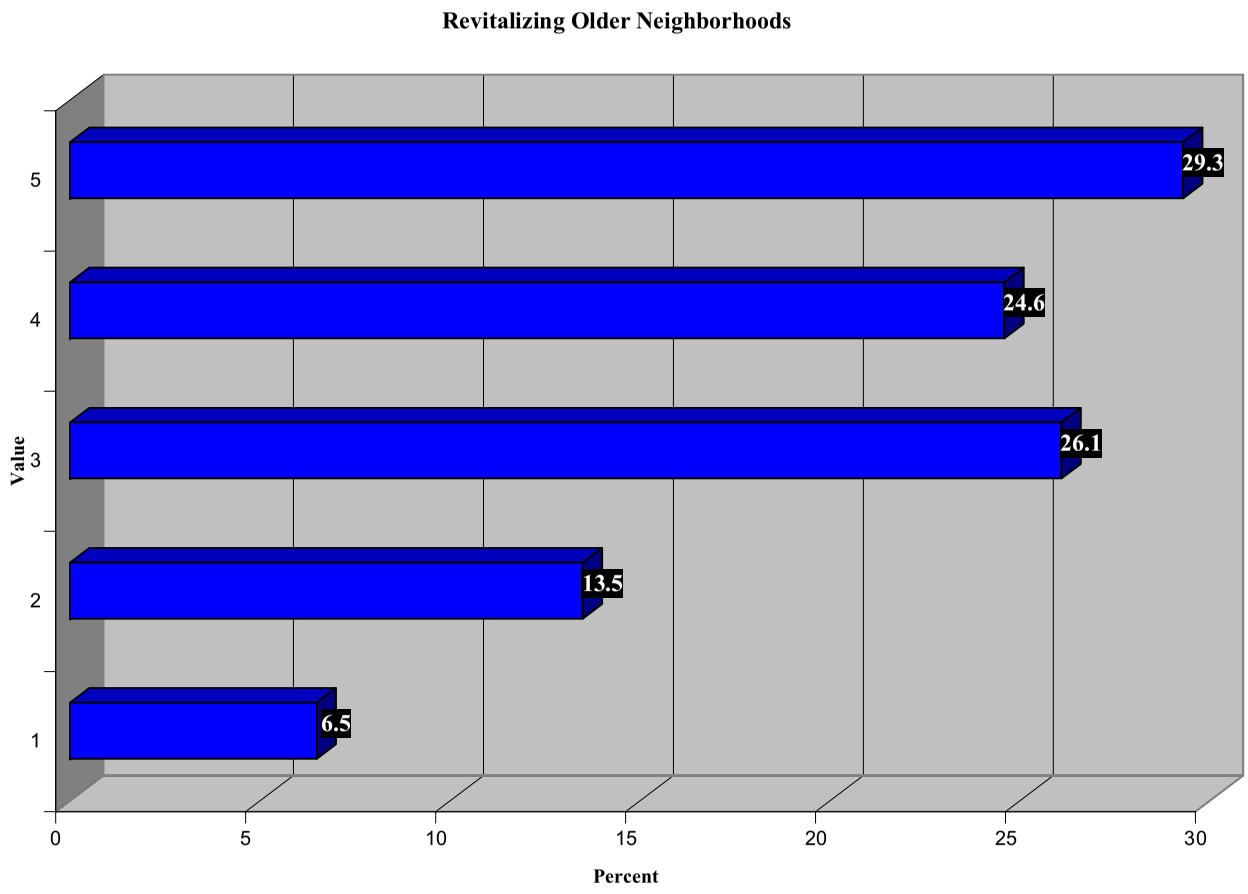
Importance Variable	N Valid	N Missing	Mean	Std. Error of Mean	Median	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
Public Safety Services (cont.)												
Examining potential impacts from Yucca Mountain nuclear waste shipments	581	19	3.99	0.054	5	1.295	-1.059	0.101	-0.082	0.202	1	5
Regional justice services and facilities	585	15	3.93	0.042	4	1.014	-0.723	0.101	0	0.202	1	5
Community Development Services												
Providing affordable housing	593	6	3.86	0.054	4	1.305	-0.862	0.1	-0.456	0.2	1	5
Managing growth	591	8	4.1	0.049	5	1.197	-1.215	0.1	0.45	0.201	1	5
Increasing job opportunities	595	5	4.13	0.047	5	1.154	-1.264	0.1	0.666	0.2	1	5
Improving the business climate	591	9	4.01	0.045	4	1.098	-0.867	0.101	-0.156	0.201	1	5
Planning for commercial development	596	4	3.72	0.048	4	1.17	-0.673	0.1	-0.352	0.2	1	5
Reducing traffic congestion	599	1	4.3	0.045	5	1.1	-1.651	0.1	1.9	0.199	1	5
Access to freeways	598	2	4.11	0.043	4	1.055	-1.142	0.1	0.743	0.2	1	5
Improving road conditions	598	2	4.18	0.044	5	1.069	-1.269	0.1	0.942	0.2	1	5
Reducing travel time	597	3	3.96	0.05	4	1.213	-0.935	0.1	-0.139	0.2	1	5
Providing mass public transit	597	2	3.77	0.054	4	1.318	-0.788	0.1	-0.535	0.2	1	5
Adequate airport facilities	596	4	3.96	0.049	4	1.19	-1.037	0.1	0.177	0.2	1	5
Parks and recreation programs	598	2	4.18	0.04	4	0.977	-1.112	0.1	0.756	0.2	1	5

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



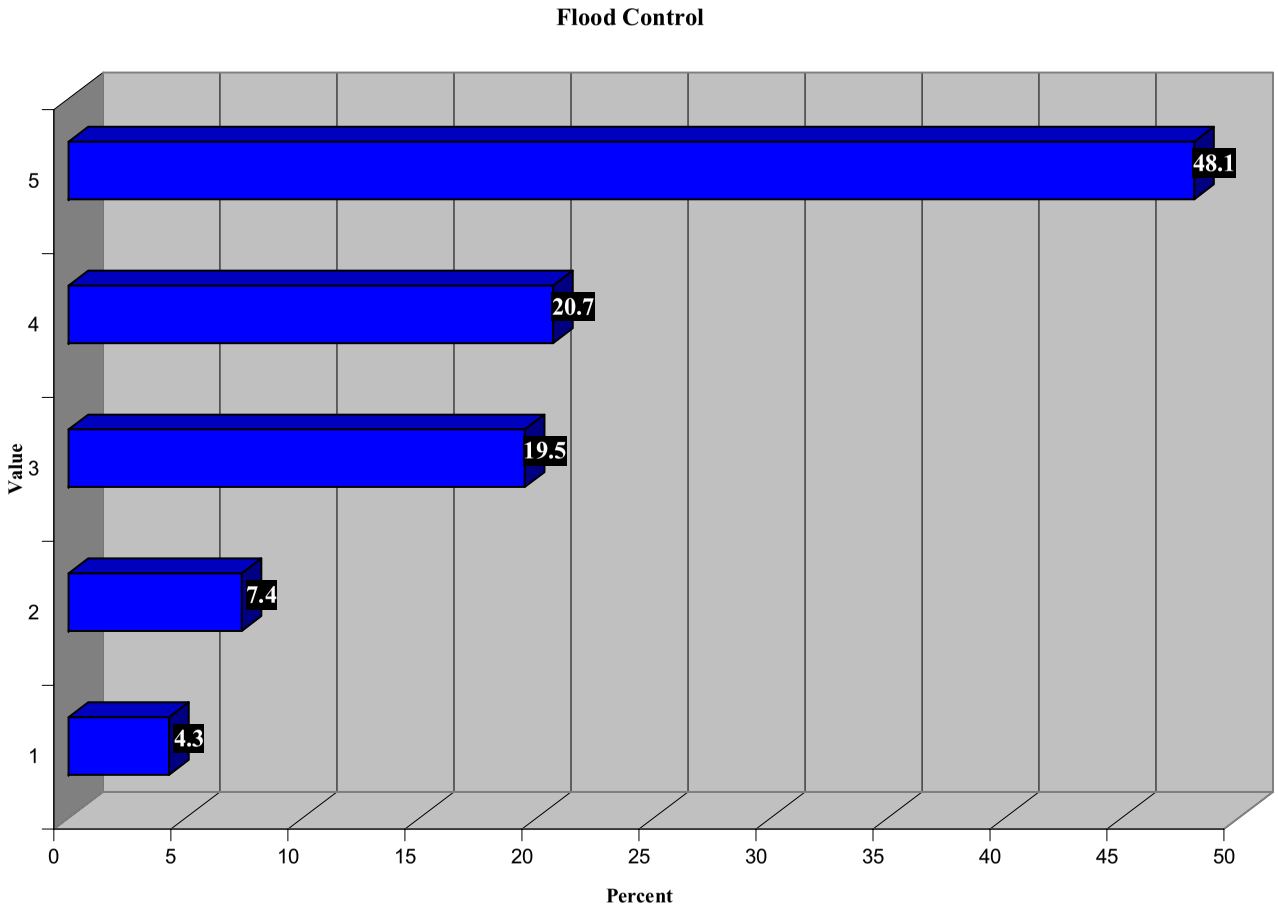
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



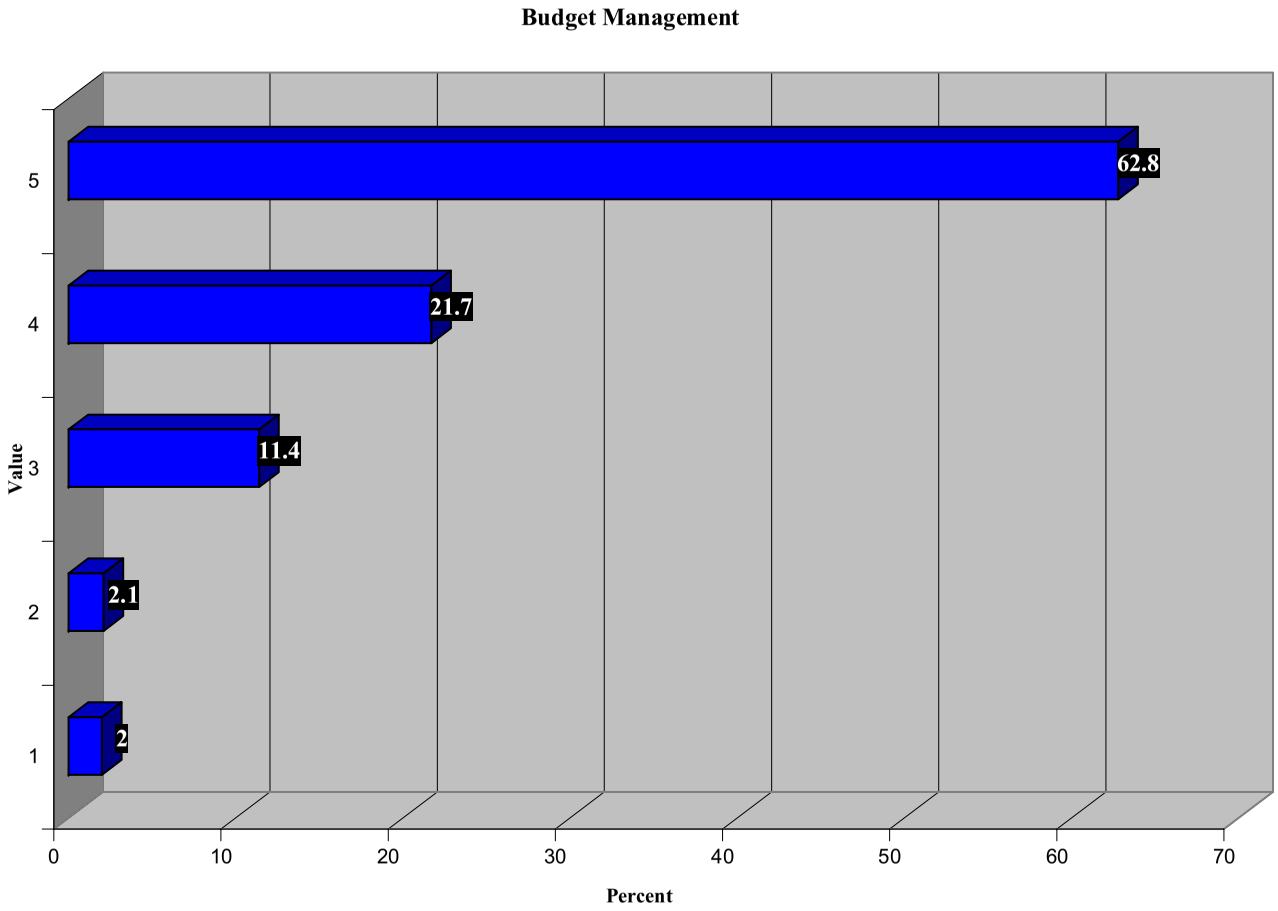
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



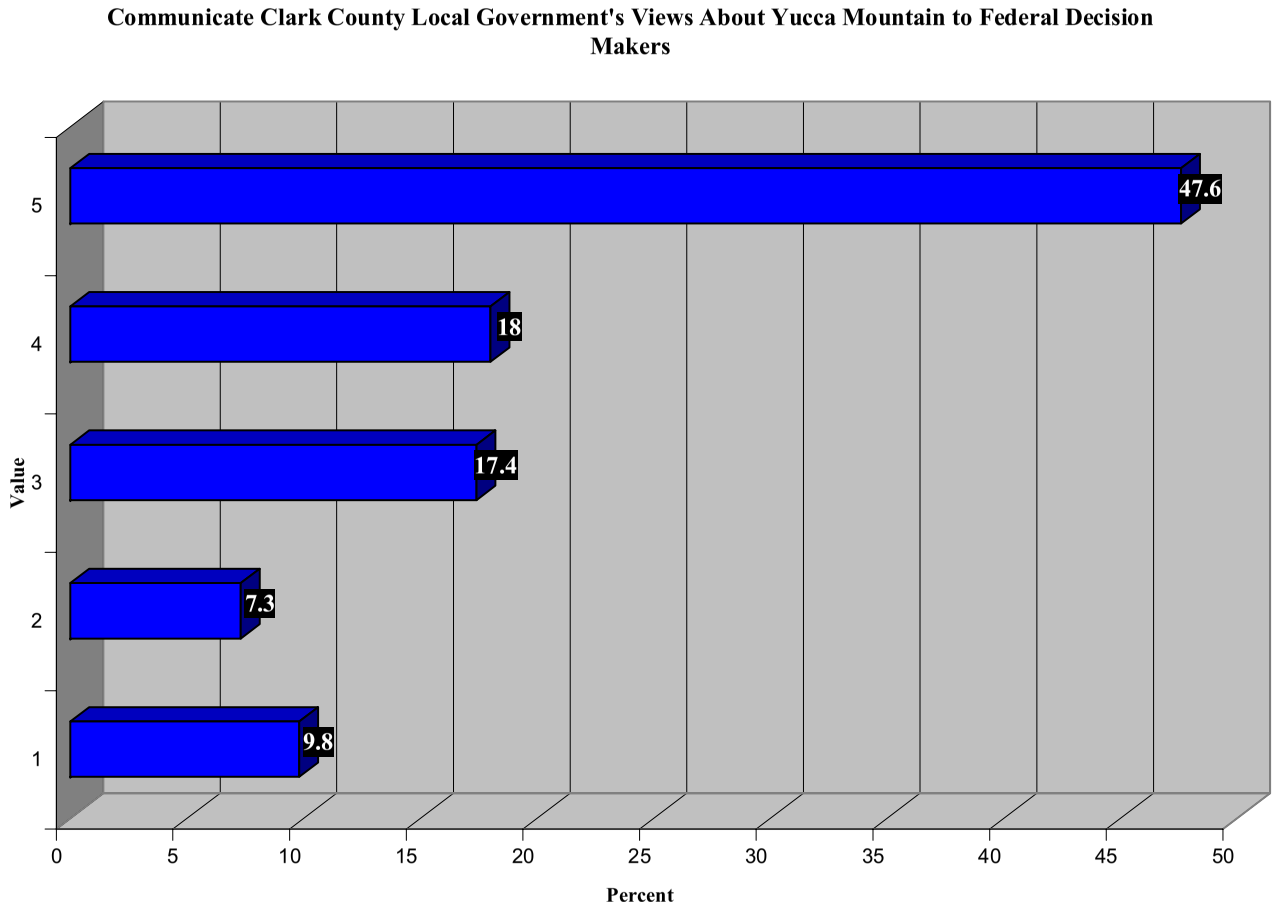
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



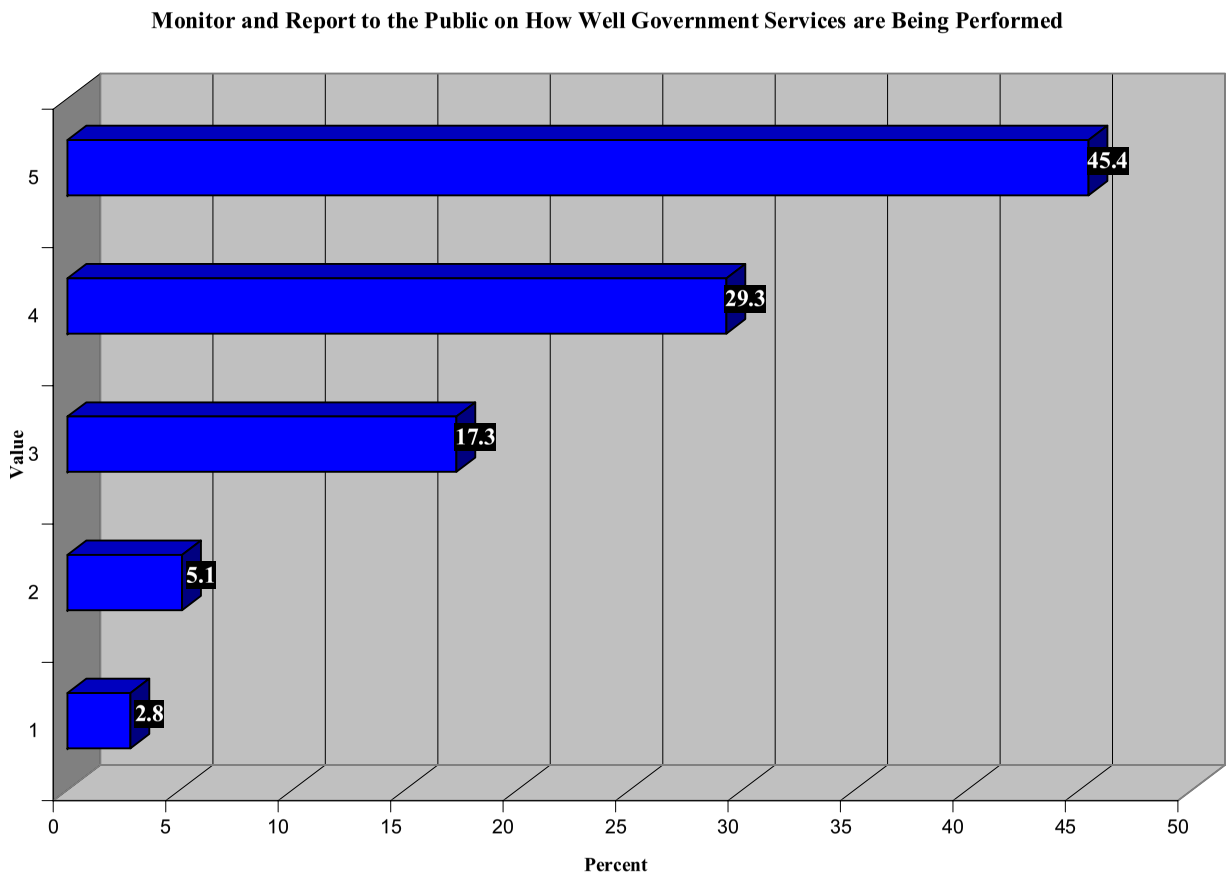
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



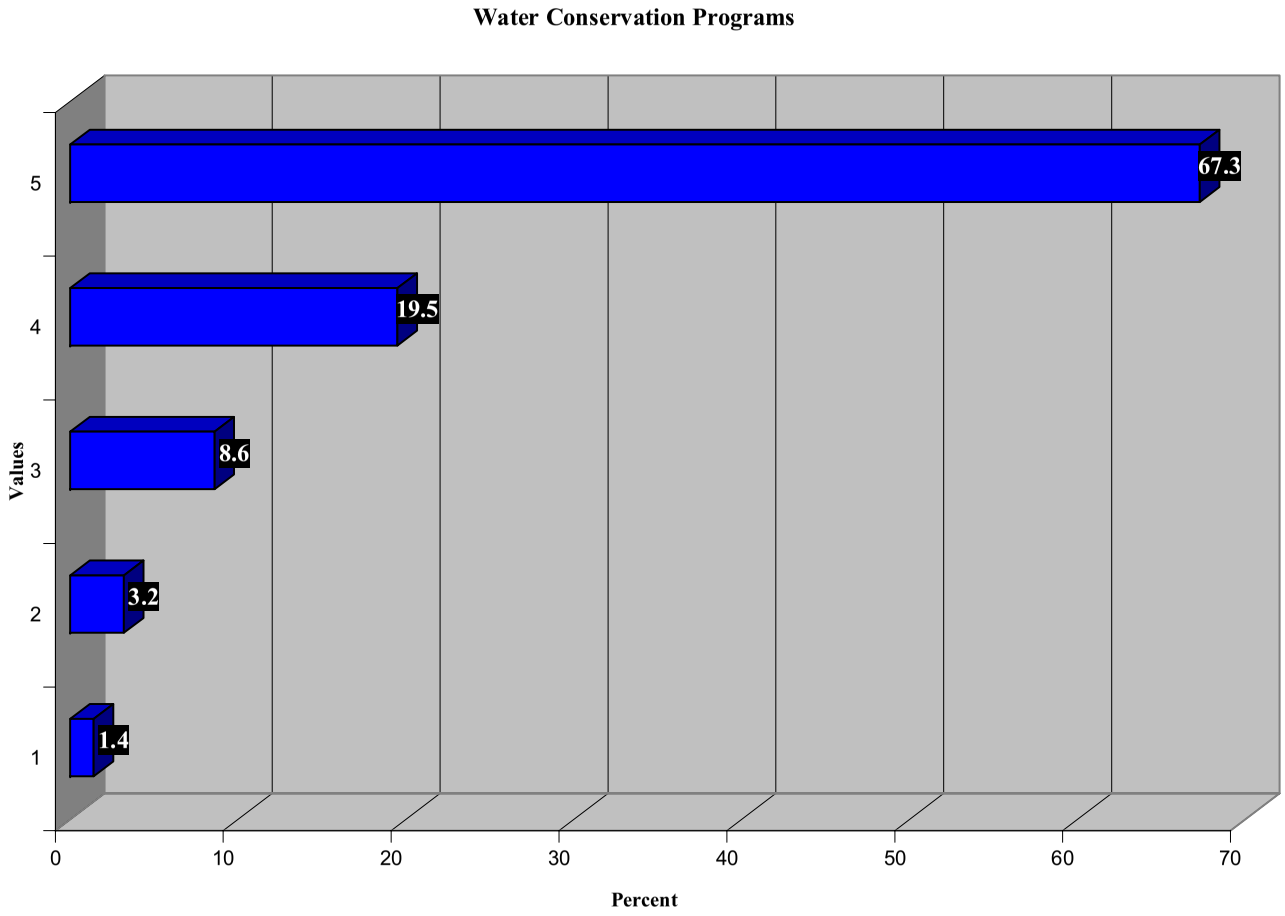
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



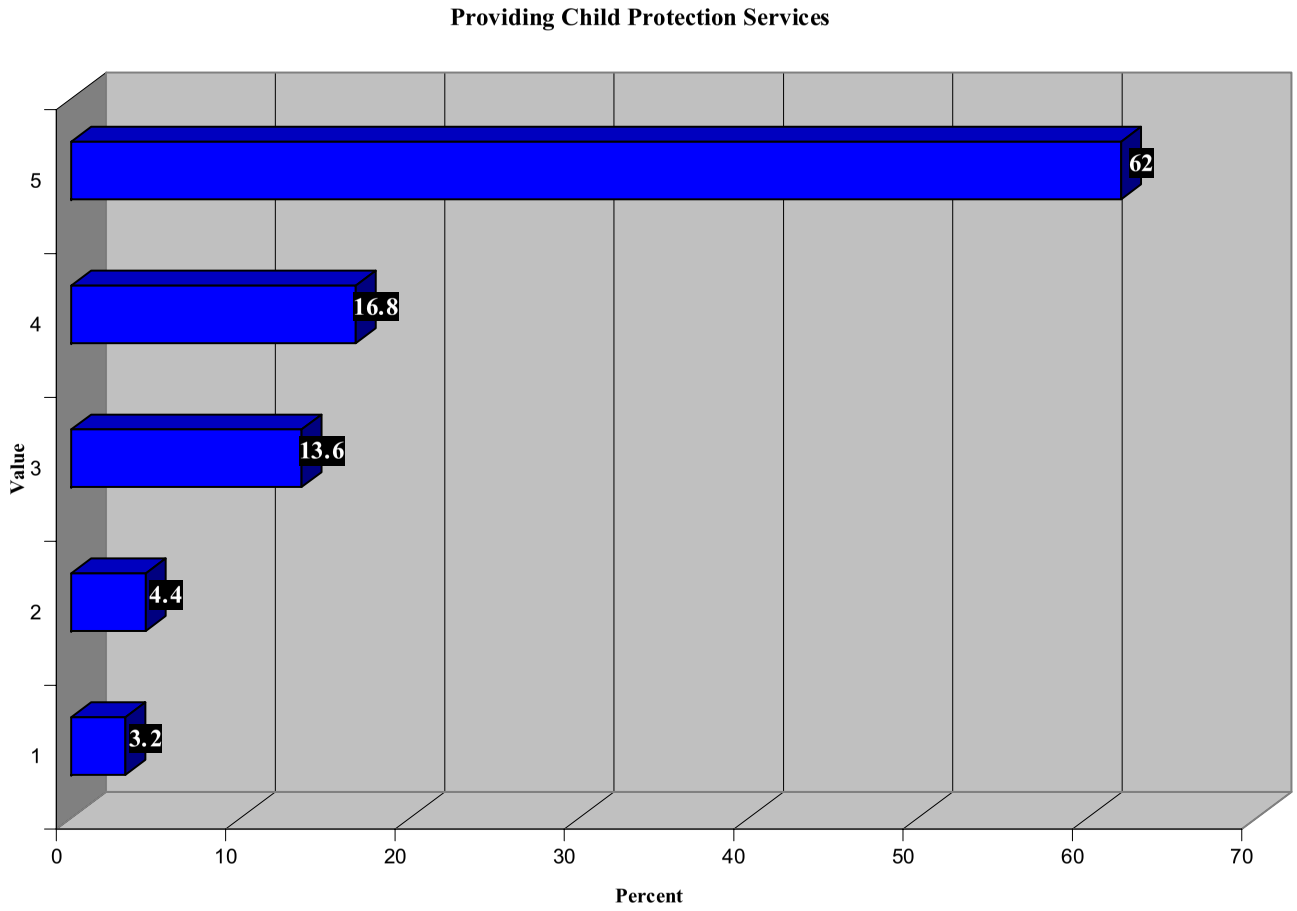
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



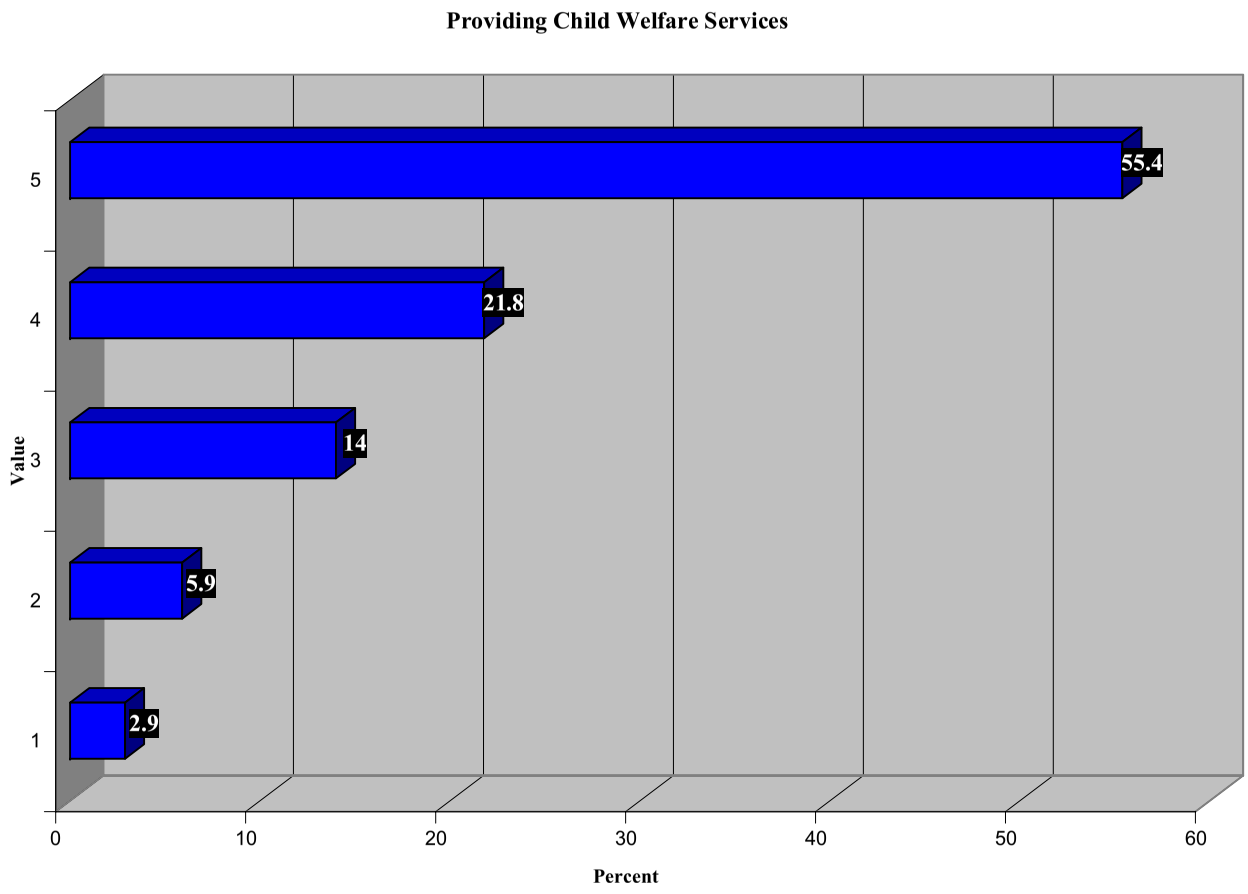
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



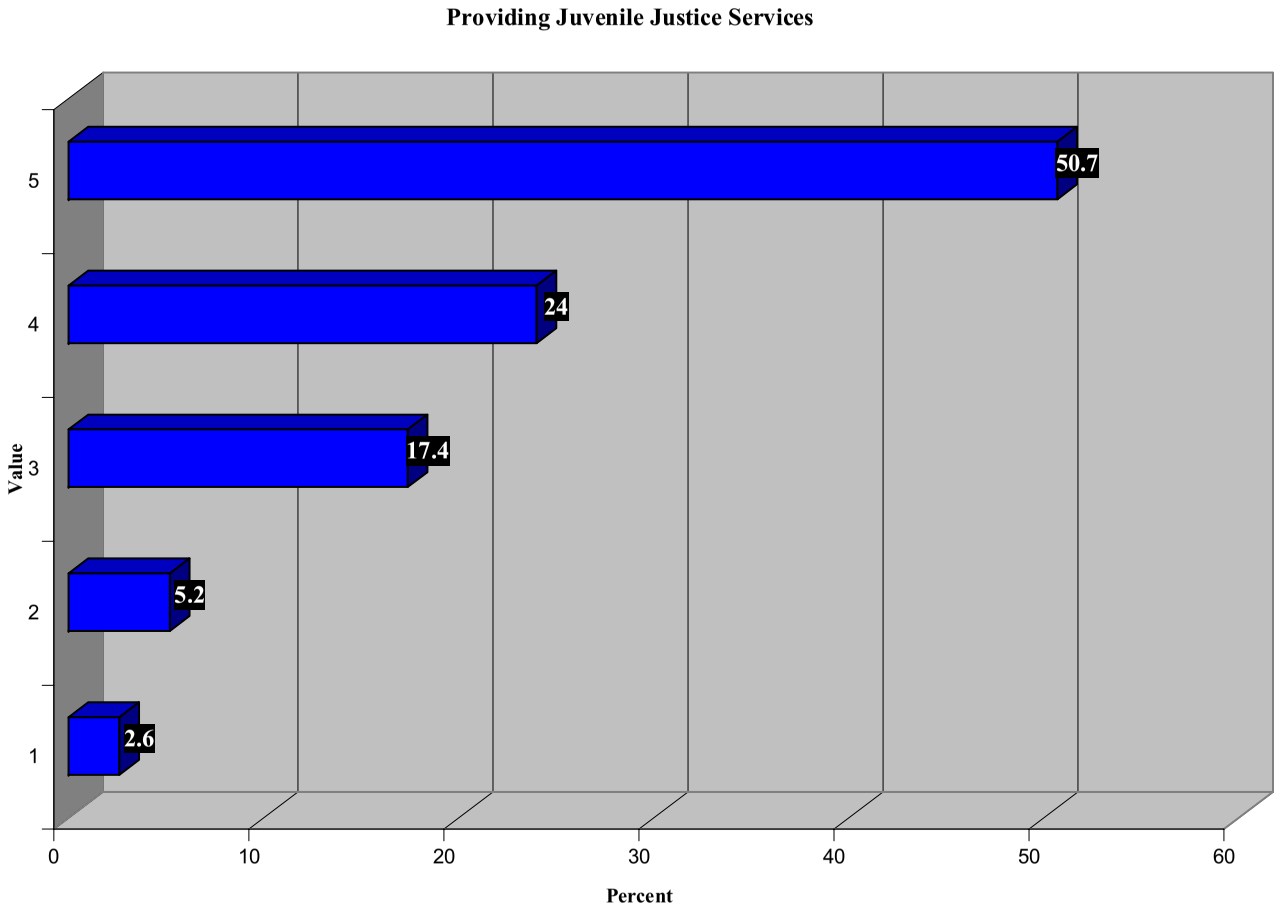
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

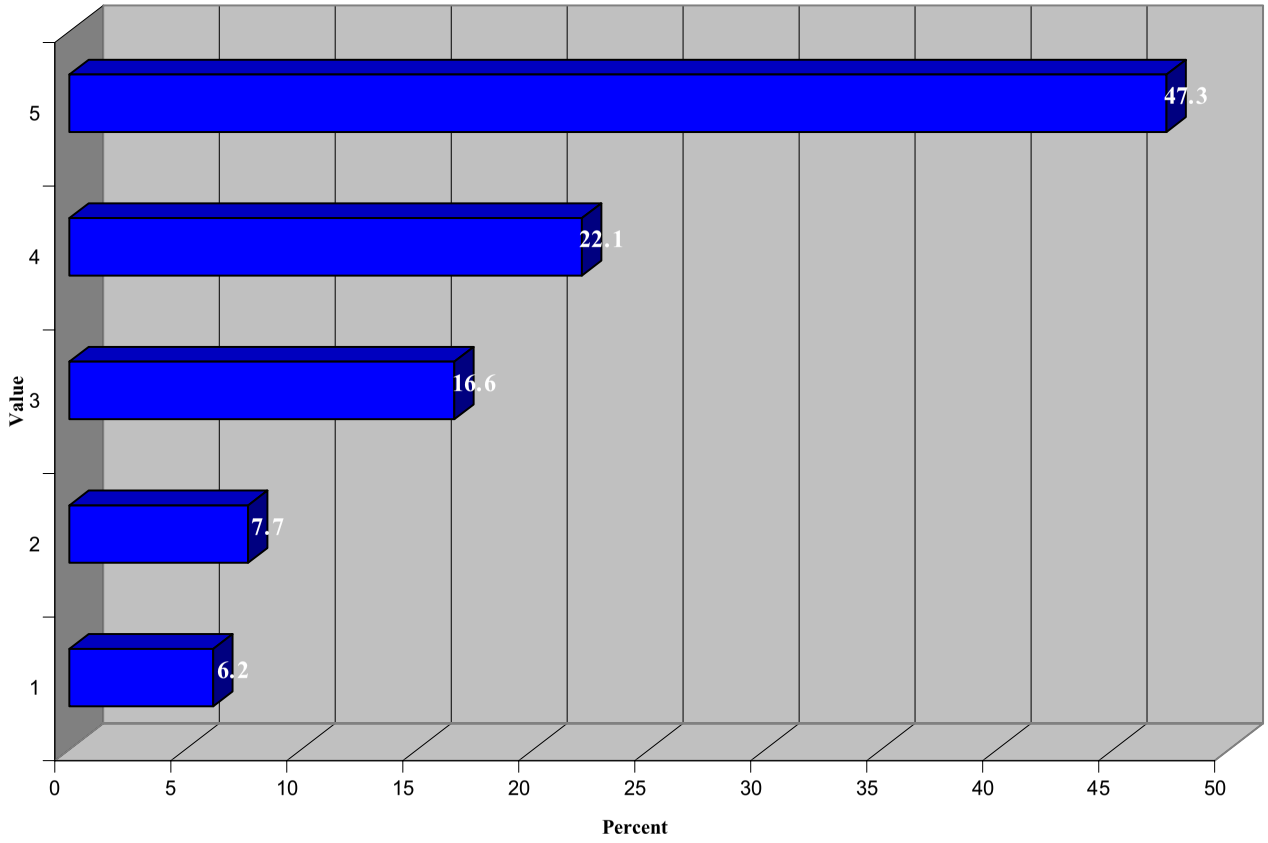
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

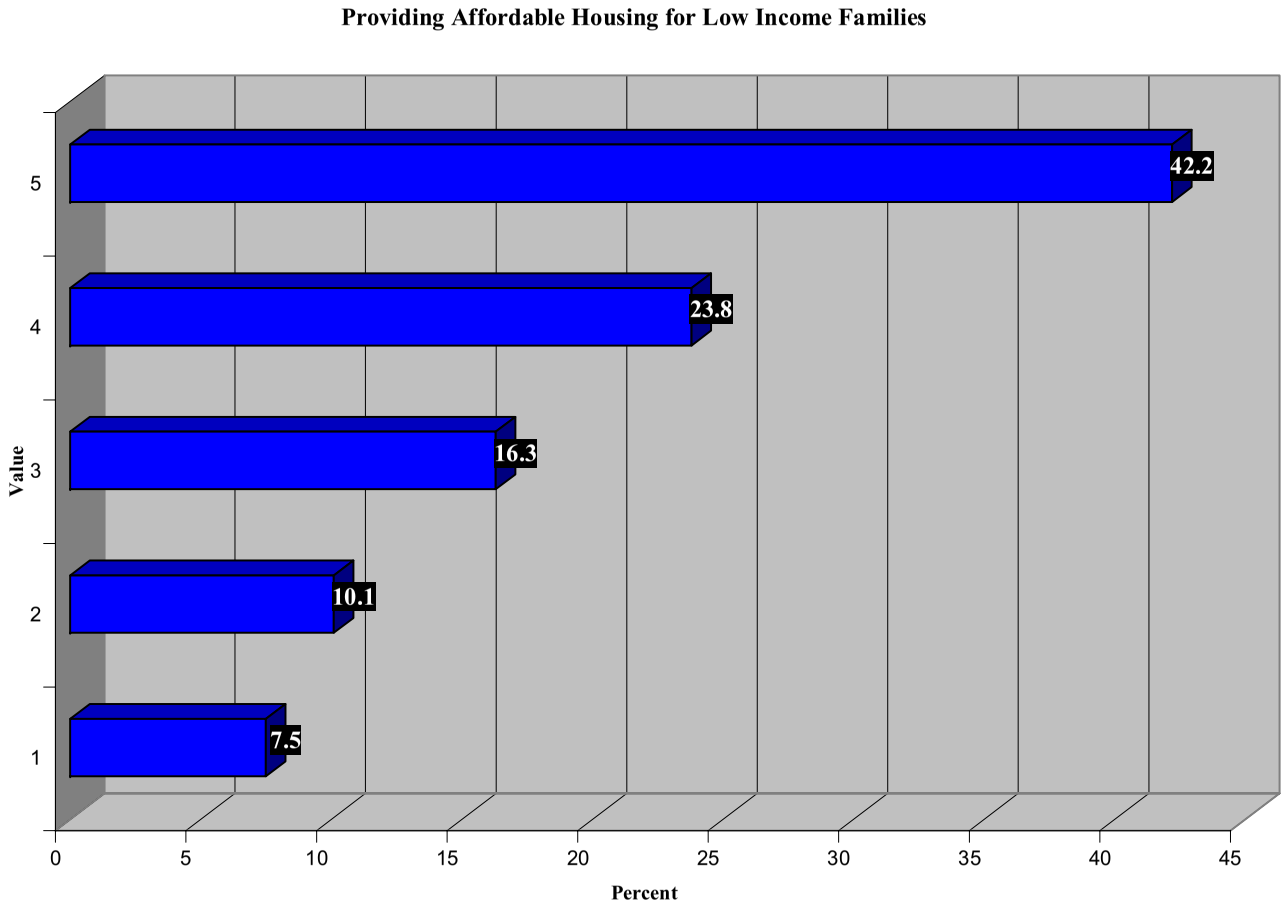
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)

Providing Attainable Housing for Working Class Families



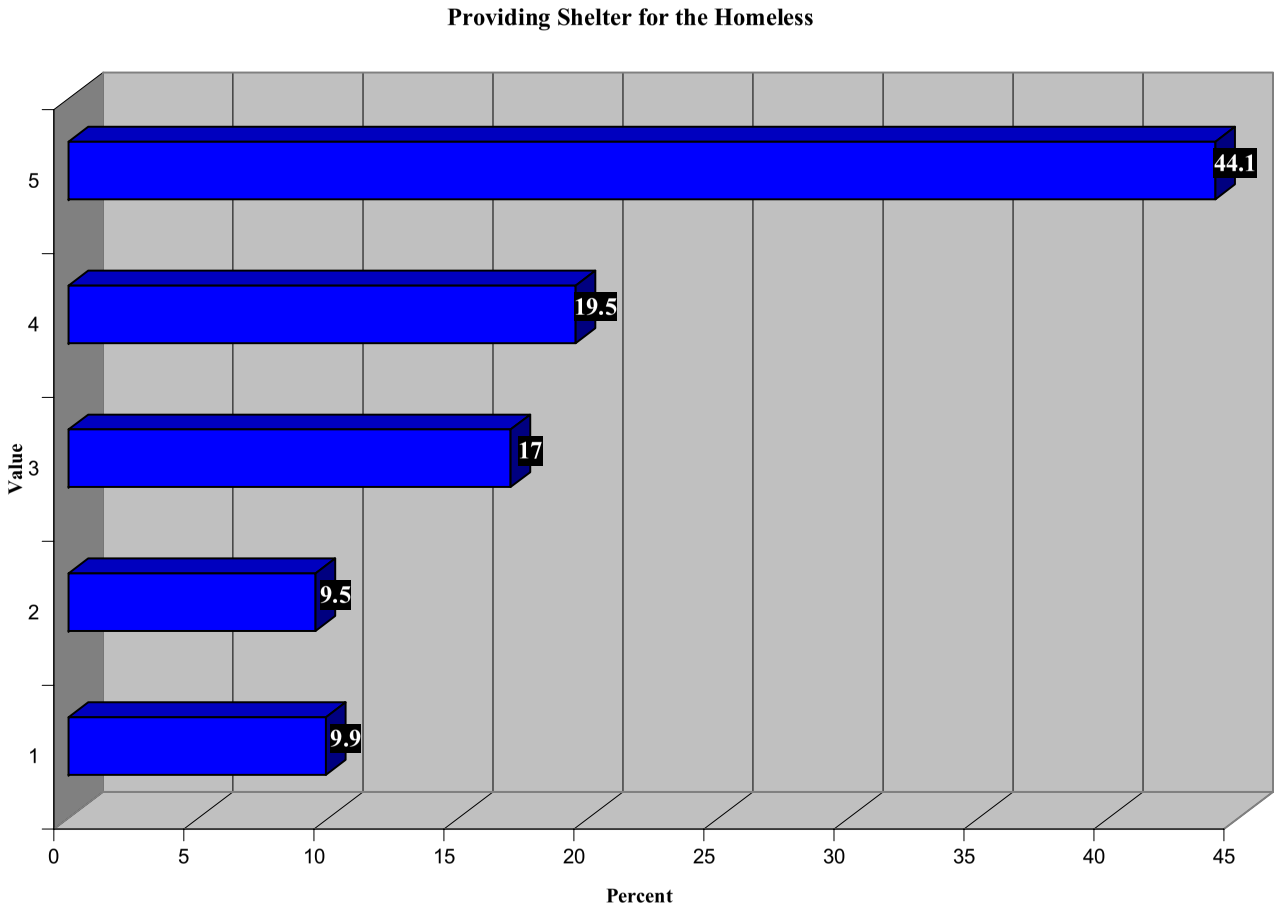
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



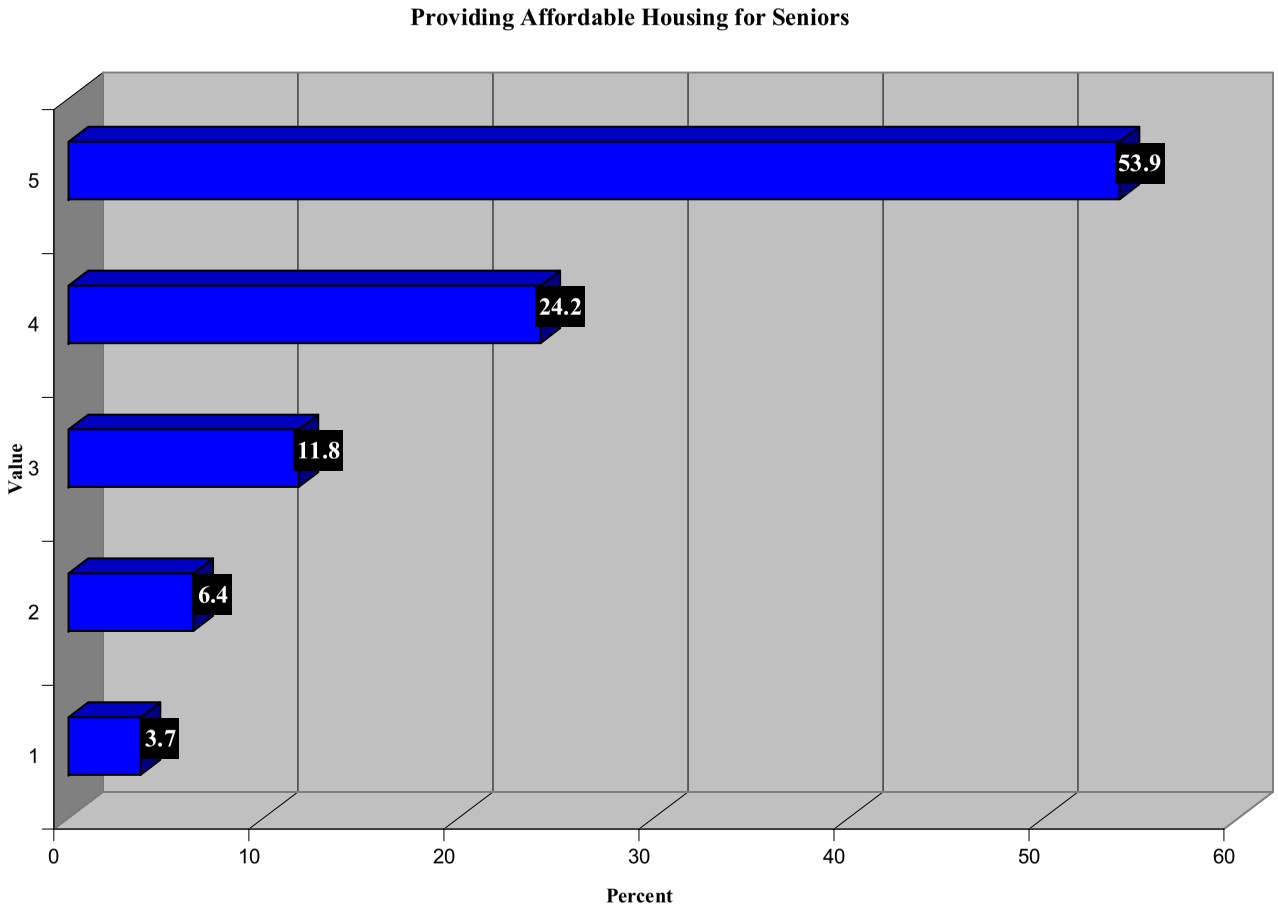
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



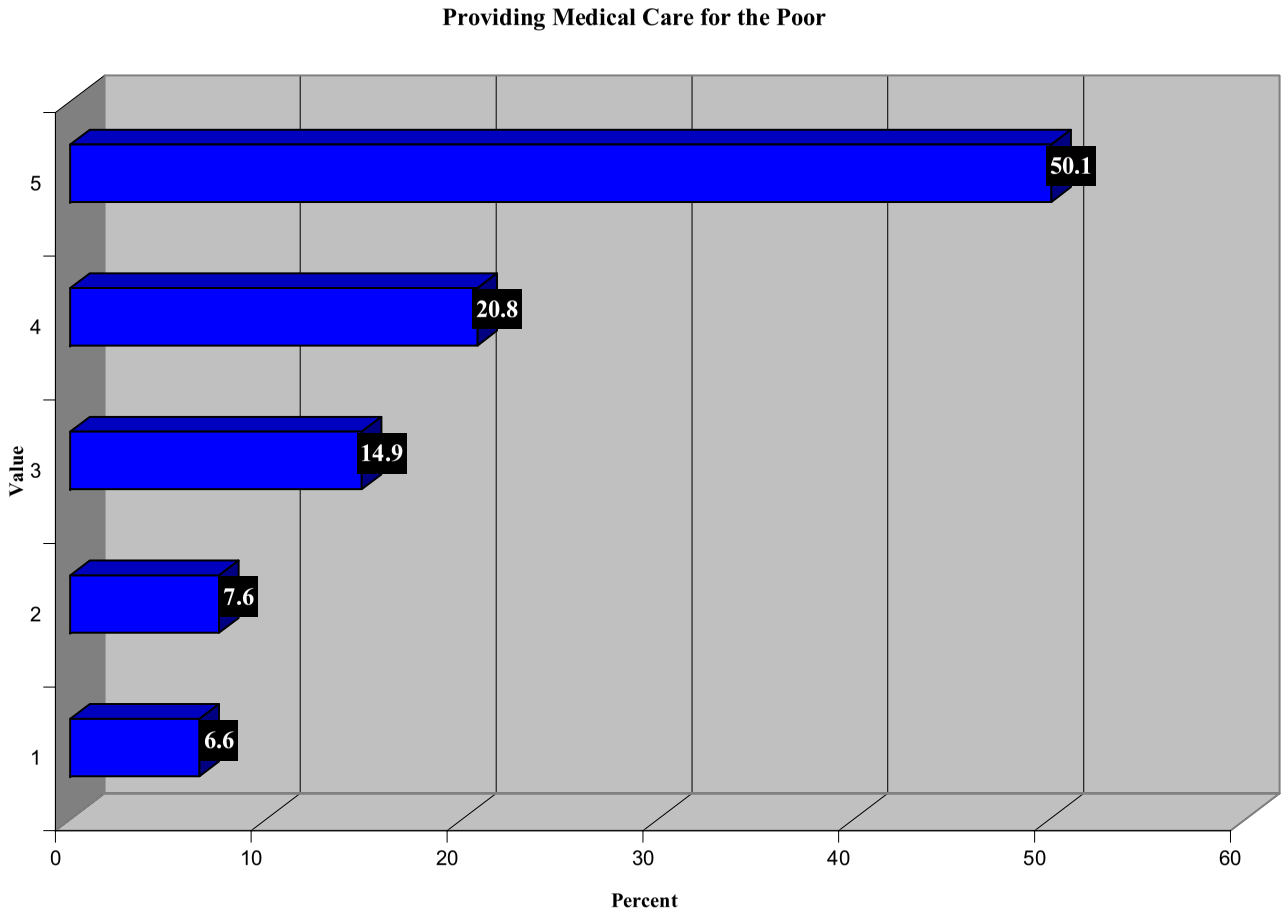
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



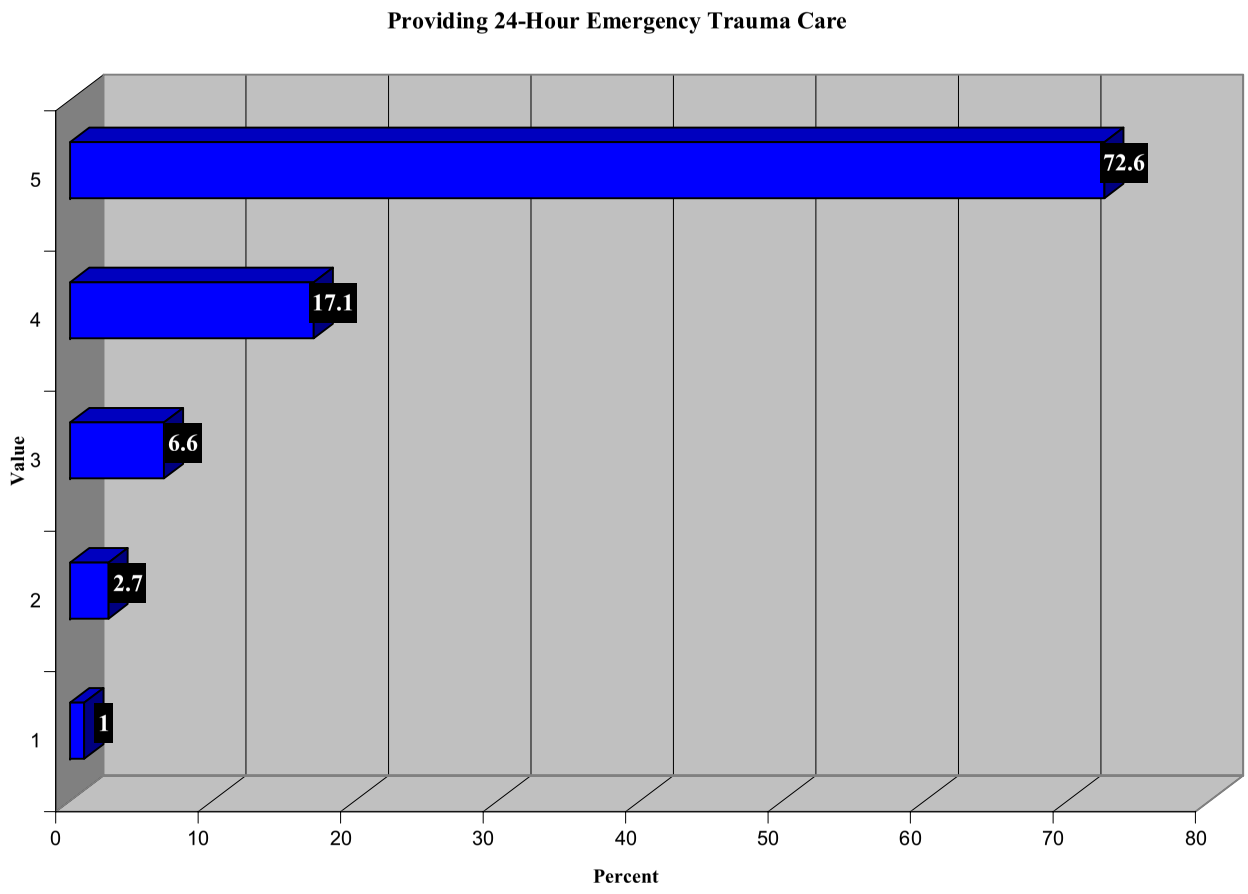
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



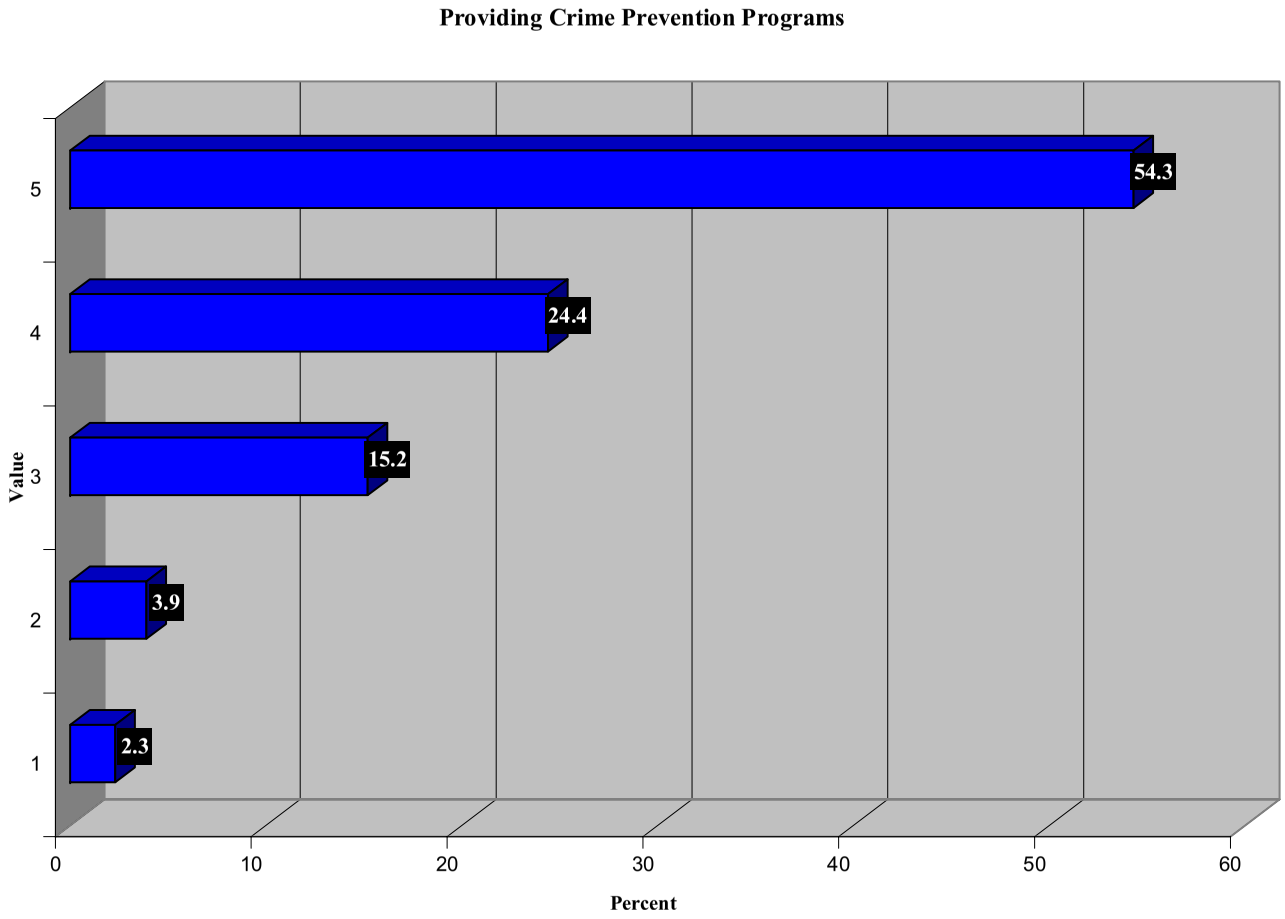
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



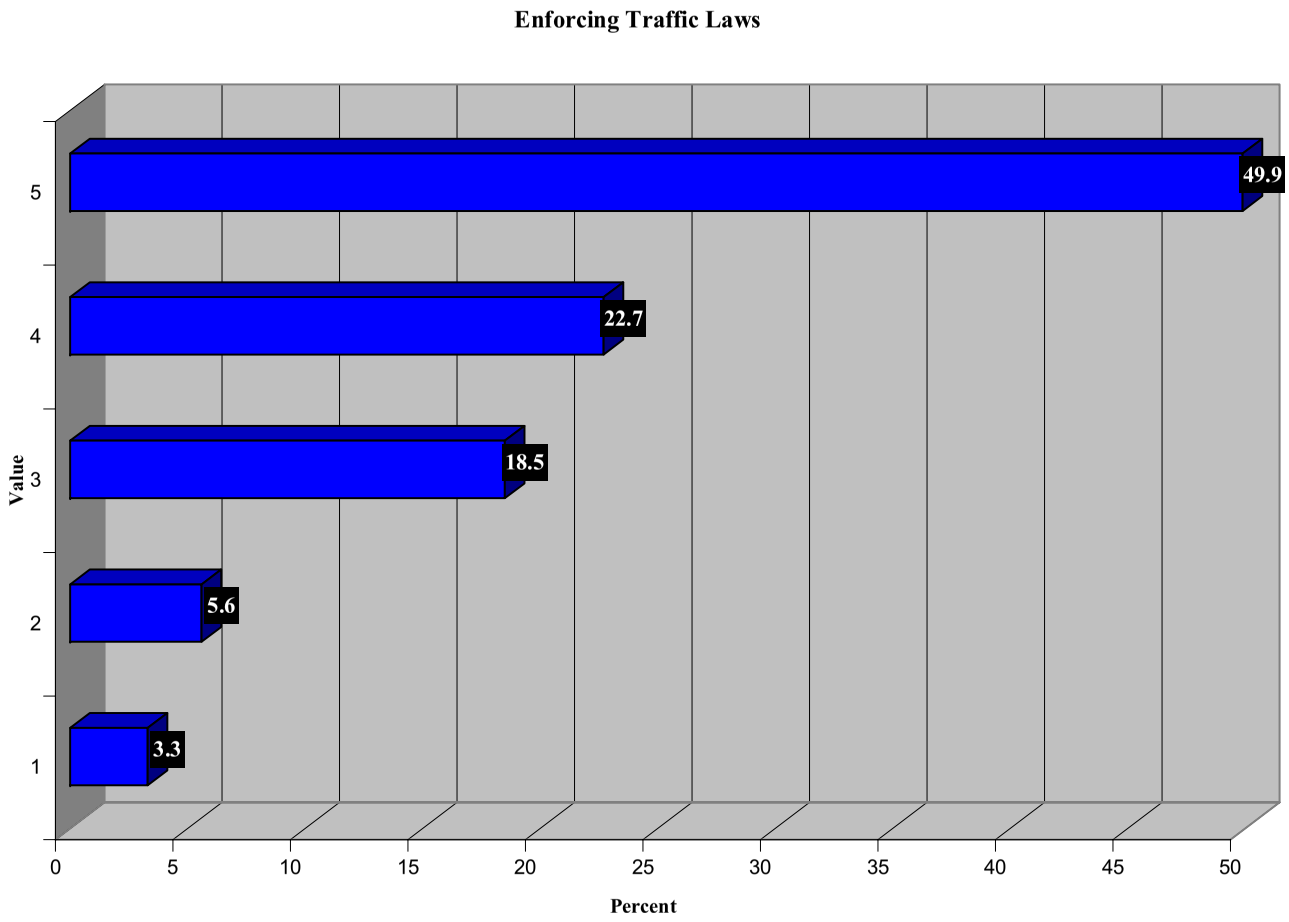
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



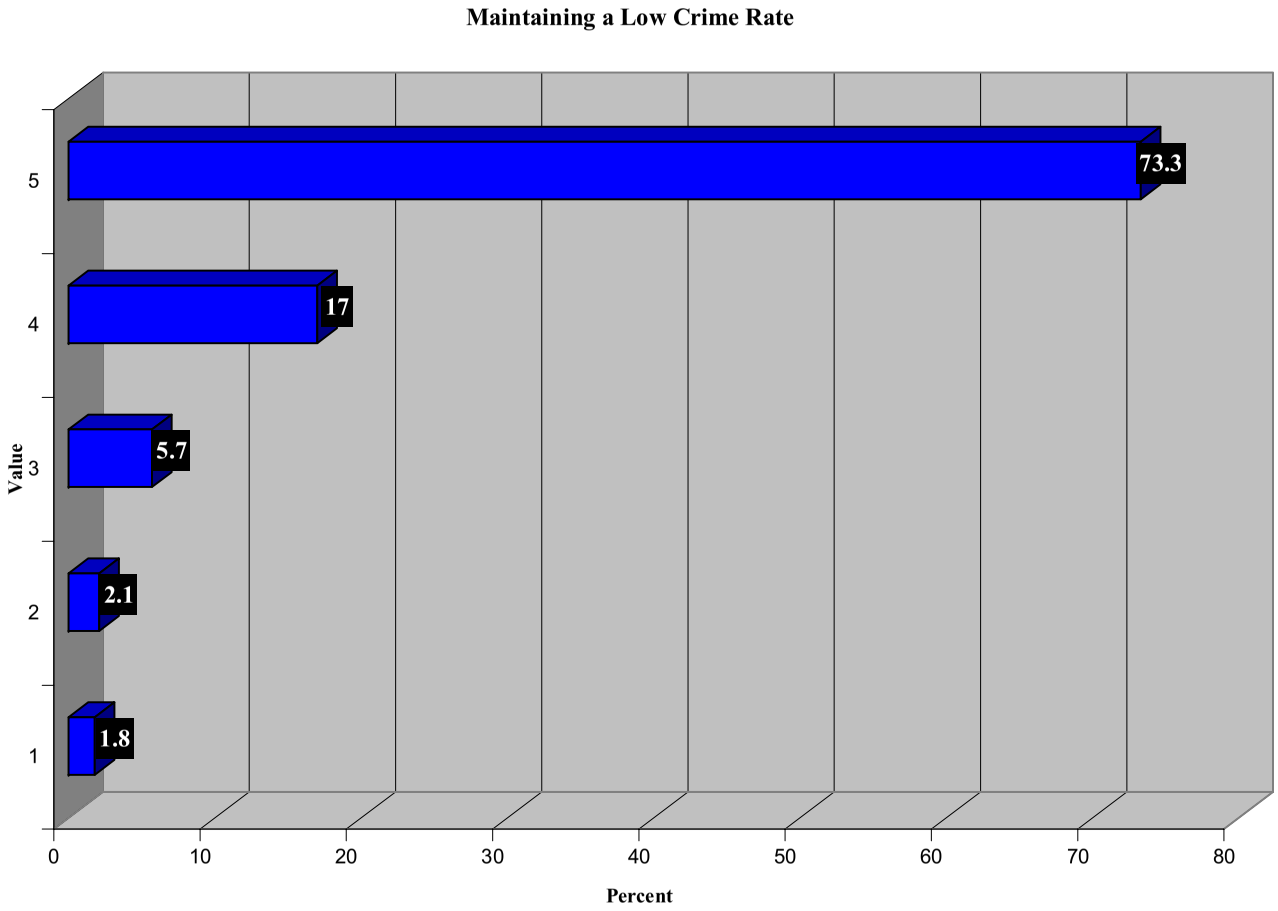
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



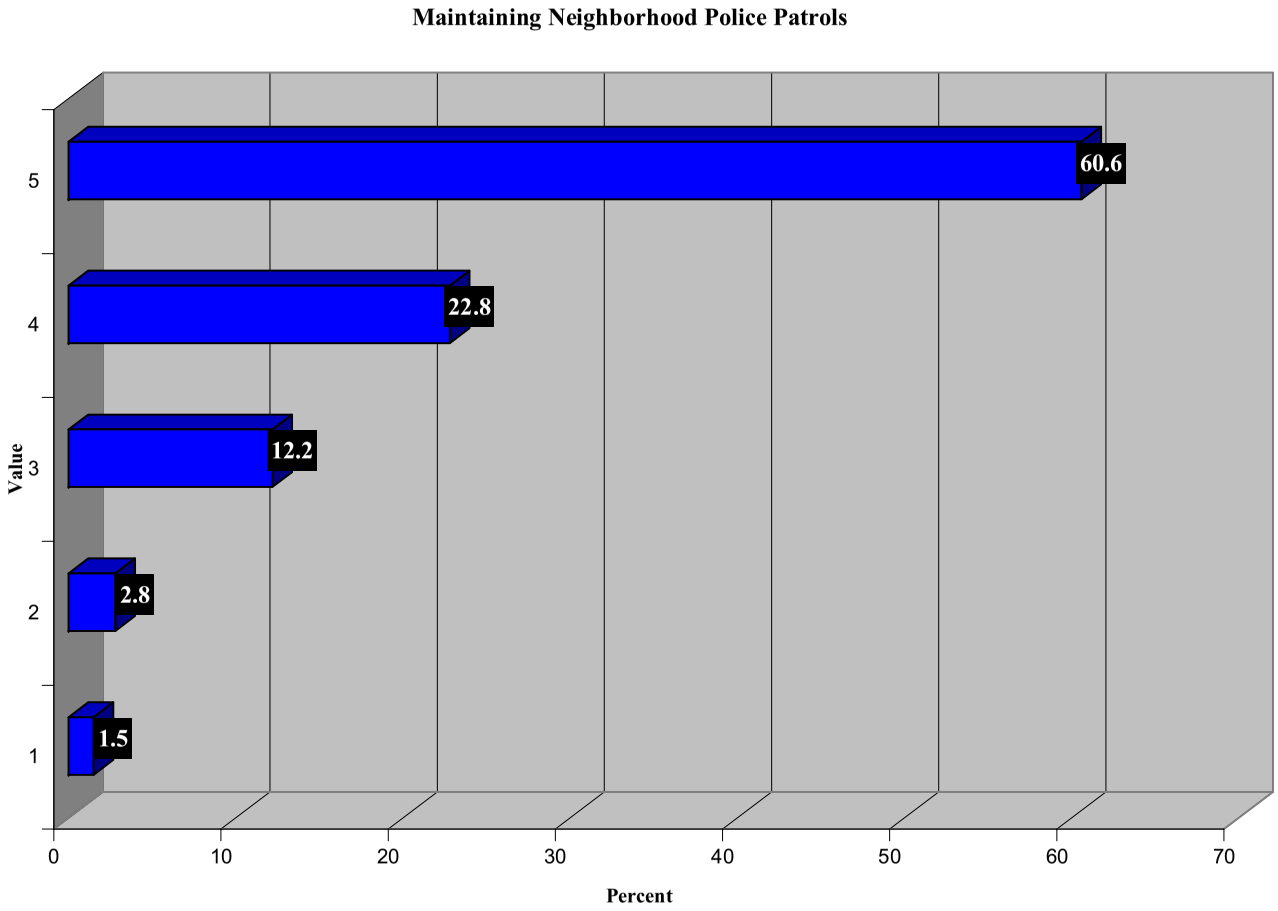
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



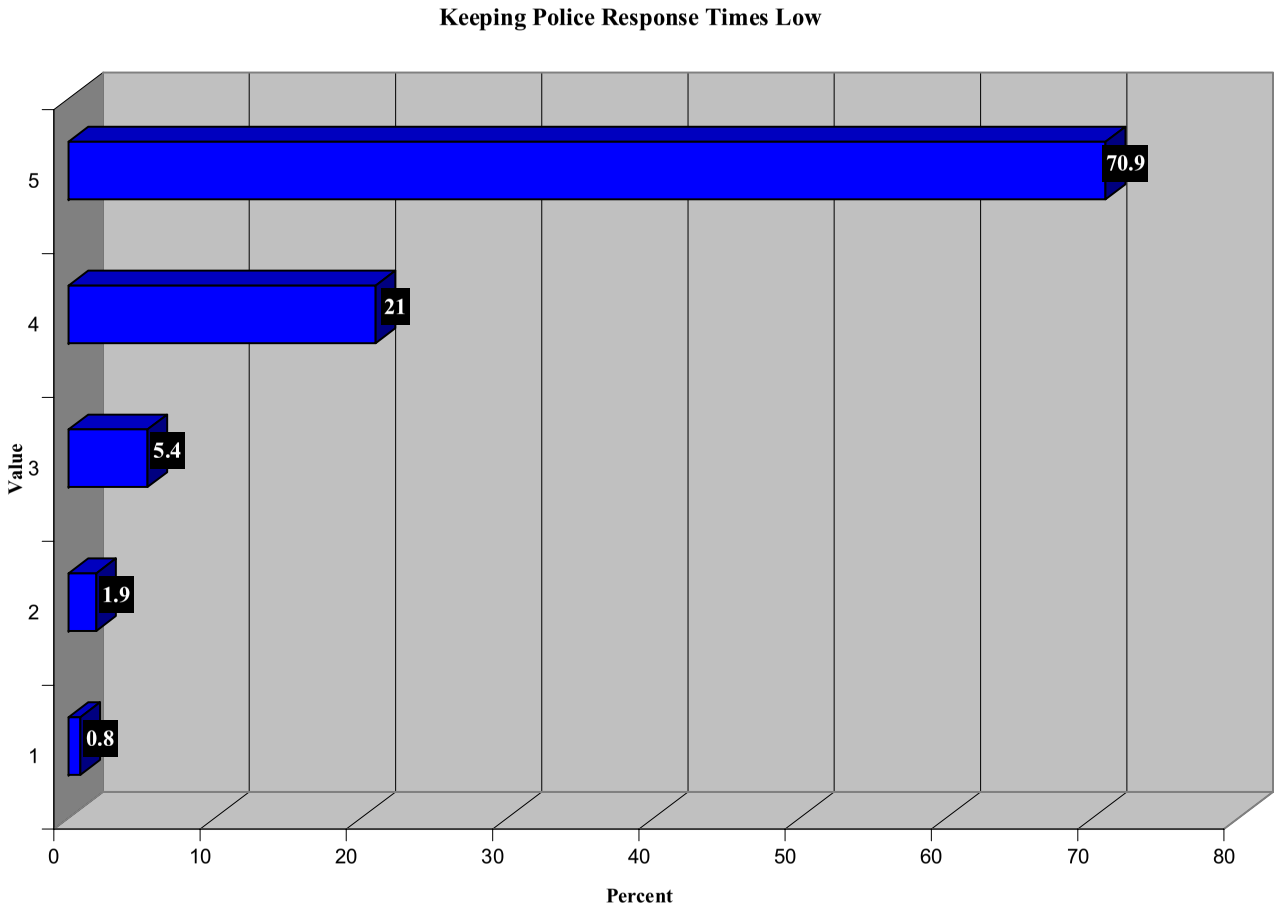
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



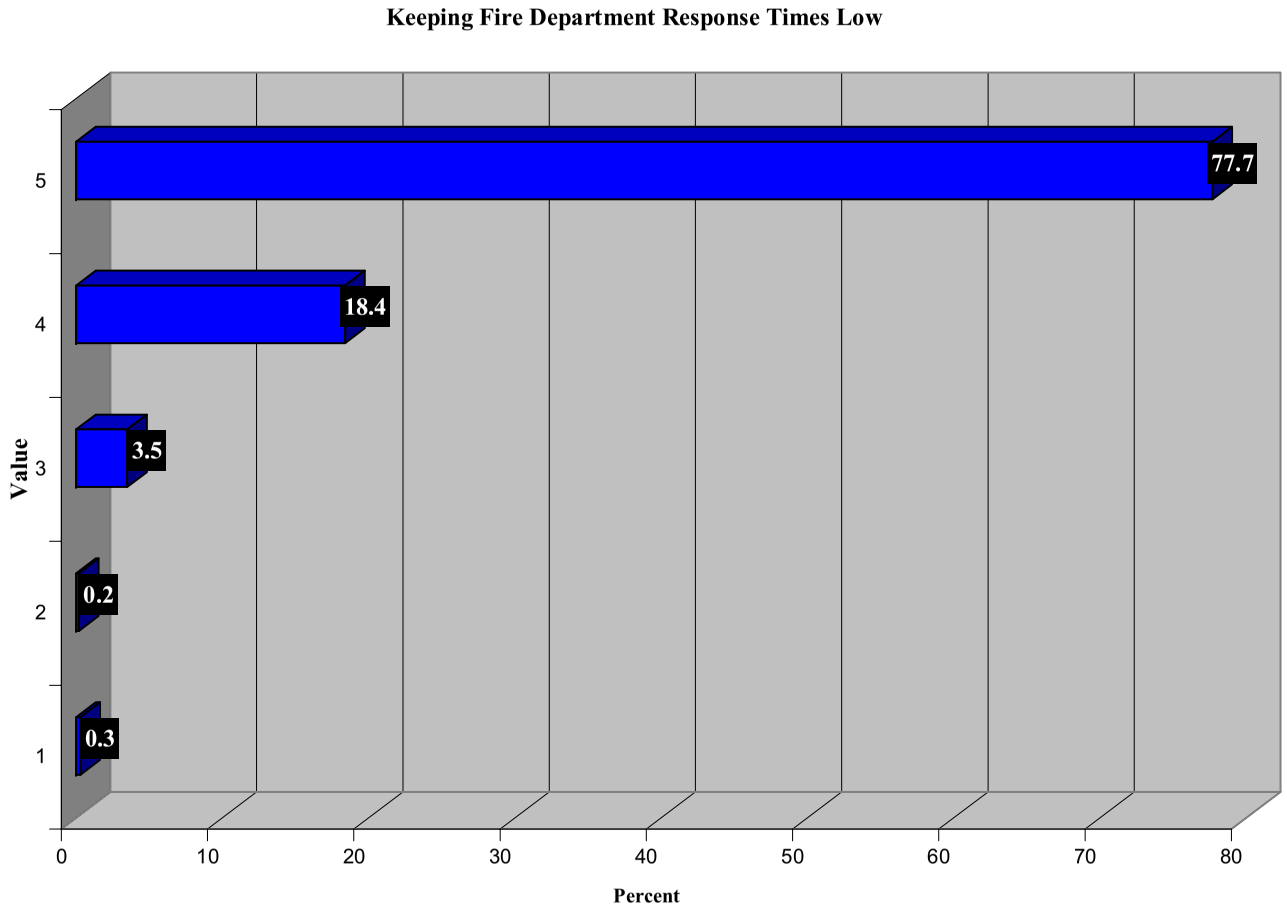
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



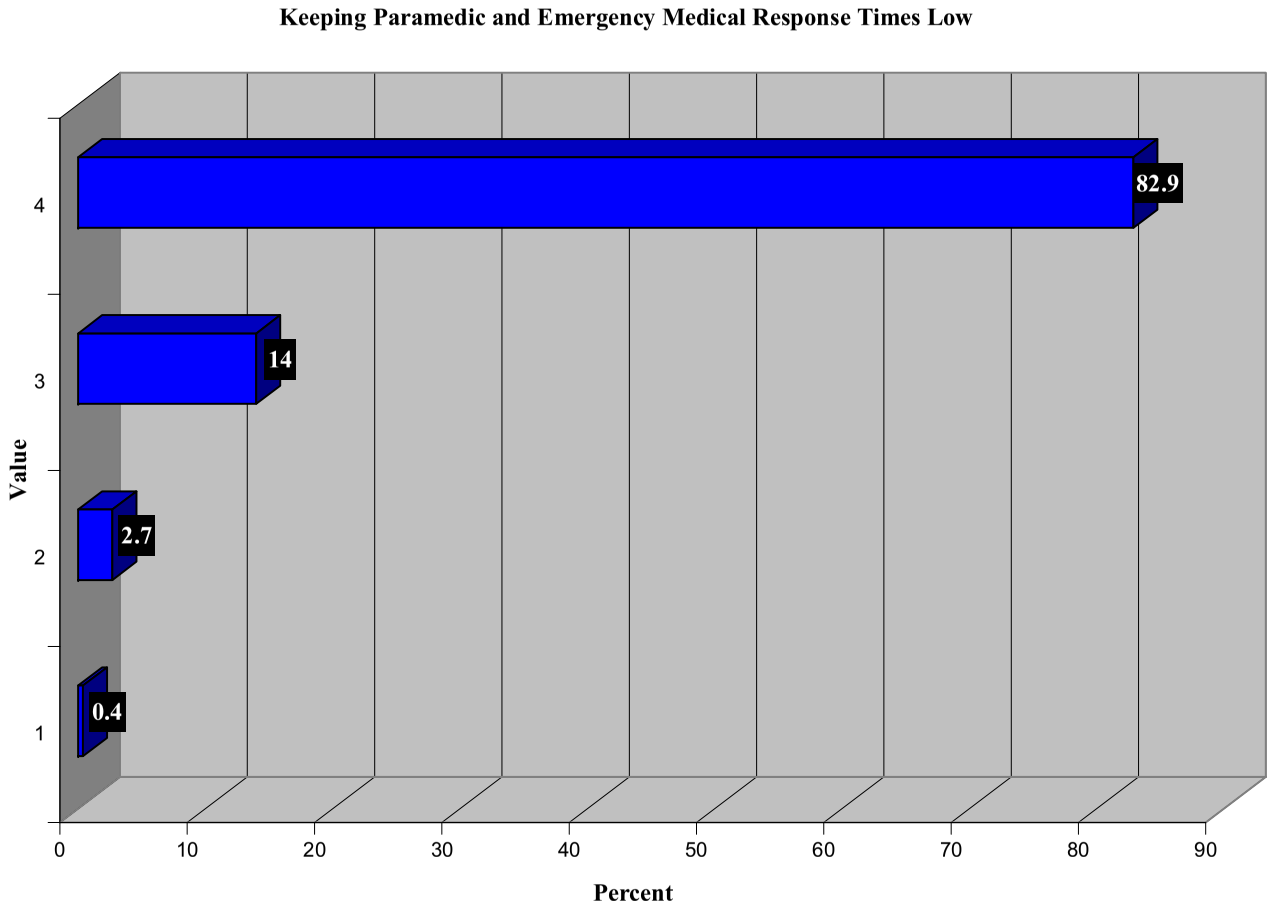
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



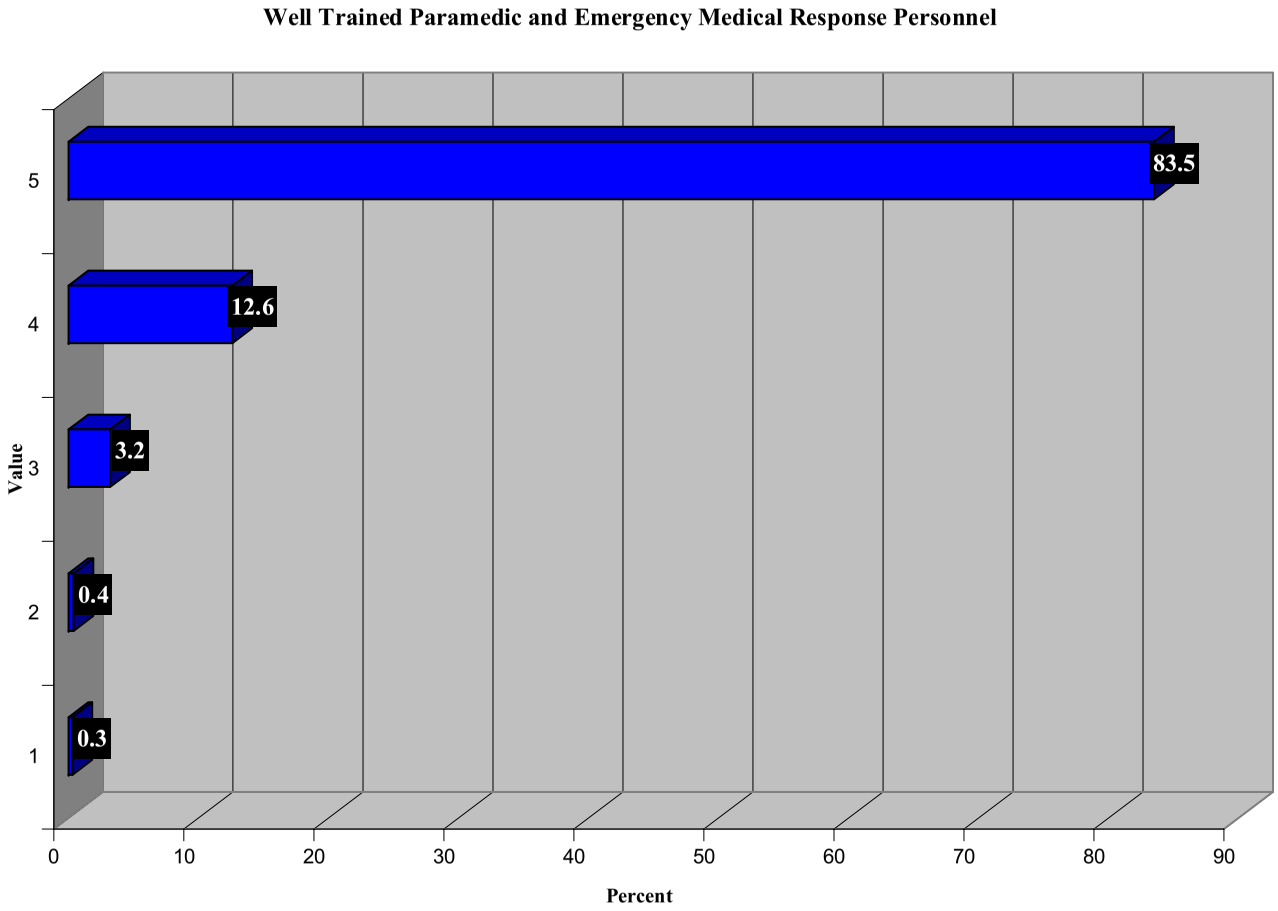
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



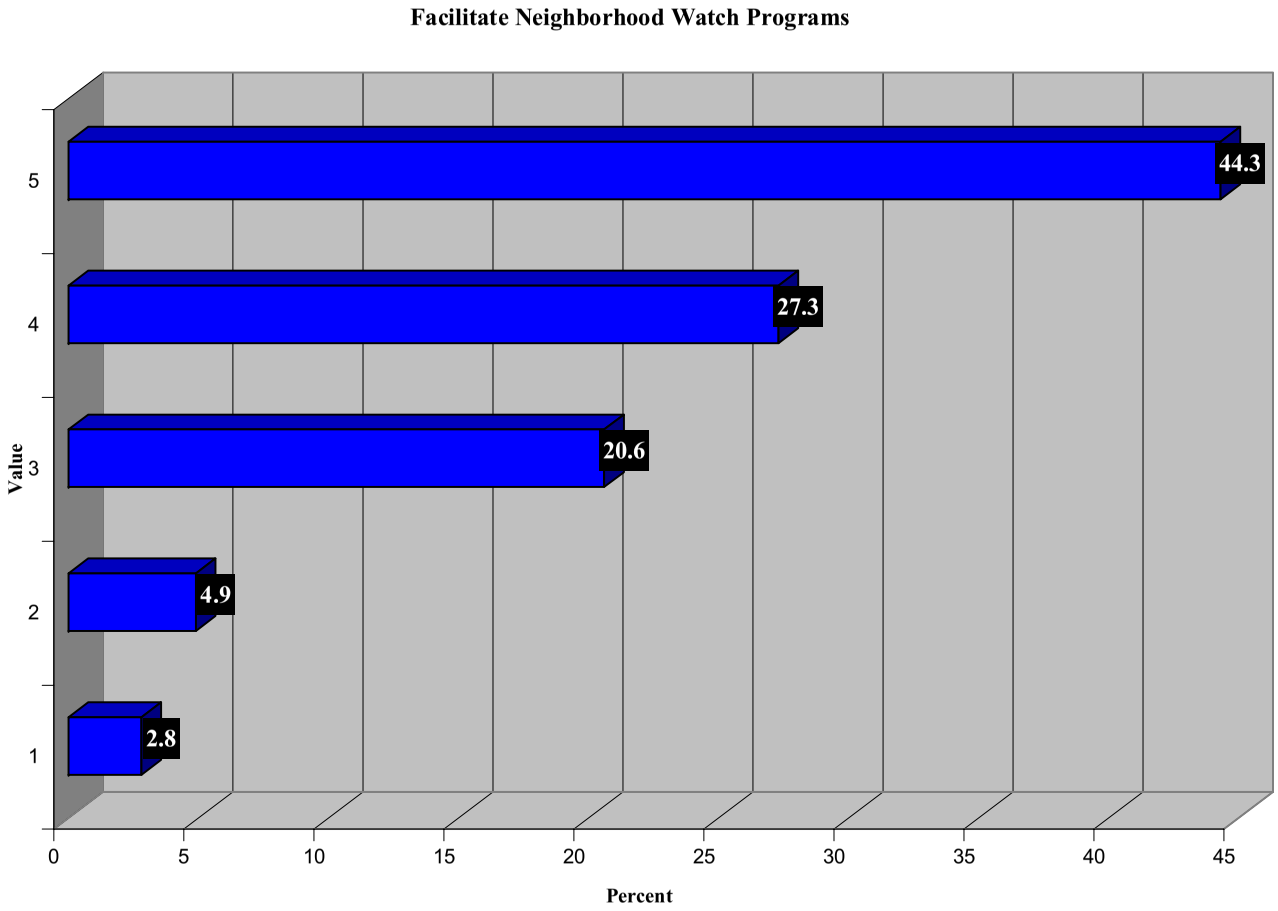
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

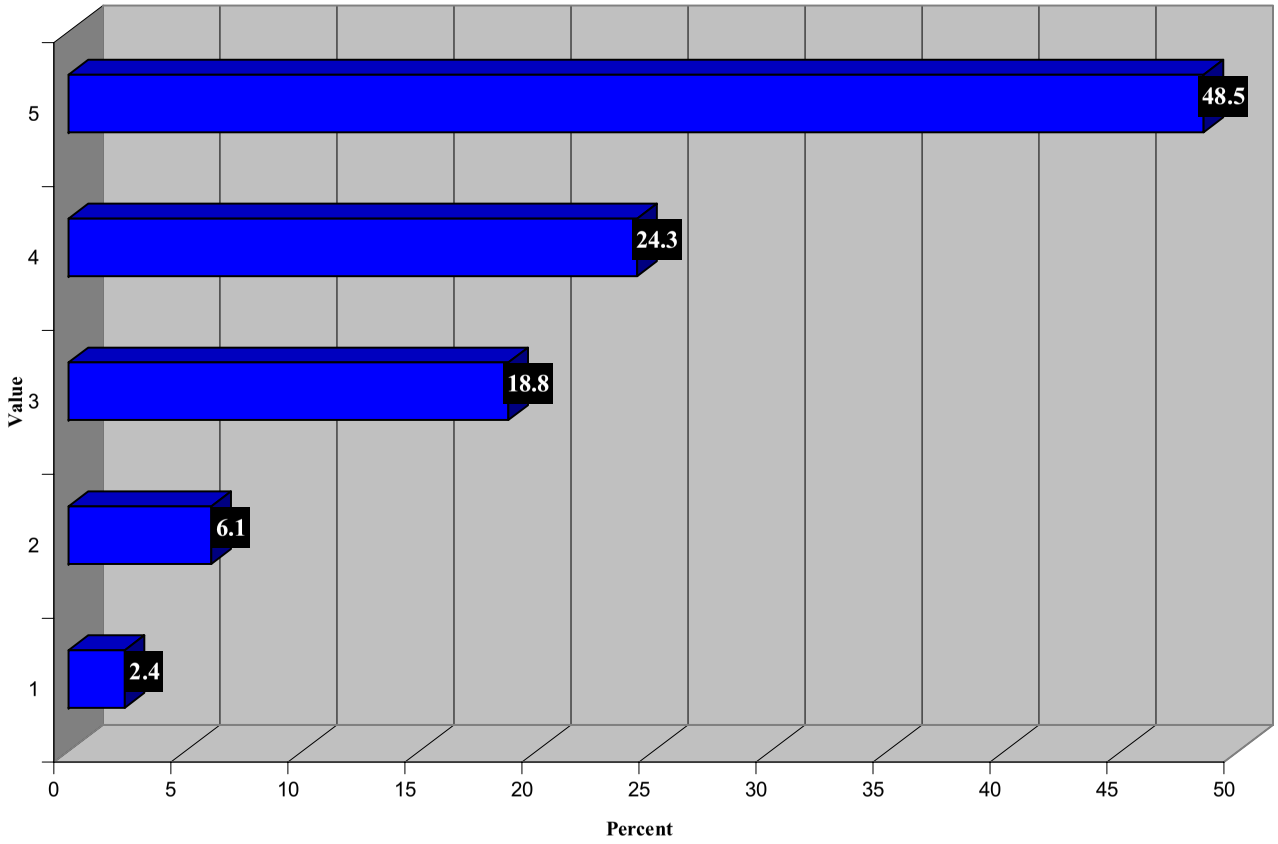
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)

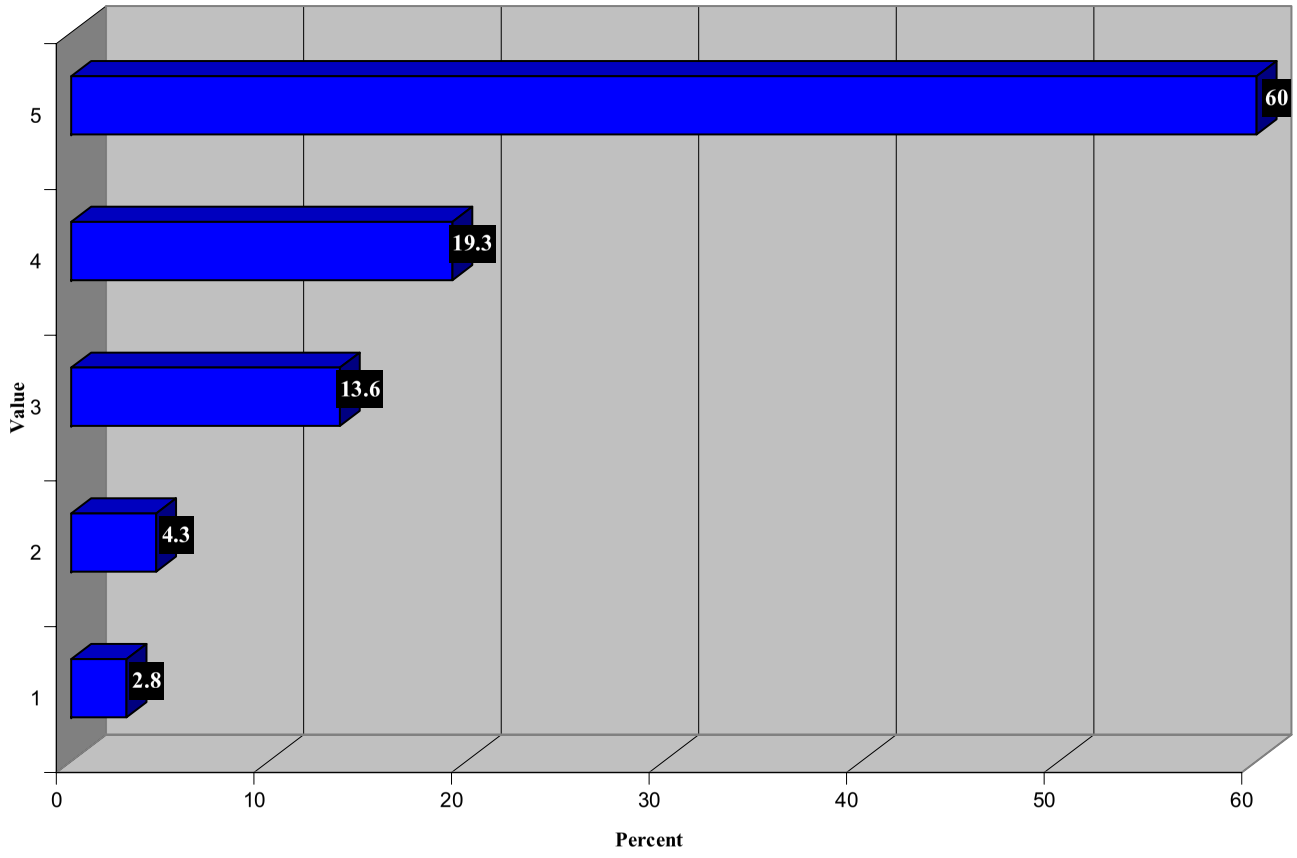
Preparing for Natural Disasters, (i.e. floods, earthquakes, ect.)



Note- Graph does not include Don't Know/ No Answer

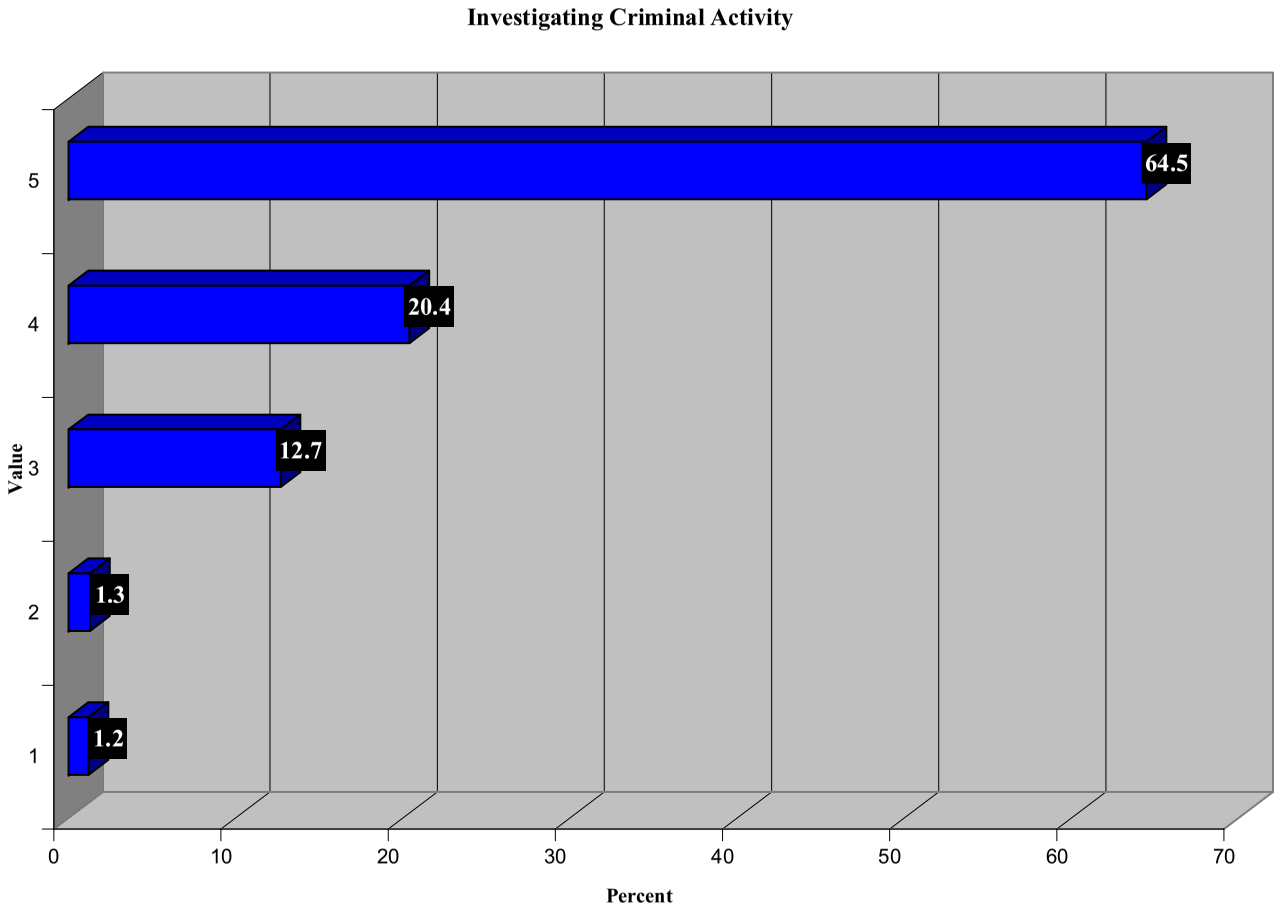
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)

Preparing for Man-Made (such as hazardous or radiological materials) Accidents or Terrorist Events



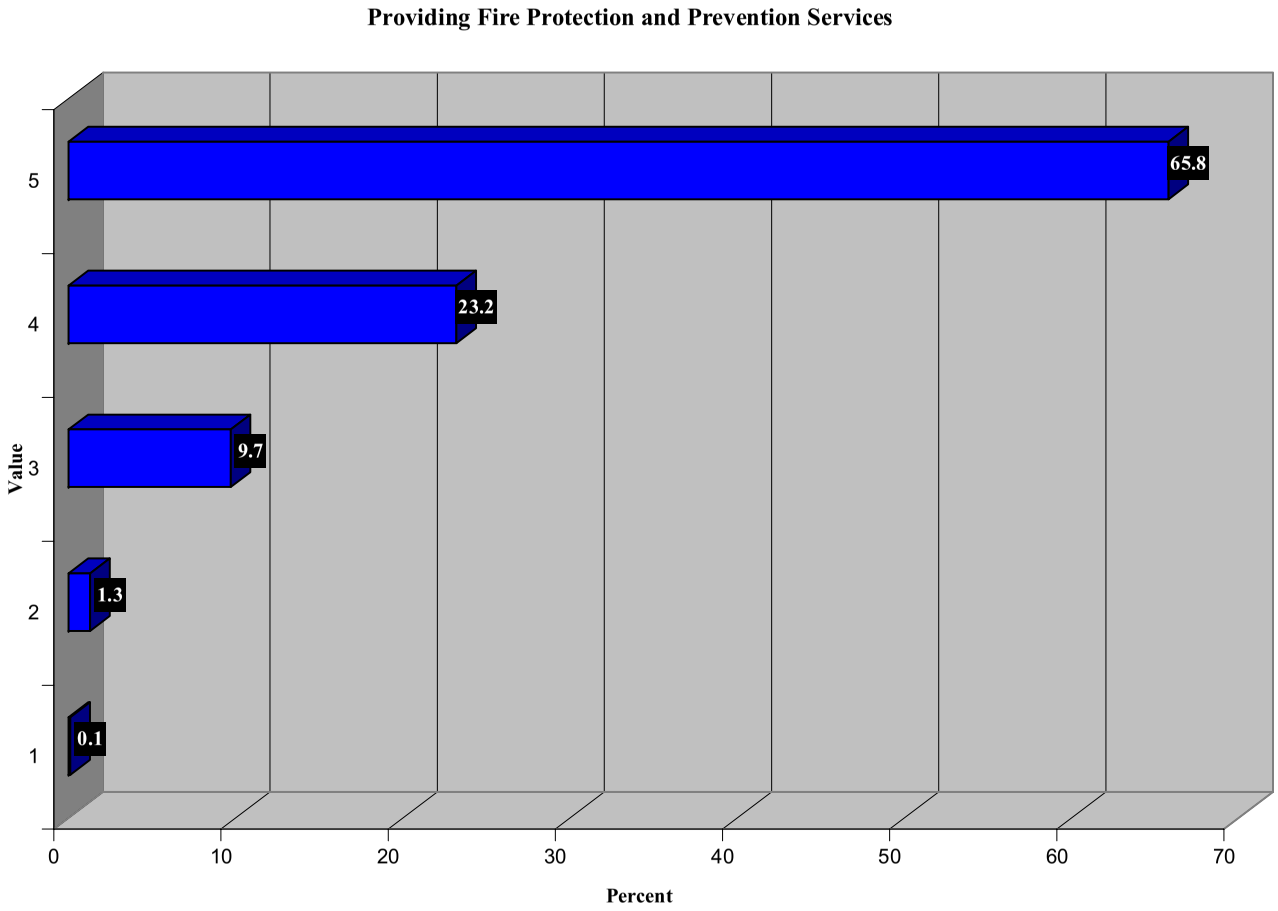
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



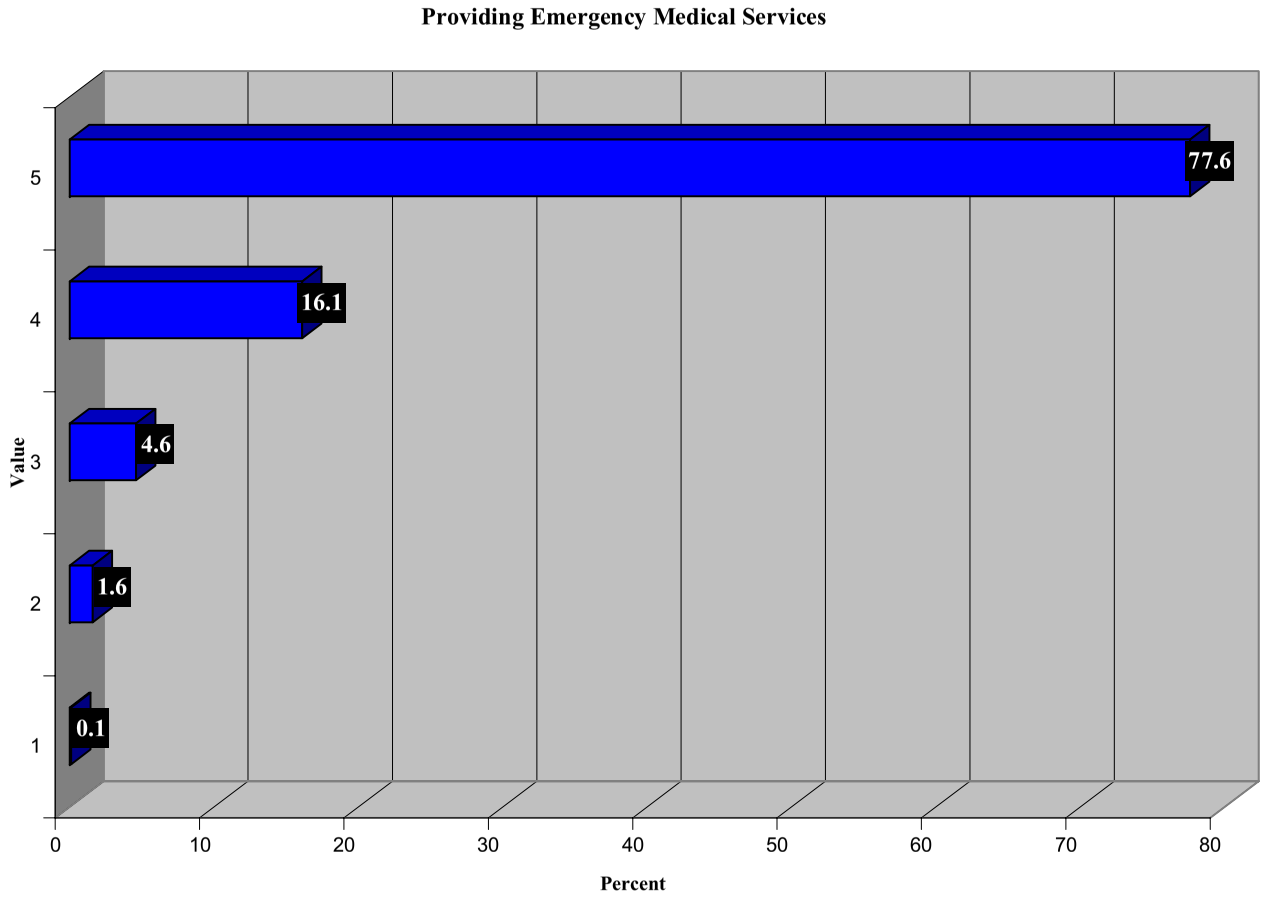
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



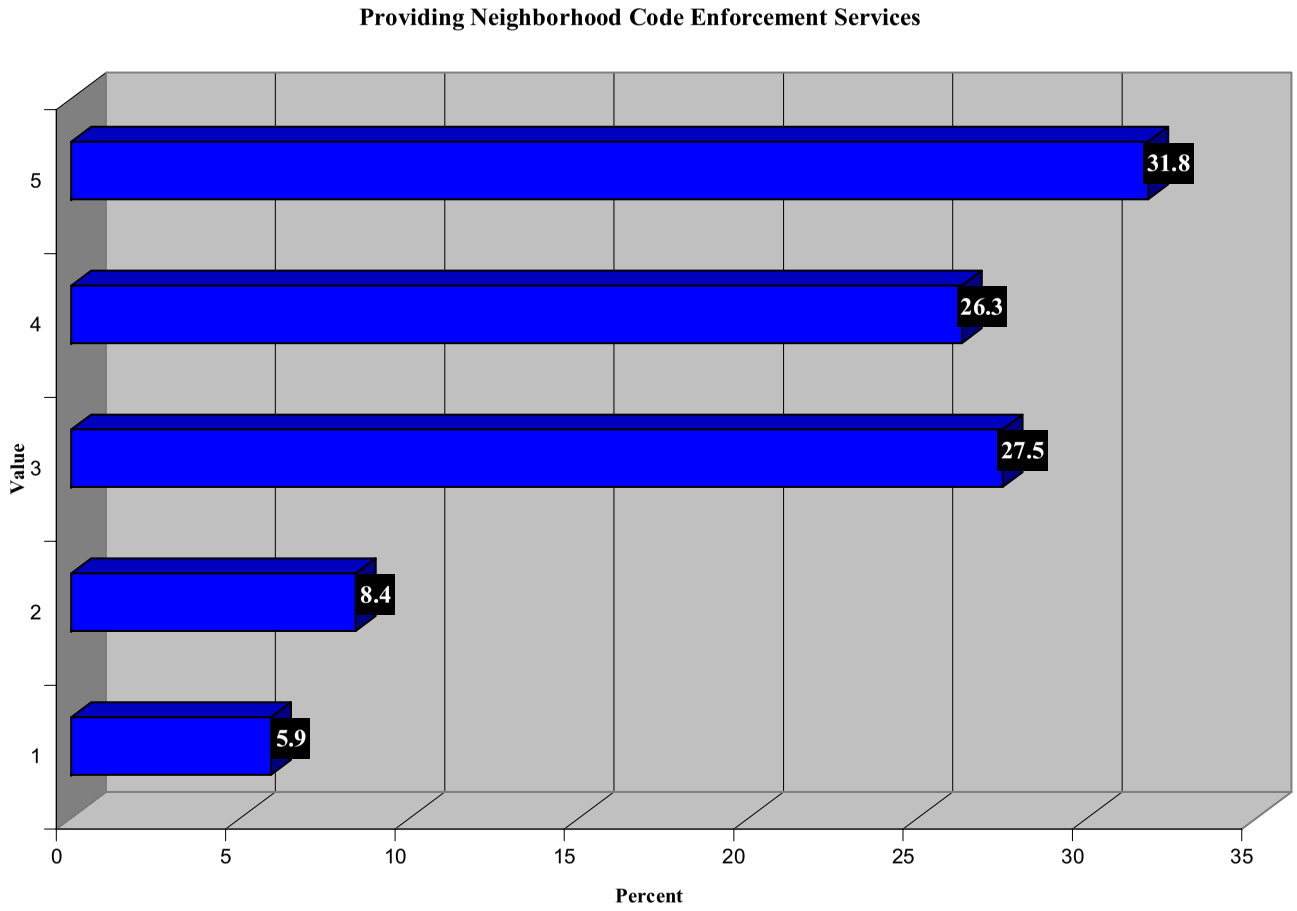
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



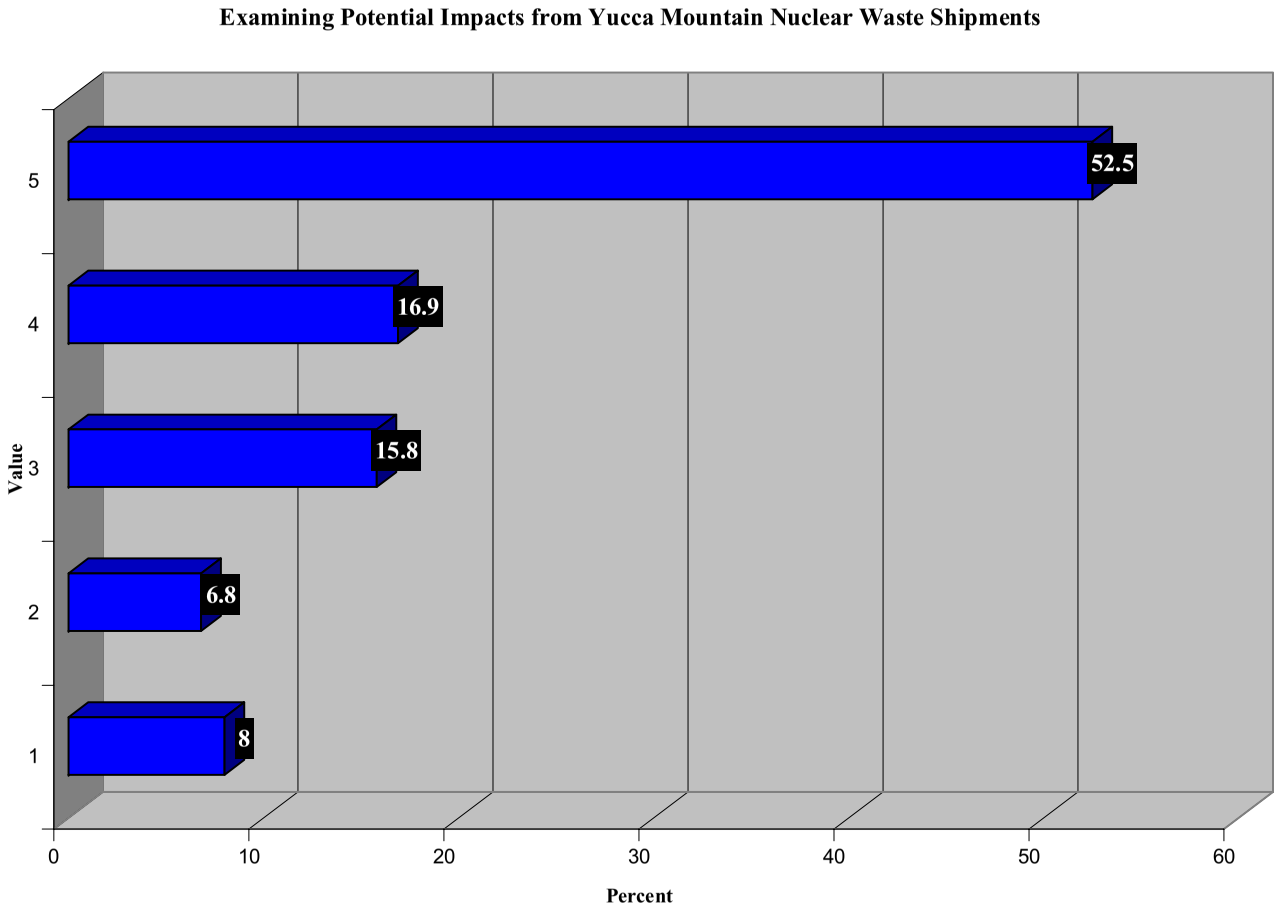
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



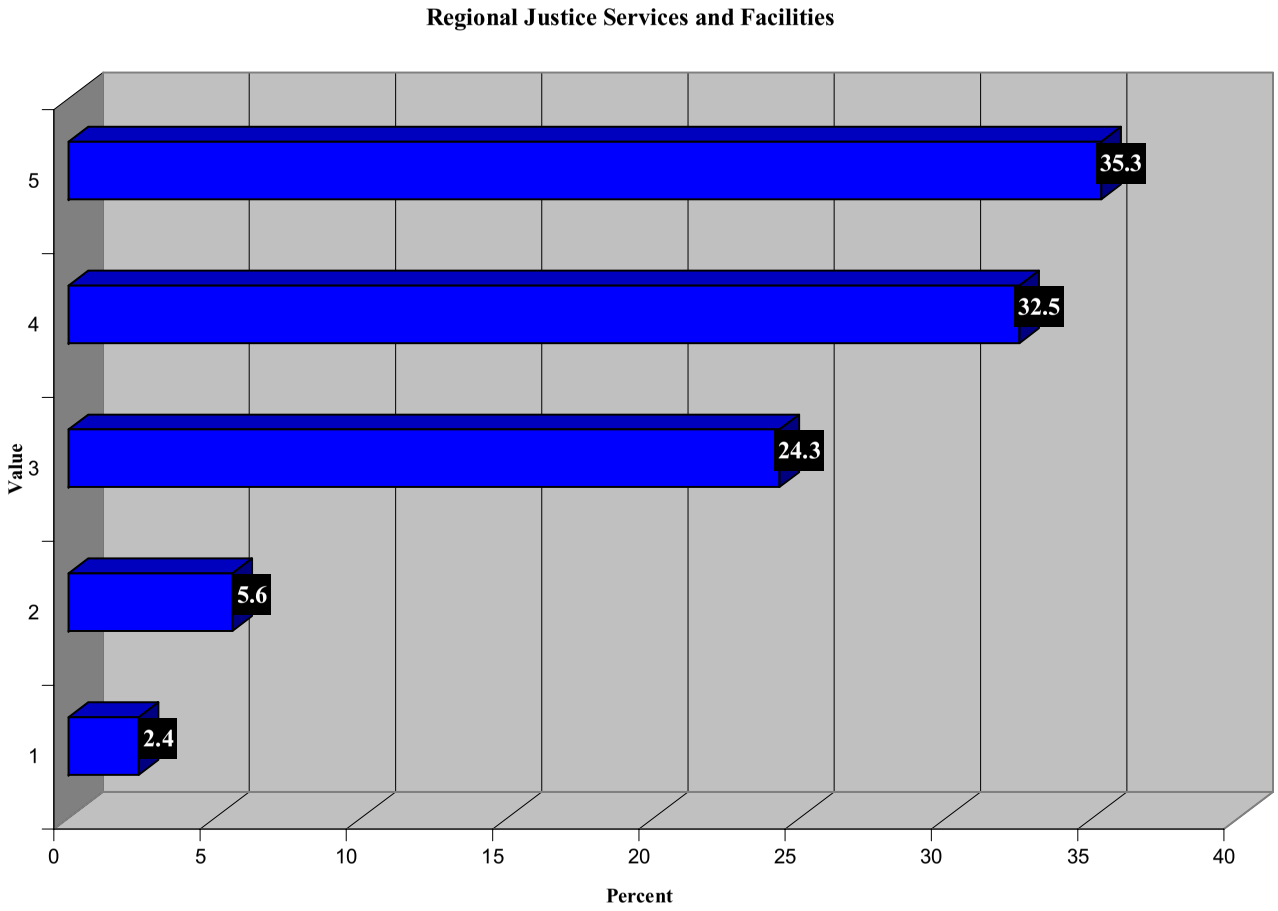
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



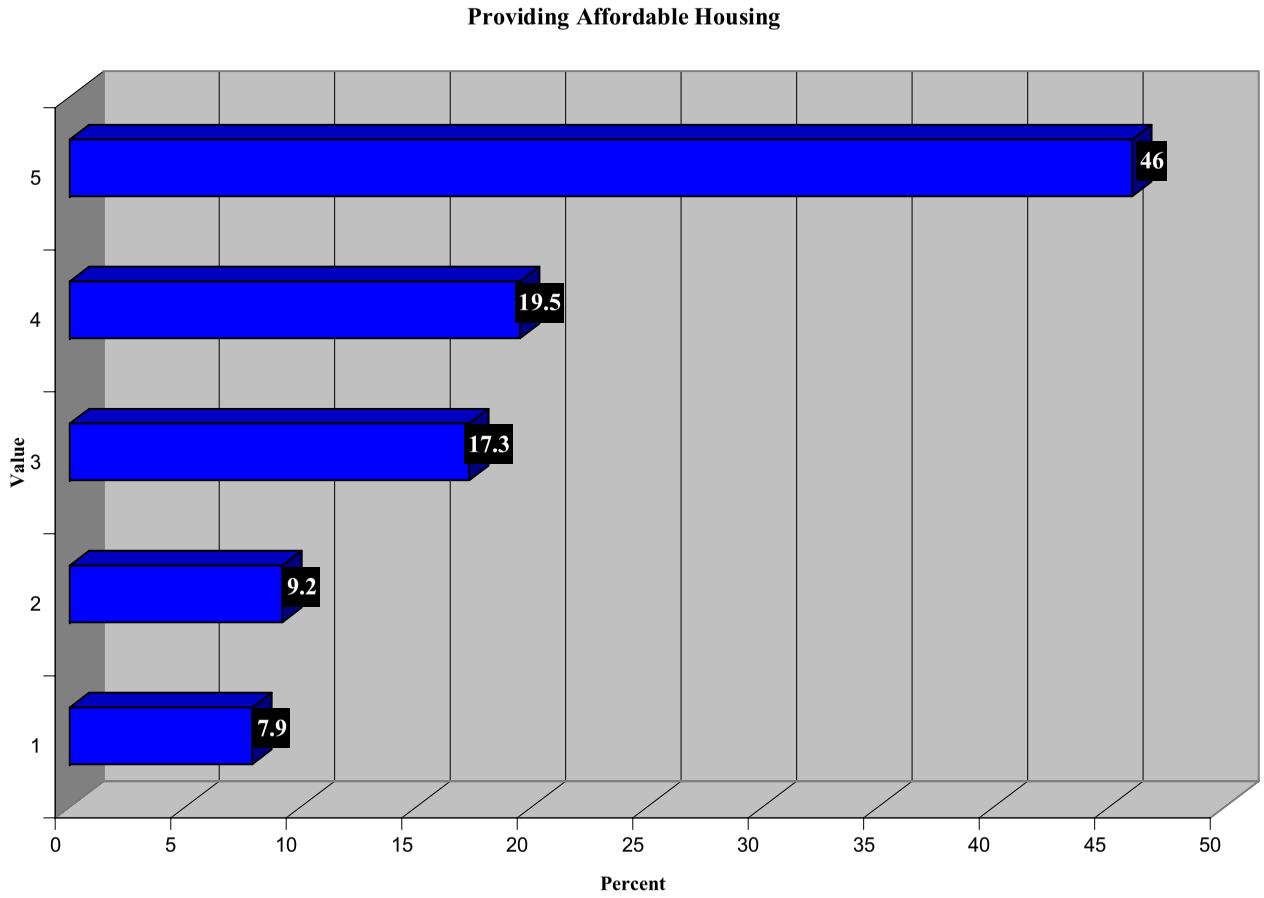
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



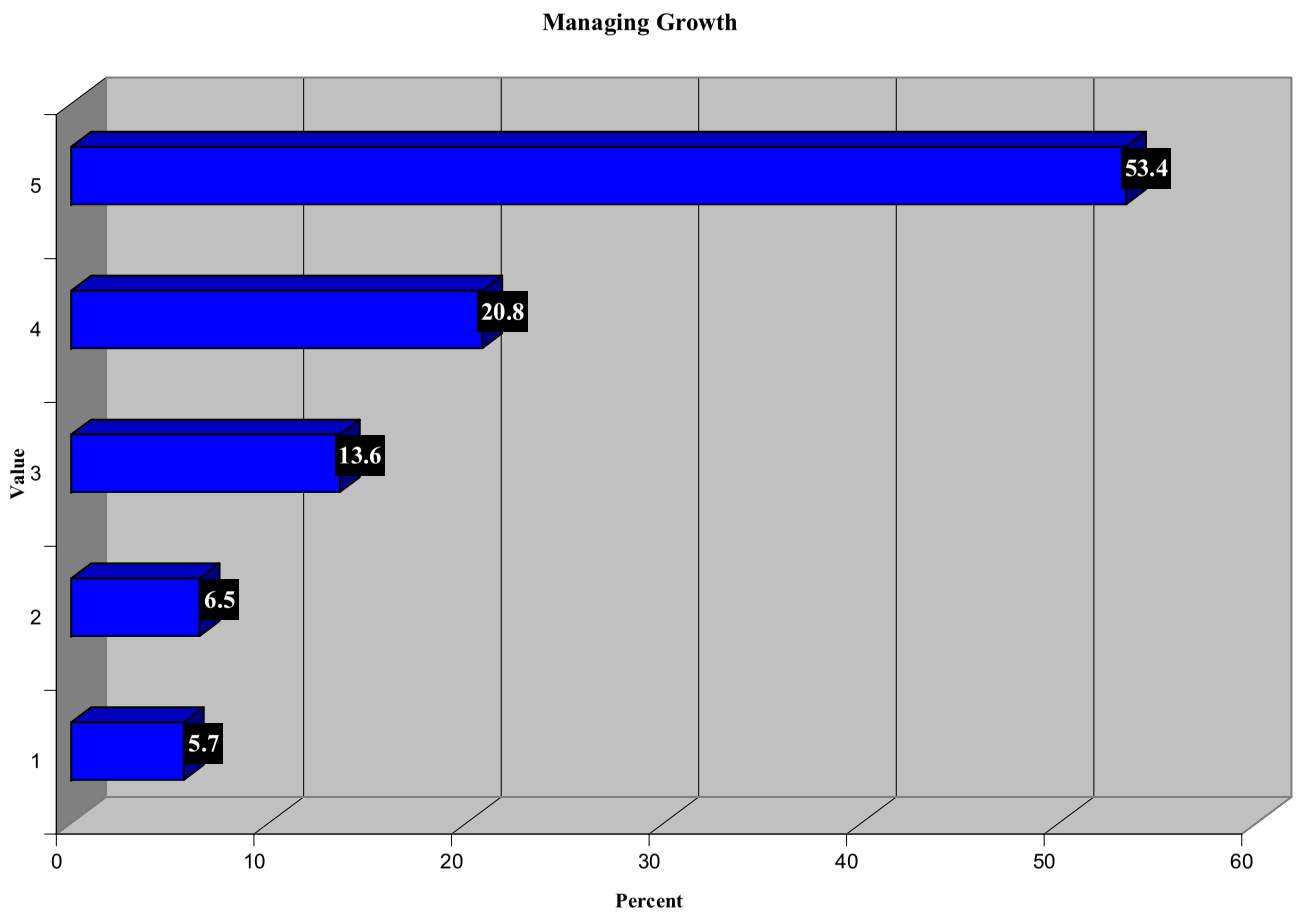
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



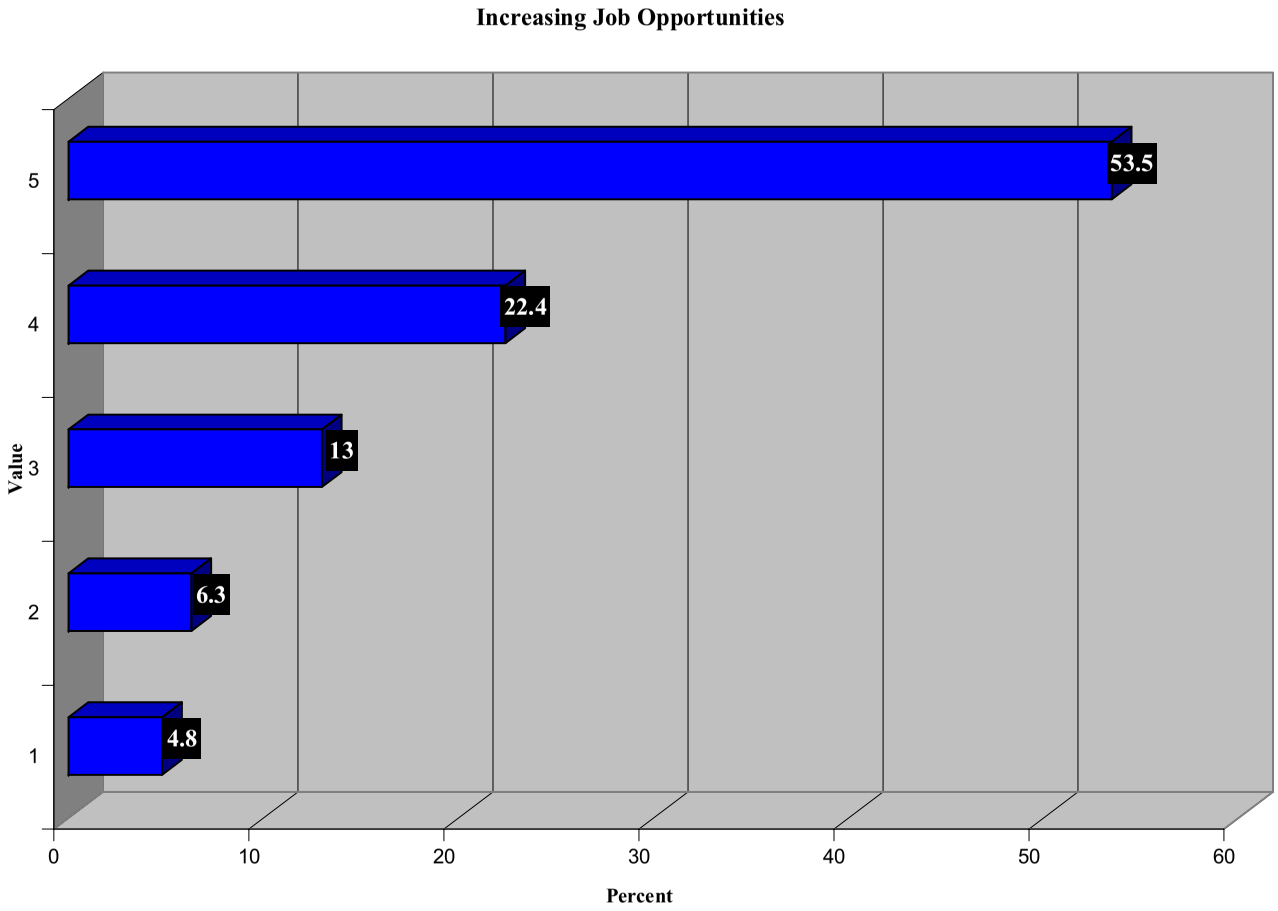
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



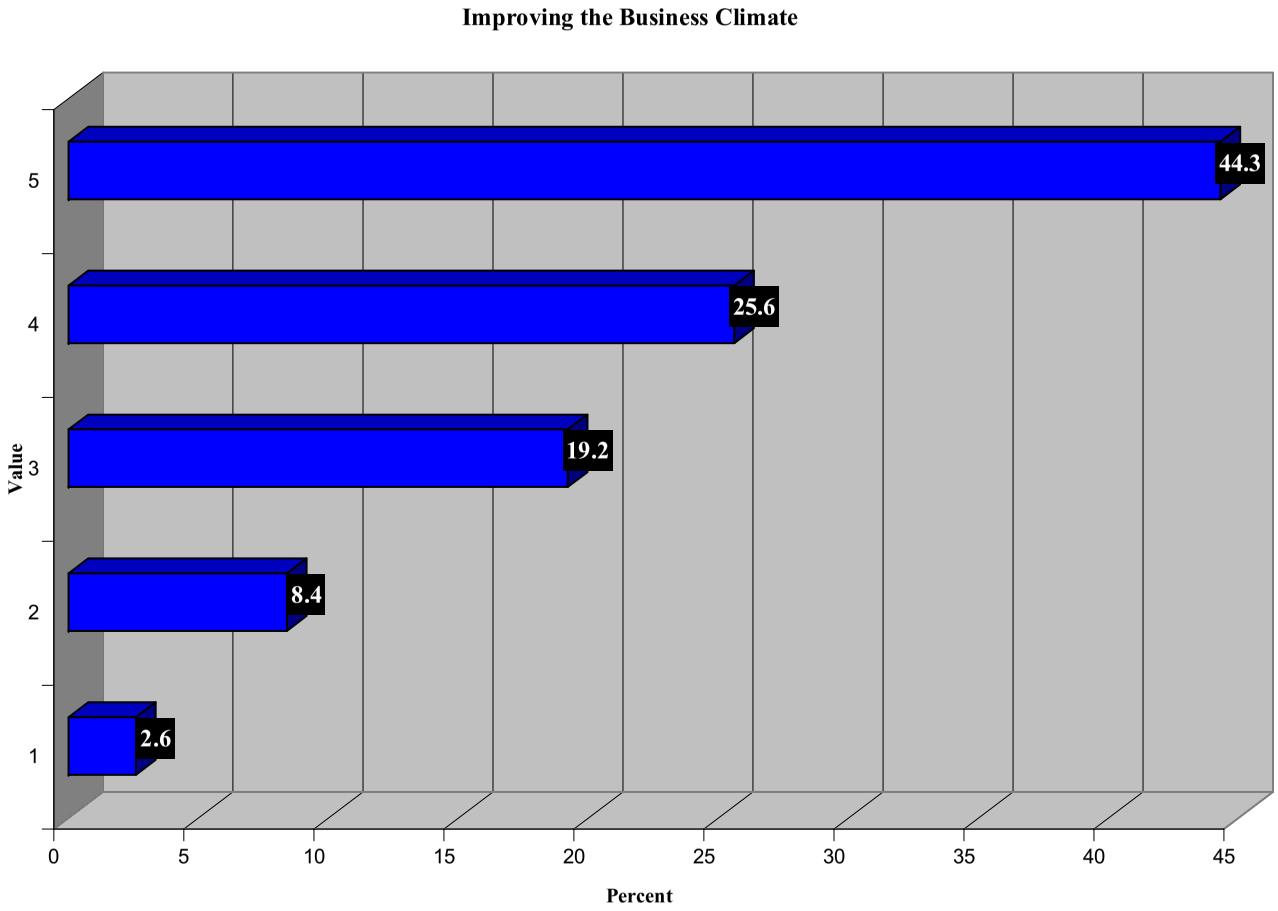
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



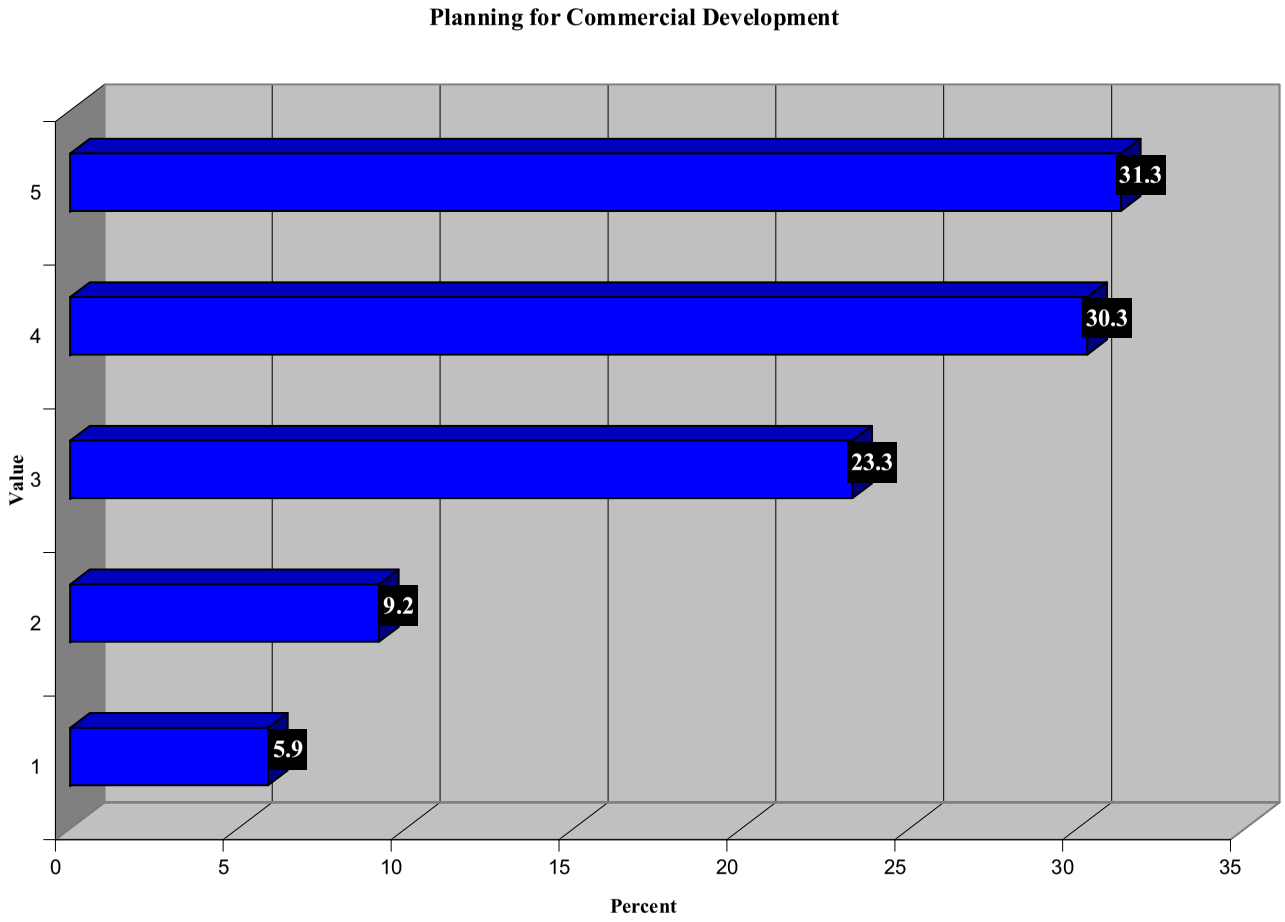
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



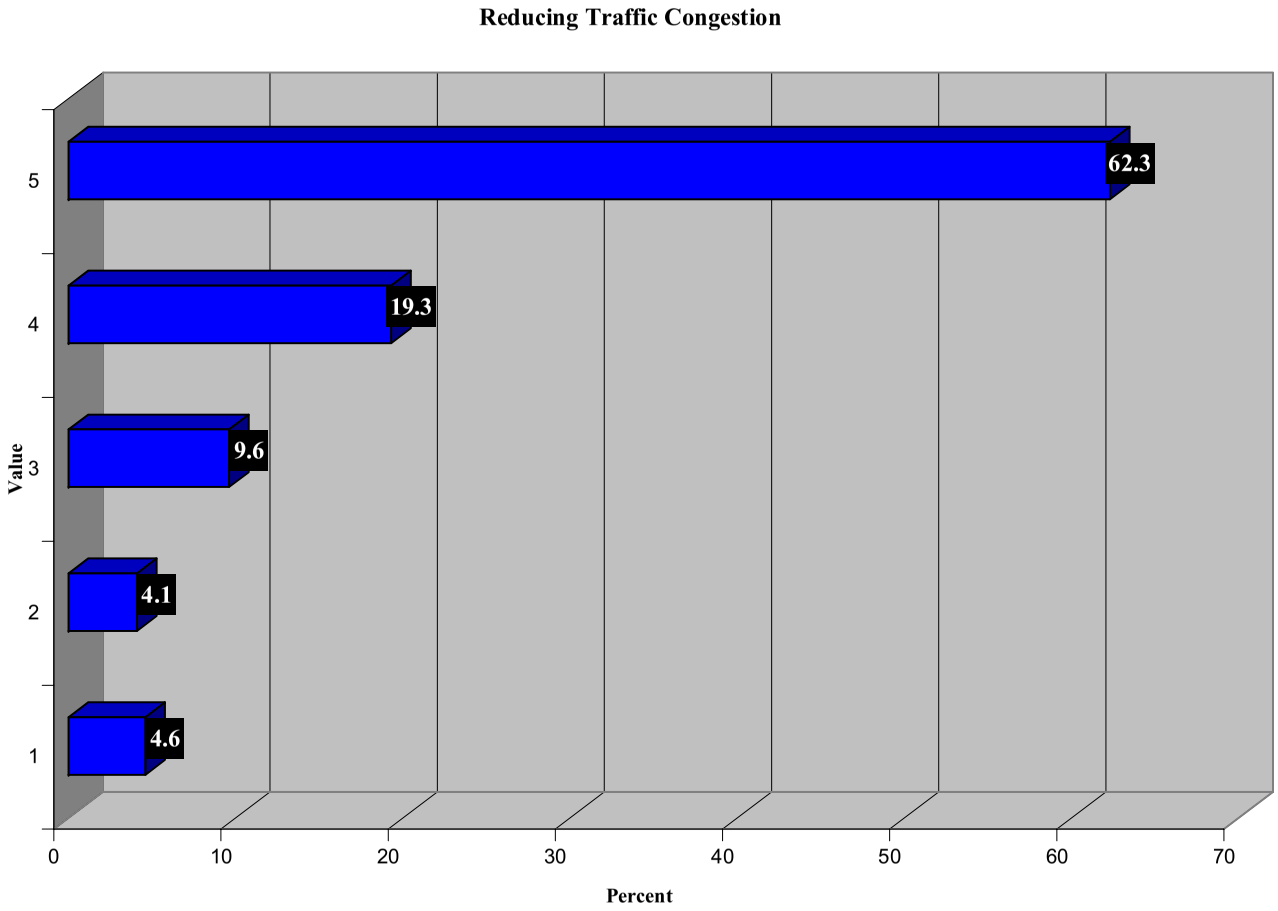
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



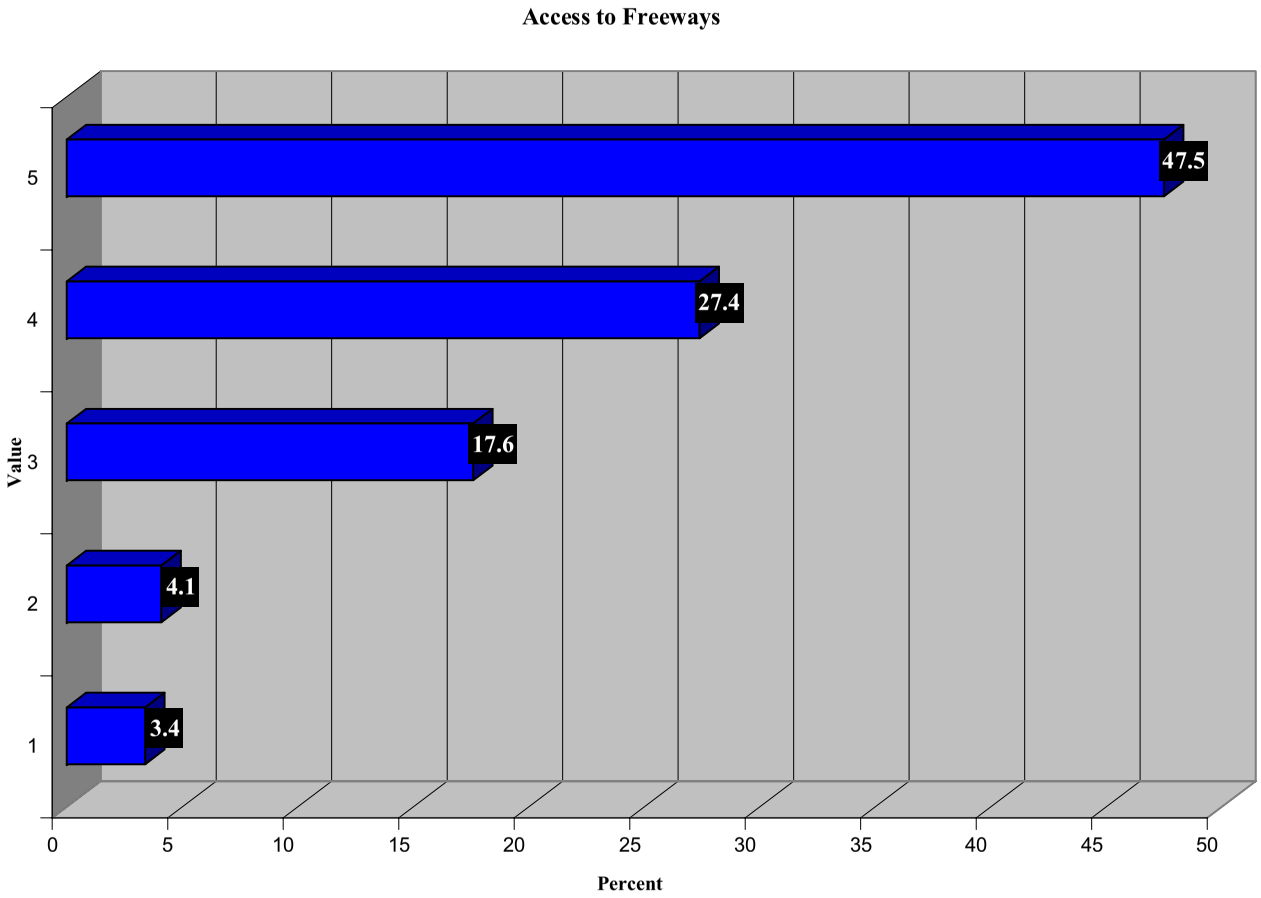
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



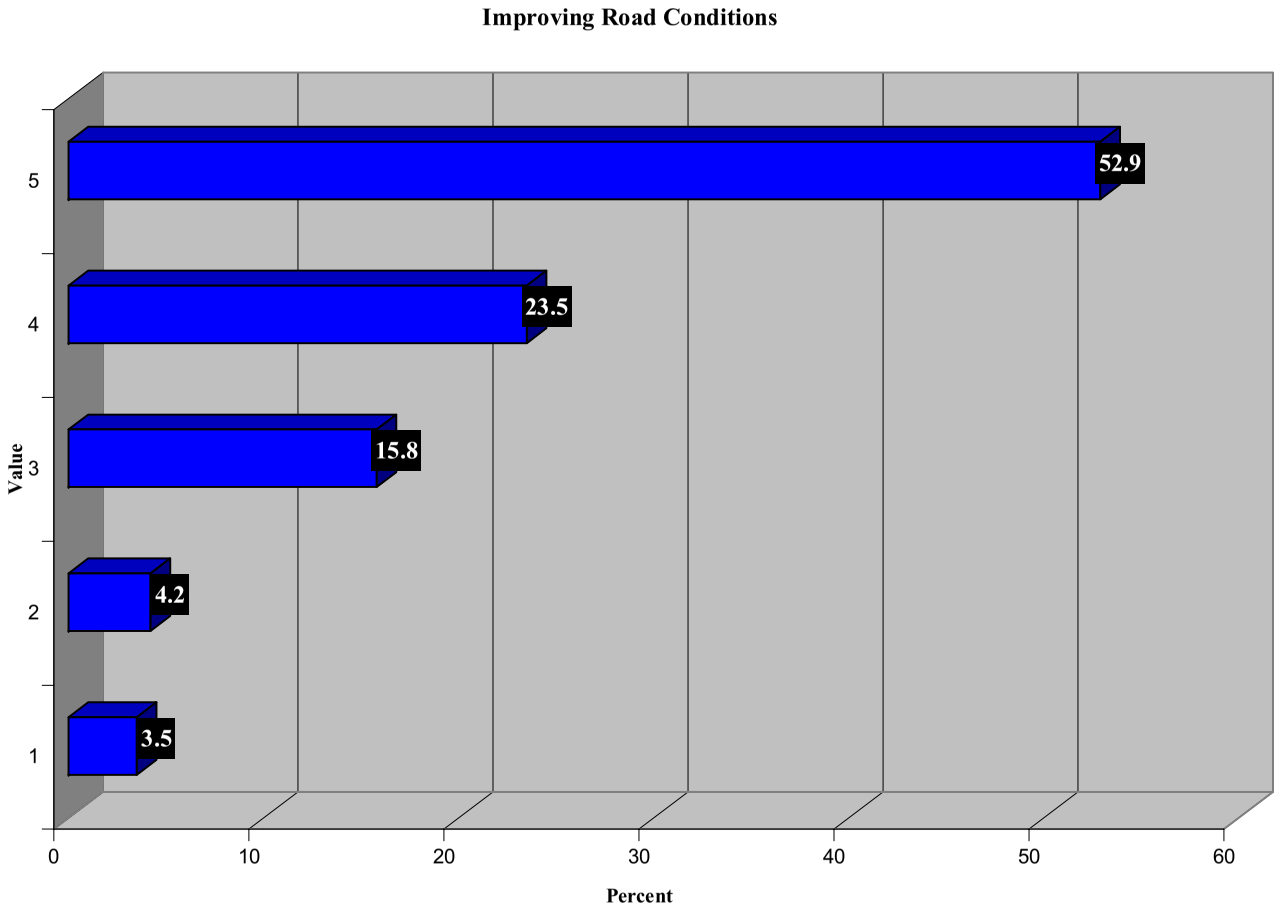
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



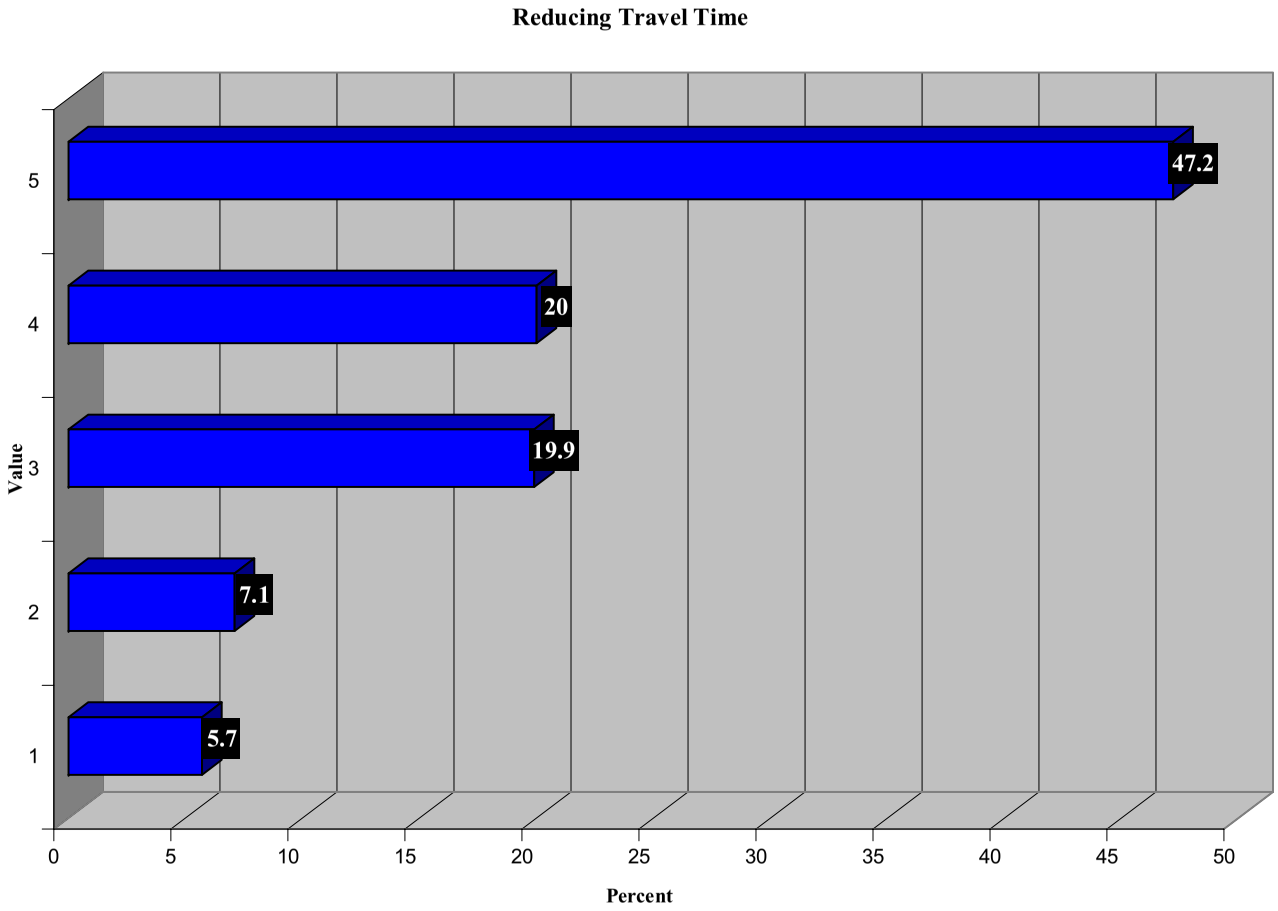
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



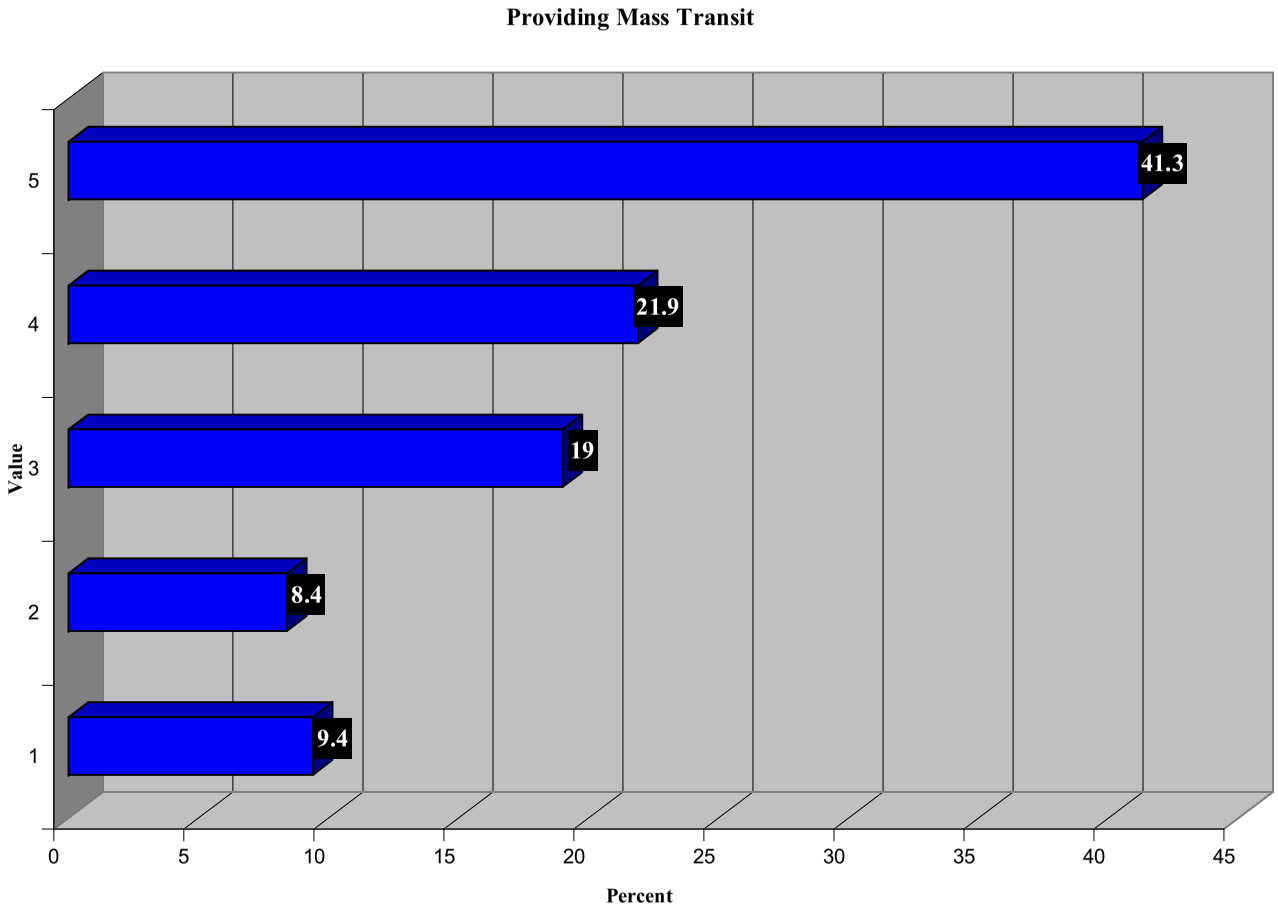
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



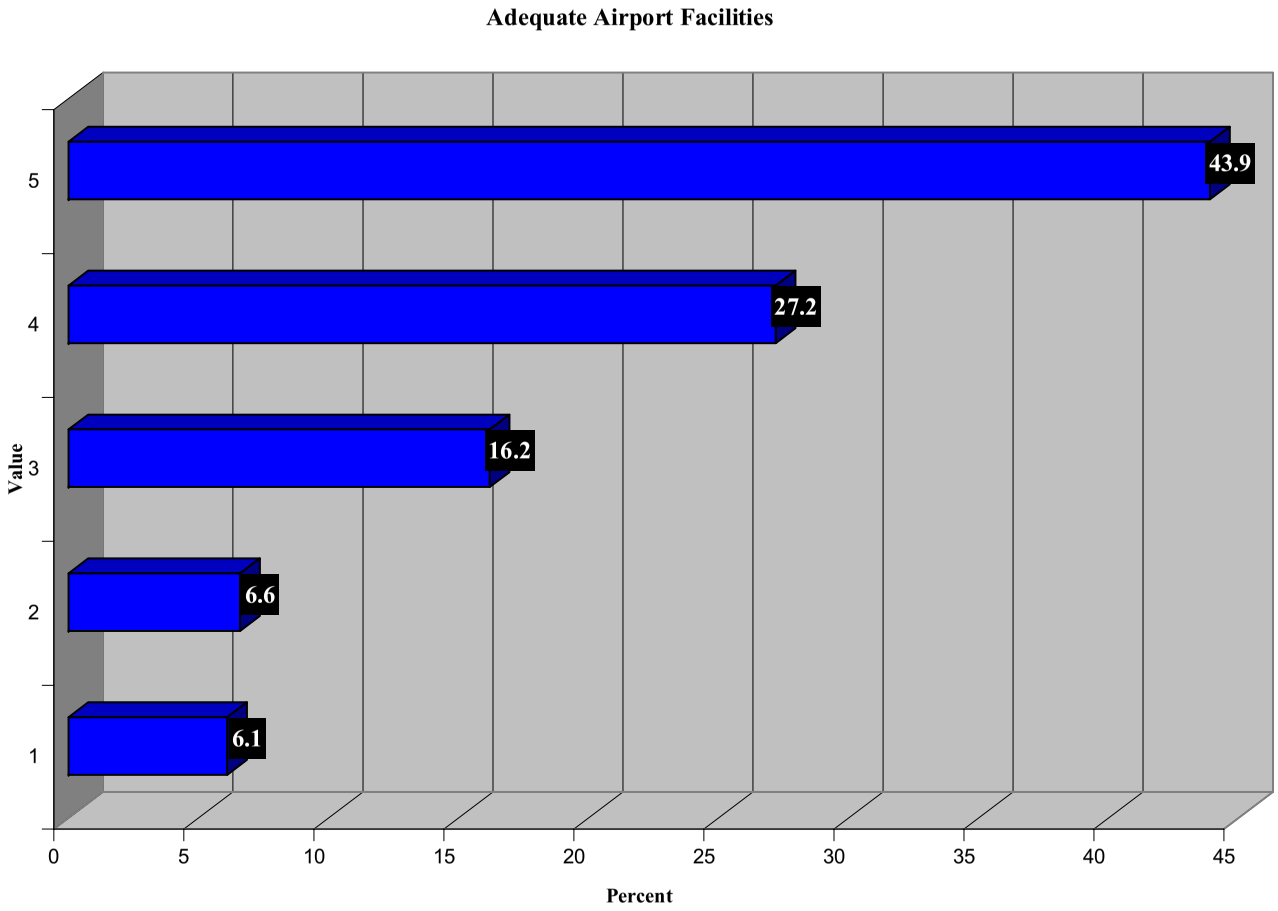
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



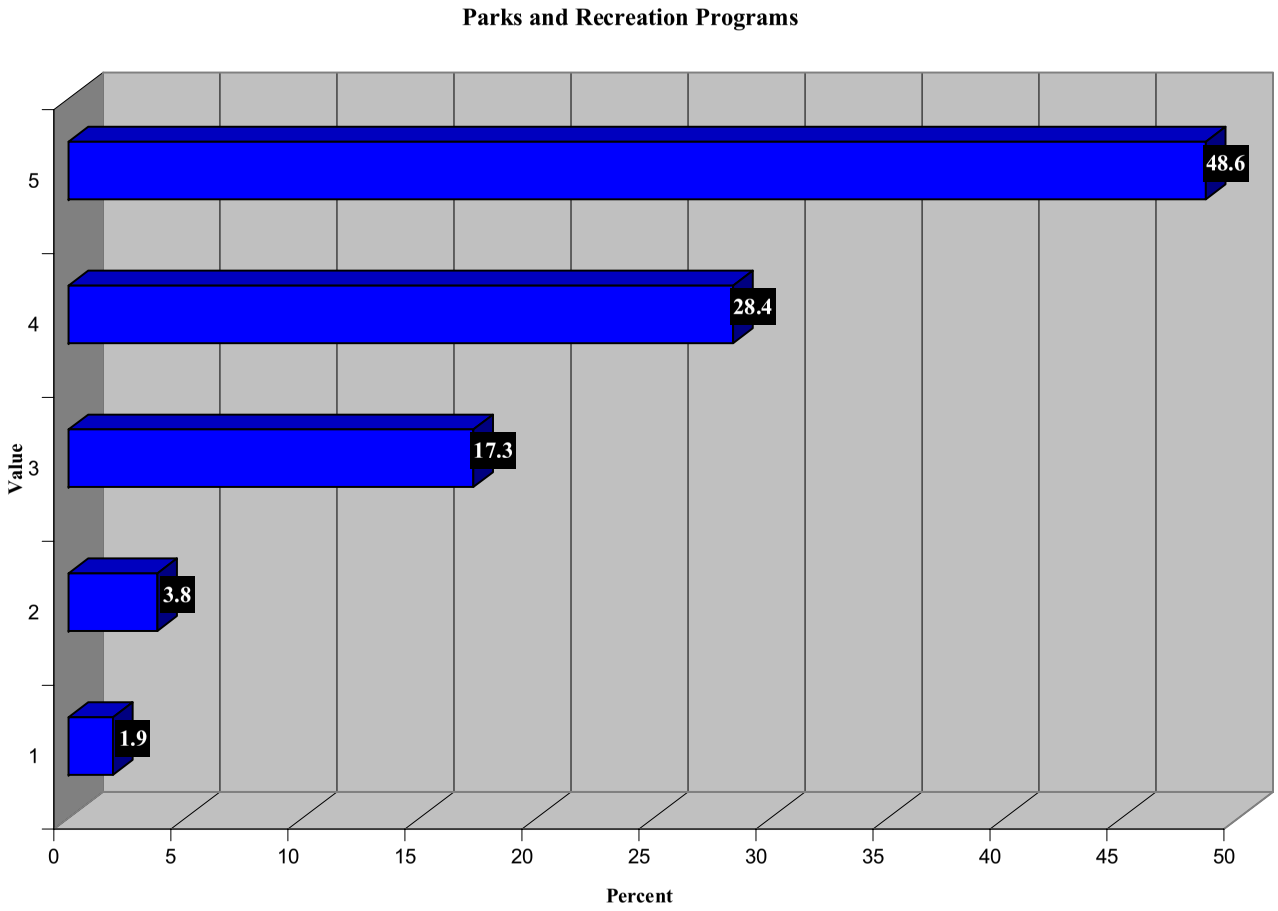
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

Appendix I
Importance for Selected Services
Importance scores for General Government
Summary Statistics by Jurisdiction

Unincorporated Clark County		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	260	255	260	255	252	258	260
	Missing	0	5	0	5	8	3	0
Mean		4.09	3.62	3.89	4.34	3.9	4.11	4.5
Std. Error of Mean		0.063	0.077	0.076	0.061	0.081	0.061	0.05
Median		4	4	4	5	4	4	5
Mode		5	5	5	5	5	5	5
Std. Deviation		1.022	1.232	1.22	0.968	1.278	0.987	0.814
Variance		1.045	1.517	1.489	0.937	1.634	0.973	0.662
Skewness		-0.973	-0.466	-0.809	-1.574	-0.953	-1.066	-1.638
Std. Error of Skewness		0.151	0.153	0.151	0.152	0.153	0.152	0.151
Kurtosis		0.403	-0.792	-0.356	2.154	-0.155	0.761	2.321
Std. Error of Kurtosis		0.301	0.304	0.301	0.304	0.306	0.302	0.301
Range		4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

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City of Las Vegas		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	193	191	193	192	187	191	193
	Missing	0	2	0	1	6	2	0
Mean		4.22	3.51	4.04	4.49	3.87	4.12	4.4
Std. Error of Mean		0.067	0.088	0.078	0.063	0.1	0.075	0.071
Median		4	4	4	5	4	4	5
Mode		5	3	5	5	5	5	5
Std. Deviation		0.936	1.214	1.088	0.871	1.369	1.033	0.993
Variance		0.877	1.474	1.184	0.759	1.874	1.068	0.986
Skewness		-1.125	-0.334	-1.022	-2.011	-0.914	-1.208	-1.77
Std. Error of Skewness		0.175	0.176	0.175	0.176	0.178	0.176	0.175
Kurtosis		0.801	-0.864	0.407	4.21	-0.475	1.061	2.494
Std. Error of Kurtosis		0.348	0.35	0.348	0.349	0.353	0.35	0.348
Range		4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

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City of North Las Vegas		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	68	68	68	67	67	68	67
	Missing	0	0	0	1	0	0	0
Mean		3.94	3.67	4.38	4.55	3.93	4.07	4.58
Std. Error of Mean		0.135	0.138	0.123	0.098	0.165	0.14	0.109
Median		4	4	5	5	4.68	5	5
Mode		5	5	5	5	5	5	5
Std. Deviation		1.114	1.135	1.015	0.802	1.352	1.155	0.891
Variance		1.241	1.288	1.029	0.642	1.827	1.335	0.794
Skewness		-0.794	-0.461	-1.422	-1.883	-1.047	-0.94	-2.594
Std. Error of Skewness		0.291	0.291	0.291	0.294	0.292	0.291	0.292
Kurtosis		-0.2	-0.579	0.804	3.425	-0.184	-0.189	6.763
Std. Error of Kurtosis		0.575	0.575	0.575	0.58	0.577	0.575	0.577
Range		4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

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City of Henderson		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	66	66	66	66	63	66	65
	Missing	0	0	0	0	3	0	2
Mean		4.08	3.32	3.91	4.32	3.49	3.9	4.52
Std. Error of Mean		0.11	0.157	0.158	0.118	0.188	0.146	0.108
Median		4	4	4	5	3.96	4	5
Mode		5	4	5	5	5	5	5
Std. Deviation		0.895	1.269	1.286	0.953	1.495	1.186	0.865
Variance		0.8	1.611	1.653	0.907	2.235	1.406	0.749
Skewness		-0.547	-0.432	-0.771	-1.272	-0.435	-0.792	-1.994
Std. Error of Skewness		0.295	0.296	0.295	0.296	0.302	0.295	0.298
Kurtosis		-0.682	-0.829	-0.76	1.035	-1.221	-0.375	3.62
Std. Error of Kurtosis		0.582	0.584	0.582	0.584	0.595	0.582	0.588
Range		3	4	4	4	4	4	4
Minimum		2	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

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Boulder City		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	9	8	8	7	9	9	9
	Missing	0	1	0	2	0	0	0
Mean		4.89	4.72	4.81	4.57	4.78	4.47	4.65
Std. Error of Mean		0.164	0.269	0.147	0.201	0.329	0.181	0.173
Median		5	5	5	4.97	5	4.21	5
Mode		5	5	5	5	5	4	5
Std. Deviation		0.483	0.745	0.419	0.535	0.965	0.531	0.509
Variance		0.233	0.555	0.175	0.286	0.932	0.281	0.259
Skewness		-4.806	-2.609	-1.962	-0.345	-4.806	0.168	-0.744
Std. Error of Skewness		0.729	0.764	0.746	0.789	0.729	0.729	0.729
Kurtosis		27.642	6.479	2.381	-2.807	27.642	-2.674	-1.983
Std. Error of Kurtosis		1.428	1.511	1.467	1.575	1.428	1.428	1.428
Range		2	2	1	1	4	1	1
Minimum		3	3	4	4	1	4	4
Maximum		5	5	5	5	5	5	5

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Mesquite		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	4	4	4	4	3	4	3
	Missing	0	0	0	0	0	0	0
Mean		4.48	3.52	4	4.12	3.73	4.24	4.41
Std. Error of Mean		0.293	0.708	0.706	0.732	0.804	0.479	0.316
Median		4.43	3.57	4	4.43	4	4.43	4.2
Mode		4	3	4	5	4	5	4
Std. Deviation		0.579	1.399	1.395	1.445	1.488	0.946	0.585
Variance		0.336	1.956	1.945	2.087	2.215	0.894	0.342
Skewness		0.127	-1.169	-2.944	-3.052	-2.313	-0.828	0.73
Std. Error of Skewness		1.028	1.028	1.028	1.028	1.108	1.028	1.108
Range		1	4	4	4	4	2	1
Minimum		4	1	1	1	1	3	4
Maximum		5	5	5	5	5	5	5

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Unincorporated Clark County		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Provide attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	259	258	258	260	258	258	259	259	257
	Missing	1	2	2	0	2	2	2	1	4
Mean		4.35	4.25	4.14	3.91	3.84	3.79	4.19	4	4.59
Std. Error of Mean		0.062	0.063	0.065	0.078	0.079	0.084	0.067	0.076	0.053
Median		5	5	5	4	4	4	5	4.62	5
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1	1.019	1.038	1.265	1.275	1.345	1.077	1.229	0.846
Variance		1	1.039	1.078	1.6	1.626	1.809	1.16	1.51	0.715
Skewness		-1.487	-1.302	-0.912	-0.905	-0.897	-0.739	-1.31	-1.029	-2.425
Std. Error of Skewness		0.151	0.152	0.152	0.151	0.152	0.152	0.151	0.151	0.152
Kurtosis		1.492	1.036	-0.225	-0.301	-0.291	-0.748	0.947	-0.01	5.825
Std. Error of Kurtosis		0.301	0.302	0.302	0.301	0.302	0.302	0.302	0.301	0.303
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

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City of Las Vegas		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Provide attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	190	190	188	188	188	191	191	191	192
	Missing	3	3	5	5	5	2	2	2	1
Mean		4.23	4.2	4.07	3.95	3.78	3.77	4.1	3.97	4.58
Std. Error of Mean		0.082	0.08	0.082	0.091	0.094	0.1	0.084	0.091	0.056
Median		5	5	4	4	4	4	5	4	5
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.133	1.1	1.121	1.248	1.288	1.388	1.167	1.26	0.769
Variance		1.285	1.21	1.256	1.557	1.66	1.926	1.362	1.586	0.592
Skewness		-1.438	-1.266	-1.171	-1.026	-0.748	-0.795	-1.187	-1.113	-1.977
Std. Error of Skewness		0.176	0.176	0.177	0.177	0.177	0.176	0.176	0.176	0.175
Kurtosis		1.209	0.706	0.699	-0.002	-0.579	-0.662	0.384	0.203	3.714
Std. Error of Kurtosis		0.351	0.351	0.353	0.353	0.353	0.35	0.35	0.35	0.349
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

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City of North Las Vegas		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Provide attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	67	68	67	68	67	68	68	67	68
	Missing	0	0	0	0	0	0	0	0	0
Mean		4.45	4.39	4.44	4.2	4	3.83	4.35	4.13	4.65
Std. Error of Mean		0.122	0.13	0.118	0.134	0.159	0.178	0.126	0.157	0.095
Median		5	5	5	5	5	4.27	5	5	5
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.002	1.073	0.965	1.099	1.308	1.465	1.035	1.289	0.78
Variance		1.003	1.152	0.931	1.208	1.71	2.147	1.072	1.66	0.609
Skewness		-1.935	-1.898	-2.02	-1.276	-1.014	-0.961	-1.792	-1.275	-2.424
Std. Error of Skewness		0.292	0.291	0.292	0.291	0.292	0.291	0.291	0.292	0.291
Kurtosis		3.045	2.841	4.014	0.774	-0.37	-0.515	2.839	0.295	5.716
Std. Error of Kurtosis		0.577	0.575	0.577	0.575	0.577	0.575	0.575	0.577	0.575
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

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City of Henderson		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Provide attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	66	66	66	66	66	66	66	66	66
	Missing	0	0	0	0	0	0	0	0	0
Mean		4.1	3.9	4.08	3.88	3.69	3.68	4.12	3.88	4.46
Std. Error of Mean		0.147	0.146	0.123	0.148	0.157	0.154	0.141	0.158	0.105
Median		5	4	4	4	4	4	5	4	5
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.196	1.186	1	1.207	1.28	1.254	1.148	1.288	0.849
Variance		1.43	1.407	1	1.457	1.639	1.573	1.318	1.659	0.721
Skewness		-1.139	-0.807	-1.033	-0.896	-0.674	-0.748	-1.262	-0.85	-1.758
Std. Error of Skewness		0.295	0.295	0.296	0.295	0.295	0.295	0.295	0.295	0.296
Kurtosis		0.27	-0.386	0.742	-0.067	-0.552	-0.311	0.869	-0.519	2.98
Std. Error of Kurtosis		0.582	0.582	0.584	0.582	0.582	0.582	0.582	0.582	0.584
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

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Boulder City		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Provide attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	9	9	8	9	9	9	9	9	9
	Missing	0	0	0	0	0	0	0	0	0
Mean		4.66	4.3	4.38	4.66	4.37	4.5	4.82	4.48	4.41
Std. Error of Mean		0.269	0.237	0.292	0.209	0.403	0.275	0.138	0.306	0.304
Median		5	4	5	5	5	5	5	5	5
Mode		5	4	5	5	5	5	5	5	5
Std. Deviation		0.79	0.696	0.834	0.614	1.185	0.808	0.406	0.898	0.893
Variance		0.624	0.485	0.696	0.377	1.405	0.652	0.165	0.807	0.798
Skewness		-3.123	-0.498	-0.964	-1.824	-2.101	-1.353	-2.068	-1.344	-1.092
Std. Error of Skewness		0.729	0.729	0.746	0.729	0.729	0.729	0.729	0.729	0.729
Kurtosis		13.241	-0.238	-0.583	3.572	5.264	0.478	2.912	-0.142	-0.724
Std. Error of Kurtosis		1.428	1.428	1.467	1.428	1.428	1.428	1.428	1.428	1.428
Range		3	2	2	2	4	2	1	2	2
Minimum		2	3	3	3	1	3	4	3	3
Maximum		5	5	5	5	5	5	5	5	5

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Mesquite		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Provide attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	4	4	4	4	4	3	4	4	4
	Missing	0	0	0	0	0	0	0	0	0
Mean		4.36	4.24	4.12	4.24	4.24	3.86	4.24	4.36	4.36
Std. Error of Mean		0.403	0.559	0.45	0.479	0.479	0.783	0.479	0.403	0.282
Median		4.43	4.43	4	4.43	4.43	4.2	4.43	4.43	4
Mode		5	5	4	5	5	5	5	5	4
Std. Deviation		0.797	1.104	0.889	0.946	0.946	1.45	0.946	0.797	0.557
Variance		0.635	1.218	0.791	0.894	0.894	2.101	0.894	0.635	0.31
Skewness		-1.079	-2.363	-0.368	-0.828	-0.828	-1.297	-0.828	-1.079	1.02
Std. Error of Skewness		1.028	1.028	1.028	1.028	1.028	1.108	1.028	1.028	1.028
Range		2	3	2	2	2	3	2	2	1
Minimum		3	2	3	3	3	2	3	3	4
Maximum		5	5	5	5	5	5	5	5	5

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Unincorporated Clark County		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	259	260	260	259	259	260	259	258
	Missing	1	0	0	1	2	0	1	3
Mean		4.24	4.08	4.53	4.37	4.54	4.71	4.75	4.76
Std. Error of Mean		0.064	0.071	0.054	0.058	0.051	0.036	0.034	0.036
Median		5	5	5	5	5	5	5	5
Mode		5	5	5	5	5	5	5	5
Std. Deviation		1.03	1.14	0.871	0.933	0.818	0.582	0.542	0.576
Variance		1.061	1.3	0.758	0.87	0.67	0.339	0.294	0.332
Skewness		-1.286	-1.009	-2.258	-1.599	-2.099	-2.365	-2.367	-2.932
Std. Error of Skewness		0.151	0.151	0.151	0.151	0.151	0.151	0.151	0.152
Kurtosis		1.006	0.031	5.071	2.338	4.427	7.522	5.716	10.655
Std. Error of Kurtosis		0.301	0.301	0.301	0.301	0.302	0.301	0.301	0.302
Range		4	4	4	4	4	4	3	4
Minimum		1	1	1	1	1	1	2	1
Maximum		5	5	5	5	5	5	5	5

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Unincorporated Clark County (cont.)		Facilitate neighborhood watch programs	Preparing for natural disasters, (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	Investigating criminal activity	Providing fire protection & prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	Valid	259	260	260	260	257	260	249	251	253
	Missing	2	0	0	0	3	0	11	9	8
Mean		4.06	4.11	4.3	4.44	4.52	4.67	3.65	4.02	3.88
Std. Error of Mean		0.064	0.063	0.061	0.052	0.045	0.041	0.079	0.077	0.068
Median		4	4	5	5	5	5	4	5	4
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.023	1.015	0.978	0.833	0.727	0.664	1.241	1.225	1.078
Variance		1.046	1.031	0.957	0.694	0.528	0.441	1.54	1.5	1.162
Skewness		-0.874	-0.982	-1.378	-1.446	-1.451	-2.245	-0.534	-1.038	-0.726
Std. Error of Skewness		0.151	0.151	0.151	0.151	0.152	0.151	0.154	0.154	0.153
Kurtosis		0.13	0.308	1.283	1.833	1.523	5.122	-0.726	-0.015	-0.192
Std. Error of Kurtosis		0.302	0.301	0.301	0.301	0.303	0.301	0.307	0.306	0.305
Range		4	4	4	4	3	4	4	4	4
Minimum		1	1	1	1	2	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

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City of Las Vegas		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	191	193	191	193	189	193	192	190
	Missing	2	0	2	0	4	0	1	3
Mean		4.31	4.15	4.59	4.37	4.61	4.74	4.83	4.82
Std. Error of Mean		0.066	0.073	0.06	0.066	0.052	0.041	0.033	0.034
Median		5	4	5	5	5	5	5	5
Mode		5	5	5	5	5	5	5	5
Std. Deviation		0.915	1.017	0.83	0.915	0.718	0.563	0.451	0.466
Variance		0.837	1.034	0.689	0.837	0.515	0.317	0.203	0.217
Skewness		-1.323	-1.153	-2.418	-1.596	-2.213	-2.49	-2.982	-3.431
Std. Error of Skewness		0.176	0.175	0.176	0.175	0.177	0.175	0.175	0.176
Kurtosis		1.406	0.891	6.231	2.284	5.668	7.556	10.461	16.511
Std. Error of Kurtosis		0.35	0.348	0.35	0.348	0.351	0.349	0.349	0.351
Range		4	4	4	4	4	4	3	4
Minimum		1	1	1	1	1	2	1	1
Maximum		5	5	5	5	5	5	5	5

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Importance for Selected Services
Importance scores for Public Safety
Summary Statistics by Jurisdiction

City of Las Vegas (cont.)		Facilitate neighborhood watch programs	Preparing for natural disasters, (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	Investigating criminal activity	Providing fire protection & prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	Valid	193	193	191	190	193	193	182	188	189
	Missing	0	0	2	3	0	0	11	5	4
Mean		3.93	4.15	4.3	4.47	4.56	4.74	3.74	4.04	4
Std. Error of Mean		0.08	0.076	0.076	0.064	0.049	0.041	0.082	0.095	0.069
Median		4	5	5	5	5	5	4	5	4
Mode		5	5	5	5	5	5	3	5	4
Std. Deviation		1.115	1.055	1.058	0.883	0.686	0.575	1.108	1.299	0.946
Variance		1.244	1.114	1.119	0.779	0.471	0.331	1.228	1.688	0.895
Skewness		-0.951	-1.07	-1.501	-1.865	-1.358	-2.506	-0.648	-1.164	-0.82
Std. Error of Skewness		0.175	0.175	0.176	0.176	0.175	0.175	0.18	0.177	0.177
Kurtosis		0.275	0.327	1.483	3.494	0.83	6.838	-0.061	0.2	0.598
Std. Error of Kurtosis		0.348	0.349	0.35	0.351	0.349	0.349	0.358	0.353	0.352
Range		4	4	4	4	3	3	4	4	4
Minimum		1	1	1	2	2	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

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City of North Las Vegas		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	68	68	68	68	68	68	68	68
	Missing	0	0	0	0	0	0	0	0
Mean		4.25	4.08	4.64	4.47	4.71	4.85	4.84	4.85
Std. Error of Mean		0.126	0.145	0.103	0.102	0.088	0.054	0.057	0.055
Median		5	5	5	5	5	5	5	5
Mode		5	5	5	5	5	5	5	5
Std. Deviation		1.04	1.196	0.847	0.842	0.726	0.441	0.466	0.454
Variance		1.081	1.431	0.718	0.709	0.527	0.194	0.217	0.206
Skewness		-1.391	-1.174	-2.771	-1.24	-3.127	-3.076	-2.948	-3.198
Std. Error of Skewness		0.291	0.291	0.291	0.291	0.291	0.291	0.291	0.291
Kurtosis		1.252	0.415	7.96	0.104	11.248	9.179	8.176	9.729
Std. Error of Kurtosis		0.575	0.575	0.575	0.575	0.575	0.575	0.575	0.575
Range		4	4	4	3	4	2	2	2
Minimum		1	1	1	2	1	3	3	3
Maximum		5	5	5	5	5	5	5	5

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City of North Las Vegas (cont.)		Facilitate neighborhood watch programs	Preparing for natural disasters, (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	Investigating criminal activity	Providing fire protection & prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	Valid	67	68	68	68	68	68	68	63	65
	Missing	0	0	0	0	0	0	0	5	3
Mean		4.38	4.15	4.38	4.54	4.56	4.75	3.8	3.88	3.93
Std. Error of Mean		0.112	0.138	0.124	0.1	0.095	0.088	0.154	0.173	0.136
Median		5	5	5	5	5	5	4	4	4
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		0.918	1.132	1.018	0.819	0.781	0.723	1.264	1.369	1.096
Variance		0.843	1.282	1.037	0.671	0.61	0.522	1.597	1.875	1.2
Skewness		-1.28	-1.07	-1.47	-1.563	-1.658	-2.94	-0.697	-0.909	-0.71
Std. Error of Skewness		0.292	0.291	0.291	0.291	0.291	0.291	0.291	0.302	0.297
Kurtosis		0.507	0.019	1.202	1.194	1.788	7.729	-0.601	-0.57	-0.217
Std. Error of Kurtosis		0.577	0.575	0.575	0.575	0.575	0.575	0.575	0.595	0.586
Range		3	4	4	3	3	3	4	4	4
Minimum		2	1	1	2	2	2	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

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City of Henderson		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	66	66	66	66	66	66	66	66
	Missing	0	0	0	0	0	0	0	0
Mean		3.98	4.04	4.6	4.34	4.57	4.67	4.79	4.74
Std. Error of Mean		0.132	0.132	0.1	0.113	0.078	0.067	0.057	0.081
Median		4	4	5	5	5	5	5	5
Mode		5	5	5	5	5	5	5	5
Std. Deviation		1.076	1.07	0.815	0.92	0.63	0.544	0.46	0.659
Variance		1.158	1.145	0.664	0.847	0.397	0.295	0.212	0.435
Skewness		-1.062	-0.951	-2.369	-1.267	-1.549	-1.712	-2.121	-2.578
Std. Error of Skewness		0.295	0.296	0.295	0.295	0.295	0.295	0.295	0.295
Kurtosis		0.642	0.305	5.96	0.896	2.939	3.737	3.953	6.041
Std. Error of Kurtosis		0.582	0.584	0.582	0.582	0.582	0.582	0.582	0.582
Range		4	4	4	4	3	3	2	3
Minimum		1	1	1	1	2	2	3	2
Maximum		5	5	5	5	5	5	5	5

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City of Henderson (cont.)		Facilitate neighborhood watch programs	Preparing for natural disasters, (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	Investigating criminal activity	Providing fire protection & prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	Valid	66	66	66	66	66	66	65	66	66
	Missing	0	0	0	0	0	0	2	0	0
Mean		4.08	3.86	4.07	4.38	4.42	4.59	3.63	3.75	3.87
Std. Error of Mean		0.131	0.149	0.154	0.11	0.103	0.084	0.131	0.186	0.11
Median		4	4	5	5	5	5	4	4	4
Mode		5	5	5	5	5	5	4	5	4
Std. Deviation		1.065	1.207	1.25	0.898	0.836	0.679	1.05	1.511	0.896
Variance		1.133	1.457	1.563	0.806	0.699	0.461	1.103	2.283	0.802
Skewness		-0.984	-0.802	-1.269	-1.453	-1.312	-1.67	-0.7	-0.834	-0.26
Std. Error of Skewness		0.295	0.296	0.296	0.295	0.295	0.295	0.298	0.295	0.295
Kurtosis		0.378	-0.286	0.619	1.909	1.261	2.535	0.343	-0.816	-0.797
Std. Error of Kurtosis		0.582	0.584	0.584	0.582	0.582	0.582	0.588	0.582	0.582
Range		4	4	4	4	4	3	4	4	3
Minimum		1	1	1	1	1	2	1	1	2
Maximum		5	5	5	5	5	5	5	5	5

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Boulder City		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	9	9	9	9	9	9	9	9
	Missing	0	0	0	0	0	0	0	0
Mean		4.59	4.4	5	4.77	4.71	4.82	4.82	4.82
Std. Error of Mean		0.28	0.333	0	0.194	0.203	0.138	0.138	0.138
Median		5	5	5	5	5	5	5	5
Mode		5	5	5	5	5	5	5	5
Std. Deviation		0.821	0.977	0	0.571	0.595	0.406	0.406	0.406
Variance		0.674	0.954	0	0.326	0.354	0.165	0.165	0.165
Skewness		-1.788	-1.053		-2.734	-2.238	-2.068	-2.068	-2.068
Std. Error of Skewness		0.729	0.729	0.729	0.729	0.729	0.729	0.729	0.729
Kurtosis		1.765	-1.254		8.952	5.775	2.912	2.912	2.912
Std. Error of Kurtosis		1.428	1.428	1.428	1.428	1.428	1.428	1.428	1.428
Range		2	2	0	2	2	1	1	1
Minimum		3	3	5	3	3	4	4	4
Maximum		5	5	5	5	5	5	5	5

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Boulder City (cont.)		Facilitate neighborhood watch programs	Preparing for natural disasters, (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	Investigating criminal activity	Providing fire protection & prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	Valid	9	9	9	9	9	9	9	9	9
	Missing	0	0	0	0	0	0	0	0	0
Mean		3.99	4.23	4.71	4.7	5	4.82	3.59	4.52	3.99
Std. Error of Mean		0.278	0.29	0.203	0.166	0	0.138	0.281	0.281	0.302
Median		4	4.21	5	5	5	5	3	5	4
Mode		4	5	5	5	5	5	3	5	3
Std. Deviation		0.817	0.853	0.596	0.488	0	0.406	0.824	0.827	0.887
Variance		0.668	0.727	0.355	0.239	0	0.165	0.68	0.683	0.786
Skewness		0.029	-0.547	-2.219	-1.053		-2.068	1.043	-1.469	0.032
Std. Error of Skewness		0.729	0.729	0.729	0.729	0.729	0.729	0.729	0.729	0.729
Kurtosis		-1.346	-1.35	5.662	-1.254		2.912	-0.393	0.677	-1.846
Std. Error of Kurtosis		1.428	1.428	1.428	1.428	1.428	1.428	1.428	1.428	1.428
Range		2	2	2	1	0	1	2	2	2
Minimum		3	3	3	4	5	4	3	3	3
Maximum		5	5	5	5	5	5	5	5	5

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Mesquite		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	4	4	4	4	4	4	4	4
	Missing	0	0	0	0	0	0	0	0
Mean		4.76	4.52	4.64	4.4	4.48	4.6	5	4.6
Std. Error of Mean		0.251	0.411	0.403	0.499	0.293	0.287	0	0.287
Median		5	5	5	5	4.43	4.9	5	4.9
Mode		5	5	5	5	4	5	5	5
Std. Deviation		0.496	0.812	0.797	0.985	0.579	0.568	0	0.568
Variance		0.246	0.66	0.635	0.97	0.336	0.322	0	0.322
Skewness		-2.143	-1.975	-2.87	-1.518	0.127	-0.742		-0.742
Std. Error of Skewness		1.028	1.028	1.028	1.028	1.028	1.028	1.028	1.028
Range		1	2	2	2	1	1	0	1
Minimum		4	3	3	3	4	4	5	4
Maximum		5	5	5	5	5	5	5	5

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Mesquite (cont.)		Facilitate neighborhood watch programs	Preparing for natural disasters, (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	Investigating criminal activity	Providing fire protection & prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	Valid	4	4	4	4	4	4	3	4	3
	Missing	0	0	0	0	0	0	0	0	0
Mean		4.08	4.48	4.6	4.88	4.6	4.6	4	4.52	4.59
Std. Error of Mean		0.467	0.293	0.287	0.191	0.287	0.287	0.336	0.502	0.316
Median		4	4.43	4.9	5	4.9	4.9	4	5	4.81
Mode		4(a)	4	5	5	5	5	4	5	5
Std. Deviation		0.921	0.579	0.568	0.378	0.568	0.568	0.622	0.992	0.585
Variance		0.849	0.336	0.322	0.143	0.322	0.322	0.387	0.984	0.342
Skewness		-0.269	0.127	-0.742	-4.126	-0.742	-0.742	0	-2.143	-0.73
Std. Error of Skewness		1.028	1.028	1.028	1.028	1.028	1.028	1.108	1.028	1.108
Range		2	1	1	1	1	1	2	2	1
Minimum		3	4	4	4	4	4	3	3	4
Maximum		5	5	5	5	5	5	5	5	5

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Unincorporated Clark County		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	Valid	259	256	259	257	260	260	259	260	260	259	260	259
	Missing	2	4	2	4	0	0	2	0	0	2	0	2
Mean		3.88	4.09	4.1	3.98	3.71	4.26	3.99	4.18	3.88	3.72	3.87	4.19
Std. Error of Mean		0.082	0.076	0.072	0.071	0.077	0.069	0.07	0.068	0.078	0.086	0.079	0.062
Median		4	5	5	4	4	5	4	5	4	4	4	4.25
Mode		5	5	5	5	5	5	5	5	5	5	5	5
Std. Deviation		1.312	1.215	1.165	1.13	1.244	1.106	1.131	1.09	1.261	1.391	1.278	0.992
Variance		1.722	1.475	1.357	1.278	1.547	1.224	1.278	1.188	1.59	1.935	1.634	0.984
Skewness		-0.884	-1.171	-1.165	-0.845	-0.609	-1.533	-1.021	-1.308	-0.86	-0.698	-0.964	-1.203
Std. Error of Skewness		0.151	0.152	0.151	0.152	0.151	0.151	0.151	0.151	0.151	0.151	0.151	0.151
Kurtosis		-0.448	0.291	0.415	-0.307	-0.635	1.568	0.386	1.008	-0.35	-0.832	-0.151	1.011
Std. Error of Kurtosis		0.302	0.303	0.302	0.303	0.301	0.301	0.302	0.301	0.301	0.302	0.301	0.302
Range		4	4	4	4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5	5	5	5

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City of Las Vegas		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	Valid	188	191	190	188	191	193	193	191	192	193	191	193
	Missing	4	2	3	5	2	0	0	2	1	0	2	0
Mean		3.73	4.02	4.06	3.92	3.72	4.26	4.15	4.14	3.95	3.8	4.07	4.07
Std. Error of Mean		0.097	0.089	0.085	0.078	0.083	0.083	0.074	0.075	0.084	0.091	0.074	0.067
Median		4	4	4	4	4	5	4	4	4	4	4	4
Mode		5	5	5	5	4	5	5	5	5	5	5	5
Std. Deviation		1.326	1.225	1.171	1.066	1.149	1.149	1.031	1.042	1.168	1.266	1.02	0.935
Variance		1.759	1.502	1.372	1.136	1.32	1.32	1.064	1.085	1.364	1.604	1.041	0.875
Skewness		-0.74	-1.169	-1.241	-0.646	-0.789	-1.625	-1.16	-1.195	-0.951	-0.858	-0.99	-0.683
Std. Error of Skewness		0.177	0.176	0.176	0.177	0.176	0.175	0.175	0.176	0.176	0.175	0.176	0.175
Kurtosis		-0.638	0.352	0.677	-0.418	-0.077	1.693	0.819	0.921	0.146	-0.291	0.381	-0.262
Std. Error of Kurtosis		0.352	0.35	0.351	0.353	0.35	0.348	0.349	0.35	0.349	0.349	0.35	0.348
Range		4	4	4	4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5	5	5	5

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City of North Las Vegas		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	Valid	67	66	68	68	67	67	68	68	68	67	68	67
	Missing	0	2	0	0	1	0	0	0	0	0	0	0
Mean		4.28	4.36	4.3	4.15	3.77	4.59	4.32	4.22	4.04	3.74	3.82	4.3
Std. Error of Mean		0.131	0.134	0.141	0.138	0.13	0.112	0.12	0.14	0.161	0.155	0.163	0.131
Median		5	5	5	5	4	5	5	5	5	4	4	5
Mode		5	5	5	5	4	5	5	5	5	5	5	5
Std. Deviation		1.073	1.085	1.16	1.139	1.06	0.92	0.986	1.153	1.325	1.274	1.342	1.078
Variance		1.151	1.178	1.347	1.297	1.125	0.846	0.972	1.329	1.756	1.624	1.801	1.162
Skewness		-1.443	-1.721	-1.578	-1.183	-0.579	-2.632	-1.344	-1.296	-0.935	-0.835	-0.796	-1.66
Std. Error of Skewness		0.292	0.296	0.291	0.291	0.294	0.292	0.291	0.291	0.291	0.292	0.291	0.292
Kurtosis		1.363	2.041	1.346	0.52	-0.361	6.864	0.848	0.673	-0.633	-0.25	-0.604	2.256
Std. Error of Kurtosis		0.577	0.584	0.575	0.575	0.58	0.577	0.575	0.575	0.575	0.577	0.575	0.577
Range		4	4	4	4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5	5	5	5

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City of Henderson		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	Valid	66	66	66	66	66	66	66	66	66	66	65	66
	Missing	0	0	0	0	0	0	0	0	0	0	1	0
Mean		3.71	4.09	4.23	4.13	3.61	4.26	4.22	4.21	4.16	3.79	4.04	4.25
Std. Error of Mean		0.173	0.147	0.135	0.125	0.13	0.137	0.108	0.127	0.126	0.158	0.144	0.116
Median		4	5	5	4	4	5	4	5	4	4	4	4.55
Mode		5	5	5	5	4	5	5	5	5	5	5	5
Std. Deviation		1.406	1.194	1.094	1.019	1.051	1.111	0.882	1.033	1.023	1.283	1.158	0.943
Variance		1.976	1.426	1.197	1.038	1.104	1.233	0.778	1.067	1.047	1.647	1.341	0.889
Skewness		-0.692	-1.189	-1.5	-1.189	-0.551	-1.54	-1.309	-1.311	-1.251	-0.767	-1.32	-1.373
Std. Error of Skewness		0.295	0.295	0.295	0.295	0.296	0.295	0.295	0.295	0.296	0.295	0.297	0.295
Kurtosis		-0.858	0.574	1.552	0.97	0.061	1.697	2.119	1.355	1.092	-0.326	1.198	1.711
Std. Error of Kurtosis		0.582	0.582	0.582	0.582	0.584	0.582	0.582	0.582	0.584	0.582	0.586	0.582
Range		4	4	4	4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

Boulder City		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	Valid	9	9	8	9	9	9	9	9	9	9	9	9
	Missing	0	0	0	0	0	0	0	0	0	0	0	0
Mean		4.07	4.28	4.45	4.44	4.03	4.59	4.3	4.54	3.96	4.66	4.41	4.59
Std. Error of Mean		0.361	0.32	0.321	0.364	0.418	0.28	0.298	0.281	0.434	0.209	0.28	0.28
Median		4.63	4.66	5	5	4	5	4.82	5	4.63	5	5	5
Mode		5	5	5	5	4	5	5	5	5	5	5	5
Std. Deviation		1.061	0.939	0.917	1.068	1.229	0.821	0.874	0.826	1.274	0.614	0.822	0.821
Variance		1.125	0.883	0.841	1.141	1.511	0.674	0.764	0.682	1.622	0.377	0.675	0.674
Skewness		-0.179	-1.297	-1.255	-2.763	-2.143	-1.788	-0.752	-1.538	-0.847	-1.824	-1.056	-1.788
Std. Error of Skewness		0.729	0.729	0.746	0.729	0.729	0.729	0.729	0.729	0.729	0.729	0.729	0.729
Kurtosis		-2.668	1.657	-0.461	10.687	5.792	1.765	-1.231	0.893	0.272	3.572	-0.347	1.765
Std. Error of Kurtosis		1.428	1.428	1.467	1.428	1.428	1.428	1.428	1.428	1.428	1.428	1.428	1.428
Range		2	3	2	4	4	2	2	2	4	2	2	2
Minimum		3	2	3	1	1	3	3	3	1	3	3	3
Maximum		5	5	5	5	5	5	5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

Mesquite		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	Valid	4	3	4	4	4	4	4	4	3	4	4	4
	Missing	0	0	0	0	0	0	0	0	0	0	0	0
Mean		4.08	3.96	4.64	4.64	4.4	4.64	4.64	4.64	4.59	4.4	4.64	4.52
Std. Error of Mean		0.548	0.492	0.403	0.403	0.407	0.574	0.282	0.403	0.461	0.499	0.403	0.411
Median		4.43	4	5	5	4.57	5	5	5	5	5	5	5
Mode		5	4	5	5	5	5	5	5	5	5	5	5
Std. Deviation		1.083	0.91	0.797	0.797	0.804	1.133	0.557	0.797	0.854	0.985	0.797	0.812
Variance		1.173	0.829	0.635	0.635	0.646	1.283	0.31	0.635	0.729	0.97	0.635	0.66
Skewness		-0.299	0.14	-2.87	-2.87	-1.266	-4.126	-1.02	-2.87	-2.871	-1.518	-2.87	-1.975
Std. Error of Skewness		1.028	1.108	1.028	1.028	1.028	1.028	1.028	1.028	1.108	1.028	1.028	1.028
Range		2	2	2	2	2	3	1	2	2	2	2	2
Minimum		3	3	3	3	3	2	4	3	3	3	3	3
Maximum		5	5	5	5	5	5	5	5	5	5	5	5

Appendix II
Performance Score for Selected Services

Appendix II
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)

Performance Variables	N Valid	N Missing	Mean	Std. Error of Mean	Median	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
General Government Services												
Road maintenance	596	4	3.14	0.042	3	1.036	-0.116	0.1	-0.334	0.2	1	5
Revitalizing older neighborhoods	589	11	2.59	0.042	3	1.024	0.365	0.101	-0.182	0.201	1	5
Flood control	581	19	3.6	0.046	4	1.1	-0.647	0.101	-0.091	0.202	1	5
Budget management	586	14	2.72	0.045	3	1.091	0.015	0.101	-0.555	0.202	1	5
Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	575	25	3.01	0.05	3	1.202	-0.076	0.102	-0.755	0.203	1	5
Monitor and report to the public on how well government services are being performed	575	24	2.6	0.046	3	1.094	0.126	0.102	-0.615	0.203	1	5
Water conservation programs	588	11	3.44	0.047	4	1.151	-0.486	0.101	-0.511	0.201	1	5
Social & Judicial Services												
Providing child protection services	586	13	3.03	0.046	3	1.108	-0.07	0.101	-0.572	0.201	1	5
Providing child welfare services	587	13	3.03	0.045	3	1.091	-0.072	0.101	-0.549	0.201	1	5
Providing juvenile justice services	583	17	2.96	0.043	3	1.05	-0.086	0.101	-0.268	0.202	1	5
Providing attainable housing for working class families	584	16	2.59	0.045	3	1.096	0.355	0.101	-0.364	0.202	1	5
Providing affordable housing for low income families	577	22	2.52	0.046	2	1.113	0.403	0.102	-0.404	0.203	1	5
Providing shelter for the homeless	586	14	2.22	0.047	2	1.128	0.618	0.101	-0.385	0.202	1	5
Providing affordable housing for seniors	580	19	2.76	0.047	3	1.139	0.075	0.101	-0.622	0.203	1	5
Providing medical care for the poor	577	23	2.58	0.051	3	1.226	0.371	0.102	-0.738	0.203	1	5
Providing 24 hour emergency trauma care	578	21	3.42	0.05	3	1.198	-0.306	0.102	-0.791	0.203	1	5

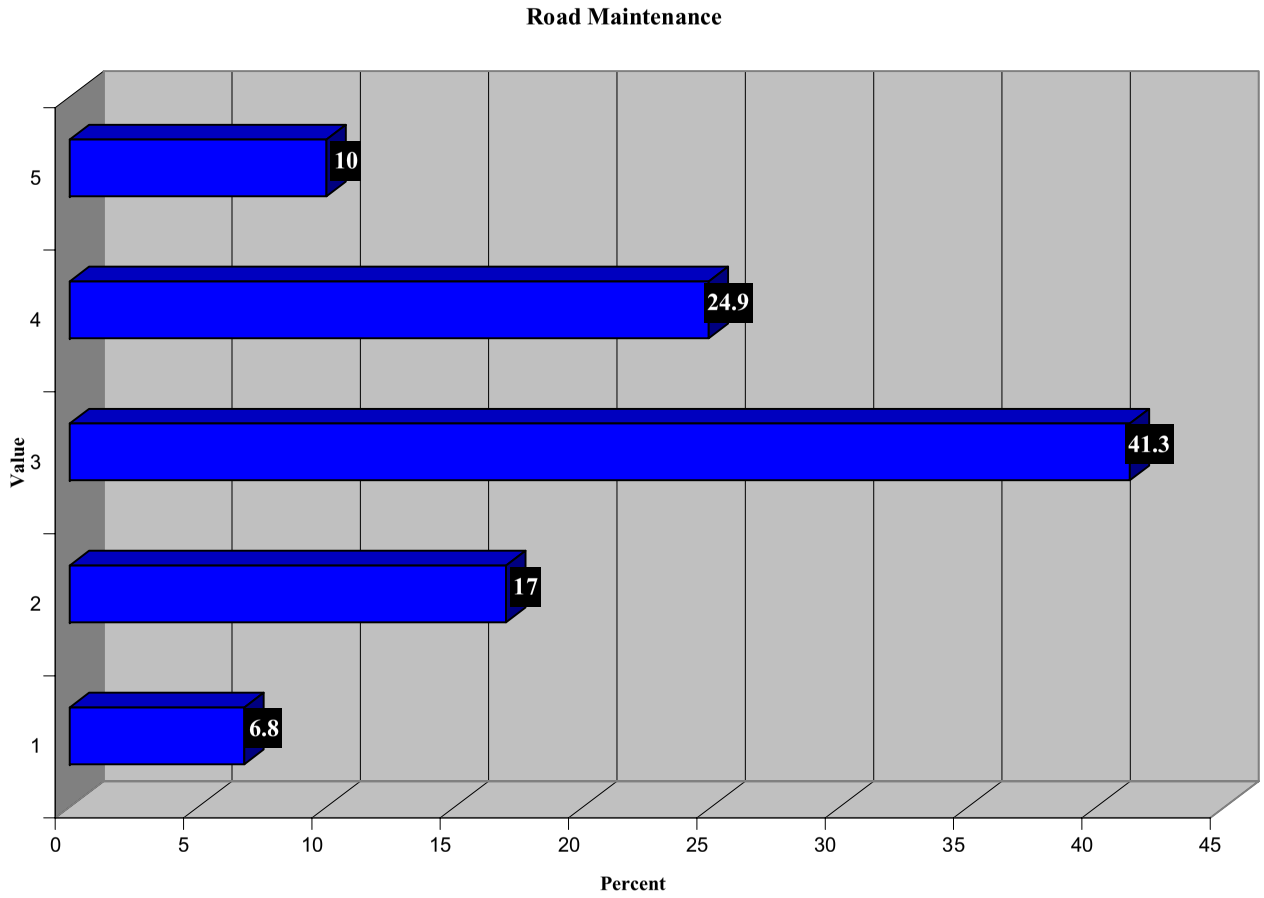
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)

Performance Variables	N Valid	N Missing	Mean	Std. Error of Mean	Median	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
Public Safety Services												
Providing crime prevention programs	579	21	3.19	0.042	3	1.011	-0.136	0.102	-0.241	0.203	1	5
Enforcing traffic laws	593	7	3.24	0.049	3	1.181	-0.279	0.1	-0.673	0.2	1	5
Maintaining a low crime rate	590	10	3	0.046	3	1.113	-0.056	0.101	-0.597	0.201	1	5
Maintaining neighborhood police patrols	582	18	2.82	0.05	3	1.2	0.158	0.101	-0.827	0.202	1	5
Keeping police response times low	577	23	3.16	0.049	3	1.186	-0.279	0.102	-0.68	0.203	1	5
Keeping fire department response times low	575	24	3.92	0.039	4	0.93	-0.694	0.102	0.451	0.203	1	5
Keeping paramedic and emergency medical response times low	577	22	3.94	0.04	4	0.951	-0.85	0.102	0.744	0.203	1	5
Well trained paramedic and emergency medical response personnel	578	22	4.11	0.039	4	0.929	-1.054	0.102	1.088	0.203	1	5
Facilitate neighborhood watch programs	581	19	2.87	0.047	3	1.144	0.115	0.101	-0.615	0.202	1	5
Preparing for natural disasters, (i.e. floods, earthquakes, etc)	583	16	3.01	0.047	3	1.132	-0.064	0.101	-0.657	0.202	1	5
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	583	16	3.05	0.05	3	1.201	-0.094	0.101	-0.775	0.202	1	5
Investigating criminal activity	584	16	3.13	0.048	3	1.152	-0.193	0.101	-0.723	0.202	1	5
Providing fire protection & prevention services	582	18	3.73	0.041	4	0.983	-0.563	0.101	-0.018	0.202	1	5
Providing emergency medical services	579	20	3.84	0.041	4	0.98	-0.695	0.102	0.263	0.203	1	5

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)

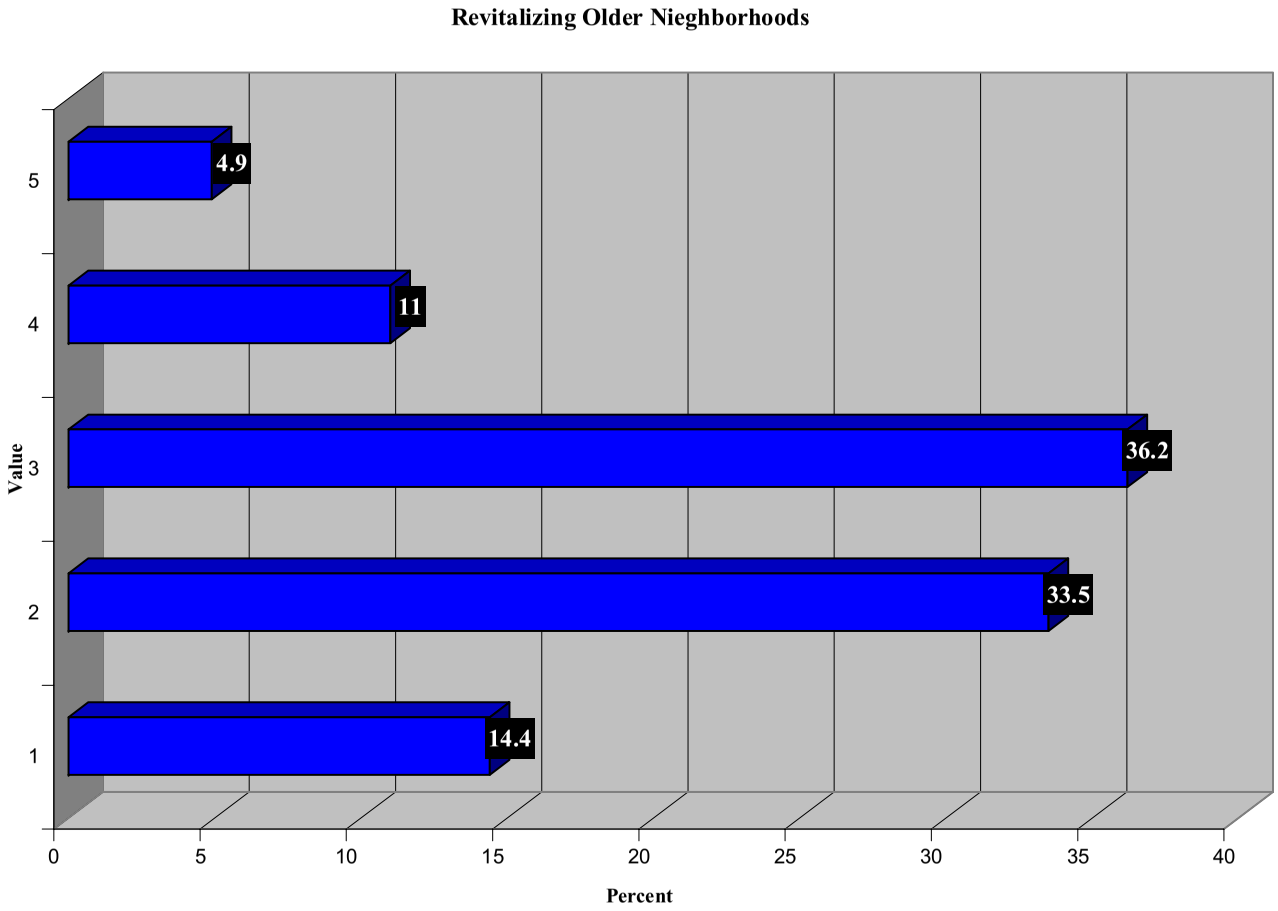
Performance Variables	N Valid	N Missing	Mean	Std. Error of Mean	Median	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
Public Safety Services (cont.)												
Providing for neighborhood code enforcement services	574	25	3.03	0.048	3	1.139	0.001	0.102	-0.569	0.204	1	5
Examining potential impacts from Yucca Mountain nuclear waste shipments	577	22	2.98	0.049	3	1.172	-0.039	0.102	-0.706	0.203	1	5
Regional justice services and facilities	584	15	3.22	0.043	3	1.041	-0.256	0.101	-0.194	0.202	1	5
Community Development Services												
Providing affordable housing	583	17	2.62	0.045	3	1.092	0.271	0.101	-0.37	0.202	1	5
Managing growth	586	13	2.53	0.049	3	1.192	0.253	0.101	-0.875	0.201	1	5
Increasing job opportunities	585	15	2.84	0.046	3	1.119	0.064	0.101	-0.566	0.202	1	5
Improving the business climate	581	19	3	0.046	3	1.098	-0.141	0.101	-0.579	0.202	1	5
Planning for commercial development	582	18	3.14	0.049	3	1.174	-0.233	0.101	-0.741	0.202	1	5
Reducing traffic congestion	593	6	2.59	0.052	3	1.272	0.28	0.1	-0.992	0.2	1	5
Access to freeways	594	6	3.28	0.047	3	1.155	-0.272	0.1	-0.647	0.2	1	5
Improving road conditions	592	8	3.12	0.048	3	1.166	-0.131	0.1	-0.752	0.201	1	5
Reducing travel time	586	14	2.75	0.048	3	1.165	0.112	0.101	-0.699	0.202	1	5
Providing mass public transit	586	14	2.81	0.051	3	1.227	0.11	0.101	-0.896	0.202	1	5
Adequate airport facilities	586	13	3.56	0.046	4	1.125	-0.564	0.101	-0.27	0.201	1	5
Parks and recreation programs	586	14	3.51	0.046	4	1.118	-0.466	0.101	-0.416	0.202	1	5

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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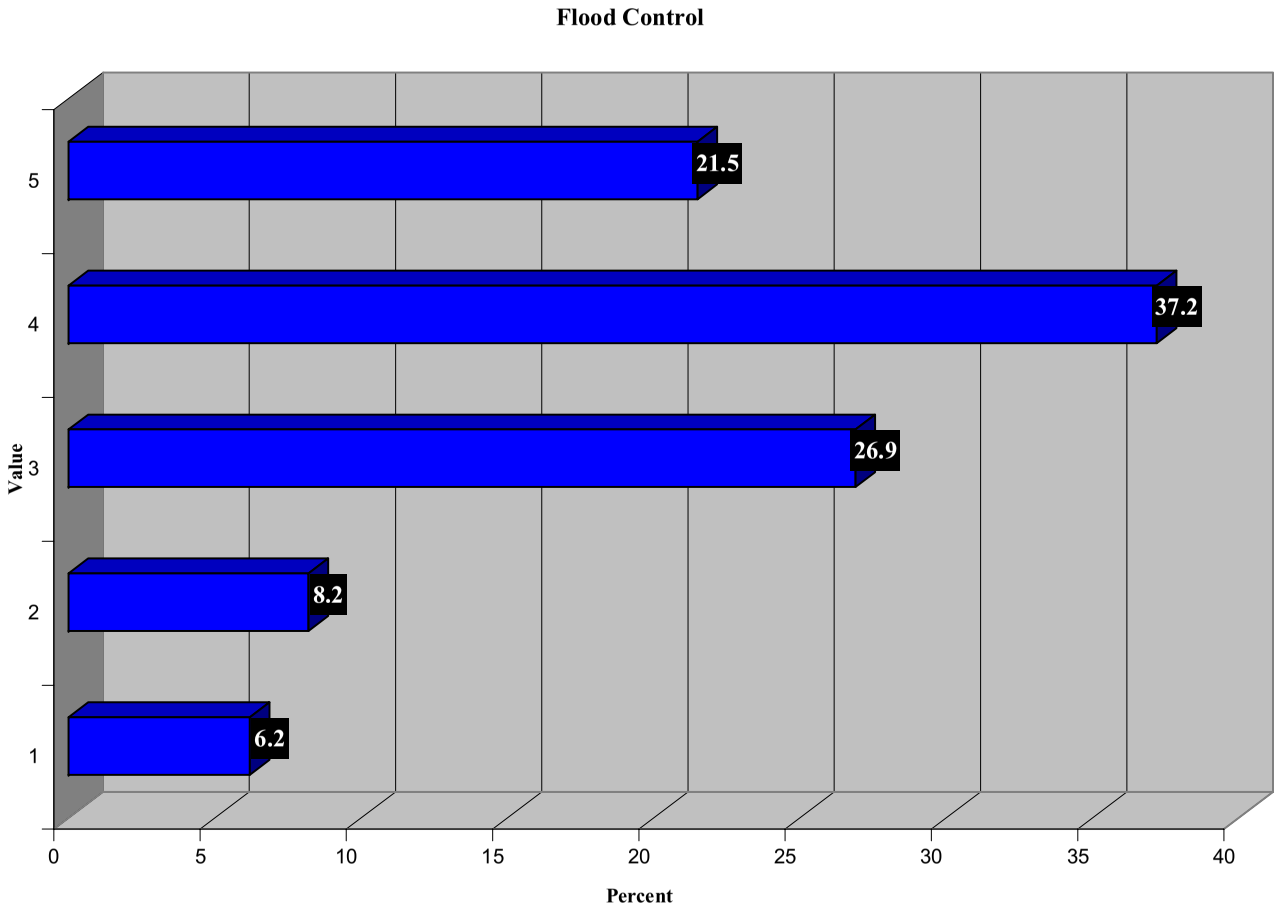
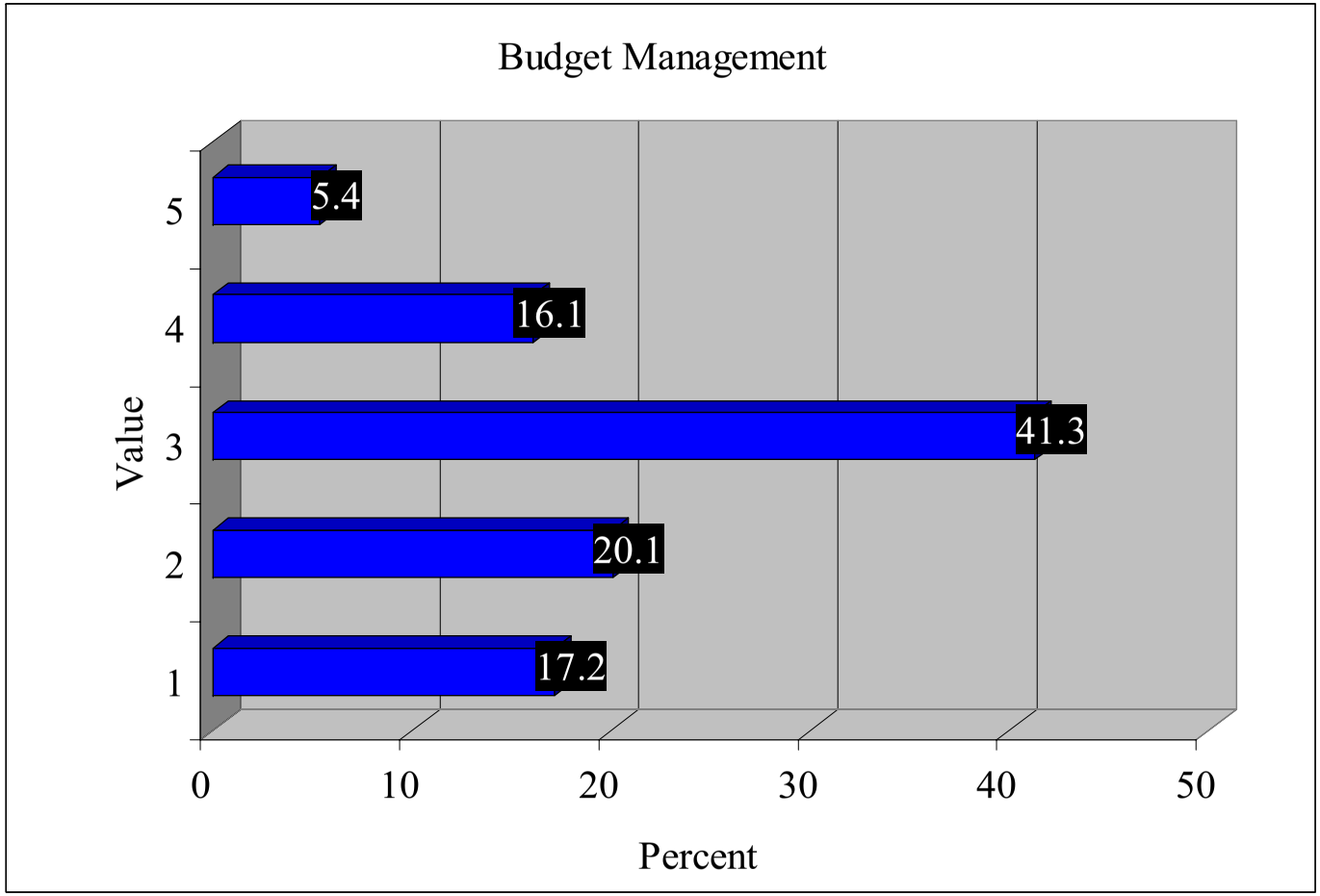
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



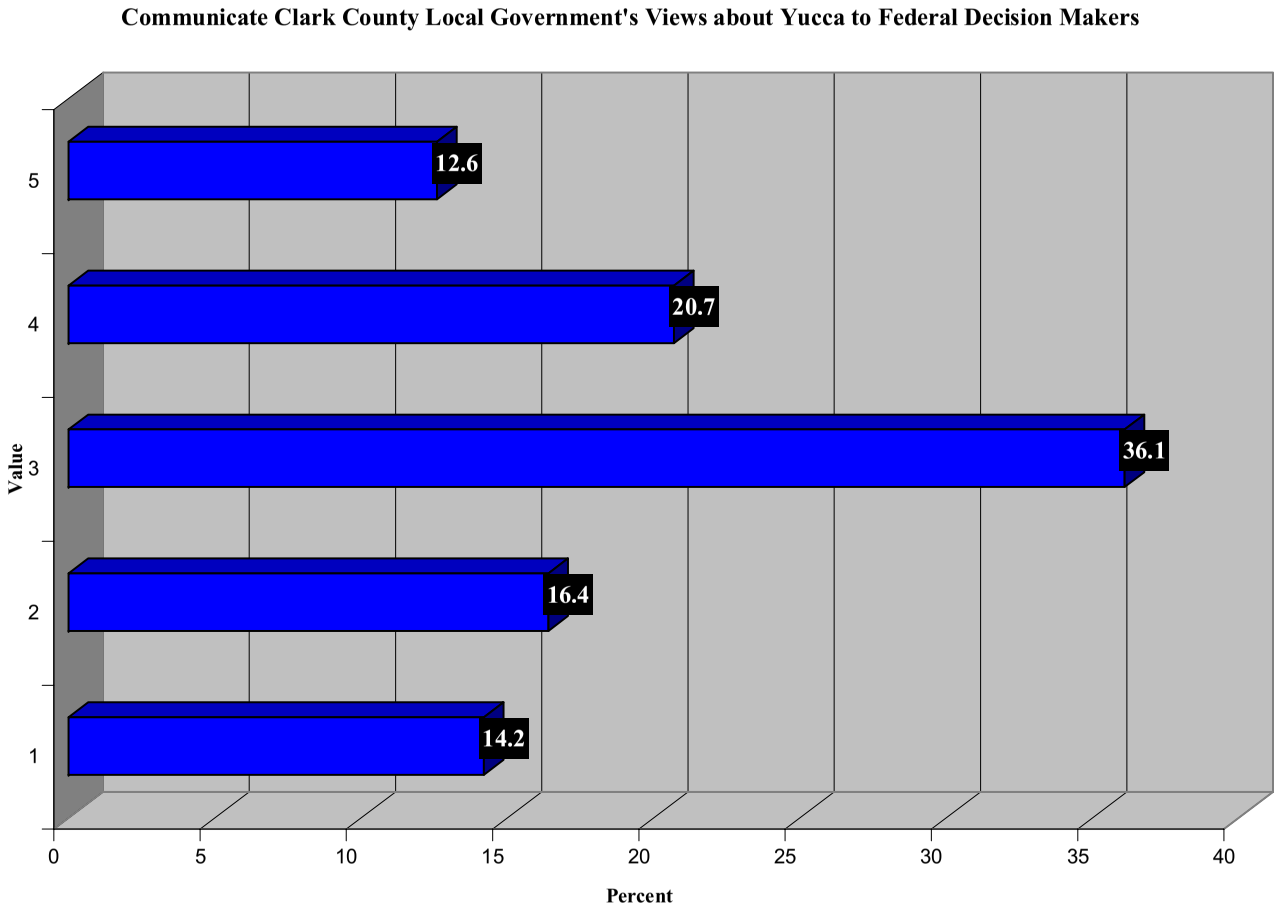
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



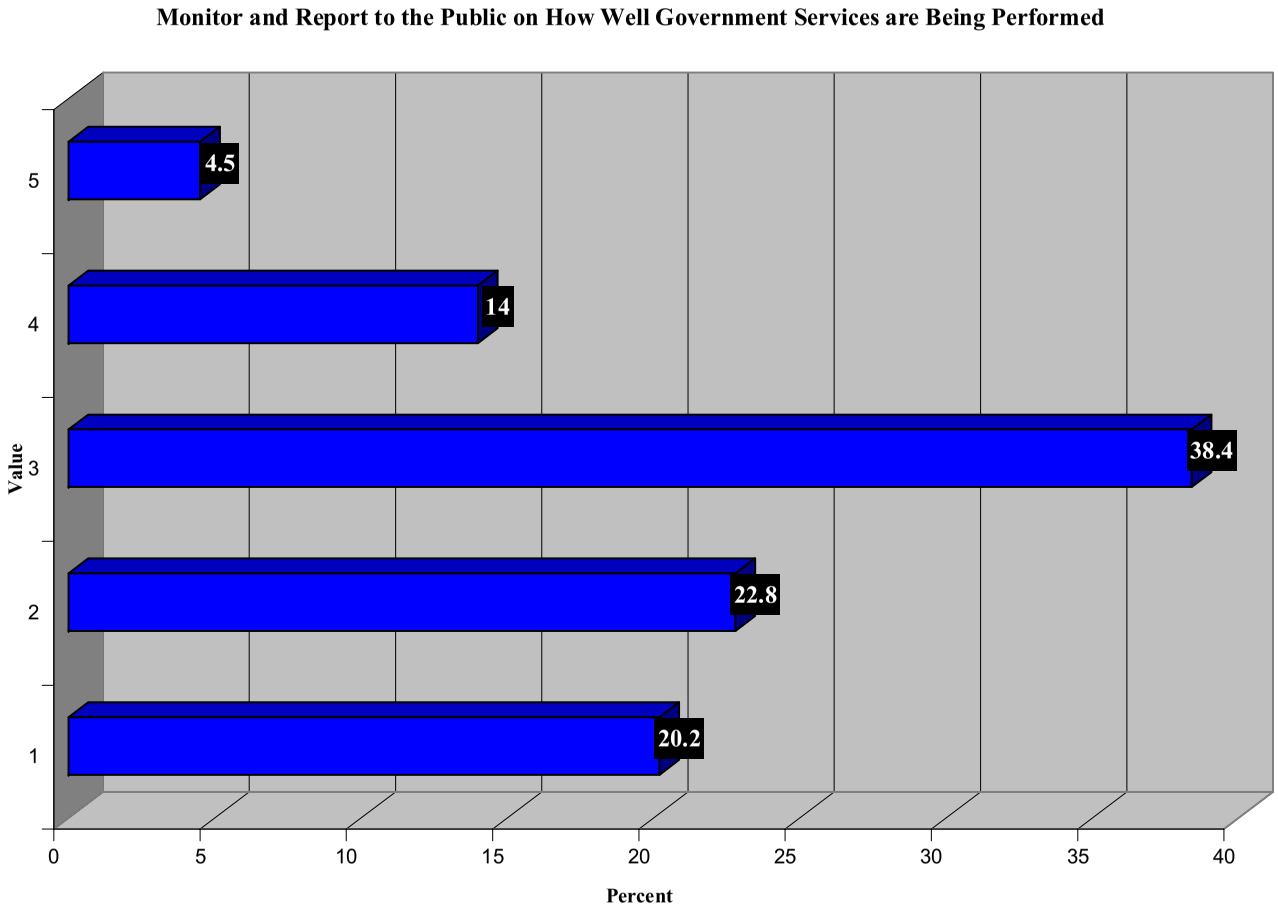
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



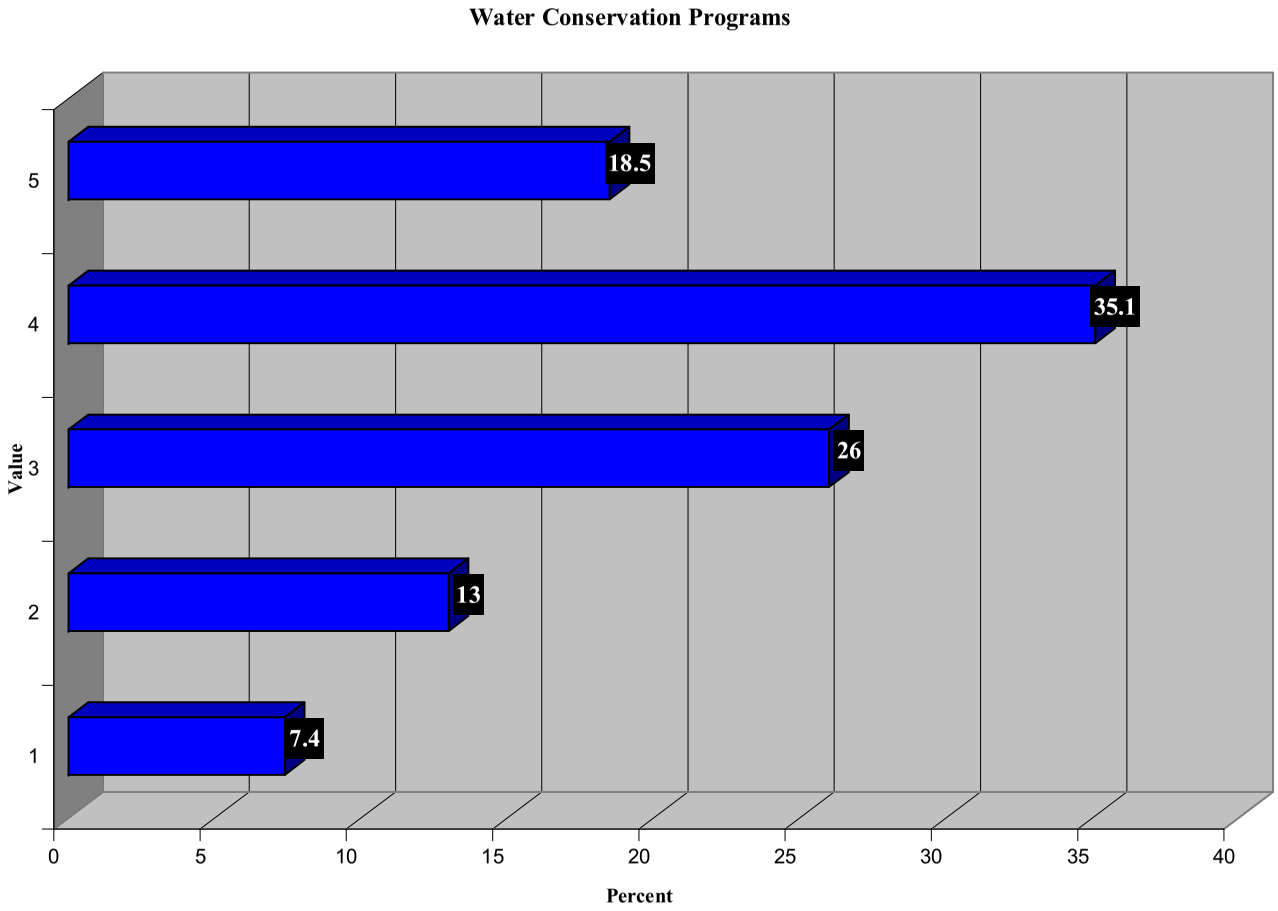
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



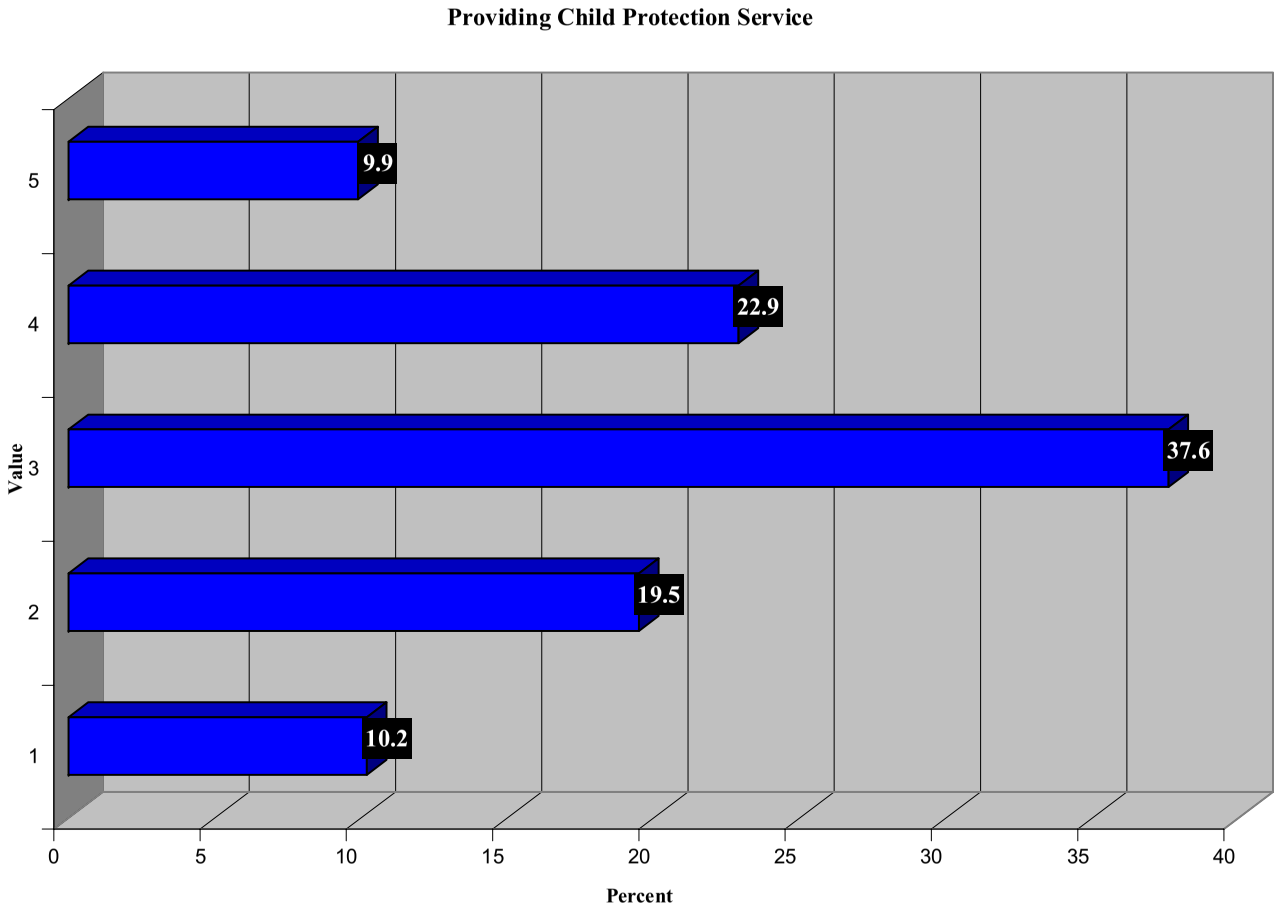
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



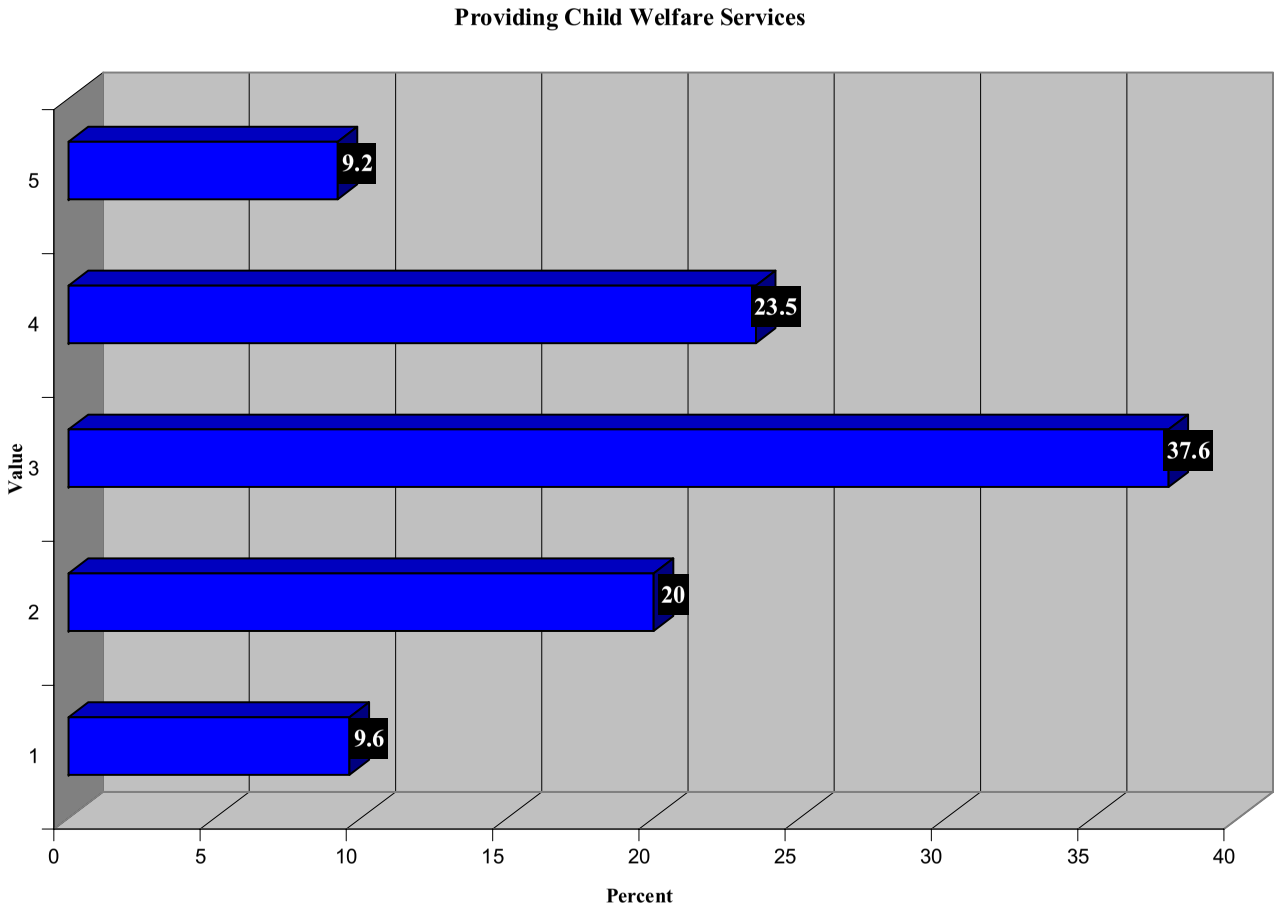
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



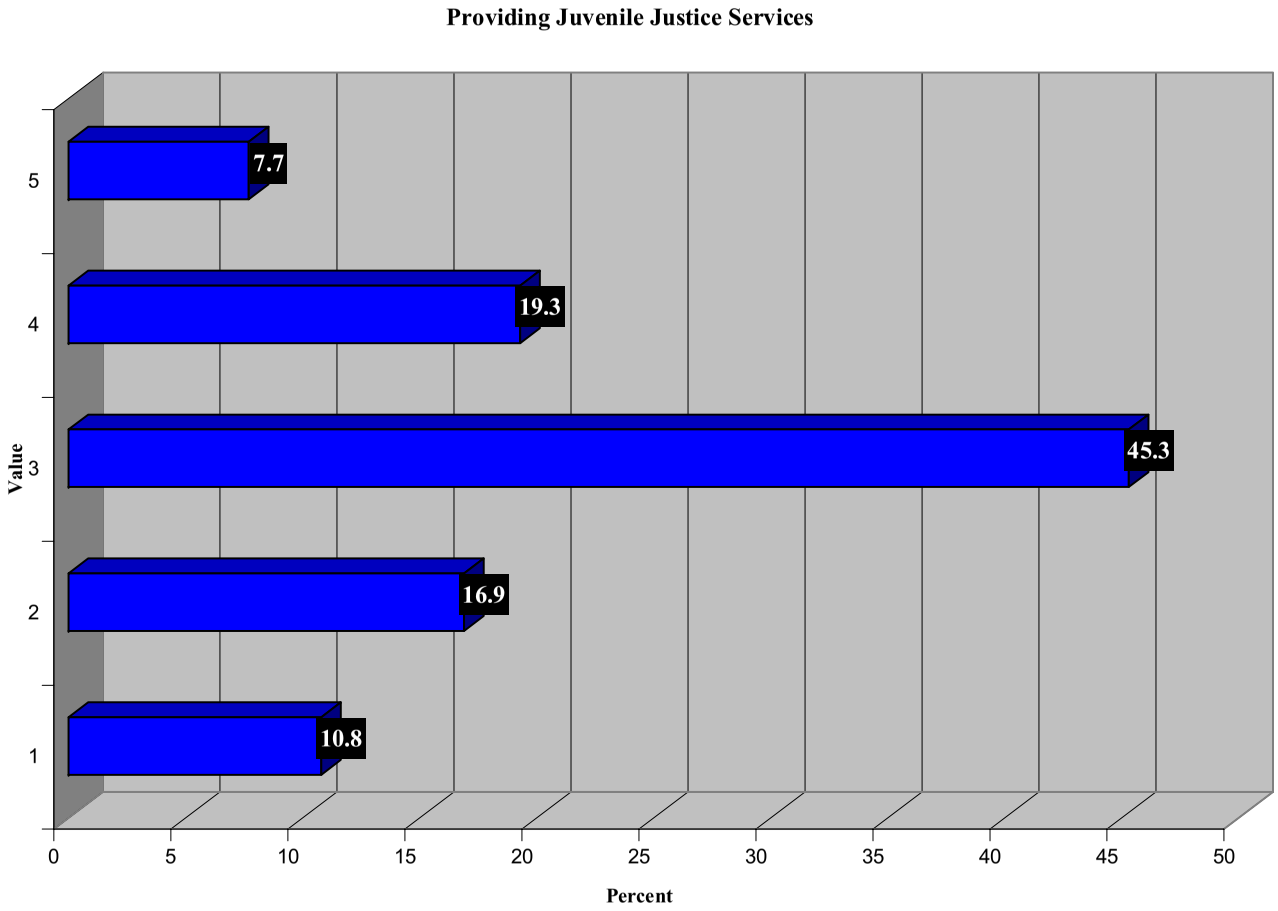
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



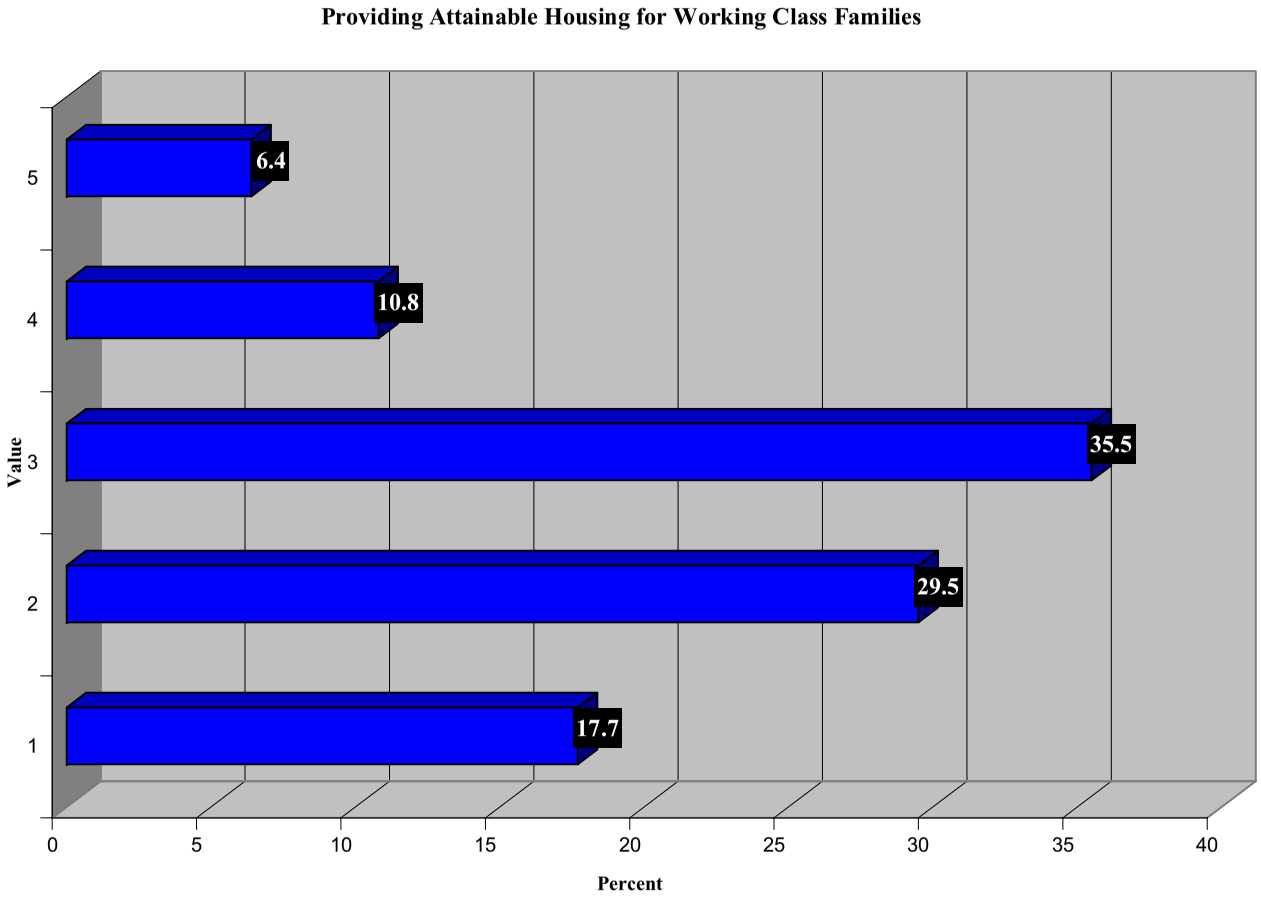
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



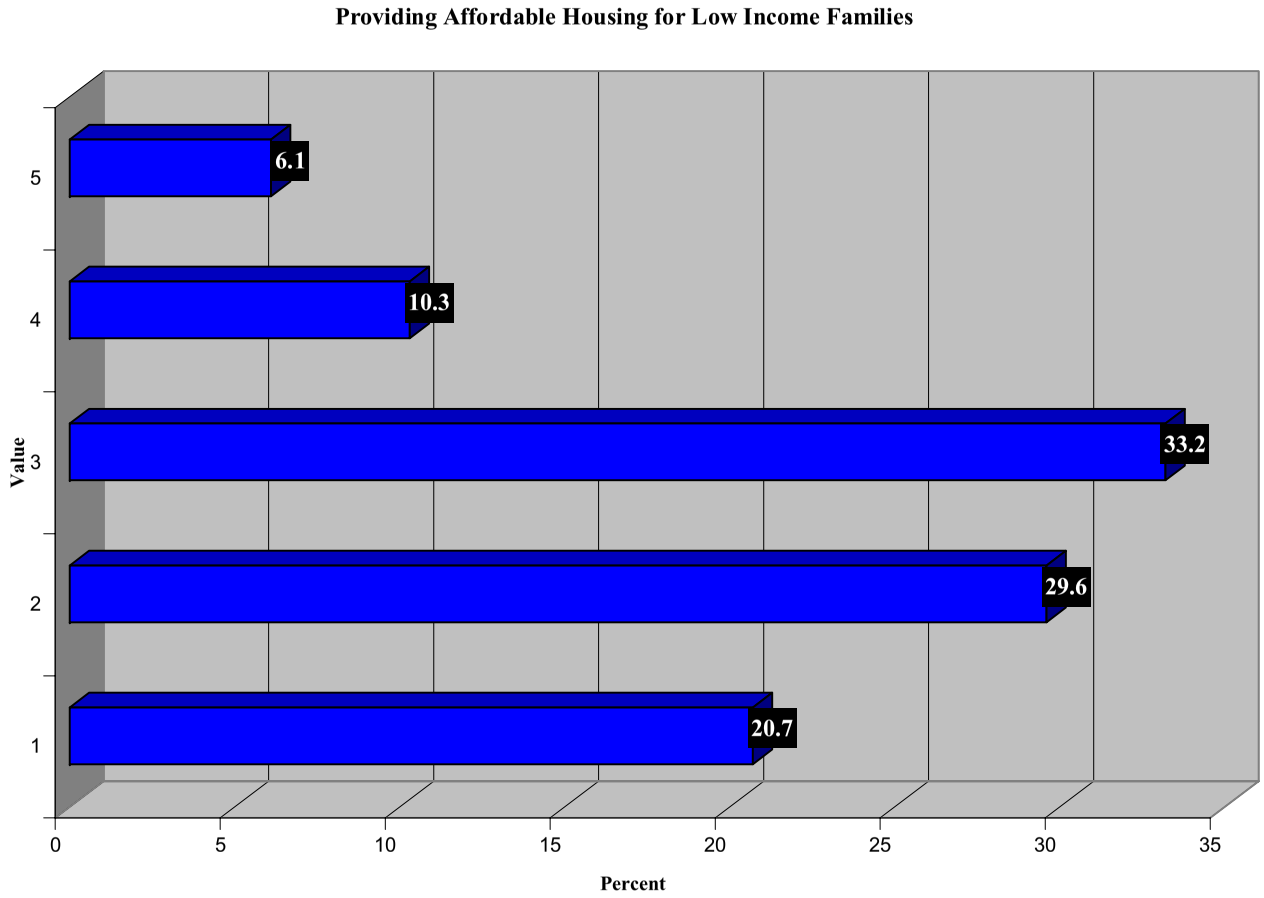
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



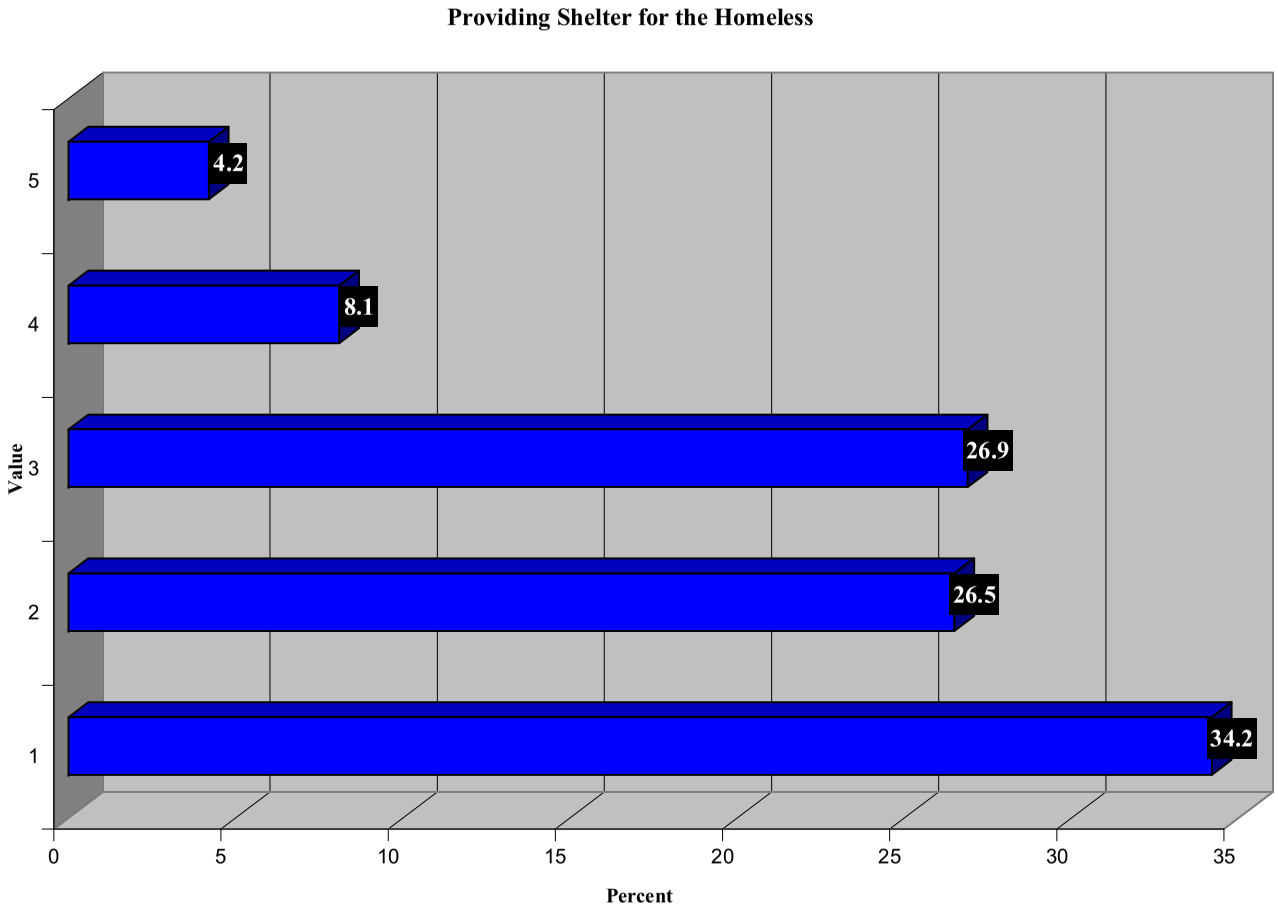
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



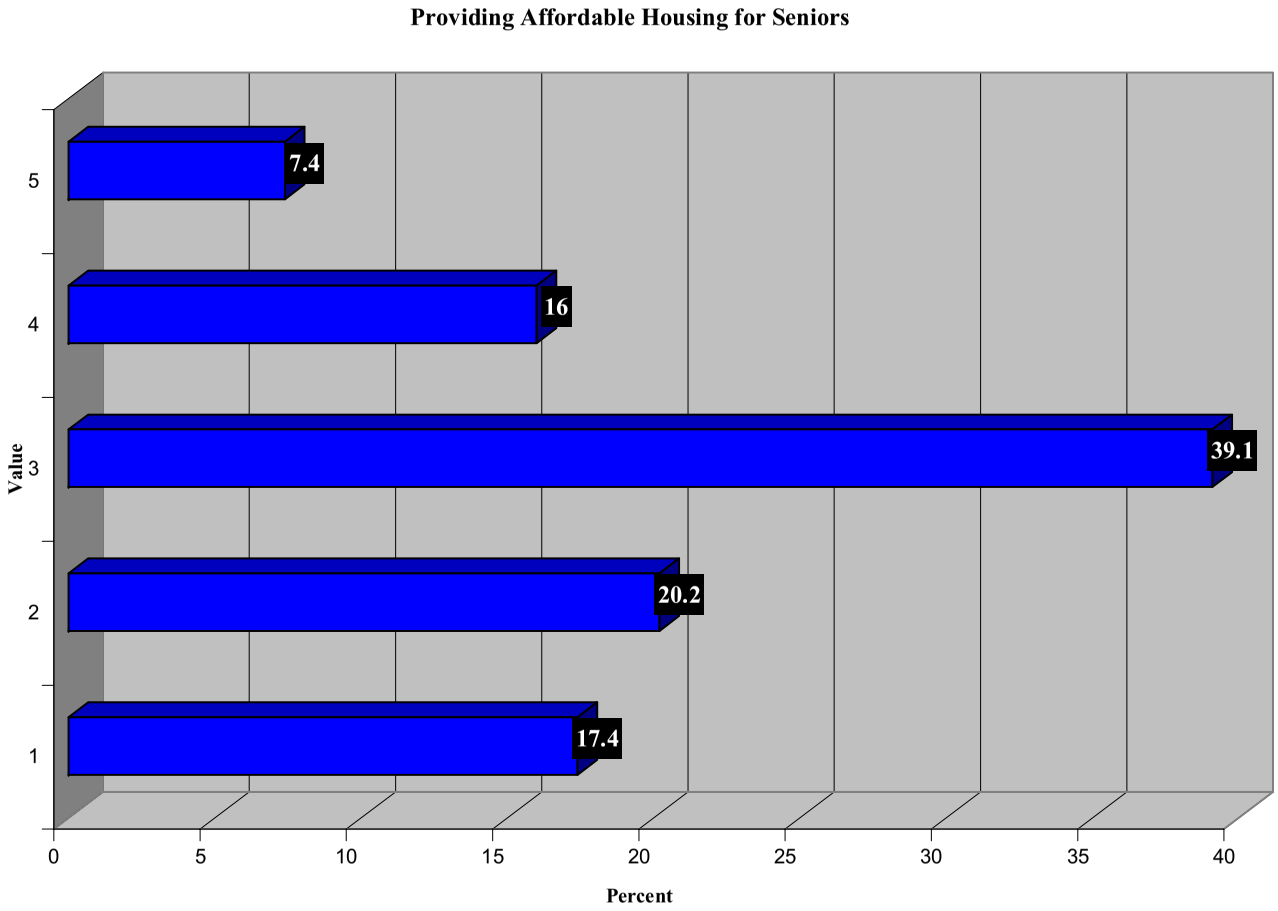
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



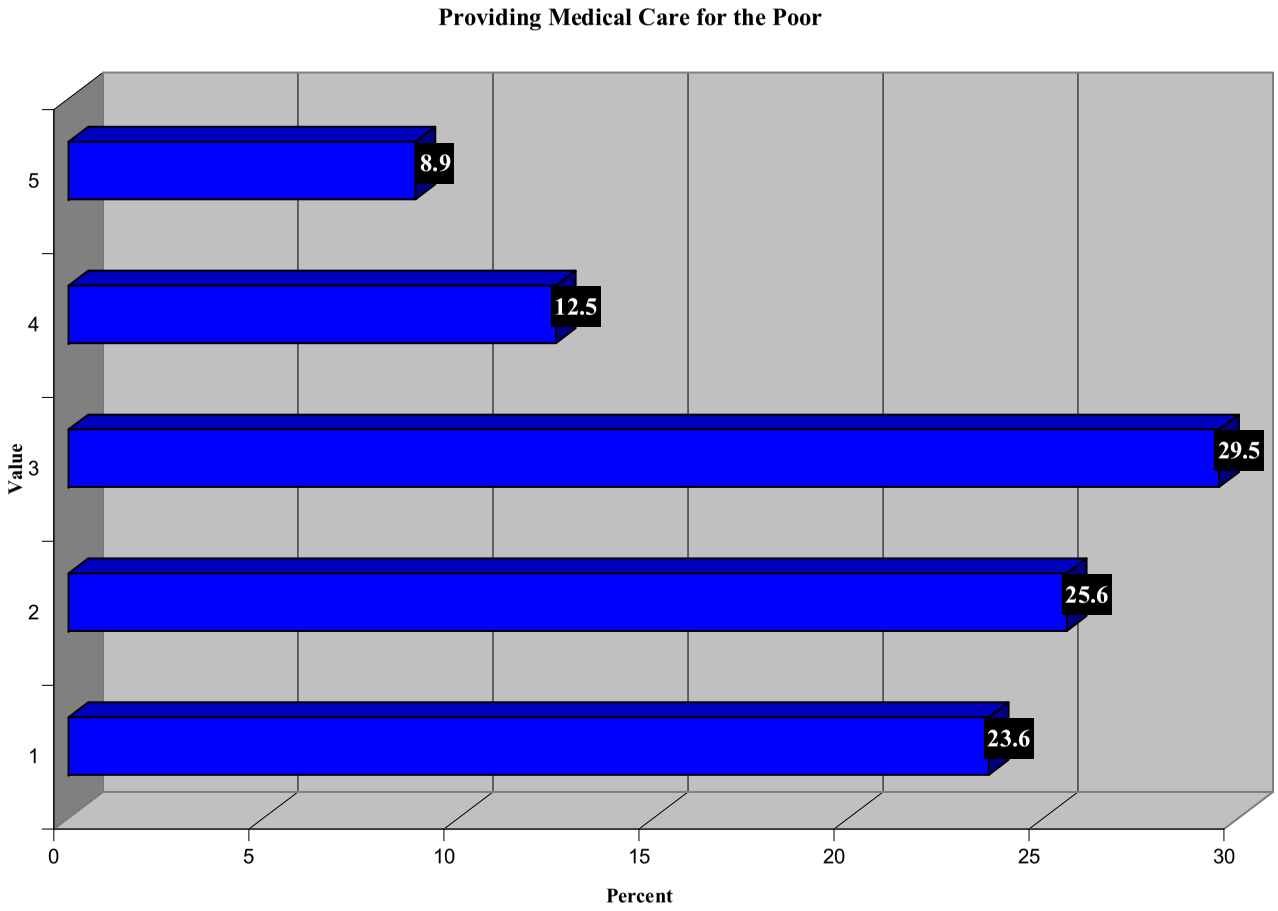
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



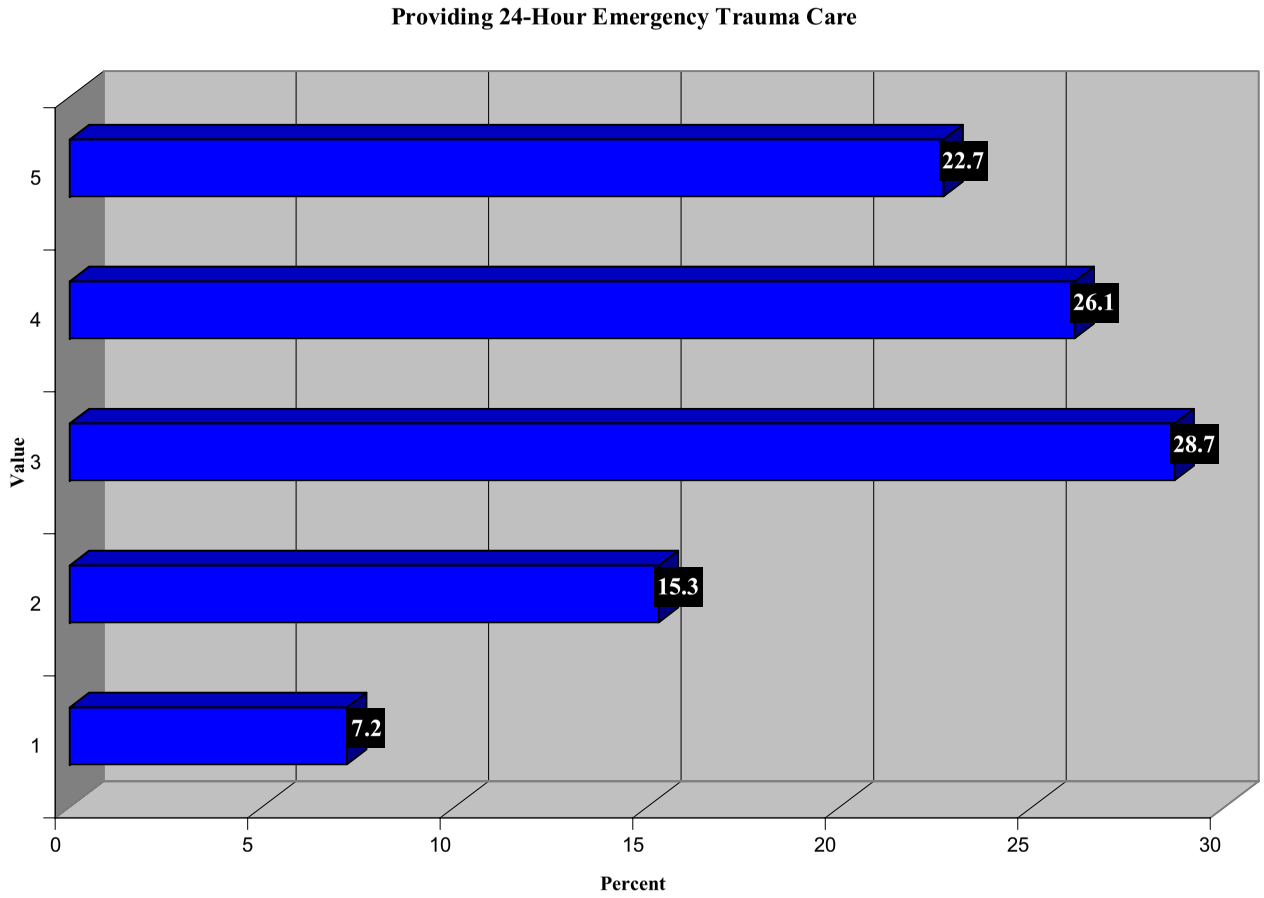
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



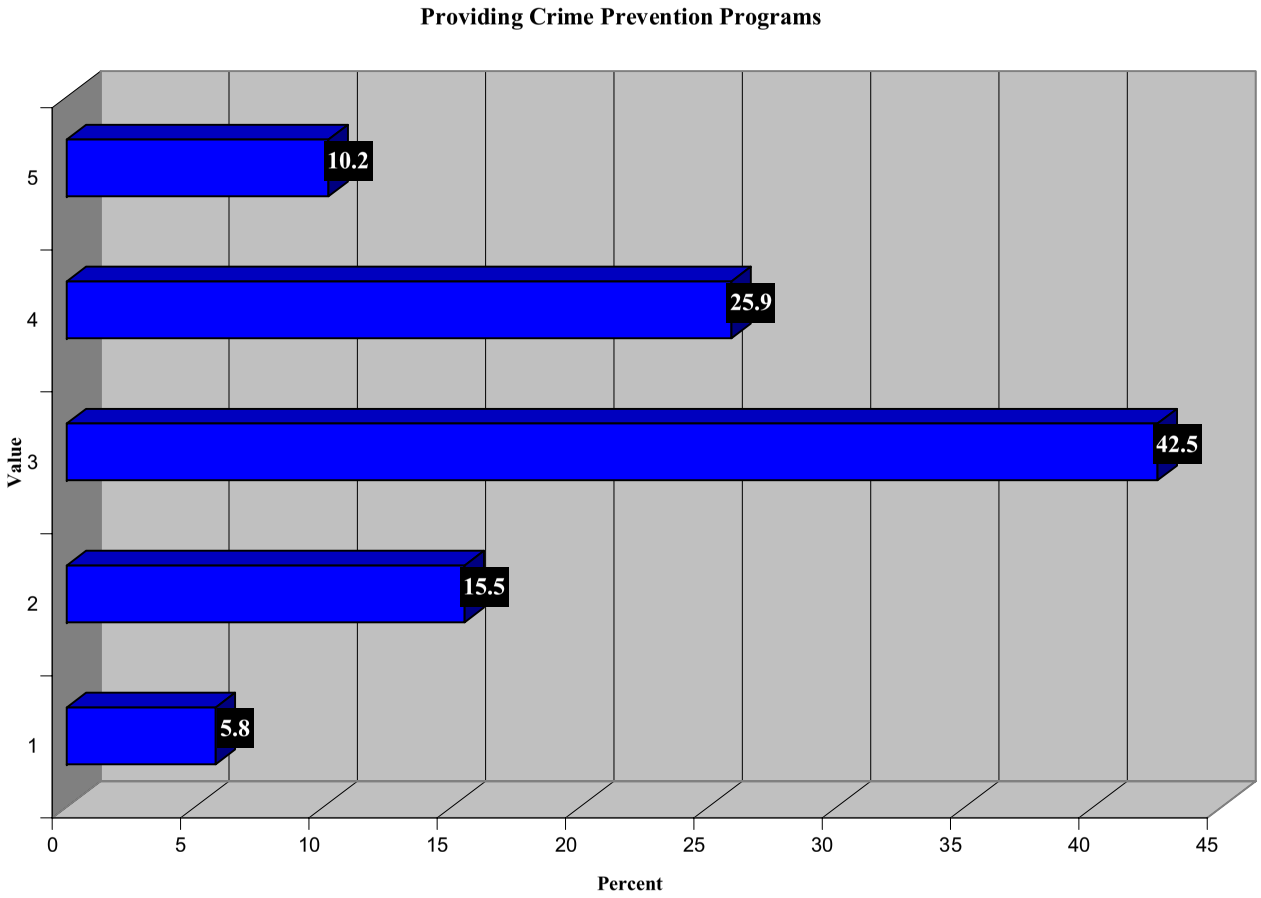
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



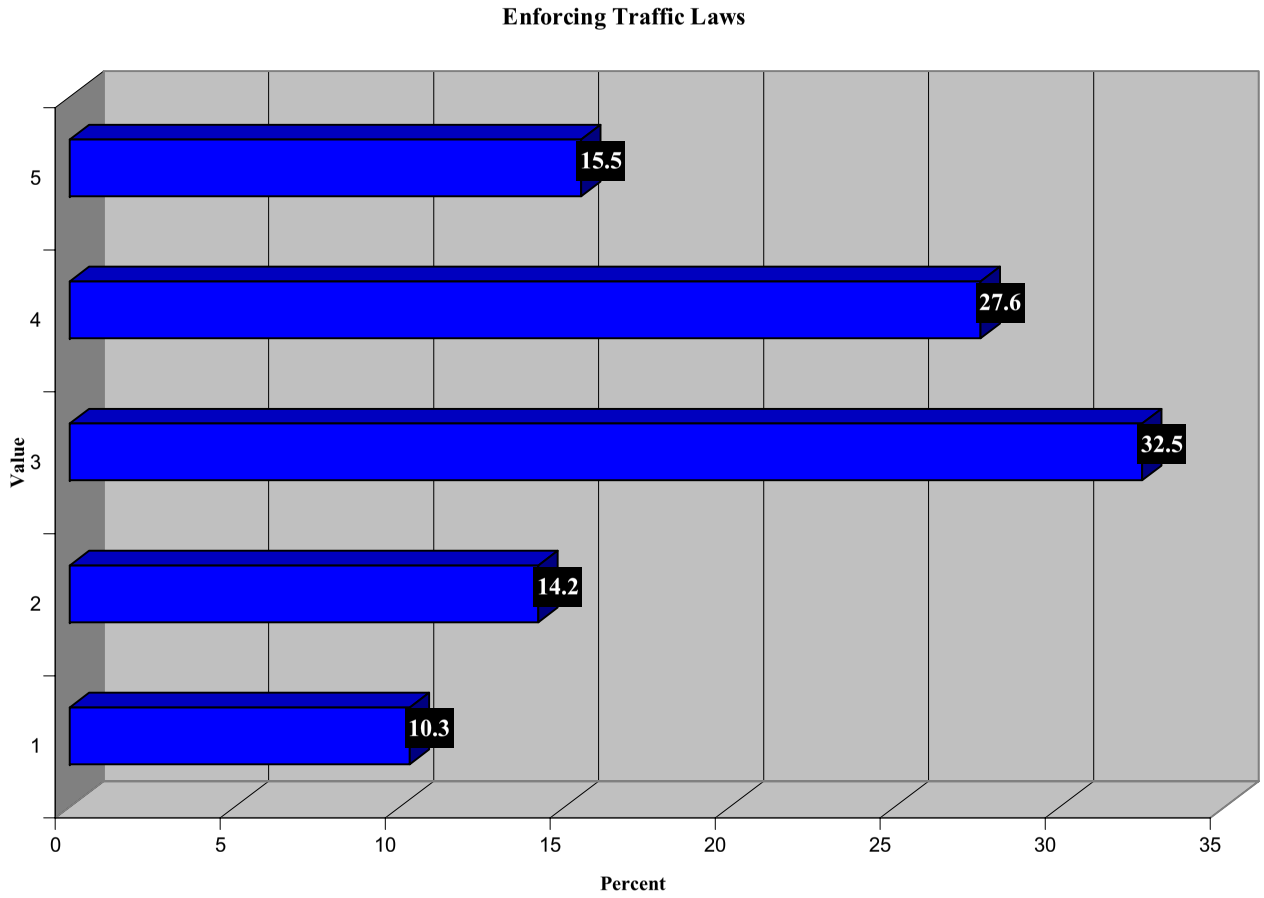
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



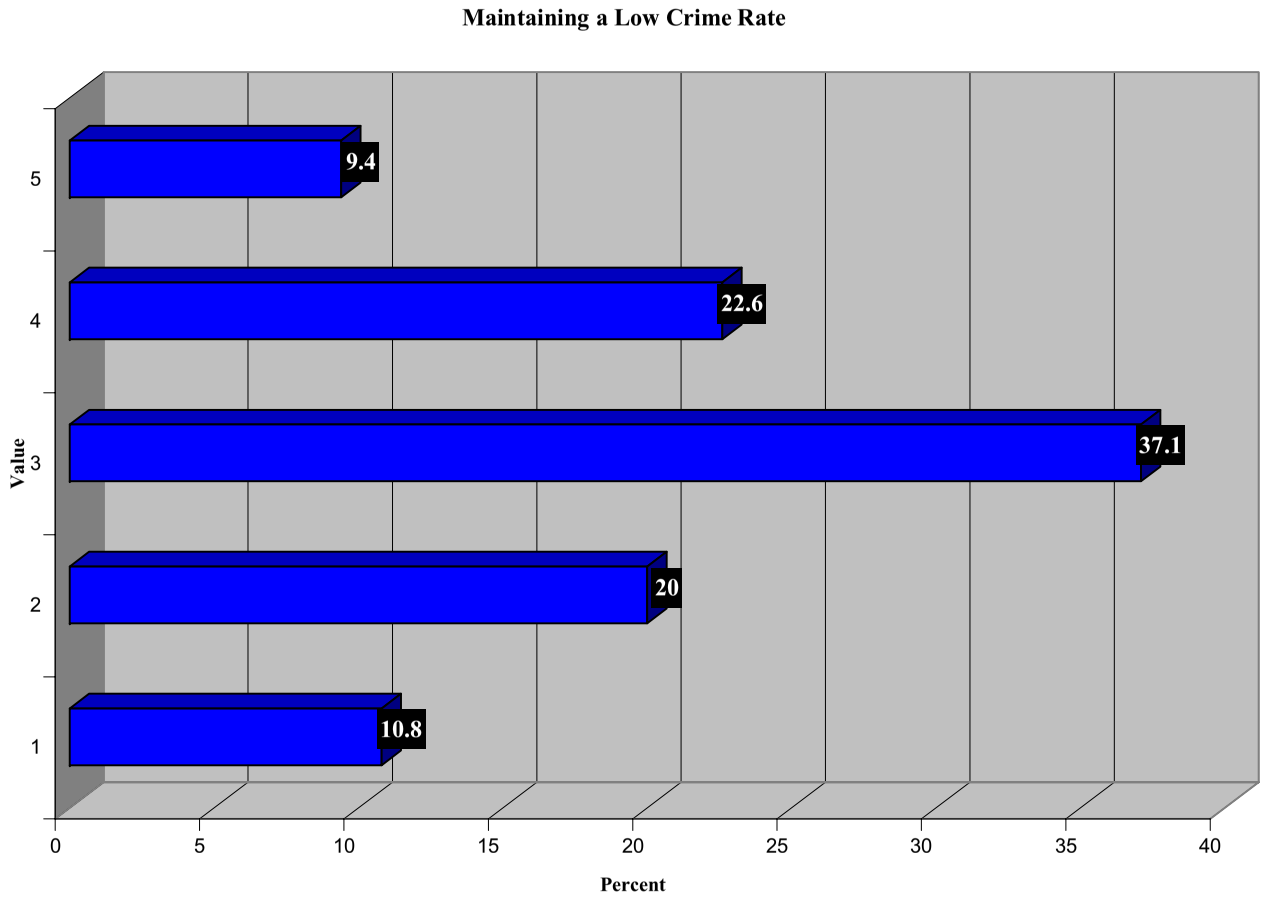
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



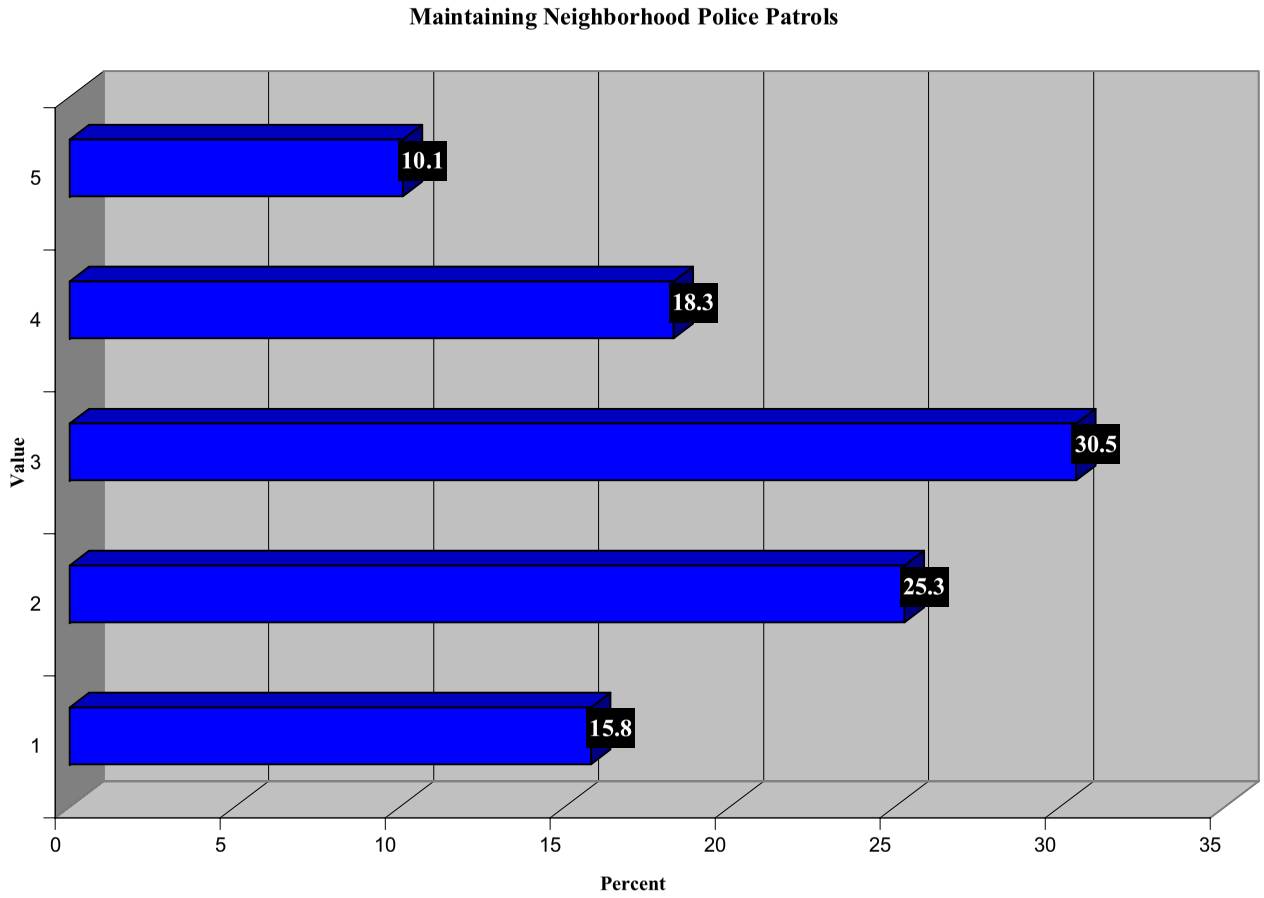
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



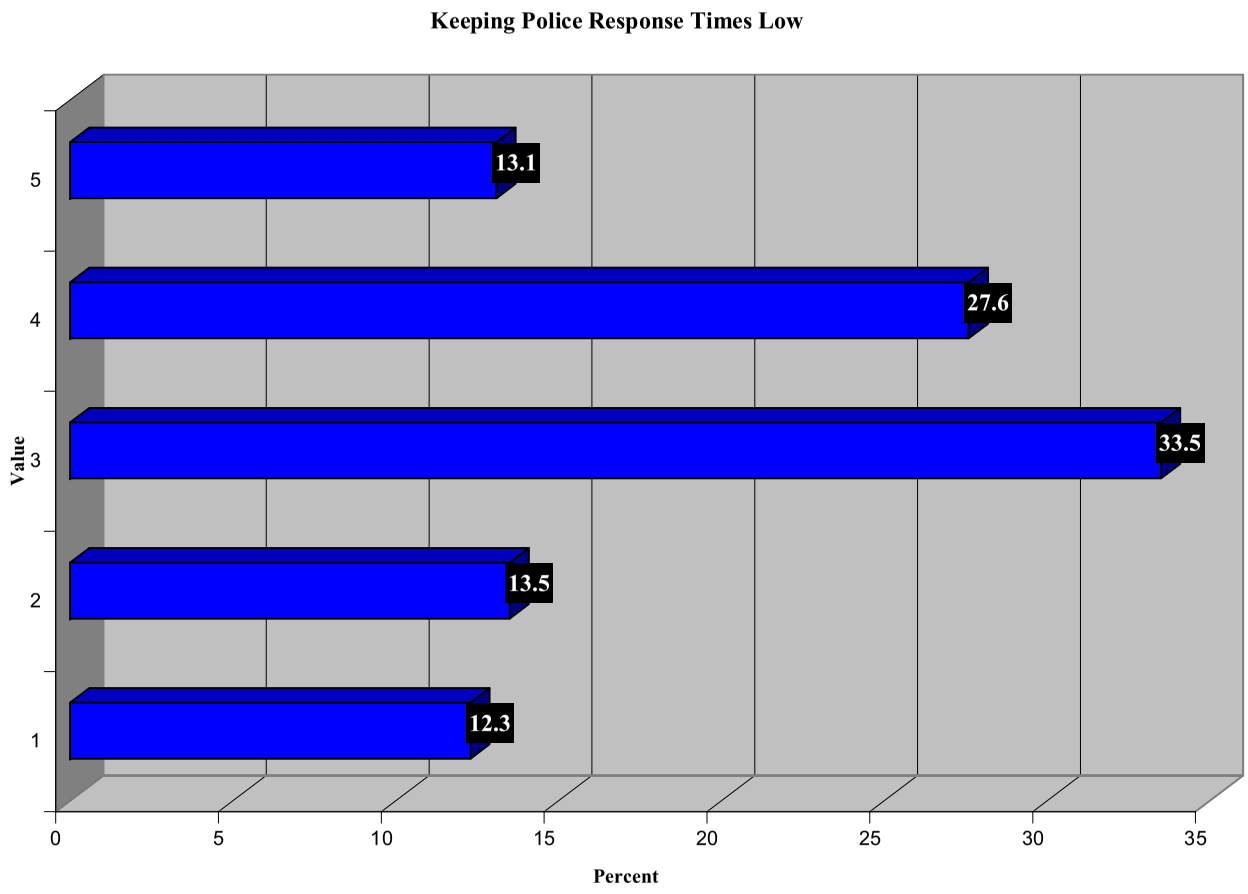
Note- Graph does not include Don't Know/ No

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



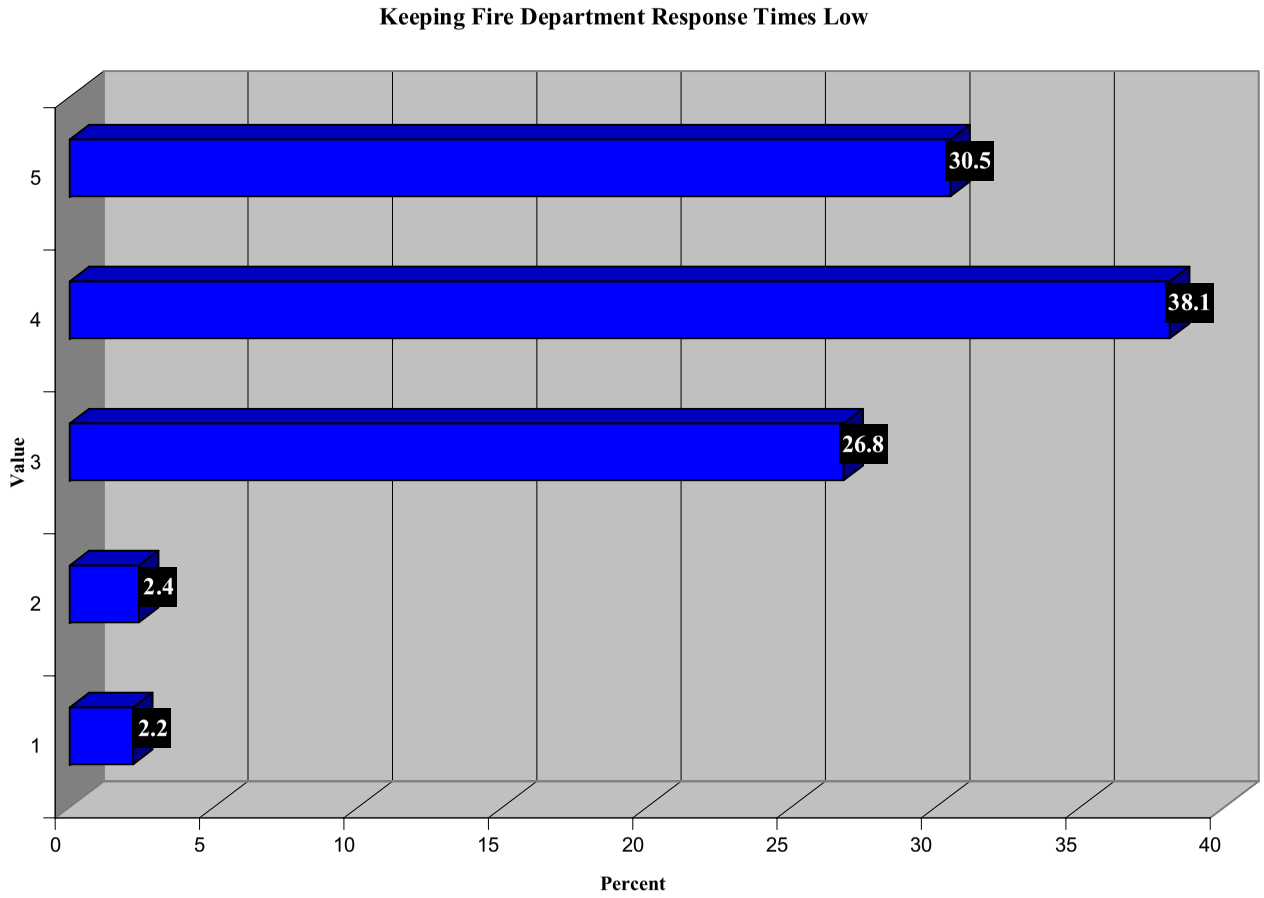
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



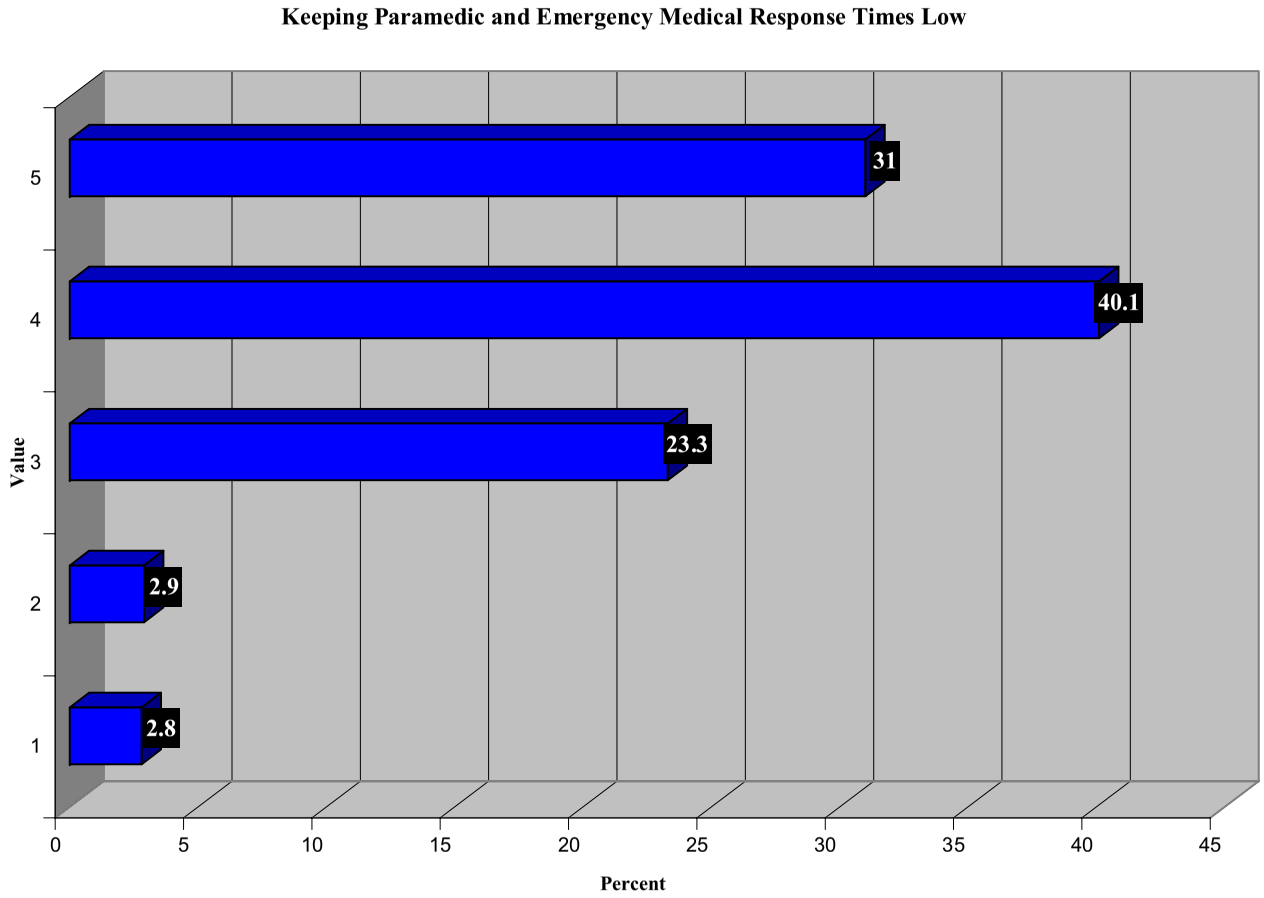
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



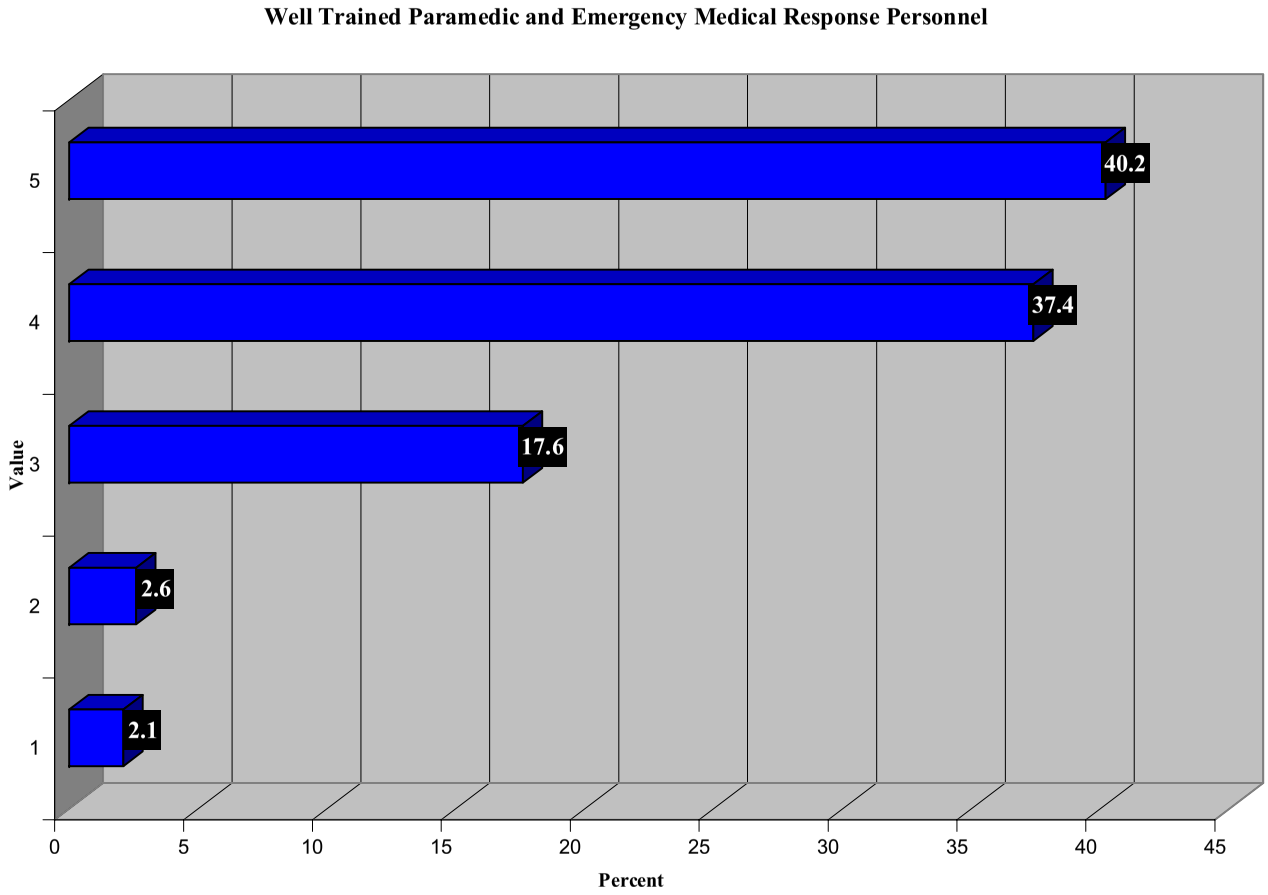
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



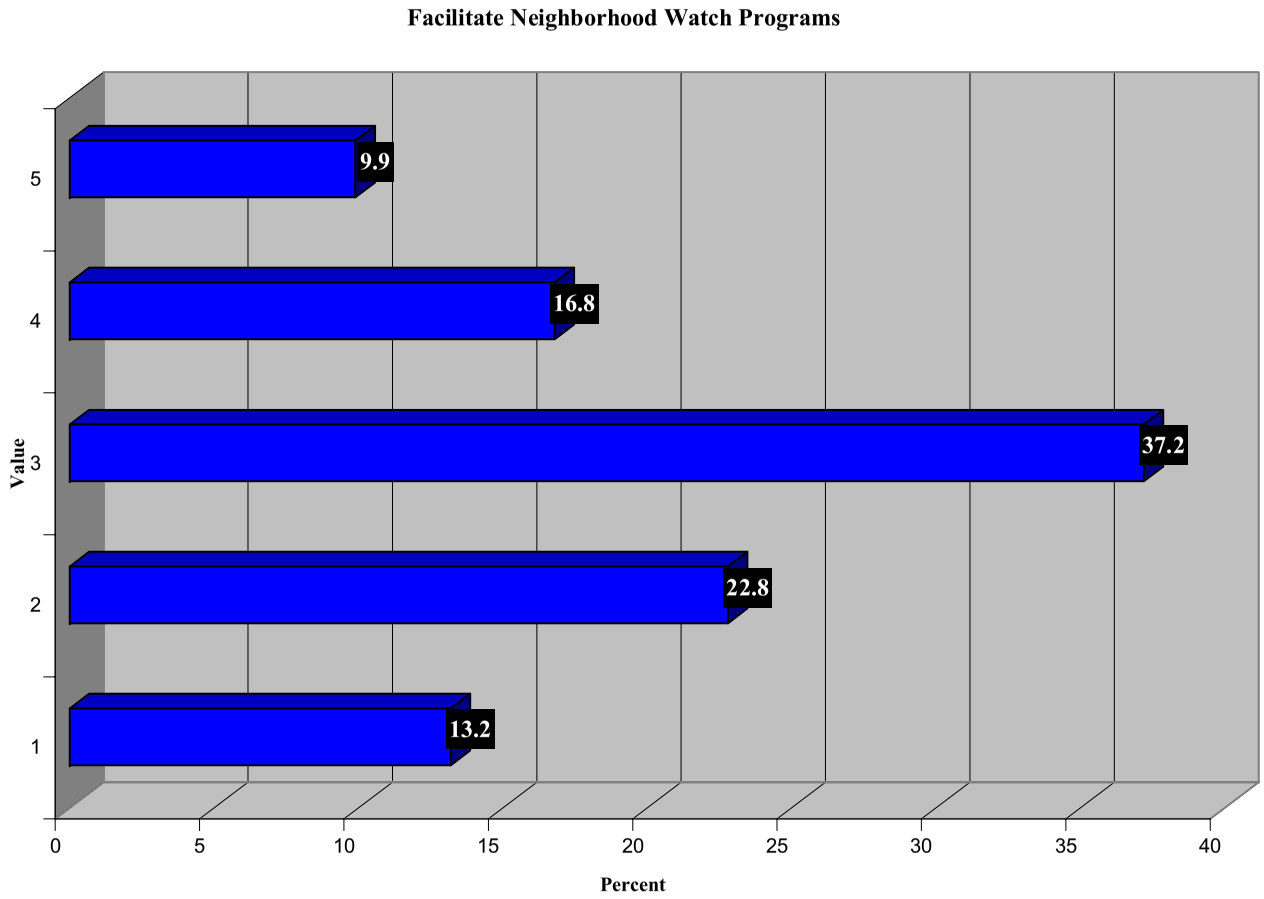
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



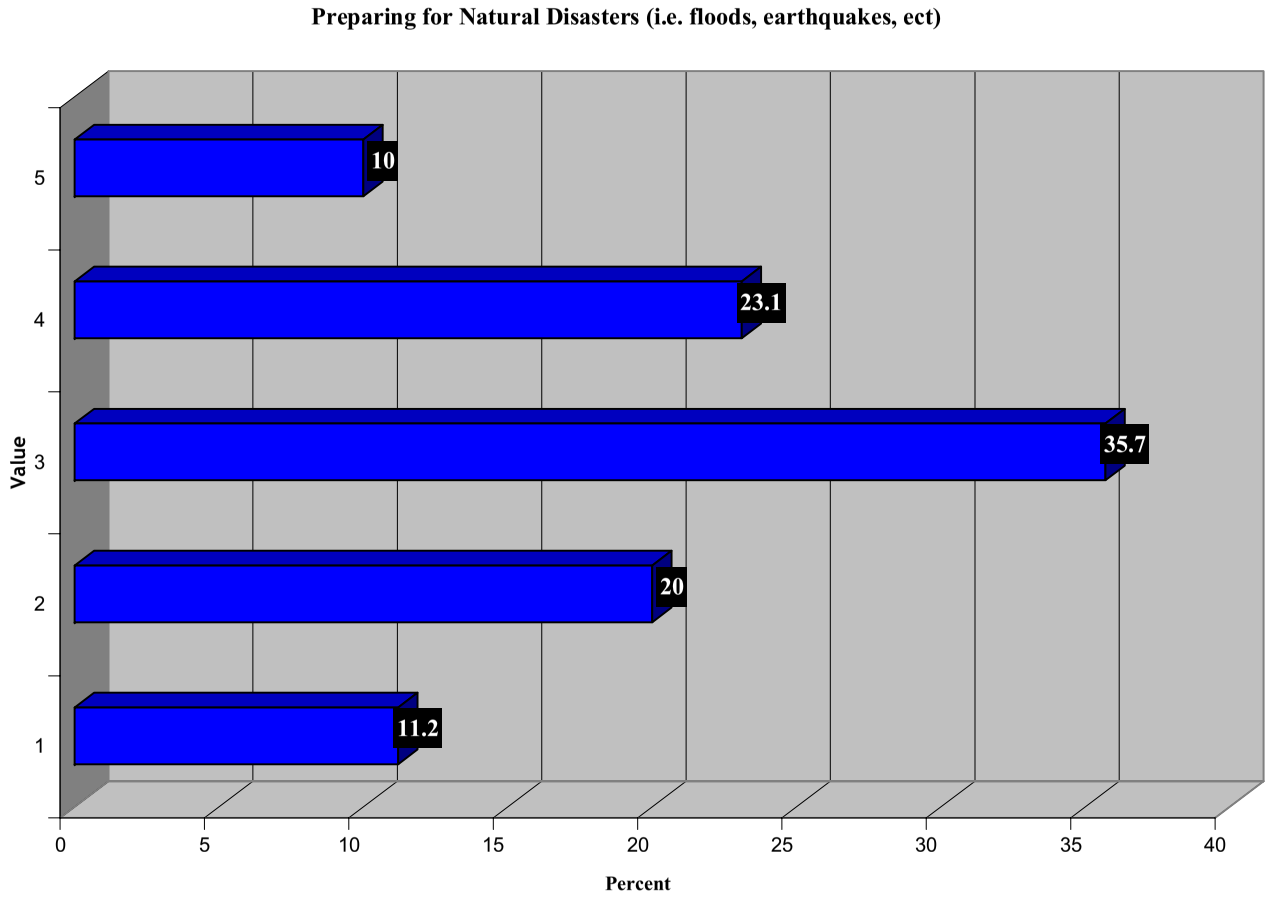
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

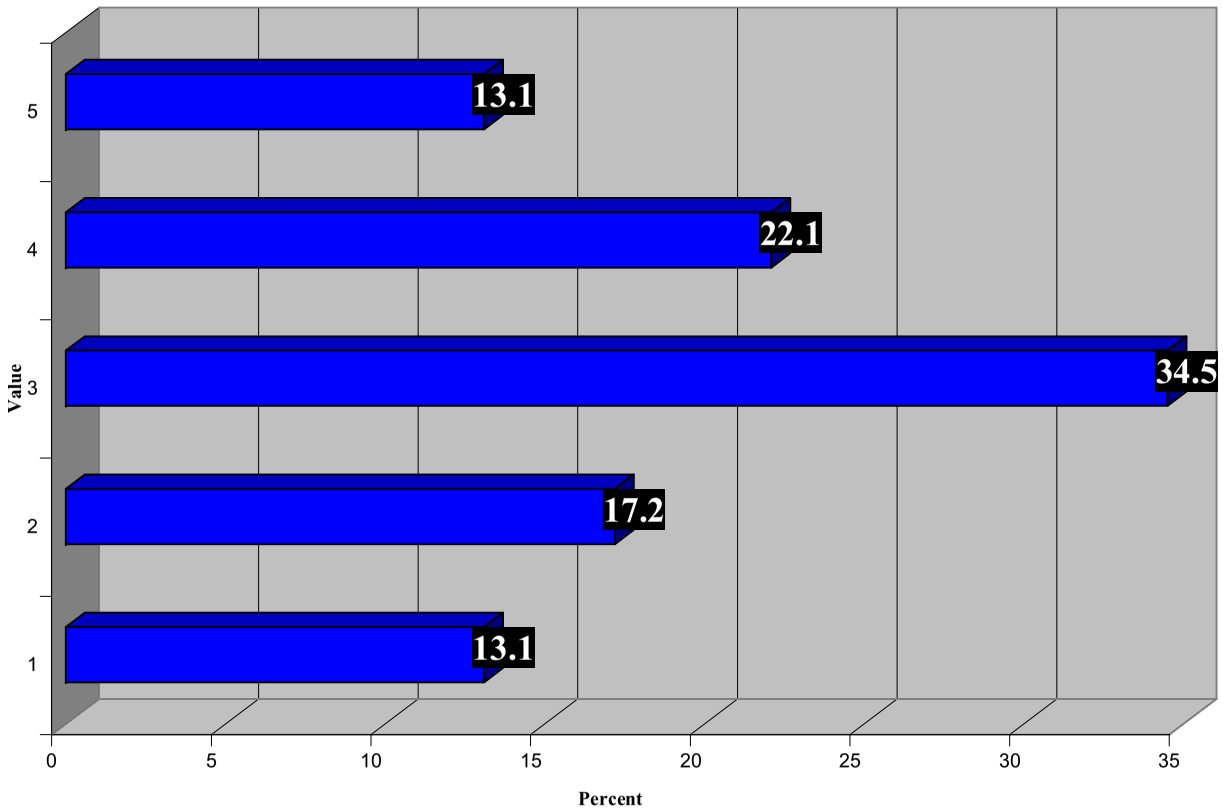
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

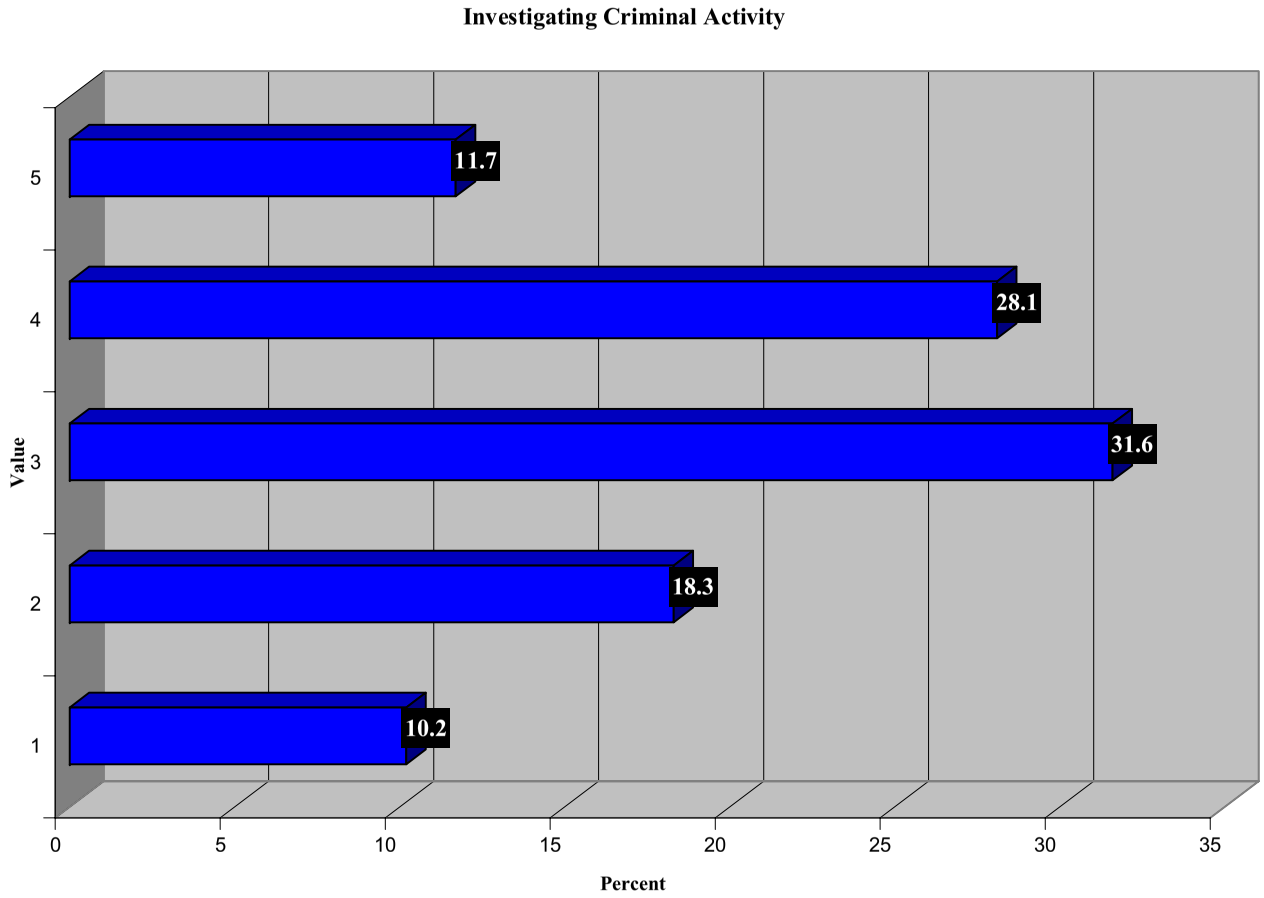
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)

Preparing for Man Made (such as hazardous or radiological materials) Accidents or Terrorist Events



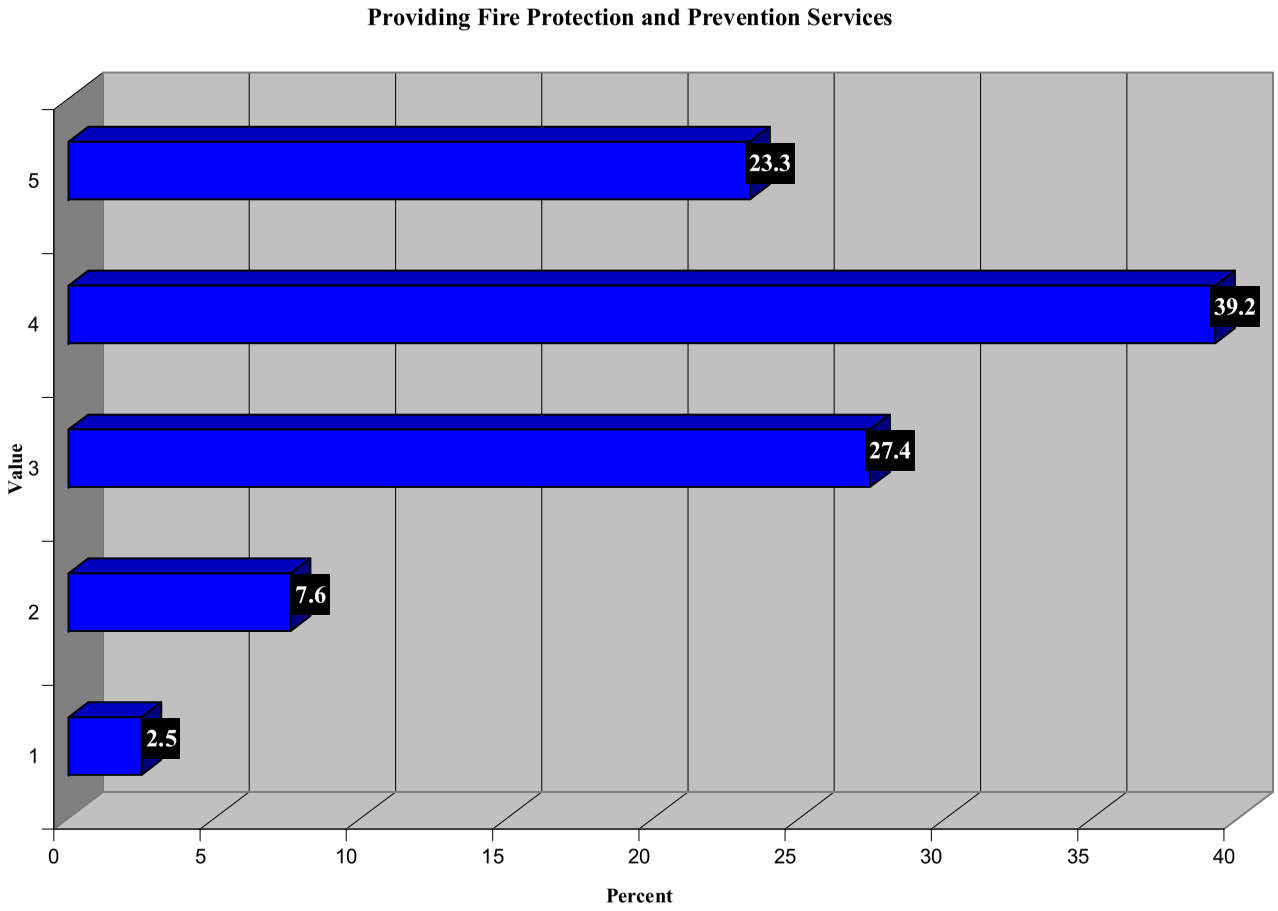
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



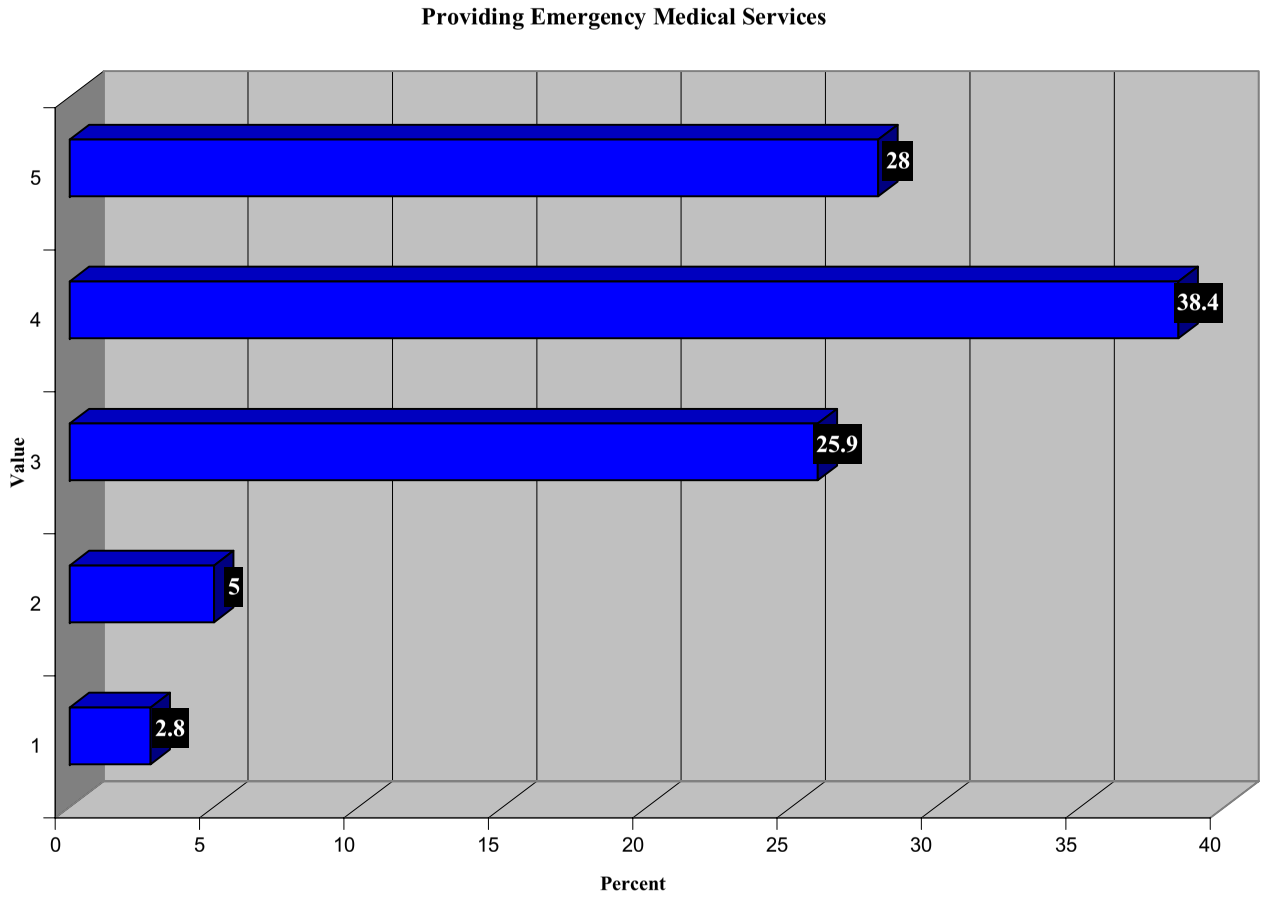
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



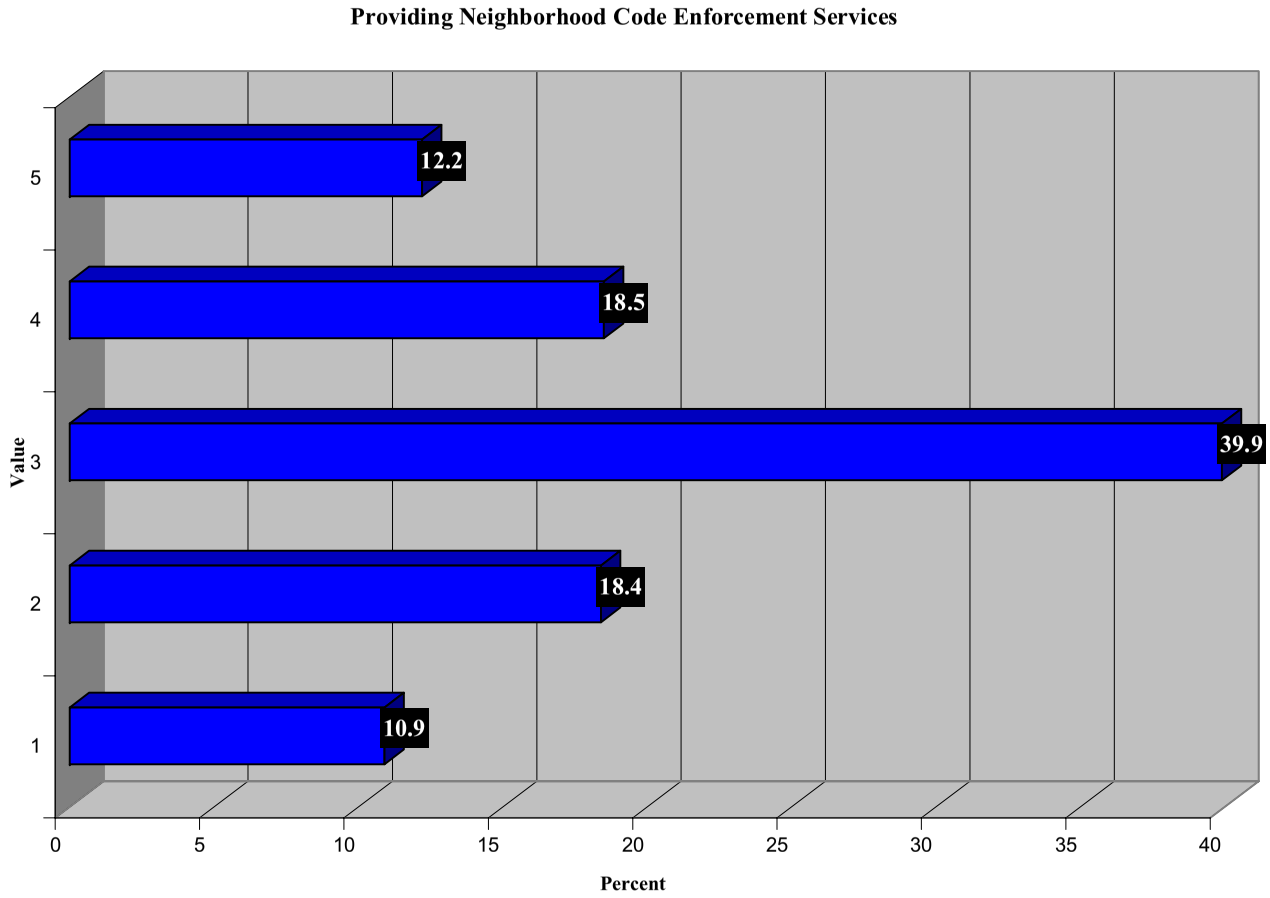
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



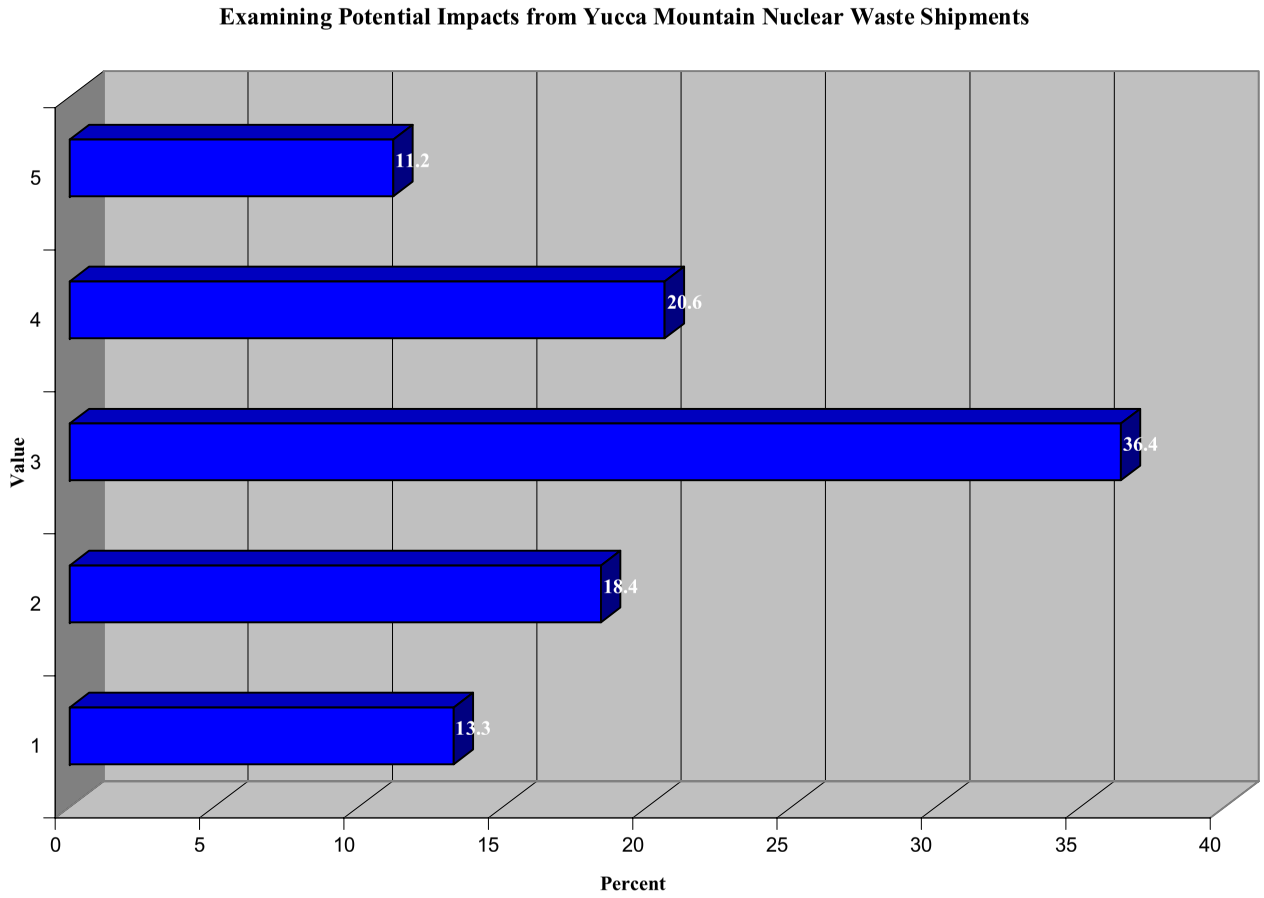
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



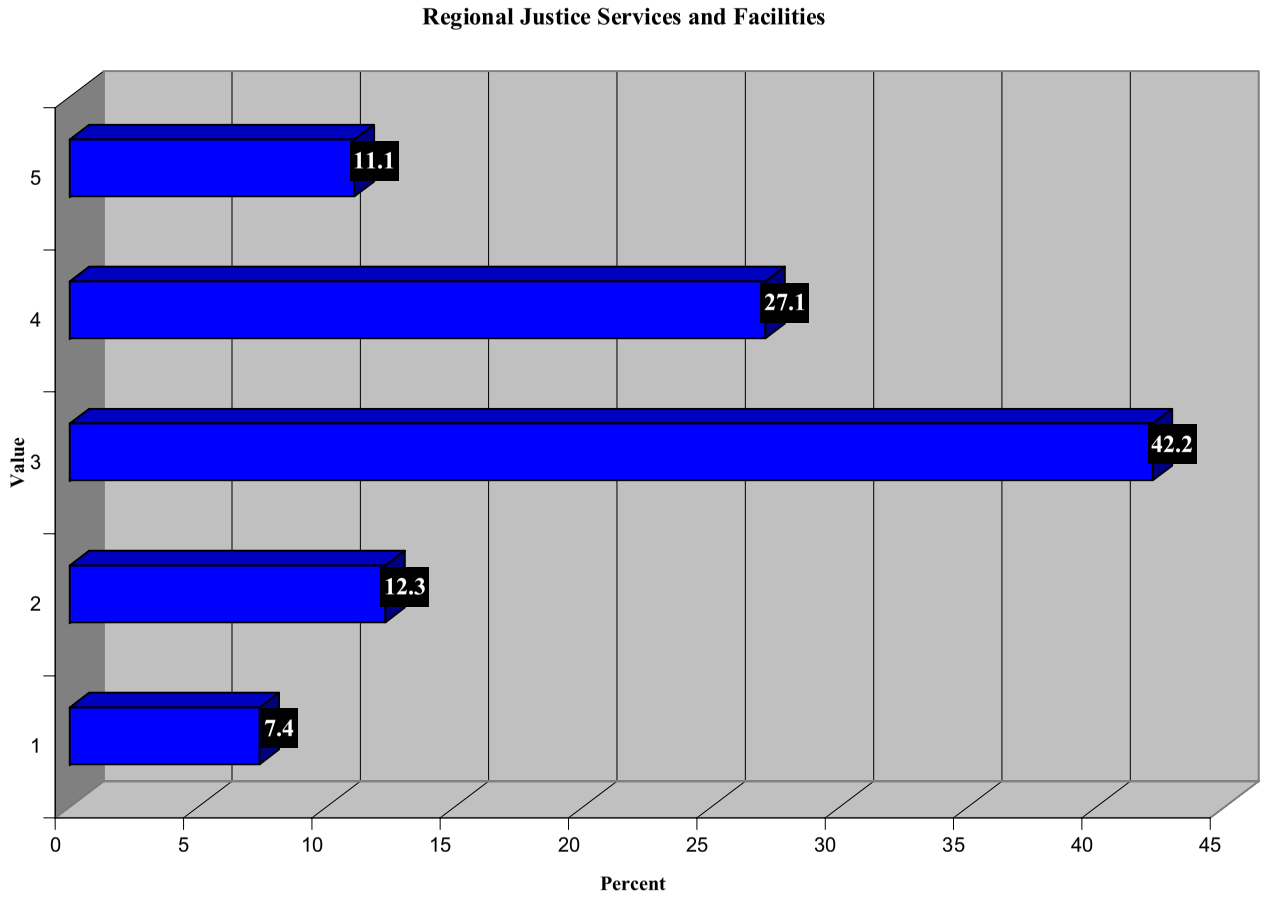
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



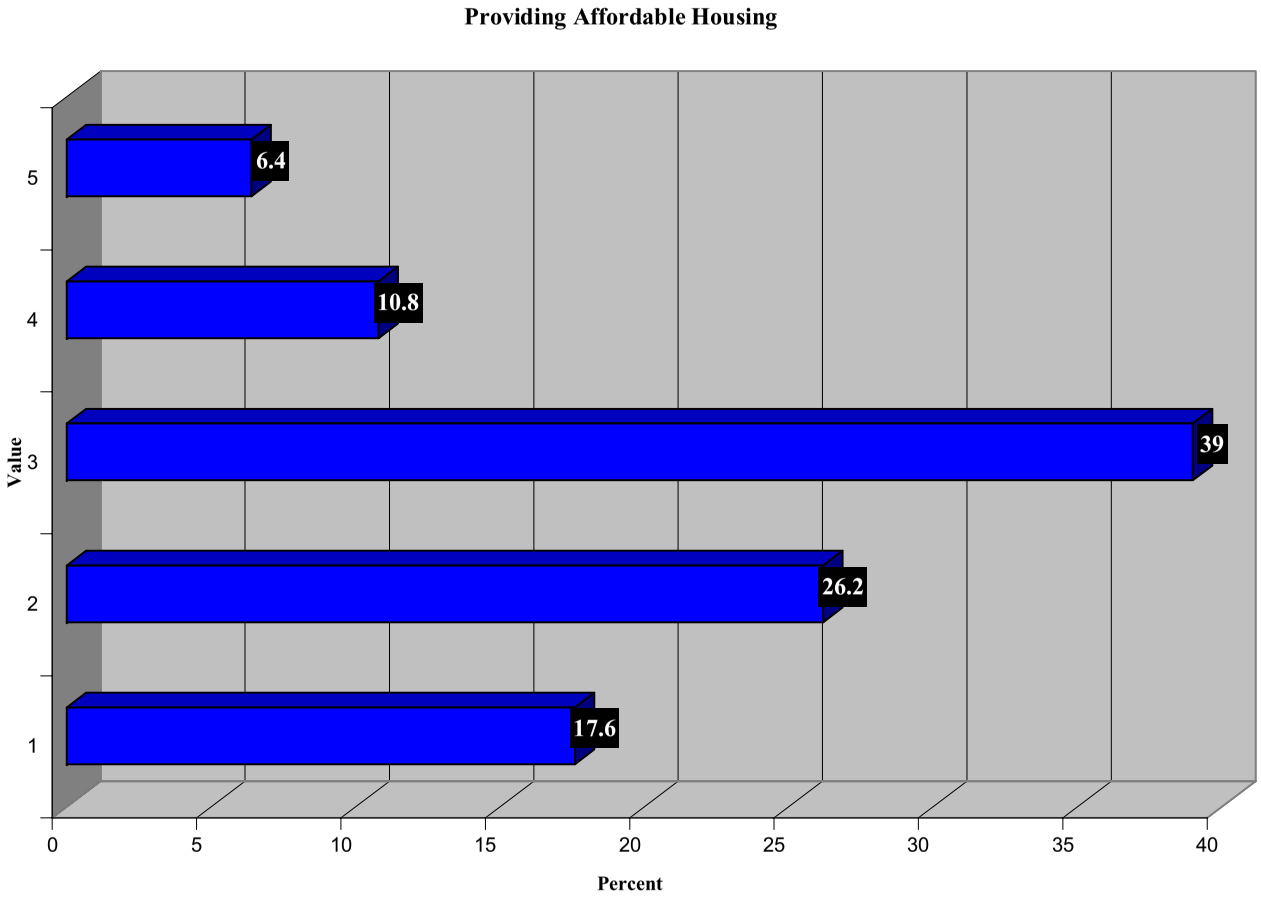
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



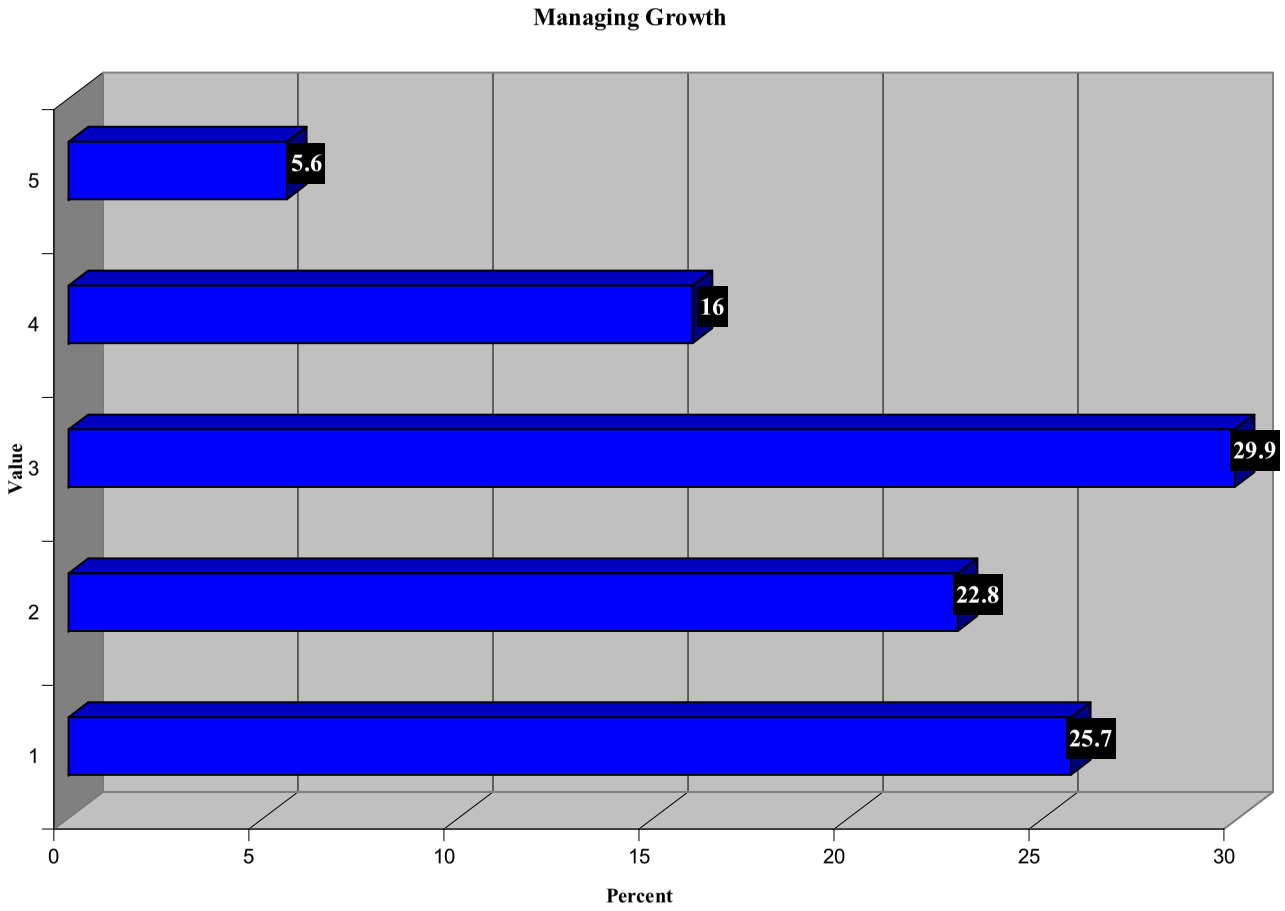
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



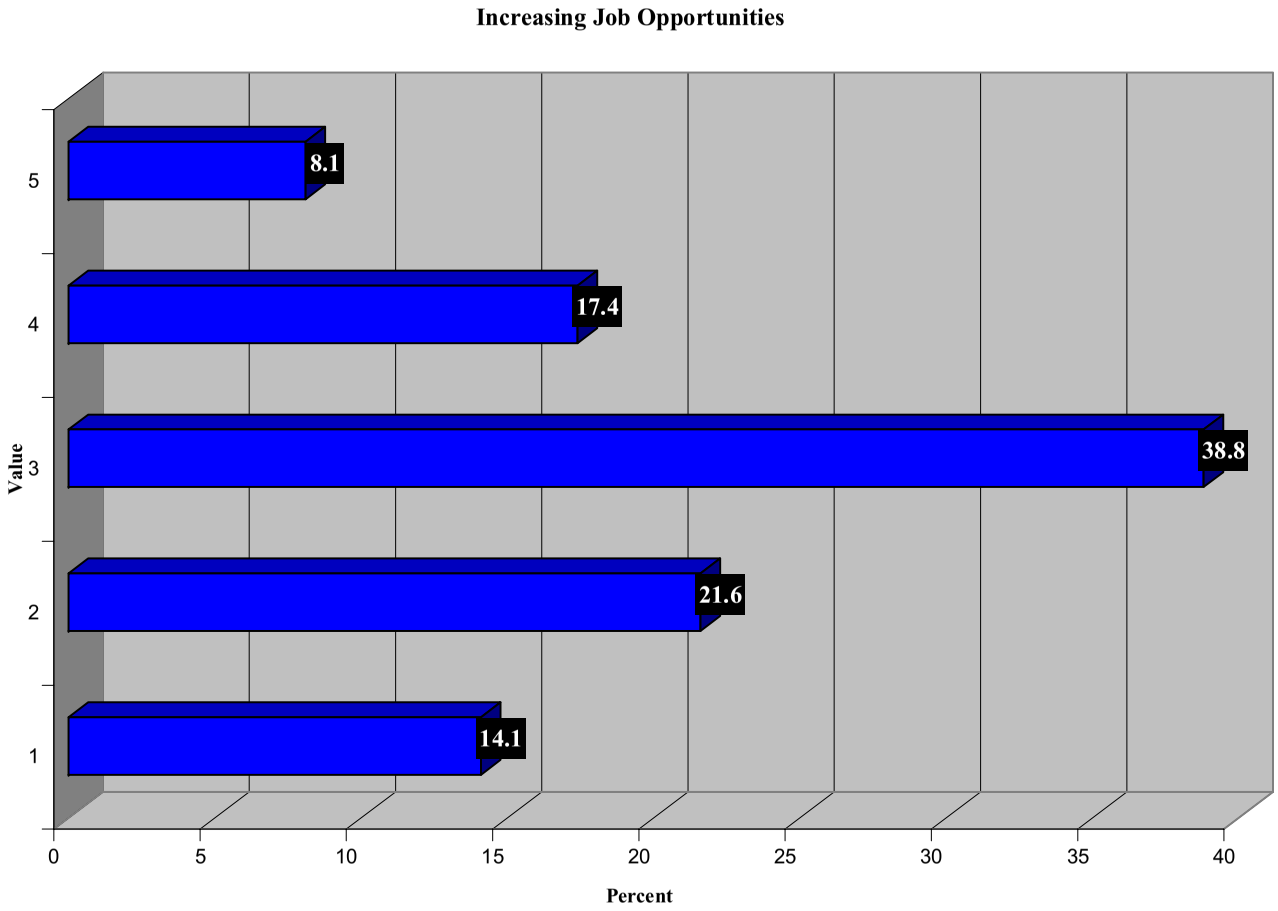
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



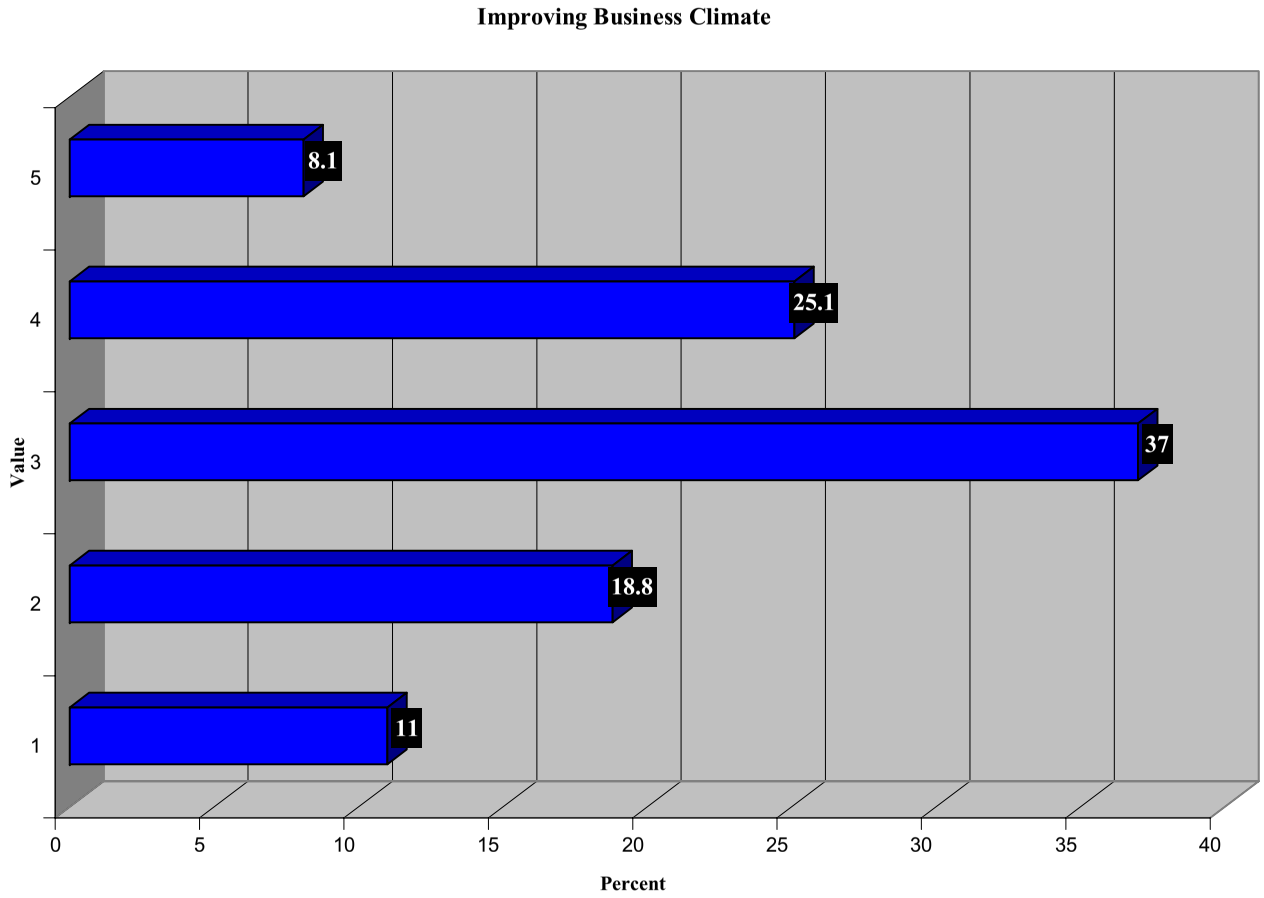
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



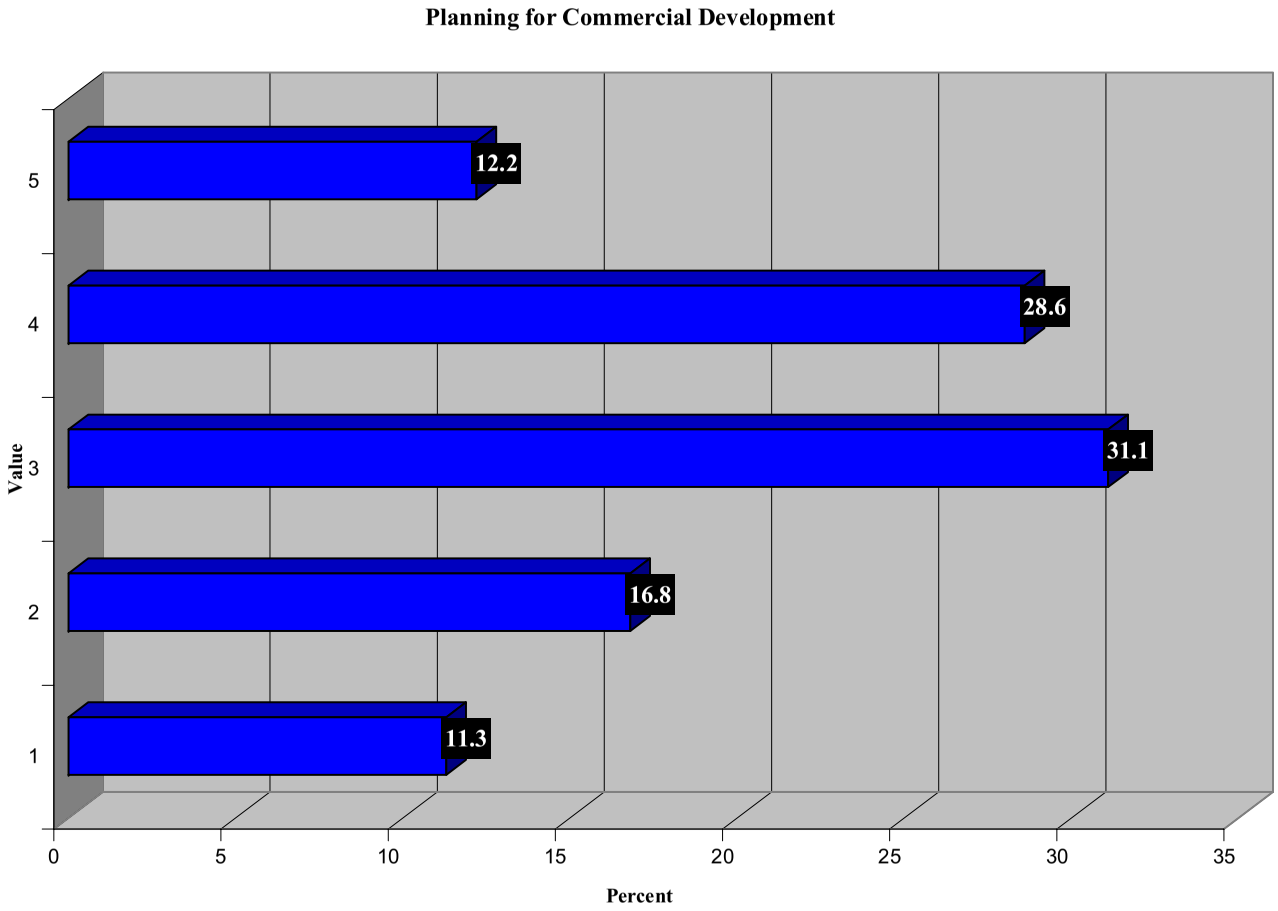
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



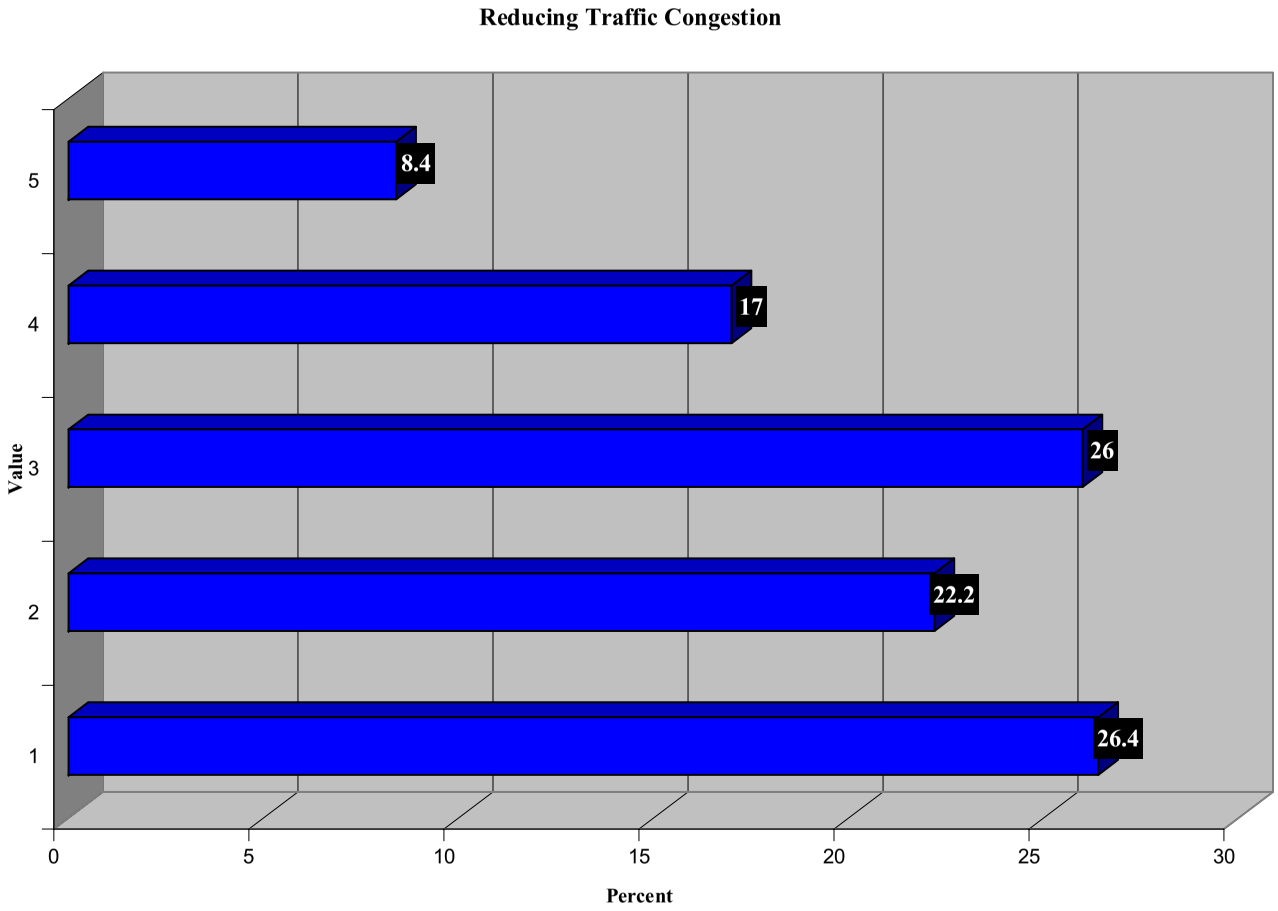
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



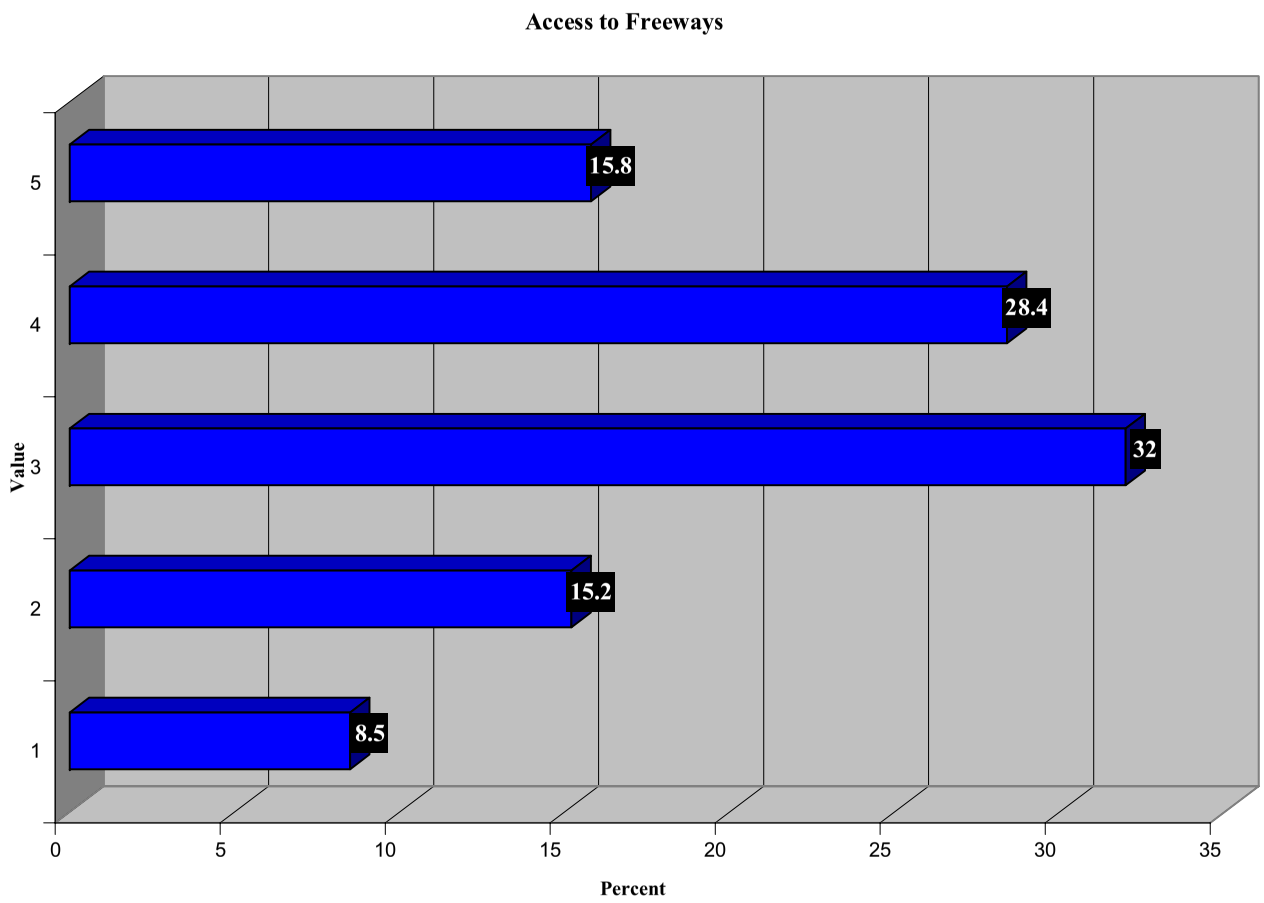
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



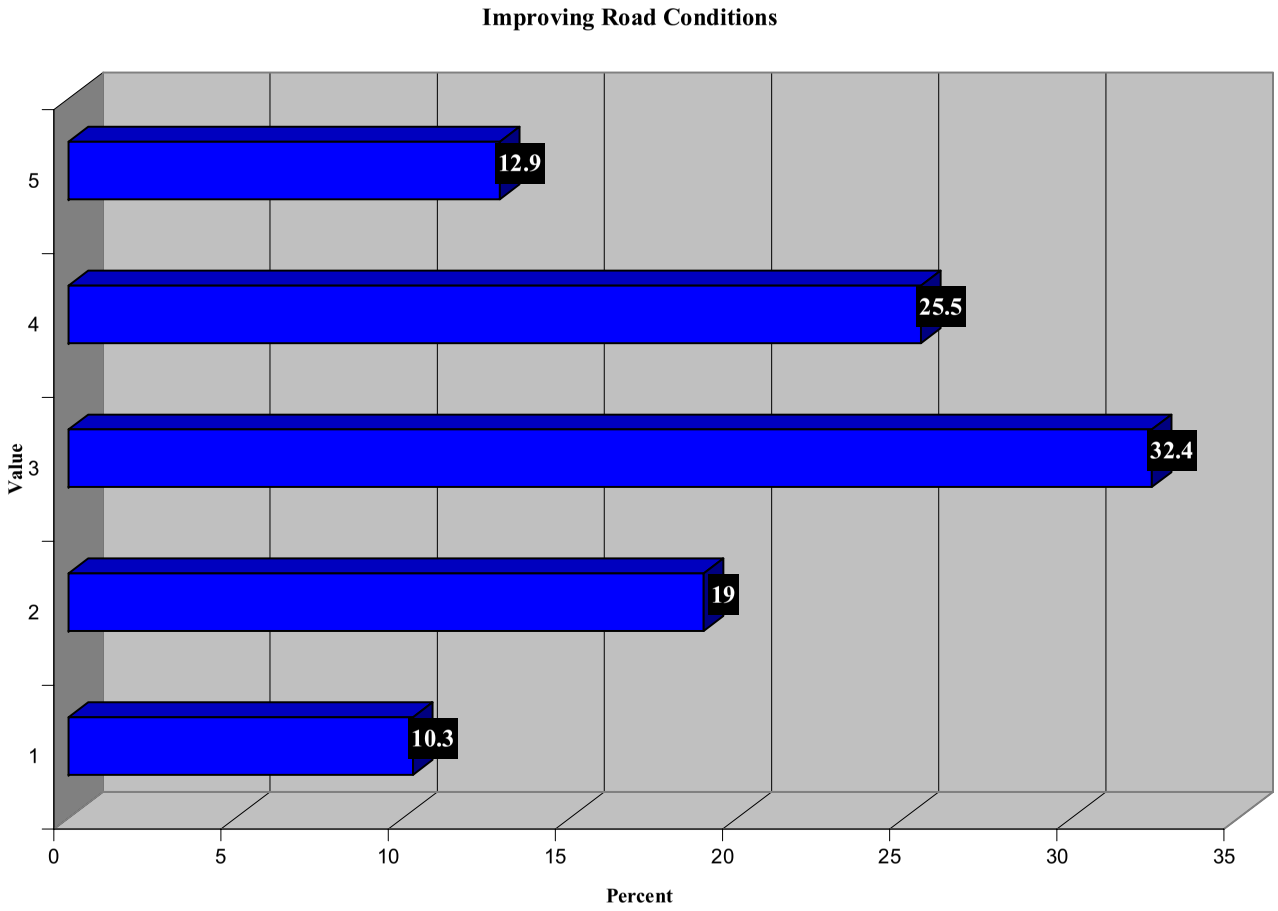
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



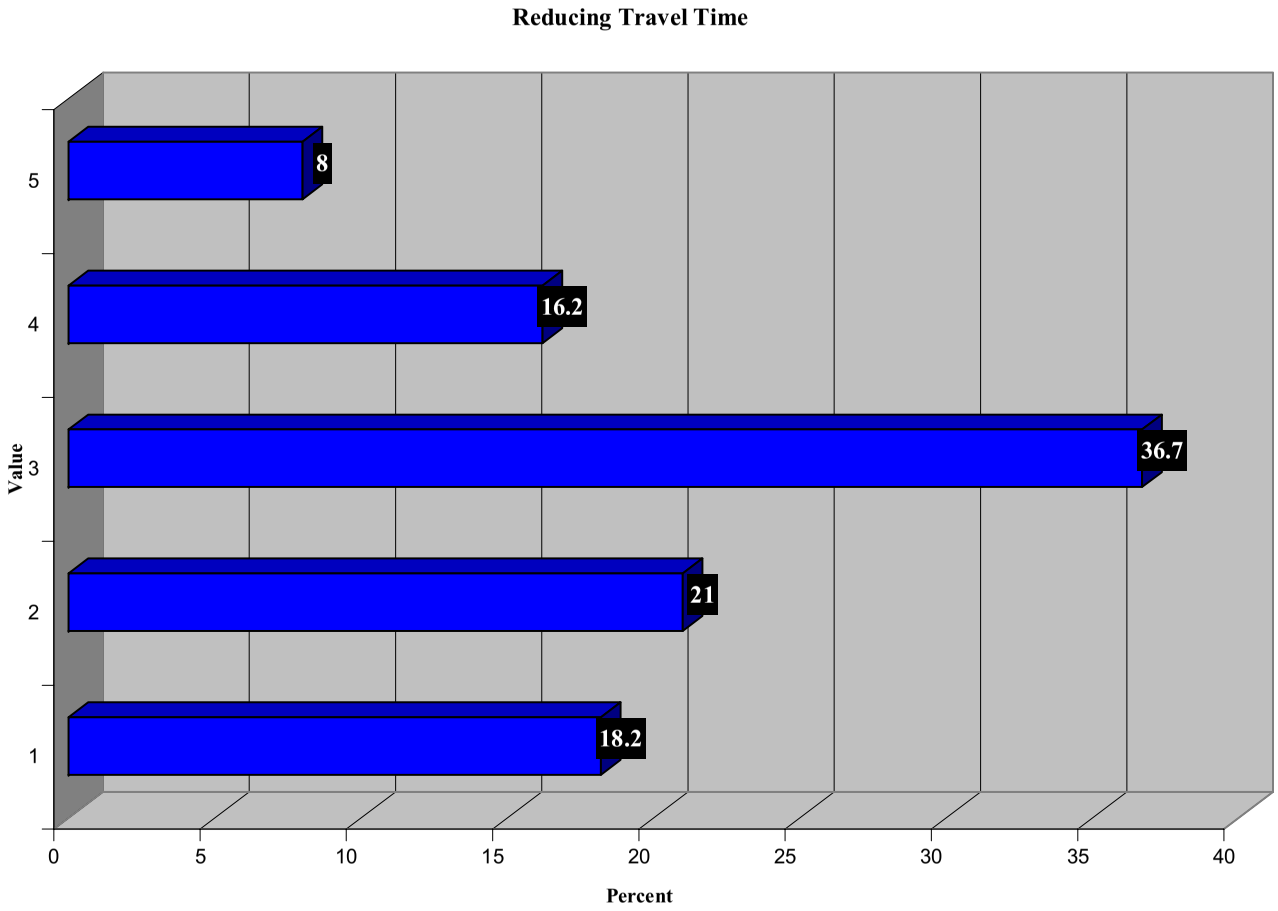
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



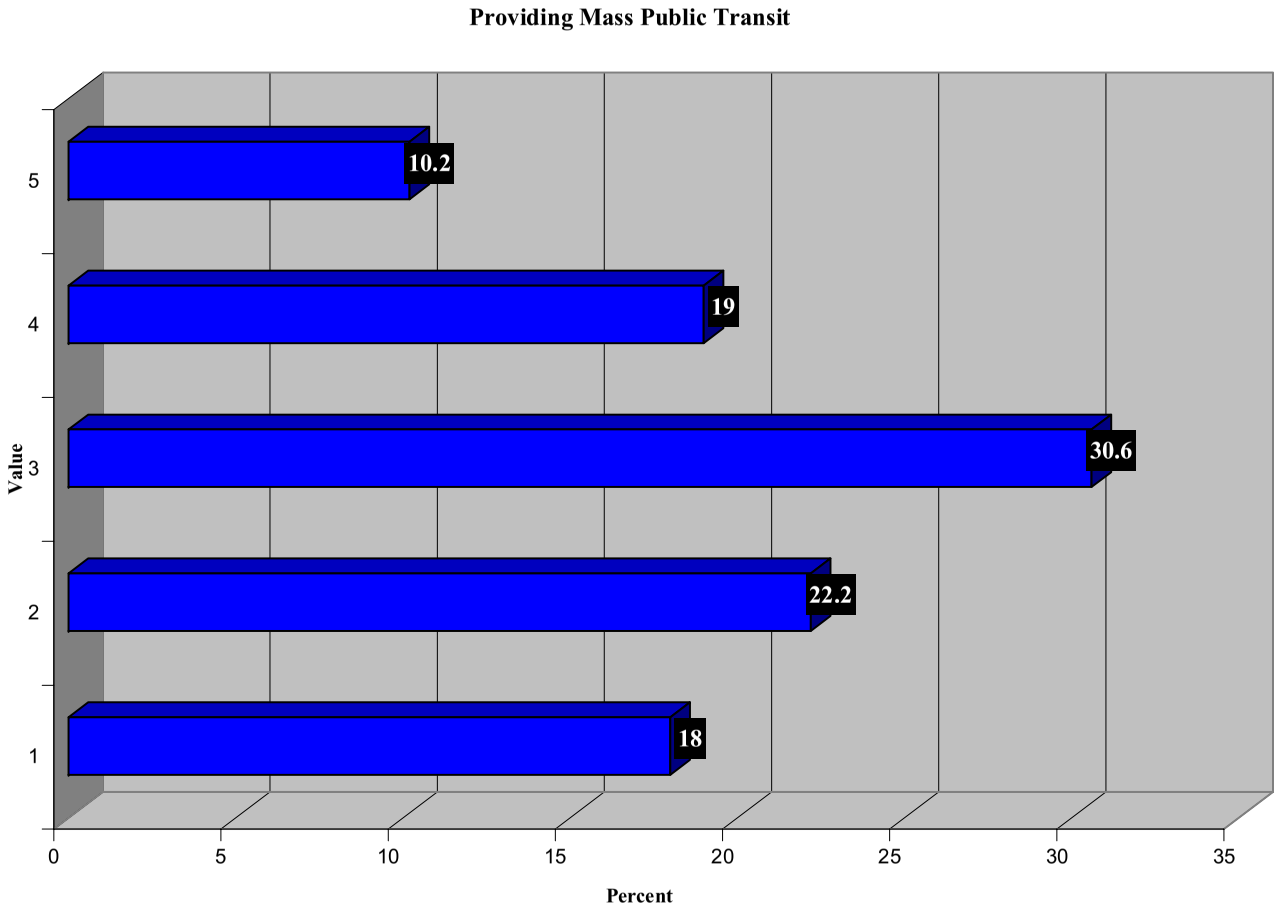
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



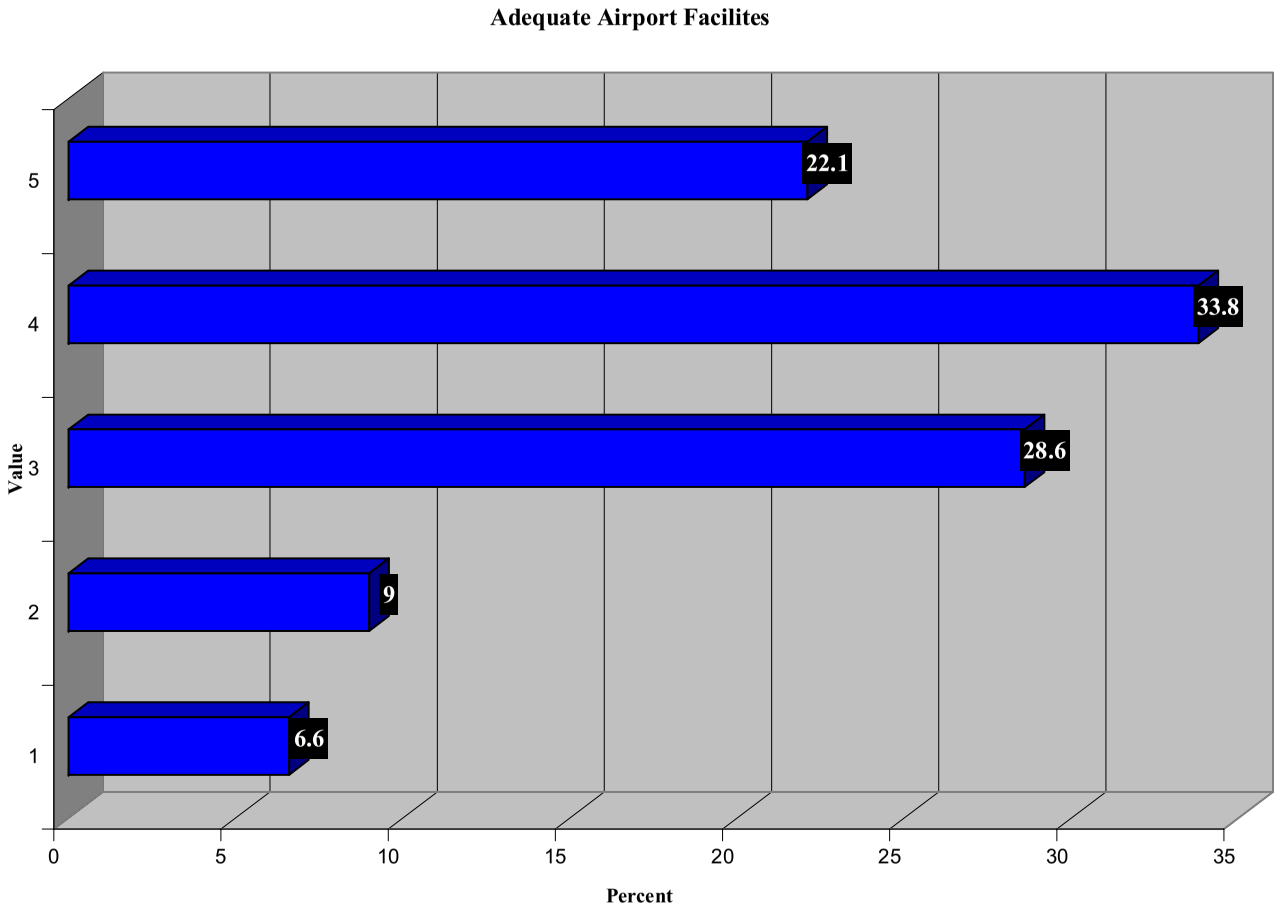
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



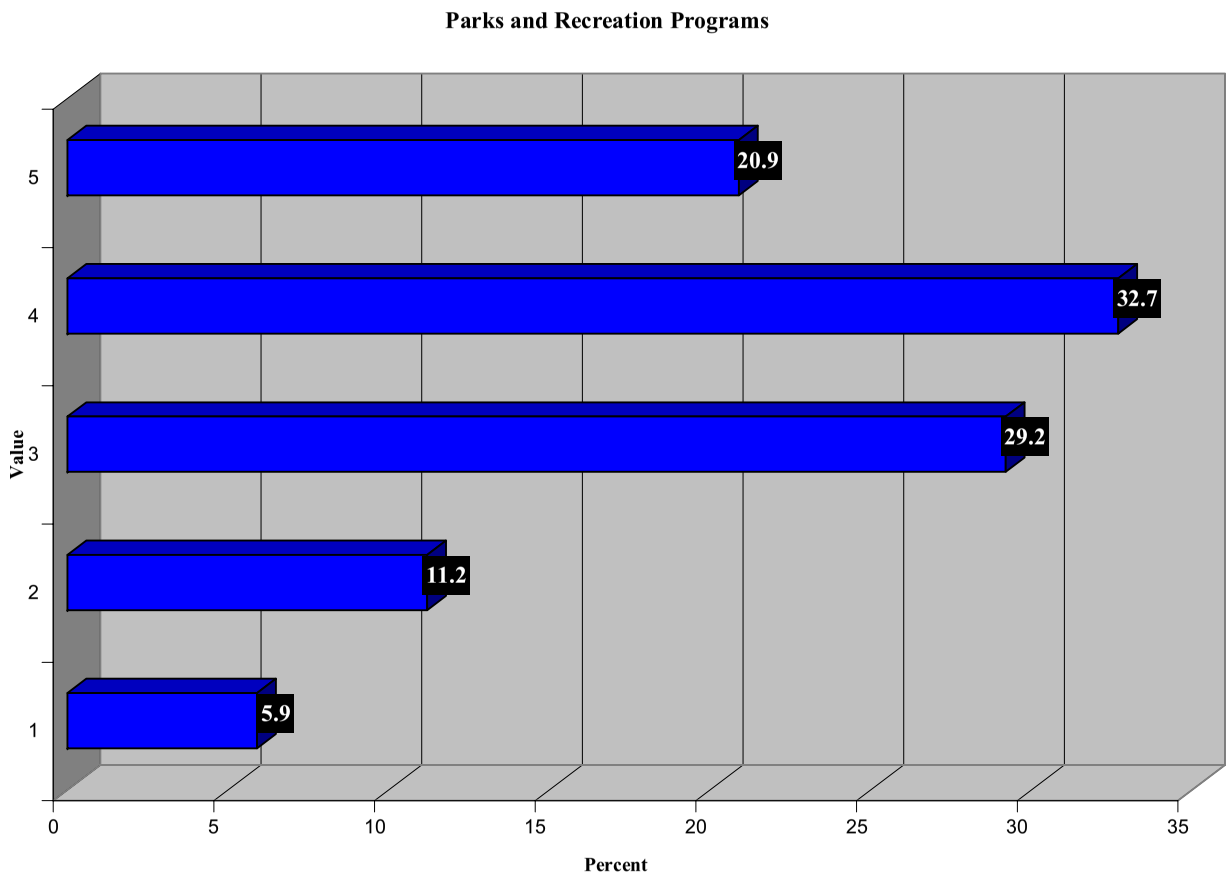
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

Appendix II
Performance for Selected Services
Performance scores for General Government
Summary Statistics by Jurisdiction

Unincorporated Clark County		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	257	257	255	255	250	248	256
	Missing	4	3	5	6	10	13	5
Mean		3.08	2.54	3.6	2.72	3	2.6	3.37
Std. Error of Mean		0.067	0.066	0.07	0.072	0.076	0.071	0.075
Median		3	3	4	3	3	3	4
Mode		3	3	4	3	3	3	4
Std. Deviation		1.07	1.065	1.122	1.15	1.203	1.115	1.193
Variance		1.145	1.135	1.259	1.322	1.447	1.244	1.423
Skewness		0.031	0.389	-0.599	0.028	-0.085	0.171	-0.457
Std. Error of Skewness		0.152	0.152	0.152	0.153	0.154	0.155	0.152
Kurtosis		-0.472	-0.228	-0.269	-0.717	-0.725	-0.607	-0.582
Std. Error of Kurtosis		0.303	0.303	0.304	0.304	0.307	0.308	0.303
Range		4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for General Government
Summary Statistics by Jurisdiction

City of Las Vegas		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	193	188	189	190	187	187	188
	Missing	0	5	4	2	6	6	5
Mean		3.3	2.69	3.7	2.82	3	2.71	3.58
Std. Error of Mean		0.073	0.072	0.072	0.076	0.084	0.077	0.079
Median		3	3	4	3	3	3	4
Mode		3	3	4	3	3	3	4
Std. Deviation		1.008	0.992	0.996	1.055	1.153	1.057	1.08
Variance		1.017	0.984	0.993	1.112	1.328	1.117	1.166
Skewness		-0.385	0.362	-0.701	-0.062	-0.024	-0.015	-0.53
Std. Error of Skewness		0.175	0.177	0.177	0.176	0.178	0.178	0.177
Kurtosis		-0.072	-0.173	0.257	-0.33	-0.657	-0.396	-0.346
Std. Error of Kurtosis		0.348	0.353	0.351	0.35	0.354	0.353	0.352
Range		4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for General Government
Summary Statistics by Jurisdiction

City of North Las Vegas		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	68	68	65	67	65	66	67
	Missing	0	0	3	0	3	2	1
Mean		2.98	2.35	3.48	2.66	3.21	2.52	3.39
Std. Error of Mean		0.124	0.1	0.144	0.119	0.161	0.127	0.138
Median		3	2	4	3	3	2.72	4
Mode		3	3	4	3	4	3	4
Std. Deviation		1.021	0.822	1.158	0.975	1.291	1.035	1.127
Variance		1.042	0.676	1.341	0.95	1.666	1.071	1.269
Skewness		0.142	-0.134	-0.653	0.139	-0.206	0.249	-0.342
Std. Error of Skewness		0.291	0.291	0.298	0.292	0.298	0.295	0.293
Kurtosis		-0.04	-0.655	-0.03	0.004	-1.011	-0.444	-0.671
Std. Error of Kurtosis		0.575	0.575	0.588	0.577	0.588	0.581	0.579
Range		4	3	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	4	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for General Government
Summary Statistics by Jurisdiction

City of Henderson		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	66	65	61	62	62	62	66
	Missing	0	1	5	5	4	4	0
Mean		2.99	2.56	3.33	2.39	2.86	2.3	3.27
Std. Error of Mean		0.117	0.13	0.15	0.134	0.161	0.144	0.144
Median		3	2.15	3	2	3	2	3
Mode		3	2	3	3	3	1	4
Std. Deviation		0.955	1.047	1.173	1.048	1.271	1.13	1.167
Variance		0.911	1.096	1.376	1.099	1.616	1.278	1.363
Skewness		-0.301	0.463	-0.444	0.21	-0.022	0.398	-0.468
Std. Error of Skewness		0.295	0.297	0.307	0.305	0.304	0.304	0.295
Kurtosis		0.042	-0.073	-0.303	-0.775	-0.825	-0.807	-0.548
Std. Error of Kurtosis		0.582	0.586	0.604	0.602	0.599	0.599	0.582
Range		4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for General Government
Summary Statistics by Jurisdiction

Boulder City		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	9	8	8	9	9	9	9
	Missing	0	0	0	0	0	0	0
Mean		3.64	3.36	3.93	3.23	3.34	2.53	4.32
Std. Error of Mean		0.301	0.343	0.551	0.194	0.318	0.41	0.358
Median		3	3	4.44	3	3	3	4.8
Mode		3	3	5	3	3	3	5
Std. Deviation		0.885	0.979	1.575	0.57	0.933	1.205	1.052
Variance		0.784	0.958	2.479	0.325	0.87	1.453	1.107
Skewness		0.913	0.154	-1.591	0.158	-0.287	-0.241	-2.466
Std. Error of Skewness		0.729	0.746	0.746	0.729	0.729	0.729	0.729
Kurtosis		-1.034	-0.335	1.47	0.747	3.679	-1.48	9.441
Std. Error of Kurtosis		1.428	1.467	1.467	1.428	1.428	1.428	1.428
Range		2	3	4	2	4	3	4
Minimum		3	2	1	2	1	1	1
Maximum		5	5	5	4	5	4	5

Appendix II
Performance for Selected Services
Performance Scores for General Government
Summary Statistics by Jurisdiction

Mesquite		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	3	3	2	3	3	3	3
	Missing	0	1	1	1	1	0	1
Mean		4	3.84	4	4	3.05	3.45	3.36
Std. Error of Mean		0.475	0.744	0.503	0.569	0.998	0.572	0.777
Median		4	4	4	4	3.14	3.34	3.57
Mode		4	4	4	4	4	3	4
Std. Deviation		0.88	1.281	0.794	0.979	1.716	1.06	1.337
Variance		0.774	1.64	0.631	0.959	2.946	1.123	1.789
Skewness		0					0.293	
Std. Error of Skewness		1.108					1.108	
Range		2	3	2	2	4	3	3
Minimum		3	2	3	3	1	2	2
Maximum		5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Social & Judicial Services
Summary Statistics by Jurisdiction

Unincorporated Clark County		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	254	254	251	253	249	253	251	245	252
	Missing	6	6	9	7	12	7	9	15	8
Mean		2.97	2.98	2.97	2.53	2.48	2.15	2.72	2.46	3.4
Std. Error of Mean		0.069	0.07	0.068	0.07	0.073	0.069	0.075	0.077	0.076
Median		3	3	3	2.99	2	2	3	2	3
Mode		3	3	3	3	3	1	3	3	3
Std. Deviation		1.104	1.109	1.084	1.117	1.157	1.104	1.194	1.213	1.2
Variance		1.219	1.231	1.176	1.249	1.338	1.22	1.426	1.471	1.44
Skewness		-0.023	-0.024	-0.078	0.464	0.535	0.687	0.195	0.518	-0.305
Std. Error of Skewness		0.153	0.153	0.154	0.153	0.154	0.153	0.154	0.155	0.153
Kurtosis		-0.536	-0.63	-0.302	-0.252	-0.29	-0.105	-0.72	-0.552	-0.798
Std. Error of Kurtosis		0.304	0.304	0.306	0.305	0.308	0.305	0.306	0.31	0.306
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Social & Judicial Services
Summary Statistics by Jurisdiction

City of Las Vegas		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	189	190	190	189	189	192	187	191	190
	Missing	4	3	2	4	4	1	6	2	3
Mean		3.02	3.11	2.96	2.65	2.53	2.34	2.75	2.63	3.52
Std. Error of Mean		0.077	0.077	0.072	0.082	0.081	0.085	0.08	0.087	0.083
Median		3	3	3	3	2.02	2	3	3	4
Mode		3	3	3	3	3	2	3	3	3
Std. Deviation		1.063	1.065	0.99	1.123	1.109	1.178	1.091	1.201	1.146
Variance		1.13	1.135	0.98	1.261	1.23	1.387	1.189	1.443	1.313
Skewness		-0.083	-0.128	-0.17	0.265	0.352	0.608	-0.04	0.274	-0.369
Std. Error of Skewness		0.177	0.176	0.176	0.177	0.177	0.175	0.178	0.176	0.176
Kurtosis		-0.446	-0.443	-0.153	-0.48	-0.506	-0.509	-0.551	-0.819	-0.609
Std. Error of Kurtosis		0.351	0.351	0.35	0.352	0.352	0.349	0.354	0.35	0.351
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Social & Judicial Services
Summary Statistics by Jurisdiction

City of North Las Vegas		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	67	68	67	67	67	67	67	67	66
	Missing	1	0	1	1	1	1	1	1	2
Mean		3.33	3.13	2.96	2.67	2.62	2.02	2.85	2.53	3.32
Std. Error of Mean		0.141	0.144	0.139	0.128	0.127	0.119	0.118	0.156	0.159
Median		3	3	3	3	3	2	3	3	3
Mode		4	3	3	3	3	1	3	3	3
Std. Deviation		1.148	1.184	1.132	1.046	1.035	0.974	0.964	1.274	1.283
Variance		1.318	1.402	1.281	1.095	1.071	0.949	0.929	1.622	1.647
Skewness		-0.247	-0.106	-0.017	0.252	0.038	0.436	-0.335	0.303	-0.213
Std. Error of Skewness		0.294	0.291	0.294	0.294	0.294	0.294	0.294	0.294	0.296
Kurtosis		-0.724	-0.525	-0.439	-0.431	-0.823	-0.995	-0.175	-0.844	-1.015
Std. Error of Kurtosis		0.58	0.575	0.58	0.58	0.58	0.58	0.58	0.58	0.584
Range		4	4	4	4	4	3	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	4	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Social & Judicial Services
Summary Statistics by Jurisdiction

City of Henderson		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	65	65	63	65	62	64	66	63	58
	Missing	2	2	3	2	4	3	0	3	8
Mean		2.85	2.83	2.9	2.51	2.54	2.3	2.77	2.79	3.19
Std. Error of Mean		0.136	0.122	0.125	0.125	0.133	0.15	0.151	0.157	0.167
Median		3	3	3	2.72	3	2	3	3	3
Mode		3	3	3	3	3	1	3	3	3
Std. Deviation		1.095	0.982	0.995	1.008	1.045	1.197	1.225	1.245	1.277
Variance		1.198	0.965	0.989	1.015	1.093	1.433	1.5	1.549	1.631
Skewness		-0.213	-0.181	0.013	0.345	0.306	0.384	0.169	0.301	-0.145
Std. Error of Skewness		0.298	0.298	0.3	0.298	0.304	0.3	0.296	0.302	0.313
Kurtosis		-0.553	-0.467	-0.076	-0.071	0.071	-0.98	-0.673	-0.758	-1.011
Std. Error of Kurtosis		0.588	0.588	0.593	0.588	0.599	0.593	0.584	0.595	0.616
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Social & Judicial Services
Summary Statistics by Jurisdiction

Boulder City		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	9	7	7	7	7	7	7	7	9
	Missing	0	2	2	2	2	2	2	2	0
Mean		3.69	3.17	3.04	2.43	1.7	1.93	3.04	3.19	3.88
Std. Error of Mean		0.521	0.371	0.397	0.393	0.279	0.39	0.493	0.496	0.349
Median		4.33	3.64	3	2	1.97	2.03	3	3	3.44
Mode		5	4	3	2	1(a)	1	3	3	3
Std. Deviation		1.531	0.988	1.058	1.047	0.744	1.04	1.314	1.321	1.026
Variance		2.344	0.975	1.12	1.095	0.553	1.082	1.727	1.745	1.052
Skewness		-0.563	-0.446	-1.181	0.604	0.613	0.171	-0.192	-0.212	0.303
Std. Error of Skewness		0.729	0.789	0.789	0.789	0.789	0.789	0.789	0.789	0.729
Kurtosis		-1.651	-2.309	1.48	-0.287	-0.249	-2.765	-0.049	0.804	-2.473
Std. Error of Kurtosis		1.428	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.428
Range		4	2	3	3	2	2	4	4	2
Minimum		1	2	1	1	1	1	1	1	3
Maximum		5	4	4	4	3	3	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Social & Judicial Services
Summary Statistics by Jurisdiction

Mesquite		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	3	3	4	3	4	4	3	3	4
	Missing	1	0	0	0	0	0	1	0	0
Mean		3.16	3.41	3.36	3.27	3.24	2.88	3.32	3.69	3.84
Std. Error of Mean		0.846	0.815	0.813	0.286	0.559	0.607	0.659	0.735	0.543
Median		3	3.41	3	3	3	2.57	3	3.39	3.91
Mode		3	3	3	3	3	2	3	3	3
Std. Deviation		1.456	1.509	1.606	0.53	1.104	1.2	1.134	1.361	1.072
Variance		2.12	2.276	2.579	0.281	1.218	1.439	1.286	1.852	1.15
Range		4	4	4	1	3	3	3	3	2
Minimum		1	1	1	3	2	2	2	2	3
Maximum		5	5	5	4	5	5	5	5	5
Skewness			-0.813	-0.213	2.045	0.605	1.585		0.179	0.557
Std. Error of Skewness			1.108	1.028	1.108	1.028	1.028		1.108	1.028

Appendix II
Performance for Selected Services
Performance Scores for Public Safety
Summary Statistics by Jurisdiction

Unincorporated Clark County		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	247	258	255	249	245	249	249	249
	Missing	14	3	5	12	15	11	11	11
Mean		3.13	3.12	2.96	2.82	3.09	3.88	3.86	4.05
Std. Error of Mean		0.066	0.076	0.069	0.079	0.08	0.06	0.063	0.063
Median		3	3	3	3	3	4	4	4
Mode		3	3	3	3	4	4	4	5
Std. Deviation		1.03	1.221	1.109	1.241	1.247	0.948	0.993	0.989
Variance		1.06	1.49	1.23	1.539	1.555	0.898	0.987	0.979
Skewness		-0.08	-0.121	-0.02	0.134	-0.311	-0.774	-0.959	-0.965
Std. Error of Skewness		0.155	0.152	0.152	0.154	0.156	0.154	0.154	0.154
Kurtosis		-0.231	-0.821	-0.561	-0.867	-0.866	0.68	1.049	0.706
Std. Error of Kurtosis		0.309	0.302	0.304	0.308	0.31	0.307	0.307	0.307
Range		4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Public Safety
Summary Statistics by Jurisdiction

Unincorporated Clark County (cont.)		Facilitate neighborhood watch programs	Preparing for natural disasters, (i.e. floods, earthquakes, etc)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	Investigating criminal activity	Providing fire protection & prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	Valid	250	253	253	249	249	249	248	248	249
	Missing	11	7	8	11	11	12	13	13	11
Mean		2.87	2.99	2.99	3.03	3.66	3.79	2.98	2.99	3.22
Std. Error of Mean		0.073	0.072	0.078	0.075	0.068	0.067	0.076	0.075	0.068
Median		3	3	3	3	4	4	3	3	3
Mode		3	3	3	3	4	4	3	3	3
Std. Deviation		1.156	1.14	1.243	1.189	1.079	1.055	1.193	1.173	1.08
Variance		1.336	1.299	1.544	1.414	1.164	1.114	1.424	1.375	1.166
Skewness		0.118	-0.103	0.025	-0.078	-0.558	-0.726	0.054	-0.049	-0.347
Std. Error of Skewness		0.154	0.153	0.153	0.154	0.154	0.154	0.155	0.155	0.154
Kurtosis		-0.646	-0.702	-0.878	-0.874	-0.34	0.187	-0.708	-0.687	-0.193
Std. Error of Kurtosis		0.307	0.305	0.305	0.307	0.308	0.308	0.308	0.308	0.307
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Public Safety
Summary Statistics by Jurisdiction

City of Las Vegas		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	190	191	190	192	191	188	188	187
	Missing	3	2	2	1	2	5	5	6
Mean		3.22	3.37	3.08	2.83	3.29	4.06	4.12	4.21
Std. Error of Mean		0.073	0.082	0.079	0.086	0.084	0.069	0.067	0.065
Median		3	4	3	3	3	4	4	4
Mode		3	4	3	3	3	5	5	5
Std. Deviation		1.006	1.129	1.089	1.187	1.161	0.95	0.912	0.882
Variance		1.013	1.274	1.186	1.408	1.347	0.902	0.832	0.778
Skewness		-0.306	-0.541	-0.141	0.156	-0.305	-0.967	-1.039	-1.243
Std. Error of Skewness		0.176	0.176	0.176	0.176	0.176	0.177	0.177	0.178
Kurtosis		-0.032	-0.276	-0.399	-0.835	-0.616	0.899	1.044	1.896
Std. Error of Kurtosis		0.351	0.35	0.35	0.349	0.35	0.352	0.353	0.354
Range		4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Public Safety
Summary Statistics by Jurisdiction

City of Las Vegas (cont.)		Facilitate neighborhood watch programs	Preparing for natural disasters, (i.e. floods, earthquakes, etc)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	Investigating criminal activity	Providing fire protection & prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	Valid	188	189	189	192	190	188	185	190	191
	Missing	5	4	4	1	2	5	8	2	2
Mean		2.86	3.05	3.09	3.25	3.81	3.92	3.07	2.9	3.31
Std. Error of Mean		0.081	0.079	0.085	0.08	0.066	0.067	0.078	0.08	0.071
Median		3	3	3	3	4	4	3	3	3
Mode		3	3	3	3	4	4	3	3	3
Std. Deviation		1.118	1.084	1.168	1.107	0.911	0.92	1.055	1.101	0.983
Variance		1.249	1.176	1.364	1.226	0.829	0.846	1.113	1.212	0.966
Skewness		0.108	-0.038	-0.139	-0.394	-0.643	-0.892	-0.074	-0.107	-0.447
Std. Error of Skewness		0.177	0.177	0.177	0.175	0.176	0.177	0.179	0.176	0.176
Kurtosis		-0.503	-0.48	-0.772	-0.411	0.483	0.989	-0.245	-0.589	0.113
Std. Error of Kurtosis		0.353	0.352	0.351	0.349	0.35	0.353	0.356	0.35	0.35
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Public Safety
Summary Statistics by Jurisdiction

City of North Las Vegas		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	67	68	67	66	67	65	67	68
	Missing	1	0	0	2	1	3	0	0
Mean		3.2	3.28	2.85	2.5	2.98	3.74	3.79	4.1
Std. Error of Mean		0.126	0.147	0.142	0.128	0.133	0.102	0.104	0.101
Median		3	3	3	2	3	4	4	4
Mode		3	3	3	2	3	3	4	4
Std. Deviation		1.029	1.206	1.166	1.043	1.088	0.823	0.856	0.829
Variance		1.06	1.455	1.36	1.087	1.184	0.678	0.732	0.687
Skewness		0.143	-0.11	0.115	0.463	-0.008	0.34	-0.028	-0.785
Std. Error of Skewness		0.294	0.291	0.292	0.295	0.294	0.297	0.292	0.291
Kurtosis		-0.399	-0.942	-0.71	-0.105	-0.222	-1.093	-0.857	0.315
Std. Error of Kurtosis		0.58	0.575	0.577	0.582	0.58	0.586	0.577	0.575
Range		4	4	4	4	4	3	3	3
Minimum		1	1	1	1	1	2	2	2
Maximum		5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Public Safety
Summary Statistics by Jurisdiction

City of North Las Vegas (cont.)		Facilitate neighborhood watch programs	Preparing for natural disasters, (i.e. floods, earthquakes, etc)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	Investigating criminal activity	Providing fire protection & prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	Valid	68	67	66	68	68	67	67	65	67
	Missing	0	1	2	0	0	1	1	3	0
Mean		2.69	3.05	3.24	3.09	3.69	3.72	2.87	3.1	3.18
Std. Error of Mean		0.129	0.142	0.141	0.139	0.124	0.12	0.141	0.174	0.129
Median		3	3	3	3	4	4	3	3	3
Mode		3	3	3	3	4	3	3	3	3
Std. Deviation		1.063	1.159	1.14	1.142	1.02	0.976	1.151	1.405	1.059
Variance		1.129	1.343	1.299	1.304	1.04	0.952	1.325	1.975	1.121
Skewness		0.085	0.062	-0.451	-0.031	-0.402	-0.086	0.115	-0.101	0.159
Std. Error of Skewness		0.291	0.293	0.296	0.291	0.291	0.294	0.294	0.297	0.292
Kurtosis		-0.644	-0.689	-0.22	-0.654	-0.348	-1.059	-0.667	-1.21	-0.395
Std. Error of Kurtosis		0.575	0.579	0.583	0.575	0.575	0.58	0.58	0.586	0.577
Range		4	4	4	4	4	3	4	4	4
Minimum		1	1	1	1	1	2	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Public Safety
Summary Statistics by Jurisdiction

City of Henderson		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	63	64	65	63	63	62	62	63
	Missing	3	2	2	3	3	4	4	3
Mean		3.26	3.25	2.99	3.01	3.17	3.82	3.81	4.06
Std. Error of Mean		0.117	0.145	0.143	0.145	0.138	0.111	0.12	0.12
Median		3	3	3	3	3	4	4	4
Mode		4	3	3	3	3	4	4	4
Std. Deviation		0.929	1.158	1.147	1.154	1.101	0.878	0.942	0.951
Variance		0.864	1.342	1.315	1.332	1.211	0.77	0.888	0.905
Skewness		-0.117	-0.276	-0.06	-0.023	-0.365	-0.58	-0.671	-1.147
Std. Error of Skewness		0.301	0.299	0.298	0.301	0.3	0.304	0.304	0.301
Kurtosis		-0.536	-0.433	-0.813	-0.723	-0.261	0.643	0.551	1.446
Std. Error of Kurtosis		0.595	0.59	0.588	0.595	0.593	0.599	0.599	0.595
Range		4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Public Safety
Summary Statistics by Jurisdiction

City of Henderson (cont.)		Facilitate neighborhood watch programs	Preparing for natural disasters, (i.e. floods, earthquakes, etc)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	Investigating criminal activity	Providing fire protection & prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	Valid	65	65	65	64	63	65	63	64	65
	Missing	2	2	2	2	4	2	3	3	2
Mean		3.07	2.82	2.94	3.05	3.76	3.87	3.09	2.97	3.03
Std. Error of Mean		0.148	0.147	0.14	0.142	0.096	0.111	0.141	0.143	0.134
Median		3	3	3	3	4	4	3	3	3
Mode		3	3	3	3	3	4	3	3	3
Std. Deviation		1.192	1.181	1.123	1.138	0.761	0.89	1.116	1.143	1.074
Variance		1.421	1.396	1.26	1.296	0.578	0.792	1.245	1.307	1.153
Skewness		0.052	-0.007	-0.108	-0.151	0.336	-0.431	-0.046	0.105	0.088
Std. Error of Skewness		0.298	0.298	0.298	0.299	0.303	0.298	0.302	0.3	0.298
Kurtosis		-0.711	-0.742	-0.297	-0.684	-0.974	-0.173	-0.296	-0.559	-0.312
Std. Error of Kurtosis		0.588	0.588	0.588	0.59	0.597	0.588	0.595	0.593	0.588
Range		4	4	4	4	3	4	4	4	4
Minimum		1	1	1	1	2	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Public Safety
Summary Statistics by Jurisdiction

Boulder City		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	9	9	9	9	8	7	7	7
	Missing	0	0	0	0	1	2	2	2
Mean		3.59	3.21	3.3	3.16	3.33	4.2	4.13	4.22
Std. Error of Mean		0.373	0.387	0.343	0.484	0.42	0.312	0.3	0.223
Median		3.8	3.8	3.8	4	3	4	4	4
Mode		4	4	4	4	3	5	4	4
Std. Deviation		1.095	1.138	1.007	1.421	1.154	0.832	0.8	0.594
Variance		1.199	1.295	1.013	2.019	1.332	0.691	0.639	0.353
Skewness		-0.109	-1.493	-0.299	-0.58	0.763	-0.453	-0.273	0.073
Std. Error of Skewness		0.729	0.729	0.729	0.729	0.77	0.789	0.789	0.789
Kurtosis		-1.015	1.466	-1.257	-1.144	-0.595	-1.187	-0.992	1.185
Std. Error of Kurtosis		1.428	1.428	1.428	1.428	1.525	1.575	1.575	1.575
Range		3	3	3	4	3	2	2	2
Minimum		2	1	2	1	2	3	3	3
Maximum		5	4	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Public Safety
Summary Statistics by Jurisdiction

Boulder City (cont.)		Facilitate neighborhood watch programs	Preparing for natural disasters, (i.e. floods, earthquakes, etc)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	Investigating criminal activity	Providing fire protection & prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	Valid	7	7	7	7	9	8	9	7	9
	Missing	2	2	2	2	0	1	0	2	0
Mean		3.13	3.64	3.28	3.59	4.12	4.06	3.89	3.78	3.04
Std. Error of Mean		0.572	0.442	0.652	0.42	0.267	0.167	0.426	0.347	0.283
Median		3	4	3.5	3.5	4	4	4	3.5	3
Mode		3	4	5	3	4	4	5	3	3
Std. Deviation		1.523	1.178	1.736	1.119	0.784	0.459	1.252	0.924	0.832
Variance		2.321	1.388	3.014	1.253	0.615	0.211	1.569	0.854	0.691
Skewness		-0.121	-0.695	-0.48	-0.687	-1.241	0.451	-0.782	0.56	1.587
Std. Error of Skewness		0.789	0.789	0.789	0.789	0.729	0.77	0.729	0.789	0.729
Kurtosis		-0.598	-0.83	-1.558	2.599	4.4	6.544	-0.967	-1.796	4.873
Std. Error of Kurtosis		1.575	1.575	1.575	1.575	1.428	1.525	1.428	1.575	1.428
Range		4	3	4	4	3	2	3	2	3
Minimum		1	2	1	1	2	3	2	3	2
Maximum		5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Public Safety
Summary Statistics by Jurisdiction

Mesquite		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	4	4	4	4	3	3	4	4
	Missing	0	0	0	0	0	0	0	0
Mean		3.84	3.6	3.84	3.45	3.64	3.96	4.08	3.96
Std. Error of Mean		0.46	0.499	0.615	0.78	0.761	0.492	0.548	0.511
Median		3.9	3	3.96	3.91	4	4	4.43	3.96
Mode		3	3	5	2	4	4	5	3
Std. Deviation		0.909	0.985	1.214	1.541	1.409	0.91	1.083	1.009
Variance		0.826	0.97	1.474	2.374	1.986	0.829	1.173	1.019
Skewness		0.499	1.518	-0.557	0.124	-0.845	0.14	-0.299	0.123
Std. Error of Skewness		1.028	1.028	1.028	1.028	1.108	1.108	1.028	1.028
Range		2	2	3	3	3	2	2	2
Minimum		3	3	2	2	2	3	3	3
Maximum		5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Public Safety
Summary Statistics by Jurisdiction

Mesquite (cont.)		Facilitate neighborhood watch programs	Preparing for natural disasters, (i.e. floods, earthquakes, etc)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	Investigating criminal activity	Providing fire protection & prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	Valid	3	3	4	4	3	4	3	3	3
	Missing	0	1	0	0	0	0	0	0	0
Mean		3	3.48	3.24	3.96	3.96	3.96	3.55	3	3.27
Std. Error of Mean		0.95	0.968	0.75	0.511	0.492	0.587	0.463	0.582	0.554
Median		3	3.91	3	3.96	4	3.86	3.21	3	3
Mode		3	3	3	3	4	3	3	3	3
Std. Deviation		1.759	1.666	1.48	1.009	0.91	1.159	0.858	1.077	1.027
Variance		3.095	2.775	2.191	1.019	0.829	1.343	0.736	1.16	1.054
Skewness		0		-0.194	0.123	0.14	0.127	1.863	2.227	1.443
Std. Error of Skewness		1.108		1.028	1.028	1.108	1.028	1.108	1.108	1.108
Range		4	4	4	2	2	2	2	3	3
Minimum		1	1	1	3	3	3	3	2	2
Maximum		5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Community Development
Summary Statistics by Jurisdiction

Unincorporated Clark County		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	Valid	251	251	253	250	253	258	258	258	252	253	255	252
	Missing	9	9	7	10	8	3	3	3	8	7	6	8
Mean		2.44	2.48	2.75	2.91	3.1	2.41	3.28	3.02	2.54	2.79	3.46	3.41
Std. Error of Mean		0.07	0.077	0.073	0.074	0.074	0.077	0.078	0.071	0.074	0.079	0.074	0.075
Median		2	2	3	3	3	2	3	3	3	3	4	3
Mode		3	1	3	3	3	1	3	3	3	3	3	3
Std. Deviation		1.107	1.215	1.163	1.173	1.178	1.23	1.249	1.143	1.182	1.262	1.186	1.195
Variance		1.225	1.475	1.353	1.375	1.389	1.513	1.561	1.307	1.396	1.592	1.406	1.428
Skewness		0.42	0.258	0.016	-0.049	-0.181	0.385	-0.286	-0.031	0.251	0.206	-0.477	-0.421
Std. Error of Skewness		0.154	0.154	0.153	0.154	0.153	0.152	0.152	0.152	0.153	0.153	0.153	0.153
Kurtosis		-0.313	-1.023	-0.767	-0.748	-0.74	-0.908	-0.831	-0.634	-0.722	-0.862	-0.45	-0.591
Std. Error of Kurtosis		0.306	0.306	0.305	0.307	0.305	0.302	0.302	0.302	0.306	0.305	0.304	0.306
Range		4	4	4	4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Community Development
Summary Statistics by Jurisdiction

City of Las Vegas		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	Valid	189	190	189	187	186	191	192	191	191	190	191	190
	Missing	4	2	4	6	7	2	1	2	2	3	2	3
Mean		2.82	2.62	2.94	3.06	3.16	2.86	3.3	3.27	2.96	2.95	3.75	3.62
Std. Error of Mean		0.078	0.089	0.079	0.075	0.083	0.094	0.081	0.083	0.083	0.084	0.072	0.076
Median		3	3	3	3	3	3	3	3	3	3	4	4
Mode		3	3	3	3	4	3	4	4	3	3	4	4
Std. Deviation		1.076	1.226	1.092	1.022	1.136	1.297	1.119	1.15	1.14	1.155	0.996	1.044
Variance		1.158	1.504	1.193	1.044	1.291	1.681	1.251	1.321	1.3	1.333	0.993	1.089
Skewness		0.241	0.299	0.188	-0.163	-0.33	0.084	-0.322	-0.428	0.062	-0.128	-0.841	-0.554
Std. Error of Skewness		0.177	0.176	0.177	0.178	0.178	0.176	0.176	0.176	0.176	0.177	0.176	0.176
Kurtosis		-0.217	-0.835	-0.384	-0.369	-0.644	-1.078	-0.603	-0.557	-0.677	-0.764	0.644	-0.071
Std. Error of Kurtosis		0.352	0.35	0.352	0.354	0.354	0.35	0.349	0.35	0.35	0.351	0.35	0.351
Range		4	4	4	4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Community Development
Summary Statistics by Jurisdiction

City of North Las Vegas		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	Valid	68	68	67	67	67	68	68	68	68	66	66	67
	Missing	0	0	1	1	1	0	0	0	0	2	2	1
Mean		2.84	2.68	2.97	3.21	3.3	2.78	3.3	3.16	2.89	2.97	3.48	3.47
Std. Error of Mean		0.12	0.136	0.143	0.128	0.148	0.157	0.14	0.159	0.142	0.143	0.147	0.123
Median		3	3	3	3	3	3	3	3	3	3	3	4
Mode		3	3	3	4	4	4	4	3	3	3	3	4
Std. Deviation		0.984	1.116	1.163	1.047	1.206	1.29	1.154	1.305	1.166	1.166	1.186	1.008
Variance		0.968	1.245	1.353	1.096	1.455	1.665	1.332	1.703	1.36	1.359	1.407	1.017
Skewness		0.138	-0.12	0.053	-0.577	-0.433	0.029	-0.244	-0.099	-0.032	-0.139	-0.208	-0.222
Std. Error of Skewness		0.291	0.291	0.294	0.294	0.294	0.291	0.291	0.291	0.291	0.295	0.296	0.293
Kurtosis		-0.147	-0.747	-0.837	-0.263	-0.609	-1.198	-0.718	-1.077	-0.543	-0.741	-0.891	-0.665
Std. Error of Kurtosis		0.575	0.575	0.58	0.58	0.58	0.575	0.575	0.575	0.575	0.582	0.584	0.579
Range		4	4	4	4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Community Development
Summary Statistics by Jurisdiction

City of Henderson		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	Valid	63	65	65	65	64	65	65	63	64	65	63	65
	Missing	3	2	2	2	3	2	2	3	2	2	3	2
Mean		2.5	2.26	2.7	2.91	3.01	2.17	3.13	2.87	2.64	2.3	3.45	3.58
Std. Error of Mean		0.133	0.127	0.12	0.124	0.148	0.135	0.115	0.135	0.127	0.153	0.135	0.14
Median		3	2	3	3	3	2	3	3	3	2	4	4
Mode		3	3	3	3	3	1	3	3	3	1	4	4
Std. Deviation		1.053	1.018	0.963	0.998	1.181	1.085	0.923	1.069	1.021	1.226	1.074	1.124
Variance		1.109	1.036	0.927	0.995	1.394	1.178	0.852	1.143	1.042	1.503	1.154	1.263
Skewness		0.174	0.402	-0.03	0.137	0.015	0.755	-0.087	0.211	-0.061	0.697	-0.55	-0.464
Std. Error of Skewness		0.301	0.298	0.298	0.298	0.3	0.298	0.298	0.302	0.299	0.298	0.302	0.298
Kurtosis		-0.643	-0.297	-0.295	-0.189	-0.733	0.239	0.261	-0.547	-0.53	-0.474	-0.165	-0.445
Std. Error of Kurtosis		0.595	0.588	0.588	0.588	0.593	0.588	0.588	0.595	0.59	0.588	0.595	0.588
Range		4	4	4	4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Community Development
Summary Statistics by Jurisdiction

Boulder City		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	Valid	9	9	8	9	9	9	9	9	9	9	9	9
	Missing	0	0	0	0	0	0	0	0	0	0	0	0
Mean		2.57	2.74	2.85	3.35	3.23	3.12	3.41	3.87	3.48	3	3.93	3.64
Std. Error of Mean		0.41	0.487	0.321	0.496	0.572	0.509	0.215	0.394	0.428	0.508	0.386	0.407
Median		2.19	3	3	3.8	4	3	3	4	3.8	2.39	4	4
Mode		2	3	3	4	4	3	3	5	4	2	5	4
Std. Deviation		1.206	1.43	0.917	1.458	1.682	1.494	0.63	1.156	1.258	1.492	1.135	1.196
Variance		1.454	2.044	0.84	2.124	2.828	2.233	0.397	1.337	1.582	2.225	1.288	1.431
Skewness		0.467	0.013	-0.517	-0.648	-0.369	-0.269	1.384	-0.409	-0.423	0.337	-0.584	-0.298
Std. Error of Skewness		0.729	0.729	0.746	0.729	0.729	0.729	0.729	0.729	0.729	0.729	0.729	0.729
Kurtosis		-0.181	-1.016	5.717	-0.524	-1.824	-0.789	1.736	-1.338	-0.467	-1.593	-0.963	-1.366
Std. Error of Kurtosis		1.428	1.428	1.467	1.428	1.428	1.428	1.428	1.428	1.428	1.428	1.428	1.428
Range		4	4	4	4	4	4	2	3	4	4	3	3
Minimum		1	1	1	1	1	1	3	2	1	1	2	2
Maximum		5	5	5	5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Performance Scores for Community Development
Summary Statistics by Jurisdiction

Mesquite		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	Valid	3	3	3	4	4	4	4	4	3	4	3	4
	Missing	0	0	0	0	0	0	0	0	1	0	0	0
Mean		3.55	3.27	3.82	3.6	3.6	3.6	3.96	3.72	3.48	2.84	2.55	4.08
Std. Error of Mean		0.463	0.554	0.535	0.499	0.499	0.762	0.511	0.634	0.538	0.615	1.002	0.467
Median		3.21	3	3.71	3	3	3.91	3.96	3.91	3	2.46	2	4
Mode		3	3	3	3	3	3	3	3	3	2	2	4(a)
Std. Deviation		0.858	1.027	0.99	0.985	0.985	1.506	1.009	1.251	0.925	1.214	1.856	0.921
Variance		0.736	1.054	0.98	0.97	0.97	2.267	1.019	1.566	0.856	1.474	3.444	0.849
Skewness		1.863	1.443	0.692	1.518	1.518	-0.984	0.123	-0.016		1.673	1.562	-0.269
Std. Error of Skewness		1.108	1.108	1.108	1.028	1.028	1.028	1.028	1.028		1.028	1.108	1.028
Range		2	3	2	2	2	4	2	3	2	3	4	2
Minimum		3	2	3	3	3	1	3	2	3	2	1	3
Maximum		5	5	5	5	5	5	5	5	5	5	5	5

Appendix III

Quality of Life Considerations

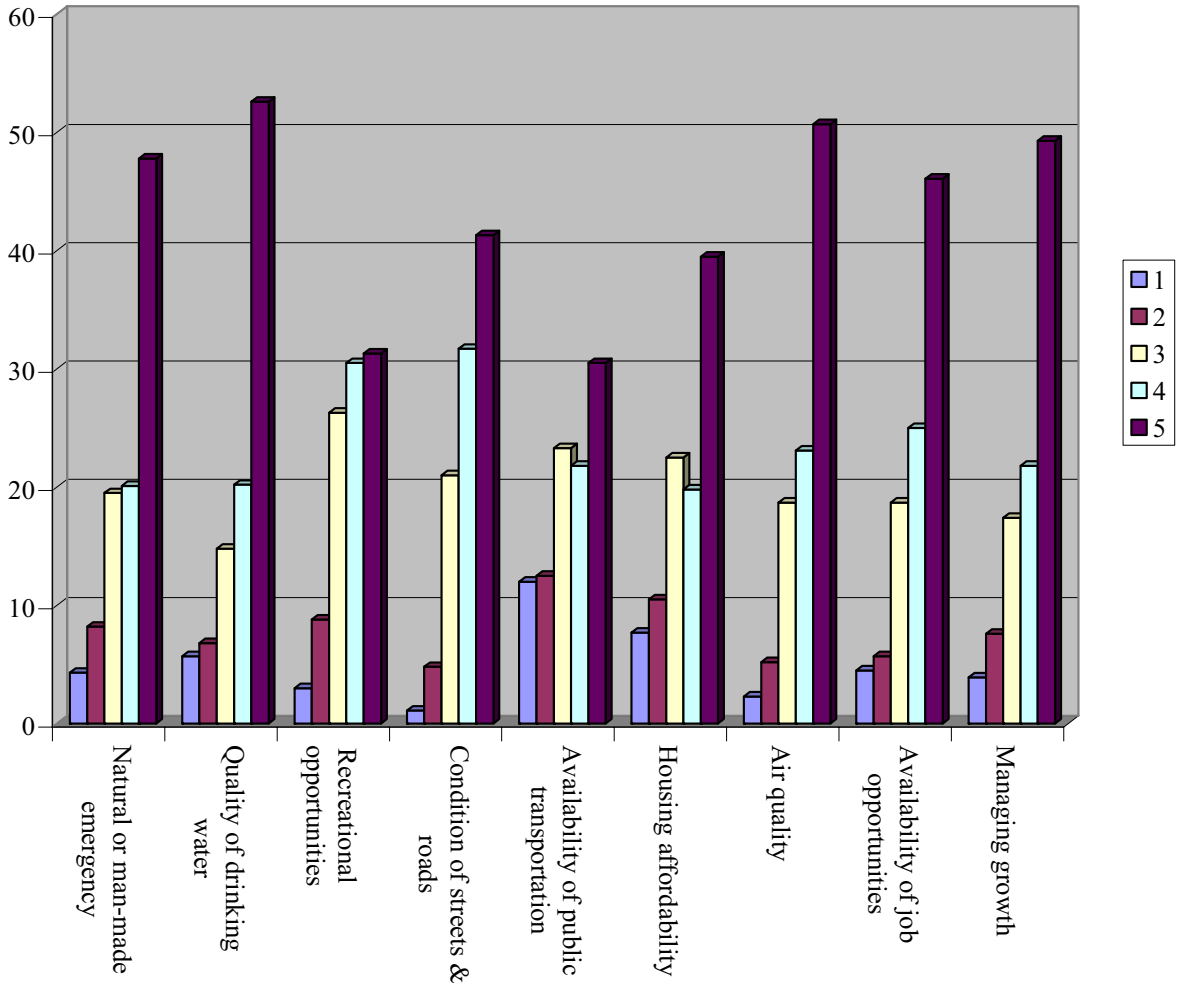
Appendix III
Quality of Life Considerations Condition Ratings
Summary Statistics

Now I'd like to ask you about different factors that may contribute to your quality of life. On a scale of one to five, where one means "low importance" and five means "high importance," please rate the level of importance for the following services:

		Overall sense of preparedness in the event of a large scale natural or man-made emergency	Quality of drinking water	Recreational opportunities	Condition of streets & roads	Availability of public transportation	Housing affordability	Air quality	Availability of job opportunities	Managing growth
N	Valid	595	596	592	596	591	593	596	593	593
	Missing	5	4	8	4	9	6	3	7	7
Mean		3.99	4.07	3.78	4.07	3.46	3.73	4.15	4.02	4.05
Std. Error of Mean		.048	.049	.044	.039	.056	.053	.043	.047	.047
Median		4.00	5.00	4.00	4.00	4.00	4.00	5.00	4.00	4.00
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.181	1.206	1.075	.957	1.352	1.289	1.044	1.134	1.150
Skewness		-.913	-1.155	-.574	-.790	-.433	-.648	-1.064	-1.033	-1.020
Std. Error of Skewness		.100	.100	.100	.100	.101	.100	.100	.100	.100
Kurtosis		-.193	.289	-.374	-.014	-.986	-.705	.364	.272	.078
Std. Error of Kurtosis		.200	.200	.201	.200	.201	.200	.200	.200	.200
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations Condition Ratings

	1	2	3	4	5	DK/No answer	Total
Natural or man-made emergency	4.3	8.2	19.4	19.9	47.5	0.8	100
Quality of drinking water	5.7	6.7	14.7	20.1	52.3	0.6	100
Recreational opportunities	3	8.7	25.9	30.1	30.9	1.3	100
Condition of streets & roads	1.1	4.8	20.9	31.5	41.1	0.6	100
Availability of public transportation	11.8	12.3	22.9	21.5	30.1	1.4	100
Housing affordability	7.6	10.4	22.3	19.6	39.1	1	100
Air quality	2.3	5.2	18.6	23	50.5	0.5	100
Availability of job opportunities	4.5	5.6	18.5	24.7	45.6	1.2	100
Managing growth	3.9	7.5	17.2	21.6	48.7	1.1	100



Note- Graph does not include Don't Know/ No Answer

Appendix III
Quality of Life Considerations Condition Ratings
Summary Statistics by Jurisdiction

Unincorporated Clark County		Overall sense of preparedness in the event of a large scale natural or man-made emergency:	Quality of drinking water:	Recreational opportunities:	Condition of streets & roads:	Availability of public transportation:	Housing affordability:	Air quality:	Availability of job opportunities:	Managing growth:
N	Valid	257	258	257	258	256	257	258	257	257
	Missing	4	3	3	3	5	4	3	4	4
Mean		3.96	4.20	3.80	4.12	3.47	3.80	4.18	3.95	4.12
Std. Error of Mean		.075	.069	.071	.061	.089	.081	.066	.073	.073
Median		4.00	5.00	4.00	4.00	4.00	4.00	5.00	4.00	5.00
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.207	1.112	1.136	.980	1.415	1.295	1.065	1.164	1.168
Skewness		-.843	-1.308	-.665	-1.047	-.437	-.714	-1.264	-.946	-1.227
Std. Error of Skewness		.152	.152	.152	.152	.152	.152	.152	.152	.152
Kurtosis		-.429	.807	-.434	.635	-1.103	-.674	.960	.038	.533
Std. Error of Kurtosis		.303	.302	.303	.302	.304	.303	.302	.303	.303
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations Condition Ratings
Summary Statistics by Jurisdiction

City of Las Vegas		Overall sense of preparedness in the event of a large scale natural or man-made emergency:	Quality of drinking water:	Recreational opportunities:	Condition of streets & roads:	Availability of public transportation:	Housing affordability:	Air quality:	Availability of job opportunities:	Managing growth:
N	Valid	193	192	190	192	190	192	193	190	190
	Missing	0	1	3	1	3	1	0	3	3
Mean		3.97	3.97	3.82	4.07	3.46	3.63	4.20	4.10	4.01
Std. Error of Mean		.083	.090	.071	.065	.094	.095	.070	.081	.080
Median		4.00	4.00	4.00	4.00	4.00	4.00	5.00	4.00	4.00
Mode		5	5	4	5	5	5	5	5	5
Std. Deviation		1.147	1.246	.976	.902	1.300	1.319	.966	1.113	1.109
Skewness		-.929	-1.023	-.588	-.619	-.427	-.562	-.946	-1.248	-.922
Std. Error of Skewness		.175	.175	.176	.175	.176	.176	.175	.176	.176
Kurtosis		.043	-.011	.186	-.351	-.849	-.821	-.015	.938	-.040
Std. Error of Kurtosis		.349	.349	.351	.349	.351	.349	.349	.351	.351
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations Condition Ratings
Summary Statistics by Jurisdiction

City of North Las Vegas		Overall sense of preparedness in the event of a large scale natural or man-made emergency:	Quality of drinking water:	Recreational opportunities:	Condition of streets & roads:	Availability of public transportation:	Housing affordability:	Air quality:	Availability of job opportunities:	Managing growth:
N	Valid	68	68	66	68	68	68	68	68	68
	Missing	0	0	2	0	0	0	0	0	0
Mean		4.07	3.90	3.77	3.91	3.47	3.93	4.09	4.23	4.07
Std. Error of Mean		.143	.148	.136	.121	.157	.141	.130	.125	.138
Median		5.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00
Mode		5	5	5	5	4	5	5	5	5
Std. Deviation		1.175	1.217	1.102	.991	1.291	1.162	1.066	1.031	1.138
Skewness		-.959	-.913	-.291	-.293	-.546	-.972	-.947	-1.280	-.890
Std. Error of Skewness		.291	.291	.295	.291	.291	.291	.291	.291	.291
Kurtosis		-.228	.031	-1.138	-1.157	-.734	.331	.109	1.008	-.324
Std. Error of Kurtosis		.575	.575	.582	.575	.575	.575	.575	.575	.575
Range		4	4	4	3	4	4	4	4	4
Minimum		1	1	1	2	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations Condition Ratings
Summary Statistics by Jurisdiction

Henderson		Overall sense of preparedness in the event of a large scale natural or man-made emergency:	Quality of drinking water:	Recreational opportunities:	Condition of streets & roads:	Availability of public transportation:	Housing affordability:	Air quality:	Availability of job opportunities:	Managing growth:
N	Valid	66	66	66	66	66	65	66	66	66
	Missing	0	0	0	0	0	1	0	0	0
Mean		3.99	3.97	3.71	4.02	3.34	3.43	3.87	3.84	3.89
Std. Error of Mean		.152	.170	.124	.123	.169	.165	.142	.145	.151
Median		4.00	5.00	4.00	4.00	3.00	3.18	4.00	4.00	4.00
Mode		5	5	4	5	5	5	5	5	5
Std. Deviation		1.240	1.380	1.011	.998	1.371	1.329	1.151	1.177	1.229
Skewness		-1.106	-1.078	-.422	-.753	-.241	-.306	-.614	-.671	-.715
Std. Error of Skewness		.295	.295	.295	.295	.296	.297	.295	.296	.295
Kurtosis		.251	-.286	-.309	-.025	-1.154	-1.078	-.605	-.428	-.498
Std. Error of Kurtosis		.582	.582	.582	.582	.584	.586	.582	.584	.582
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations Condition Ratings
Summary Statistics by Jurisdiction

Boulder City		Overall sense of preparedness in the event of a large scale natural or man-made emergency:	Quality of drinking water:	Recreational opportunities:	Condition of streets & roads:	Availability of public transportation:	Housing affordability:	Air quality:	Availability of job opportunities:	Managing growth:
N	Valid	9	9	9	9	8	9	9	9	9
	Missing	0	0	0	0	0	0	0	0	0
Mean		4.67	4.84	3.73	4.55	4.38	4.48	4.71	4.60	4.17
Std. Error of Mean		.268	.179	.461	.247	.221	.217	.203	.245	.371
Median		5.00	5.00	3.69	5.00	4.00	4.82	5.00	5.00	4.19
Mode		5	5	5	5	4	5	5	5	5
Std. Deviation		.786	.527	1.355	.725	.632	.637	.595	.719	1.089
Skewness		-2.229	-3.674	-.198	-1.483	-.436	-.847	-2.238	-1.766	-1.925
Std. Error of Skewness		.729	.729	.729	.729	.746	.729	.729	.729	.729
Kurtosis		3.817	16.433	-2.129	1.481	-.077	.272	5.775	2.524	6.049
Std. Error of Kurtosis		1.428	1.428	1.428	1.428	1.467	1.428	1.428	1.428	1.428
Range		2	2	3	2	2	2	2	2	4
Minimum		3	3	2	3	3	3	3	3	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations Condition Ratings
Summary Statistics by Jurisdiction

Mesquite		Overall sense of preparedness in the event of a large scale natural or man-made emergency:	Quality of drinking water:	Recreational opportunities:	Condition of streets & roads:	Availability of public transportation:	Housing affordability:	Air quality:	Availability of job opportunities:	Managing growth:
N	Valid	3	4	4	4	4	4	4	4	4
	Missing	0	0	0	0	0	0	0	0	0
Mean		3.69	3.77	2.93	3.48	3.24	3.48	3.81	3.36	3.72
Std. Error of Mean		.561	1.024	.892	.502	.750	.411	.703	.574	.634
Median		3.41	4.90	2.96	3.43	3.00	3.00	4.00	3.00	3.91
Mode		3	5	1	3	3	3	4(a)	3	3
Std. Deviation		1.038	2.023	1.762	.992	1.480	.812	1.388	1.133	1.251
Skewness		1.324	-1.594	.106	.099	-.194	1.975	-1.054	1.379	-.016
Std. Error of Skewness		1.108	1.028	1.028	1.028	1.028	1.028	1.028	1.028	1.028
Range		2	4	4	3	4	2	3	3	3
Minimum		3	1	1	2	1	3	2	2	2
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations Condition Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Now I'd like to ask you about different factors that may contribute to your quality of life. On a scale of one to five, where one means "low importance" and five means "high importance," please rate the level of importance for the following services: Overall sense of preparedness in the event of a large scale natural or man-made emergency:

			Overall sense of preparedness in the event of a large scale natural or man-made emergency:					
			1	2	3	4	5	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	10	26	49	47	124	256
		% within Respondent Jurisdiction	3.9%	10.2%	19.1%	18.4%	48.4%	100.0%
	City of Las Vegas	Count	9	13	39	47	84	192
		% within Respondent Jurisdiction	4.7%	6.8%	20.3%	24.5%	43.8%	100.0%
	City of North Las Vegas	Count	2	6	13	10	37	68
		% within Respondent Jurisdiction	2.9%	8.8%	19.1%	14.7%	54.4%	100.0%
	City of Henderson	Count	5	4	11	15	32	67
		% within Respondent Jurisdiction	7.5%	6.0%	16.4%	22.4%	47.8%	100.0%
	Boulder City	Count	0	0	1	0	7	8
		% within Respondent Jurisdiction	.0%	.0%	12.5%	.0%	87.5%	100.0%
	Mesquite	Count	0	0	2	0	1	3
		% within Respondent Jurisdiction	.0%	.0%	66.7%	.0%	33.3%	100.0%
Total		Count	26	49	115	119	285	594
		% within Respondent Jurisdiction	4.4%	8.2%	19.4%	20.0%	48.0%	100.0%

Appendix III
Quality of Life Considerations Condition Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Now I'd like to ask you about different factors that may contribute to your quality of life. On a scale of one to five, where one means "low importance" and five means "high importance," please rate the level of importance for the following services: Overall sense of preparedness in the event of a large scale natural or man-made emergency: (cont.)

Chi-Square Tests (cont.)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.142(a)	20	.513
Likelihood Ratio	20.682	20	.416
Linear-by-Linear Association	.523	1	.470
N of Valid Cases	594		

Appendix III
Quality of Life Considerations Condition Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Now I'd like to ask you about different factors that may contribute to your quality of life. On a scale of one to five, where one means "low importance" and five means "high importance," please rate the level of importance for the following services: Quality of drinking water:

			Quality of drinking water:					
			1	2	3	4	5	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	9	16	35	51	146	257
		% within Respondent Jurisdiction	3.5%	6.2%	13.6%	19.8%	56.8%	100.0%
	City of Las Vegas	Count	13	14	32	41	92	192
		% within Respondent Jurisdiction	6.8%	7.3%	16.7%	21.4%	47.9%	100.0%
	City of North Las Vegas	Count	5	3	17	14	29	68
		% within Respondent Jurisdiction	7.4%	4.4%	25.0%	20.6%	42.6%	100.0%
	City of Henderson	Count	6	8	4	13	36	67
		% within Respondent Jurisdiction	9.0%	11.9%	6.0%	19.4%	53.7%	100.0%
	Boulder City	Count	0	0	0	0	8	8
		% within Respondent Jurisdiction	.0%	.0%	.0%	.0%	100.0%	100.0%
	Mesquite	Count	1	0	0	0	2	3
		% within Respondent Jurisdiction	33.3%	.0%	.0%	.0%	66.7%	100.0%
Total		Count	34	41	88	119	313	595
		% within Respondent Jurisdiction	5.7%	6.9%	14.8%	20.0%	52.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	32.178(a)	20	.041
Likelihood Ratio	34.407	20	.023
Linear-by-Linear Association	1.833	1	.176
N of Valid Cases	595		

Appendix III
Quality of Life Considerations Condition Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Now I'd like to ask you about different factors that may contribute to your quality of life. On a scale of one to five, where one means "low importance" and five means "high importance," please rate the level of importance for the following services: Recreational opportunities:

			Recreational opportunities:					
			1	2	3	4	5	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	10	29	54	78	87	258
		% within Respondent Jurisdiction	3.9%	11.2%	20.9%	30.2%	33.7%	100.0%
	City of Las Vegas	Count	5	7	59	66	54	191
		% within Respondent Jurisdiction	2.6%	3.7%	30.9%	34.6%	28.3%	100.0%
	City of North Las Vegas	Count	0	9	19	14	23	65
		% within Respondent Jurisdiction	.0%	13.8%	29.2%	21.5%	35.4%	100.0%
	City of Henderson	Count	1	6	20	22	17	66
		% within Respondent Jurisdiction	1.5%	9.1%	30.3%	33.3%	25.8%	100.0%
	Boulder City	Count	0	2	2	0	4	8
		% within Respondent Jurisdiction	.0%	25.0%	25.0%	.0%	50.0%	100.0%
	Mesquite	Count	1	0	1	0	1	3
		% within Respondent Jurisdiction	33.3%	.0%	33.3%	.0%	33.3%	100.0%
Total		Count	17	53	155	180	186	591
		% within Respondent Jurisdiction	2.9%	9.0%	26.2%	30.5%	31.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	39.148(a)	20	.006
Likelihood Ratio	39.036	20	.007
Linear-by-Linear Association	.413	1	.520
N of Valid Cases	591		

Appendix III
Quality of Life Considerations Condition Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Now I'd like to ask you about different factors that may contribute to your quality of life. On a scale of one to five, where one means "low importance" and five means "high importance," please rate the level of importance for the following services: Condition of streets & roads:

			Condition of streets & roads:					
			1	2	3	4	5	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	5	13	42	85	113	258
		% within Respondent Jurisdiction	1.9%	5.0%	16.3%	32.9%	43.8%	100.0%
	City of Las Vegas	Count	1	7	44	65	75	192
		% within Respondent Jurisdiction	.5%	3.6%	22.9%	33.9%	39.1%	100.0%
	City of North Las Vegas	Count	0	5	21	17	25	68
		% within Respondent Jurisdiction	.0%	7.4%	30.9%	25.0%	36.8%	100.0%
	City of Henderson	Count	1	3	16	19	27	66
		% within Respondent Jurisdiction	1.5%	4.5%	24.2%	28.8%	40.9%	100.0%
	Boulder City	Count	0	0	1	2	6	9
		% within Respondent Jurisdiction	.0%	.0%	11.1%	22.2%	66.7%	100.0%
	Mesquite	Count	0	0	2	1	0	3
		% within Respondent Jurisdiction	.0%	.0%	66.7%	33.3%	.0%	100.0%
Total		Count	7	28	126	189	246	596
		% within Respondent Jurisdiction	1.2%	4.7%	21.1%	31.7%	41.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.391(a)	20	.434
Likelihood Ratio	21.734	20	.355
Linear-by-Linear Association	.850	1	.356
N of Valid Cases	596		

Appendix III
Quality of Life Considerations Condition Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Now I'd like to ask you about different factors that may contribute to your quality of life. On a scale of one to five, where one means "low importance" and five means "high importance," please rate the level of importance for the following services: Availability of public transportation:

			Availability of public transportation:					Total
			1	2	3	4	5	
Respondent Jurisdiction	Unincorporated Clark County	Count	35	32	55	47	87	256
		% within Respondent Jurisdiction	13.7%	12.5%	21.5%	18.4%	34.0%	100.0%
	City of Las Vegas	Count	20	22	51	44	53	190
		% within Respondent Jurisdiction	10.5%	11.6%	26.8%	23.2%	27.9%	100.0%
	City of North Las Vegas	Count	7	8	14	21	17	67
		% within Respondent Jurisdiction	10.4%	11.9%	20.9%	31.3%	25.4%	100.0%
	City of Henderson	Count	8	11	16	12	19	66
		% within Respondent Jurisdiction	12.1%	16.7%	24.2%	18.2%	28.8%	100.0%
	Boulder City	Count	0	0	0	4	4	8
		% within Respondent Jurisdiction	.0%	.0%	.0%	50.0%	50.0%	100.0%
	Mesquite	Count	0	0	2	0	1	3
		% within Respondent Jurisdiction	.0%	.0%	66.7%	.0%	33.3%	100.0%
Total		Count	70	73	138	128	181	590
		% within Respondent Jurisdiction	11.9%	12.4%	23.4%	21.7%	30.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.126(a)	20	.334
Likelihood Ratio	25.169	20	.195
Linear-by-Linear Association	.149	1	.699
N of Valid Cases	590		

Appendix III
Quality of Life Considerations Condition Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Now I'd like to ask you about different factors that may contribute to your quality of life. On a scale of one to five, where one means "low importance" and five means "high importance," please rate the level of importance for the following services: Housing affordability:

			Housing affordability:					
			1	2	3	4	5	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	18	28	54	45	112	257
		% within Respondent Jurisdiction	7.0%	10.9%	21.0%	17.5%	43.6%	100.0%
	City of Las Vegas	Count	18	21	46	38	70	193
		% within Respondent Jurisdiction	9.3%	10.9%	23.8%	19.7%	36.3%	100.0%
	City of North Las Vegas	Count	4	2	16	17	28	67
		% within Respondent Jurisdiction	6.0%	3.0%	23.9%	25.4%	41.8%	100.0%
	City of Henderson	Count	6	11	16	13	19	65
		% within Respondent Jurisdiction	9.2%	16.9%	24.6%	20.0%	29.2%	100.0%
	Boulder City	Count	0	0	0	4	5	9
		% within Respondent Jurisdiction	.0%	.0%	.0%	44.4%	55.6%	100.0%
	Mesquite	Count	0	0	2	1	0	3
		% within Respondent Jurisdiction	.0%	.0%	66.7%	33.3%	.0%	100.0%
Total		Count	46	62	134	118	234	594
		% within Respondent Jurisdiction	7.7%	10.4%	22.6%	19.9%	39.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.878(a)	20	.206
Likelihood Ratio	29.601	20	.077
Linear-by-Linear Association	.516	1	.472
N of Valid Cases	594		

Appendix III
Quality of Life Considerations Condition Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Now I'd like to ask you about different factors that may contribute to your quality of life. On a scale of one to five, where one means "low importance" and five means "high importance," please rate the level of importance for the following services: Air quality:

			Air quality:					Total
			1	2	3	4	5	
Respondent Jurisdiction	Unincorporated Clark County	Count	9	10	42	60	136	257
		% within Respondent Jurisdiction	3.5%	3.9%	16.3%	23.3%	52.9%	100.0%
	City of Las Vegas	Count	1	10	36	47	98	192
		% within Respondent Jurisdiction	.5%	5.2%	18.8%	24.5%	51.0%	100.0%
	City of North Las Vegas	Count	2	4	15	15	33	69
		% within Respondent Jurisdiction	2.9%	5.8%	21.7%	21.7%	47.8%	100.0%
	City of Henderson	Count	2	6	18	13	27	66
		% within Respondent Jurisdiction	3.0%	9.1%	27.3%	19.7%	40.9%	100.0%
	Boulder City	Count	0	0	0	2	7	9
		% within Respondent Jurisdiction	.0%	.0%	.0%	22.2%	77.8%	100.0%
	Mesquite	Count	0	1	0	1	1	3
		% within Respondent Jurisdiction	.0%	33.3%	.0%	33.3%	33.3%	100.0%
Total		Count	14	31	111	138	302	596
		% within Respondent Jurisdiction	2.3%	5.2%	18.6%	23.2%	50.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.284(a)	20	.325
Likelihood Ratio	23.128	20	.283
Linear-by-Linear Association	2.195	1	.138
N of Valid Cases	596		

Appendix III
Quality of Life Considerations Condition Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Now I'd like to ask you about different factors that may contribute to your quality of life. On a scale of one to five, where one means "low importance" and five means "high importance," please rate the level of importance for the following services: Availability of job opportunities:

			Availability of job opportunities:					
			1	2	3	4	5	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	13	18	48	67	110	256
		% within Respondent Jurisdiction	5.1%	7.0%	18.8%	26.2%	43.0%	100.0%
	City of Las Vegas	Count	10	7	31	51	92	191
		% within Respondent Jurisdiction	5.2%	3.7%	16.2%	26.7%	48.2%	100.0%
	City of North Las Vegas	Count	2	3	10	15	37	67
		% within Respondent Jurisdiction	3.0%	4.5%	14.9%	22.4%	55.2%	100.0%
	City of Henderson	Count	3	5	18	13	27	66
		% within Respondent Jurisdiction	4.5%	7.6%	27.3%	19.7%	40.9%	100.0%
	Boulder City	Count	0	0	1	2	6	9
		% within Respondent Jurisdiction	.0%	.0%	11.1%	22.2%	66.7%	100.0%
	Mesquite	Count	0	0	2	0	1	3
		% within Respondent Jurisdiction	.0%	.0%	66.7%	.0%	33.3%	100.0%
Total		Count	28	33	110	148	273	592
		% within Respondent Jurisdiction	4.7%	5.6%	18.6%	25.0%	46.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.738(a)	20	.605
Likelihood Ratio	18.026	20	.586
Linear-by-Linear Association	.405	1	.524
N of Valid Cases	592		

Appendix III
Quality of Life Considerations Condition Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Now I'd like to ask you about different factors that may contribute to your quality of life. On a scale of one to five, where one means "low importance" and five means "high importance," please rate the level of importance for the following services: Managing growth:

			Managing growth:					Total
			1	2	3	4	5	
Respondent Jurisdiction	Unincorporated Clark County	Count	12	18	34	57	136	257
		% within Respondent Jurisdiction	4.7%	7.0%	13.2%	22.2%	52.9%	100.0%
	City of Las Vegas	Count	5	17	33	51	84	190
		% within Respondent Jurisdiction	2.6%	8.9%	17.4%	26.8%	44.2%	100.0%
	City of North Las Vegas	Count	2	6	15	10	35	68
		% within Respondent Jurisdiction	2.9%	8.8%	22.1%	14.7%	51.5%	100.0%
	City of Henderson	Count	4	4	20	8	31	67
		% within Respondent Jurisdiction	6.0%	6.0%	29.9%	11.9%	46.3%	100.0%
	Boulder City	Count	0	0	1	3	4	8
		% within Respondent Jurisdiction	.0%	.0%	12.5%	37.5%	50.0%	100.0%
	Mesquite	Count	0	0	2	0	1	3
		% within Respondent Jurisdiction	.0%	.0%	66.7%	.0%	33.3%	100.0%
Total		Count	23	45	105	129	291	593
		% within Respondent Jurisdiction	3.9%	7.6%	17.7%	21.8%	49.1%	100.0%

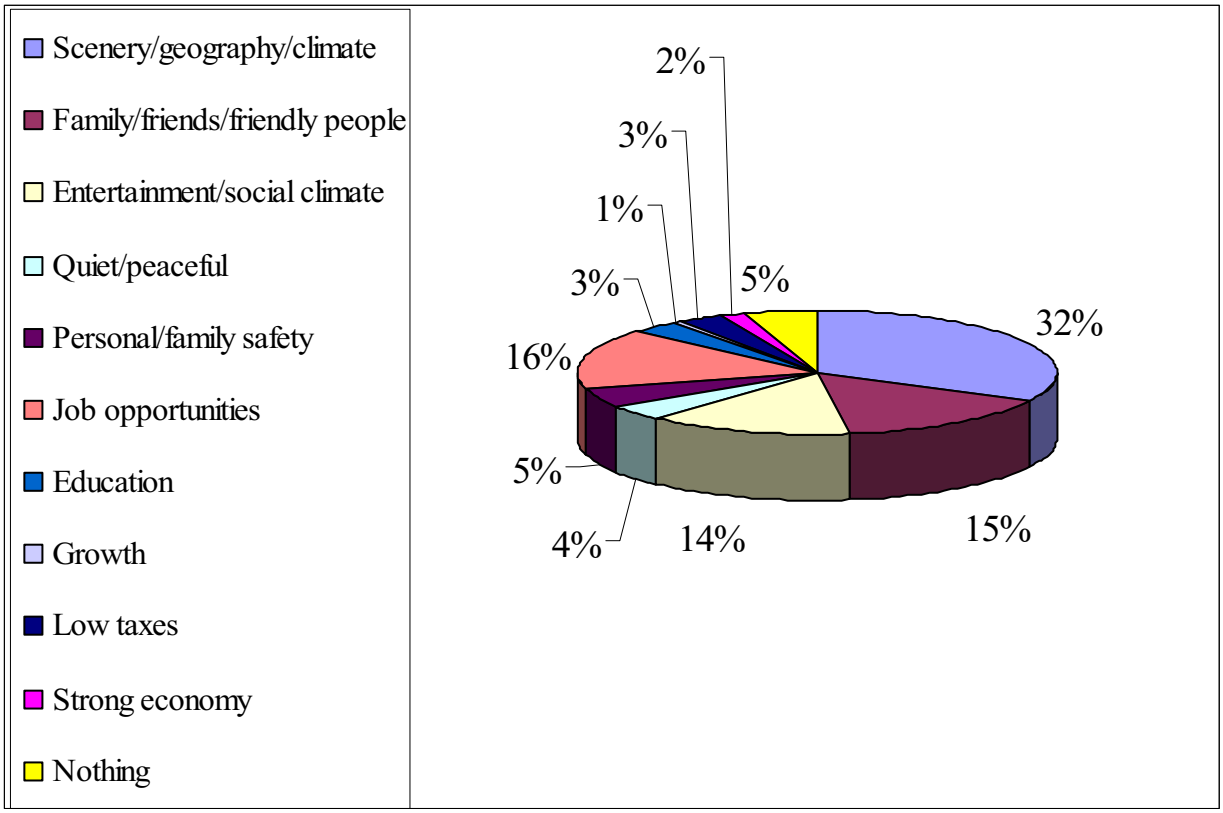
Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	28.102(a)	20	.107
Likelihood Ratio	28.066	20	.108
Linear-by-Linear Association	1.712	1	.191
N of Valid Cases	593		

Appendix III
Quality of Life Considerations Perception Measures

Generally speaking, what aspect of living in Clark County, if any, has the greatest positive impact on your quality of life?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Scenery/geography/climate	188	31.3	31.3	31.3
	Family/friends/friendly people	87	14.4	14.4	45.8
	Entertainment/social climate	80	13.3	13.3	59.1
	Quiet/peaceful	24	3.9	3.9	63.1
	Personal/family safety	27	4.5	4.5	67.5
	Job opportunities	90	15	15	82.5
	Education	19	3.2	3.2	85.7
	Growth	5	0.8	0.8	86.5
	Low taxes	17	2.8	2.8	89.3
	Strong economy	9	1.6	1.6	90.8
	Nothing	29	4.9	4.9	95.7
	DK/No answer	26	4.3	4.3	100
	Total	600	100	100	

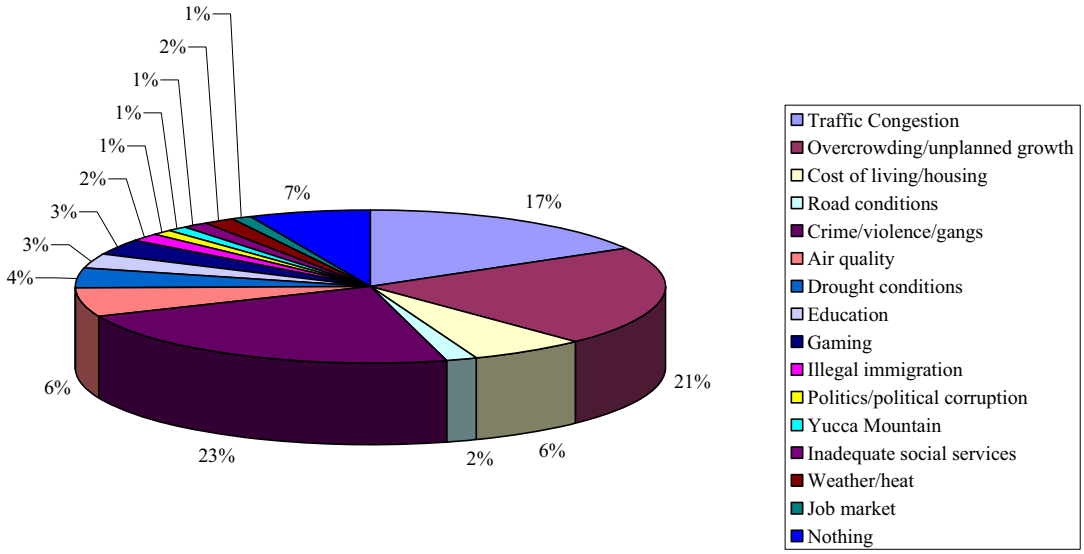


Note- Graph does not include Don't Know/ No Answer

Appendix III
Quality of Life Considerations Perception Measures

Generally speaking, what aspect of living in Clark County, if any, has the greatest negative impact on your quality of life?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Traffic Congestion	99	16.5	16.5	16.5
	Overcrowding/unplanned growth	125	20.8	20.8	37.3
	Cost of living/housing	39	6.5	6.5	43.8
	Road conditions	11	1.8	1.8	45.5
	Crime/violence/gangs	135	22.5	22.5	68.1
	Air quality	37	6.1	6.1	74.2
	Drought conditions	24	3.9	3.9	78.1
	Education	18	2.9	2.9	81
	Gaming	20	3.4	3.4	84.4
	Illegal immigration	10	1.7	1.7	86.2
	Politics/political corruption	7	1.2	1.2	87.3
	Yucca Mountain	6	1	1	88.3
	Inadequate social services	8	1.4	1.4	89.7
	Weather/heat	11	1.8	1.8	91.5
	Job market	6	1.1	1.1	92.6
	Nothing	39	6.5	6.5	99.1
	DK/No answer	6	0.9	0.9	100
	Total	600	100	100	

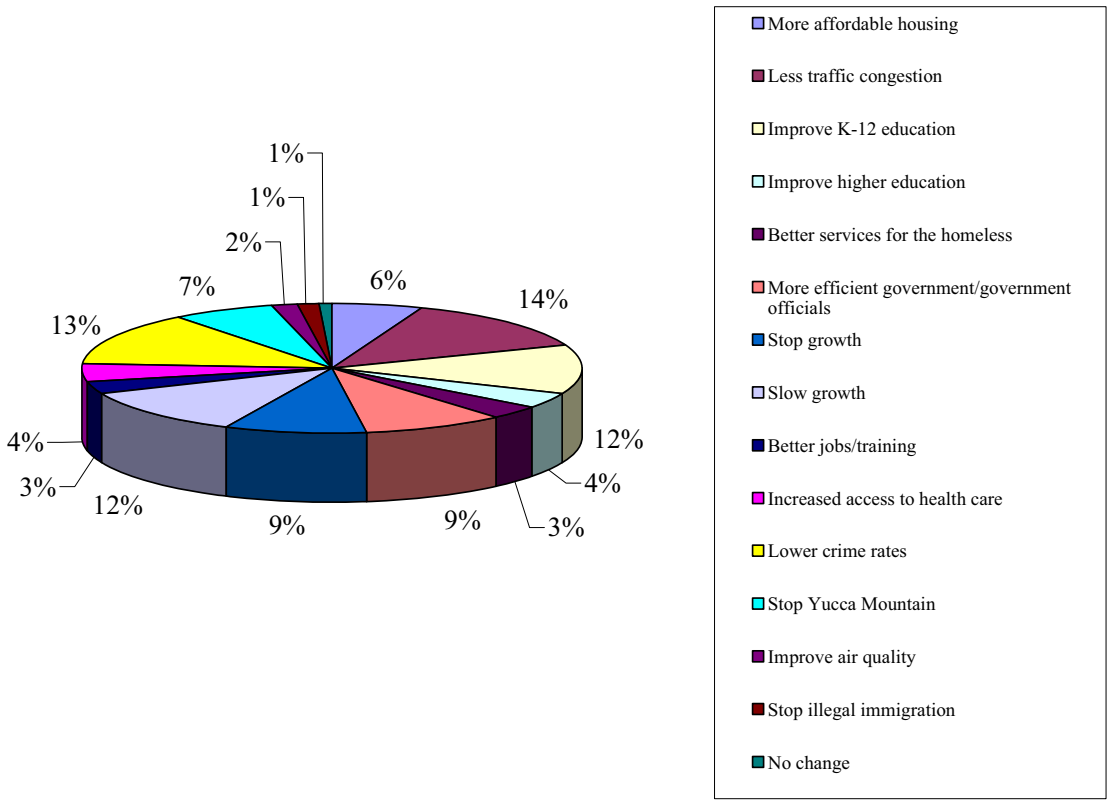


Note- Graph does not include Don't Know/ No Answer

Appendix III
Quality of Life Considerations Perception Measures

In thinking about all of the issues we have talked about today, if you could make one major change locally to improve the quality of life in Clark County, what would it be?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	More affordable housing	35	5.9	5.9	5.9
	Less traffic congestion	79	13.1	13.1	19
	Improve K-12 education	74	12.4	12.4	31.3
	Improve higher education	23	3.8	3.8	35.2
	Better services for the homeless	20	3.3	3.3	38.5
	More efficient government/government officials	54	9	9	47.4
	Stop growth	55	9.1	9.1	56.6
	Slow growth	71	11.8	11.8	68.4
	Better jobs/training	18	3	3	71.3
	Increased access to health care	26	4.4	4.4	75.7
	Lower crime rates	79	13.2	13.2	88.9
	Stop Yucca Mountain	40	6.7	6.7	95.6
	Improve air quality	11	1.8	1.8	97.4
	Stop illegal immigration	7	1.2	1.2	98.7
	No change	5	0.8	0.8	99.5
	DK/No answer	3	0.5	0.5	100
	Total	600	100	100	

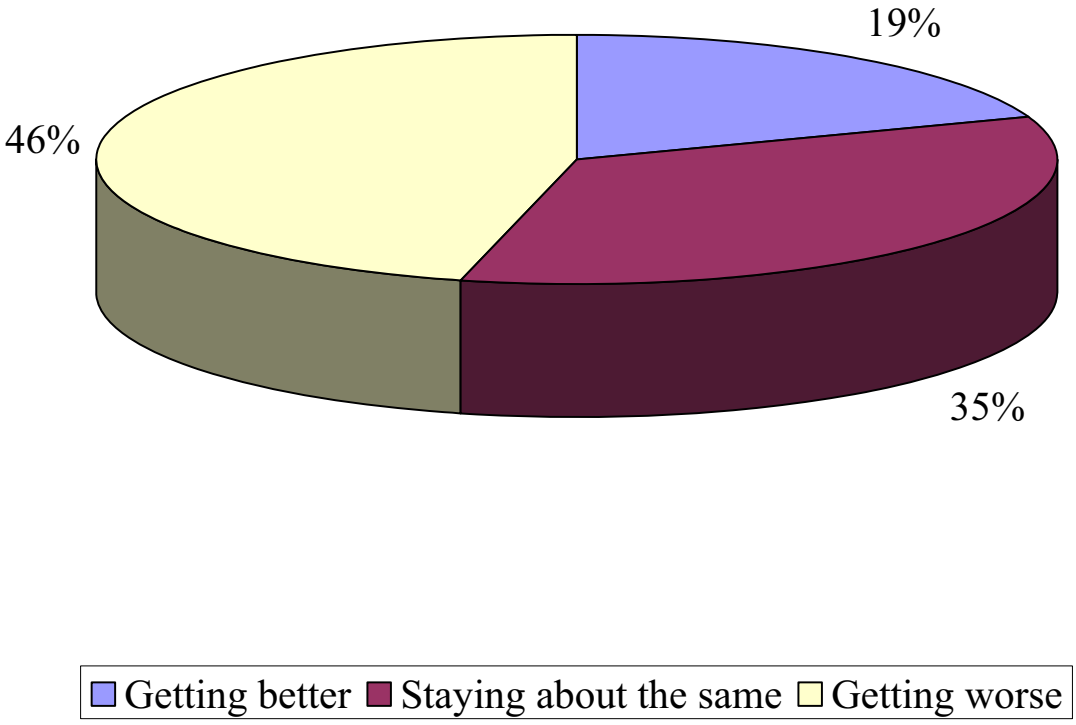


Note- Graph does not include Don't Know/ No Answer

Appendix III
Quality of Life Considerations Perception Measures

Overall would you say the quality of life in Clark County is getting better, worse, or staying the same?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Getting better	114	19.1	19.4	19.4
	Staying about the same	205	34.1	34.6	54
	Getting worse	272	45.3	46	100
	Total	591	98.6	100	
Missing	DK/No answer	9	1.4		
Total		600	100		



Note- Graph does not include Don't Know/ No Answer

Appendix III
Quality of Life Considerations Perception Measures
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Generally speaking, what aspect of living in Clark County, if any, has the greatest positive impact on your quality of life?

			Generally speaking, what aspect of living in Clark County, if any, has the greatest positive impact on your quality of life?											Total
			Scenery/ geography/ climate	Family/friends /friendly people	Entertainment/ social climate	Quiet/ peaceful	Personal/ family safety	Job opportunities	Education	Growth	Low taxes	Strong economy	Nothing	
Respondent Jurisdiction	Unincorporated Clark County	Count	90	40	29	11	11	35	6	3	8	2	12	247
		% within Respondent Jurisdiction	36.4%	16.2%	11.7%	4.5%	4.5%	14.2%	2.4%	1.2%	3.2%	.8%	4.9%	100.0%
	City of Las Vegas	Count	59	23	25	6	10	40	3	2	4	4	9	185
		% within Respondent Jurisdiction	31.9%	12.4%	13.5%	3.2%	5.4%	21.6%	1.6%	1.1%	2.2%	2.2%	4.9%	100.0%
	City of North Las Vegas	Count	12	15	15	4	3	5	5	0	3	2	2	66
		% within Respondent Jurisdiction	18.2%	22.7%	22.7%	6.1%	4.5%	7.6%	7.6%	.0%	4.5%	3.0%	3.0%	100.0%
	City of Henderson	Count	24	8	9	3	3	7	4	0	2	0	6	66
		% within Respondent Jurisdiction	36.4%	12.1%	13.6%	4.5%	4.5%	10.6%	6.1%	.0%	3.0%	.0%	9.1%	100.0%
	Boulder City	Count	1	0	1	0	0	2	0	0	1	2	0	7
		% within Respondent Jurisdiction	14.3%	.0%	14.3%	.0%	.0%	28.6%	.0%	.0%	14.3%	28.6%	.0%	100.0%
	Mesquite	Count	1	1	0	0	0	1	0	0	0	0	0	3
		% within Respondent Jurisdiction	33.3%	33.3%	.0%	.0%	.0%	33.3%	.0%	.0%	.0%	.0%	.0%	100.0%
Total		Count	187	87	79	24	27	90	18	5	18	10	29	574
		% within Respondent Jurisdiction	32.6%	15.2%	13.8%	4.2%	4.7%	15.7%	3.1%	.9%	3.1%	1.7%	5.1%	100.0%

Appendix III
Quality of Life Considerations Perception Measures
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Generally speaking, what aspect of living in Clark County, if any, has the greatest positive impact on your quality of life? (cont.)

Chi-Square Tests (cont.)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	77.818(a)	50	.007
Likelihood Ratio	59.278	50	.173
Linear-by-Linear Association	.449	1	.503
N of Valid Cases	574		

Appendix III
Quality of Life Considerations Perception Measures
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Generally speaking, what aspect of living in Clark County, if any, has the greatest negative impact on your quality of life?

			Generally speaking, what aspect of living in Clark County, if any, has the greatest negative impact on your quality of life?							
			Traffic Congestion	Overcrowding/ Unplanned growth	Cost of living/ housing	Road conditions	Crime/ violence/ gangs	Air quality	Drought conditions	Education
Respondent Jurisdiction	Unincorporated Clark County	Count	36	62	17	3	55	19	10	7
		% within Respondent Jurisdiction	14.00%	24.00%	6.60%	1.20%	21.30%	7.40%	3.90%	2.70%
	City of Las Vegas	Count	32	45	11	5	46	12	7	8
		% within Respondent Jurisdiction	16.80%	23.70%	5.80%	2.60%	24.20%	6.30%	3.70%	4.20%
	City of North Las Vegas	Count	14	9	3	2	21	0	2	3
		% within Respondent Jurisdiction	20.30%	13.00%	4.30%	2.90%	30.40%	0.00%	2.90%	4.30%
	City of Henderson	Count	16	9	6	1	12	4	4	0
		% within Respondent Jurisdiction	24.20%	13.60%	9.10%	1.50%	18.20%	6.10%	6.10%	0.00%
	Boulder City	Count	0	0	2	0	0	2	0	0
		% within Respondent Jurisdiction	0.00%	0.00%	22.20%	0.00%	0.00%	22.20%	0.00%	0.00%
	Mesquite	Count	0	0	0	0	1	0	0	0
		% within Respondent Jurisdiction	0.00%	0.00%	0.00%	0.00%	33.30%	0.00%	0.00%	0.00%
Total		Count	98	125	39	11	135	37	23	18
		% within Respondent Jurisdiction	16.50%	21.00%	6.60%	1.80%	22.70%	6.20%	3.90%	3.00%

Appendix III
Quality of Life Considerations Perception Measures
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Generally speaking, what aspect of living in Clark County, if any, has the greatest negative impact on your quality of life? (cont.)

			Generally speaking, what aspect of living in Clark County, if any, has the greatest negative impact on your quality of life?								
			Gaming	Illegal immigration	Politics/political corruption	Yucca Mountain	Inadequate social services	Weather/heat	Job market	Nothing	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	12	7	3	1	5	5	2	14	258
		% within Respondent Jurisdiction	4.70%	2.70%	1.20%	0.40%	1.90%	1.90%	0.80%	5.40%	100.00%
	City of Las Vegas	Count	5	2	2	3	1	2	2	7	190
		% within Respondent Jurisdiction	2.60%	1.10%	1.10%	1.60%	0.50%	1.10%	1.10%	3.70%	100.00%
	City of North Las Vegas	Count	0	0	0	0	3	3	3	6	69
		% within Respondent Jurisdiction	0.00%	0.00%	0.00%	0.00%	4.30%	4.30%	4.30%	8.70%	100.00%
	City of Henderson	Count	3	1	2	2	0	0	0	6	66
		% within Respondent Jurisdiction	4.50%	1.50%	3.00%	3.00%	0.00%	0.00%	0.00%	9.10%	100.00%
	Boulder City	Count	0	0	0	0	0	1	0	4	9
		% within Respondent Jurisdiction	0.00%	0.00%	0.00%	0.00%	0.00%	11.10%	0.00%	44.40%	100.00%
	Mesquite	Count	0	0	0	0	0	0	0	2	3
		% within Respondent Jurisdiction	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	66.70%	100.00%
Total		Count	20	10	7	6	9	11	7	39	595
		% within Respondent Jurisdiction	3.40%	1.70%	1.20%	1.00%	1.50%	1.80%	1.20%	6.60%	100.00%

Appendix III
Quality of Life Considerations Perception Measures
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Generally speaking, what aspect of living in Clark County, if any, has the greatest negative impact on your quality of life? (cont.)

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	118.214(a)	75	.001
Likelihood Ratio	109.251	75	.006
Linear-by-Linear Association	14.103	1	.000
N of Valid Cases	595		

Appendix III
Quality of Life Considerations Perception Measures
Jurisdictional Cross-tabulations

Respondent Jurisdiction * In thinking about all of the issues we have talked about today, if you could make one major change locally to improve the quality of life in Clark County, what would it be?

			In thinking about all of the issues we have talked about today, if you could make **one** major change locally to improve the quality of life in Clark County, what would it be?															Total
			More affordable housing	Less traffic congestion	Improve K-12 education	Improve higher education	Better services for the homeless	More efficient government/ government officials	Stop growth	Slow growth	Better jobs/ training	Increased access to health care	Lower crime rates	Stop Yucca Mountain	Improve air quality	Stop illegal immigration	No change	
Respondent Jurisdiction	Unincorporated Clark County	Count	14	33	36	6	9	24	27	38	5	10	30	15	5	5	2	259
		% within Respondent Jurisdiction	5.4%	12.7%	13.9%	2.3%	3.5%	9.3%	10.4%	14.7%	1.9%	3.9%	11.6%	5.8%	1.9%	1.9%	.8%	100.0%
	City of Las Vegas	Count	7	25	19	14	6	20	17	19	10	10	31	11	2	1	0	192
		% within Respondent Jurisdiction	3.6%	13.0%	9.9%	7.3%	3.1%	10.4%	8.9%	9.9%	5.2%	5.2%	16.1%	5.7%	1.0%	.5%	.0%	100.0%
	City of North Las Vegas	Count	7	9	12	0	5	4	2	4	0	4	8	7	4	0	2	68
		% within Respondent Jurisdiction	10.3%	13.2%	17.6%	.0%	7.4%	5.9%	2.9%	5.9%	.0%	5.9%	11.8%	10.3%	5.9%	.0%	2.9%	100.0%
	City of Henderson	Count	5	11	8	3	0	6	7	9	1	2	10	4	0	1	0	67
		% within Respondent Jurisdiction	7.5%	16.4%	11.9%	4.5%	.0%	9.0%	10.4%	13.4%	1.5%	3.0%	14.9%	6.0%	.0%	1.5%	.0%	100.0%
	Boulder City	Count	2	0	0	0	0	0	2	0	0	0	0	2	0	0	2	8
		% within Respondent Jurisdiction	25.0%	.0%	.0%	.0%	.0%	.0%	25.0%	.0%	.0%	.0%	.0%	25.0%	.0%	.0%	25.0%	100.0%
	Mesquite	Count	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	3
		% within Respondent Jurisdiction	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	66.7%	.0%	.0%	33.3%	.0%	.0%	.0%	100.0%
Total		Count	35	78	75	23	20	54	55	70	18	26	79	40	11	7	6	597
		% within Respondent Jurisdiction	5.9%	13.1%	12.6%	3.9%	3.4%	9.0%	9.2%	11.7%	3.0%	4.4%	13.2%	6.7%	1.8%	1.2%	1.0%	100.0%

Appendix III
Quality of Life Considerations Perception Measures
Jurisdictional Cross-tabulations

Respondent Jurisdiction * In thinking about all of the issues we have talked about today, if you could make one major change locally to improve the quality of life in Clark County, what would it be?

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	169.818(a)	70	.000
Likelihood Ratio	111.330	70	.001
Linear-by-Linear Association	4.579	1	.032
N of Valid Cases	597		

Appendix III
Quality of Life Considerations Perception Measures
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Overall would you say the quality of life in Clark County is getting better, worse, or staying the same?

			Overall would you say the quality of life in Clark County is getting better, worse, or staying the same?			
			Getting better	Staying about the same	Getting worse	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	44	78	133	255
		% within Respondent Jurisdiction	17.3%	30.6%	52.2%	100.0%
	City of Las Vegas	Count	38	76	78	192
		% within Respondent Jurisdiction	19.8%	39.6%	40.6%	100.0%
	City of North Las Vegas	Count	17	24	25	66
		% within Respondent Jurisdiction	25.8%	36.4%	37.9%	100.0%
	City of Henderson	Count	13	23	31	67
		% within Respondent Jurisdiction	19.4%	34.3%	46.3%	100.0%
	Boulder City	Count	0	3	4	7
		% within Respondent Jurisdiction	.0%	42.9%	57.1%	100.0%
	Mesquite	Count	1	1	2	4
		% within Respondent Jurisdiction	25.0%	25.0%	50.0%	100.0%
Total		Count	113	205	273	591
		% within Respondent Jurisdiction	19.1%	34.7%	46.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.739(a)	10	.378
Likelihood Ratio	11.958	10	.288
Linear-by-Linear Association	1.401	1	.237
N of Valid Cases	591		

Appendix IV

General Economic Considerations

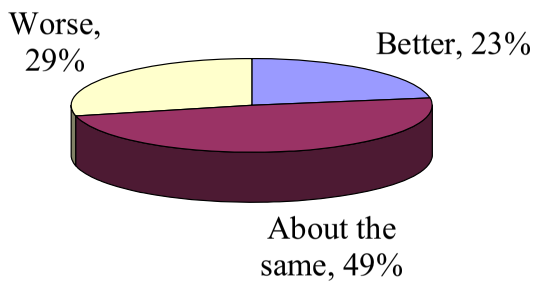
Appendix IV
General Economic Conditions Ratings
Summary Statistics

		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse, or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	593	587	584	585	591
	Missing	7	13	16	15	9
Mean		2.06	1.74	2.43	1.85	1.3
Std. Error of Mean		0.029	0.029	0.032	0.026	0.019
Median		2	2	2	2	1
Mode		2	2	2	2	1
Std. Deviation		0.714	0.711	0.781	0.631	0.459
Variance		0.51	0.506	0.61	0.398	0.211
Skewness		-0.09	0.415	0.052	0.126	0.873
Std. Error of Skewness		0.1	0.101	0.101	0.101	0.101
Kurtosis		-1.032	-0.96	-0.403	-0.555	-1.242
Std. Error of Kurtosis		0.2	0.201	0.202	0.202	0.201
Range		2	2	3	2	1
Minimum		1	1	1	1	1
Maximum		3	3	4	3	2

Appendix IV
General Economic Conditions

We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse of financially than you were a year ago, or about the same?

	Frequency	Valid Percent
Better	134	22.5
About the same	289	48.8
Worse	170	28.7
DK/No answer	7	1.1
Total	600	100

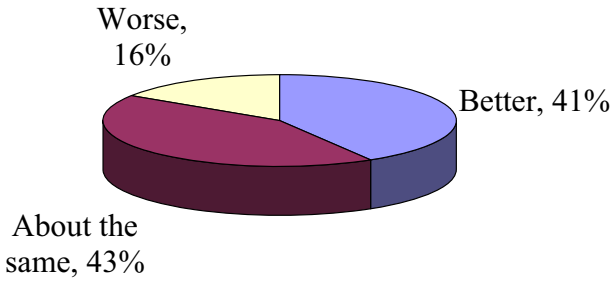


Note- Graph does not include Don't Know/ No Answer

Appendix IV
General Economic Conditions

Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?

		Frequency	Valid Percent
Valid	Better	242	40.4
	About the same	252	42.0
	Worse	92	15.4
	DK/No answer	13	2.2
	Total	600	100.0

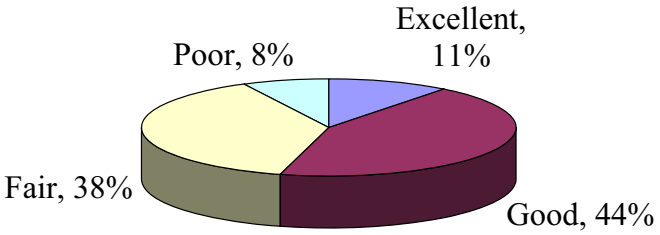


Note- Graph does not include Don't Know/ No Answer

Appendix IV
General Economic Conditions

Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?

	Frequency	Valid Percent
Excellent	62	10.6
Good	255	43.6
Fair	223	38.1
Poor	44	7.6
DK/No answer	16	2.6
Total	600	100

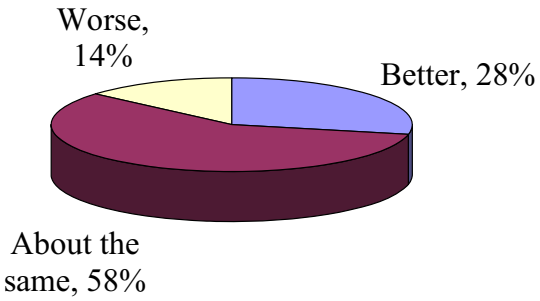


Note- Graph does not include Don't Know/ No Answer

Appendix IV
General Economic Conditions

And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?

	Frequency	Valid Percent
Better	166	28.3
About the same	340	58.1
Worse	80	13.6
DK/No answer	15	2.5
Total	600	100

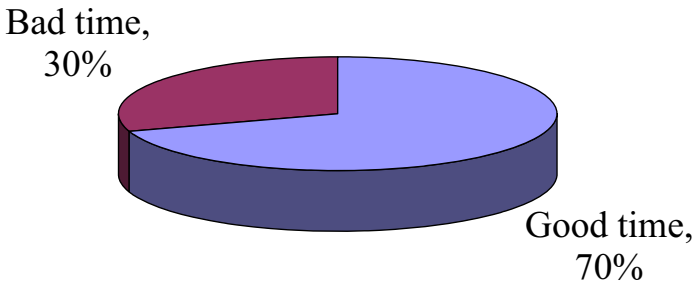


Note- Graph does not include Don't Know/ No Answer

Appendix IV
General Economic Conditions

Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?

		Frequency	Valid Percent
Valid	Good time	413	68.9
	Bad time	177	29.6
	DK/No answer	9	1.5
	Total	600	100.0



Note- Graph does not include Don't Know/ No Answer

Appendix IV
General Economic Conditions
Summary Statistic by Jurisdiction

Unincorporated Clark County		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse, or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	259	253	251	252	256
	Missing	2	7	9	8	4
Mean		2.09	1.8	2.45	1.86	1.33
Std. Error of Mean		0.045	0.046	0.053	0.04	0.03
Median		2	2	2	2	1
Mode		2	2	2	2	1
Std. Deviation		0.728	0.736	0.835	0.637	0.473
Variance		0.53	0.542	0.697	0.406	0.224
Skewness		-0.135	0.334	0.054	0.127	0.705
Std. Error of Skewness		0.151	0.153	0.154	0.153	0.152
Kurtosis		-1.097	-1.095	-0.549	-0.574	-1.515
Std. Error of Kurtosis		0.302	0.305	0.306	0.306	0.303
Range		2	2	3	2	1
Minimum		1	1	1	1	1
Maximum		3	3	4	3	2

Appendix IV
General Economic Conditions
Summary Statistic by Jurisdiction

City of Las Vegas		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse, or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	191	191	189	189	192
	Missing	2	2	4	4	1
Mean		2.09	1.69	2.43	1.89	1.28
Std. Error of Mean		0.05	0.049	0.056	0.044	0.032
Median		2	2	2	2	1
Mode		2	2	3	2	1
Std. Deviation		0.686	0.67	0.771	0.602	0.45
Variance		0.47	0.449	0.594	0.363	0.202
Skewness		-0.114	0.466	-0.089	0.049	0.994
Std. Error of Skewness		0.176	0.176	0.177	0.177	0.175
Kurtosis		-0.859	-0.761	-0.406	-0.28	-1.023
Std. Error of Kurtosis		0.35	0.35	0.352	0.352	0.349
Range		2	2	3	2	1
Minimum		1	1	1	1	1
Maximum		3	3	4	3	2

Appendix IV
General Economic Conditions
Summary Statistic by Jurisdiction

City of North Las Vegas		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse, or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	68	68	67	67	68
	Missing	0	0	0	0	0
Mean		1.99	1.57	2.23	1.73	1.3
Std. Error of Mean		0.093	0.081	0.094	0.084	0.056
Median		2	1	2	2	1
Mode		2	1	2	2	1
Std. Deviation		0.763	0.67	0.769	0.688	0.462
Variance		0.583	0.449	0.591	0.473	0.214
Skewness		0.017	0.777	0.208	0.402	0.884
Std. Error of Skewness		0.291	0.291	0.292	0.292	0.291
Kurtosis		-1.262	-0.476	-0.235	-0.824	-1.257
Std. Error of Kurtosis		0.575	0.575	0.577	0.577	0.575
Range		2	2	3	2	1
Minimum		1	1	1	1	1
Maximum		3	3	4	3	2

Appendix IV
General Economic Conditions
Summary Statistic by Jurisdiction

City of Henderson		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse, or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	65	64	65	66	65
	Missing	2	2	1	0	2
Mean		2.06	1.88	2.53	1.84	1.27
Std. Error of Mean		0.083	0.097	0.075	0.082	0.056
Median		2	2	2	2	1
Mode		2	2	2	2	1
Std. Deviation		0.668	0.774	0.603	0.664	0.447
Variance		0.446	0.599	0.364	0.441	0.2
Skewness		-0.071	0.209	0.657	0.183	1.065
Std. Error of Skewness		0.298	0.299	0.297	0.295	0.298
Kurtosis		-0.692	-1.287	-0.484	-0.702	-0.895
Std. Error of Kurtosis		0.588	0.591	0.586	0.582	0.588
Range		2	2	2	2	1
Minimum		1	1	2	1	1
Maximum		3	3	4	3	2

Appendix IV
General Economic Conditions
Summary Statistic by Jurisdiction

Boulder City		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse, or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	7	7	7	7	7
	Missing	2	2	2	2	2
Mean		1.41	1.63	2.35	1.84	1.07
Std. Error of Mean		0.248	0.195	0.243	0.156	0.108
Median		1	2	2	2	1
Mode		1	2	2	2	1
Std. Deviation		0.661	0.52	0.647	0.401	0.279
Variance		0.436	0.271	0.419	0.161	0.078
Skewness		1.542	-0.709	1.946	-2.409	4.413
Std. Error of Skewness		0.789	0.789	0.789	0.811	0.811
Kurtosis		2.577	-2.263	4.491	5.418	25.48
Std. Error of Kurtosis		1.575	1.575	1.575	1.637	1.637
Range		2	1	2	1	1
Minimum		1	1	2	1	1
Maximum		3	2	4	2	2

Appendix IV
General Economic Conditions
Summary Statistic by Jurisdiction

Mesquite		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse, or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	4	4	4	4	4
	Missing	0	0	0	0	0
Mean		1.48	2	2.52	1.88	1
Std. Error of Mean		0.293	0	0.293	0.191	0
Median		1.43	2	2.57	2	1
Mode		1	2	3	2	1
Std. Deviation		0.579	0	0.579	0.378	0
Variance		0.336	0	0.336	0.143	0
Skewness		0.127		-0.127	-4.126	
Std. Error of Skewness		1.028	1.028	1.028	1.028	1.028
Range		1	0	1	1	0
Minimum		1	2	2	1	1
Maximum		2	2	3	2	1

Appendix IV
General Economic Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse of financially than you were a year ago, or about the same?

		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?			Total
Respondent Jurisdiction		Better	About the same	Worse	
Unincorporated Clark County	Count	58	120	81	259
	% within Respondent Jurisdiction	22.40%	46.30%	31.30%	100.00%
City of Las Vegas	Count	37	100	54	191
	% within Respondent Jurisdiction	19.40%	52.40%	28.30%	100.00%
City of North Las Vegas	Count	20	29	19	68
	% within Respondent Jurisdiction	29.40%	42.60%	27.90%	100.00%
City of Henderson	Count	12	36	16	64
	% within Respondent Jurisdiction	18.80%	56.30%	25.00%	100.00%
Boulder City	Count	5	2	0	7
	% within Respondent Jurisdiction	71.40%	28.60%	0.00%	100.00%
Mesquite	Count	2	2	0	4
	% within Respondent Jurisdiction	50.00%	50.00%	0.00%	100.00%
	Count	134	289	170	593
Total	% within Respondent Jurisdiction	22.60%	48.70%	28.70%	100.00%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.172(a)	10	0.052
Likelihood Ratio	18.294	10	0.05
Linear-by-Linear Association	3.875	1	0.049
N of Valid Cases	593		

Appendix IV
General Economic Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?

		Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse, or about the same?			Total
Respondent Jurisdiction		Better	About the same	Worse	
Unincorporated Clark County	Count	99	107	48	254
	% within Respondent Jurisdiction	39.00%	42.10%	18.90%	100.00%
City of Las Vegas	Count	82	87	22	191
	% within Respondent Jurisdiction	42.90%	45.50%	11.50%	100.00%
City of North Las Vegas	Count	36	25	7	68
	% within Respondent Jurisdiction	52.90%	36.80%	10.30%	100.00%
City of Henderson	Count	23	25	16	64
	% within Respondent Jurisdiction	35.90%	39.10%	25.00%	100.00%
Boulder City	Count	3	4	0	7
	% within Respondent Jurisdiction	42.90%	57.10%	0.00%	100.00%
Mesquite	Count	0	4	0	4
	% within Respondent Jurisdiction	0.00%	100.00%	0.00%	100.00%
Total	Count	243	252	93	588
	% within Respondent Jurisdiction	41.30%	42.90%	15.80%	100.00%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.544(a)	10	0.034
Likelihood Ratio	21.752	10	0.016
Linear-by-Linear Association	0.113	1	0.737
N of Valid Cases	588		

Appendix IV
General Economic Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?

		Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?				Total
		Excellent	Good	Fair	Poor	
Respondent Jurisdiction						
Unincorporated Clark County	Count	31	103	93	26	253
	% within Respondent Jurisdiction	12.30%	40.70%	36.80%	10.30%	100.00%
City of Las Vegas	Count	21	77	79	12	189
	% within Respondent Jurisdiction	11.10%	40.70%	41.80%	6.30%	100.00%
City of North Las Vegas	Count	10	34	20	3	67
	% within Respondent Jurisdiction	14.90%	50.70%	29.90%	4.50%	100.00%
City of Henderson	Count	0	34	28	4	66
	% within Respondent Jurisdiction	0.00%	51.50%	42.40%	6.10%	100.00%
Boulder City	Count	0	5	2	0	7
	% within Respondent Jurisdiction	0.00%	71.40%	28.60%	0.00%	100.00%
Mesquite	Count	0	2	2	0	4
	% within Respondent Jurisdiction	0.00%	50.00%	50.00%	0.00%	100.00%
Total	Count	62	255	224	45	586
	% within Respondent Jurisdiction	10.60%	43.50%	38.20%	7.70%	100.00%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.167(a)	15	0.132
Likelihood Ratio	29.769	15	0.013
Linear-by-Linear Association	0.051	1	0.822
N of Valid Cases	586		

Appendix IV
General Economic Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?

		And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?			Total
		Better	About the same	Worse	
Respondent Jurisdiction					
Unincorporated Clark County	Count	71	145	36	252
	% within Respondent Jurisdiction	28.20%	57.50%	14.30%	100.00%
City of Las Vegas	Count	46	118	25	189
	% within Respondent Jurisdiction	24.30%	62.40%	13.20%	100.00%
City of North Las Vegas	Count	27	31	9	67
	% within Respondent Jurisdiction	40.30%	46.30%	13.40%	100.00%
City of Henderson	Count	20	36	10	66
	% within Respondent Jurisdiction	30.30%	54.50%	15.20%	100.00%
Boulder City	Count	1	6	0	7
	% within Respondent Jurisdiction	14.30%	85.70%	0.00%	100.00%
Mesquite	Count	0	3	0	3
	% within Respondent Jurisdiction	0.00%	100.00%	0.00%	100.00%
Total	Count	165	339	80	584
	% within Respondent Jurisdiction	28.30%	58.00%	13.70%	100.00%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.676(a)	10	0.307
Likelihood Ratio	13.466	10	0.199
Linear-by-Linear Association	0.287	1	0.592
N of Valid Cases	584		

Appendix IV
General Economic Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?

		Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?		Total
		Good time	Bad time	
Respondent Jurisdiction				
Unincorporated Clark County	Count	170	86	256
	% within Respondent Jurisdiction	66.40%	33.60%	100.00%
City of Las Vegas	Count	138	54	192
	% within Respondent Jurisdiction	71.90%	28.10%	100.00%
City of North Las Vegas	Count	47	20	67
	% within Respondent Jurisdiction	70.10%	29.90%	100.00%
City of Henderson	Count	47	17	64
	% within Respondent Jurisdiction	73.40%	26.60%	100.00%
Boulder City	Count	6	0	6
	% within Respondent Jurisdiction	100.00%	0.00%	100.00%
Mesquite	Count	4	0	4
	% within Respondent Jurisdiction	100.00%	0.00%	100.00%
Total	Count	412	177	589
	% within Respondent Jurisdiction	69.90%	30.10%	100.00%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.535(a)	5	0.258
Likelihood Ratio	9.369	5	0.095
Linear-by-Linear Association	3.895	1	0.048
N of Valid Cases	589		

Appendix V

Property Value Considerations

Appendix V
Property Value Conditions
(Summary Statistics)

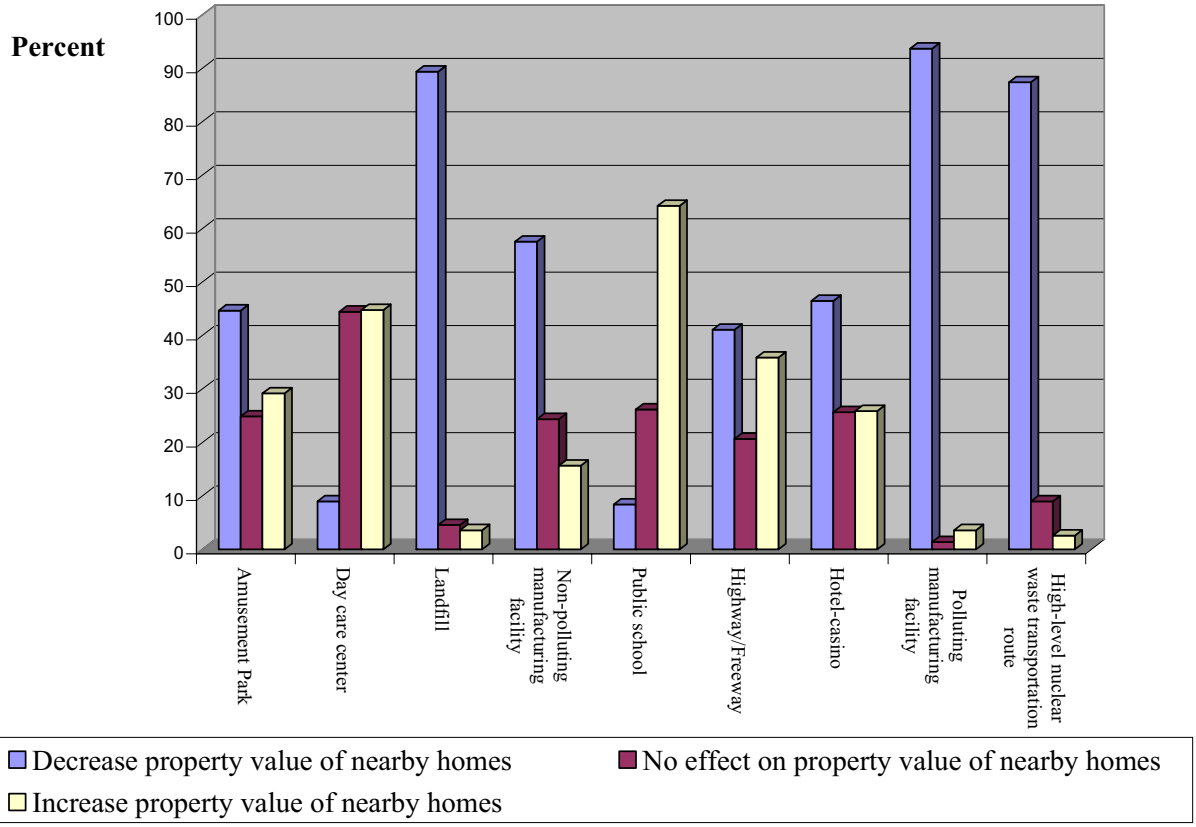
"Now I am going to read you a list of things that may or may not affect the value of residential (homes) property in Clark County. For each item please tell me whether you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes."

		Amusement Park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/Freeway	Hotel-casino	Polluting manufacturing facility	High-level nuclear waste transportation route
N	Valid	593	589	585	586	593	586	588	592	594
	Missing	7	10	15	14	7	14	12	8	6
Mean		1.84	2.36	1.12	1.57	2.57	1.95	1.79	1.09	1.14
Std. Error of Mean		0.035	0.027	0.018	0.031	0.026	0.037	0.034	0.016	0.017
Median		2	2	1	1	3	2	2	1	1
Mode		1	3	1	1	3	1	1	1	1
Std. Deviation		0.851	0.645	0.423	0.753	0.645	0.887	0.834	0.39	0.42
Skewness		0.304	-0.515	3.626	0.891	-1.199	0.103	0.411	4.483	3.036
Std. Error of Skewness		0.1	0.101	0.101	0.101	0.1	0.101	0.101	0.1	0.1
Kurtosis		-1.555	-0.673	12.292	-0.685	0.259	-1.723	-1.442	18.719	8.812
Std. Error of Kurtosis		0.2	0.201	0.202	0.202	0.2	0.202	0.201	0.201	0.2
Minimum		1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	3	3

Appendix V
Property Value Conditions

"Now I am going to read you a list of things that may or may not affect the value of residential (homes) property in Clark County. For each item please tell me whether you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes."

	Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	DK/No answer	Total
Amusement Park	44.7	24.9	29.2	1.2	100
Day care center	9	44.5	44.8	1.7	100
Landfill	89.4	4.6	3.6	2.4	100
Non-polluting manufacturing facility	57.6	24.4	15.7	2.3	100
Public school	8.4	26.2	64.3	1.1	100
Highway/Freeway	41.1	20.7	35.9	2.3	100
Hotel-casino	46.5	25.7	25.9	1.9	100
Polluting manufacturing facility	93.7	1.4	3.6	1.3	100
High-level nuclear waste transportation route	87.4	9	2.6	1	100



Note- Graph does not include Don't Know/ No Answer

Appendix V
Property Value Conditions
Summary Statistic by Jurisdiction

Unincorporated Clark County		Amusement Park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/Freeway	Hotel-casino	Polluting manufacturing facility	High-level nuclear waste transportation route
N	Valid	256	257	254	254	257	257	256	256	258
	Missing	4	4	6	7	3	4	4	4	2
Mean		1.91	2.42	1.12	1.6	2.62	1.96	1.72	1.08	1.15
Std. Error of Mean		0.053	0.042	0.027	0.049	0.039	0.055	0.051	0.024	0.028
Median		2	3	1	1	3	2	1	1	1
Mode		1	3	1	1	3	1	1	1	1
Std. Deviation		0.854	0.665	0.435	0.787	0.631	0.874	0.818	0.378	0.453
Skewness		0.181	-0.733	3.775	0.83	-1.419	0.072	0.553	4.793	3.046
Std. Error of Skewness		0.152	0.152	0.153	0.153	0.152	0.152	0.152	0.152	0.152
Kurtosis		-1.608	-0.547	13.074	-0.889	0.825	-1.693	-1.289	21.485	8.569
Std. Error of Kurtosis		0.303	0.303	0.304	0.305	0.303	0.303	0.303	0.303	0.302
Range		2	2	2	2	2	2	2	2	2
Minimum		1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	3	3
Sum		488	622	283	407	673	504	440	276	297

Appendix V
Property Value Conditions
Summary Statistic by Jurisdiction

City of Las Vegas		Amusement Park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/Freeway	Hotel-casino	Polluting manufacturing facility	High-level nuclear waste transportation route
N	Valid	192	189	189	190	193	190	190	191	192
	Missing	1	4	4	3	0	2	3	2	1
Mean		1.77	2.27	1.09	1.53	2.49	2.02	1.91	1.1	1.14
Std. Error of Mean		0.06	0.045	0.026	0.053	0.048	0.064	0.061	0.03	0.029
Median		2	2	1	1	3	2	2	1	1
Mode		1	2	1	1	3	3	1	1	1
Std. Deviation		0.834	0.622	0.352	0.723	0.665	0.887	0.84	0.411	0.402
Skewness		0.46	-0.265	4.183	0.972	-0.947	-0.036	0.178	4.241	3.046
Std. Error of Skewness		0.175	0.177	0.177	0.177	0.175	0.176	0.177	0.176	0.175
Kurtosis		-1.412	-0.622	17.717	-0.439	-0.257	-1.736	-1.563	16.662	9.111
Std. Error of Kurtosis		0.349	0.351	0.352	0.351	0.349	0.35	0.351	0.35	0.349
Range		2	2	2	2	2	2	2	2	2
Minimum		1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	3	3
Sum		339	431	206	291	479	384	361	209	218

Appendix V
Property Value Conditions
Summary Statistic by Jurisdiction

City of North Las Vegas		Amusement Park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/Freeway	Hotel-casino	Polluting manufacturing facility	High-level nuclear waste transportation route
N	Valid	68	67	65	68	68	64	68	68	68
	Missing	0	1	3	0	0	4	0	0	0
Mean		2.08	2.52	1.21	1.59	2.67	1.73	1.91	1.15	1.11
Std. Error of Mean		0.113	0.076	0.068	0.095	0.071	0.118	0.111	0.061	0.047
Median		2	3	1	1	3	1	2	1	1
Mode		3	3	1	1	3	1	1	1	1
Std. Deviation		0.932	0.617	0.544	0.786	0.586	0.942	0.915	0.506	0.385
Skewness		-0.153	-0.928	2.604	0.865	-1.647	0.565	0.187	3.316	3.634
Std. Error of Skewness		0.291	0.294	0.298	0.291	0.291	0.299	0.291	0.291	0.291
Kurtosis		-1.863	-0.116	5.685	-0.82	1.735	-1.663	-1.807	9.622	13.497
Std. Error of Kurtosis		0.575	0.58	0.587	0.575	0.575	0.59	0.575	0.575	0.575
Range		2	2	2	2	2	2	2	2	2
Minimum		1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	3	3
Sum		140	168	78	108	181	111	129	78	75

Appendix V
Property Value Conditions
Summary Statistic by Jurisdiction

City of Henderson		Amusement Park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/Freeway	Hotel-casino	Polluting manufacturing facility	High-level nuclear waste transportation route
N	Valid	66	66	66	64	66	63	64	66	65
	Missing	0	0	0	2	0	3	2	0	1
Mean		1.62	2.25	1.14	1.57	2.45	1.89	1.61	1.04	1.17
Std. Error of Mean		0.093	0.076	0.052	0.086	0.085	0.109	0.093	0.03	0.05
Median		1	2	1	1	3	2	1	1	1
Mode		1	2	1	1	3	1	1	1	1
Std. Deviation		0.756	0.617	0.426	0.691	0.688	0.865	0.745	0.24	0.4
Skewness		0.78	-0.209	3.31	0.8	-0.853	0.213	0.777	6.022	2.121
Std. Error of Skewness		0.295	0.295	0.295	0.299	0.295	0.3	0.299	0.295	0.297
Kurtosis		-0.811	-0.534	10.788	-0.519	-0.442	-1.644	-0.768	40.236	3.637
Std. Error of Kurtosis		0.582	0.582	0.582	0.59	0.582	0.593	0.591	0.582	0.586
Range		2	2	2	2	2	2	2	2	2
Minimum		1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	3	3
Sum		107	149	75	101	162	120	103	69	76

Appendix V
Property Value Conditions
Summary Statistic by Jurisdiction

Boulder City		Amusement Park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/Freeway	Hotel-casino	Polluting manufacturing facility	High-level nuclear waste transportation route
N	Valid	7	7	7	7	6	7	7	7	7
	Missing	2	2	2	2	3	2	2	2	2
Mean		1.41	2	1.07	1.26	3	1.89	1.5	1	1.07
Std. Error of Mean		0.248	0.241	0.101	0.232	0	0.389	0.335	0	0.101
Median		1	2	1	1	3	1.77	1	1	1
Mode		1	2	1	1	3	1	1	1	1
Std. Deviation		0.661	0.619	0.268	0.617	0	1.036	0.894	0	0.268
Skewness		1.542	0	4.503	2.646		0.274	1.474		4.503
Std. Error of Skewness		0.789	0.811	0.789	0.789	0.872	0.789	0.789	0.789	0.789
Kurtosis		2.577	2.187	25.799	8.859		-2.698	0.409		25.799
Std. Error of Kurtosis		1.575	1.637	1.575	1.575	1.833	1.575	1.575	1.575	1.575
Range		2	2	1	2	0	2	2	0	1
Minimum		1	1	1	1	3	1	1	1	1
Maximum		3	3	2	3	3	3	3	1	2
Sum		10	13	8	9	17	13	11	7	8

Appendix V
Property Value Conditions
Summary Statistic by Jurisdiction

Mesquite		Amusement Park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/Freeway	Hotel-casino	Polluting manufacturing facility	High-level nuclear waste transportation route
N	Valid	4	4	4	4	4	4	4	4	4
	Missing	0	0	0	0	0	0	0	0	0
Mean		2.12	2.48	1.24	1.36	2.48	2	1.88	1	1
Std. Error of Mean		0.346	0.293	0.382	0.403	0.293	0.408	0.346	0	0
Median		2	2.43	1	1	2.43	2	2	1	1
Mode		2	2	1	1	2	2	2	1	1
Std. Deviation		0.683	0.579	0.755	0.797	0.579	0.805	0.683	0	0
Skewness		-0.058	0.127	4.126	2.87	0.127	0	0.058		
Std. Error of Skewness		1.028	1.028	1.028	1.028	1.028	1.028	1.028	1.028	1.028
Range		2	1	2	2	1	2	2	0	0
Minimum		1	2	1	1	2	1	1	1	1
Maximum		3	3	3	3	3	3	3	1	1
Sum		8	10	5	5	10	8	7	4	4

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Amusement Park

			Amusement Park:			Total
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Respondent Jurisdiction	Unincorporated Clark County	Count	106	68	82	256
		% within Respondent Jurisdiction	41.4%	26.6%	32.0%	100.0%
	City of Las Vegas	Count	94	49	49	192
		% within Respondent Jurisdiction	49.0%	25.5%	25.5%	100.0%
	City of North Las Vegas	Count	27	9	32	68
		% within Respondent Jurisdiction	39.7%	13.2%	47.1%	100.0%
	City of Henderson	Count	36	19	11	66
		% within Respondent Jurisdiction	54.5%	28.8%	16.7%	100.0%
	Boulder City	Count	5	2	0	7
		% within Respondent Jurisdiction	71.4%	28.6%	.0%	100.0%
	Mesquite	Count	0	2	1	3
		% within Respondent Jurisdiction	.0%	66.7%	33.3%	100.0%
Total		Count	268	149	175	592
		% within Respondent Jurisdiction	45.3%	25.2%	29.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.467(a)	10	.003
Likelihood Ratio	29.489	10	.001
Linear-by-Linear Association	2.506	1	.113
N of Valid Cases	592		

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Day care center

			Day care center:			Total
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Respondent Jurisdiction	Unincorporated Clark County	Count	25	97	134	256
		% within Respondent Jurisdiction	9.8%	37.9%	52.3%	100.0%
	City of Las Vegas	Count	18	102	70	190
		% within Respondent Jurisdiction	9.5%	53.7%	36.8%	100.0%
	City of North Las Vegas	Count	4	23	39	66
		% within Respondent Jurisdiction	6.1%	34.8%	59.1%	100.0%
	City of Henderson	Count	6	37	23	66
		% within Respondent Jurisdiction	9.1%	56.1%	34.8%	100.0%
	Boulder City	Count	1	4	1	6
		% within Respondent Jurisdiction	16.7%	66.7%	16.7%	100.0%
	Mesquite	Count	0	2	2	4
		% within Respondent Jurisdiction	.0%	50.0%	50.0%	100.0%
Total		Count	54	265	269	588
		% within Respondent Jurisdiction	9.2%	45.1%	45.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.680(a)	10	.012
Likelihood Ratio	23.403	10	.009
Linear-by-Linear Association	1.843	1	.175
N of Valid Cases	588		

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Landfill

			Landfill:			Total
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Respondent Jurisdiction	Unincorporated Clark County	Count	235	8	11	254
		% within Respondent Jurisdiction	92.5%	3.1%	4.3%	100.0%
	City of Las Vegas	Count	176	9	4	189
		% within Respondent Jurisdiction	93.1%	4.8%	2.1%	100.0%
	City of North Las Vegas	Count	56	5	4	65
		% within Respondent Jurisdiction	86.2%	7.7%	6.2%	100.0%
	City of Henderson	Count	59	5	2	66
		% within Respondent Jurisdiction	89.4%	7.6%	3.0%	100.0%
	Boulder City	Count	7	0	0	7
		% within Respondent Jurisdiction	100.0%	.0%	.0%	100.0%
	Mesquite	Count	3	0	0	3
		% within Respondent Jurisdiction	100.0%	.0%	.0%	100.0%
Total		Count	536	27	21	584
		% within Respondent Jurisdiction	91.8%	4.6%	3.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.756(a)	10	.653
Likelihood Ratio	8.278	10	.602
Linear-by-Linear Association	.120	1	.729
N of Valid Cases	584		

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Non-polluting manufacturing facility

			Non-polluting manufacturing facility:			
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	148	57	48	253
		% within Respondent Jurisdiction	58.5%	22.5%	19.0%	100.0%
	City of Las Vegas	Count	114	50	26	190
		% within Respondent Jurisdiction	60.0%	26.3%	13.7%	100.0%
	City of North Las Vegas	Count	40	15	12	67
		% within Respondent Jurisdiction	59.7%	22.4%	17.9%	100.0%
	City of Henderson	Count	35	22	7	64
		% within Respondent Jurisdiction	54.7%	34.4%	10.9%	100.0%
	Boulder City	Count	6	1	0	7
		% within Respondent Jurisdiction	85.7%	14.3%	.0%	100.0%
	Mesquite	Count	3	0	0	3
		% within Respondent Jurisdiction	100.0%	.0%	.0%	100.0%
Total		Count	346	145	93	584
		% within Respondent Jurisdiction	59.2%	24.8%	15.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.046(a)	10	.354
Likelihood Ratio	13.028	10	.222
Linear-by-Linear Association	1.591	1	.207
N of Valid Cases	584		

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Public school

			Public school:			Total
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Respondent Jurisdiction	Unincorporated Clark County	Count	21	57	179	257
		% within Respondent Jurisdiction	8.2%	22.2%	69.6%	100.0%
	City of Las Vegas	Count	18	62	113	193
		% within Respondent Jurisdiction	9.3%	32.1%	58.5%	100.0%
	City of North Las Vegas	Count	4	14	50	68
		% within Respondent Jurisdiction	5.9%	20.6%	73.5%	100.0%
	City of Henderson	Count	7	22	37	66
		% within Respondent Jurisdiction	10.6%	33.3%	56.1%	100.0%
	Boulder City	Count	0	0	6	6
		% within Respondent Jurisdiction	.0%	.0%	100.0%	100.0%
	Mesquite	Count	0	2	2	4
		% within Respondent Jurisdiction	.0%	50.0%	50.0%	100.0%
Total		Count	50	157	387	594
		% within Respondent Jurisdiction	8.4%	26.4%	65.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.482(a)	10	.115
Likelihood Ratio	17.585	10	.062
Linear-by-Linear Association	.573	1	.449
N of Valid Cases	594		

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Highway/freeway

			Highway/Freeway:			Total
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Respondent Jurisdiction	Unincorporated Clark County	Count	103	61	93	257
		% within Respondent Jurisdiction	40.1%	23.7%	36.2%	100.0%
	City of Las Vegas	Count	73	41	76	190
		% within Respondent Jurisdiction	38.4%	21.6%	40.0%	100.0%
	City of North Las Vegas	Count	39	4	22	65
		% within Respondent Jurisdiction	60.0%	6.2%	33.8%	100.0%
	City of Henderson	Count	27	16	20	63
		% within Respondent Jurisdiction	42.9%	25.4%	31.7%	100.0%
	Boulder City	Count	4	0	3	7
		% within Respondent Jurisdiction	57.1%	.0%	42.9%	100.0%
	Mesquite	Count	1	2	1	4
		% within Respondent Jurisdiction	25.0%	50.0%	25.0%	100.0%
Total		Count	247	124	215	586
		% within Respondent Jurisdiction	42.2%	21.2%	36.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.158(a)	10	.038
Likelihood Ratio	22.328	10	.014
Linear-by-Linear Association	1.189	1	.275
N of Valid Cases	586		

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Hotel-casino

			Hotel-casino:			Total
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Respondent Jurisdiction	Unincorporated Clark County	Count	131	65	60	256
		% within Respondent Jurisdiction	51.2%	25.4%	23.4%	100.0%
	City of Las Vegas	Count	76	55	59	190
		% within Respondent Jurisdiction	40.0%	28.9%	31.1%	100.0%
	City of North Las Vegas	Count	31	11	25	67
		% within Respondent Jurisdiction	46.3%	16.4%	37.3%	100.0%
	City of Henderson	Count	35	19	10	64
		% within Respondent Jurisdiction	54.7%	29.7%	15.6%	100.0%
	Boulder City	Count	5	0	2	7
		% within Respondent Jurisdiction	71.4%	.0%	28.6%	100.0%
	Mesquite	Count	1	2	0	3
		% within Respondent Jurisdiction	33.3%	66.7%	.0%	100.0%
Total		Count	279	152	156	587
		% within Respondent Jurisdiction	47.5%	25.9%	26.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.772(a)	10	.023
Likelihood Ratio	23.228	10	.010
Linear-by-Linear Association	.031	1	.860
N of Valid Cases	587		

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Polluting manufacturing facility

			Polluting manufacturing facility:			Total
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Respondent Jurisdiction	Unincorporated Clark County	Count	245	2	9	256
		% within Respondent Jurisdiction	95.7%	.8%	3.5%	100.0%
	City of Las Vegas	Count	180	3	8	191
		% within Respondent Jurisdiction	94.2%	1.6%	4.2%	100.0%
	City of North Las Vegas	Count	62	2	4	68
		% within Respondent Jurisdiction	91.2%	2.9%	5.9%	100.0%
	City of Henderson	Count	64	2	0	66
		% within Respondent Jurisdiction	97.0%	3.0%	.0%	100.0%
	Boulder City	Count	7	0	0	7
		% within Respondent Jurisdiction	100.0%	.0%	.0%	100.0%
	Mesquite	Count	4	0	0	4
		% within Respondent Jurisdiction	100.0%	.0%	.0%	100.0%
Total		Count	562	9	21	592
		% within Respondent Jurisdiction	94.9%	1.5%	3.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.167(a)	10	.710
Likelihood Ratio	9.661	10	.471
Linear-by-Linear Association	.178	1	.673
N of Valid Cases	592		

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: High level nuclear waste transportation route

			High-level nuclear waste transportation route:			
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	228	20	10	258
		% within Respondent Jurisdiction	88.4%	7.8%	3.9%	100.0%
	City of Las Vegas	Count	170	18	4	192
		% within Respondent Jurisdiction	88.5%	9.4%	2.1%	100.0%
	City of North Las Vegas	Count	62	5	2	69
		% within Respondent Jurisdiction	89.9%	7.2%	2.9%	100.0%
	City of Henderson	Count	54	10	0	64
		% within Respondent Jurisdiction	84.4%	15.6%	.0%	100.0%
	Boulder City	Count	7	0	0	7
		% within Respondent Jurisdiction	100.0%	.0%	.0%	100.0%
	Mesquite	Count	4	0	0	4
		% within Respondent Jurisdiction	100.0%	.0%	.0%	100.0%
Total		Count	525	53	16	594
		% within Respondent Jurisdiction	88.4%	8.9%	2.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.798(a)	10	.551
Likelihood Ratio	11.093	10	.350
Linear-by-Linear Association	.457	1	.499
N of Valid Cases	594		

Appendix VI

Environmental Considerations

Appendix VI
Environmental Considerations Condition Ratings
Summary Statistics

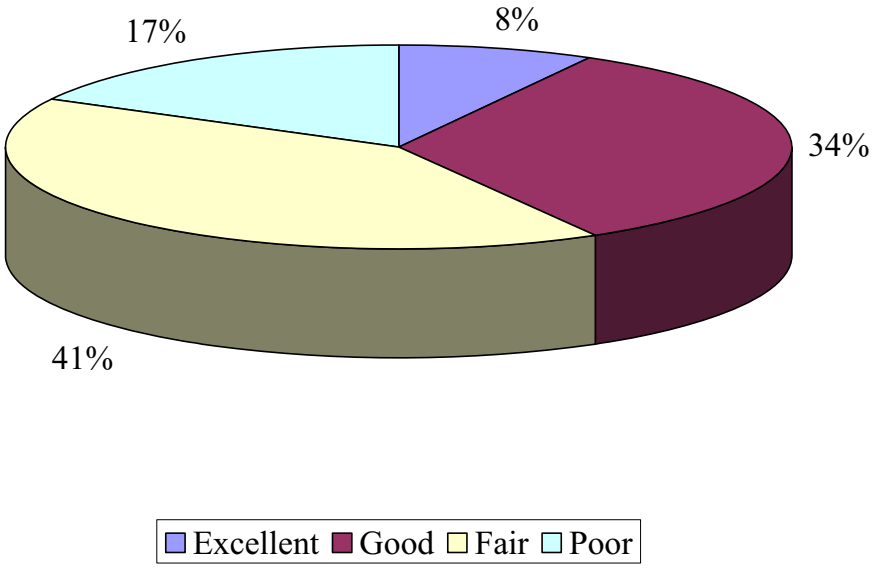
		How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	589	597	590	599
	Missing	10	2	9	0
Mean		2.68	1.52	2.95	2.82
Std. Error of Mean		.035	.030	.038	.031
Median		3.00	1.00	3.00	3.00
Mode		3	1	3	3
Std. Deviation		.852	.721	.931	.758
Skewness		-.114	1.535	-.436	-.033
Std. Error of Skewness		.101	.100	.101	.100
Kurtosis		-.634	2.450	-.797	-.623
Std. Error of Kurtosis		.201	.200	.201	.199
Range		3	3	3	3
Minimum		1	1	1	1
Maximum		4	4	4	4

Appendix VI
Environmental Considerations Condition Ratings

How would you rate local government's performance in preserving natural areas within Clark County?

		Frequency	Valid Percent
Valid	Excellent	48	8
	Good	197	32.9
	Fair	243	40.5
	Poor	101	16.9
	DK/No answer	10	1.7
	Total	600	100

Preserving Natural Areas



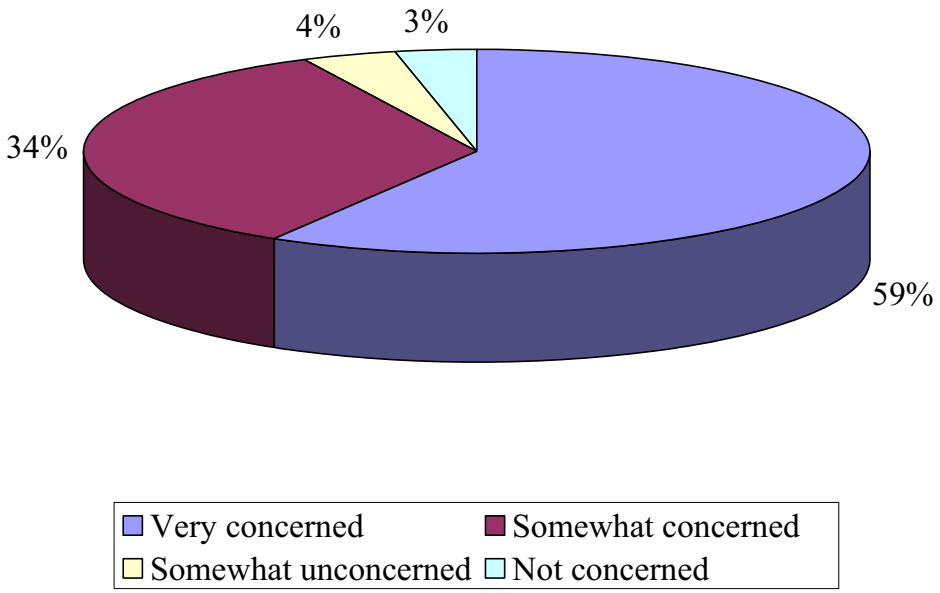
Note- Graph does not include Don't Know/ No Answer

Appendix VI
Environmental Considerations Condition Ratings

Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?

		Frequency	Valid Percent
Valid	Very concerned	349	58.3
	Somewhat concerned	205	34.2
	Somewhat unconcerned	23	3.9
	Not concerned	19	3.2
	DK/No answer	2	0.4
	Total	600	100

Drought



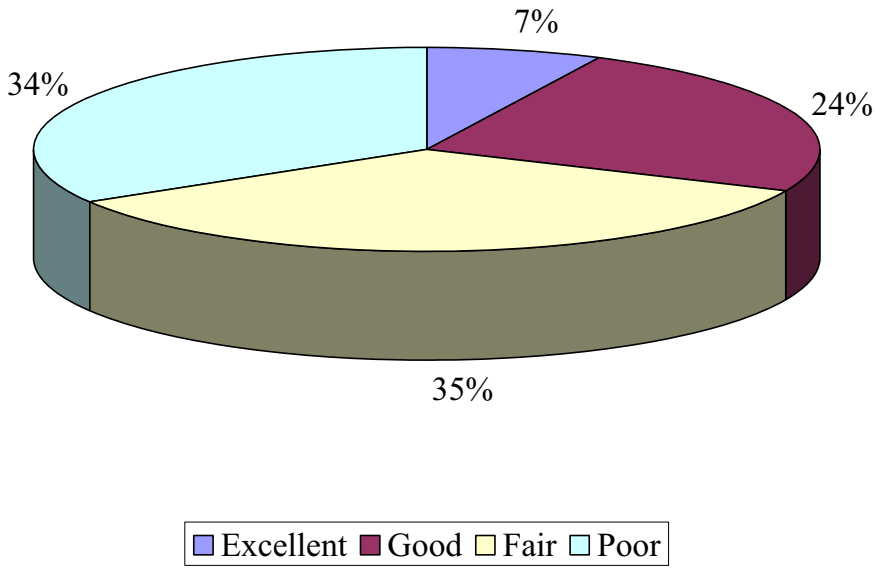
Note- Graph does not include Don't Know/ No Answer

Appendix VI
Environmental Considerations Condition Ratings

In general, how would you rate the quality of Clark County's drinking water?

		Frequency	Valid Percent
Valid	Excellent	42	7.1
	Good	144	24
	Fair	206	34.3
	Poor	199	33.1
	DK/No answer	9	1.5
	Total	600	100

Drinking Water



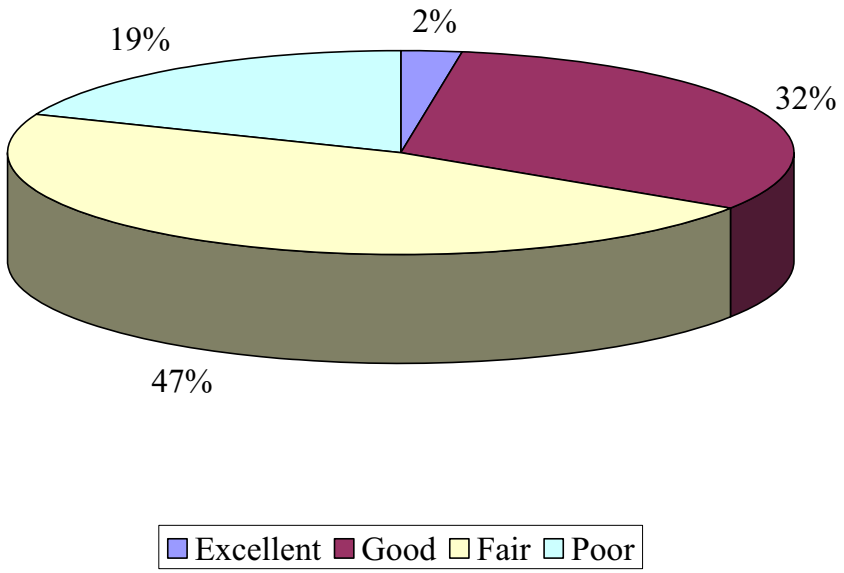
Note- Graph does not include Don't Know/ No Answer

Appendix VI
Environmental Considerations Condition Ratings

In general, how would you rate Clark County's air quality?

		Frequency	Valid Percent
Valid	Excellent	15	2.4
	Good	190	31.6
	Fair	281	46.9
	Poor	114	19
	DK/No answer	0	0.1
	Total	600	100

Air Quality



Note- Graph does not include Don't Know/ No Answer

Appendix VI
Environmental Considerations Condition Ratings
Summary Statistics by Jurisdiction

Unincorporated Clark County		How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	253	260	260	260
	Missing	7	0	0	0
Mean		2.73	1.50	2.87	2.86
Std. Error of Mean		.053	.045	.059	.049
Median		3.00	1.00	3.00	3.00
Mode		3	1	3	3
Std. Deviation		.843	.729	.946	.785
Skewness		-.263	1.526	-.346	-.118
Std. Error of Skewness		.153	.151	.151	.151
Kurtosis		-.483	2.149	-.870	-.652
Std. Error of Kurtosis		.305	.301	.301	.301
Range		3	3	3	3
Minimum		1	1	1	1
Maximum		4	4	4	4

Appendix VI
Environmental Considerations Condition Ratings
Summary Statistics by Jurisdiction

City of Las Vegas		How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	190	191	185	193
	Missing	3	2	8	0
Mean		2.65	1.54	2.84	2.72
Std. Error of Mean		.062	.050	.069	.053
Median		3.00	1.00	3.00	3.00
Mode		3	1	3	3
Std. Deviation		.856	.697	.935	.739
Skewness		-.069	1.540	-.289	.223
Std. Error of Skewness		.176	.176	.179	.175
Kurtosis		-.645	3.102	-.878	-.694
Std. Error of Kurtosis		.351	.350	.355	.349
Range		3	3	3	3
Minimum		1	1	1	1
Maximum		4	4	4	4

Appendix VI
Environmental Considerations Condition Ratings
Summary Statistics by Jurisdiction

City of North Las Vegas		How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	67	68	68	68
	Missing	0	0	0	0
Mean		2.58	1.60	3.31	2.90
Std. Error of Mean		.108	.096	.097	.077
Median		2.34	1.00	3.00	3.00
Mode		2	1	4	3
Std. Deviation		.885	.789	.802	.636
Skewness		.121	1.540	-1.014	-.303
Std. Error of Skewness		.292	.291	.291	.291
Kurtosis		-.733	2.512	.511	.556
Std. Error of Kurtosis		.577	.575	.575	.575
Range		3	3	3	3
Minimum		1	1	1	1
Maximum		4	4	4	4

Appendix VI
Environmental Considerations Condition Ratings
Summary Statistics by Jurisdiction

Henderson		How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	66	66	65	66
	Missing	0	0	1	0
Mean		2.65	1.43	3.17	2.82
Std. Error of Mean		.105	.086	.108	.094
Median		3.00	1.00	3.00	3.00
Mode		2	1	4	3
Std. Deviation		.856	.696	.870	.761
Skewness		.047	1.770	-.794	-.208
Std. Error of Skewness		.295	.295	.297	.295
Kurtosis		-.690	3.230	-.122	-.247
Std. Error of Kurtosis		.582	.582	.586	.582
Range		3	3	3	3
Minimum		1	1	1	1
Maximum		4	4	4	4

Appendix VI
Environmental Considerations Condition Ratings
Summary Statistics by Jurisdiction

Boulder City		How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	9	9	9	9
	Missing	0	0	0	0
Mean		2.59	1.53	3.00	3.46
Std. Error of Mean		.304	.281	.328	.256
Median		2.19	1.00	3.00	4.00
Mode		2	1	2(a)	4
Std. Deviation		.894	.826	.965	.751
Skewness		.426	1.258	.000	-1.146
Std. Error of Skewness		.729	.729	.729	.729
Kurtosis		-.263	.097	-2.286	.350
Std. Error of Kurtosis		1.428	1.428	1.428	1.428
Range		3	2	2	2
Minimum		1	1	2	2
Maximum		4	3	4	4

Appendix VI
Environmental Considerations Condition Ratings
Summary Statistics by Jurisdiction

Mesquite		How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	4	4	4	N
	Missing	0	0	0	
Mean		2.52	1.52	3.28	2.79
Std. Error of Mean		.411	.293	.564	.575
Median		3.00	1.57	4.00	2.20
Mode		3	2	4	2
Std. Deviation		.812	.579	1.114	1.135
Skewness		-1.975	-.127	-1.020	.742
Std. Error of Skewness		1.028	1.028	1.028	1.028
Range		2	1	2	2
Minimum		1	1	2	2
Maximum		3	2	4	4

Appendix VI
Environmental Considerations Condition Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * How would you rate local government's performance in preserving natural areas within Clark County?

			How would you rate local government's performance in preserving natural areas within Clark County?				
			Excellent	Good	Fair	Poor	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	20	72	116	45	253
		% within Respondent Jurisdiction	7.9%	28.5%	45.8%	17.8%	100.0%
	City of Las Vegas	Count	16	67	76	32	191
		% within Respondent Jurisdiction	8.4%	35.1%	39.8%	16.8%	100.0%
	City of North Las Vegas	Count	6	28	22	12	68
		% within Respondent Jurisdiction	8.8%	41.2%	32.4%	17.6%	100.0%
	City of Henderson	Count	5	26	24	12	67
		% within Respondent Jurisdiction	7.5%	38.8%	35.8%	17.9%	100.0%
	Boulder City	Count	0	4	2	2	8
		% within Respondent Jurisdiction	.0%	50.0%	25.0%	25.0%	100.0%
	Mesquite	Count	0	1	2	0	3
		% within Respondent Jurisdiction	.0%	33.3%	66.7%	.0%	100.0%
Total		Count	47	198	242	103	590
		% within Respondent Jurisdiction	8.0%	33.6%	41.0%	17.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.506(a)	15	.787
Likelihood Ratio	11.857	15	.690
Linear-by-Linear Association	1.099	1	.294
N of Valid Cases	590		

Appendix VI
Environmental Considerations Condition Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?

			Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?				
			Very concerned	Somewhat concerned	Somewhat unconcerned	Not concerned	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	159	79	15	7	260
		% within Respondent Jurisdiction	61.2%	30.4%	5.8%	2.7%	100.0%
	City of Las Vegas	Count	104	78	2	7	191
		% within Respondent Jurisdiction	54.5%	40.8%	1.0%	3.7%	100.0%
	City of North Las Vegas	Count	36	27	2	4	69
		% within Respondent Jurisdiction	52.2%	39.1%	2.9%	5.8%	100.0%
	City of Henderson	Count	44	18	3	2	67
		% within Respondent Jurisdiction	65.7%	26.9%	4.5%	3.0%	100.0%
	Boulder City	Count	6	2	2	0	10
		% within Respondent Jurisdiction	60.0%	20.0%	20.0%	.0%	100.0%
	Mesquite	Count	2	2	0	0	4
		% within Respondent Jurisdiction	50.0%	50.0%	.0%	.0%	100.0%
Total		Count	351	206	24	20	601
		% within Respondent Jurisdiction	58.4%	34.3%	4.0%	3.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.106(a)	15	.082
Likelihood Ratio	21.911	15	.110
Linear-by-Linear Association	.057	1	.812
N of Valid Cases	601		

Appendix VI
Environmental Considerations Condition Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * In general, how would you rate the quality of Clark County's drinking water?

			In general, how would you rate the quality of Clark County's drinking water?				
			Excellent	Good	Fair	Poor	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	22	69	90	79	260
		% within Respondent Jurisdiction	8.5%	26.5%	34.6%	30.4%	100.0%
	City of Las Vegas	Count	15	52	65	53	185
		% within Respondent Jurisdiction	8.1%	28.1%	35.1%	28.6%	100.0%
	City of North Las Vegas	Count	2	8	25	33	68
		% within Respondent Jurisdiction	2.9%	11.8%	36.8%	48.5%	100.0%
	City of Henderson	Count	3	10	24	28	65
		% within Respondent Jurisdiction	4.6%	15.4%	36.9%	43.1%	100.0%
	Boulder City	Count	0	4	2	4	10
		% within Respondent Jurisdiction	.0%	40.0%	20.0%	40.0%	100.0%
	Mesquite	Count	0	1	0	2	3
		% within Respondent Jurisdiction	.0%	33.3%	.0%	66.7%	100.0%
Total		Count	42	144	206	199	591
		% within Respondent Jurisdiction	7.1%	24.4%	34.9%	33.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.650(a)	15	.055
Likelihood Ratio	27.582	15	.024
Linear-by-Linear Association	10.738	1	.001
N of Valid Cases	591		

Appendix VI
Environmental Considerations Condition Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * In general, how would you rate Clark County's air quality?

			In general, how would you rate Clark County's air quality?				
			Excellent	Good	Fair	Poor	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	8	78	118	57	261
		% within Respondent Jurisdiction	3.1%	29.9%	45.2%	21.8%	100.0%
	City of Las Vegas	Count	3	76	84	30	193
		% within Respondent Jurisdiction	1.6%	39.4%	43.5%	15.5%	100.0%
	City of North Las Vegas	Count	1	14	43	9	67
		% within Respondent Jurisdiction	1.5%	20.9%	64.2%	13.4%	100.0%
	City of Henderson	Count	2	19	34	11	66
		% within Respondent Jurisdiction	3.0%	28.8%	51.5%	16.7%	100.0%
	Boulder City	Count	0	1	2	5	8
		% within Respondent Jurisdiction	.0%	12.5%	25.0%	62.5%	100.0%
	Mesquite	Count	0	2	0	2	4
		% within Respondent Jurisdiction	.0%	50.0%	.0%	50.0%	100.0%
Total		Count	14	190	281	114	599
		% within Respondent Jurisdiction	2.3%	31.7%	46.9%	19.0%	100.0%

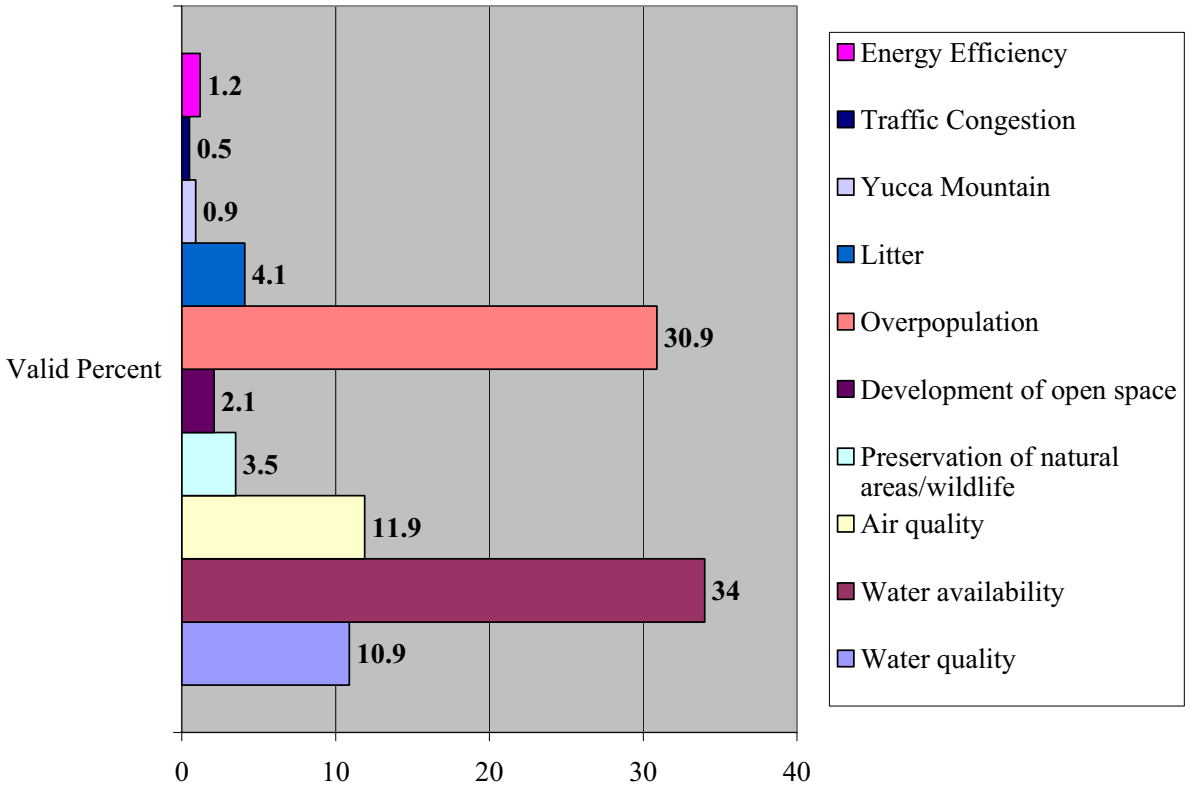
Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	31.026(a)	15	.009
Likelihood Ratio	29.795	15	.013
Linear-by-Linear Association	.484	1	.487
N of Valid Cases	599		

Appendix VI
Environmental Considerations Perception Ratings

In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?

		Frequency	Valid Percent
Valid	Water quality	65	10.8
	Water availability	202	33.6
	Air quality	71	11.8
	Preservation of natural areas/wildlife	21	3.5
	Development of open space	12	2.1
	Overpopulation	183	30.5
	Litter	24	4
	Yucca Mountain	5	0.9
	Traffic Congestion	3	0.5
	Energy Efficiency	7	1.2
	DK/No answer	7	1.2
	Total	600	100



Appendix VI
Environmental Considerations Perception Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?

			In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?										
			Water quality	Water availability	Air quality	Preservation of natural areas/wildlife	Development of open space	Overpopulation	Litter	Yucca Mountain	Traffic Congestion	Energy Efficiency	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	30	86	24	11	4	85	8	3	2	4	257
		% within Respondent Jurisdiction	11.7%	33.5%	9.3%	4.3%	1.6%	33.1%	3.1%	1.2%	.8%	1.6%	100.0%
	City of Las Vegas	Count	17	60	26	6	4	64	10	2	0	2	191
		% within Respondent Jurisdiction	8.9%	31.4%	13.6%	3.1%	2.1%	33.5%	5.2%	1.0%	.0%	1.0%	100.0%
	City of North Las Vegas	Count	6	23	10	1	0	23	3	0	0	2	68
		% within Respondent Jurisdiction	8.8%	33.8%	14.7%	1.5%	.0%	33.8%	4.4%	.0%	.0%	2.9%	100.0%
	City of Henderson	Count	11	29	8	2	4	9	2	0	0	0	65
		% within Respondent Jurisdiction	16.9%	44.6%	12.3%	3.1%	6.2%	13.8%	3.1%	.0%	.0%	.0%	100.0%
	Boulder City	Count	1	3	3	0	0	0	2	0	0	0	9
		% within Respondent Jurisdiction	11.1%	33.3%	33.3%	.0%	.0%	.0%	22.2%	.0%	.0%	.0%	100.0%
	Mesquite	Count	0	1	0	2	0	1	0	0	0	0	4
		% within Respondent Jurisdiction	.0%	25.0%	.0%	50.0%	.0%	25.0%	.0%	.0%	.0%	.0%	100.0%
Total		Count	65	202	71	22	12	182	25	5	2	8	594
		% within Respondent Jurisdiction	10.9%	34.0%	12.0%	3.7%	2.0%	30.6%	4.2%	.8%	.3%	1.3%	100.0%

Appendix VI
Environmental Considerations Perception Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County? (cont.)

Chi-Square Tests (cont.)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	70.240(a)	45	.009
Likelihood Ratio	57.169	45	.105
Linear-by-Linear Association	4.792	1	.029
N of Valid Cases	594		

Appendix VII

Yucca Mountain Considerations

Appendix VII
Yucca Mountain Considerations
Summary Statistics

Clark County receives money from the federal government to conduct specific activities related to Yucca Mountain. These activities include overseeing technical scientific studies; assessing a broad array of impacts that may result from Yucca Mountain; analyzing transportation impacts; conducting public outreach. From the list below please rank the importance of each activity where 1 is low and 5 is high.

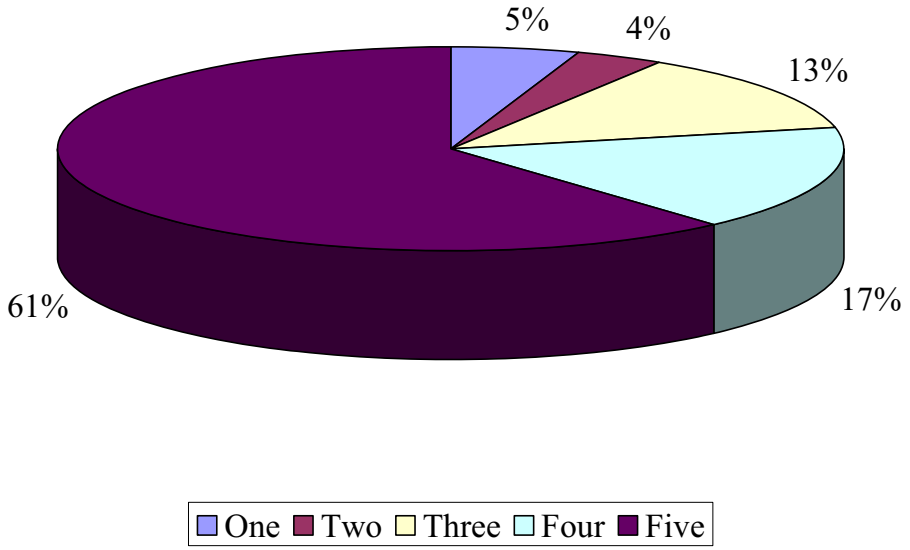
		Keeping local Decision makers up to date about Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourism sector	Assess impacts to the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	591	590	582	590	585	583	587	586	594
	Missing	9	9	17	10	14	17	12	13	6
Mean		4.26	4.32	4.12	4.28	3.89	3.85	3.85	3.99	4.22
Std. Error of Mean		0.047	0.047	0.051	0.043	0.049	0.05	0.05	0.047	0.048
Median		5	5	5	5	4	4	4	4	5
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.139	1.132	1.225	1.032	1.194	1.213	1.203	1.132	1.169
Skewness		-1.515	-1.675	-1.229	-1.447	-0.863	-0.856	-0.896	-0.989	-1.41
Std. Error of Skewness		0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.1
Kurtosis		1.381	1.84	0.375	1.417	-0.158	-0.214	-0.034	0.207	0.967
Std. Error of Kurtosis		0.201	0.201	0.202	0.201	0.202	0.202	0.201	0.201	0.2
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations

Clark County receives money from the federal government to conduct specific activities related to Yucca Mountain. These activities include overseeing technical scientific studies; assessing a broad array of impacts that may result from Yucca Mountain; analyzing transportation impacts; conducting public outreach. From the list below please rank the importance of each activity where 1 is low and 5 is high: <u>Keeping local Decision makers up to date about Yucca Mountain</u>

		Frequency	Valid Percent
Valid	One	31	5.1
	Two	22	3.7
	Three	76	12.7
	Four	97	16.3
	Five	365	60.8
	DK/No answer	9	1.4
	Total	600	100

Keeping Local Decision Makers Up to Date About Yucca Mountain



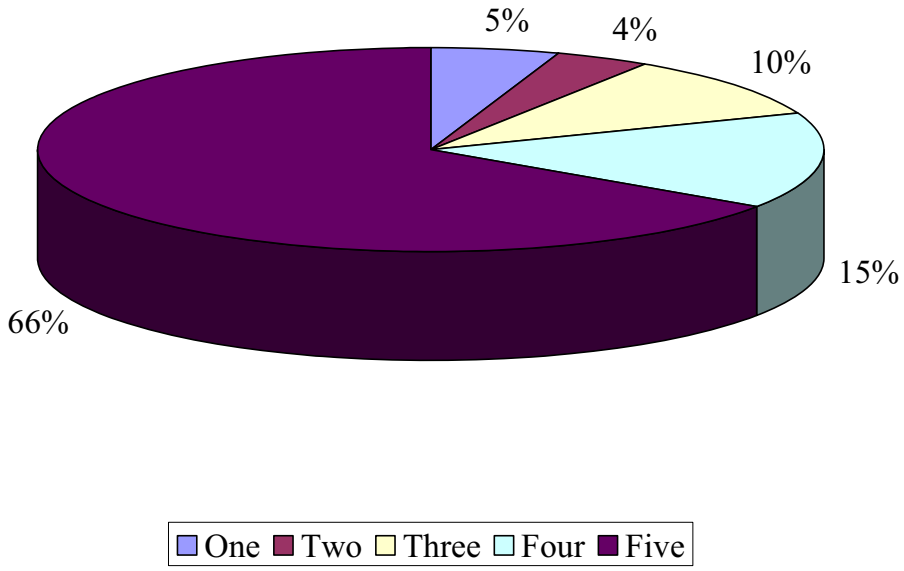
Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations

Clark County receives money from the federal government to conduct specific activities related to Yucca Mountain. These activities include overseeing technical scientific studies; assessing a broad array of impacts that may result from Yucca Mountain; analyzing transportation impacts; conducting public outreach. From the list below please rank the importance of each activity where 1 is low and 5 is high: <u>Keeping the public up to date about Yucca Mountain</u>:

		Frequency	Valid Percent
Valid	One	30	5.1
	Two	23	3.9
	Three	60	10.1
	Four	89	14.9
	Five	387	64.6
	DK/No answer	9	1.5
	Total	600	100

Keeping Public Up to Date About Yucca Mountain



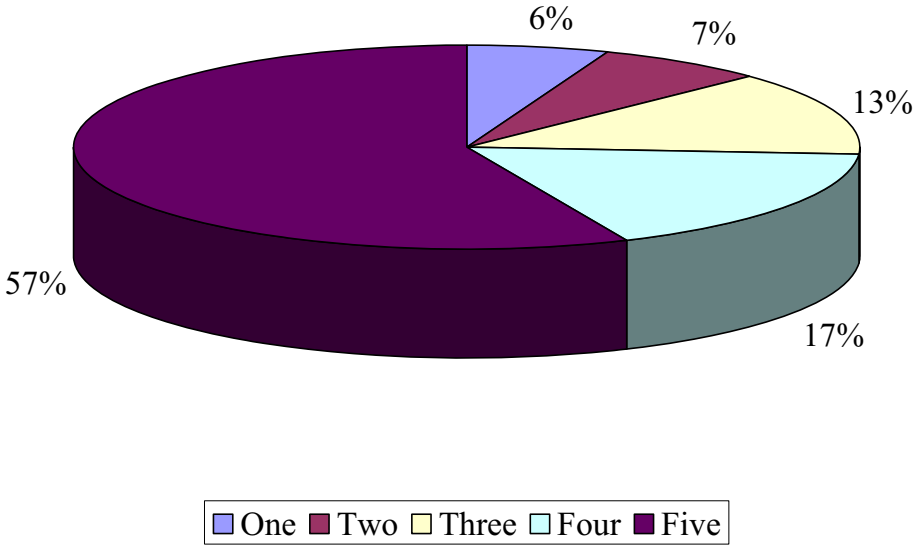
Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations

Clark County receives money from the federal government to conduct specific activities related to Yucca Mountain. These activities include overseeing technical scientific studies; assessing a broad array of impacts that may result from Yucca Mountain; analyzing transportation impacts; conducting public outreach. From the list below please rank the importance of each activity where 1 is low and 5 is high: <u>Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology:</u>

		Frequency	Valid Percent
Valid	One	35	5.8
	Two	40	6.7
	Three	78	13.1
	Four	100	16.6
	Five	330	55
	DK/No answer	17	2.9
	Total	600	100

Reviewing Technical, Scientific Studies About Seismic, Vulcanology, Geology, and Hydrology



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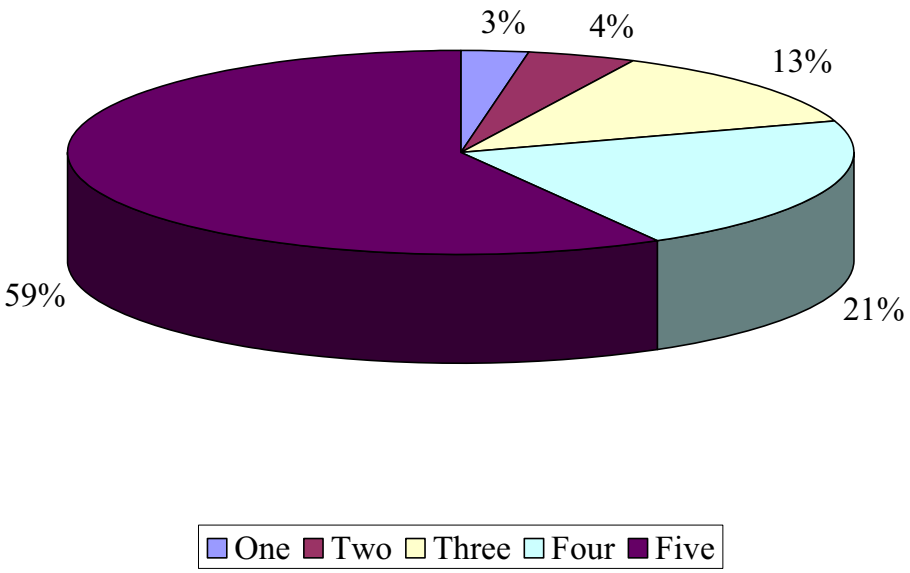
Appendix VII
Yucca Mountain Considerations

Clark County receives money from the federal government to conduct specific activities related to Yucca Mountain. These activities include overseeing technical scientific studies; assessing a broad array of impacts that may result from Yucca Mountain; analyzing transportation impacts; conducting public outreach. From the list below please rank the importance of each activity where 1 is low and 5 is high: <u>Identify public safety needs and impacts:</u>

		Frequency	Valid Percent
Valid	One	17	2.8
	Two	26	4.4
	Three	75	12.6
	Four	127	21.1
	Five	345	57.5
	DK/No answer	10	1.6
	Total	600	100

Identify Public Safety Needs and Impacts



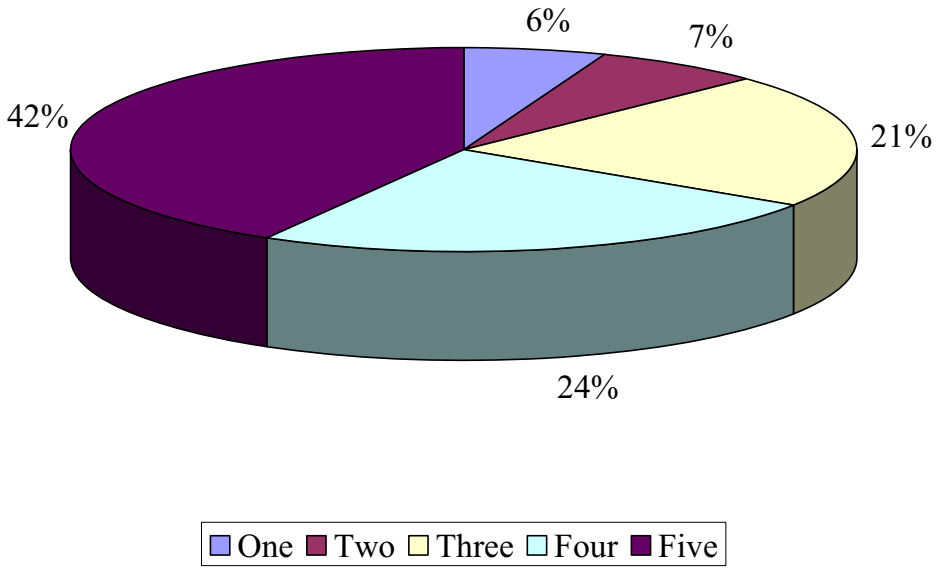
Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations

Clark County receives money from the federal government to conduct specific activities related to Yucca Mountain. These activities include overseeing technical scientific studies; assessing a broad array of impacts that may result from Yucca Mountain; analyzing transportation impacts; conducting public outreach. From the list below please rank the importance of each activity where 1 is low and 5 is high: <u>Assess other government impacts:</u>

		Frequency	Valid Percent
Valid	One	34	5.7
	Two	41	6.8
	Three	124	20.7
	Four	142	23.7
	Five	244	40.7
	DK/No answer	14	2.4
	Total	600	100

Asses Other Government Impacts



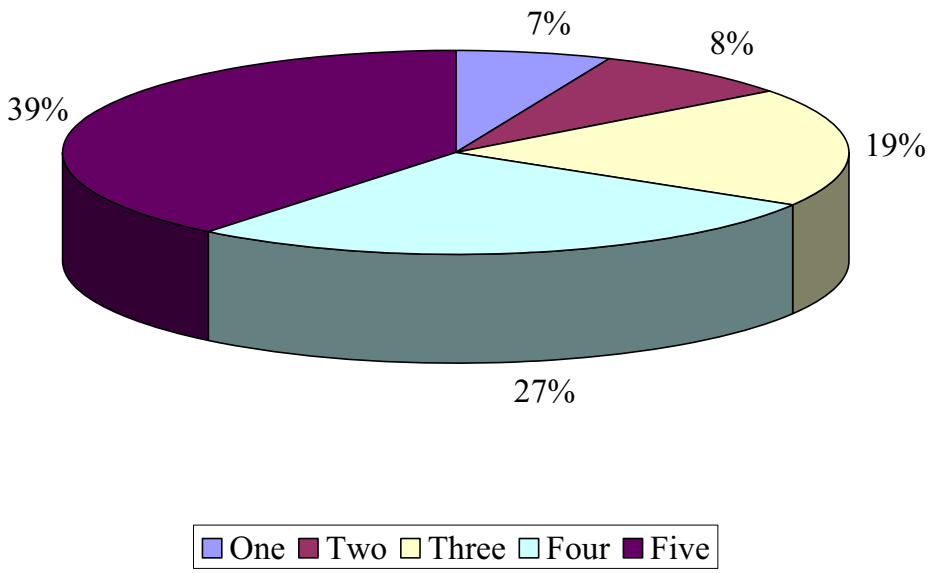
Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations

Clark County receives money from the federal government to conduct specific activities related to Yucca Mountain. These activities include overseeing technical scientific studies; assessing a broad array of impacts that may result from Yucca Mountain; analyzing transportation impacts; conducting public outreach. From the list below please rank the importance of each activity where 1 is low and 5 is high: <u>Assess impacts on the tourism sector:</u>

		Frequency	Valid Percent
Valid	One	38	6.3
	Two	48	8
	Three	109	18.2
	Four	159	26.5
	Five	229	38.2
	DK/No answer	17	2.8
	Total	600	100

Assess Impacts on the Tourism Sector



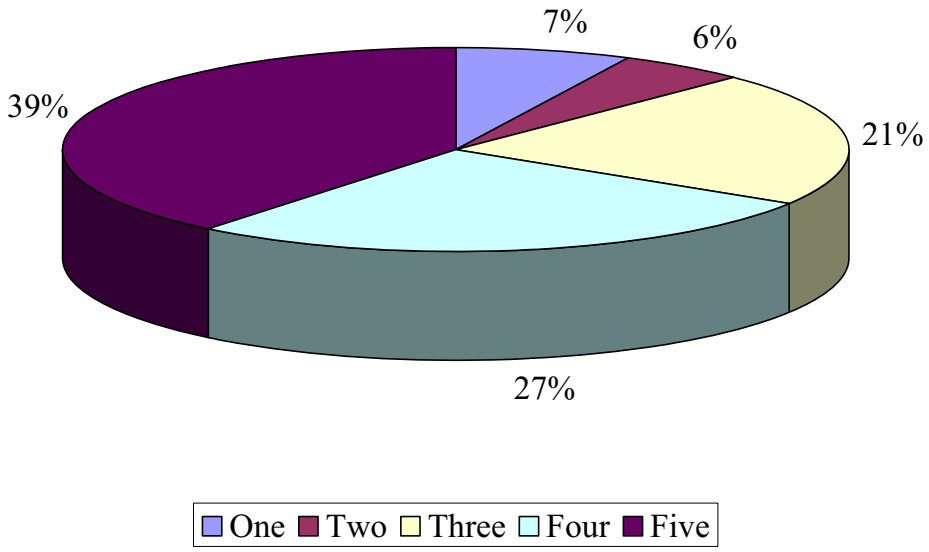
Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations

Clark County receives money from the federal government to conduct specific activities related to Yucca Mountain. These activities include overseeing technical scientific studies; assessing a broad array of impacts that may result from Yucca Mountain; analyzing transportation impacts; conducting public outreach. From the list below please rank the importance of each activity where 1 is low and 5 is high: <u>Assess impacts to the building, construction, and development sectors:</u>

		Frequency	Valid Percent
Valid	One	42	7
	Two	32	5.4
	Three	125	20.9
	Four	158	26.4
	Five	230	38.3
	DK/No answer	12	2
	Total	600	100

Assess Impacts to the Building, Construction, and Development Sectors



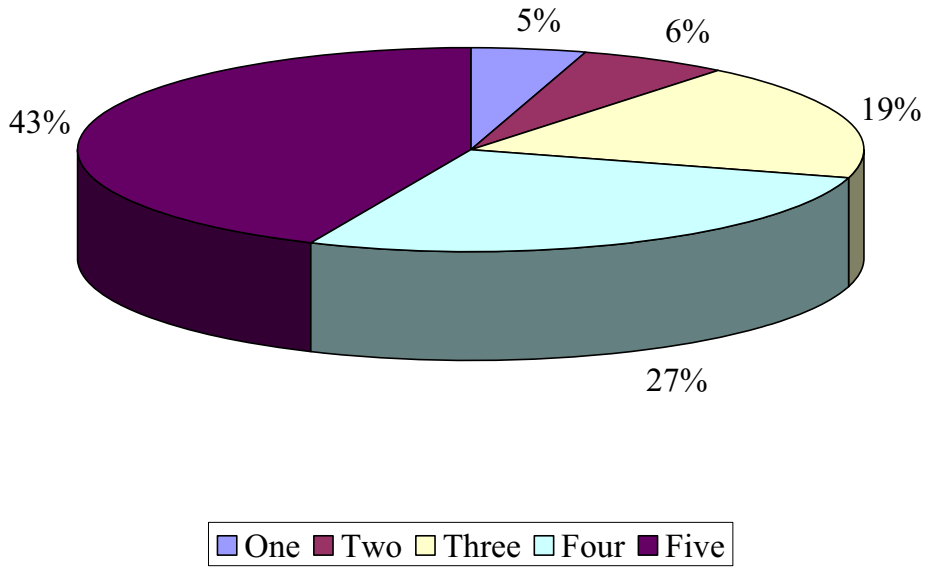
Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations

Clark County receives money from the federal government to conduct specific activities related to Yucca Mountain. These activities include overseeing technical scientific studies; assessing a broad array of impacts that may result from Yucca Mountain; analyzing transportation impacts; conducting public outreach. From the list below please rank the importance of each activity where 1 is low and 5 is high: <u>Identify transportation impacts:</u>

		Frequency	Valid Percent
Valid	One	27	4.5
	Two	36	6
	Three	110	18.4
	Four	159	26.5
	Five	255	42.5
	DK/No answer	13	2.2
	Total	600	100

Identify Transportation Impacts



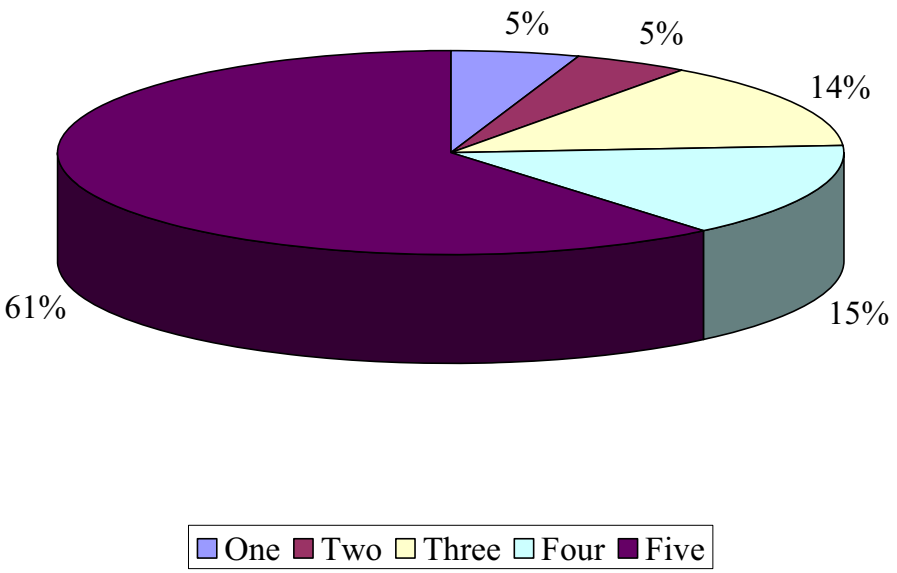
Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations

Clark County receives money from the federal government to conduct specific activities related to Yucca Mountain. These activities include overseeing technical scientific studies; assessing a broad array of impacts that may result from Yucca Mountain; analyzing transportation impacts; conducting public outreach. From the list below please rank the importance of each activity where 1 is low and 5 is high: <u>Provide information to the public on all facts of Yucca Mountain:</u>

		Frequency	Valid Percent
Valid	One	31	5.2
	Two	29	4.8
	Three	81	13.5
	Four	90	15
	Five	363	60.5
	DK/No answer	6	1
	Total	600	100

Provide Information to the Public on All Facts of Yucca Mountain



Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations
Jurisdictional Summary Statistics

Unincorporated Clark County		Keeping local Decision makers up to date about Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourism sector	Assess impacts to the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	258	257	256	259	254	254	258	255	259
	Missing	2	4	4	2	6	6	3	5	1
Mean		4.22	4.28	4.05	4.19	3.83	3.85	3.83	3.97	4.20
Std. Error of Mean		.075	.076	.077	.067	.077	.077	.076	.070	.074
Median		5.00	5.00	5.00	5.00	4.00	4.00	4.00	4.00	5.00
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.209	1.211	1.231	1.082	1.233	1.225	1.219	1.110	1.188
Skewness		-1.520	-1.708	-1.155	-1.357	-.866	-.886	-.872	-.975	-1.444
Std. Error of Skewness		.152	.152	.152	.151	.153	.153	.152	.152	.151
Kurtosis		1.246	1.853	.282	1.250	-.100	-.136	-.096	.322	1.081
Std. Error of Kurtosis		.302	.303	.303	.302	.304	.304	.302	.304	.302
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdictional Summary Statistics

City of Las Vegas		Keeping local Decision makers up to date about Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourism sector	Assess impacts to the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	192	191	185	189	189	187	189	190	190
	Missing	1	2	8	4	4	6	4	3	3
Mean		4.29	4.33	4.18	4.32	3.96	3.86	3.94	4.03	4.19
Std. Error of Mean		.080	.080	.088	.075	.088	.083	.082	.082	.085
Median		5.00	5.00	5.00	5.00	4.00	4.00	4.00	4.00	5.00
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.110	1.108	1.201	1.026	1.212	1.136	1.123	1.125	1.168
Skewness		-1.610	-1.580	-1.324	-1.500	-.900	-.782	-.999	-1.028	-1.273
Std. Error of Skewness		.176	.176	.178	.177	.177	.178	.177	.176	.176
Kurtosis		1.812	1.474	.620	1.492	-.278	-.147	.480	.245	.525
Std. Error of Kurtosis		.349	.350	.355	.352	.351	.353	.352	.351	.351
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdictional Summary Statistics

City of North Las Vegas		Keeping local Decision makers up to date about Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourism sector	Assess impacts to the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	63	64	64	64	64	64	64	63	67
	Missing	5	4	4	4	4	4	4	5	1
Mean		4.25	4.26	4.00	4.43	3.89	3.68	3.79	3.95	4.20
Std. Error of Mean		.139	.124	.173	.123	.136	.172	.167	.142	.143
Median		5.00	5.00	5.00	5.00	4.00	4.00	4.00	4.00	5.00
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.099	.991	1.387	.987	1.087	1.380	1.334	1.128	1.166
Skewness		-1.288	-1.181	-1.048	-1.489	-.631	-.649	-.823	-.770	-1.343
Std. Error of Skewness		.302	.299	.299	.299	.299	.299	.299	.302	.293
Kurtosis		.655	.254	-.323	.817	-.728	-.900	-.532	-.392	.851
Std. Error of Kurtosis		.595	.590	.590	.590	.590	.590	.590	.595	.579
Range		4	3	4	3	4	4	4	4	4
Minimum		1	2	1	2	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdictional Summary Statistics

Henderson		Keeping local Decision makers up to date about Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourism sector	Assess impacts to the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	66	66	65	66	66	65	65	66	66
	Missing	0	0	1	0	0	1	1	0	0
Mean		4.21	4.39	4.24	4.38	3.90	3.87	3.70	3.85	4.27
Std. Error of Mean		.125	.134	.134	.108	.139	.154	.153	.154	.142
Median		5.00	5.00	5.00	5.00	4.00	4.00	4.00	4.00	5.00
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.014	1.087	1.083	.881	1.132	1.241	1.232	1.255	1.158
Skewness		-1.167	-1.856	-1.310	-1.581	-.870	-.968	-.672	-.966	-1.606
Std. Error of Skewness		.295	.295	.297	.295	.295	.297	.297	.295	.295
Kurtosis		.643	2.616	.803	2.304	.115	-.135	-.446	.013	1.785
Std. Error of Kurtosis		.582	.582	.586	.582	.582	.586	.586	.582	.582
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdictional Summary Statistics

Boulder City		Keeping local Decision makers up to date about Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourism sector	Assess impacts to the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	9	9	9	9	8	9	9	9	9
	Missing	0	0	0	0	0	0	0	0	0
Mean		4.78	5.00	4.62	4.60	4.15	4.25	4.37	4.71	5.00
Std. Error of Mean		.329	.000	.399	.342	.361	.332	.341	.203	.000
Median		5.00	5.00	5.00	5.00	4.00	4.00	4.82	5.00	5.00
Mode		5	5	5	5	4	4	5	5	5
Std. Deviation		.965	.000	1.173	1.005	1.031	.975	1.002	.595	.000
Skewness		-4.806		-3.203	-3.691	-2.276	-2.701	-2.898	-2.238	
Std. Error of Skewness		.729	.729	.729	.729	.746	.729	.729	.729	.729
Kurtosis		27.642		11.184	18.152	9.300	12.602	13.171	5.775	
Std. Error of Kurtosis		1.428	1.428	1.428	1.428	1.467	1.428	1.428	1.428	1.428
Range		4	0	4	4	4	4	4	2	0
Minimum		1	5	1	1	1	1	1	3	5
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdictional Summary Statistics

Mesquite		Keeping local Decision makers up to date about Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourism sector	Assess impacts to the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	4	4	3	3	3	3	3	3	3
	Missing	0	0	0	0	0	0	0	0	0
Mean		4.45	4.76	4.45	3.96	3.96	4.04	3.90	4.31	4.31
Std. Error of Mean		.526	.382	.882	.595	.595	.898	.927	.875	.875
Median		5.00	5.00	5.00	4.20	4.20	4.81	4.61	5.00	5.00
Mode		5	5	5	3	3	5	5	5	5
Std. Deviation		1.038	.755	1.634	1.103	1.103	1.662	1.716	1.620	1.620
Skewness		-1.765	-4.126	-4.262	.163	.163	-2.571	-1.863	-3.790	-3.790
Std. Error of Skewness		1.028	1.028	1.108	1.108	1.108	1.108	1.108	1.108	1.108
Range		2	2	4	2	2	4	4	4	4
Minimum		3	3	1	3	3	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Clark County receives money from the federal government to conduct specific activities related to Yucca Mountain. These activities include overseeing technical scientific studies; assessing a broad array of impacts that may result from Yucca Mountain; analyzing transportation impacts; conducting public outreach. From the list below please rank the importance of each activity where 1 is low and 5 is high:
Respondent Jurisdiction * Keeping local Decision makers up to date about Yucca Mountain:

			Keeping local Decision makers up to date about Yucca Mountain:					
			One	Two	Three	Four	Five	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	18	9	30	41	160	258
		% within Respondent Jurisdiction	7.0%	3.5%	11.6%	15.9%	62.0%	100.0%
	City of Las Vegas	Count	9	6	24	33	120	192
		% within Respondent Jurisdiction	4.7%	3.1%	12.5%	17.2%	62.5%	100.0%
	City of North Las Vegas	Count	2	4	10	9	38	63
		% within Respondent Jurisdiction	3.2%	6.3%	15.9%	14.3%	60.3%	100.0%
	City of Henderson	Count	1	4	11	15	35	66
		% within Respondent Jurisdiction	1.5%	6.1%	16.7%	22.7%	53.0%	100.0%
	Boulder City	Count	0	0	0	0	8	8
		% within Respondent Jurisdiction	.0%	.0%	.0%	.0%	100.0%	100.0%
	Mesquite	Count	0	0	1	0	3	4
		% within Respondent Jurisdiction	.0%	.0%	25.0%	.0%	75.0%	100.0%
Total		Count	30	23	76	98	364	591
		% within Respondent Jurisdiction	5.1%	3.9%	12.9%	16.6%	61.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	16.918(a)	20	.658
Likelihood Ratio	20.666	20	.417
Linear-by-Linear Association	.426	1	.514
N of Valid Cases	591		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Keeping the public up to date about Yucca Mountain:

			Keeping the public up to date about Yucca Mountain:					Total
			One	Two	Three	Four	Five	
Respondent Jurisdiction	Unincorporated Clark County	Count	21	3	26	40	167	257
		% within Respondent Jurisdiction	8.2%	1.2%	10.1%	15.6%	65.0%	100.0%
	City of Las Vegas	Count	7	11	22	24	127	191
		% within Respondent Jurisdiction	3.7%	5.8%	11.5%	12.6%	66.5%	100.0%
	City of North Las Vegas	Count	0	6	6	16	36	64
		% within Respondent Jurisdiction	.0%	9.4%	9.4%	25.0%	56.3%	100.0%
	City of Henderson	Count	3	3	6	9	46	67
		% within Respondent Jurisdiction	4.5%	4.5%	9.0%	13.4%	68.7%	100.0%
	Boulder City	Count	0	0	0	0	9	9
		% within Respondent Jurisdiction	.0%	.0%	.0%	.0%	100.0%	100.0%
	Mesquite	Count	0	0	0	0	3	3
		% within Respondent Jurisdiction	.0%	.0%	.0%	.0%	100.0%	100.0%
Total		Count	31	23	60	89	388	591
		% within Respondent Jurisdiction	5.2%	3.9%	10.2%	15.1%	65.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	33.057(a)	20	.033
Likelihood Ratio	39.352	20	.006
Linear-by-Linear Association	1.858	1	.173
N of Valid Cases	591		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology:

			Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology:					
			One	Two	Three	Four	Five	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	17	16	39	52	133	257
		% within Respondent Jurisdiction	6.6%	6.2%	15.2%	20.2%	51.8%	100.0%
	City of Las Vegas	Count	9	14	22	30	110	185
		% within Respondent Jurisdiction	4.9%	7.6%	11.9%	16.2%	59.5%	100.0%
	City of North Las Vegas	Count	6	6	10	5	38	65
		% within Respondent Jurisdiction	9.2%	9.2%	15.4%	7.7%	58.5%	100.0%
	City of Henderson	Count	2	5	9	12	38	66
		% within Respondent Jurisdiction	3.0%	7.6%	13.6%	18.2%	57.6%	100.0%
	Boulder City	Count	0	0	0	0	8	8
		% within Respondent Jurisdiction	.0%	.0%	.0%	.0%	100.0%	100.0%
	Mesquite	Count	0	0	0	0	3	3
		% within Respondent Jurisdiction	.0%	.0%	.0%	.0%	100.0%	100.0%
Total		Count	34	41	80	99	330	584
		% within Respondent Jurisdiction	5.8%	7.0%	13.7%	17.0%	56.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.402(a)	20	.496
Likelihood Ratio	24.234	20	.232
Linear-by-Linear Association	2.534	1	.111
N of Valid Cases	584		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Identify public safety needs and impacts:

			Identify public safety needs and impacts:					Total
			One	Two	Three	Four	Five	
Respondent Jurisdiction	Unincorporated Clark County	Count	11	7	41	59	139	257
		% within Respondent Jurisdiction	4.3%	2.7%	16.0%	23.0%	54.1%	100.0%
	City of Las Vegas	Count	4	10	21	38	115	188
		% within Respondent Jurisdiction	2.1%	5.3%	11.2%	20.2%	61.2%	100.0%
	City of North Las Vegas	Count	0	5	7	7	45	64
		% within Respondent Jurisdiction	.0%	7.8%	10.9%	10.9%	70.3%	100.0%
	City of Henderson	Count	0	4	4	21	37	66
		% within Respondent Jurisdiction	.0%	6.1%	6.1%	31.8%	56.1%	100.0%
	Boulder City	Count	0	0	0	2	7	9
		% within Respondent Jurisdiction	.0%	.0%	.0%	22.2%	77.8%	100.0%
	Mesquite	Count	0	0	2	0	1	3
		% within Respondent Jurisdiction	.0%	.0%	66.7%	.0%	33.3%	100.0%
Total		Count	15	26	75	127	344	587
		% within Respondent Jurisdiction	2.6%	4.4%	12.8%	21.6%	58.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	35.389(a)	20	.018
Likelihood Ratio	38.039	20	.009
Linear-by-Linear Association	3.441	1	.064
N of Valid Cases	587		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Assess other government impacts:

			Assess other government impacts:					Total
			One	Two	Three	Four	Five	
Respondent Jurisdiction	Unincorporated Clark County	Count	21	10	62	60	101	254
		% within Respondent Jurisdiction	8.3%	3.9%	24.4%	23.6%	39.8%	100.0%
	City of Las Vegas	Count	9	18	35	38	90	190
		% within Respondent Jurisdiction	4.7%	9.5%	18.4%	20.0%	47.4%	100.0%
	City of North Las Vegas	Count	0	9	10	21	23	63
		% within Respondent Jurisdiction	.0%	14.3%	15.9%	33.3%	36.5%	100.0%
	City of Henderson	Count	3	4	15	19	25	66
		% within Respondent Jurisdiction	4.5%	6.1%	22.7%	28.8%	37.9%	100.0%
	Boulder City	Count	0	0	0	4	3	7
		% within Respondent Jurisdiction	.0%	.0%	.0%	57.1%	42.9%	100.0%
	Mesquite	Count	0	0	2	0	1	3
		% within Respondent Jurisdiction	.0%	.0%	66.7%	.0%	33.3%	100.0%
Total		Count	33	41	124	142	243	583
		% within Respondent Jurisdiction	5.7%	7.0%	21.3%	24.4%	41.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	35.774(a)	20	.016
Likelihood Ratio	39.850	20	.005
Linear-by-Linear Association	.761	1	.383
N of Valid Cases	583		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Assess impacts on the tourism sector:

			Assess impacts on the tourism sector:					Total
			One	Two	Three	Four	Five	
Respondent Jurisdiction	Unincorporated Clark County	Count	18	17	51	66	102	254
		% within Respondent Jurisdiction	7.1%	6.7%	20.1%	26.0%	40.2%	100.0%
	City of Las Vegas	Count	8	14	43	52	70	187
		% within Respondent Jurisdiction	4.3%	7.5%	23.0%	27.8%	37.4%	100.0%
	City of North Las Vegas	Count	6	9	9	14	25	63
		% within Respondent Jurisdiction	9.5%	14.3%	14.3%	22.2%	39.7%	100.0%
	City of Henderson	Count	4	8	6	22	25	65
		% within Respondent Jurisdiction	6.2%	12.3%	9.2%	33.8%	38.5%	100.0%
	Boulder City	Count	0	0	0	5	4	9
		% within Respondent Jurisdiction	.0%	.0%	.0%	55.6%	44.4%	100.0%
	Mesquite	Count	0	0	0	0	2	2
		% within Respondent Jurisdiction	.0%	.0%	.0%	.0%	100.0%	100.0%
Total		Count	36	48	109	159	228	580
		% within Respondent Jurisdiction	6.2%	8.3%	18.8%	27.4%	39.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.086(a)	20	.239
Likelihood Ratio	27.141	20	.131
Linear-by-Linear Association	.231	1	.631
N of Valid Cases	580		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Assess impacts to the building, construction, and development sectors:

			Assess impacts to the building, construction, and development sectors:					
			One	Two	Three	Four	Five	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	20	14	56	68	100	258
		% within Respondent Jurisdiction	7.8%	5.4%	21.7%	26.4%	38.8%	100.0%
	City of Las Vegas	Count	11	5	43	54	75	188
		% within Respondent Jurisdiction	5.9%	2.7%	22.9%	28.7%	39.9%	100.0%
	City of North Las Vegas	Count	6	7	9	15	27	64
		% within Respondent Jurisdiction	9.4%	10.9%	14.1%	23.4%	42.2%	100.0%
	City of Henderson	Count	5	6	15	17	22	65
		% within Respondent Jurisdiction	7.7%	9.2%	23.1%	26.2%	33.8%	100.0%
	Boulder City	Count	0	0	0	4	5	9
		% within Respondent Jurisdiction	.0%	.0%	.0%	44.4%	55.6%	100.0%
	Mesquite	Count	0	0	1	0	2	3
		% within Respondent Jurisdiction	.0%	.0%	33.3%	.0%	66.7%	100.0%
Total		Count	42	32	124	158	231	587
		% within Respondent Jurisdiction	7.2%	5.5%	21.1%	26.9%	39.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.766(a)	20	.537
Likelihood Ratio	22.357	20	.321
Linear-by-Linear Association	.029	1	.865
N of Valid Cases	587		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Identify transportation impacts:

			Identify transportation impacts:					Total
			One	Two	Three	Four	Five	
Respondent Jurisdiction	Unincorporated Clark County	Count	12	13	53	73	105	256
		% within Respondent Jurisdiction	4.7%	5.1%	20.7%	28.5%	41.0%	100.0%
	City of Las Vegas	Count	7	13	32	50	87	189
		% within Respondent Jurisdiction	3.7%	6.9%	16.9%	26.5%	46.0%	100.0%
	City of North Las Vegas	Count	2	6	13	15	27	63
		% within Respondent Jurisdiction	3.2%	9.5%	20.6%	23.8%	42.9%	100.0%
	City of Henderson	Count	6	4	12	18	26	66
		% within Respondent Jurisdiction	9.1%	6.1%	18.2%	27.3%	39.4%	100.0%
	Boulder City	Count	0	0	0	2	7	9
		% within Respondent Jurisdiction	.0%	.0%	.0%	22.2%	77.8%	100.0%
	Mesquite	Count	0	0	0	0	2	2
		% within Respondent Jurisdiction	.0%	.0%	.0%	.0%	100.0%	100.0%
Total		Count	27	36	110	158	254	585
		% within Respondent Jurisdiction	4.6%	6.2%	18.8%	27.0%	43.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.424(a)	20	.752
Likelihood Ratio	17.638	20	.611
Linear-by-Linear Association	.126	1	.723
N of Valid Cases	585		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Provide information to the public on all facts of Yucca Mountain:

			Provide information to the public on all facts of Yucca Mountain:					
			One	Two	Three	Four	Five	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	16	11	33	44	155	259
		% within Respondent Jurisdiction	6.2%	4.2%	12.7%	17.0%	59.8%	100.0%
	City of Las Vegas	Count	8	13	29	26	115	191
		% within Respondent Jurisdiction	4.2%	6.8%	15.2%	13.6%	60.2%	100.0%
	City of North Las Vegas	Count	3	4	10	10	40	67
		% within Respondent Jurisdiction	4.5%	6.0%	14.9%	14.9%	59.7%	100.0%
	City of Henderson	Count	4	1	10	9	42	66
		% within Respondent Jurisdiction	6.1%	1.5%	15.2%	13.6%	63.6%	100.0%
	Boulder City	Count	0	0	0	0	9	9
		% within Respondent Jurisdiction	.0%	.0%	.0%	.0%	100.0%	100.0%
	Mesquite	Count	0	0	0	0	2	2
		% within Respondent Jurisdiction	.0%	.0%	.0%	.0%	100.0%	100.0%
Total		Count	31	29	82	89	363	594
		% within Respondent Jurisdiction	5.2%	4.9%	13.8%	15.0%	61.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.184(a)	20	.869
Likelihood Ratio	17.405	20	.627
Linear-by-Linear Association	1.462	1	.227
N of Valid Cases	594		

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Quality of Life Measures

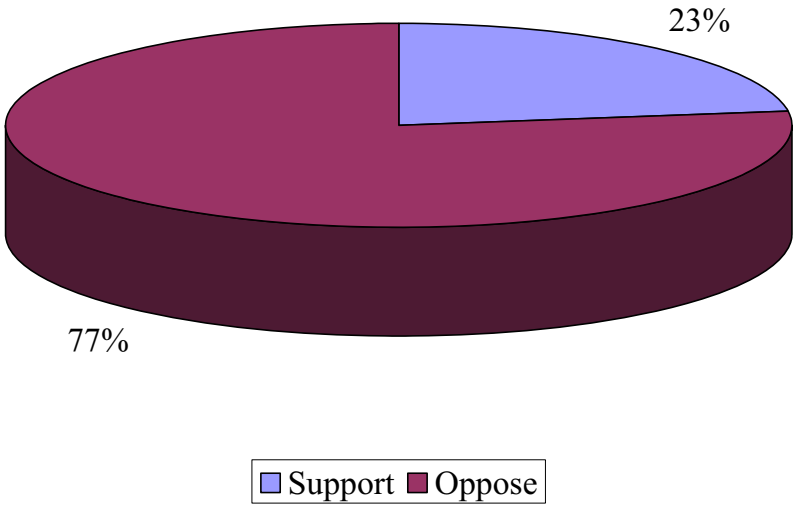
		The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain in Southern Nevada. If given the opportunity to vote on this matter, would your vote support or oppose locating a nuclear waste repository at Yucca Mountain?	The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you strongly agree, agree, disagree, or strongly disagree with this claim?	Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative effect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.
N	Valid	584	578	580
	Missing	15	21	20
Mean		1.77	3.04	2.62
Std. Error of Mean		0.017	0.039	0.027
Median		2	3	3
Mode		2	4	3
Std. Deviation		0.419	0.931	0.642
Skewness		-1.308	-0.537	-1.438
Std. Error of Skewness		0.101	0.102	0.101
Kurtosis		-0.29	-0.786	0.814
Std. Error of Kurtosis		0.202	0.203	0.203
Range		1	3	2
Minimum		1	1	1
Maximum		2	4	3

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Quality of Life Measures

The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain in Southern Nevada. If given the opportunity to vote on this matter, would your vote support or oppose locating a nuclear waste repository at Yucca Mountain?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Support	132	22.1	22.1	22.1
	Oppose	452	75.3	75.3	97.4
	DK/No answer	15	2.6	2.6	100
	Total	600	100	100	

If Given the Opportunity to Vote on Yucca Mountain, Would Your Vote Support or Oppose Locating a Nuclear Waste Repository at Yucca Mountain



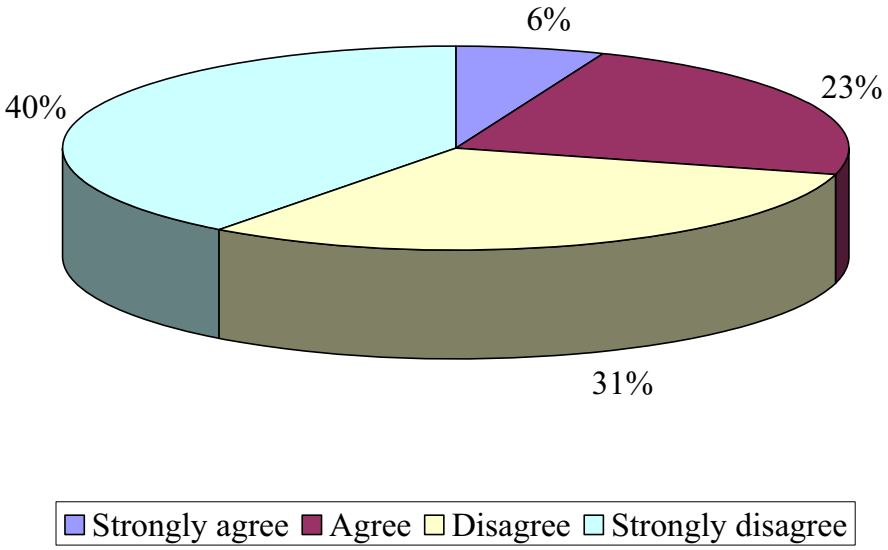
Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Quality of Life Measures

The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you strongly agree, agree, disagree, or strongly disagree with this claim?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	35	5.8	5.8	5.8
	Agree	134	22.3	22.3	28.1
	Disagree	181	30.2	30.2	58.3
	Strongly disagree	229	38.2	38.2	96.5
	DK/No answer	21	3.5	3.5	100
	Total	600	100	100	

Do You Strongly Agree, Agree, Disagree, or Strongly Disagree
With this Claim?



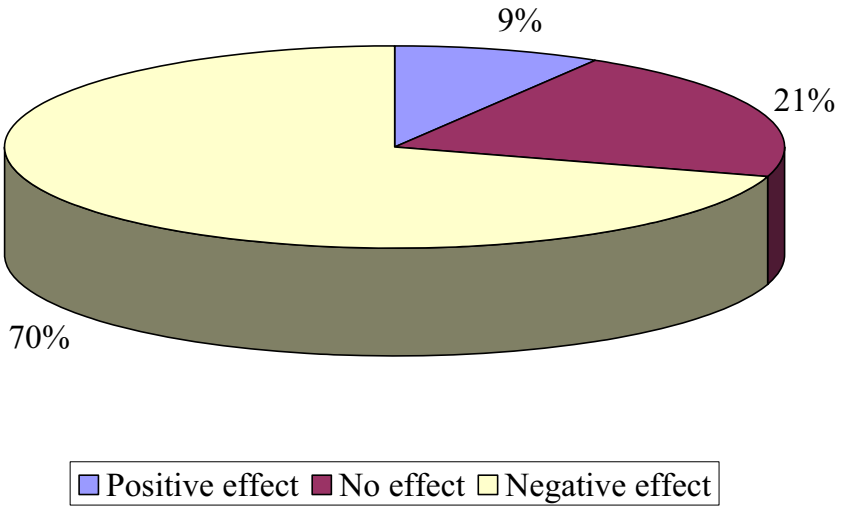
Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Quality of Life Measures

Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative effect on the quality of life of Southern Nevada residents? If you feel it will have no effect you can tell me that too.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Positive effect	51	8.5	8.5	8.5
	No effect	121	20.2	20.2	28.6
	Negative effect	408	68.1	68.1	96.7
	DK/No answer	20	3.3	3.3	100
	Total	600	100	100	

Do you Believe the Storage of High-level Nuclear Waste at Yucca Mountain Will Have a Positive or Negative Effect on the Quality of Life of Southern Nevada Residents? If You Feel it Will Have No Effect You Can Tell Me That Too.



Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Quality of Life Measures Jurisdictional Summary Statistics

Unincorporated Clark County		The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain in Southern Nevada. If given the opportunity to vote on this matter, would your vote support or oppose locating a nuclear waste repository at Yucca Mountain?	The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you strongly agree, agree, disagree, or strongly disagree with this claim?	Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative effect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.
N	Valid	249	252	252
	Missing	11	8	8
Mean		1.78	3.08	2.62
Std. Error of Mean		.026	.059	.041
Median		2.00	3.00	3.00
Mode		2	4	3
Std. Deviation		.415	.931	.644
Skewness		-1.359	-.558	-1.443
Std. Error of Skewness		.154	.153	.153
Kurtosis		-.156	-.831	.830
Std. Error of Kurtosis		.307	.306	.305
Range		1	3	2
Minimum		1	1	1
Maximum		2	4	3

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Quality of Life Measures Jurisdictional Summary Statistics

City of Las Vegas		The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain in Southern Nevada. If given the opportunity to vote on this matter, would your vote support or oppose locating a nuclear waste repository at Yucca Mountain?	The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you strongly agree, agree, disagree, or strongly disagree with this claim?	Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative effect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.
N	Valid	190	187	190
	Missing	3	6	3
Mean		1.79	3.01	2.58
Std. Error of Mean		.030	.070	.049
Median		2.00	3.00	3.00
Mode		2	4	3
Std. Deviation		.410	.954	.676
Skewness		-1.421	-.555	-1.341
Std. Error of Skewness		.176	.177	.176
Kurtosis		.020	-.750	.453
Std. Error of Kurtosis		.351	.353	.351
Range		1	3	2
Minimum		1	1	1
Maximum		2	4	3

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Quality of Life Measures Jurisdictional Summary Statistics

City of North Las Vegas		The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain in Southern Nevada. If given the opportunity to vote on this matter, would your vote support or oppose locating a nuclear waste repository at Yucca Mountain?	The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you strongly agree, agree, disagree, or strongly disagree with this claim?	Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative effect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.
N	Valid	67	62	62
	Missing	1	5	6
Mean		1.73	2.87	2.72
Std. Error of Mean		.055	.120	.071
Median		2.00	3.00	3.00
Mode		2	3	3
Std. Deviation		.447	.944	.558
Skewness		-1.066	-.368	-1.911
Std. Error of Skewness		.294	.303	.304
Kurtosis		-.892	-.800	2.775
Std. Error of Kurtosis		.580	.598	.600
Range		1	3	2
Minimum		1	1	1
Maximum		2	4	3

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Quality of Life Measures Jurisdictional Summary Statistics

Henderson		The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain in Southern Nevada. If given the opportunity to vote on this matter, would your vote support or oppose locating a nuclear waste repository at Yucca Mountain?	The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you strongly agree, agree, disagree, or strongly disagree with this claim?	Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative effect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.
N	Valid	66	65	65
	Missing	0	2	2
Mean		1.73	3.12	2.59
Std. Error of Mean		.055	.112	.078
Median		2.00	3.00	3.00
Mode		2	4	3
Std. Deviation		.445	.899	.626
Skewness		-1.090	-.504	-1.259
Std. Error of Skewness		.296	.298	.298
Kurtosis		-.839	-.957	.529
Std. Error of Kurtosis		.584	.588	.588
Range		1	3	2
Minimum		1	1	1
Maximum		2	4	3

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Quality of Life Measures Jurisdictional Summary Statistics

Boulder City		The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain in Southern Nevada. If given the opportunity to vote on this matter, would your vote support or oppose locating a nuclear waste repository at Yucca Mountain?	The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you strongly agree, agree, disagree, or strongly disagree with this claim?	Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative effect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.
N	Valid	9	9	7
	Missing	0	0	2
Mean		1.82	3.34	3.00
Std. Error of Mean		.138	.172	.000
Median		2.00	3.00	3.00
Mode		2	3	3
Std. Deviation		.406	.504	.000
Skewness		-2.068	.823	
Std. Error of Skewness		.729	.729	.789
Kurtosis		2.912	-1.821	
Std. Error of Kurtosis		1.428	1.428	1.575
Range		1	1	0
Minimum		1	3	3
Maximum		2	4	3

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Quality of Life Measures Jurisdictional Summary Statistics

Mesquite		The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain in Southern Nevada. If given the opportunity to vote on this matter, would your vote support or oppose locating a nuclear waste repository at Yucca Mountain?	The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you strongly agree, agree, disagree, or strongly disagree with this claim?	Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative effect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.
N	Valid	4	3	4
	Missing	0	0	0
Mean		1.88	3.14	2.52
Std. Error of Mean		.191	.402	.411
Median		2.00	3.00	3.00
Mode		2	3	3
Std. Deviation		.378	.744	.812
Skewness		-4.126	-.220	-1.975
Std. Error of Skewness		1.028	1.108	1.028
Range		1	2	2
Minimum		1	2	1
Maximum		2	4	3

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Quality of Life Measures Jurisdictional Cross-tabulations

Respondent Jurisdiction * The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain in Southern Nevada. If given the opportunity to vote on this matter, would your vote support or oppose locating a nuclear waste repository at Yucca Mountain?

			The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain in Southern Nevada. If given the opportunity to vote on this matter, would your vote support or oppose locating a nuclear waste repository at Yucca Mountain?		
			Support	Oppose	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	55	195	250
		% within Respondent Jurisdiction	22.0%	78.0%	100.0%
	City of Las Vegas	Count	40	150	190
		% within Respondent Jurisdiction	21.1%	78.9%	100.0%
	City of North Las Vegas	Count	18	49	67
		% within Respondent Jurisdiction	26.9%	73.1%	100.0%
	City of Henderson	Count	17	48	65
		% within Respondent Jurisdiction	26.2%	73.8%	100.0%
	Boulder City	Count	2	7	9
		% within Respondent Jurisdiction	22.2%	77.8%	100.0%
	Mesquite	Count	0	3	3
		% within Respondent Jurisdiction	.0%	100.0%	100.0%
Total		Count	132	452	584
		% within Respondent Jurisdiction	22.6%	77.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.354(a)	5	.798
Likelihood Ratio	2.976	5	.704
Linear-by-Linear Association	.307	1	.579
N of Valid Cases	584		

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Quality of Life Measures Jurisdictional Cross-tabulations

Respondent Jurisdiction * The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you strongly agree, agree, disagree, or strongly disagree with this claim?

			The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you strongly agree, agree, disagree, or strongly disagree with this claim?				
			Strongly agree	Agree	Disagree	Strongly disagree	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	13	60	72	107	252
		% within Respondent Jurisdiction	5.2%	23.8%	28.6%	42.5%	100.0%
	City of Las Vegas	Count	14	41	60	72	187
		% within Respondent Jurisdiction	7.5%	21.9%	32.1%	38.5%	100.0%
	City of North Las Vegas	Count	5	16	22	19	62
		% within Respondent Jurisdiction	8.1%	25.8%	35.5%	30.6%	100.0%
	City of Henderson	Count	2	16	18	28	64
		% within Respondent Jurisdiction	3.1%	25.0%	28.1%	43.8%	100.0%
	Boulder City	Count	0	0	6	3	9
		% within Respondent Jurisdiction	.0%	.0%	66.7%	33.3%	100.0%
	Mesquite	Count	0	0	2	1	3
		% within Respondent Jurisdiction	.0%	.0%	66.7%	33.3%	100.0%
Total		Count	34	133	180	230	577
		% within Respondent Jurisdiction	5.9%	23.1%	31.2%	39.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.522(a)	15	.486
Likelihood Ratio	16.966	15	.321
Linear-by-Linear Association	.008	1	.930
N of Valid Cases	577		

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Quality of Life Measures Jurisdictional Cross-tabulations

Respondent Jurisdiction * Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative effect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.

			Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative effect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.			
			Positive effect	No effect	Negative effect	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	22	52	178	252
		% within Respondent Jurisdiction	8.7%	20.6%	70.6%	100.0%
	City of Las Vegas	Count	20	39	131	190
		% within Respondent Jurisdiction	10.5%	20.5%	68.9%	100.0%
	City of North Las Vegas	Count	3	11	48	62
		% within Respondent Jurisdiction	4.8%	17.7%	77.4%	100.0%
	City of Henderson	Count	5	17	43	65
		% within Respondent Jurisdiction	7.7%	26.2%	66.2%	100.0%
	Boulder City	Count	0	0	7	7
		% within Respondent Jurisdiction	.0%	.0%	100.0%	100.0%
	Mesquite	Count	0	1	2	3
		% within Respondent Jurisdiction	.0%	33.3%	66.7%	100.0%
Total		Count	50	120	409	579
		% within Respondent Jurisdiction	8.6%	20.7%	70.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.157(a)	10	.711
Likelihood Ratio	9.420	10	.493
Linear-by-Linear Association	.413	1	.521
N of Valid Cases	579		

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Willingness to Pay Measures

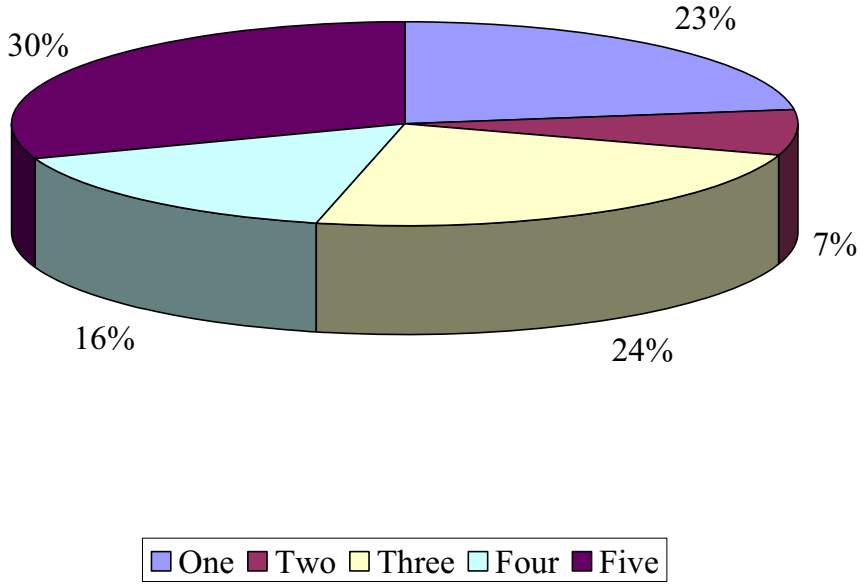
The U.S. Department of Energy plans to submit a license application in order to gain approval for the storage of high level nuclear waste at Yucca Mountain. If the State of Nevada, Clark County, and other local governments in Nevada want to formally oppose the storage of nuclear waste at Yucca Mountain by participating in government hearings, it may cost millions of dollars over a period of several years to do so. I am going to read you four statements. After I finish with each statement, please tell me, on a scale of one to five, where one means "I strongly disagree" and five means "I strongly agree", how much you disagree or agree with each statement.

		The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application hearings, even if it means participation is funded only by dollars provided to local and/or state government specifically for the purpose of Yucca Mountain oversight activities.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, even if it means participation is funded only by local taxpayer dollars.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, even if it means participation is partially funded by local taxpayer dollars.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, but I do not support the use of any local taxpayer dollars to do so.
N	Valid	582	580	580	579
	Missing	18	20	20	20
Mean		3.24	2.82	3.05	3.21
Std. Error of Mean		.063	.066	.065	.067
Median		3.00	3.00	3.00	3.00
Mode		5	1	1	5
Std. Deviation		1.519	1.598	1.568	1.621
Skewness		-.281	.169	-.104	-.190
Std. Error of Skewness		.101	.101	.101	.102
Kurtosis		-1.327	-1.526	-1.493	-1.564
Std. Error of Kurtosis		.202	.203	.203	.203
Range		4	4	4	4
Minimum		1	1	1	1
Maximum		5	5	5	5

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Willingness to Pay Measures

The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application hearings, <u>even if it means participation is funded only by dollars provided to local and/or state government specifically for the purpose of Yucca Mountain oversight activities</u>.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	One	132	22.1	22.1	22.1
	Two	42	7.1	7.1	29.1
	Three	137	22.8	22.8	51.9
	Four	93	15.4	15.4	67.4
	Five	178	29.6	29.6	97
	DK/No answer	18	3	3	100
	Total	600	100	100	

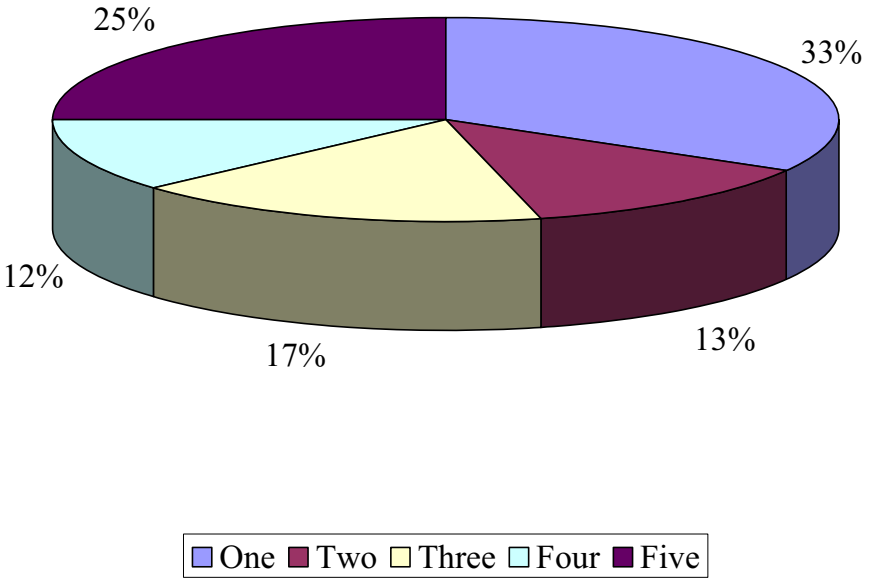


Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Willingness to Pay Measures

The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, <u>even if it means participation is funded only by local taxpayer dollars</u>.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	One	194	32.3	32.3	32.3
	Two	73	12.3	12.3	44.6
	Three	100	16.7	16.7	61.2
	Four	67	11.2	11.2	72.5
	Five	145	24.2	24.2	96.7
	DK/No answer	20	3.3	3.3	100
	Total	600	100	100	

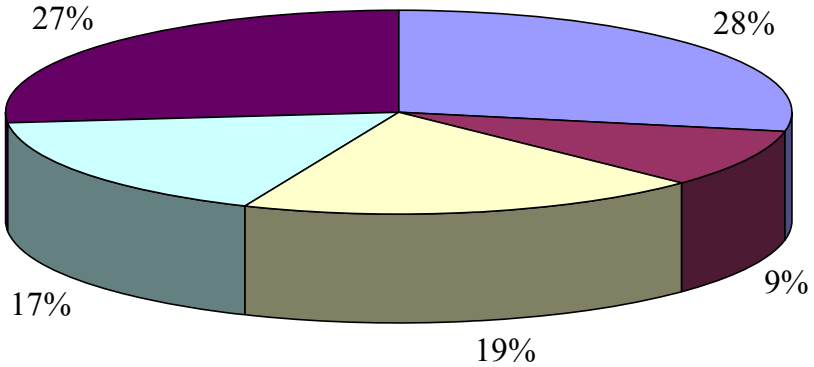


Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Willingness to Pay Measures

The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, <u>even if it means participation is partially funded by local taxpayer dollars</u>.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	One	163	27.1	27.1	27.1
	Two	53	8.9	8.9	36
	Three	111	18.5	18.5	54.5
	Four	97	16.2	16.2	70.7
	Five	156	26	26	96.7
	DK/No answer	20	3.3	3.3	100
	Total	600	100	100	



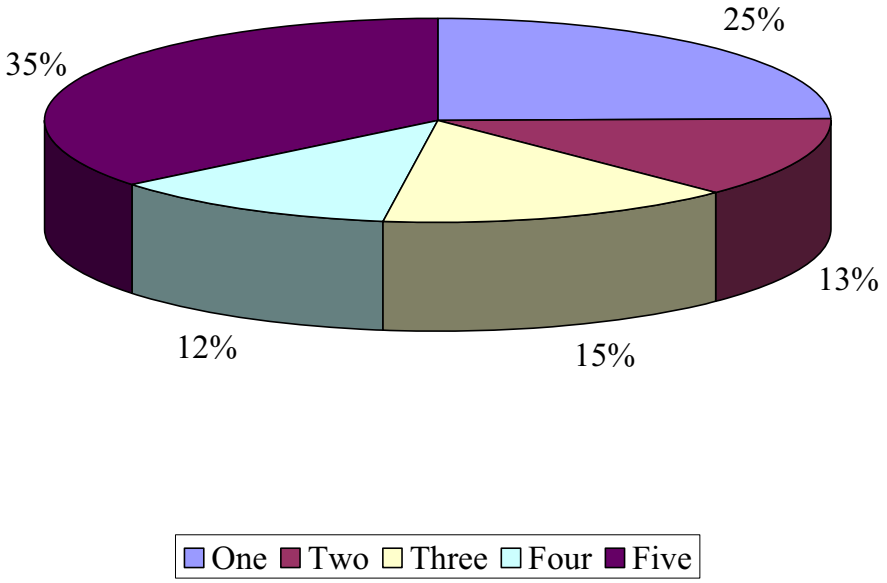
One Two Three Four Five

Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Willingness to Pay Measures

The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, <u>but I do not support the use of any local taxpayer dollars to do so</u>.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	One	143	23.9	23.9	23.9
	Two	74	12.4	12.4	36.3
	Three	85	14.3	14.3	50.5
	Four	69	11.5	11.5	62
	Five	208	34.6	34.6	96.6
	DK/No answer	20	3.4	3.4	100
	Total	600	100	100	



Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Willingness to Pay Measures Jurisdictional Summary Statistics

Unincorporated Clark County		The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application hearings, even if it means participation is funded only by dollars provided to local and/or state government specifically for the purpose of Yucca Mountain oversight activities.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, even if it means participation is funded only by local taxpayer dollars.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, even if it means participation is partially funded by local taxpayer dollars.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, but I do not support the use of any local taxpayer dollars to do so.
N	Valid	254	252	252	256
	Missing	7	8	8	4
Mean		3.27	2.79	3.01	3.24
Std. Error of Mean		.094	.101	.100	.103
Median		3.00	3.00	3.00	3.65
Mode		5	1	1	5
Std. Deviation		1.498	1.606	1.594	1.654
Skewness		-.369	.174	-.088	-.238
Std. Error of Skewness		.153	.153	.153	.152
Kurtosis		-1.234	-1.531	-1.540	-1.593
Std. Error of Kurtosis		.305	.305	.305	.303
Range		4	4	4	4
Minimum		1	1	1	1
Maximum		5	5	5	5

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Willingness to Pay Measures Jurisdictional Summary Statistics

City of Las Vegas		The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application hearings, even if it means participation is funded only by dollars provided to local and/or state government specifically for the purpose of Yucca Mountain oversight activities.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, even if it means participation is funded only by local taxpayer dollars.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, even if it means participation is partially funded by local taxpayer dollars.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, but I do not support the use of any local taxpayer dollars to do so.
N	Valid	191	188	188	188
	Missing	2	5	4	5
Mean		3.28	2.86	3.11	3.32
Std. Error of Mean		.112	.118	.116	.113
Median		3.00	3.00	3.00	3.00
Mode		5	1	5	5
Std. Deviation		1.552	1.627	1.587	1.547
Skewness		-.277	.159	-.105	-.278
Std. Error of Skewness		.176	.177	.177	.177
Kurtosis		-1.418	-1.587	-1.527	-1.422
Std. Error of Kurtosis		.350	.352	.352	.353
Range		4	4	4	4
Minimum		1	1	1	1
Maximum		5	5	5	5

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Willingness to Pay Measures Jurisdictional Summary Statistics

City of North Las Vegas		The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application hearings, even if it means participation is funded only by dollars provided to local and/or state government specifically for the purpose of Yucca Mountain oversight activities.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, even if it means participation is funded only by local taxpayer dollars.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, even if it means participation is partially funded by local taxpayer dollars.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, but I do not support the use of any local taxpayer dollars to do so.
N	Valid	64	64	64	62
	Missing	4	4	4	5
Mean		3.33	2.77	3.15	2.82
Std. Error of Mean		.185	.205	.185	.209
Median		3.00	3.00	3.00	3.00
Mode		5	1	1	1
Std. Deviation		1.475	1.637	1.482	1.653
Skewness		-.254	.222	-.261	.224
Std. Error of Skewness		.300	.300	.300	.303
Kurtosis		-1.216	-1.590	-1.283	-1.586
Std. Error of Kurtosis		.591	.591	.591	.598
Range		4	4	4	4
Minimum		1	1	1	1
Maximum		5	5	5	5

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Willingness to Pay Measures Jurisdictional Summary Statistics

Henderson		The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application hearings, even if it means participation is funded only by dollars provided to local and/or state government specifically for the purpose of Yucca Mountain oversight activities.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, even if it means participation is funded only by local taxpayer dollars.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, even if it means participation is partially funded by local taxpayer dollars.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, but I do not support the use of any local taxpayer dollars to do so.
N	Valid	61	62	62	61
	Missing	5	4	4	5
Mean		2.76	2.81	2.86	3.27
Std. Error of Mean		.191	.187	.187	.206
Median		3.00	3.00	3.00	3.80
Mode		1	1	1	5
Std. Deviation		1.489	1.477	1.476	1.608
Skewness		.129	.207	.018	-.205
Std. Error of Skewness		.307	.303	.303	.307
Kurtosis		-1.309	-1.270	-1.391	-1.608
Std. Error of Kurtosis		.605	.598	.598	.605
Range		4	4	4	4
Minimum		1	1	1	1
Maximum		5	5	5	5

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Willingness to Pay Measures Jurisdictional Summary Statistics

Boulder City		The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application hearings, even if it means participation is funded only by dollars provided to local and/or state government specifically for the purpose of Yucca Mountain oversight activities.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, even if it means participation is funded only by local taxpayer dollars.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, even if it means participation is partially funded by local taxpayer dollars.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, but I do not support the use of any local taxpayer dollars to do so.
N	Valid	9	9	9	9
	Missing	0	0	0	0
Mean		4.54	3.48	4.05	2.56
Std. Error of Mean		.281	.461	.487	.638
Median		5.00	4.00	5.00	1.65
Mode		5	4	5	1
Std. Deviation		.826	1.354	1.430	1.873
Skewness		-1.538	-.719	-1.152	.536
Std. Error of Skewness		.729	.729	.729	.729
Kurtosis		.893	-.184	-.055	-1.861
Std. Error of Kurtosis		1.428	1.428	1.428	1.428
Range		2	4	4	4
Minimum		3	1	1	1
Maximum		5	5	5	5

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Willingness to Pay Measures Jurisdictional Summary Statistics

Mesquite		The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application hearings, even if it means participation is funded only by dollars provided to local and/or state government specifically for the purpose of Yucca Mountain oversight activities.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, even if it means participation is funded only by local taxpayer dollars.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, even if it means participation is partially funded by local taxpayer dollars.	The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, but I do not support the use of any local taxpayer dollars to do so.
N	Valid	4	4	4	4
	Missing	0	0	0	0
Mean		2.69	2.21	2.33	2.93
Std. Error of Mean		.964	.998	.875	.981
Median		2.91	1.00	1.91	3.46
Mode		1	1	1	1
Std. Deviation		1.904	1.970	1.728	1.937
Skewness		.524	1.518	.930	-.155
Std. Error of Skewness		1.028	1.028	1.028	1.028
Range		4	4	4	4
Minimum		1	1	1	1
Maximum		5	5	5	5

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Willingness to Pay Measures Jurisdictional Cross-tabulations

Respondent Jurisdiction * The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application hearings, <u>even if it means participation is funded only by dollars provided to local and/or state government specifically for the purpose of Yucca Mountain oversight activities</u>.

			The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application hearings, even if it means participation is funded only by dollars provided to local and/or state government specifically for the purpose of Yucca Mountain oversight activities.					
			One	Two	Three	Four	Five	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	58	12	60	51	73	254
		% within Respondent Jurisdiction	22.8%	4.7%	23.6%	20.1%	28.7%	100.0%
	City of Las Vegas	Count	41	22	35	29	64	191
		% within Respondent Jurisdiction	21.5%	11.5%	18.3%	15.2%	33.5%	100.0%
	City of North Las Vegas	Count	11	5	21	4	22	63
		% within Respondent Jurisdiction	17.5%	7.9%	33.3%	6.3%	34.9%	100.0%
	City of Henderson	Count	20	3	19	7	11	60
		% within Respondent Jurisdiction	33.3%	5.0%	31.7%	11.7%	18.3%	100.0%
	Boulder City	Count	0	0	2	1	6	9
		% within Respondent Jurisdiction	.0%	.0%	22.2%	11.1%	66.7%	100.0%
	Mesquite	Count	2	0	0	0	1	3
		% within Respondent Jurisdiction	66.7%	.0%	.0%	.0%	33.3%	100.0%
Total		Count	132	42	137	92	177	580
		% within Respondent Jurisdiction	22.8%	7.2%	23.6%	15.9%	30.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	39.744(a)	20	.005
Likelihood Ratio	42.439	20	.002
Linear-by-Linear Association	.880	1	.348
N of Valid Cases	580		

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Willingness to Pay Measures Jurisdictional Cross-tabulations

Respondent Jurisdiction * The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, <u>even if it means participation is funded only by local taxpayer dollars</u>.

			The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, <u>even if it means participation is funded only by local taxpayer dollars</u>.					
			One	Two	Three	Four	Five	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	90	24	47	29	61	251
		% within Respondent Jurisdiction	35.9%	9.6%	18.7%	11.6%	24.3%	100.0%
	City of Las Vegas	Count	60	30	25	21	52	188
		% within Respondent Jurisdiction	31.9%	16.0%	13.3%	11.2%	27.7%	100.0%
	City of North Las Vegas	Count	23	8	9	8	16	64
		% within Respondent Jurisdiction	35.9%	12.5%	14.1%	12.5%	25.0%	100.0%
	City of Henderson	Count	17	9	17	6	13	62
		% within Respondent Jurisdiction	27.4%	14.5%	27.4%	9.7%	21.0%	100.0%
	Boulder City	Count	1	1	2	3	2	9
		% within Respondent Jurisdiction	11.1%	11.1%	22.2%	33.3%	22.2%	100.0%
	Mesquite	Count	2	0	0	0	1	3
		% within Respondent Jurisdiction	66.7%	.0%	.0%	.0%	33.3%	100.0%
Total		Count	193	72	100	67	145	577
		% within Respondent Jurisdiction	33.4%	12.5%	17.3%	11.6%	25.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.913(a)	20	.463
Likelihood Ratio	19.821	20	.469
Linear-by-Linear Association	.160	1	.689
N of Valid Cases	577		

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Willingness to Pay Measures Jurisdictional Cross-tabulations

Respondent Jurisdiction * The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, <u>even if it means participation is partially funded by local taxpayer dollars</u>.

			The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, <u>even if it means participation is partially funded by local taxpayer dollars</u>.					
			One	Two	Three	Four	Five	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	79	17	46	45	65	252
		% within Respondent Jurisdiction	31.3%	6.7%	18.3%	17.9%	25.8%	100.0%
	City of Las Vegas	Count	48	24	34	25	58	189
		% within Respondent Jurisdiction	25.4%	12.7%	18.0%	13.2%	30.7%	100.0%
	City of North Las Vegas	Count	15	5	15	14	15	64
		% within Respondent Jurisdiction	23.4%	7.8%	23.4%	21.9%	23.4%	100.0%
	City of Henderson	Count	18	7	13	13	11	62
		% within Respondent Jurisdiction	29.0%	11.3%	21.0%	21.0%	17.7%	100.0%
	Boulder City	Count	0	1	2	0	6	9
		% within Respondent Jurisdiction	.0%	11.1%	22.2%	.0%	66.7%	100.0%
	Mesquite	Count	2	0	1	0	0	3
		% within Respondent Jurisdiction	66.7%	.0%	33.3%	.0%	.0%	100.0%
Total		Count	162	54	111	97	155	579
		% within Respondent Jurisdiction	28.0%	9.3%	19.2%	16.8%	26.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.975(a)	20	.136
Likelihood Ratio	30.592	20	.061
Linear-by-Linear Association	.075	1	.785
N of Valid Cases	579		

Appendix VII
Yucca Mountain Considerations
Yucca Mountain Willingness to Pay Measures Jurisdictional Cross-tabulations

Respondent Jurisdiction * The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, but I do not support the use of any local taxpayer dollars to do so.

			The storage of nuclear waste at Yucca Mountain is an important issue for Clark County, and I believe Clark County should formally participate in the Yucca Mountain license application government hearings, but I do not support the use of any local taxpayer dollars to do so.					
			One	Two	Three	Four	Five	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	67	28	33	32	96	256
		% within Respondent Jurisdiction	26.2%	10.9%	12.9%	12.5%	37.5%	100.0%
	City of Las Vegas	Count	37	25	35	23	68	188
		% within Respondent Jurisdiction	19.7%	13.3%	18.6%	12.2%	36.2%	100.0%
	City of North Las Vegas	Count	21	9	10	4	18	62
		% within Respondent Jurisdiction	33.9%	14.5%	16.1%	6.5%	29.0%	100.0%
	City of Henderson	Count	12	12	6	8	22	60
		% within Respondent Jurisdiction	20.0%	20.0%	10.0%	13.3%	36.7%	100.0%
	Boulder City	Count	4	0	2	0	3	9
		% within Respondent Jurisdiction	44.4%	.0%	22.2%	.0%	33.3%	100.0%
	Mesquite	Count	2	0	0	1	1	4
		% within Respondent Jurisdiction	50.0%	.0%	.0%	25.0%	25.0%	100.0%
Total		Count	143	74	86	68	208	579
		% within Respondent Jurisdiction	24.7%	12.8%	14.9%	11.7%	35.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.206(a)	20	.385
Likelihood Ratio	23.809	20	.251
Linear-by-Linear Association	1.067	1	.302
N of Valid Cases	579		

Appendix VIII

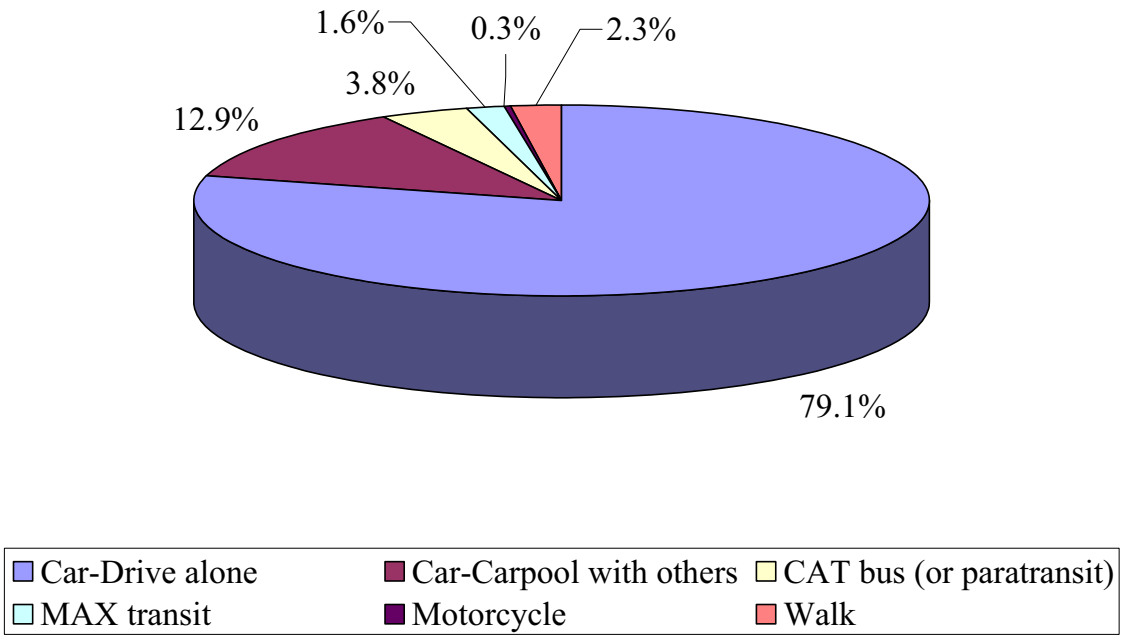
Community Profile

Appendix VIII
Community Profile

What is your most frequently used mode of transportation?

		Frequency	Valid Percent
Valid	Car-Drive alone	474	79.0
	Car-Carpool with others	77	12.8
	CAT bus (or paratransit)	22	3.7
	MAX transit	9	1.6
	Motorcycle	2	.3
	Walk	14	2.3
	DK/No answer	2	.3
	Total	600	100.0

What is Your Most Frequently Used Mode of Transportation?



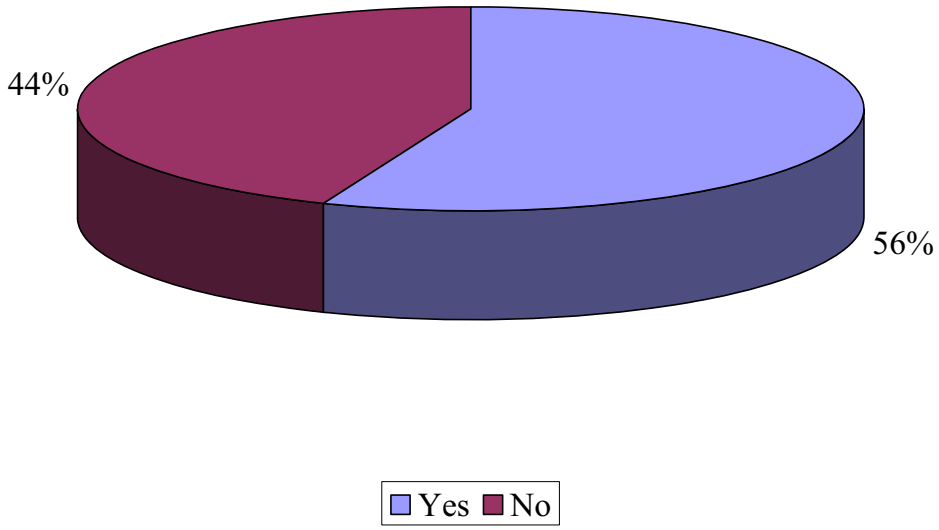
Note- Graph does not include Don't Know/ No Answer

Appendix VIII
Community Profile

Do you currently commute on a daily basis?

		Frequency	Valid Percent
Valid	Yes	336	56.0
	No	263	43.9
	DK/No answer	1	.2
	Total	600	100.0

Do You Currently Commute on a Daily Basis?



Note- Graph does not include Don't Know/ No Answer

Appendix VIII
Community Profile
Jurisdictional Cross-tabulation

Respondent Jurisdiction: * What is your most frequently used mode of transportation?

			What is your most frequently used mode of transportation?						
			Car-Drive alone	Car-Carpool with others	CAT bus (or paratransit)	MAX transit	Motorcycle	Walk	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	209	28	14	2	0	9	262
		% within Respondent Jurisdiction	79.8%	10.7%	5.3%	.8%	.0%	3.4%	100.0%
	City of Las Vegas	Count	158	23	2	3	0	5	191
		% within Respondent Jurisdiction	82.7%	12.0%	1.0%	1.6%	.0%	2.6%	100.0%
	City of North Las Vegas	Count	46	12	5	4	0	0	67
		% within Respondent Jurisdiction	68.7%	17.9%	7.5%	6.0%	.0%	.0%	100.0%
	City of Henderson	Count	54	8	2	0	1	0	65
		% within Respondent Jurisdiction	83.1%	12.3%	3.1%	.0%	1.5%	.0%	100.0%
	Boulder City	Count	3	5	0	0	0	0	8
		% within Respondent Jurisdiction	37.5%	62.5%	.0%	.0%	.0%	.0%	100.0%
	Mesquite	Count	4	0	0	0	0	0	4
		% within Respondent Jurisdiction	100.0%	.0%	.0%	.0%	.0%	.0%	100.0%
Total		Count	474	76	23	9	1	14	597
		% within Respondent Jurisdiction	79.4%	12.7%	3.9%	1.5%	.2%	2.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	53.937(a)	25	.001
Likelihood Ratio	45.610	25	.007
Linear-by-Linear Association	.430	1	.512
N of Valid Cases	597		

Appendix VIII
Community Profile
Jurisdictional Cross-tabulation

Respondent Jurisdiction: * Do you currently commute on a daily basis?

			Do you currently commute on a daily basis?		
			Yes	No	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	140	121	261
		% within Respondent Jurisdiction	53.6%	46.4%	100.0%
	City of Las Vegas	Count	109	84	193
		% within Respondent Jurisdiction	56.5%	43.5%	100.0%
	City of North Las Vegas	Count	46	21	67
		% within Respondent Jurisdiction	68.7%	31.3%	100.0%
	City of Henderson	Count	36	30	66
		% within Respondent Jurisdiction	54.5%	45.5%	100.0%
	Boulder City	Count	4	4	8
		% within Respondent Jurisdiction	50.0%	50.0%	100.0%
	Mesquite	Count	0	3	3
		% within Respondent Jurisdiction	.0%	100.0%	100.0%
Total		Count	335	263	598
		% within Respondent Jurisdiction	56.0%	44.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.956(a)	5	.111
Likelihood Ratio	10.205	5	.070
Linear-by-Linear Association	.119	1	.730
N of Valid Cases	598		

Appendix IX

Local Government Interaction

Appendix IX
Local Government Interaction General Impressions
Summary Statistics

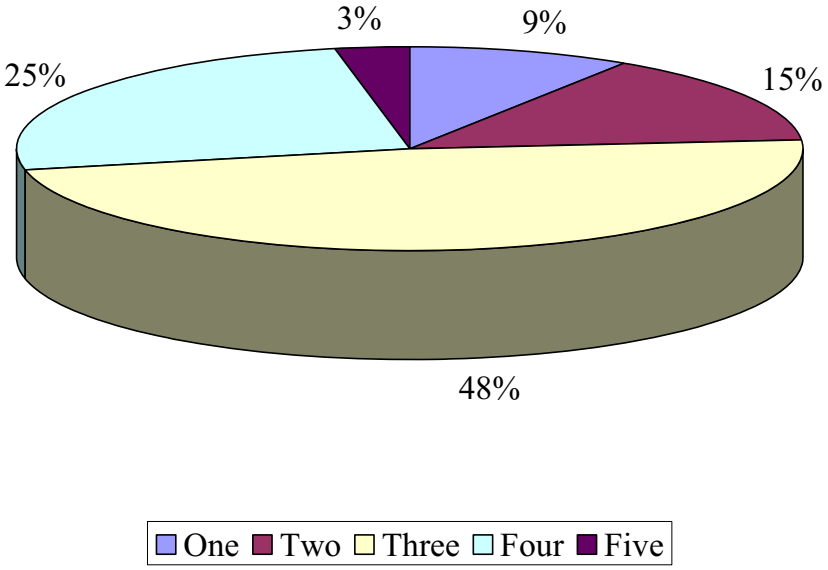
		On a scale of one to five, where one equals poor and five equals excellent, what is your impression of Clark County government?	Have you ever inquired about or accessed services from Clark County?	How often do you interact with Clark County government?	Sometimes citizens confuse government programs and services provided by Clark County with those provided by other local governments, such as the City of Las Vegas. Where one equals "Not at all knowledgeable" and five equals "very knowledgeable", how knowledgeable are you about the difference between programs and services provided by Clark County versus those provided by other local governments, such as the City of Las Vegas?	Do you know who your County Commissioner is?	On a scale of one to five, where one equals "very unsatisfied" and five equals "very satisfied", how satisfied are you with recreational opportunities, such as parks, playgrounds, music festivals and other events offered by Clark County?
N	Valid	592	596	218	594	598	238
	Missing	8	4	382	6	2	362
Mean		2.99	1.63	3.60	2.71	1.75	3.63
Std. Error of Mean		.039	.020	.091	.054	.018	.047
Median		3.00	2.00	4.00	3.00	2.00	4.00
Mode		3	2	4	3	2	3
Std. Deviation		.942	.482	1.345	1.307	.435	1.144
Skewness		-.409	-.559	-.734	.159	-1.141	-.557
Std. Error of Skewness		.100	.100	.165	.100	.100	.101
Kurtosis		-.017	-1.694	-.667	-1.072	-.700	-.305
Std. Error of Kurtosis		.201	.200	.328	.200	.200	.202
Range		4	1	4	4	1	4
Minimum		1	1	1	1	1	1
Maximum		5	2	5	5	2	5

Appendix IX
Local Government Interaction General Impressions

On a scale of one to five, where one equals poor and five equals excellent, what is your impression of Clark County government?

		Frequency	Valid Percent
Valid	One	54	9
	Two	86	14.3
	Three	284	47.4
	Four	150	25
	Five	18	3.1
	DK/No answer	8	1.3
	Total	600	100

What is Your Impression of Clark County Government?



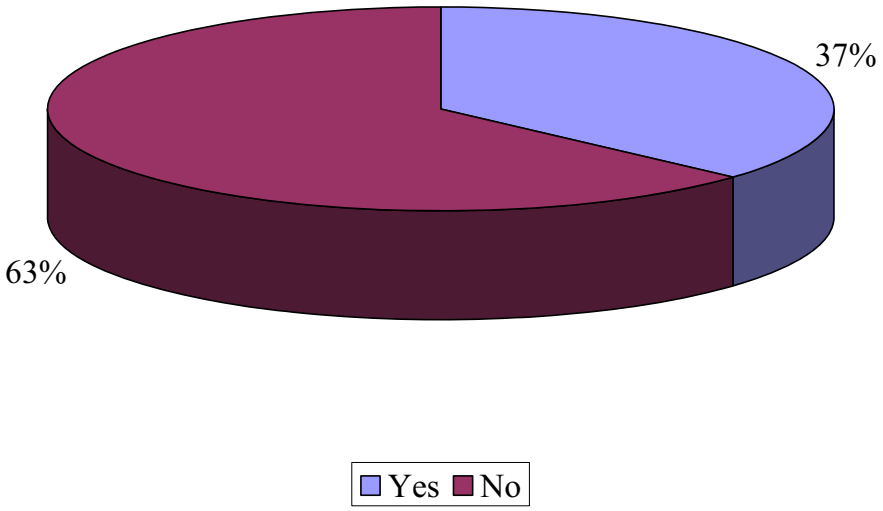
Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction General Impressions

Have you ever inquired about or accessed services from Clark County?

		Frequency	Valid Percent
Valid	Yes	218	36.3
	No	378	63
	DK/No answer	4	0.7
	Total	600	100

Have You Ever Inquired About or Accessed Services from Clark County?



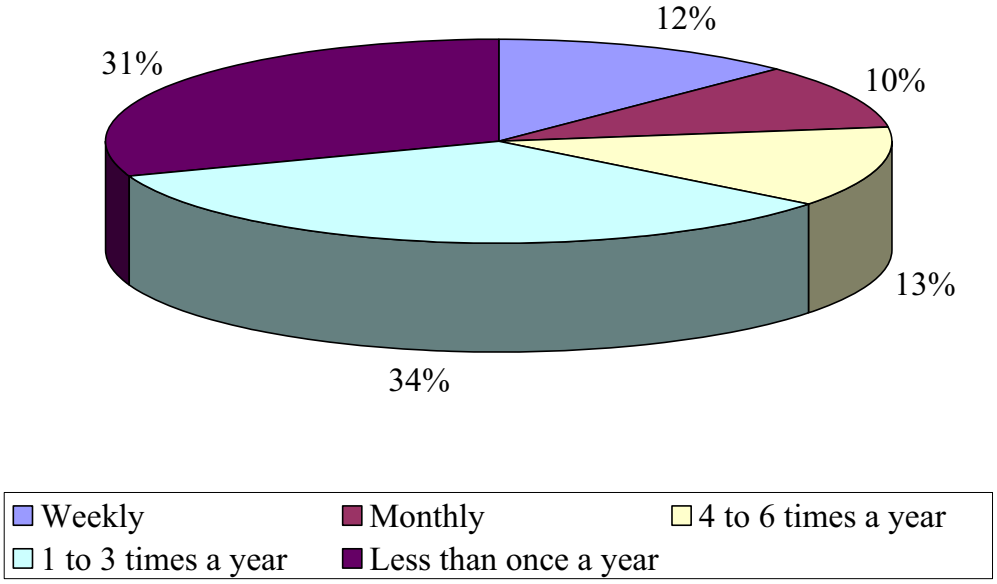
Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction General Impressions

How often do you interact with Clark County government?

		Frequency	Valid Percent
Valid	Weekly	27	12.4
	Monthly	22	10.3
	4 to 6 times a year	28	12.9
	1 to 3 times a year	74	33.8
	Less than once a year	67	30.6
	Total	218	100
Missing	System	382	
Total		600	

How Often Do You Interact with Clark County Government?

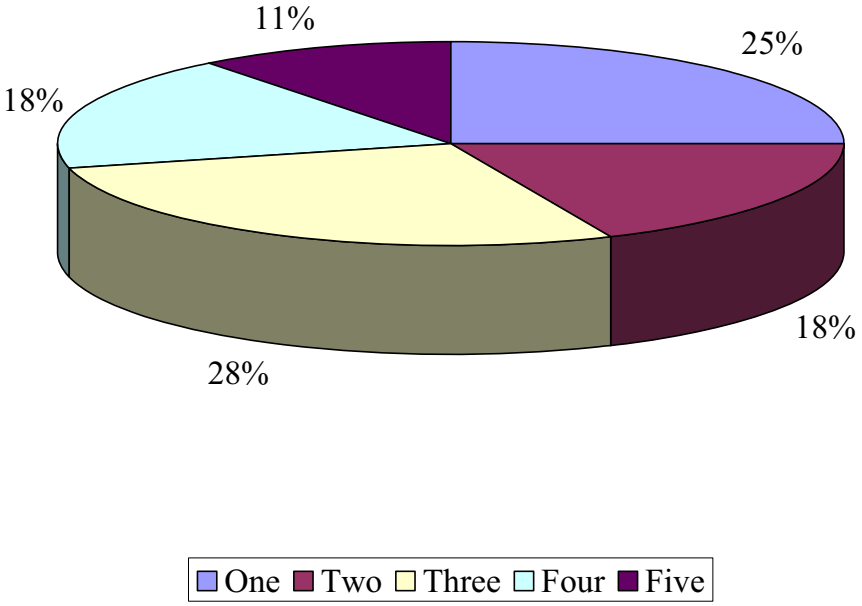


Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction General Impressions

Sometimes citizens confuse government programs and services provided by Clark County with those provided by other local governments, such as the City of Las Vegas. Where one equals "Not at all knowledgeable" and five equals "very knowledgeable", how knowledgeable are you about the difference between programs and services provided by Clark County versus those provided by other local governments, such as the City of Las Vegas?

		Frequency	Valid Percent
Valid	One	149	24.8
	Two	109	18.1
	Three	166	27.6
	Four	108	18
	Five	63	10.5
	DK/No answer	6	1
	Total	600	100



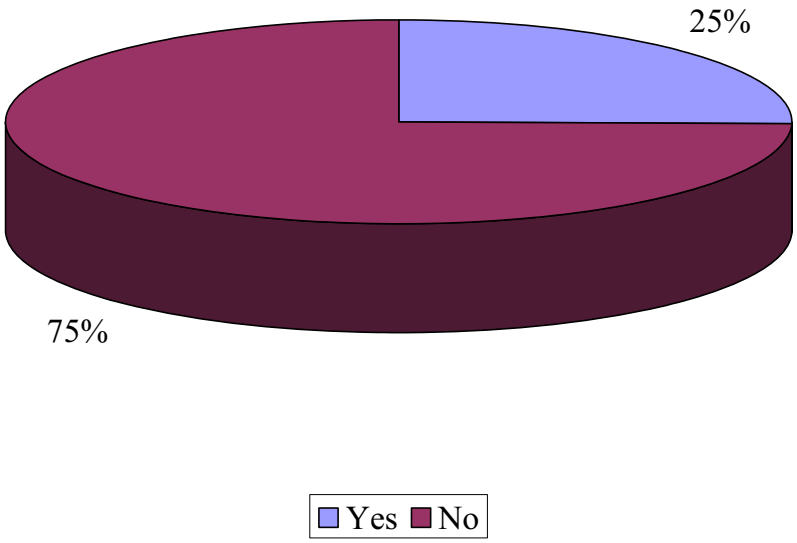
Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction General Impressions

Do you know who your County Commissioner is?

		Frequency	Valid Percent
Valid	Yes	151	25.2
	No	447	74.5
	DK/No answer	2	0.3
	Total	600	100

Do You Know Who Your County Commissioner Is?



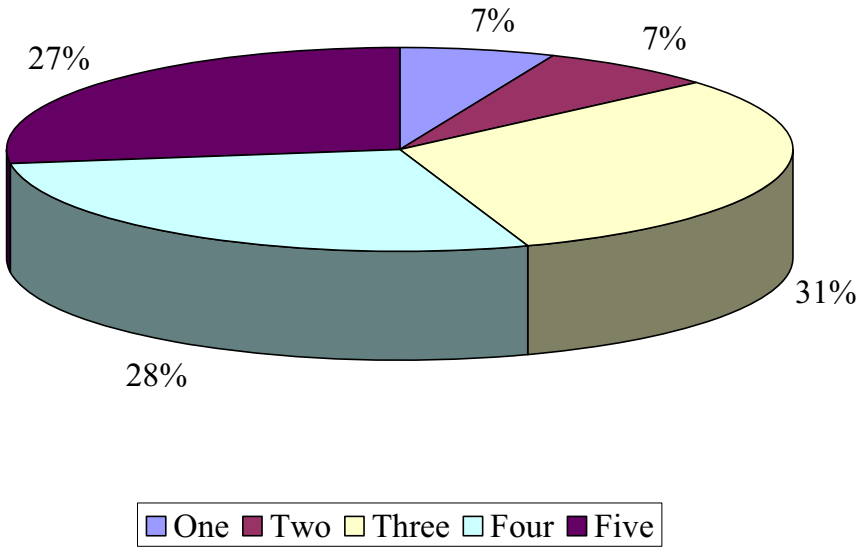
Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction General Impressions

On a scale of one to five, where one equals "very unsatisfied" and five equals "very satisfied", how satisfied are you with recreational opportunities, such as parks, playgrounds, music festivals and other events offered by Clark County?

		Frequency	Valid Percent
Valid	One	38	6.3
	Two	41	6.9
	Three	180	30
	Four	165	27.5
	Five	158	26.3
	DK/No answer	18	3
	Total	600	100

How Satisfied Are You with Recreational Opportunities and Other Events Offered By Clark County?



Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction General Impressions
Jurisdictional Summary Statistics

Unincorporated Clark County		On a scale of one to five, where one equals poor and five equals excellent, what is your impression of Clark County government?	Have you ever inquired about or accessed services from Clark County?	How often do you interact with Clark County government?	Sometimes citizens confuse government programs and services provided by Clark County with those provided by other local governments, such as the City of Las Vegas. Where one equals "Not at all knowledgeable" and five equals "very knowledgeable", how knowledgeable are you about the difference between programs and services provided by Clark County versus those provided by other local governments, such as the City of Las Vegas?	Do you know who your County Commissioner is?	On a scale of one to five, where one equals "very unsatisfied" and five equals "very satisfied", how satisfied are you with recreational opportunities, such as parks, playgrounds, music festivals and other events offered by Clark County?
N	Valid	255	259	104	256	260	252
	Missing	5	1	157	4	0	8
Mean		2.88	1.60	3.44	2.57	1.75	3.60
Std. Error of Mean		.063	.031	.136	.083	.027	.071
Median		3.00	2.00	4.00	3.00	2.00	4.00
Mode		3	2	4	1	2	3
Std. Deviation		1.007	.491	1.387	1.321	.431	1.131
Skewness		-.262	-.409	-.562	.278	-1.188	-.419
Std. Error of Skewness		.152	.151	.237	.152	.151	.153
Kurtosis		-.390	-1.847	-.969	-1.119	-.594	-.471
Std. Error of Kurtosis		.304	.302	.470	.303	.301	.306
Range		4	1	4	4	1	4
Minimum		1	1	1	1	1	1
Maximum		5	2	5	5	2	5

Appendix IX
Local Government Interaction General Impressions
Jurisdictional Summary Statistics

City of Las Vegas		On a scale of one to five, where one equals poor and five equals excellent, what is your impression of Clark County government?	Have you ever inquired about or accessed services from Clark County?	How often do you interact with Clark County government?	Sometimes citizens confuse government programs and services provided by Clark County with those provided by other local governments, such as the City of Las Vegas. Where one equals "Not at all knowledgeable" and five equals "very knowledgeable", how knowledgeable are you about the difference between programs and services provided by Clark County versus those provided by other local governments, such as the City of Las Vegas?	Do you know who your County Commissioner is?	On a scale of one to five, where one equals "very unsatisfied" and five equals "very satisfied", how satisfied are you with recreational opportunities, such as parks, playgrounds, music festivals and other events offered by Clark County?
N	Valid	191	191	65	191	193	186
	Missing	2	2	128	2	0	7
Mean		3.07	1.66	3.53	2.81	1.73	3.65
Std. Error of Mean		.063	.034	.177	.095	.032	.082
Median		3.00	2.00	4.00	3.00	2.00	4.00
Mode		3	2	4	3	2	3
Std. Deviation		.876	.475	1.434	1.309	.447	1.122
Skewness		-.507	-.676	-.699	.059	-1.027	-.577
Std. Error of Skewness		.176	.176	.297	.176	.175	.178
Kurtosis		.558	-1.559	-.897	-1.085	-.956	-.212
Std. Error of Kurtosis		.350	.350	.585	.350	.349	.354
Range		4	1	4	4	1	4
Minimum		1	1	1	1	1	1
Maximum		5	2	5	5	2	5

Appendix IX
Local Government Interaction General Impressions
Jurisdictional Summary Statistics

City of North Las Vegas		On a scale of one to five, where one equals poor and five equals excellent, what is your impression of Clark County government?	Have you ever inquired about or accessed services from Clark County?	How often do you interact with Clark County government?	Sometimes citizens confuse government programs and services provided by Clark County with those provided by other local governments, such as the City of Las Vegas. Where one equals "Not at all knowledgeable" and five equals "very knowledgeable", how knowledgeable are you about the difference between programs and services provided by Clark County versus those provided by other local governments, such as the City of Las Vegas?	Do you know who your County Commissioner is?	On a scale of one to five, where one equals "very unsatisfied" and five equals "very satisfied", how satisfied are you with recreational opportunities, such as parks, playgrounds, music festivals and other events offered by Clark County?
N	Valid	68	67	18	68	67	64
	Missing	0	1	50	0	1	4
Mean		3.16	1.73	3.69	2.86	1.71	3.49
Std. Error of Mean		.104	.055	.287	.157	.056	.147
Median		3.00	2.00	4.00	3.00	2.00	4.00
Mode		3	2	4	3	2	3
Std. Deviation		.857	.449	1.224	1.293	.457	1.174
Skewness		-.224	-1.044	-.865	-.075	-.954	-.538
Std. Error of Skewness		.291	.294	.534	.291	.294	.299
Kurtosis		.380	-.940	.270	-.915	-1.125	-.246
Std. Error of Kurtosis		.575	.580	1.034	.575	.580	.590
Range		4	1	4	4	1	4
Minimum		1	1	1	1	1	1
Maximum		5	2	5	5	2	5

Appendix IX
Local Government Interaction General Impressions
Jurisdictional Summary Statistics

Henderson		On a scale of one to five, where one equals poor and five equals excellent, what is your impression of Clark County government?	Have you ever inquired about or accessed services from Clark County?	How often do you interact with Clark County government?	Sometimes citizens confuse government programs and services provided by Clark County with those provided by other local governments, such as the City of Las Vegas. Where one equals "Not at all knowledgeable" and five equals "very knowledgeable", how knowledgeable are you about the difference between programs and services provided by Clark County versus those provided by other local governments, such as the City of Las Vegas?	Do you know who your County Commissioner is?	On a scale of one to five, where one equals "very unsatisfied" and five equals "very satisfied", how satisfied are you with recreational opportunities, such as parks, playgrounds, music festivals and other events offered by Clark County?
N	Valid	66	66	27	66	66	66
	Missing	0	0	40	0	0	0
Mean		2.95	1.60	4.24	2.87	1.84	3.83
Std. Error of Mean		.116	.061	.149	.154	.046	.142
Median		3.00	2.00	4.00	3.00	2.00	4.00
Mode		3	2	5	3	2	4
Std. Deviation		.941	.494	.767	1.252	.373	1.151
Skewness		-.623	-.408	-.452	.247	-1.856	-1.044
Std. Error of Skewness		.295	.295	.451	.295	.295	.295
Kurtosis		-.187	-1.892	-1.111	-.799	1.489	.636
Std. Error of Kurtosis		.582	.582	.878	.582	.582	.582
Range		4	1	2	4	1	4
Minimum		1	1	3	1	1	1
Maximum		5	2	5	5	2	5

Appendix IX
Local Government Interaction General Impressions
Jurisdictional Summary Statistics

Boulder City		On a scale of one to five, where one equals poor and five equals excellent, what is your impression of Clark County government?	Have you ever inquired about or accessed services from Clark County?	How often do you interact with Clark County government?	Sometimes citizens confuse government programs and services provided by Clark County with those provided by other local governments, such as the City of Las Vegas. Where one equals "Not at all knowledgeable" and five equals "very knowledgeable", how knowledgeable are you about the difference between programs and services provided by Clark County versus those provided by other local governments, such as the City of Las Vegas?	Do you know who your County Commissioner is?	On a scale of one to five, where one equals "very unsatisfied" and five equals "very satisfied", how satisfied are you with recreational opportunities, such as parks, playgrounds, music festivals and other events offered by Clark County?
N	Valid	8	9	3	9	9	9
	Missing	0	0	6	0	0	0
Mean		3.20	1.64	3.80	1.93	1.54	3.11
Std. Error of Mean		.266	.173	.945	.312	.181	.570
Median		3.00	2.00	4.49	2.00	1.82	3.80
Mode		3	2	5	1	2	1(a)
Std. Deviation		.761	.510	1.658	.918	.530	1.676
Skewness		-1.580	-.731	-1.074	.161	-.179	-.348
Std. Error of Skewness		.746	.729	1.198	.729	.729	.729
Kurtosis		7.056	-2.008		-2.012	-2.668	-1.737
Std. Error of Kurtosis		1.467	1.428		1.428	1.428	1.428
Range		3	1	3	2	1	4
Minimum		1	1	2	1	1	1
Maximum		4	2	5	3	2	5

Appendix IX
Local Government Interaction General Impressions
Jurisdictional Summary Statistics

Mesquite		On a scale of one to five, where one equals poor and five equals excellent, what is your impression of Clark County government?	Have you ever inquired about or accessed services from Clark County?	How often do you interact with Clark County government?	Sometimes citizens confuse government programs and services provided by Clark County with those provided by other local governments, such as the City of Las Vegas. Where one equals "Not at all knowledgeable" and five equals "very knowledgeable", how knowledgeable are you about the difference between programs and services provided by Clark County versus those provided by other local governments, such as the City of Las Vegas?	Do you know who your County Commissioner is?	On a scale of one to five, where one equals "very unsatisfied" and five equals "very satisfied", how satisfied are you with recreational opportunities, such as parks, playgrounds, music festivals and other events offered by Clark County?
N	Valid	3	4	1	4	4	4
	Missing	0	0	3	0	0	0
Mean		3.55	1.72	5.00	3.12	1.88	3.84
Std. Error of Mean		.463	.263		.672	.191	.543
Median		3.21	2.00	5.00	3.00	2.00	3.91
Mode		3	2	5	3	2	3
Std. Deviation		.858	.519		1.328	.378	1.072
Skewness		1.863	-1.765		-.419	-4.126	.557
Std. Error of Skewness		1.108	1.028		1.028	1.028	1.028
Range		2	1	0	4	1	2
Minimum		3	1	5	1	1	3
Maximum		5	2	5	5	2	5

Appendix IX
Local Government Interaction General Impressions
Jurisdictional Cross-tabulation

Respondent Jurisdiction * On a scale of one to five, where one equals poor and five equals excellent, what is your impression of Clark County government?

			On a scale of one to five, where one equals poor and five equals excellent, what is your impression of Clark County government?					
			One	Two	Three	Four	Five	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	31	46	111	59	9	256
		% within Respondent Jurisdiction	12.1%	18.0%	43.4%	23.0%	3.5%	100.0%
	City of Las Vegas	Count	13	21	102	49	6	191
		% within Respondent Jurisdiction	6.8%	11.0%	53.4%	25.7%	3.1%	100.0%
	City of North Las Vegas	Count	2	9	34	19	3	67
		% within Respondent Jurisdiction	3.0%	13.4%	50.7%	28.4%	4.5%	100.0%
	City of Henderson	Count	7	10	30	19	0	66
		% within Respondent Jurisdiction	10.6%	15.2%	45.5%	28.8%	.0%	100.0%
	Boulder City	Count	0	0	5	3	0	8
		% within Respondent Jurisdiction	.0%	.0%	62.5%	37.5%	.0%	100.0%
	Mesquite	Count	0	0	2	1	0	3
		% within Respondent Jurisdiction	.0%	.0%	66.7%	33.3%	.0%	100.0%
Total		Count	53	86	284	150	18	591
		% within Respondent Jurisdiction	9.0%	14.6%	48.1%	25.4%	3.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.745(a)	20	.412
Likelihood Ratio	26.240	20	.158
Linear-by-Linear Association	3.368	1	.066
N of Valid Cases	591		

Appendix IX
Local Government Interaction General Impressions
Jurisdictional Cross-tabulation

Respondent Jurisdiction * Have you ever inquired about or accessed services from Clark County

			Have you ever inquired about or accessed services from Clark County?		
			Yes	No	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	104	155	259
		% within Respondent Jurisdiction	40.2%	59.8%	100.0%
	City of Las Vegas	Count	65	126	191
		% within Respondent Jurisdiction	34.0%	66.0%	100.0%
	City of North Las Vegas	Count	18	48	66
		% within Respondent Jurisdiction	27.3%	72.7%	100.0%
	City of Henderson	Count	27	40	67
		% within Respondent Jurisdiction	40.3%	59.7%	100.0%
	Boulder City	Count	3	6	9
		% within Respondent Jurisdiction	33.3%	66.7%	100.0%
	Mesquite	Count	1	3	4
		% within Respondent Jurisdiction	25.0%	75.0%	100.0%
Total		Count	218	378	596
		% within Respondent Jurisdiction	36.6%	63.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.097(a)	5	.404
Likelihood Ratio	5.205	5	.391
Linear-by-Linear Association	1.009	1	.315
N of Valid Cases	596		

Appendix IX
Local Government Interaction General Impressions
Jurisdictional Cross-tabulation

Respondent Jurisdiction * How often do you interact with Clark County government?

			How often do you interact with Clark County government?					
			Weekly	Monthly	4 to 6 times a year	1 to 3 times a year	Less than once a year	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	15	13	14	34	27	103
		% within Respondent Jurisdiction	14.6%	12.6%	13.6%	33.0%	26.2%	100.0%
	City of Las Vegas	Count	10	7	5	23	20	65
		% within Respondent Jurisdiction	15.4%	10.8%	7.7%	35.4%	30.8%	100.0%
	City of North Las Vegas	Count	2	1	4	6	5	18
		% within Respondent Jurisdiction	11.1%	5.6%	22.2%	33.3%	27.8%	100.0%
	City of Henderson	Count	0	0	5	10	11	26
		% within Respondent Jurisdiction	.0%	.0%	19.2%	38.5%	42.3%	100.0%
	Boulder City	Count	0	1	0	0	2	3
		% within Respondent Jurisdiction	.0%	33.3%	.0%	.0%	66.7%	100.0%
	Mesquite	Count	0	0	0	0	1	1
		% within Respondent Jurisdiction	.0%	.0%	.0%	.0%	100.0%	100.0%
Total		Count	27	22	28	73	66	216
		% within Respondent Jurisdiction	12.5%	10.2%	13.0%	33.8%	30.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.115(a)	20	.451
Likelihood Ratio	26.777	20	.142
Linear-by-Linear Association	7.198	1	.007
N of Valid Cases	216		

Appendix IX
Local Government Interaction General Impressions
Jurisdictional Cross-tabulation

Respondent Jurisdiction * Sometimes citizens confuse government programs and services provided by Clark County with those provided by other local governments, such as the City of Las Vegas. Where one equals "Not at all knowledgeable" and five equals "very knowledgeable", how knowledgeable are you about the difference between programs and services provided by Clark County versus those provided by other local governments, such as the City of Las Vegas?

			Sometimes citizens confuse government programs and services provided by Clark County with those provided by other local governments, such as the City of Las Vegas. Where one equals "Not at all knowledgeable" and five equals "very knowledgeable", how knowledgeable are you about the difference between programs and services provided by Clark County versus those provided by other local governments, such as the City of Las Vegas?					
			One	Two	Three	Four	Five	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	76	50	60	47	23	256
		% within Respondent Jurisdiction	29.7%	19.5%	23.4%	18.4%	9.0%	100.0%
	City of Las Vegas	Count	43	33	54	39	22	191
		% within Respondent Jurisdiction	22.5%	17.3%	28.3%	20.4%	11.5%	100.0%
	City of North Las Vegas	Count	16	6	26	12	8	68
		% within Respondent Jurisdiction	23.5%	8.8%	38.2%	17.6%	11.8%	100.0%
	City of Henderson	Count	10	17	21	8	10	66
		% within Respondent Jurisdiction	15.2%	25.8%	31.8%	12.1%	15.2%	100.0%
	Boulder City	Count	4	2	3	0	0	9
		% within Respondent Jurisdiction	44.4%	22.2%	33.3%	.0%	.0%	100.0%
	Mesquite	Count	0	0	2	1	0	3
		% within Respondent Jurisdiction	.0%	.0%	66.7%	33.3%	.0%	100.0%
Total		Count	149	108	166	107	63	593
		% within Respondent Jurisdiction	25.1%	18.2%	28.0%	18.0%	10.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	27.555(a)	20	.120
Likelihood Ratio	31.698	20	.047
Linear-by-Linear Association	2.043	1	.153
N of Valid Cases	593		

Appendix IX
Local Government Interaction General Impressions
Jurisdictional Cross-tabulation

Respondent Jurisdiction * Do you know who your County Commissioner is?

			Do you know who your County Commissioner is?		
			Yes	No	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	64	196	260
		% within Respondent Jurisdiction	24.6%	75.4%	100.0%
	City of Las Vegas	Count	53	140	193
		% within Respondent Jurisdiction	27.5%	72.5%	100.0%
	City of North Las Vegas	Count	19	47	66
		% within Respondent Jurisdiction	28.8%	71.2%	100.0%
	City of Henderson	Count	11	55	66
		% within Respondent Jurisdiction	16.7%	83.3%	100.0%
	Boulder City	Count	4	5	9
		% within Respondent Jurisdiction	44.4%	55.6%	100.0%
	Mesquite	Count	0	3	3
		% within Respondent Jurisdiction	.0%	100.0%	100.0%
Total		Count	151	446	597
		% within Respondent Jurisdiction	25.3%	74.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.332(a)	5	.275
Likelihood Ratio	7.091	5	.214
Linear-by-Linear Association	.198	1	.657
N of Valid Cases	597		

Appendix IX
Local Government Interaction General Impressions
Jurisdictional Cross-tabulation

Respondent Jurisdiction * On a scale of one to five, where one equals "very unsatisfied" and five equals "very satisfied", how satisfied are you with recreational opportunities, such as parks, playgrounds, music festivals and other events offered by Clark County?

			On a scale of one to five, where one equals "very unsatisfied" and five equals "very satisfied", how satisfied are you with recreational opportunities, such as parks, playgrounds, music festivals and other events offered by Clark County?					
			One	Two	Three	Four	Five	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	13	22	85	63	69	252
		% within Respondent Jurisdiction	5.2%	8.7%	33.7%	25.0%	27.4%	100.0%
	City of Las Vegas	Count	11	13	57	56	50	187
		% within Respondent Jurisdiction	5.9%	7.0%	30.5%	29.9%	26.7%	100.0%
	City of North Las Vegas	Count	6	4	21	19	14	64
		% within Respondent Jurisdiction	9.4%	6.3%	32.8%	29.7%	21.9%	100.0%
	City of Henderson	Count	5	2	13	24	21	65
		% within Respondent Jurisdiction	7.7%	3.1%	20.0%	36.9%	32.3%	100.0%
	Boulder City	Count	3	0	1	3	2	9
		% within Respondent Jurisdiction	33.3%	.0%	11.1%	33.3%	22.2%	100.0%
	Mesquite	Count	0	0	2	0	1	3
		% within Respondent Jurisdiction	.0%	.0%	66.7%	.0%	33.3%	100.0%
Total		Count	38	41	179	165	157	580
		% within Respondent Jurisdiction	6.6%	7.1%	30.9%	28.4%	27.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.062(a)	20	.164
Likelihood Ratio	23.643	20	.258
Linear-by-Linear Association	.085	1	.771
N of Valid Cases	580		

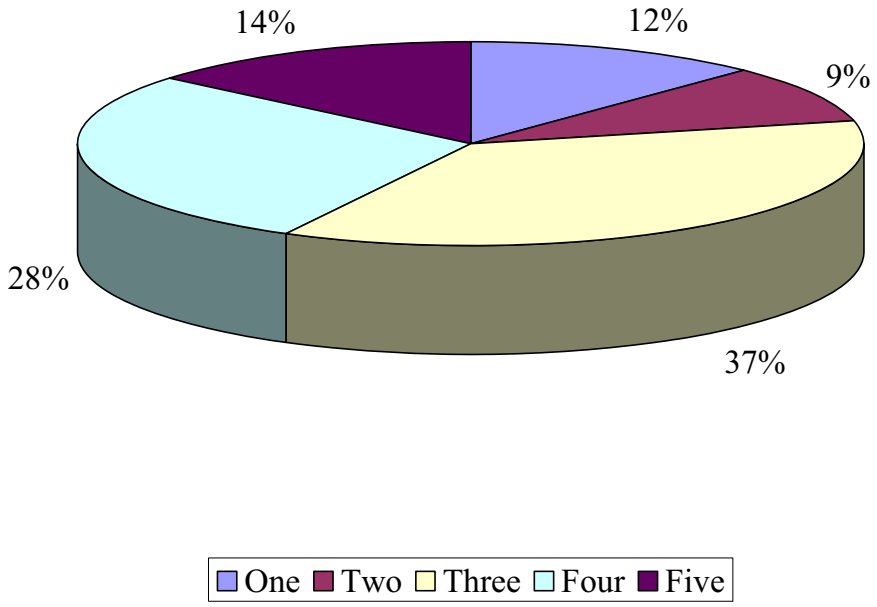
Appendix IX
Local Government Interaction Service Ratings
Summary Statistics

		On a scale of one to five, where one equals poor and five equals excellent, how did your interactions with Clark County government compare to previous local government interactions, if any, in other communities?	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee cared about and understood my needs	Based on your experiences, how would you rate Clark County government's performance in the following area: Service delivery was timely and responsive	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was able to assist me or direct me to an appropriate source	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was qualified, knowledgeable, and well informed	Based on your experiences, how would you rate Clark County government's performance in the following area: Transaction was handled in an appropriate manner	Based on your experiences, how would you rate Clark County government's performance in the following area: Policies and processes were easy to follow and/or clearly explained	Based on your experiences, how would you rate Clark County government's performance in the following area: Accessibility (i.e. facility, staff, hours of operation)	On a scale of one to five, where one equals poor and five equals excellent, how would you rate your overall customer experience with Clark County government?
N	Valid	203	212	213	212	214	215	214	216	216
	Missing	396	388	386	387	385	385	385	383	383
Mean		3.22	2.18	2.24	2.12	2.10	2.16	2.24	2.09	3.15
Std. Error of Mean		.083	.045	.043	.043	.042	.043	.043	.036	.085
Median		3.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00
Mode		3	2	2	2	2	2	2	2	3
Std. Deviation		1.176	.654	.635	.627	.612	.623	.626	.531	1.253
Skewness		-.382	-.206	-.255	-.093	-.056	-.124	-.230	.089	-.315
Std. Error of Skewness		.171	.167	.167	.167	.166	.166	.166	.165	.165
Kurtosis		-.493	-.701	-.649	-.487	-.348	-.501	-.609	.472	-.781
Std. Error of Kurtosis		.340	.333	.332	.332	.331	.330	.331	.329	.329
Range		4	2	2	2	2	2	2	2	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	3	3	3	3	3	3	3	5

Appendix IX
Local Government Interaction Service Ratings

On a scale of one to five, where one equals poor and five equals excellent, how did your interactions with Clark County government compare to previous local government interactions, if any, in other communities?

		Frequency	Valid Percent
Valid	One	25	11.5
	Two	19	8.6
	Three	74	33.8
	Four	57	26.4
	Five	28	13
	DK/No answer	15	6.8
	Total	218	100
Missing	System	382	
Total		600	



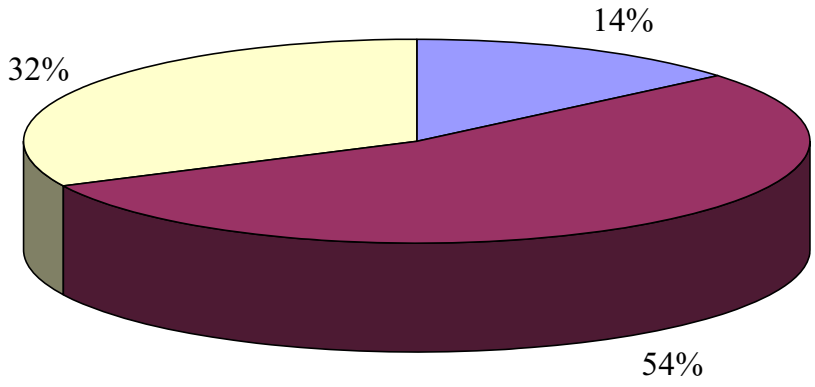
Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction Service Ratings

Based on your experiences, how would you rate Clark County government's performance in the following area: Employee cared about and understood my needs

		Frequency	Valid Percent
Valid	Exceeded expectations	29	13.4
	Met expectations	115	52.6
	Did not meet expectations	68	31.2
	DK/No answer	6	2.8
	Total	218	100
Missing	System	382	
Total		600	

Employee Cared About and Understood My Needs



Exceeded expectations Met expectations Did not meet expectations

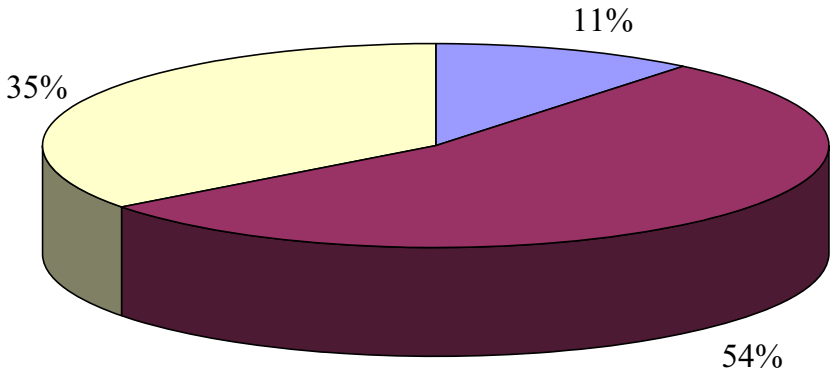
Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction Service Ratings

Based on your experiences, how would you rate Clark County government's performance in the following area: Service delivery was timely and responsive

		Frequency	Valid Percent
Valid	Exceeded expectations	23	10.6
	Met expectations	115	52.8
	Did not meet expectations	75	34.5
	DK/No answer	5	2.1
	Total	218	100
Missing	System	382	
Total		600	

Service Delivery Was Timely and Responsive



Exceeded expectations Met expectations Did not meet expectations

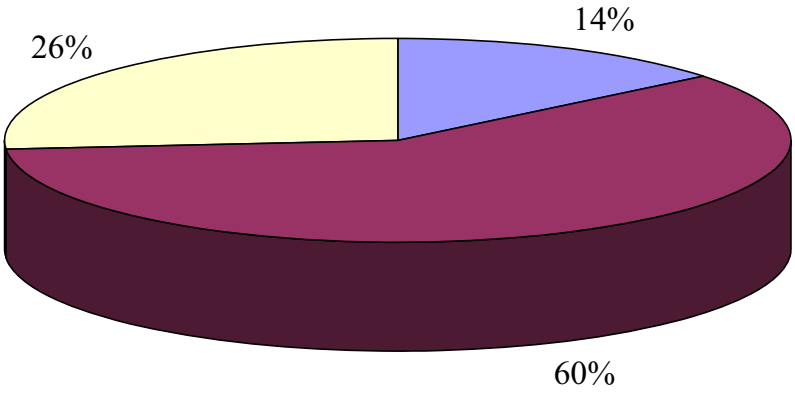
Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction Service Ratings

Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was able to assist me or direct me to an appropriate source

		Frequency	Valid Percent
Valid	Exceeded expectations	30	14
	Met expectations	126	57.9
	Did not meet expectations	56	25.6
	DK/No answer	6	2.5
	Total	218	100
Missing	System	382	
Total		600	

Employee Was Able to Assist Me or Direct Me to an Appropriate Source



Exceeded expectations Met expectations Did not meet expectations

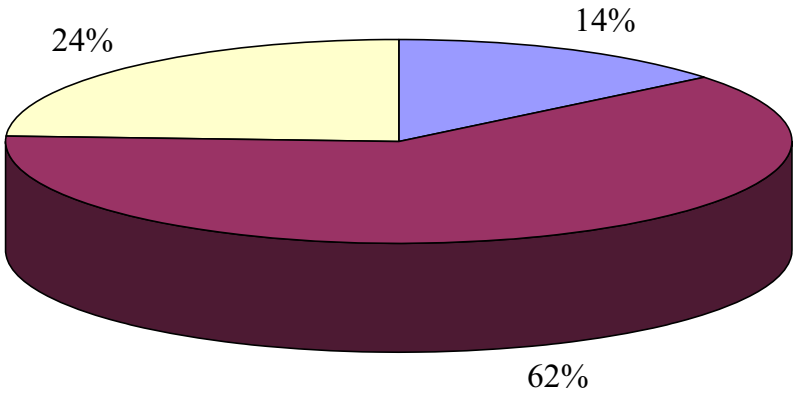
Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction Service Ratings

Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was qualified, knowledgeable, and well informed

		Frequency	Valid Percent
Valid	Exceeded expectations	30	13.9
	Met expectations	132	60.8
	Did not meet expectations	52	23.7
	DK/No answer	4	1.6
	Total	218	100
Missing	System	382	
Total		600	

Employee Was Qualified, Knowledgeable, and Well Informed



Exceeded expectations Met expectations Did not meet expectations

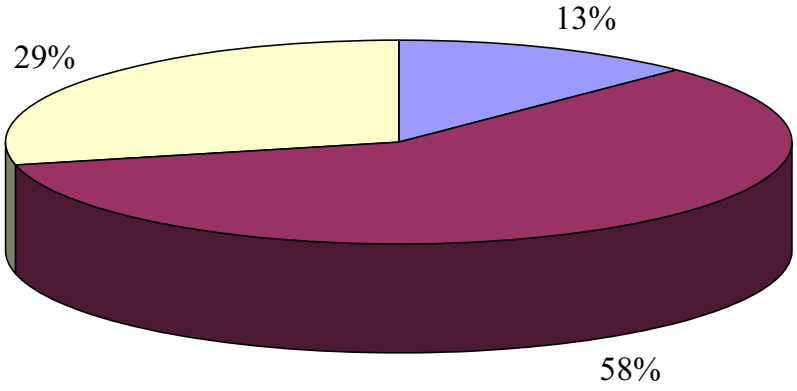
Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction Service Ratings

Based on your experiences, how would you rate Clark County government's performance in the following area: Transaction was handled in an appropriate manner

		Frequency	Valid Percent
Valid	Exceeded expectations	27	12.5
	Met expectations	126	58
	Did not meet expectations	61	28.2
	DK/No answer	3	1.4
	Total	218	100
Missing	System	382	
Total		600	

Transaction was Handled in an Appropriate Manner



Exceeded expectations Met expectations Did not meet expectations

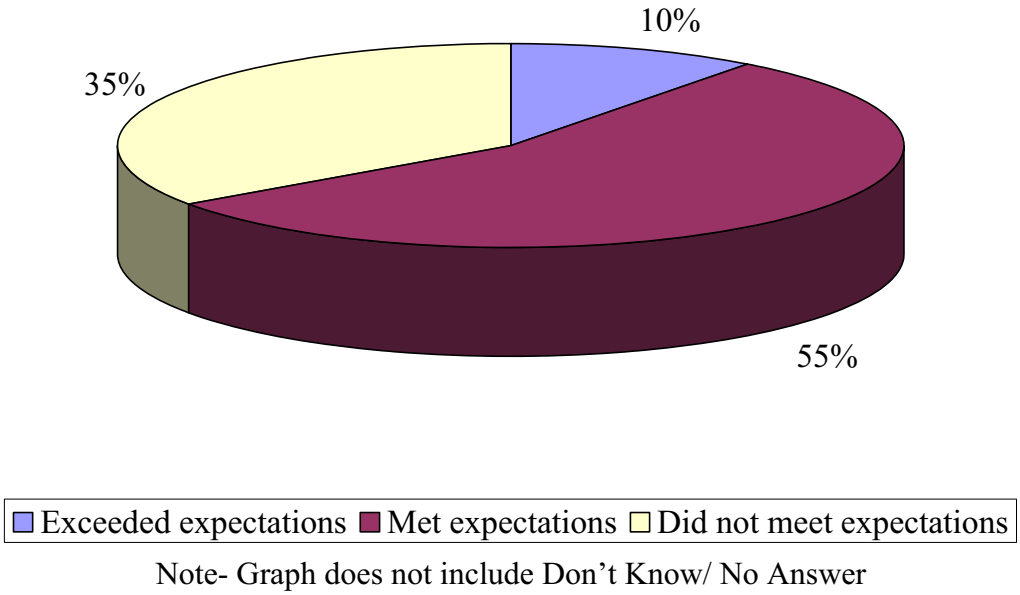
Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction Service Ratings

Based on your experiences, how would you rate Clark County government's performance in the following area: Policies and processes were easy to follow and/or clearly explained

		Frequency	Valid Percent
Valid	Exceeded expectations	22	10.1
	Met expectations	118	54.2
	Did not meet expectations	74	34.1
	DK/No answer	4	1.6
	Total	218	100
Missing	System	382	
Total		600	

Policies and Processes Were Easy to Follow and/or Clearly Explained



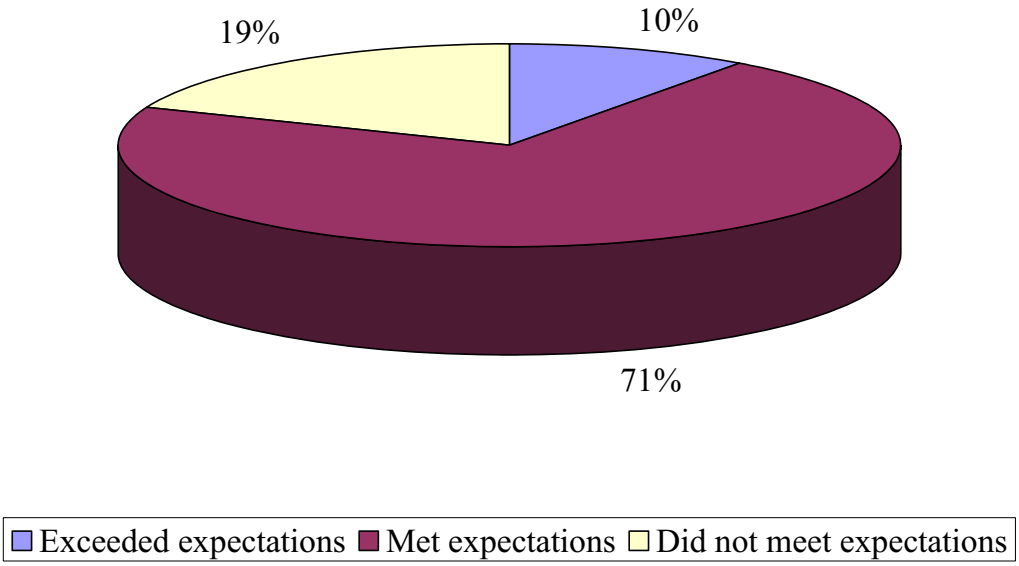
Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction Service Ratings

Based on your experiences, how would you rate Clark County government's performance in the following area: Accessibility (i.e. facility, staff, hours of operation)

		Frequency	Valid Percent
Valid	Exceeded expectations	22	10
	Met expectations	154	70.6
	Did not meet expectations	41	18.7
	DK/No answer	2	0.7
	Total	218	100
Missing	System	382	
Total		600	

Accessibility (i.e. facility, staff, hours of operation)



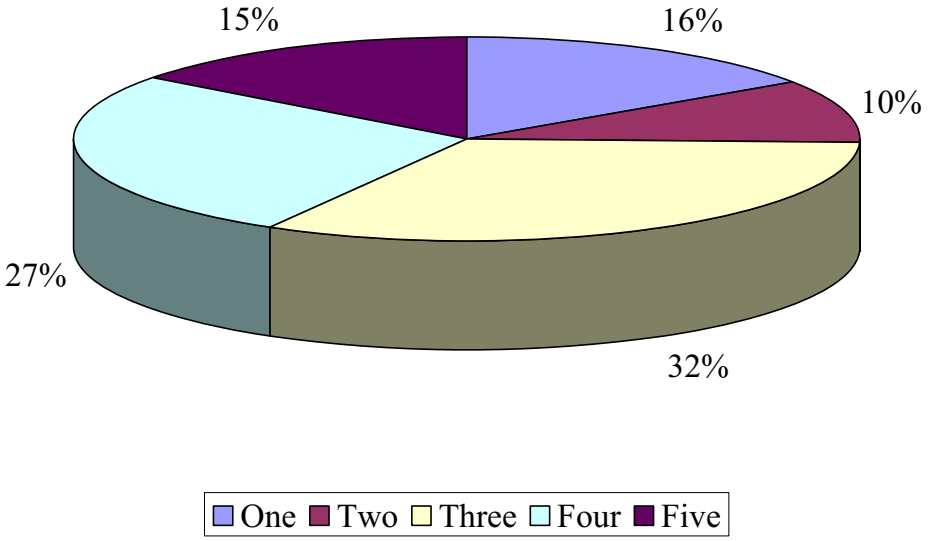
Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction Service Ratings

On a scale of one to five, where one equals poor and five equals excellent, how would you rate your overall customer experience with Clark County government?

		Frequency	Valid Percent
Valid	One	34	15.5
	Two	22	10
	Three	71	32.5
	Four	58	26.6
	Five	32	14.7
	DK/No answer	2	0.7
	Total	218	100
Missing	System	382	
Total		600	

How Would You Rate Your Overall Customer Experience with Clark County Government?



Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction Service Ratings
Jurisdictional Summary

Unincorporated Clark County		On a scale of one to five, where one equals poor and five equals excellent, how did your interactions with Clark County government compare to previous local government interactions, if any, in other communities?	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee cared about and understood my needs	Based on your experiences, how would you rate Clark County government's performance in the following area: Service delivery was timely and responsive	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was able to assist me or direct me to an appropriate source	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was qualified, knowledgeable, and well informed	Based on your experiences, how would you rate Clark County government's performance in the following area: Transaction was handled in an appropriate manner	Based on your experiences, how would you rate Clark County government's performance in the following area: Policies and processes were easy to follow and/or clearly explained	Based on your experiences, how would you rate Clark County government's performance in the following area: Accessibility (i.e. facility, staff, hours of operation)	On a scale of one to five, where one equals poor and five equals excellent, how would you rate your overall customer experience with Clark County government?
N	Valid	99	101	101	102	102	102	101	102	102
	Missing	161	160	160	159	159	158	160	158	158
Mean		3.14	2.17	2.22	2.14	2.11	2.20	2.27	2.15	2.99
Std. Error of Mean		.123	.066	.063	.064	.062	.064	.062	.057	.130
Median		3.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00
Mode		3	2	2	2	2	2	2	2	4
Std. Deviation		1.223	.659	.634	.647	.627	.642	.624	.578	1.315
Skewness		-.341	-.192	-.221	-.142	-.086	-.210	-.261	-.010	-.192
Std. Error of Skewness		.243	.241	.241	.240	.240	.239	.241	.239	.239
Kurtosis		-.540	-.703	-.603	-.609	-.449	-.626	-.606	-.106	-1.098
Std. Error of Kurtosis		.481	.477	.477	.475	.475	.474	.477	.474	.474
Range		4	2	2	2	2	2	2	2	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	3	3	3	3	3	3	3	5

Appendix IX
Local Government Interaction Service Ratings Jurisdictional Summary

City of Las Vegas		On a scale of one to five, where one equals poor and five equals excellent, how did your interactions with Clark County government compare to previous local government interactions, if any, in other communities?	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee cared about and understood my needs	Based on your experiences, how would you rate Clark County government's performance in the following area: Service delivery was timely and responsive	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was able to assist me or direct me to an appropriate source	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was qualified, knowledgeable, and well informed	Based on your experiences, how would you rate Clark County government's performance in the following area: Transaction was handled in an appropriate manner	Based on your experiences, how would you rate Clark County government's performance in the following area: Policies and processes were easy to follow and/or clearly explained	Based on your experiences, how would you rate Clark County government's performance in the following area: Accessibility (i.e. facility, staff, hours of operation)	On a scale of one to five, where one equals poor and five equals excellent, how would you rate your overall customer experience with Clark County government?
N	Valid	60	65	64	64	65	65	65	65	65
	Missing	133	128	129	129	128	128	128	128	128
Mean		3.19	2.18	2.25	2.13	2.13	2.20	2.25	2.08	3.18
Std. Error of Mean		.158	.078	.074	.075	.074	.072	.079	.053	.163
Median		3.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00
Mode		4	2	2	2	2	2	2	2	3
Std. Deviation		1.219	.625	.593	.601	.594	.582	.635	.426	1.314
Skewness		-.523	-.142	-.121	-.053	-.038	-.042	-.257	.470	-.300
Std. Error of Skewness		.309	.298	.300	.300	.297	.297	.298	.297	.297
Kurtosis		-.627	-.473	-.425	-.224	-.163	-.240	-.604	2.534	-.863
Std. Error of Kurtosis		.610	.587	.592	.592	.585	.585	.587	.585	.585
Range		4	2	2	2	2	2	2	2	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	3	3	3	3	3	3	3	5

Appendix IX
Local Government Interaction Service Ratings Jurisdictional Summary

City of North Las Vegas		On a scale of one to five, where one equals poor and five equals excellent, how did your interactions with Clark County government compare to previous local government interactions, if any, in other communities?	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee cared about and understood my needs	Based on your experiences, how would you rate Clark County government's performance in the following area: Service delivery was timely and responsive	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was able to assist me or direct me to an appropriate source	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was qualified, knowledgeable, and well informed	Based on your experiences, how would you rate Clark County government's performance in the following area: Transaction was handled in an appropriate manner	Based on your experiences, how would you rate Clark County government's performance in the following area: Policies and processes were easy to follow and/or clearly explained	Based on your experiences, how would you rate Clark County government's performance in the following area: Accessibility (i.e. facility, staff, hours of operation)	On a scale of one to five, where one equals poor and five equals excellent, how would you rate your overall customer experience with Clark County government ?
N	Valid	18	18	18	18	18	18	18	18	18
	Missing	50	50	50	50	50	50	50	50	50
Mean		3.29	2.52	2.55	2.20	2.22	2.25	2.29	1.97	3.14
Std. Error of Mean		.220	.156	.156	.181	.155	.158	.169	.133	.240
Median		3.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00
Mode		3	3	3	2(a)	2	2	3	2	3
Std. Deviation		.938	.665	.663	.772	.659	.672	.722	.569	1.022
Skewness		.586	-1.091	-1.236	-.368	-.257	-.343	-.511	-.017	.246
Std. Error of Skewness		.534	.534	.534	.534	.534	.534	.534	.534	.534
Kurtosis		-.215	.244	.576	-1.144	-.487	-.579	-.787	.769	.795
Std. Error of Kurtosis		1.034	1.034	1.034	1.034	1.034	1.034	1.034	1.034	1.034
Range		3	2	2	2	2	2	2	2	4
Minimum		2	1	1	1	1	1	1	1	1
Maximum		5	3	3	3	3	3	3	3	5

Appendix IX
Local Government Interaction Service Ratings Jurisdictional Summary

City of Henderson		On a scale of one to five, where one equals poor and five equals excellent, how did your interactions with Clark County government compare to previous local government interactions, if any, in other communities?	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee cared about and understood my needs	Based on your experiences, how would you rate Clark County government's performance in the following area: Service delivery was timely and responsive	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was able to assist me or direct me to an appropriate source	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was qualified, knowledgeable, and well informed	Based on your experiences, how would you rate Clark County government's performance in the following area: Transaction was handled in an appropriate manner	Based on your experiences, how would you rate Clark County government's performance in the following area: Policies and processes were easy to follow and/or clearly explained	Based on your experiences, how would you rate Clark County government's performance in the following area: Accessibility (i.e. facility, staff, hours of operation)	On a scale of one to five, where one equals poor and five equals excellent, how would you rate your overall customer experience with Clark County government ?
N	Valid	22	24	27	25	25	25	27	27	27
	Missing	44	42	40	42	41	41	40	40	40
Mean		3.54	1.98	2.07	1.96	1.92	1.88	2.10	2.05	3.71
Std. Error of Mean		.220	.135	.134	.113	.117	.108	.113	.104	.180
Median		4.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	4.00
Mode		4	2	2	2	2	2	2	2	4
Std. Deviation		1.034	.660	.689	.559	.588	.540	.581	.536	.930
Skewness		-.137	.020	-.087	-.024	.001	-.128	.009	.058	-.728
Std. Error of Skewness		.491	.472	.451	.467	.463	.463	.451	.451	.451
Kurtosis		-1.035	-.451	-.730	.688	.229	.684	.232	.976	1.571
Std. Error of Kurtosis		.953	.918	.878	.908	.901	.901	.878	.878	.878
Range		3	2	2	2	2	2	2	2	4
Minimum		2	1	1	1	1	1	1	1	1
Maximum		5	3	3	3	3	3	3	3	5

Appendix IX
Local Government Interaction Service Ratings Jurisdictional Summary

Boulder City		On a scale of one to five, where one equals poor and five equals excellent, how did your interactions with Clark County government compare to previous local government interactions, if any, in other communities?	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee cared about and understood my needs	Based on your experiences, how would you rate Clark County government's performance in the following area: Service delivery was timely and responsive	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was able to assist me or direct me to an appropriate source	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was qualified, knowledgeable, and well informed	Based on your experiences, how would you rate Clark County government's performance in the following area: Transaction was handled in an appropriate manner	Based on your experiences, how would you rate Clark County government's performance in the following area: Policies and processes were easy to follow and/or clearly explained	Based on your experiences, how would you rate Clark County government's performance in the following area: Accessibility (i.e. facility, staff, hours of operation)	On a scale of one to five, where one equals poor and five equals excellent, how would you rate your overall customer experience with Clark County government?
N	Valid	3	3	3	3	3	3	3	3	3
	Missing	6	6	6	6	6	6	6	6	6
Mean		3.34	2.50	2.65	2.00	1.85	1.66	2.35	1.50	3.35
Std. Error of Mean		.505	.347	.331	.000	.249	.505	.331	.347	.331
Median		3.49	2.51	2.96	2.00	2.00	1.51	2.04	1.51	3.04
Mode		4	3	3	2	2	1	2	2	3
Std. Deviation		.887	.608	.581	.000	.438	.887	.581	.608	.581
Skewness		-1.483	-.030	-1.467		-4.528	1.483	1.467	-.030	1.467
Std. Error of Skewness		1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198
Range		2	1	1	0	1	2	1	1	1
Minimum		2	2	2	2	1	1	2	1	3
Maximum		4	3	3	2	2	3	3	2	4

Appendix IX
Local Government Interaction Service Ratings Jurisdictional Summary

Mesquite		On a scale of one to five, where one equals poor and five equals excellent, how did your interactions with Clark County government compare to previous local government interactions, if any, in other communities?	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee cared about and understood my needs	Based on your experiences, how would you rate Clark County government's performance in the following area: Service delivery was timely and responsive	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was able to assist me or direct me to an appropriate source	Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was qualified, knowledgeable, and well informed	Based on your experiences, how would you rate Clark County government's performance in the following area: Transaction was handled in an appropriate manner	Based on your experiences, how would you rate Clark County government's performance in the following area: Policies and processes were easy to follow and/or clearly explained	Based on your experiences, how would you rate Clark County government's performance in the following area: Accessibility (i.e. facility, staff, hours of operation)	On a scale of one to five, where one equals poor and five equals excellent, how would you rate your overall customer experience with Clark County government?
N	Valid	1	1	1	1	1	1	1	1	1
	Missing	3	3	3	3	3	3	3	3	3
Mean		5.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00
Median		5.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00
Mode		5	2	2	2	2	2	2	2	3
Range		0	0	0	0	0	0	0	0	0
Minimum		5	2	2	2	2	2	2	2	3
Maximum		5	2	2	2	2	2	2	2	3

Appendix IX
Local Government Interaction Service Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * On a scale of one to five, where one equals poor and five equals excellent, how did your interactions with Clark County government compare to previous local government interactions, if any, in other communities?

			On a scale of one to five, where one equals poor and five equals excellent, how did your interactions with Clark County government compare to previous local government interactions, if any, in other communities?					
			One	Two	Three	Four	Five	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	16	5	41	23	14	99
		% within Respondent Jurisdiction	16.2%	5.1%	41.4%	23.2%	14.1%	100.0%
	City of Las Vegas	Count	9	6	17	22	6	60
		% within Respondent Jurisdiction	15.0%	10.0%	28.3%	36.7%	10.0%	100.0%
	City of North Las Vegas	Count	0	3	9	3	3	18
		% within Respondent Jurisdiction	.0%	16.7%	50.0%	16.7%	16.7%	100.0%
	City of Henderson	Count	0	4	6	8	4	22
		% within Respondent Jurisdiction	.0%	18.2%	27.3%	36.4%	18.2%	100.0%
	Boulder City	Count	0	0	1	2	0	3
		% within Respondent Jurisdiction	.0%	.0%	33.3%	66.7%	.0%	100.0%
	Mesquite	Count	0	0	0	0	1	1
		% within Respondent Jurisdiction	.0%	.0%	.0%	.0%	100.0%	100.0%
Total		Count	25	18	74	58	28	203
		% within Respondent Jurisdiction	12.3%	8.9%	36.5%	28.6%	13.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	28.341(a)	20	.102
Likelihood Ratio	31.136	20	.053
Linear-by-Linear Association	3.728	1	.054
N of Valid Cases	203		

Appendix IX
Local Government Interaction Service Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Based on your experiences, how would you rate Clark County government's performance in the following area: Employee cared about and understood my needs

			Based on your experiences, how would you rate Clark County government's performance in the following area: Employee cared about and understood my needs			
			Exceeded expectations	Met expectations	Did not meet expectations	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	15	54	31	100
		% within Respondent Jurisdiction	15.0%	54.0%	31.0%	100.0%
	City of Las Vegas	Count	8	38	19	65
		% within Respondent Jurisdiction	12.3%	58.5%	29.2%	100.0%
	City of North Las Vegas	Count	2	6	11	19
		% within Respondent Jurisdiction	10.5%	31.6%	57.9%	100.0%
	City of Henderson	Count	5	14	5	24
		% within Respondent Jurisdiction	20.8%	58.3%	20.8%	100.0%
	Boulder City	Count	0	2	2	4
		% within Respondent Jurisdiction	.0%	50.0%	50.0%	100.0%
	Mesquite	Count	0	1	0	1
		% within Respondent Jurisdiction	.0%	100.0%	.0%	100.0%
Total		Count	30	115	68	213
		% within Respondent Jurisdiction	14.1%	54.0%	31.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.194(a)	10	.424
Likelihood Ratio	10.651	10	.385
Linear-by-Linear Association	.036	1	.849
N of Valid Cases	213		

Appendix IX
Local Government Interaction Service Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Based on your experiences, how would you rate Clark County government's performance in the following area: Service delivery was timely and responsive

			Based on your experiences, how would you rate Clark County government's performance in the following area: Service delivery was timely and responsive			
			Exceeded expectations	Met expectations	Did not meet expectations	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	11	56	34	101
		% within Respondent Jurisdiction	10.9%	55.4%	33.7%	100.0%
	City of Las Vegas	Count	5	38	21	64
		% within Respondent Jurisdiction	7.8%	59.4%	32.8%	100.0%
	City of North Las Vegas	Count	2	5	12	19
		% within Respondent Jurisdiction	10.5%	26.3%	63.2%	100.0%
	City of Henderson	Count	5	14	7	26
		% within Respondent Jurisdiction	19.2%	53.8%	26.9%	100.0%
	Boulder City	Count	0	1	2	3
		% within Respondent Jurisdiction	.0%	33.3%	66.7%	100.0%
	Mesquite	Count	0	1	0	1
		% within Respondent Jurisdiction	.0%	100.0%	.0%	100.0%
Total		Count	23	115	76	214
		% within Respondent Jurisdiction	10.7%	53.7%	35.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.442(a)	10	.257
Likelihood Ratio	12.621	10	.246
Linear-by-Linear Association	.014	1	.907
N of Valid Cases	214		

Appendix IX
Local Government Interaction Service Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was able to assist me or direct me to an appropriate source

			Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was able to assist me or direct me to an appropriate source			
			Exceeded expectations	Met expectations	Did not meet expectations	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	15	58	29	102
		% within Respondent Jurisdiction	14.7%	56.9%	28.4%	100.0%
	City of Las Vegas	Count	8	40	16	64
		% within Respondent Jurisdiction	12.5%	62.5%	25.0%	100.0%
	City of North Las Vegas	Count	4	7	7	18
		% within Respondent Jurisdiction	22.2%	38.9%	38.9%	100.0%
	City of Henderson	Count	4	17	3	24
		% within Respondent Jurisdiction	16.7%	70.8%	12.5%	100.0%
	Boulder City	Count	0	3	0	3
		% within Respondent Jurisdiction	.0%	100.0%	.0%	100.0%
	Mesquite	Count	0	1	0	1
		% within Respondent Jurisdiction	.0%	100.0%	.0%	100.0%
Total		Count	31	126	55	212
		% within Respondent Jurisdiction	14.6%	59.4%	25.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.825(a)	10	.549
Likelihood Ratio	10.552	10	.393
Linear-by-Linear Association	1.068	1	.302
N of Valid Cases	212		

Appendix IX
Local Government Interaction Service Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was qualified, knowledgeable, and well informed

			Based on your experiences, how would you rate Clark County government's performance in the following area: Employee was qualified, knowledgeable, and well informed			
			Exceeded expectations	Met expectations	Did not meet expectations	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	15	61	26	102
		% within Respondent Jurisdiction	14.7%	59.8%	25.5%	100.0%
	City of Las Vegas	Count	8	42	16	66
		% within Respondent Jurisdiction	12.1%	63.6%	24.2%	100.0%
	City of North Las Vegas	Count	2	10	6	18
		% within Respondent Jurisdiction	11.1%	55.6%	33.3%	100.0%
	City of Henderson	Count	5	17	3	25
		% within Respondent Jurisdiction	20.0%	68.0%	12.0%	100.0%
	Boulder City	Count	0	3	0	3
		% within Respondent Jurisdiction	.0%	100.0%	.0%	100.0%
	Mesquite	Count	0	1	0	1
		% within Respondent Jurisdiction	.0%	100.0%	.0%	100.0%
Total		Count	30	134	51	215
		% within Respondent Jurisdiction	14.0%	62.3%	23.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.052(a)	10	.811
Likelihood Ratio	7.597	10	.668
Linear-by-Linear Association	.832	1	.362
N of Valid Cases	215		

Appendix IX
Local Government Interaction Service Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Based on your experiences, how would you rate Clark County government's performance in the following area: Transaction was handled in an appropriate manner

			Based on your experiences, how would you rate Clark County government's performance in the following area: Transaction was handled in an appropriate manner			
			Exceeded expectations	Met expectations	Did not meet expectations	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	13	56	33	102
		% within Respondent Jurisdiction	12.7%	54.9%	32.4%	100.0%
	City of Las Vegas	Count	6	41	19	66
		% within Respondent Jurisdiction	9.1%	62.1%	28.8%	100.0%
	City of North Las Vegas	Count	2	9	7	18
		% within Respondent Jurisdiction	11.1%	50.0%	38.9%	100.0%
	City of Henderson	Count	5	18	2	25
		% within Respondent Jurisdiction	20.0%	72.0%	8.0%	100.0%
	Boulder City	Count	2	1	0	3
		% within Respondent Jurisdiction	66.7%	33.3%	.0%	100.0%
	Mesquite	Count	0	1	0	1
		% within Respondent Jurisdiction	.0%	100.0%	.0%	100.0%
Total		Count	28	126	61	215
		% within Respondent Jurisdiction	13.0%	58.6%	28.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	16.591(a)	10	.084
Likelihood Ratio	15.842	10	.104
Linear-by-Linear Association	5.524	1	.019
N of Valid Cases	215		

Appendix IX
Local Government Interaction Service Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Based on your experiences, how would you rate Clark County government's performance in the following area: Policies and processes were easy to follow and/or clearly explained

			Based on your experiences, how would you rate Clark County government's performance in the following area: Policies and processes were easy to follow and/or clearly explained			
			Exceeded expectations	Met expectations	Did not meet expectations	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	10	55	37	102
		% within Respondent Jurisdiction	9.8%	53.9%	36.3%	100.0%
	City of Las Vegas	Count	7	35	23	65
		% within Respondent Jurisdiction	10.8%	53.8%	35.4%	100.0%
	City of North Las Vegas	Count	3	8	8	19
		% within Respondent Jurisdiction	15.8%	42.1%	42.1%	100.0%
	City of Henderson	Count	3	18	6	27
		% within Respondent Jurisdiction	11.1%	66.7%	22.2%	100.0%
	Boulder City	Count	0	2	1	3
		% within Respondent Jurisdiction	.0%	66.7%	33.3%	100.0%
	Mesquite	Count	0	1	0	1
		% within Respondent Jurisdiction	.0%	100.0%	.0%	100.0%
Total		Count	23	119	75	217
		% within Respondent Jurisdiction	10.6%	54.8%	34.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.651(a)	10	.913
Likelihood Ratio	5.436	10	.860
Linear-by-Linear Association	.783	1	.376
N of Valid Cases	217		

Appendix IX
Local Government Interaction Service Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * Based on your experiences, how would you rate Clark County government's performance in the following area: Accessibility (i.e. facility, staff, hours of operation)

			Based on your experiences, how would you rate Clark County government's performance in the following area: Accessibility (i.e. facility, staff, hours of operation)			
			Exceeded expectations	Met expectations	Did not meet expectations	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	11	66	25	102
		% within Respondent Jurisdiction	10.8%	64.7%	24.5%	100.0%
	City of Las Vegas	Count	4	53	8	65
		% within Respondent Jurisdiction	6.2%	81.5%	12.3%	100.0%
	City of North Las Vegas	Count	3	13	2	18
		% within Respondent Jurisdiction	16.7%	72.2%	11.1%	100.0%
	City of Henderson	Count	3	19	4	26
		% within Respondent Jurisdiction	11.5%	73.1%	15.4%	100.0%
	Boulder City	Count	2	2	0	4
		% within Respondent Jurisdiction	50.0%	50.0%	.0%	100.0%
	Mesquite	Count	0	1	0	1
		% within Respondent Jurisdiction	.0%	100.0%	.0%	100.0%
Total		Count	23	154	39	216
		% within Respondent Jurisdiction	10.6%	71.3%	18.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.781(a)	10	.140
Likelihood Ratio	13.132	10	.216
Linear-by-Linear Association	4.083	1	.043
N of Valid Cases	216		

Appendix IX
Local Government Interaction Service Ratings
Jurisdictional Cross-tabulations

Respondent Jurisdiction * On a scale of one to five, where one equals poor and five equals excellent, how would you rate your overall customer experience with Clark County government?

			On a scale of one to five, where one equals poor and five equals excellent, how would you rate your overall customer experience with Clark County government?					
			One	Two	Three	Four	Five	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	20	14	26	29	13	102
		% within Respondent Jurisdiction	19.6%	13.7%	25.5%	28.4%	12.7%	100.0%
	City of Las Vegas	Count	11	6	21	15	12	65
		% within Respondent Jurisdiction	16.9%	9.2%	32.3%	23.1%	18.5%	100.0%
	City of North Las Vegas	Count	1	2	11	2	3	19
		% within Respondent Jurisdiction	5.3%	10.5%	57.9%	10.5%	15.8%	100.0%
	City of Henderson	Count	1	0	10	11	5	27
		% within Respondent Jurisdiction	3.7%	.0%	37.0%	40.7%	18.5%	100.0%
	Boulder City	Count	0	0	2	1	0	3
		% within Respondent Jurisdiction	.0%	.0%	66.7%	33.3%	.0%	100.0%
	Mesquite	Count	0	0	1	0	0	1
		% within Respondent Jurisdiction	.0%	.0%	100.0%	.0%	.0%	100.0%
Total		Count	33	22	71	58	33	217
		% within Respondent Jurisdiction	15.2%	10.1%	32.7%	26.7%	15.2%	100.0%

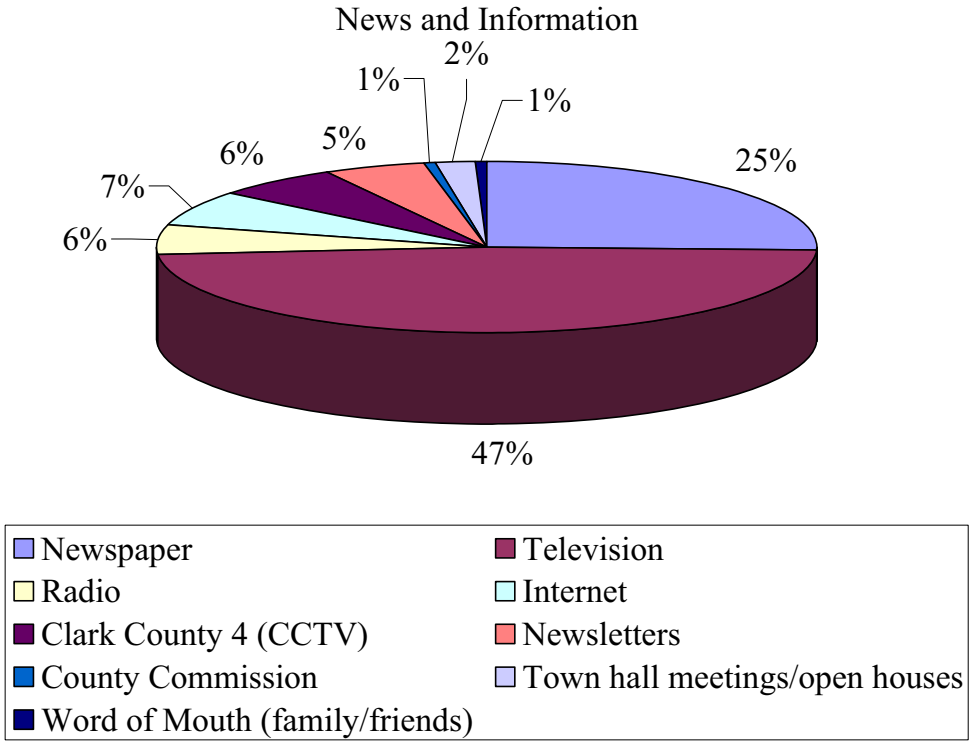
Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.285(a)	20	.230
Likelihood Ratio	29.101	20	.086
Linear-by-Linear Association	5.136	1	.023
N of Valid Cases	217		

Appendix IX
Local Government Interaction Information

Please tell me, of the following options, through which source you hear about Clark County services most often: NEWS & INFORMATION

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Newspaper	151	25.2	25.2	25.2
	Television	285	47.6	47.6	72.8
	Radio	33	5.5	5.5	78.3
	Internet	40	6.7	6.7	85
	Clark County 4 (CCTV)	36	6	6	91
	Newsletters	29	4.8	4.8	95.8
	County Commission	4	0.6	0.6	96.4
	Town hall meetings/open houses	11	1.9	1.9	98.3
	Word of Mouth (family/friends)	4	0.6	0.6	98.9
	DK/No answer	6	1.1	1.1	100
	Total	600	100	100	



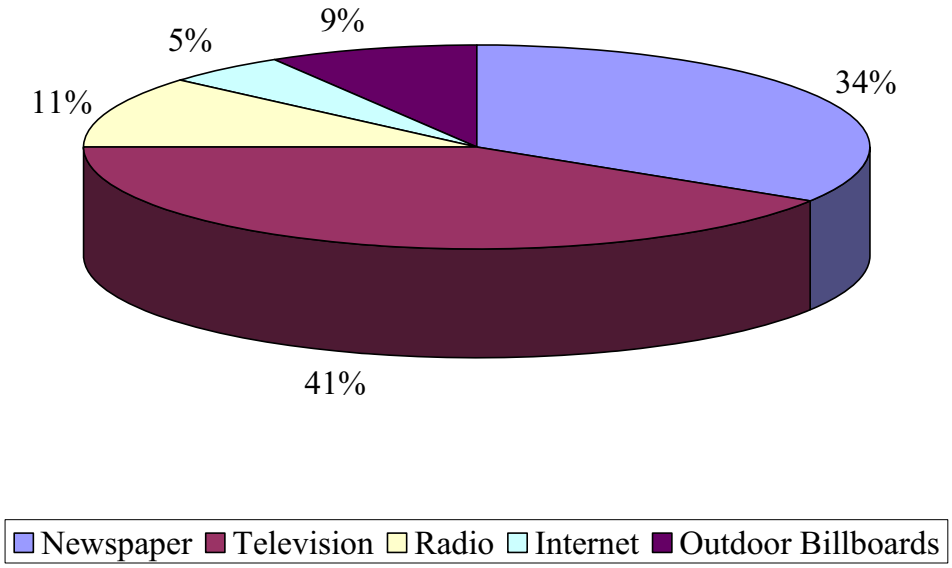
Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction Information

Please tell me, of the following options, through which source you hear about Clark County services most often: ADVERTISING

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Newspaper	197	32.9	32.9	32.9
	Television	239	39.9	39.9	72.8
	Radio	66	11.1	11.1	83.9
	Internet	28	4.6	4.6	88.5
	Outdoor Billboards	51	8.4	8.4	96.9
	DK/No answer	18	3.1	3.1	100
	Total	600	100	100	

Advertising



Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction Information Jurisdictional Cross-Tabulations

Respondent Jurisdiction * Please tell me, of the following options, through which source you hear about Clark County services most often: NEWS & INFORMATION

			Please tell me, of the following options, through which source you hear about Clark County services most often: NEWS & INFORMATION									Total
			Newspaper	Television	Radio	Internet	Clark County 4 (CCTV)	Newsletters	County Commission	Town hall meetings/open houses	Word of Mouth (family/friends)	
Respondent Jurisdiction	Unincorporated Clark County	Count	64	134	11	16	15	12	0	3	2	257
		% within Respondent Jurisdiction	24.9%	52.1%	4.3%	6.2%	5.8%	4.7%	.0%	1.2%	.8%	100.0%
	City of Las Vegas	Count	52	89	11	11	13	5	4	5	2	192
		% within Respondent Jurisdiction	27.1%	46.4%	5.7%	5.7%	6.8%	2.6%	2.1%	2.6%	1.0%	100.0%
	City of North Las Vegas	Count	18	32	4	5	3	5	0	2	0	69
		% within Respondent Jurisdiction	26.1%	46.4%	5.8%	7.2%	4.3%	7.2%	.0%	2.9%	.0%	100.0%
	City of Henderson	Count	14	28	6	7	4	5	0	0	0	64
		% within Respondent Jurisdiction	21.9%	43.8%	9.4%	10.9%	6.3%	7.8%	.0%	.0%	.0%	100.0%
	Boulder City	Count	2	2	1	1	0	0	0	2	0	8
		% within Respondent Jurisdiction	25.0%	25.0%	12.5%	12.5%	.0%	.0%	.0%	25.0%	.0%	100.0%
	Mesquite	Count	1	0	0	0	0	2	0	0	0	3
		% within Respondent Jurisdiction	33.3%	.0%	.0%	.0%	.0%	66.7%	.0%	.0%	.0%	100.0%
Total		Count	151	285	33	40	35	29	4	12	4	593
		% within Respondent Jurisdiction	25.5%	48.1%	5.6%	6.7%	5.9%	4.9%	.7%	2.0%	.7%	100.0%

Appendix IX
Local Government Interaction Information Jurisdictional Cross-Tabulations

Respondent Jurisdiction * Please tell me, of the following options, through which source you hear about Clark County services most often: NEWS & INFORMATION (cont.)

Chi-Square Tests (cont.)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	72.711(a)	40	.001
Likelihood Ratio	47.070	40	.206
Linear-by-Linear Association	3.879	1	.049
N of Valid Cases	593		

Appendix IX
Local Government Interaction Information Jurisdictional Cross-Tabulations

Respondent Jurisdiction * Please tell me, of the following options, through which source you hear about Clark County services most often: ADVERTISING

			Please tell me, of the following options, through which source you hear about Clark County services most often: ADVERTISING					
			Newspaper	Television	Radio	Internet	Outdoor Billboards	Total
Respondent Jurisdiction	Unincorporated Clark County	Count	90	97	30	12	21	250
		% within Respondent Jurisdiction	36.0%	38.8%	12.0%	4.8%	8.4%	100.0%
	City of Las Vegas	Count	64	81	15	7	19	186
		% within Respondent Jurisdiction	34.4%	43.5%	8.1%	3.8%	10.2%	100.0%
	City of North Las Vegas	Count	22	27	10	2	6	67
		% within Respondent Jurisdiction	32.8%	40.3%	14.9%	3.0%	9.0%	100.0%
	City of Henderson	Count	17	30	9	7	2	65
		% within Respondent Jurisdiction	26.2%	46.2%	13.8%	10.8%	3.1%	100.0%
	Boulder City	Count	0	4	3	0	2	9
		% within Respondent Jurisdiction	.0%	44.4%	33.3%	.0%	22.2%	100.0%
	Mesquite	Count	3	0	0	0	0	3
		% within Respondent Jurisdiction	100.0%	.0%	.0%	.0%	.0%	100.0%
Total		Count	196	239	67	28	50	580
		% within Respondent Jurisdiction	33.8%	41.2%	11.6%	4.8%	8.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	29.032(a)	20	.087
Likelihood Ratio	31.128	20	.054
Linear-by-Linear Association	.573	1	.449
N of Valid Cases	580		

Appendix X

Local Distribution Summary

Appendix X
Local Distribution Summary

Respondent zip code:

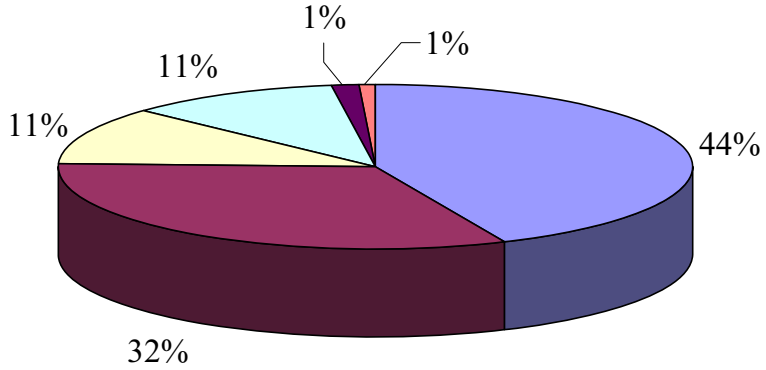
		Frequency	Percent	Valid Percent	Cumulative Percent		Frequency	Percent	Valid Percent	Cumulative Percent
	89004	2	.3	.3	.3	89123	29	4.8	4.8	66.3
	89005	9	1.4	1.4	1.8	89128	35	5.9	5.9	72.1
	89011	20	3.3	3.3	5.1	89129	4	.7	.7	72.8
	89012	40	6.7	6.7	11.8	89130	2	.4	.4	73.2
	89014	4	.7	.7	12.5	89132	3	.5	.5	73.7
	89015	6	1.0	1.0	13.4	89133	0	.1	.1	73.7
	89016	0	.1	.1	13.5	89134	44	7.4	7.4	81.1
	89018	4	.7	.7	14.2	89135	5	.8	.8	81.9
	89019	5	.9	.9	15.1	89139	12	2.1	2.1	83.9
	89021	10	1.6	1.6	16.7	89141	12	2.0	2.0	85.9
	89024	0	.1	.1	16.7	89142	8	1.3	1.3	87.2
	89025	0	.1	.1	16.8	89144	3	.4	.4	87.7
	89027	3	.6	.6	17.4	89145	29	4.8	4.8	92.4
	89029	1	.2	.2	17.6	89146	1	.2	.2	92.6
	89031	6	1.0	1.0	18.5	89147	19	3.2	3.2	95.8
	89032	66	11.0	11.0	29.5	89148	8	1.4	1.4	97.2
	89039	4	.7	.7	30.2	89149	2	.3	.3	97.4
	89040	10	1.7	1.7	32.0	89150	3	.5	.5	97.9
	89044	5	.9	.9	32.8	89156	10	1.6	1.6	99.6
	89046	3	.4	.4	33.3	89162	0	.1	.1	99.7
	89052	2	.4	.4	33.7	89178	2	.3	.3	99.9
	89056	0	.1	.1	33.8	89183	0	.1	.1	100.0
	89074	3	.5	.5	34.3	Total	600	100.0	100.0	
	89084	2	.3	.3	34.5					
	89101	0	.1	.1	34.6					
	89102	5	.8	.8	35.4					
	89103	19	3.2	3.2	38.7					
	89104	0	.1	.1	38.7					
	89106	0	.1	.1	38.8					
	89107	13	2.2	2.2	41.0					
	89108	4	.7	.7	41.7					
	89109	0	.1	.1	41.8					
	89110	2	.3	.3	42.0					
	89113	13	2.2	2.2	44.2					
	89117	10	1.6	1.6	45.8					
	89118	14	2.4	2.4	48.2					
	89119	13	2.2	2.2	50.4					
	89120	10	1.7	1.7	52.1					
	89121	35	5.9	5.9	57.9					
	89122	21	3.5	3.5	61.4					

Appendix X
Local Distribution Summary

Respondent Jurisdiction:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unincorporated Clark County	260	43.4	43.4	43.4
	City of Las Vegas	193	32.2	32.2	75.6
	City of North Las Vegas	68	11.3	11.3	86.9
	City of Henderson	66	11	11	97.9
	Boulder City	9	1.4	1.4	99.3
	Mesquite	4	0.7	0.7	100
	Total	600	100	100	

Respondent Jurisdiction



Unincorporated Clark County | City of Las Vegas
City of North Las Vegas | City of Henderson
Boulder City | Mesquite

Note- Graph does not include Don't Know/ No Answer

Appendix XI

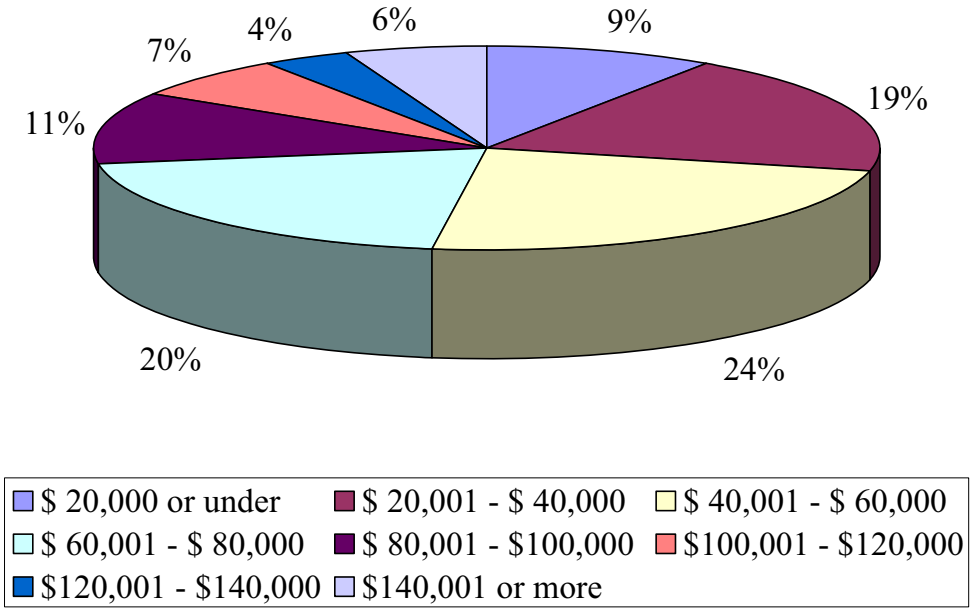
Respondent Demographic Profile

Appendix XI
Respondent Demographic Profile

Which category best describes your total household income before taxes?

		Frequency	Valid Percent
Valid	$ 20,000 or under	50	8.3
	$ 20,001 - $ 40,000	103	17.1
	$ 40,001 - $ 60,000	125	20.8
	$ 60,001 - $ 80,000	108	17.9
	$ 80,001 - $100,000	60	10.1
	$100,001 - $120,000	36	6
	$120,001 - $140,000	19	3.2
	$140,001 or more	31	5.2
	No answer/refused	68	11.4
	Total	600	100

Household Income Before Taxes

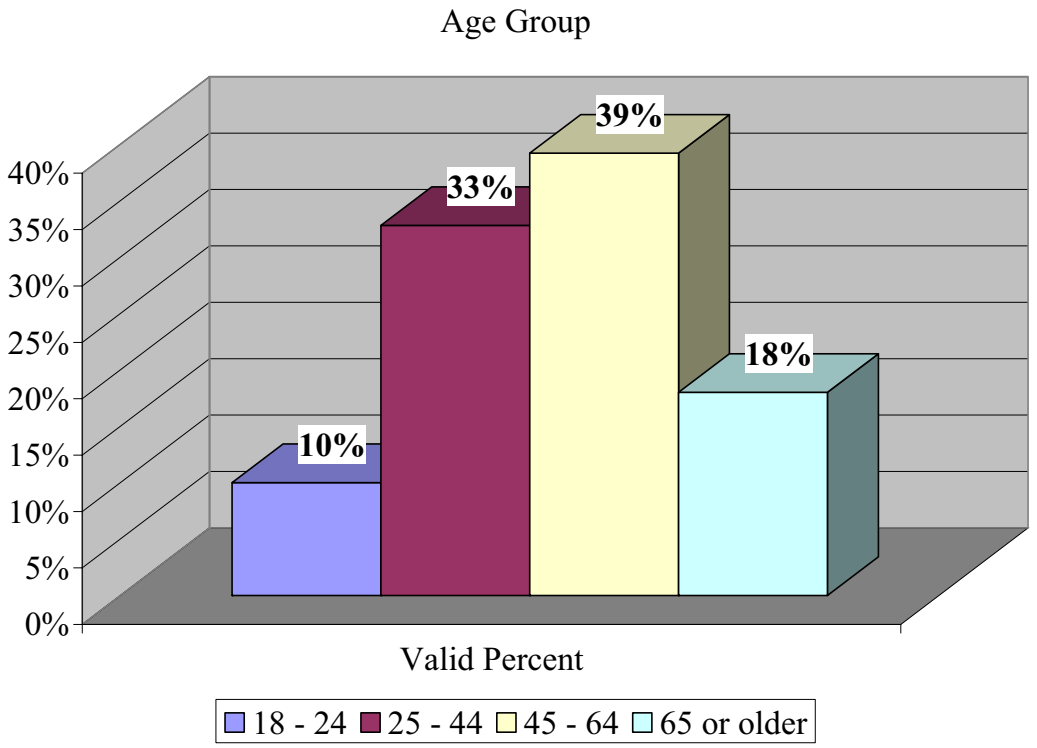


Note- Graph does not include Don't Know/ No Answer

Appendix XI
Respondent Demographic Profile

In what age group do you fall?

		Frequency	Valid Percent
Valid	18 - 24	60	10
	25 - 44	196	32.7
	45 - 64	234	39.1
	65 or older	108	18
	No answer/refused	2	0.3
	Total	600	100

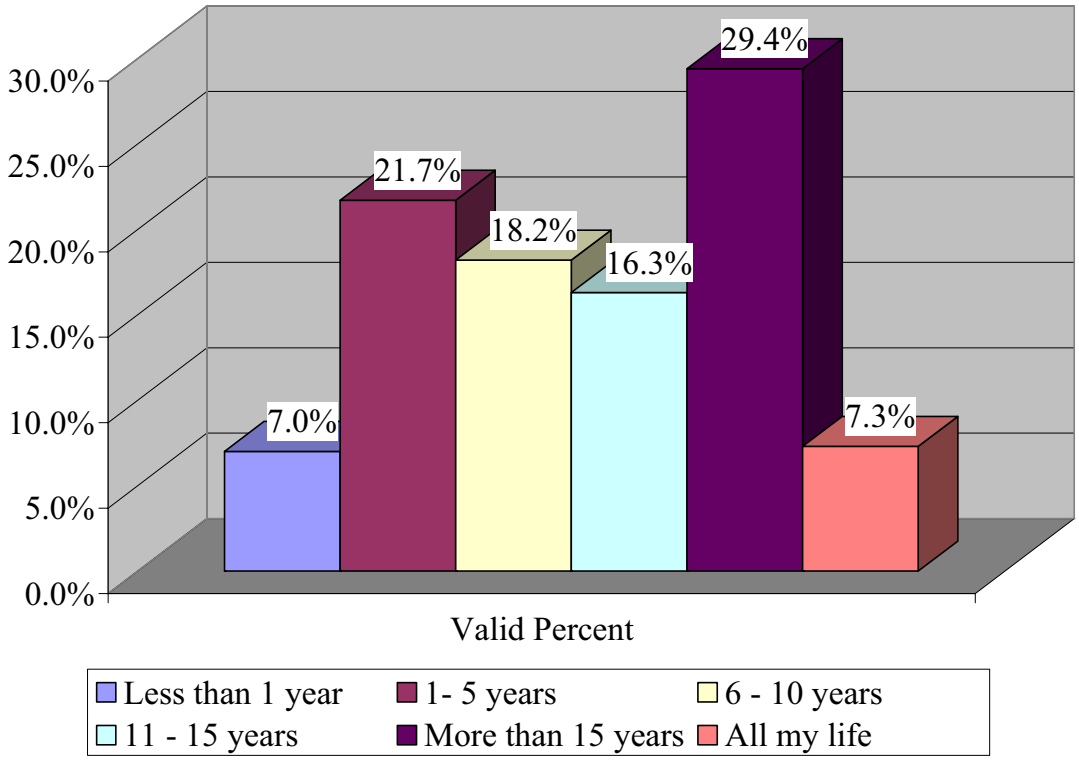


Note- Graph does not include Don't Know/ No Answer

Appendix XI
Respondent Demographic Profile

How long have you lived in Clark County?

		Frequency	Valid Percent
Valid	Less than 1 year	42	7
	1- 5 years	130	21.7
	6 - 10 years	109	18.2
	11 - 15 years	98	16.3
	More than 15 years	176	29.3
	All my life	44	7.3
	No answer/refused	2	0.3
	Total	600	100



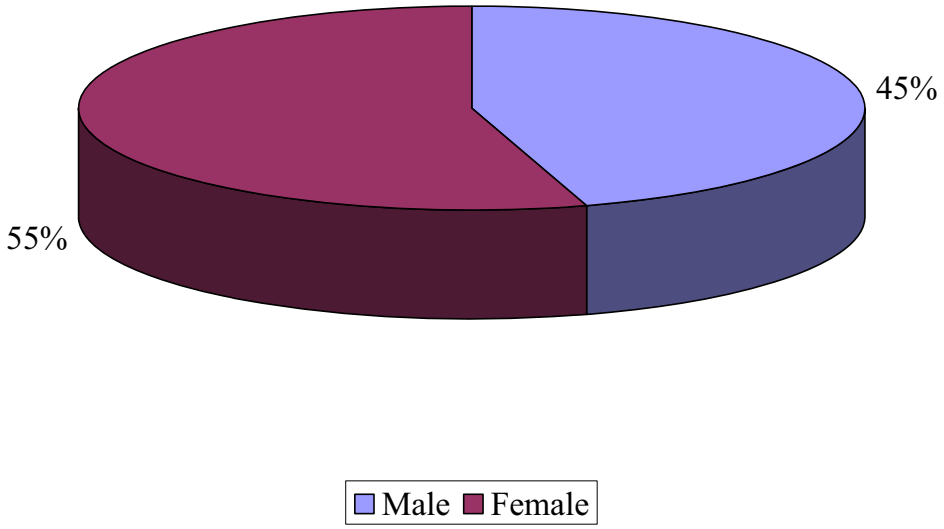
Note- Graph does not include Don't Know/ No Answer

Appendix XI
Respondent Demographic Profile

Gender observation

		Frequency	Valid Percent
Valid	Male	271	45.2
	Female	328	54.8
	Total	600	100

Gender



Note- Graph does not include Don't Know/ No Answer

Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

Respondent Jurisdiction * Which category best describes your total household income before taxes?

			Which category best describes your total household income before taxes?								Total
			$ 20,000 or under	$ 20,001 - $ 40,000	$ 40,001 - $ 60,000	$ 60,001 - $ 80,000	$ 80,001 - $100,000	$100,001 - $120,000	$120,001 - $140,000	$140,001 or more	
Respondent Jurisdiction	Unincorporated Clark County	Count	21	42	58	43	26	15	7	13	225
		% within Respondent Jurisdiction	9.3%	18.7%	25.8%	19.1%	11.6%	6.7%	3.1%	5.8%	100.0%
	City of Las Vegas	Count	16	38	34	31	22	10	5	13	169
		% within Respondent Jurisdiction	9.5%	22.5%	20.1%	18.3%	13.0%	5.9%	3.0%	7.7%	100.0%
	City of North Las Vegas	Count	6	11	17	13	7	3	3	3	63
		% within Respondent Jurisdiction	9.5%	17.5%	27.0%	20.6%	11.1%	4.8%	4.8%	4.8%	100.0%
	City of Henderson	Count	5	8	15	18	4	6	4	2	62
		% within Respondent Jurisdiction	8.1%	12.9%	24.2%	29.0%	6.5%	9.7%	6.5%	3.2%	100.0%
	Boulder City	Count	0	2	0	3	2	2	0	0	9
		% within Respondent Jurisdiction	.0%	22.2%	.0%	33.3%	22.2%	22.2%	.0%	.0%	100.0%
	Mesquite	Count	1	1	1	0	0	0	0	0	3
		% within Respondent Jurisdiction	33.3%	33.3%	33.3%	.0%	.0%	.0%	.0%	.0%	100.0%
Total		Count	49	102	125	108	61	36	19	31	531
		% within Respondent Jurisdiction	9.2%	19.2%	23.5%	20.3%	11.5%	6.8%	3.6%	5.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.243(a)	35	.857
Likelihood Ratio	28.995	35	.753
Linear-by-Linear Association	.104	1	.747
N of Valid Cases	531		

Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

Respondent Jurisdiction * In what age group do you fall?

			In what age group do you fall?				Total
			18 - 24	25 - 44	45 - 64	65 or older	
Respondent Jurisdiction	Unincorporated Clark County	Count	30	77	113	40	260
		% within Respondent Jurisdiction	11.5%	29.6%	43.5%	15.4%	100.0%
	City of Las Vegas	Count	16	64	66	45	191
		% within Respondent Jurisdiction	8.4%	33.5%	34.6%	23.6%	100.0%
	City of North Las Vegas	Count	11	28	23	7	69
		% within Respondent Jurisdiction	15.9%	40.6%	33.3%	10.1%	100.0%
	City of Henderson	Count	3	23	29	11	66
		% within Respondent Jurisdiction	4.5%	34.8%	43.9%	16.7%	100.0%
	Boulder City	Count	0	5	2	2	9
		% within Respondent Jurisdiction	.0%	55.6%	22.2%	22.2%	100.0%
	Mesquite	Count	0	0	1	3	4
		% within Respondent Jurisdiction	.0%	.0%	25.0%	75.0%	100.0%
Total		Count	60	197	234	108	599
		% within Respondent Jurisdiction	10.0%	32.9%	39.1%	18.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	29.819(a)	15	.013
Likelihood Ratio	29.442	15	.014
Linear-by-Linear Association	.408	1	.523
N of Valid Cases	599		

Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

Respondent Jurisdiction * How long have you lived in Clark County?

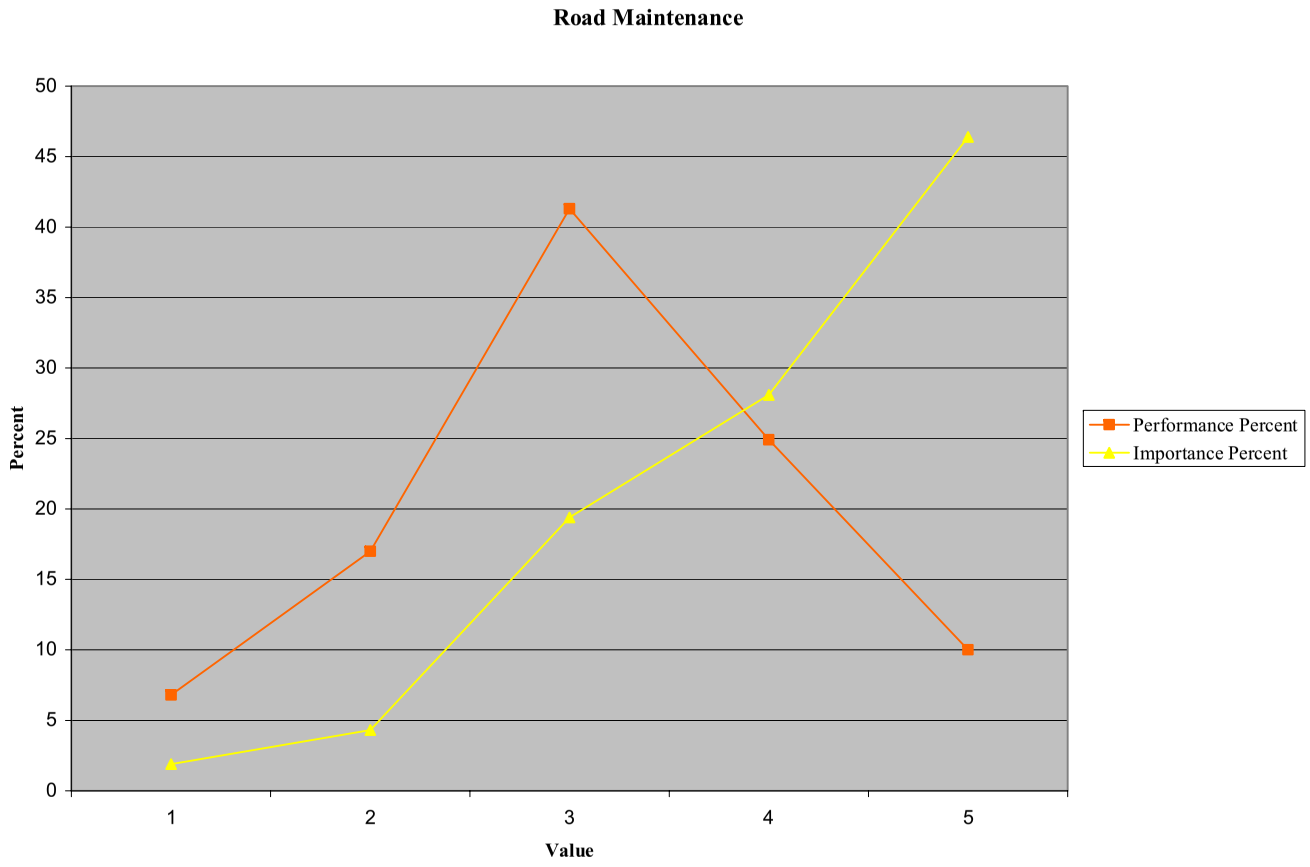
			How long have you lived in Clark County?						Total
			Less than 1 year	1- 5 years	6 - 10 years	11 - 15 years	More than 15 years	All my life	
Respondent Jurisdiction	Unincorporated Clark County	Count	19	54	53	42	78	13	259
		% within Respondent Jurisdiction	7.3%	20.8%	20.5%	16.2%	30.1%	5.0%	100.0%
	City of Las Vegas	Count	14	31	31	38	65	13	192
		% within Respondent Jurisdiction	7.3%	16.1%	16.1%	19.8%	33.9%	6.8%	100.0%
	City of North Las Vegas	Count	2	18	17	10	14	7	68
		% within Respondent Jurisdiction	2.9%	26.5%	25.0%	14.7%	20.6%	10.3%	100.0%
	City of Henderson	Count	5	23	7	7	16	8	66
		% within Respondent Jurisdiction	7.6%	34.8%	10.6%	10.6%	24.2%	12.1%	100.0%
	Boulder City	Count	2	2	0	0	3	2	9
		% within Respondent Jurisdiction	22.2%	22.2%	.0%	.0%	33.3%	22.2%	100.0%
	Mesquite	Count	1	2	1	0	0	0	4
		% within Respondent Jurisdiction	25.0%	50.0%	25.0%	.0%	.0%	.0%	100.0%
Total		Count	43	130	109	97	176	43	598
		% within Respondent Jurisdiction	7.2%	21.7%	18.2%	16.2%	29.4%	7.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	41.244(a)	25	.022
Likelihood Ratio	43.393	25	.013
Linear-by-Linear Association	.842	1	.359
N of Valid Cases	598		

Appendix XII
Importance/Performance Comparisons

Appendix XII
Importance/Performance Comparisons



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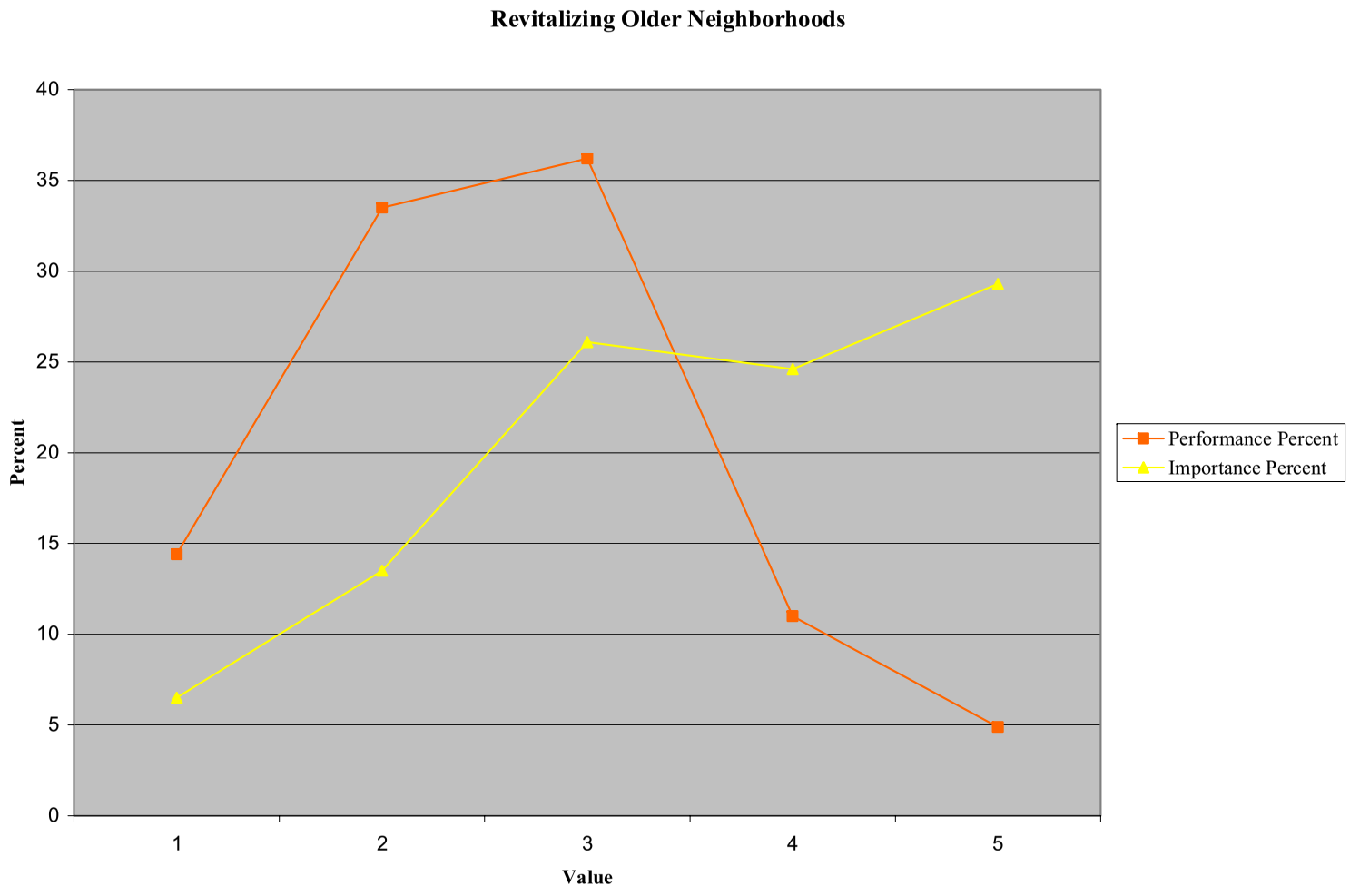

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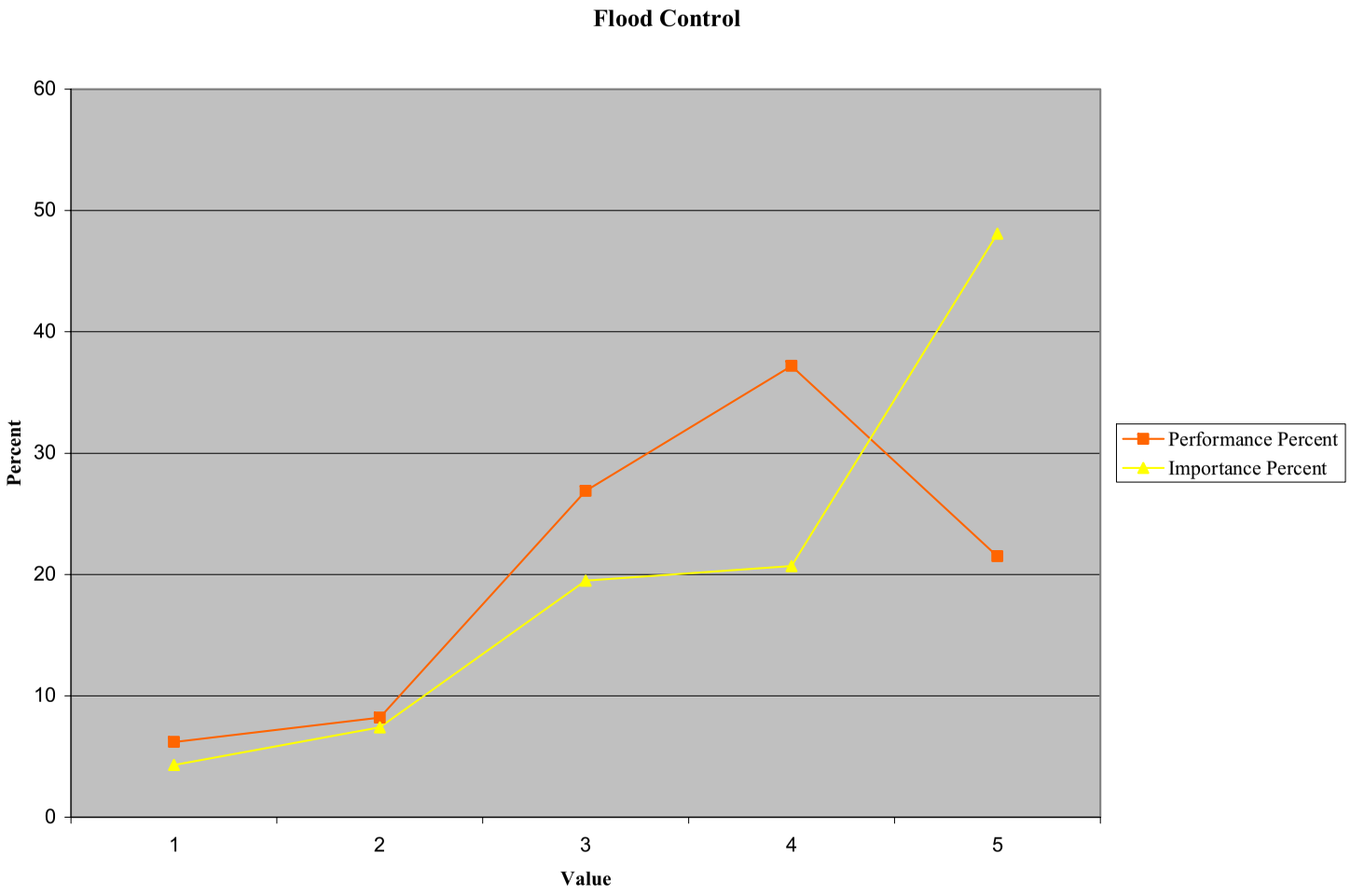

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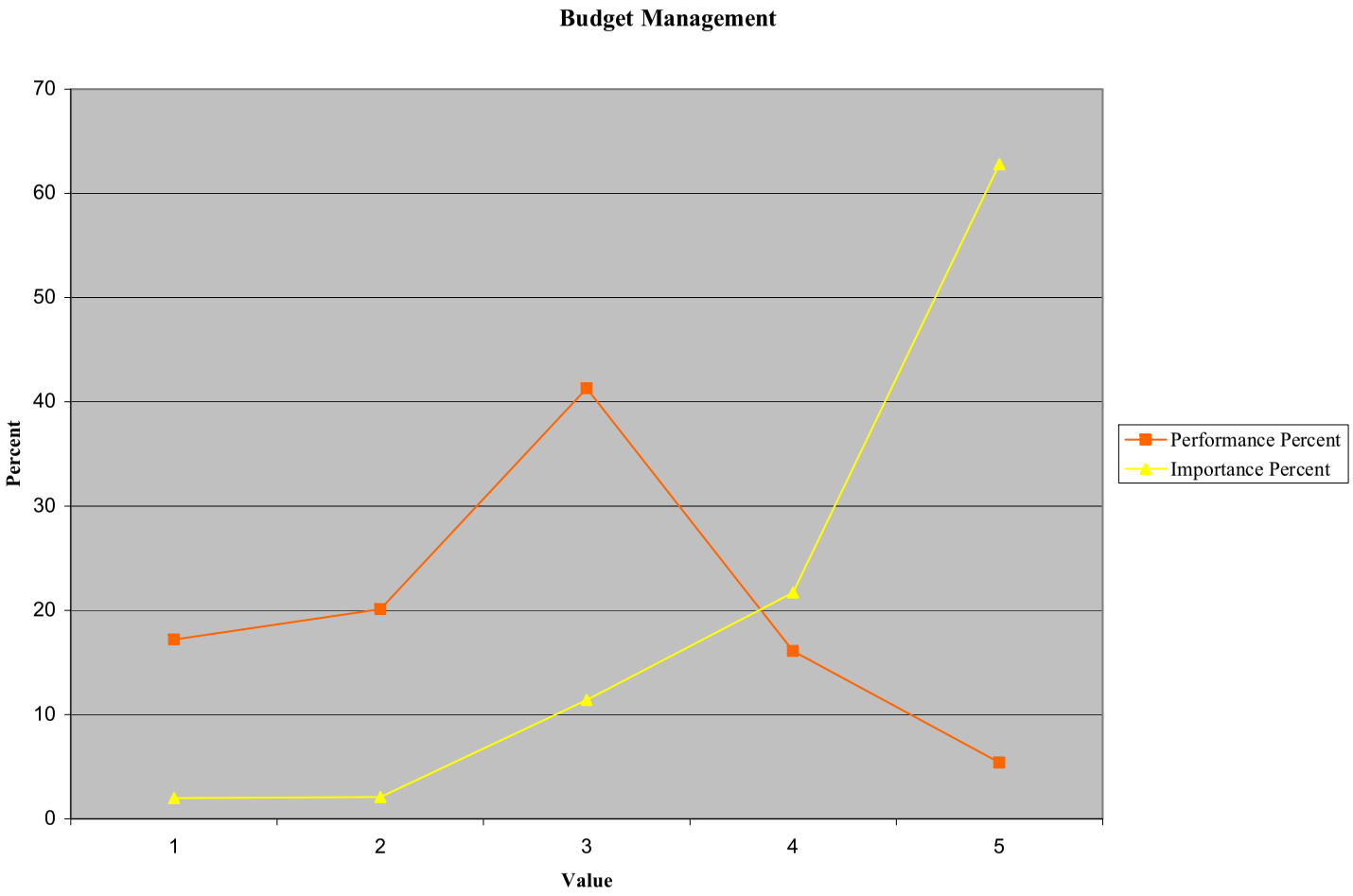
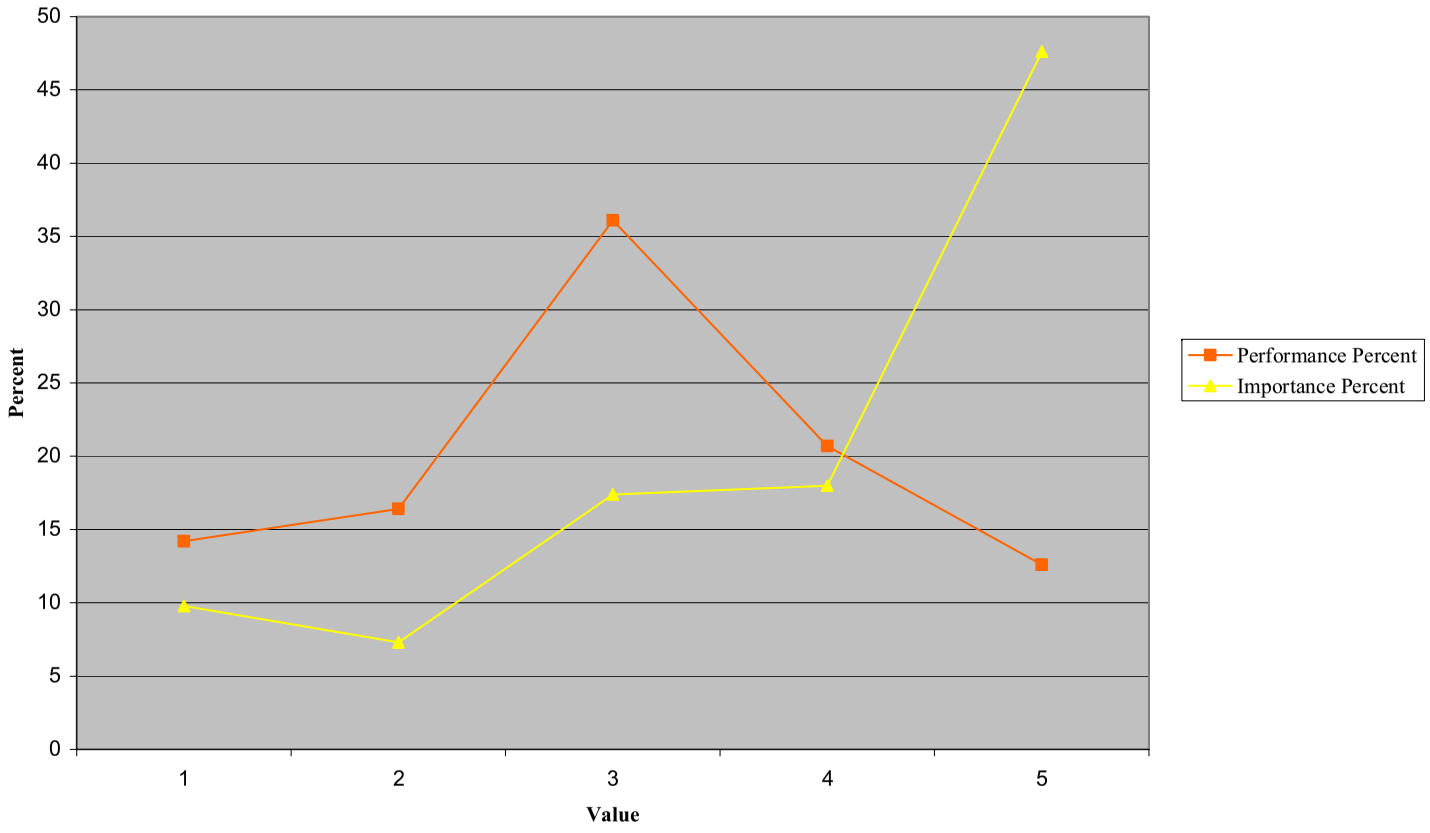


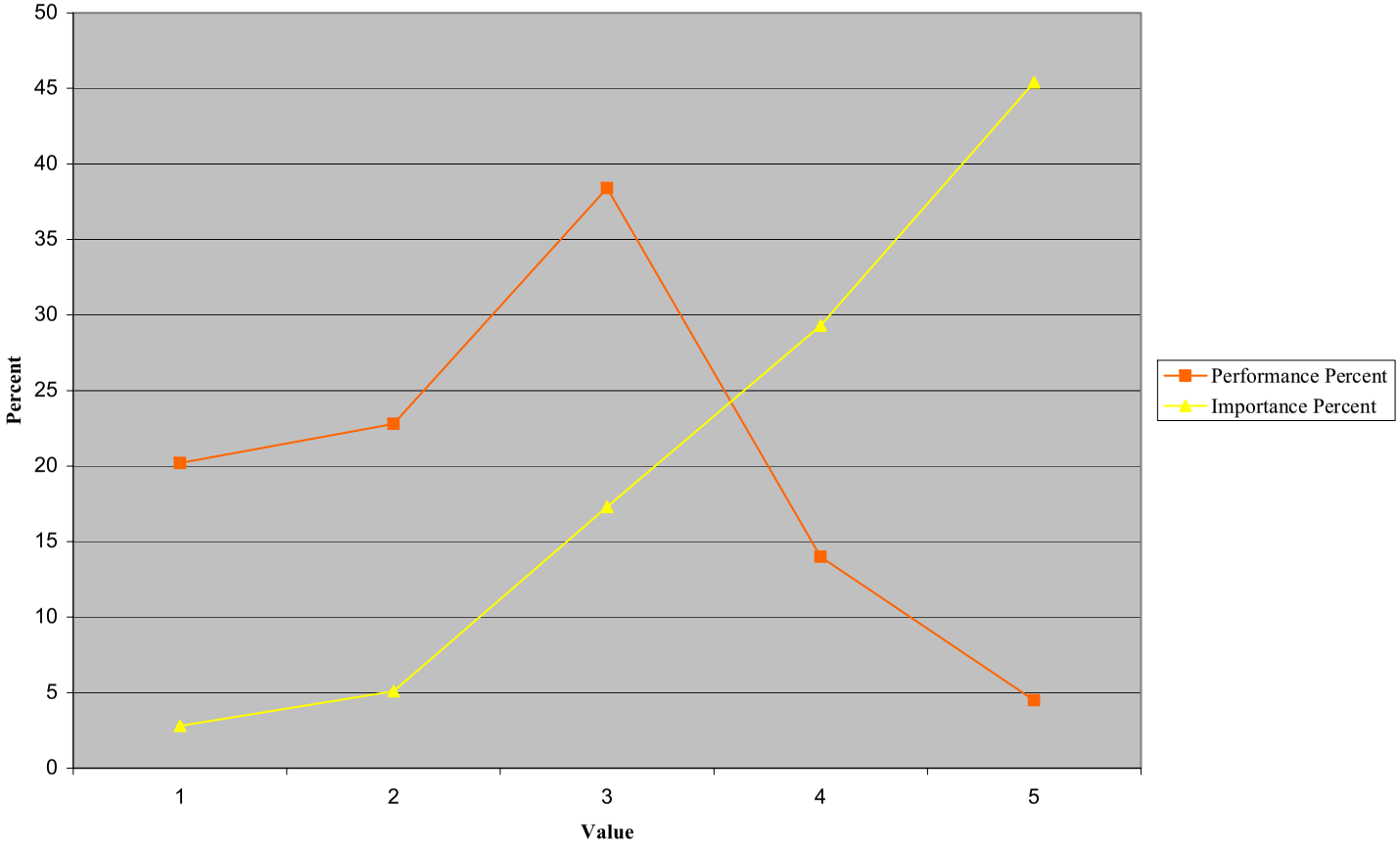
Appendix XII
Importance/Performance Comparisons

Communicate Clark County's Local Government's Views About Yucca Mountain to Federal Decision Makers



Appendix XII
Importance/Performance Comparisons

Monitor and Report to the Public on How Well Government Services are Being Performed



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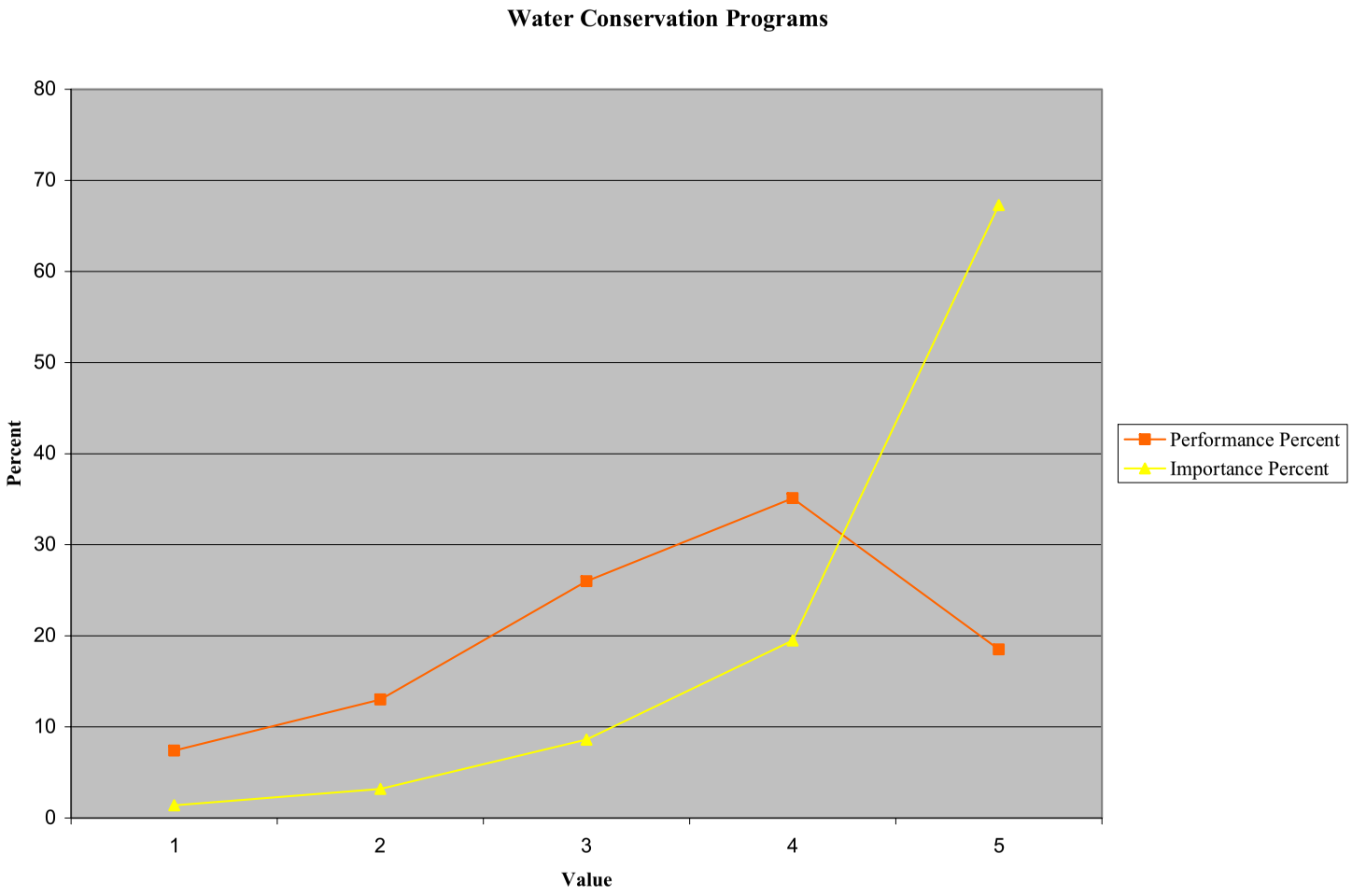
Importance/Performance Comparisons



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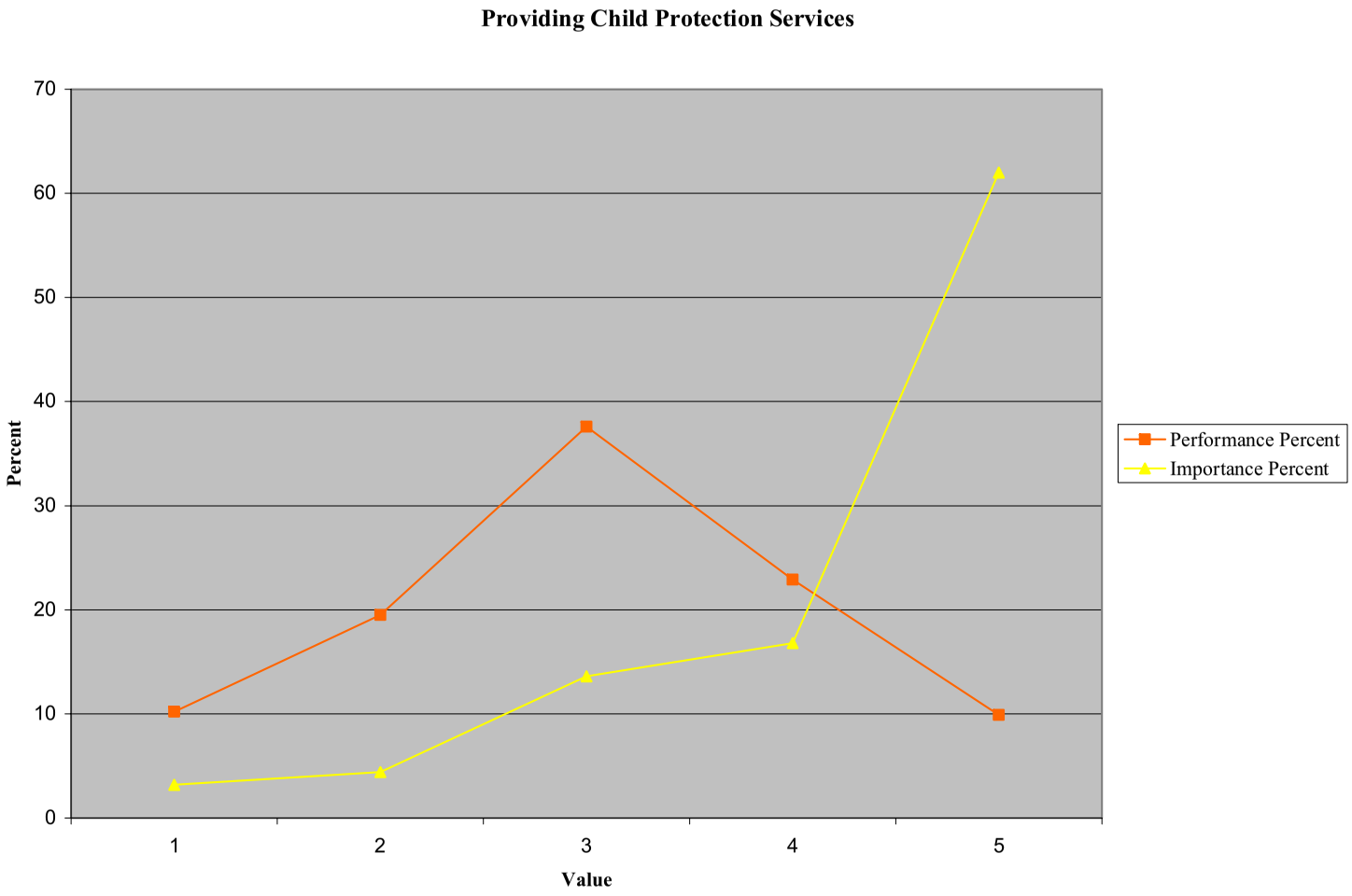

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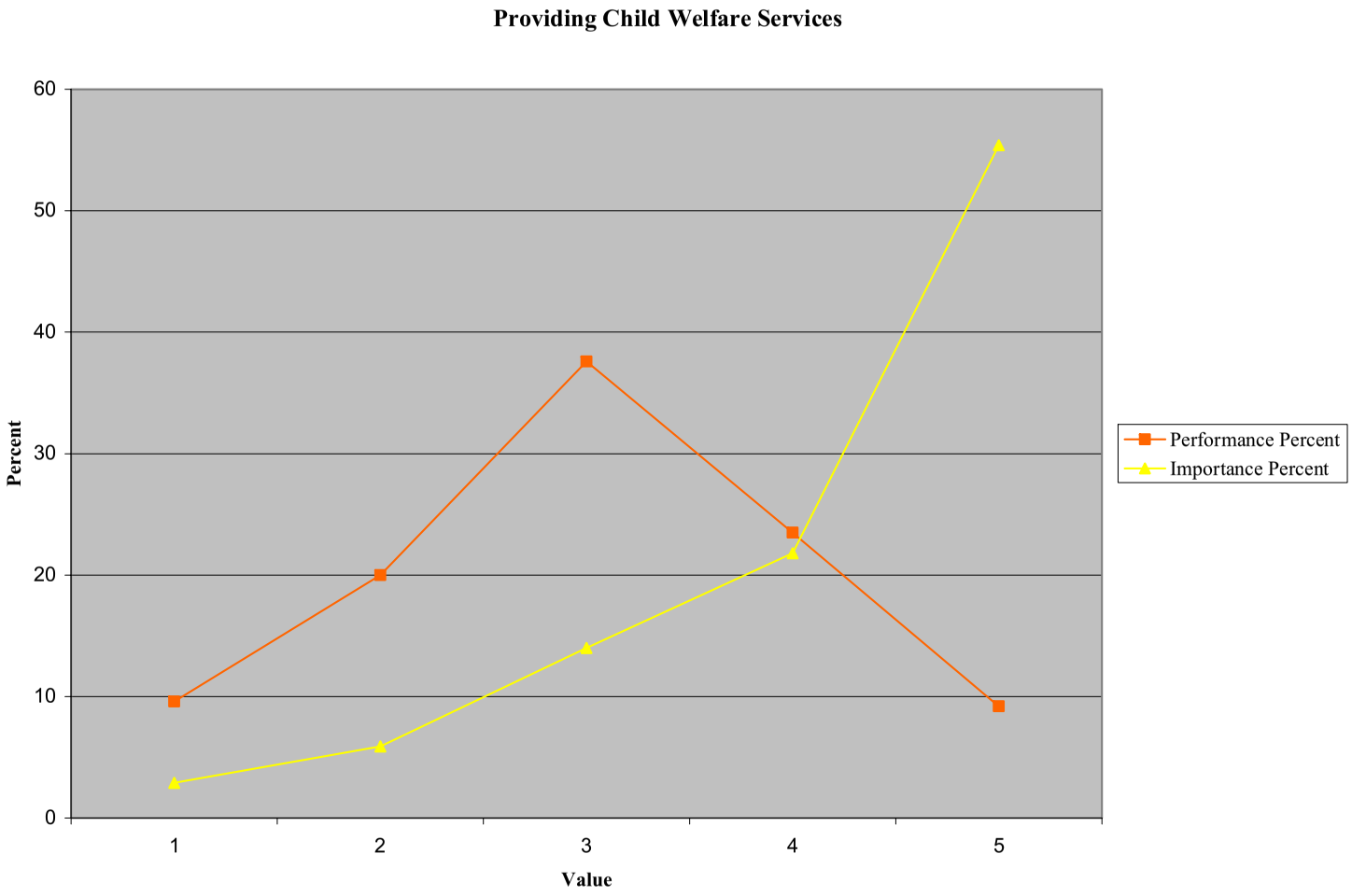

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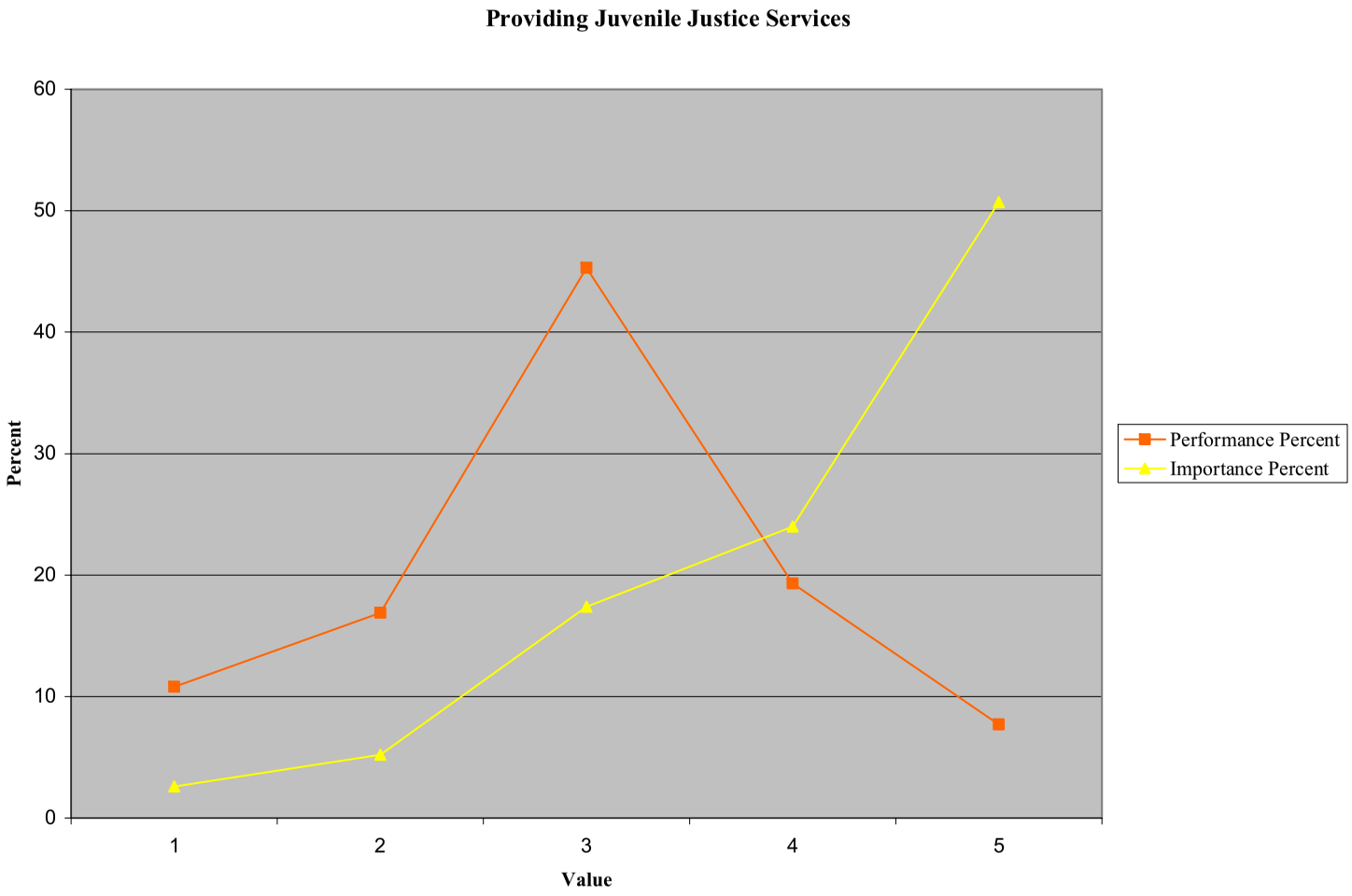

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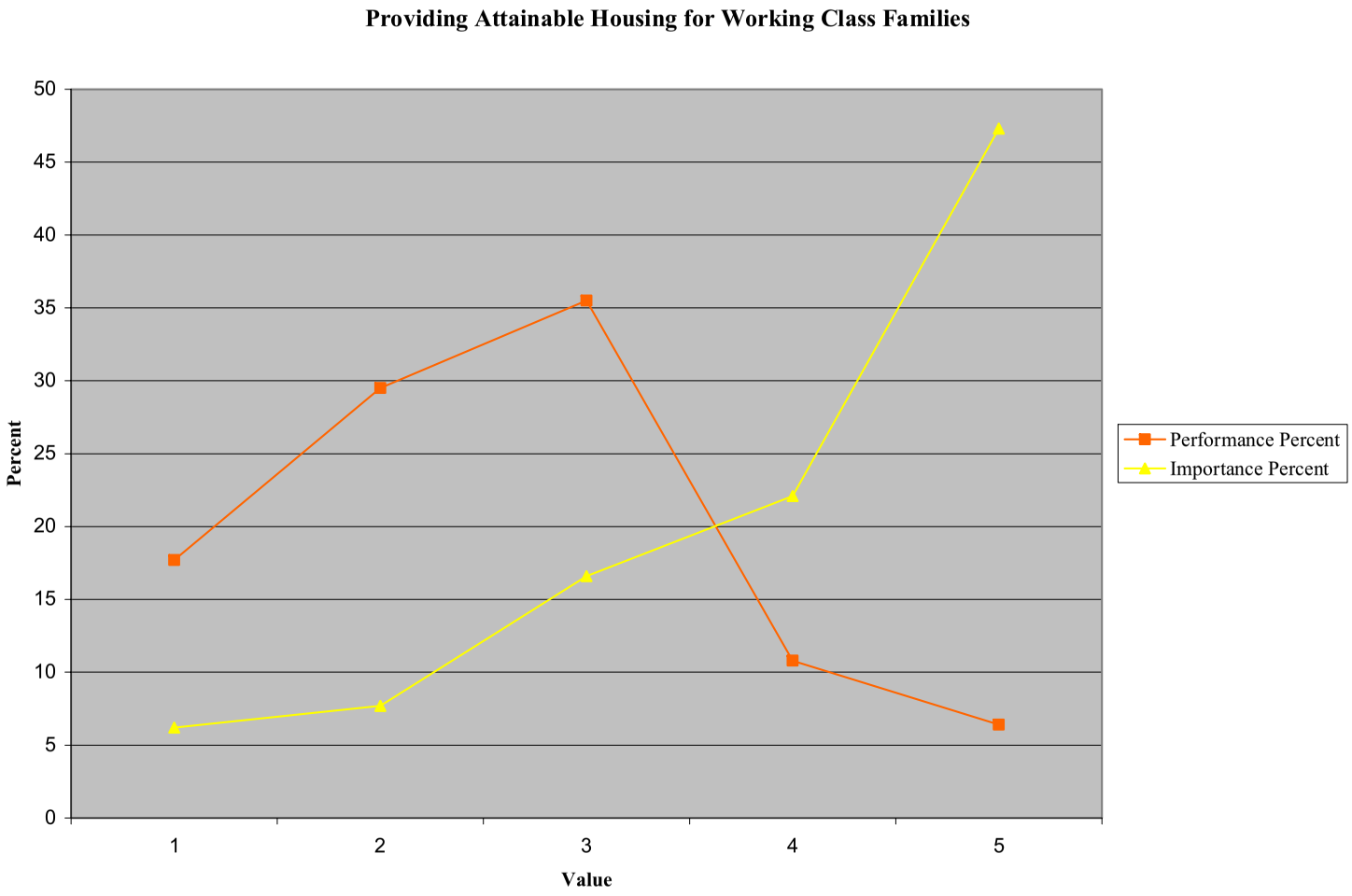

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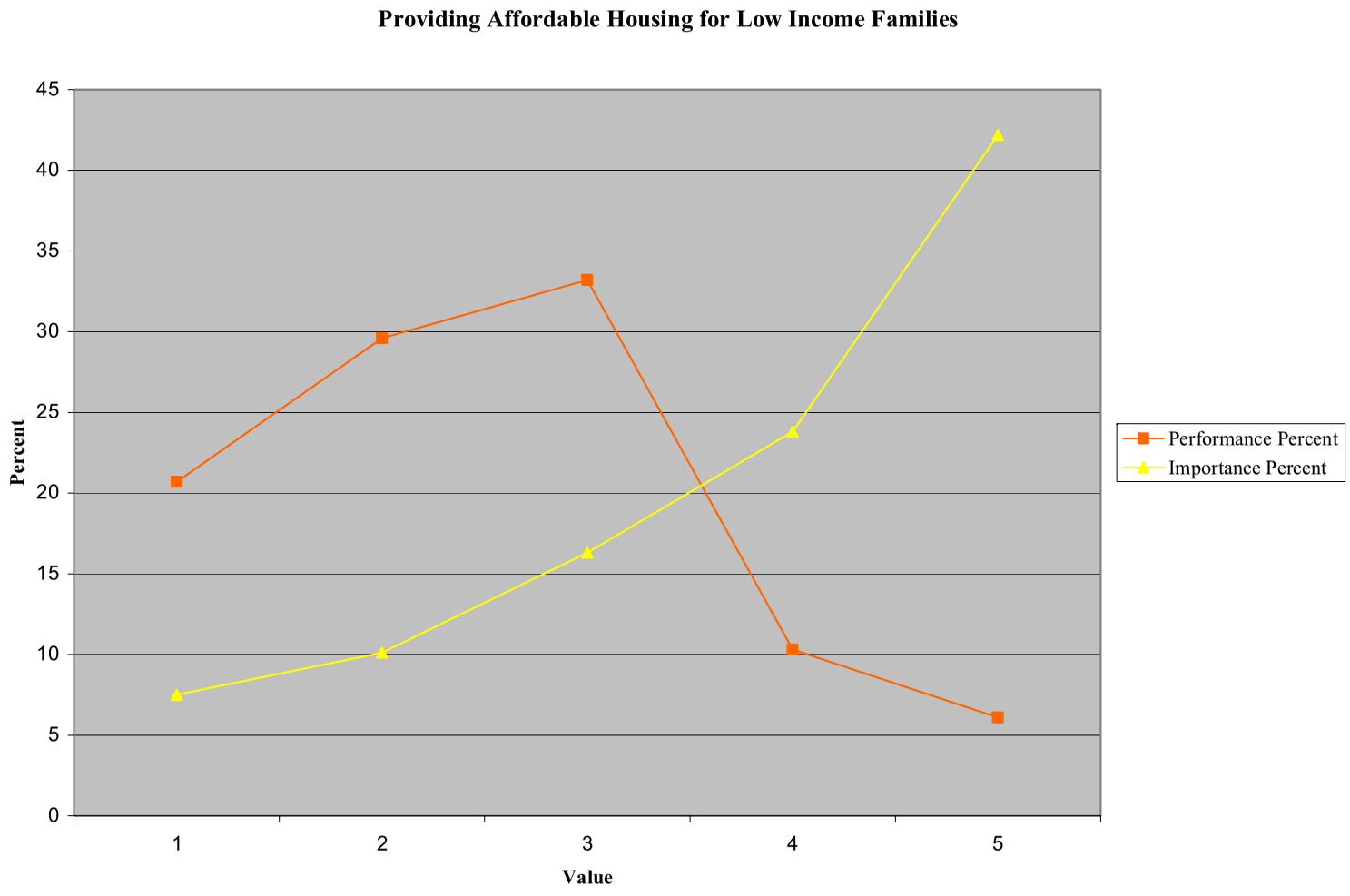

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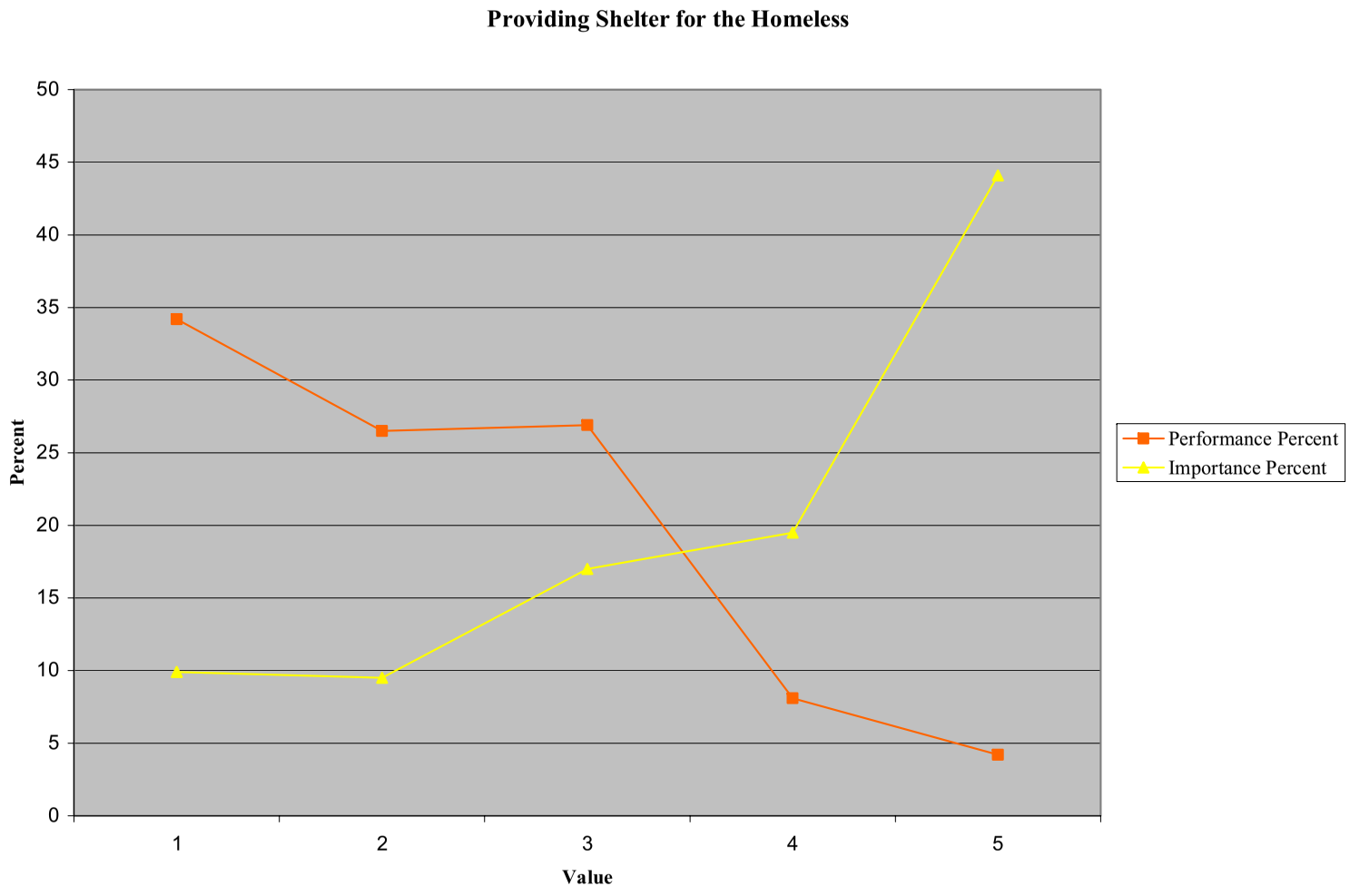

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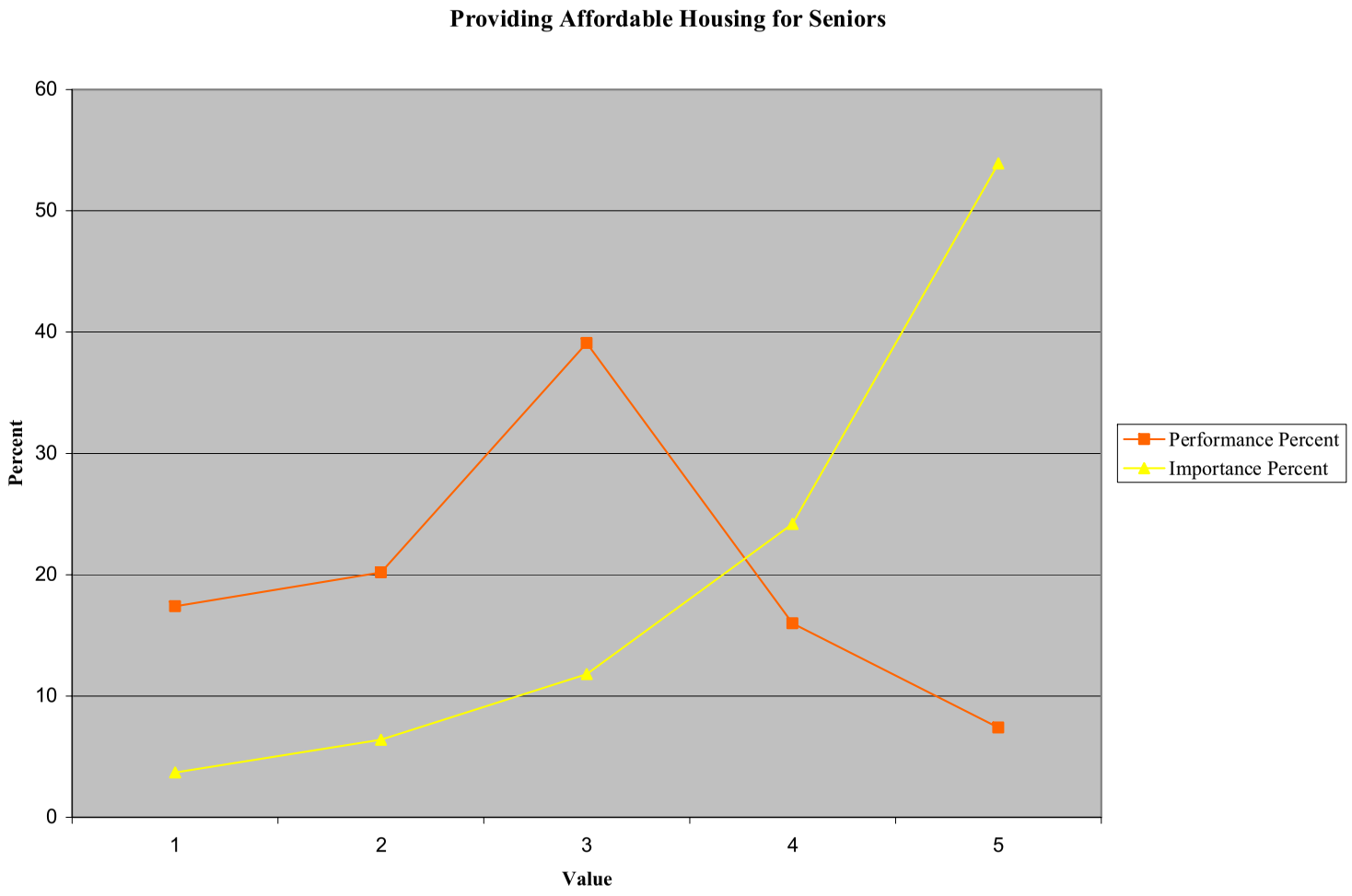

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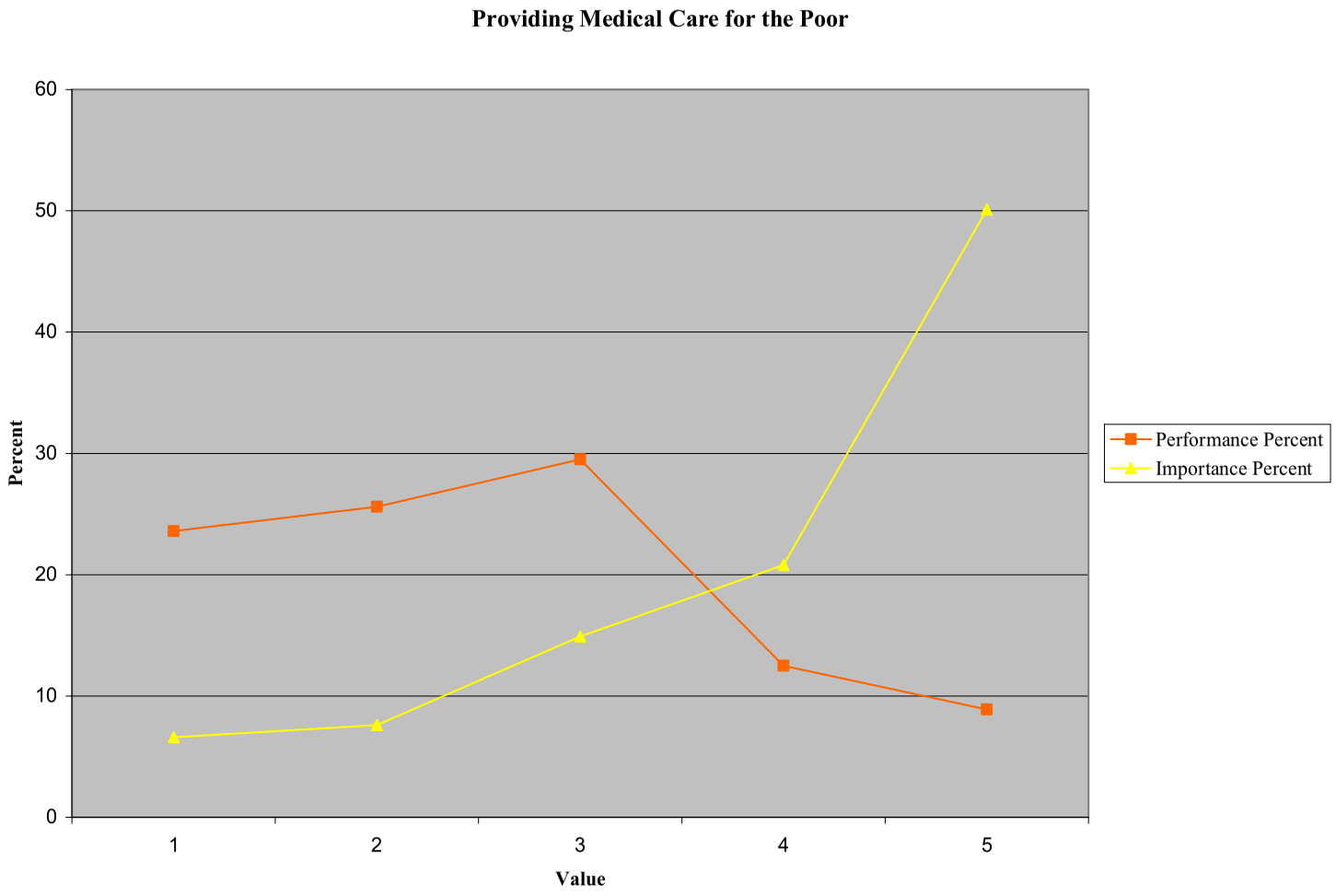

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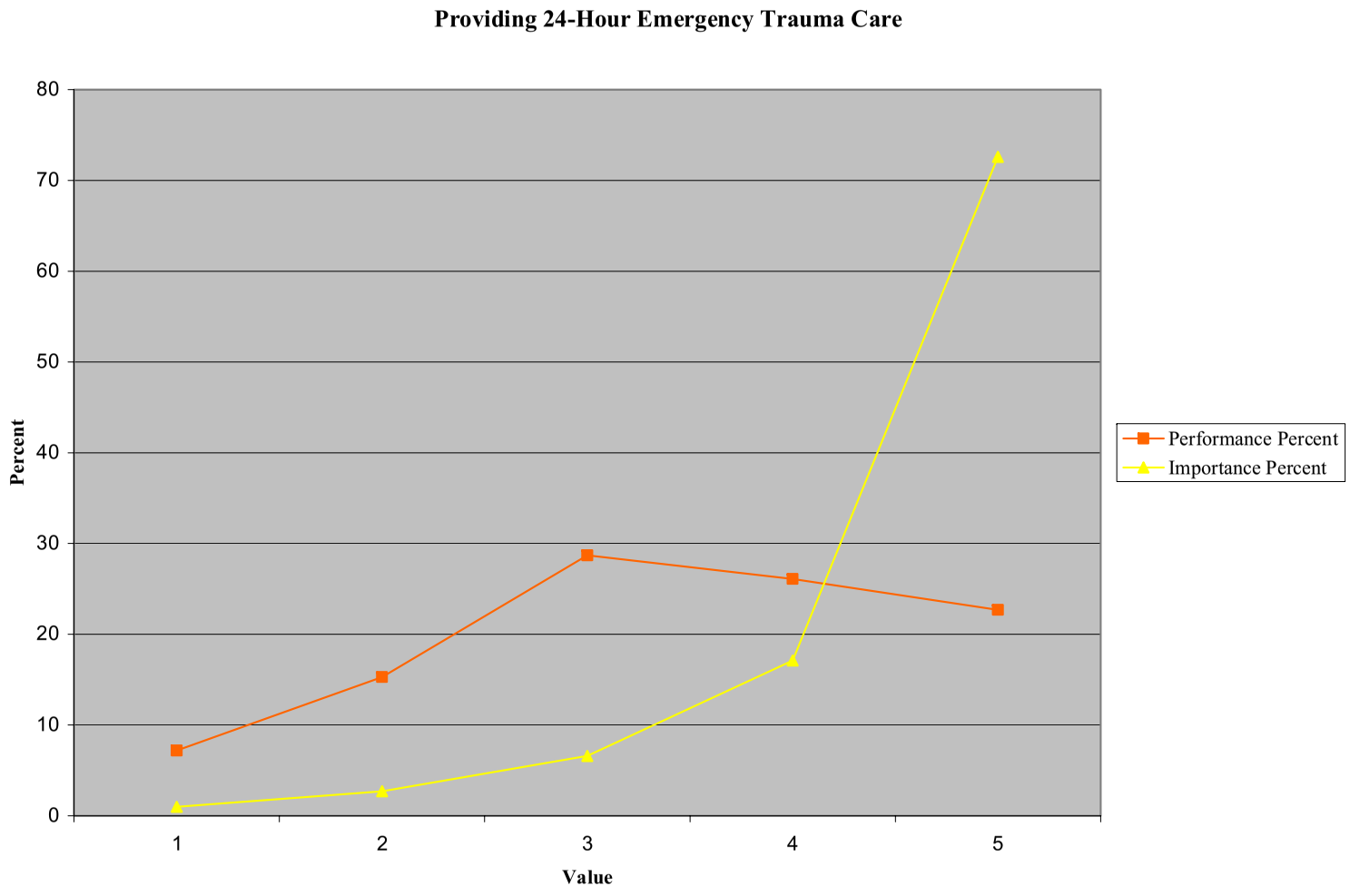

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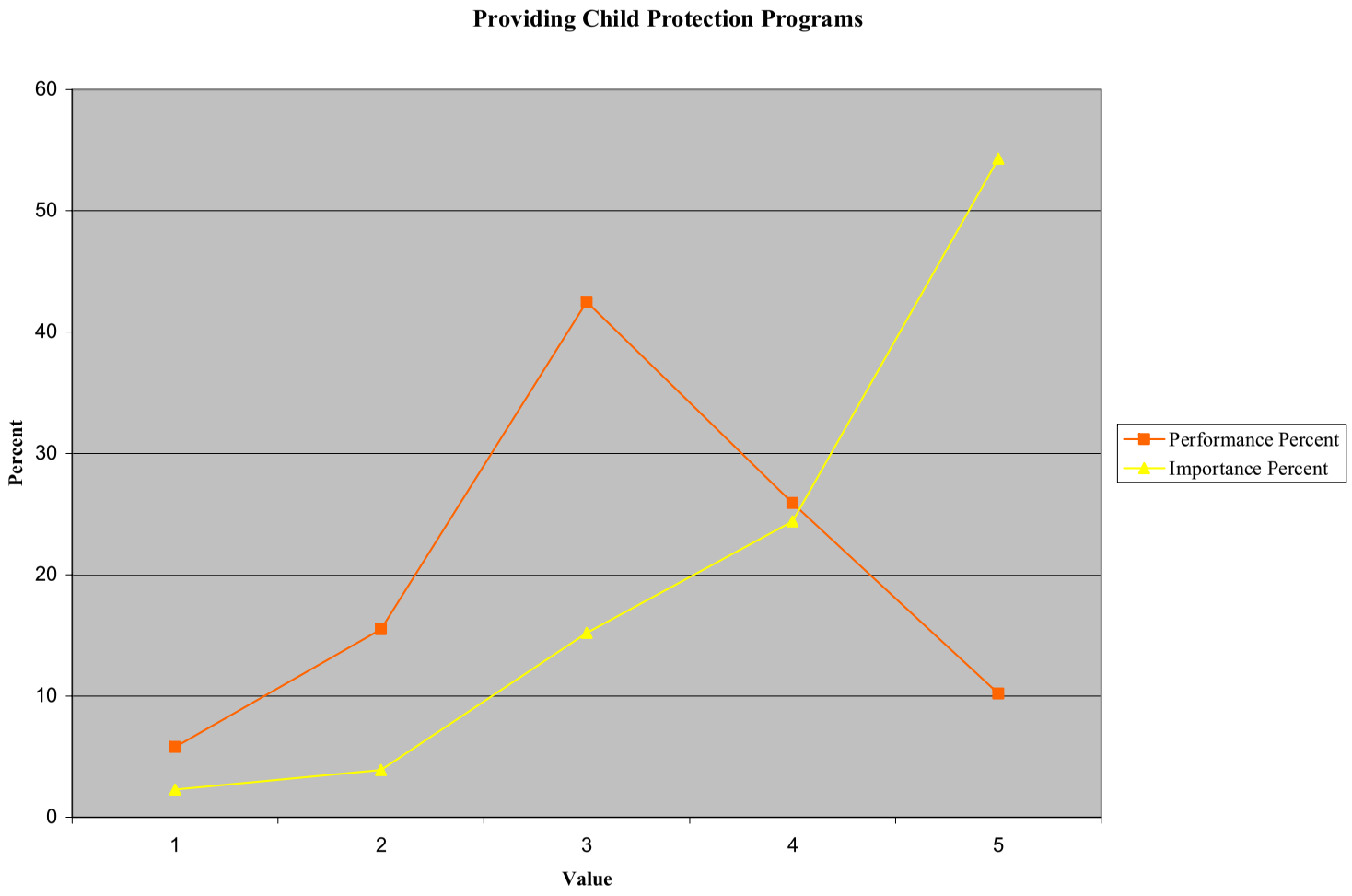

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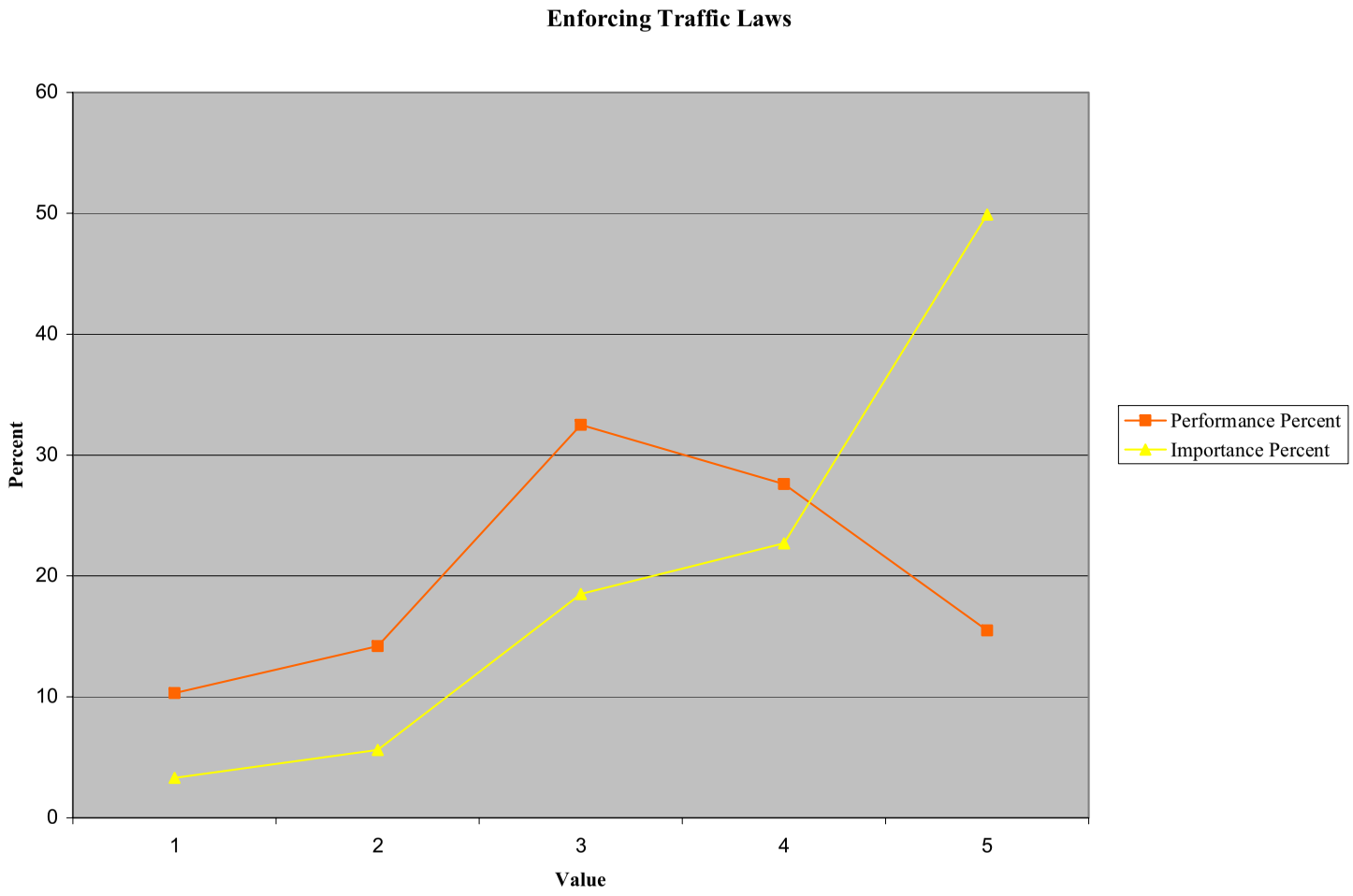

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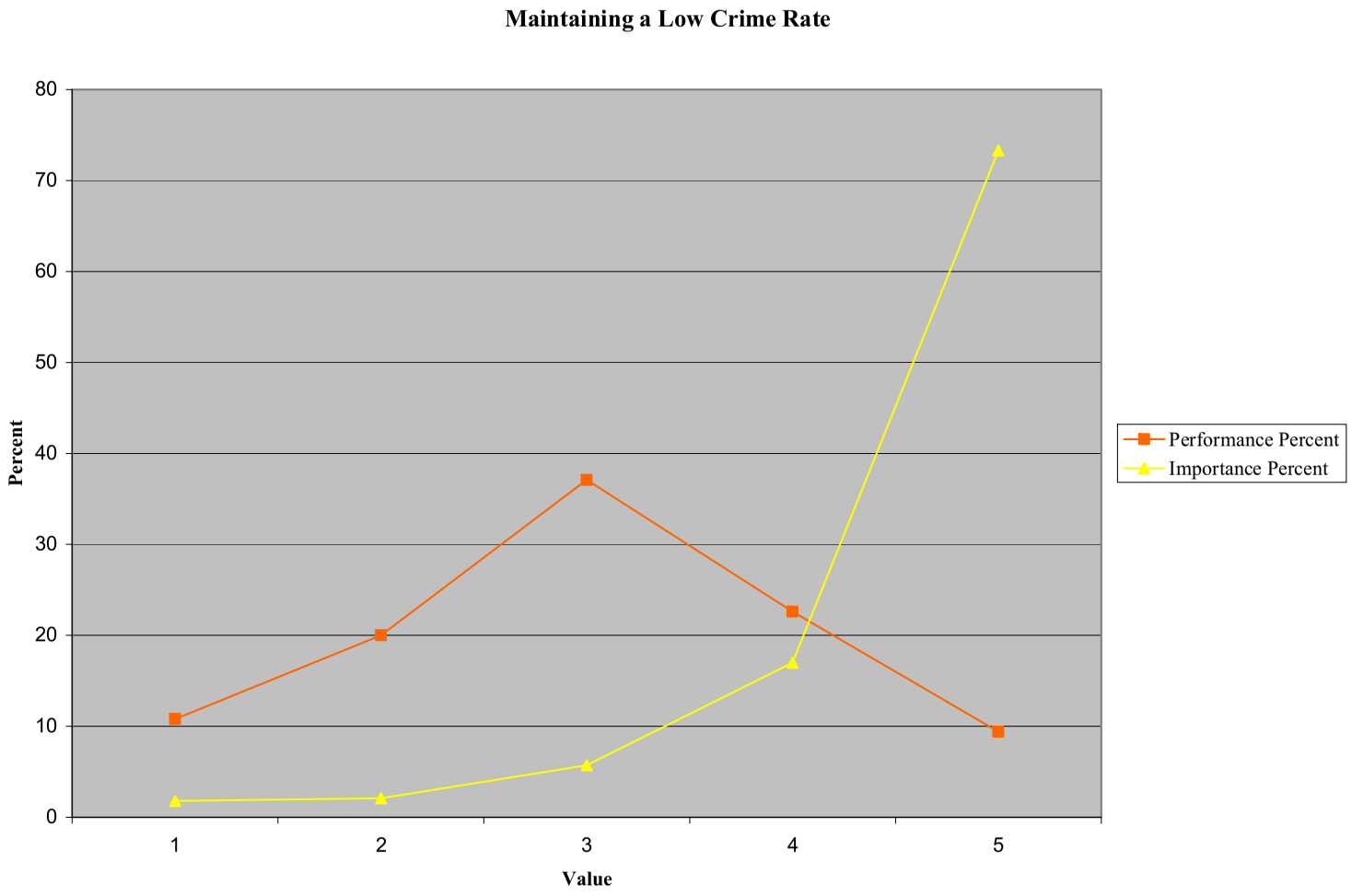

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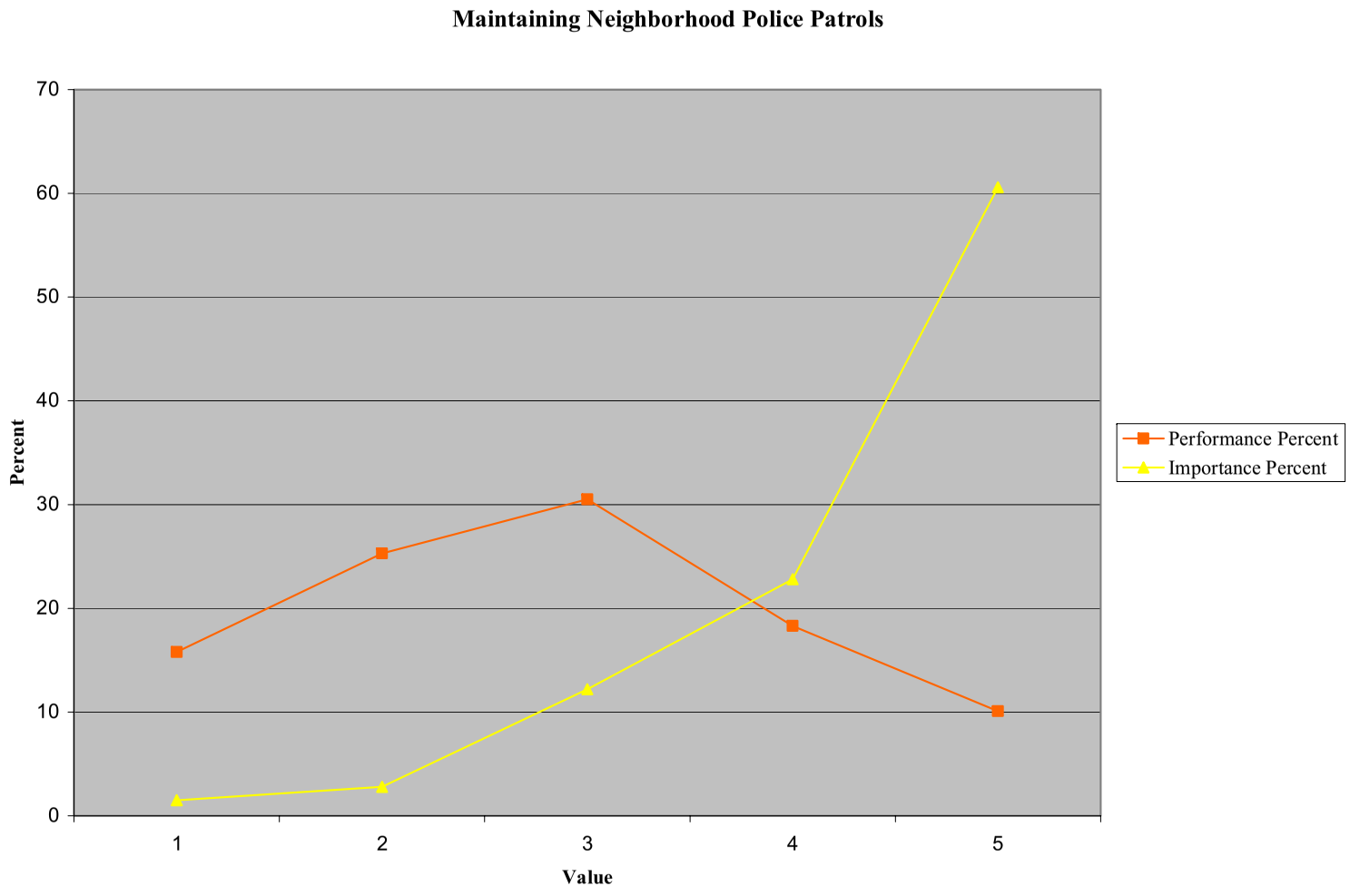

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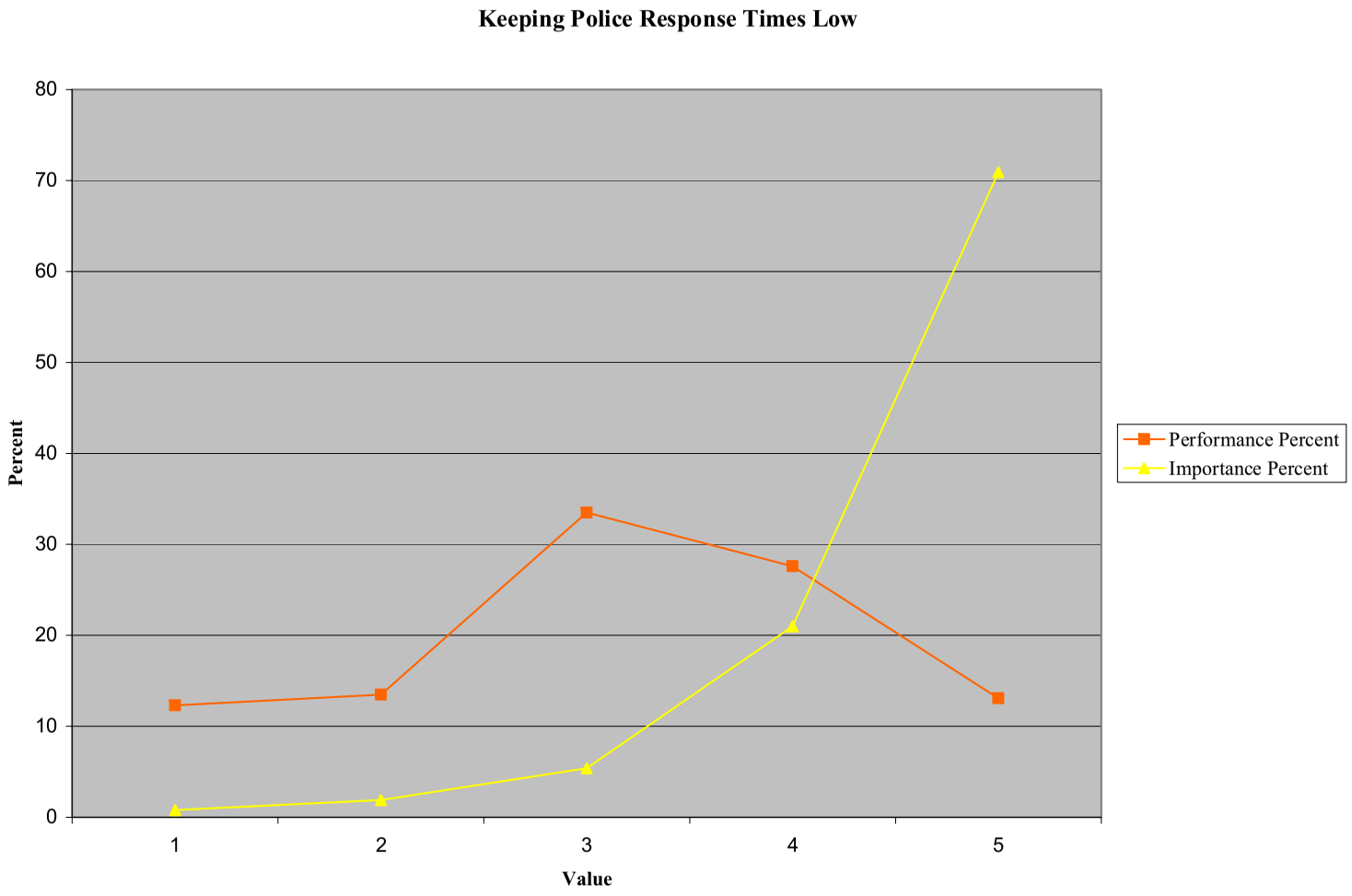

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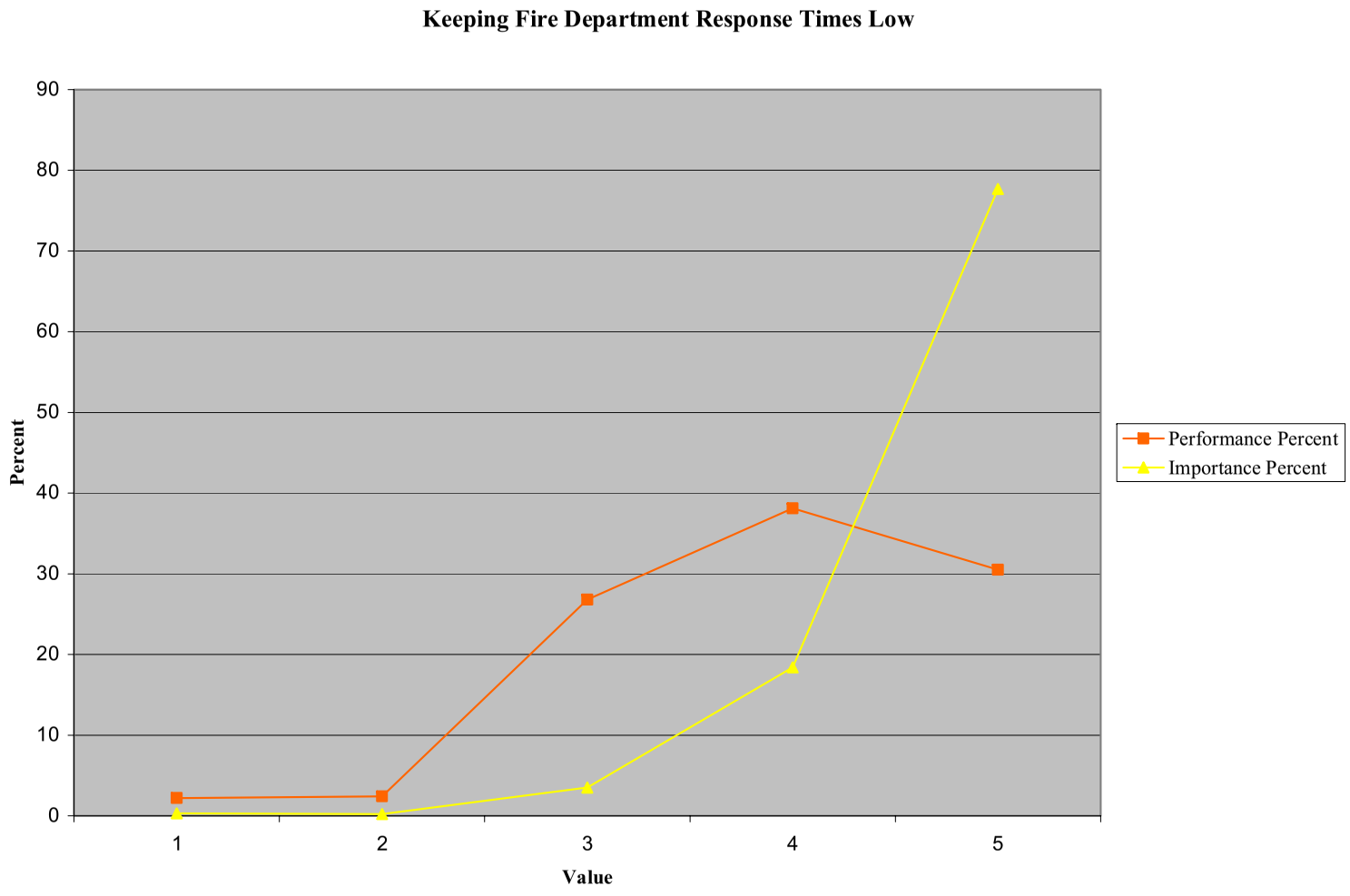

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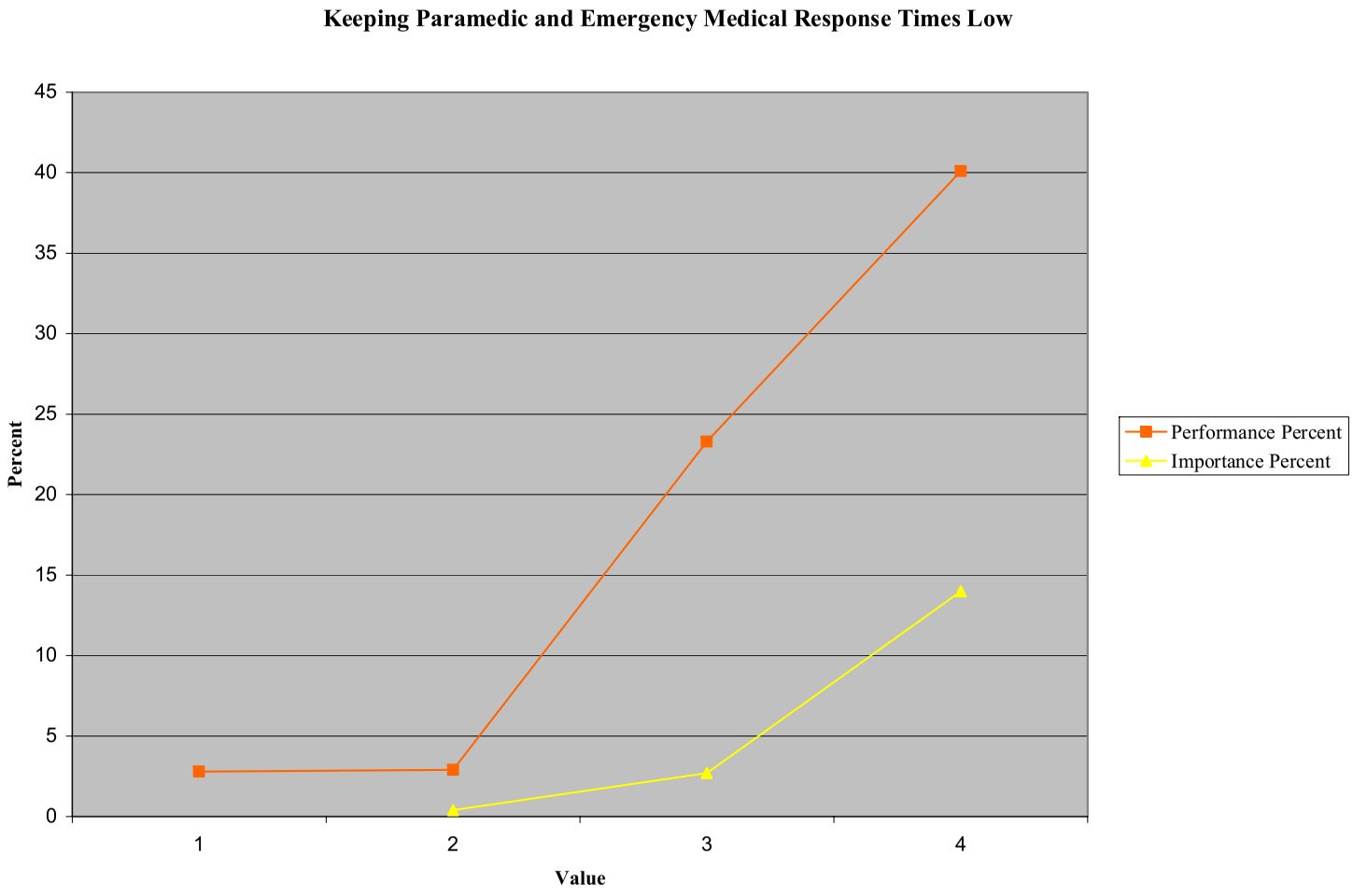

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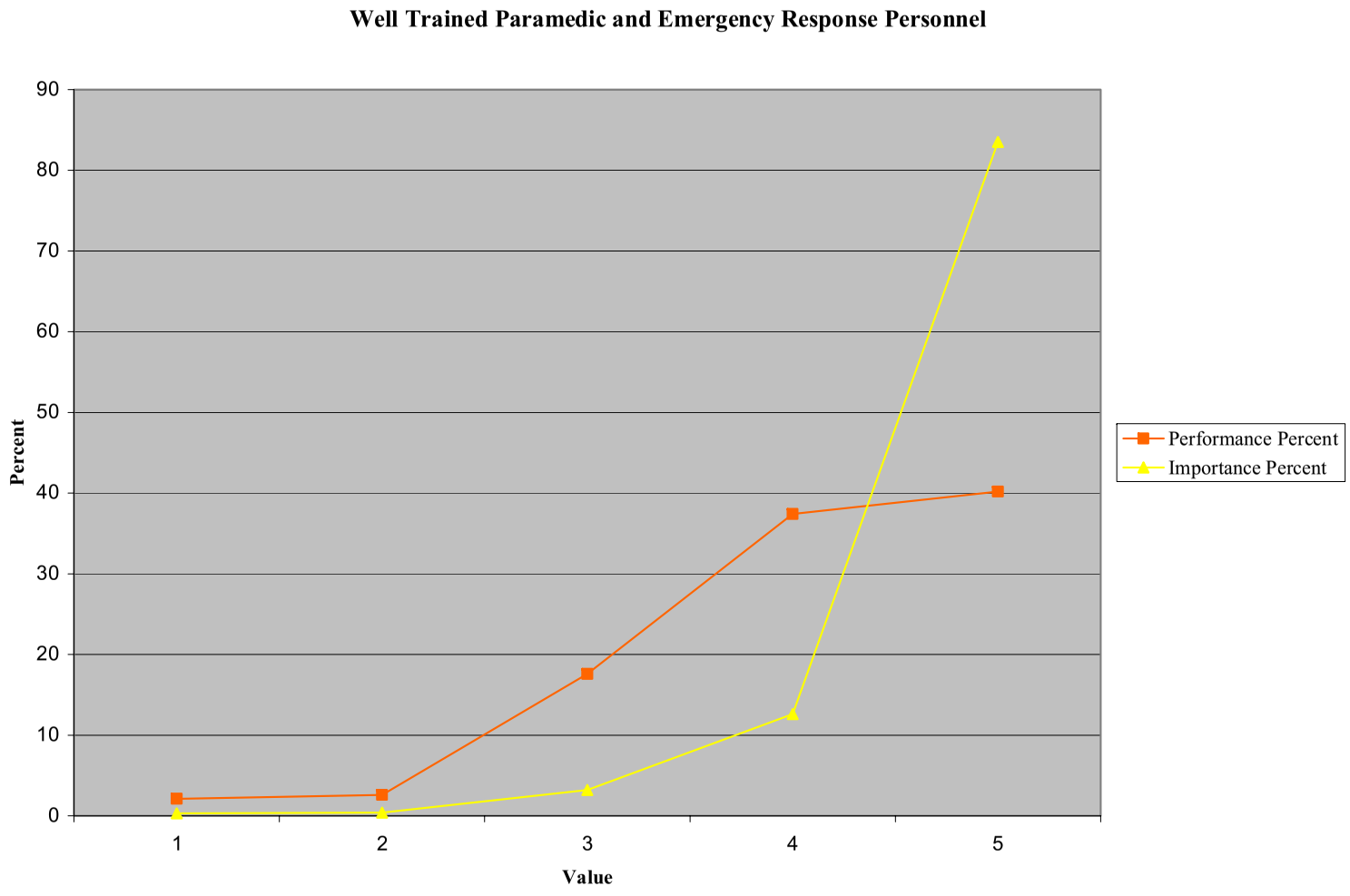

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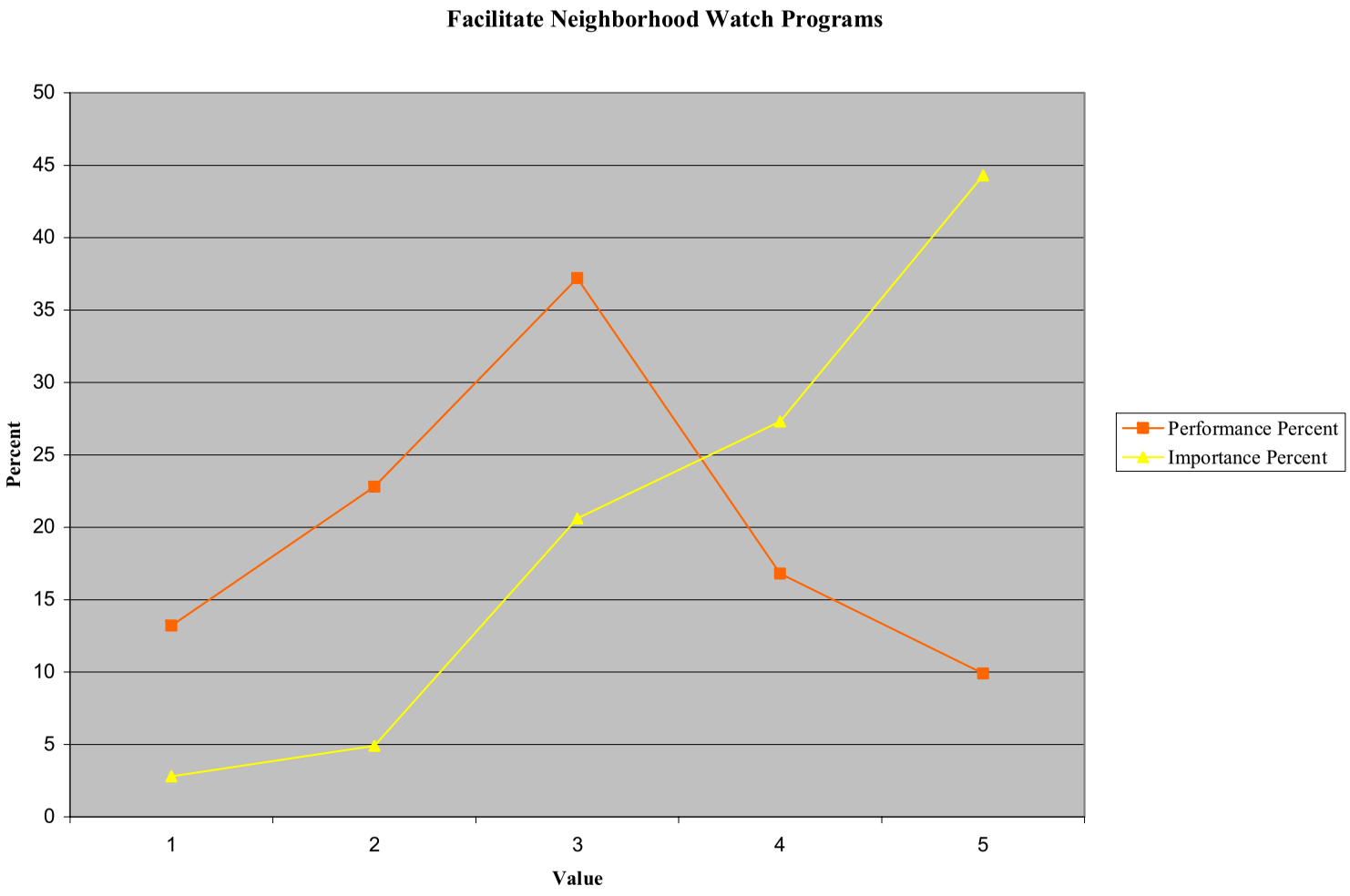
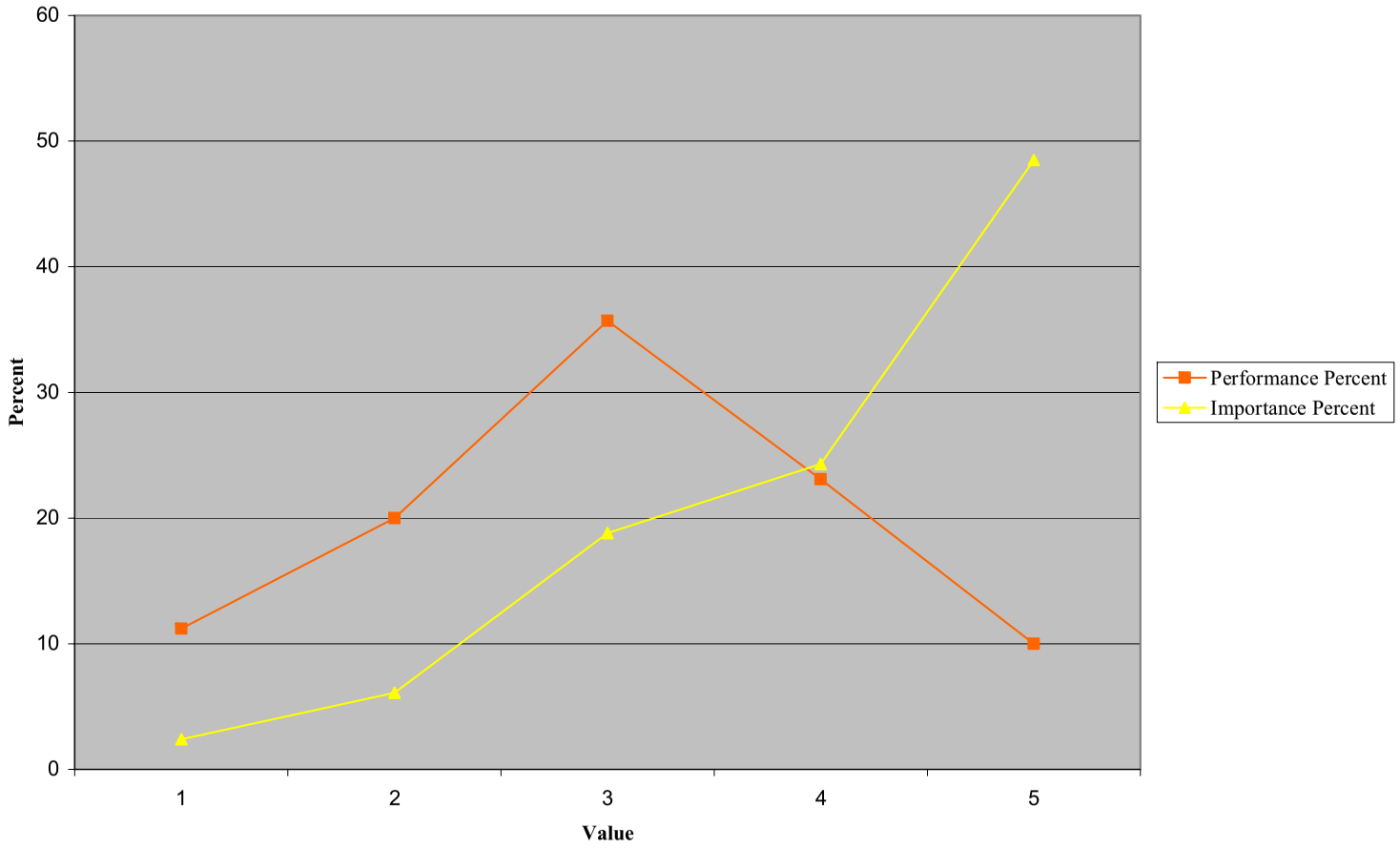
Importance/Performance Comparisons



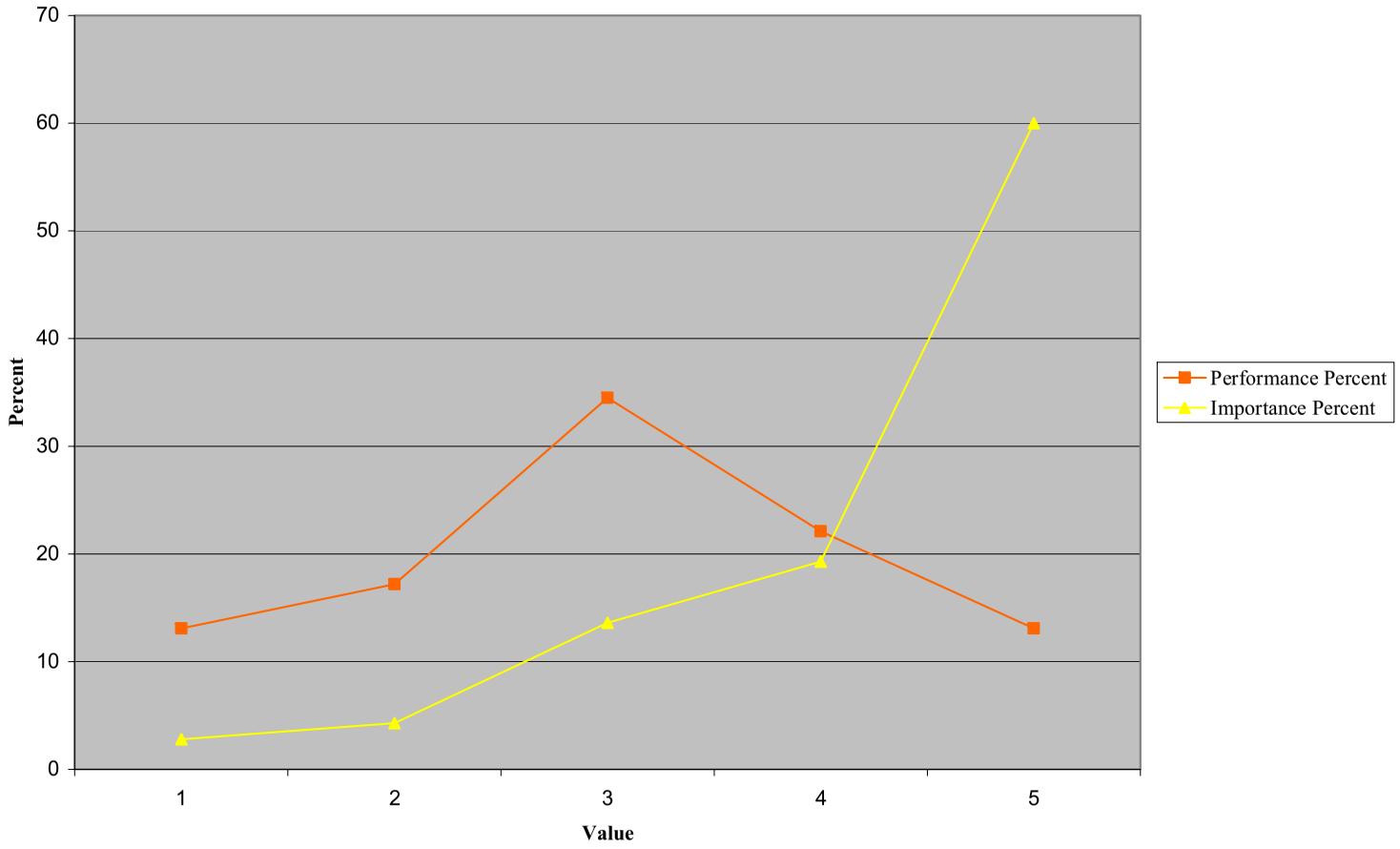
Appendix XII
Importance/Performance Comparisons

Preparing for Natural Disasters, (i.e. floods, earthquakes, ect.)



Appendix XII
Importance/Performance Comparisons

Preparing for Man-Made (such as hazardous or radiological materials) Accidents or Terrorist Events



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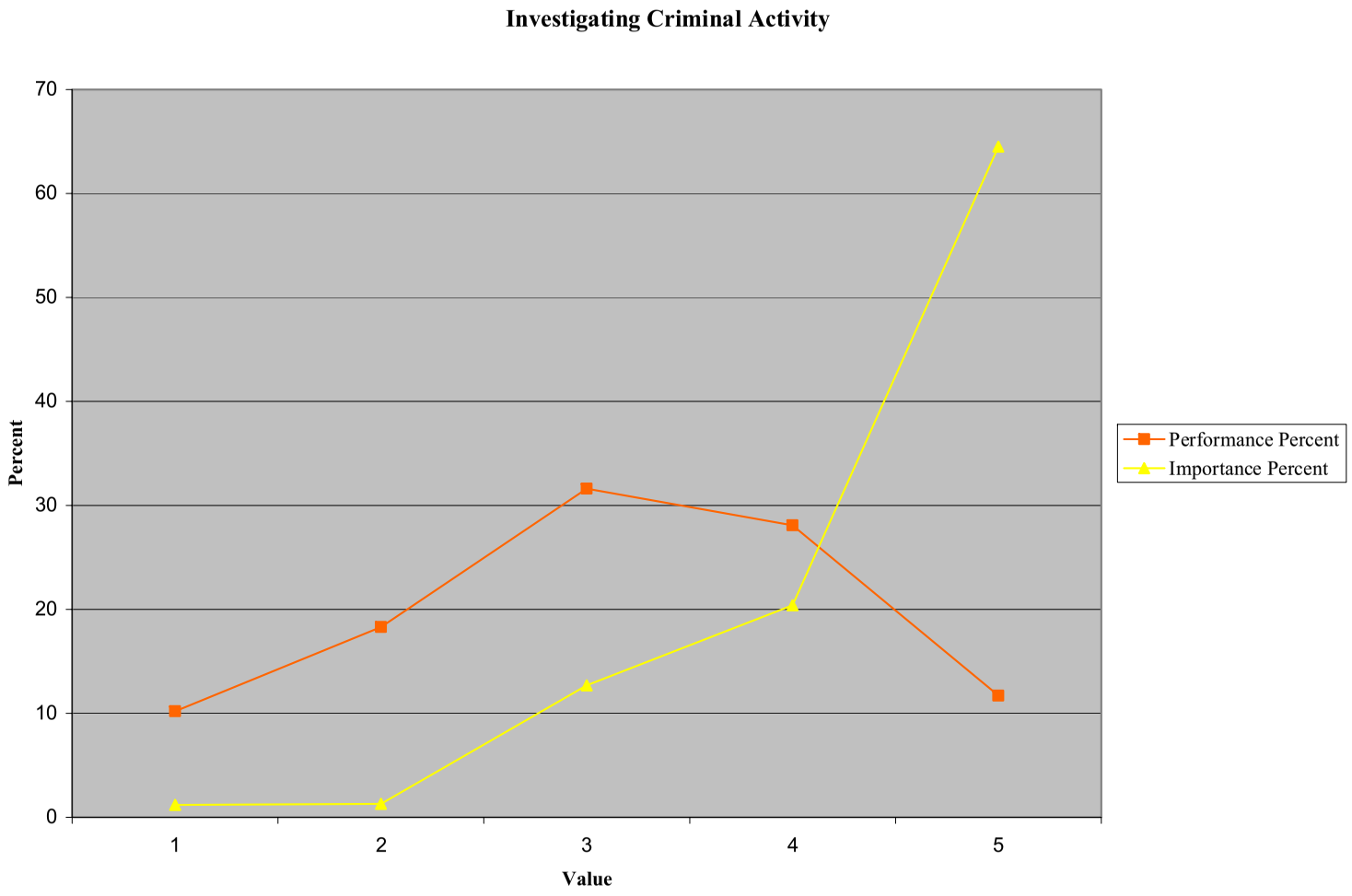
Importance/Performance Comparisons



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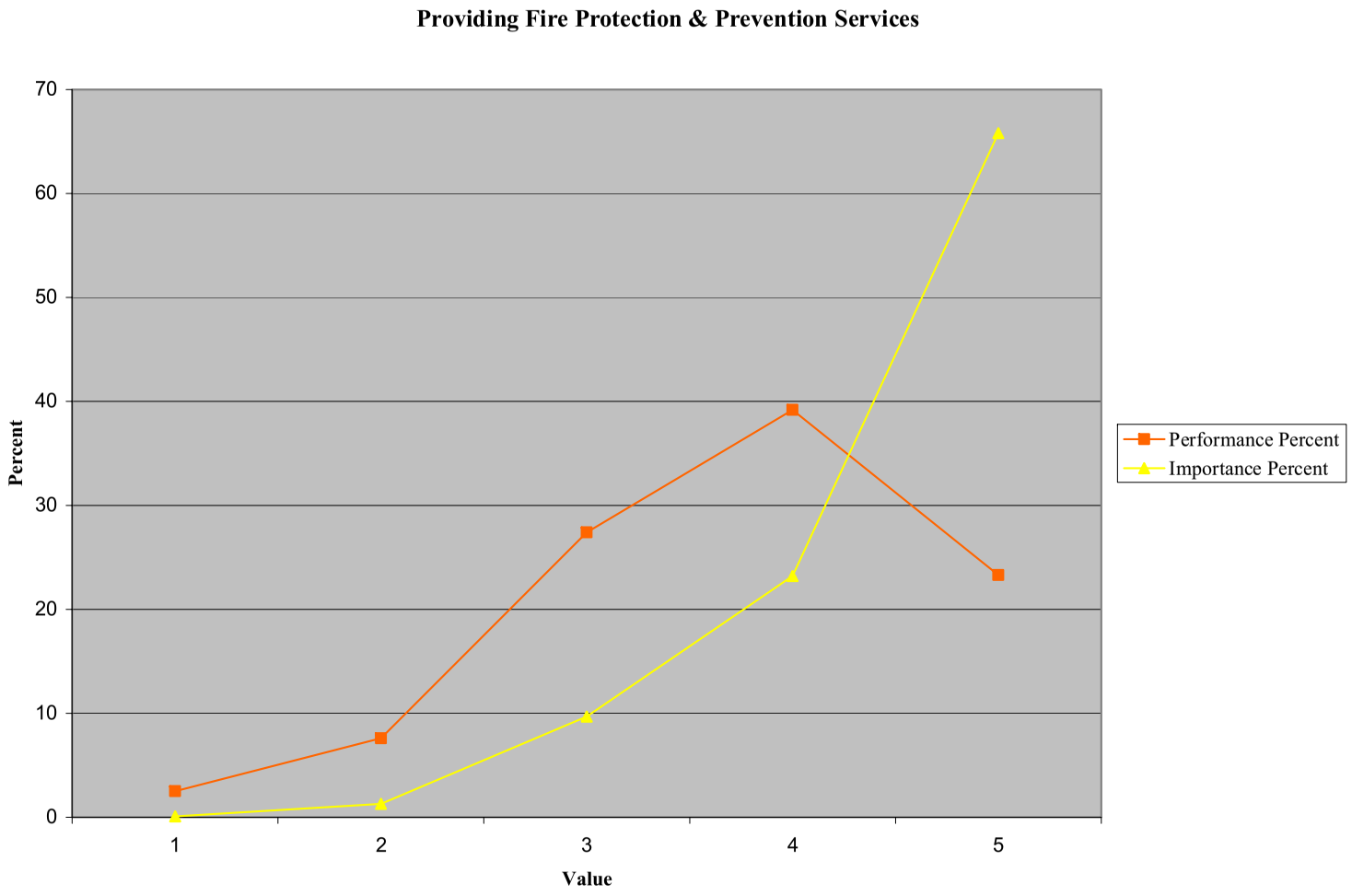
Importance/Performance Comparisons



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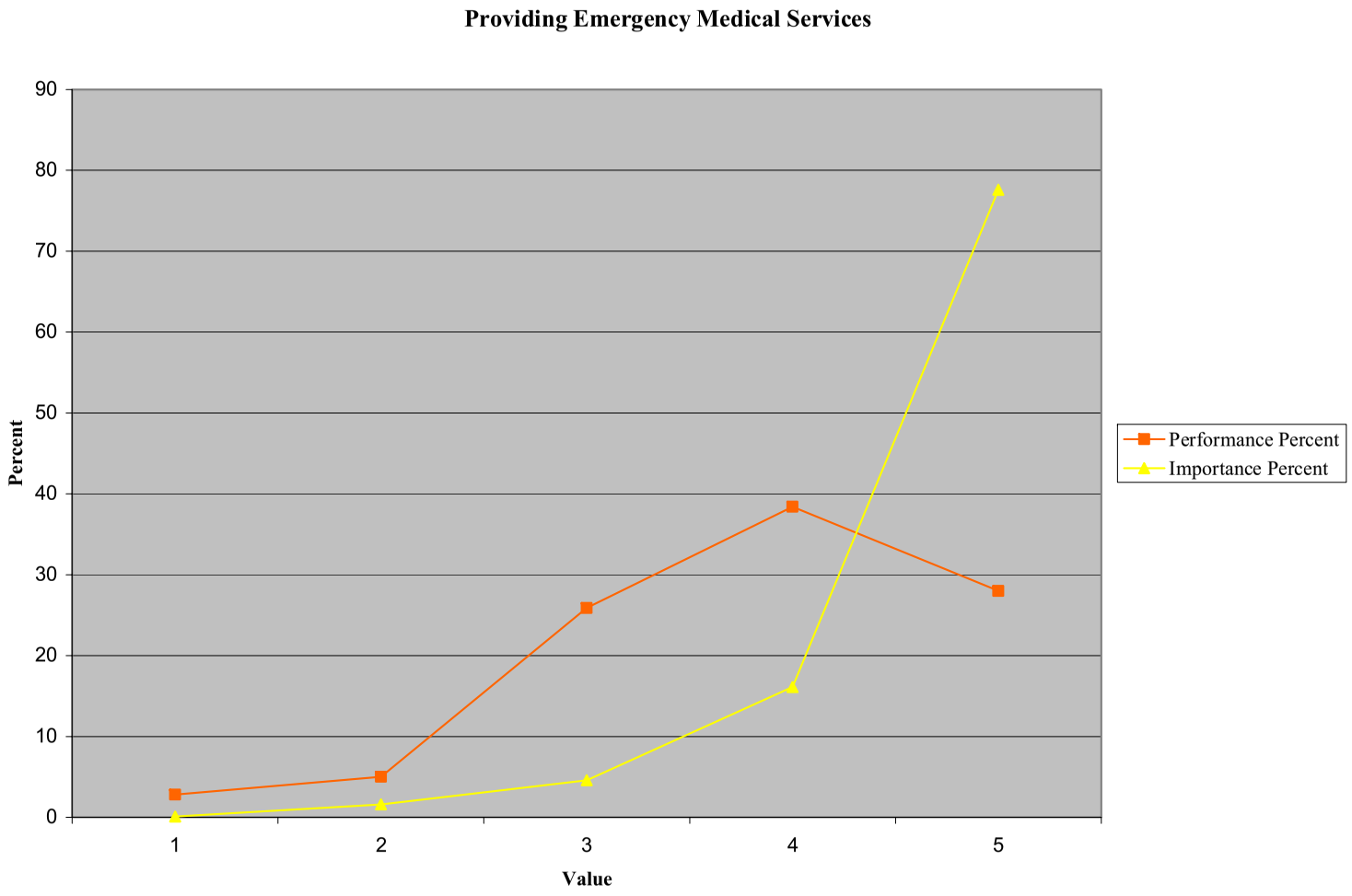
Importance/Performance Comparisons



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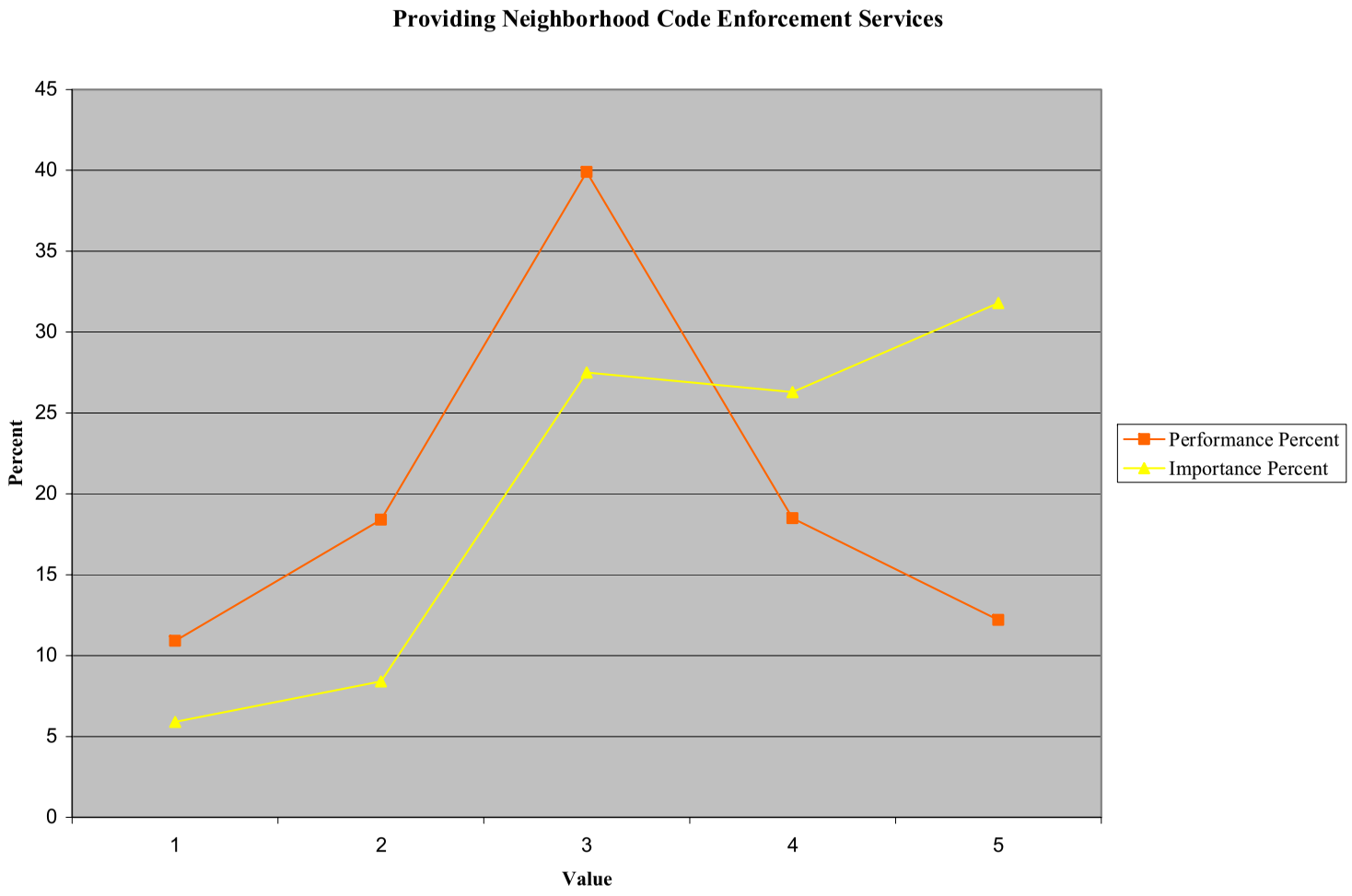

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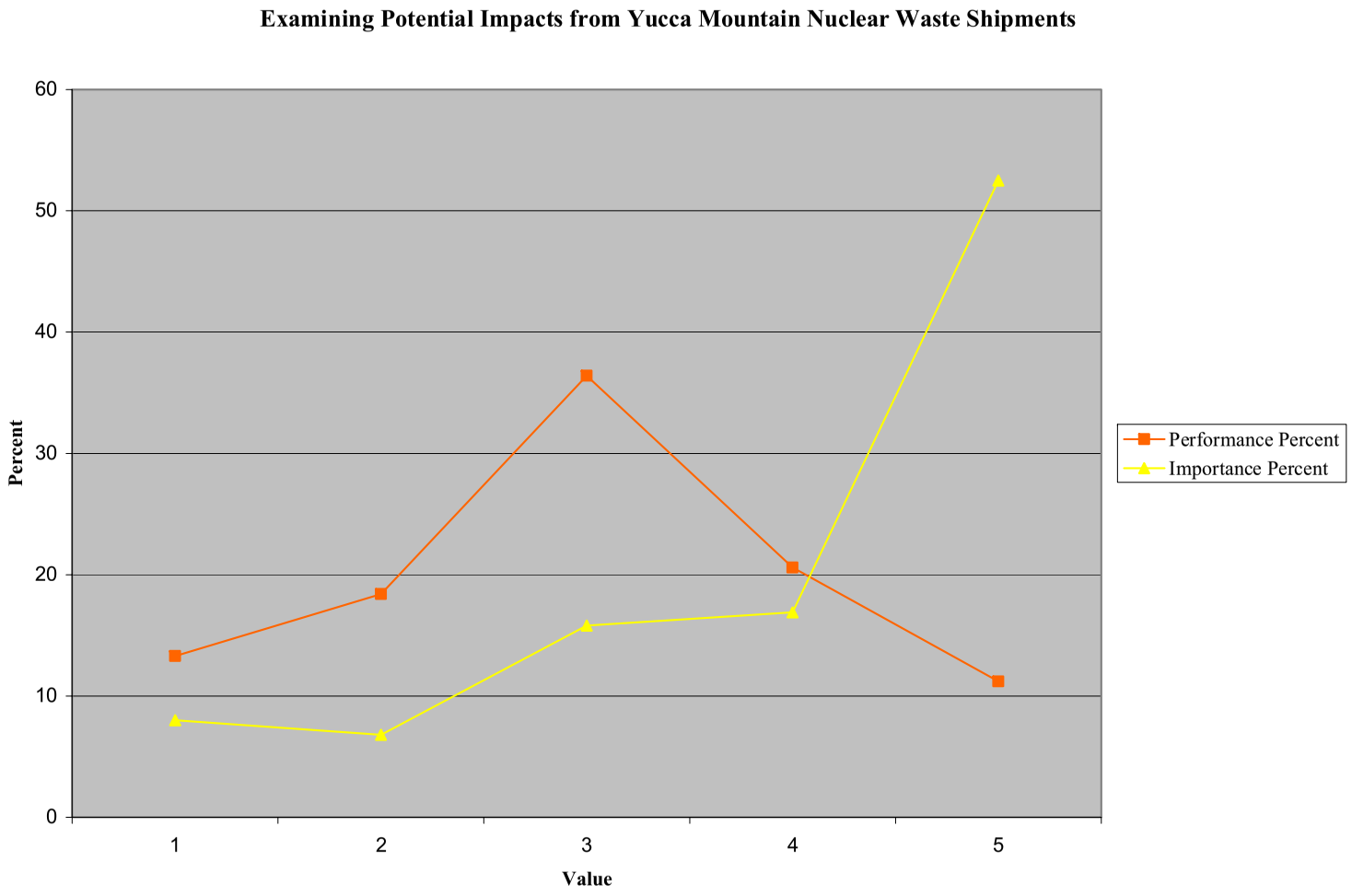

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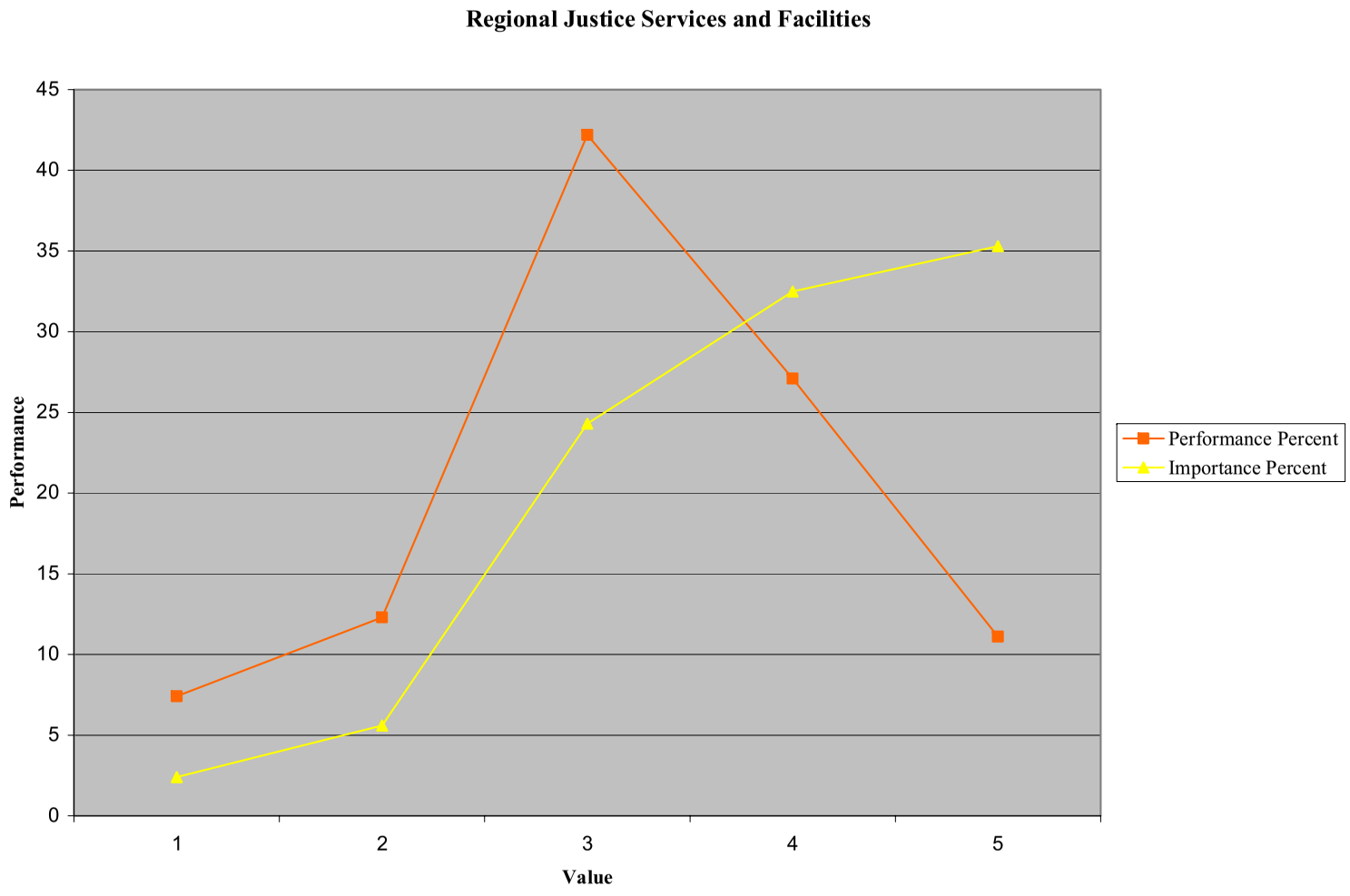

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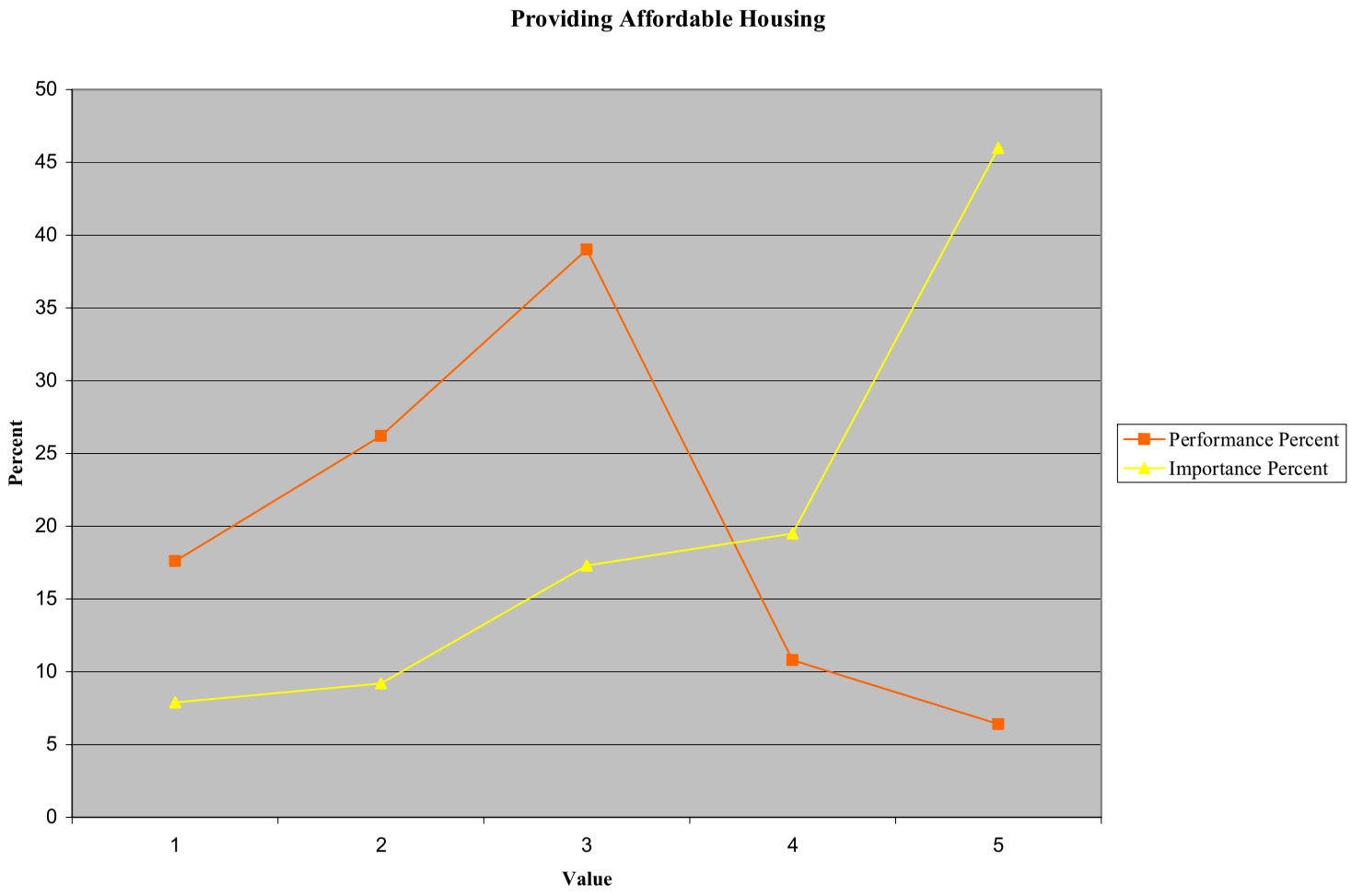
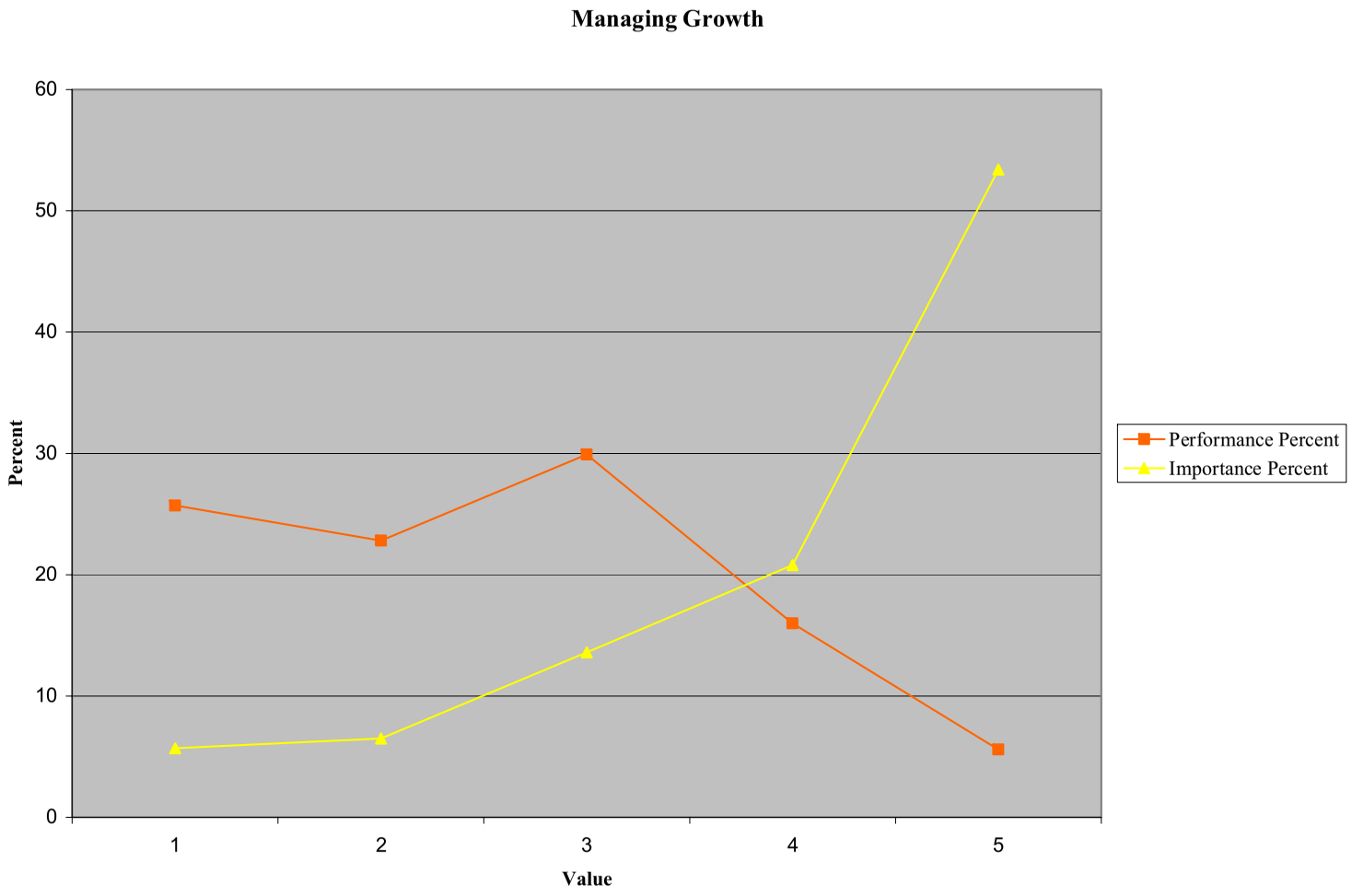
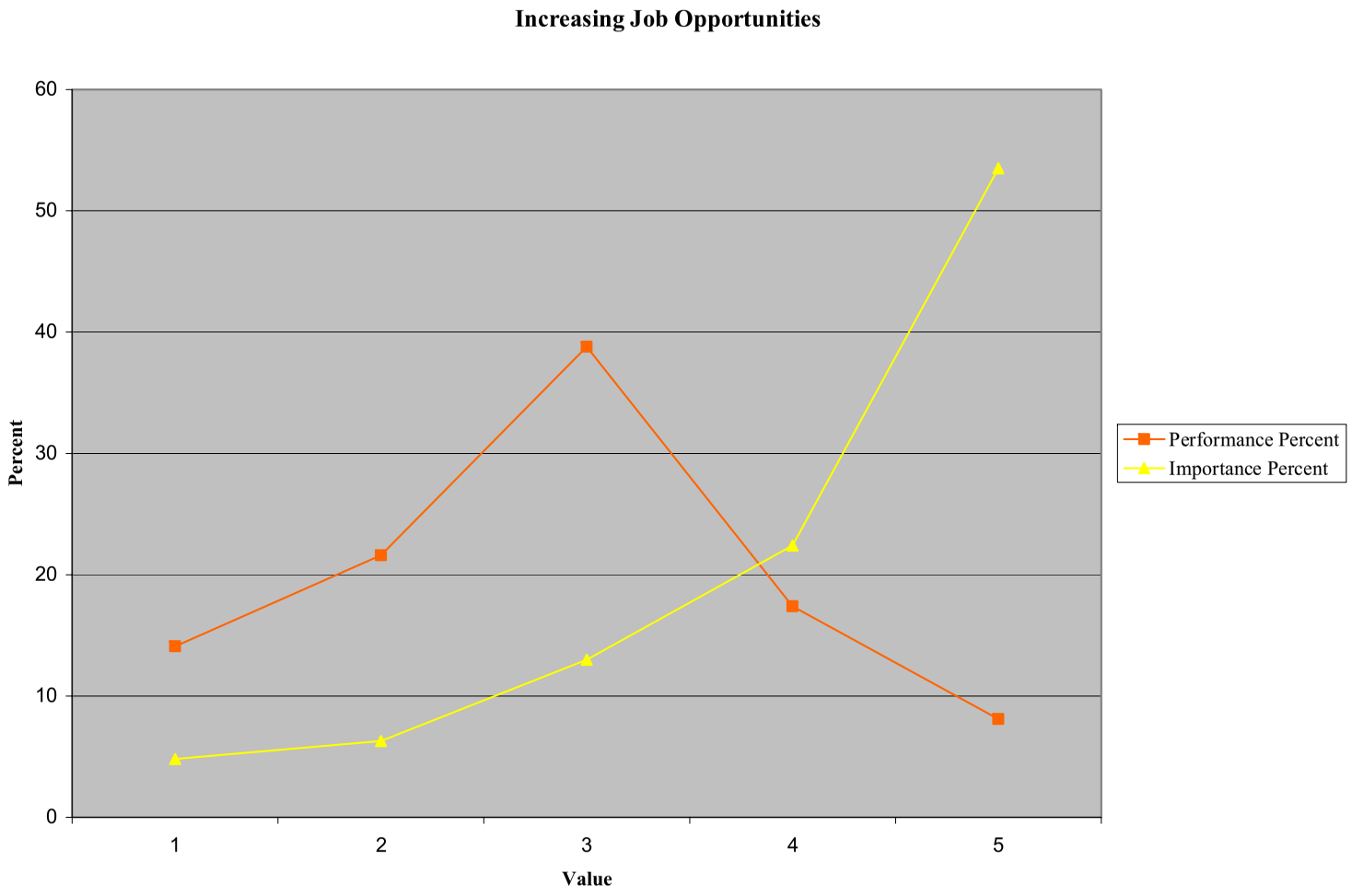


Appendix XII
Importance/Performance Comparisons

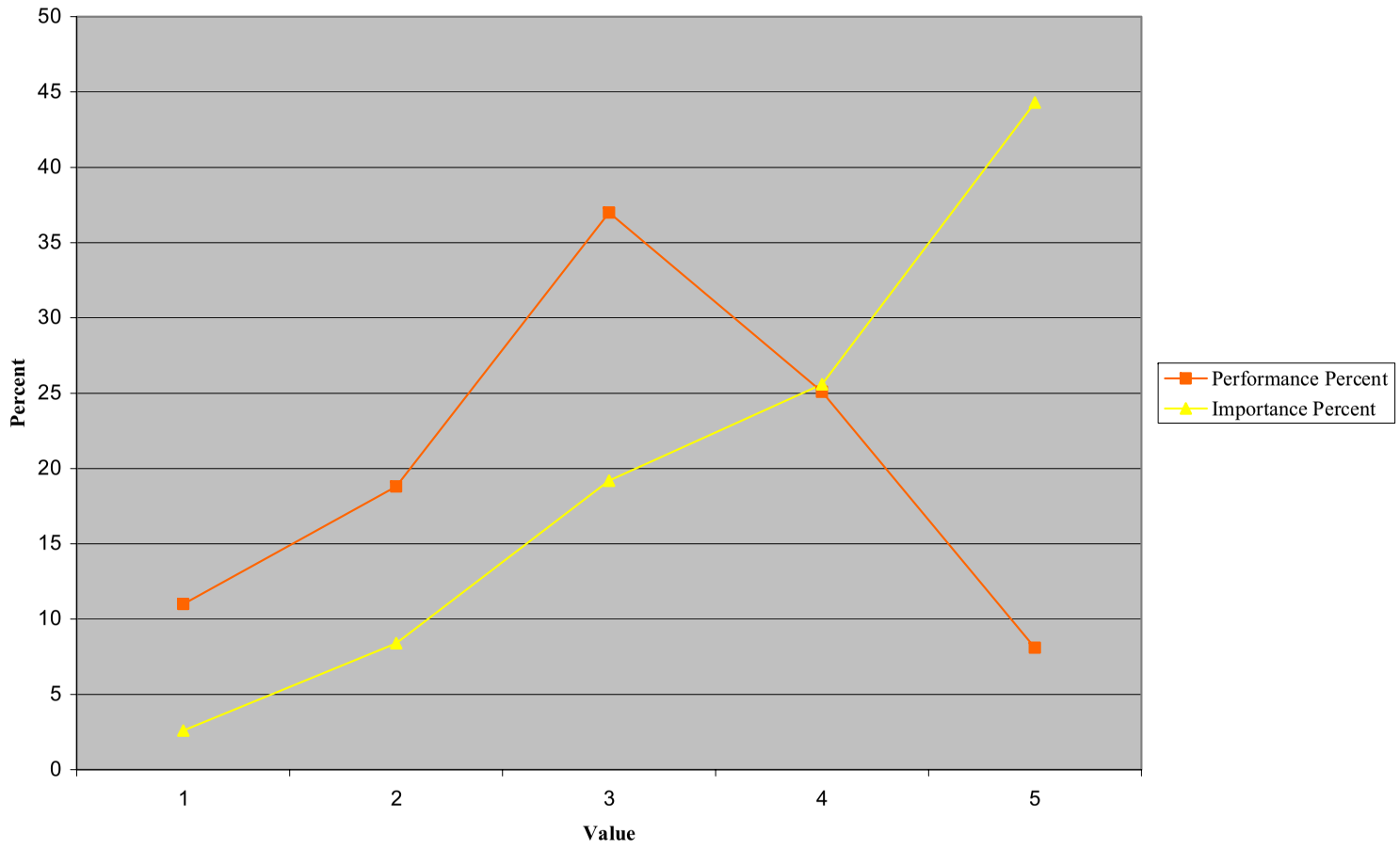


Appendix XII
Importance/Performance Comparisons



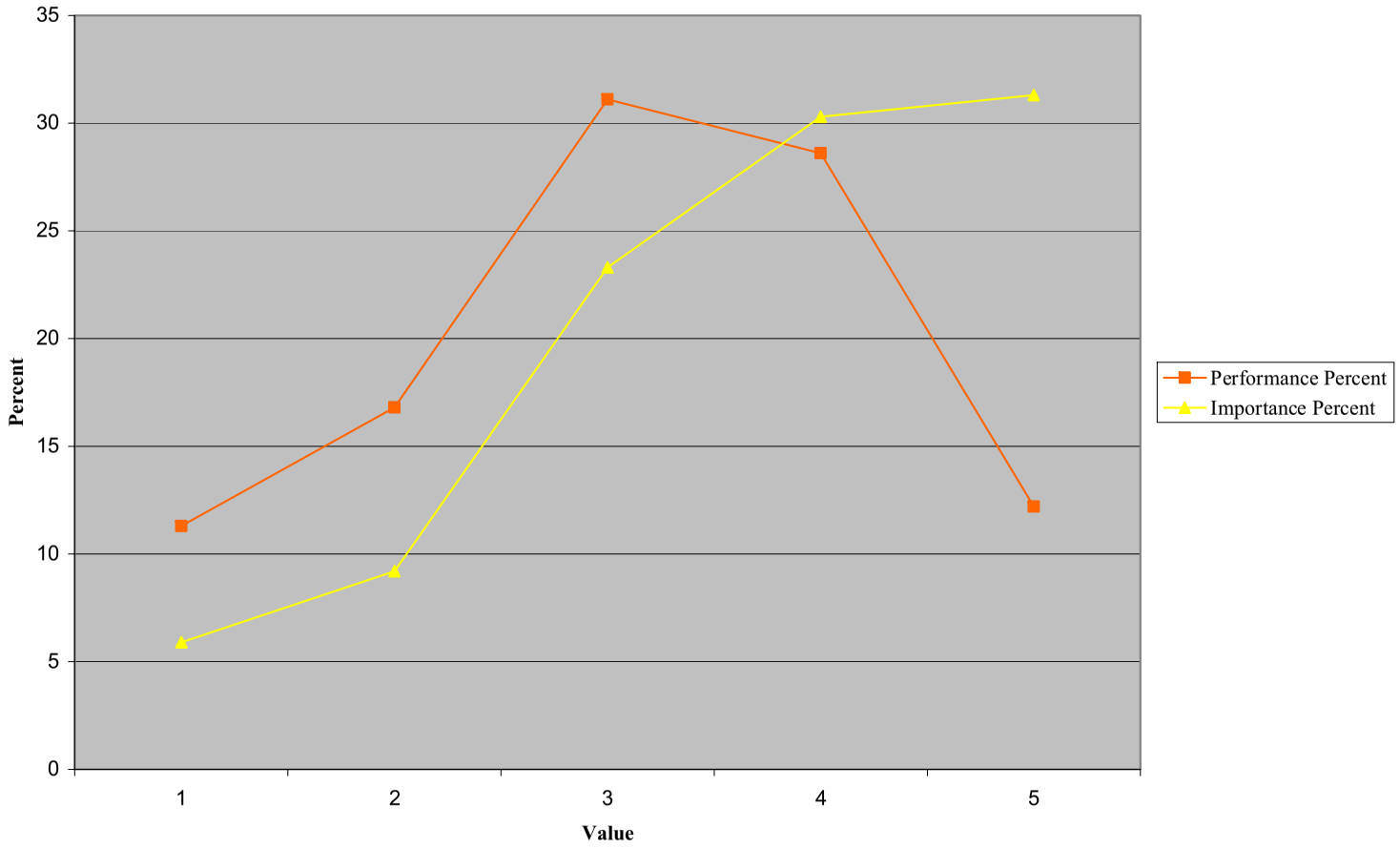
Appendix XII
Importance/Performance Comparisons

Improving Business Climate



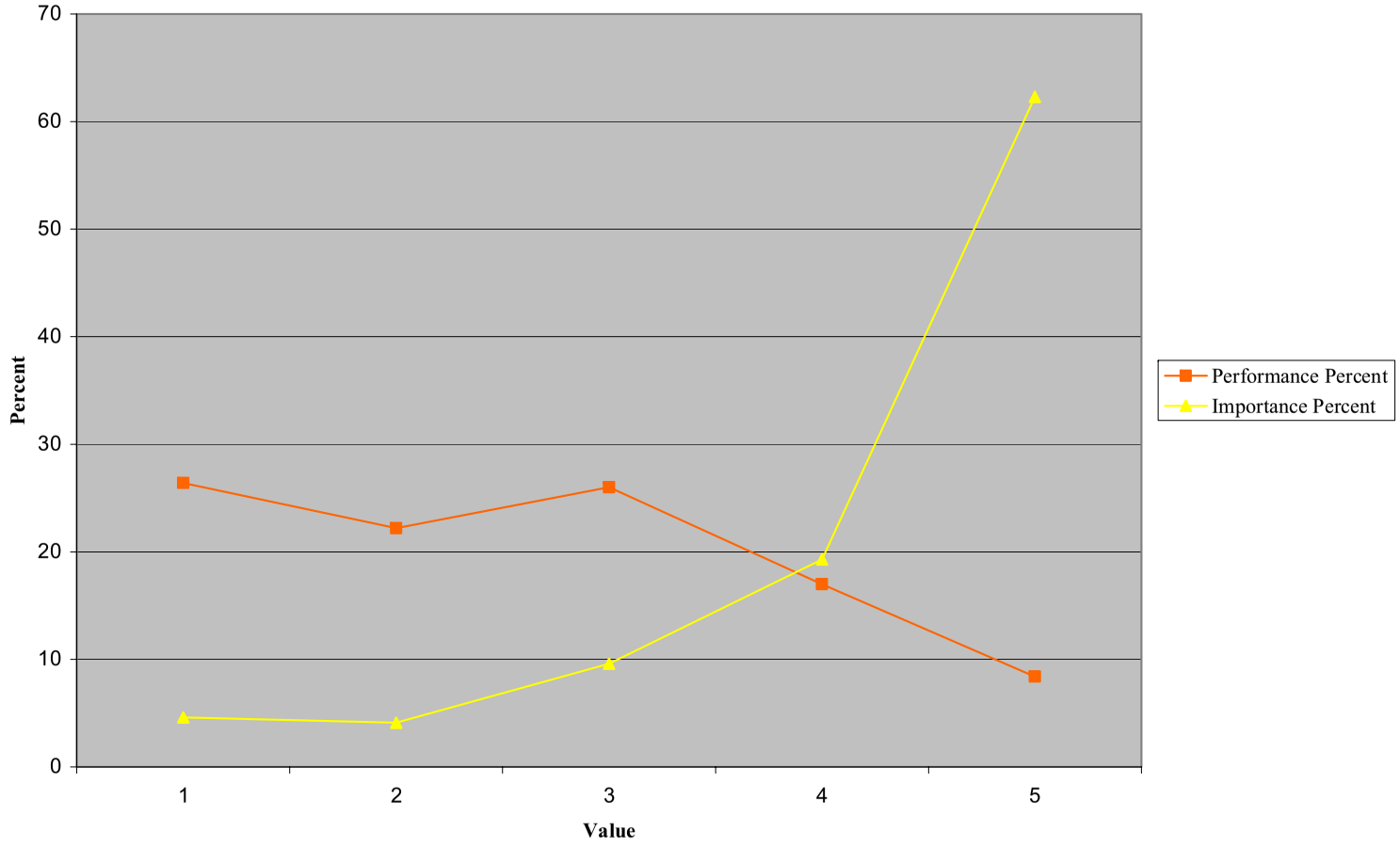
Appendix XII
Importance/Performance Comparisons

Planning for Commercial Development



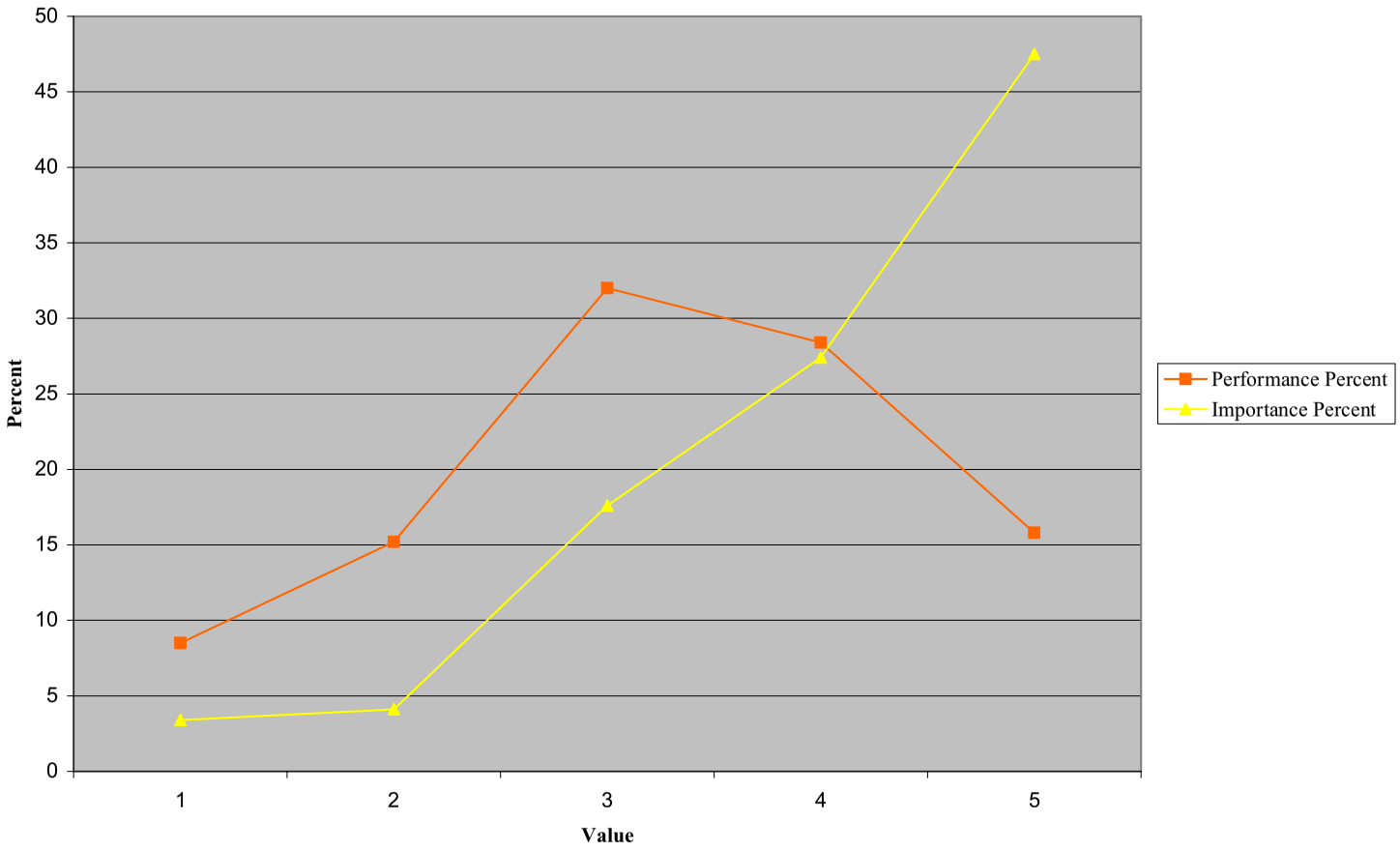
Appendix XII
Importance/Performance Comparisons

Reducing Travel Congestion



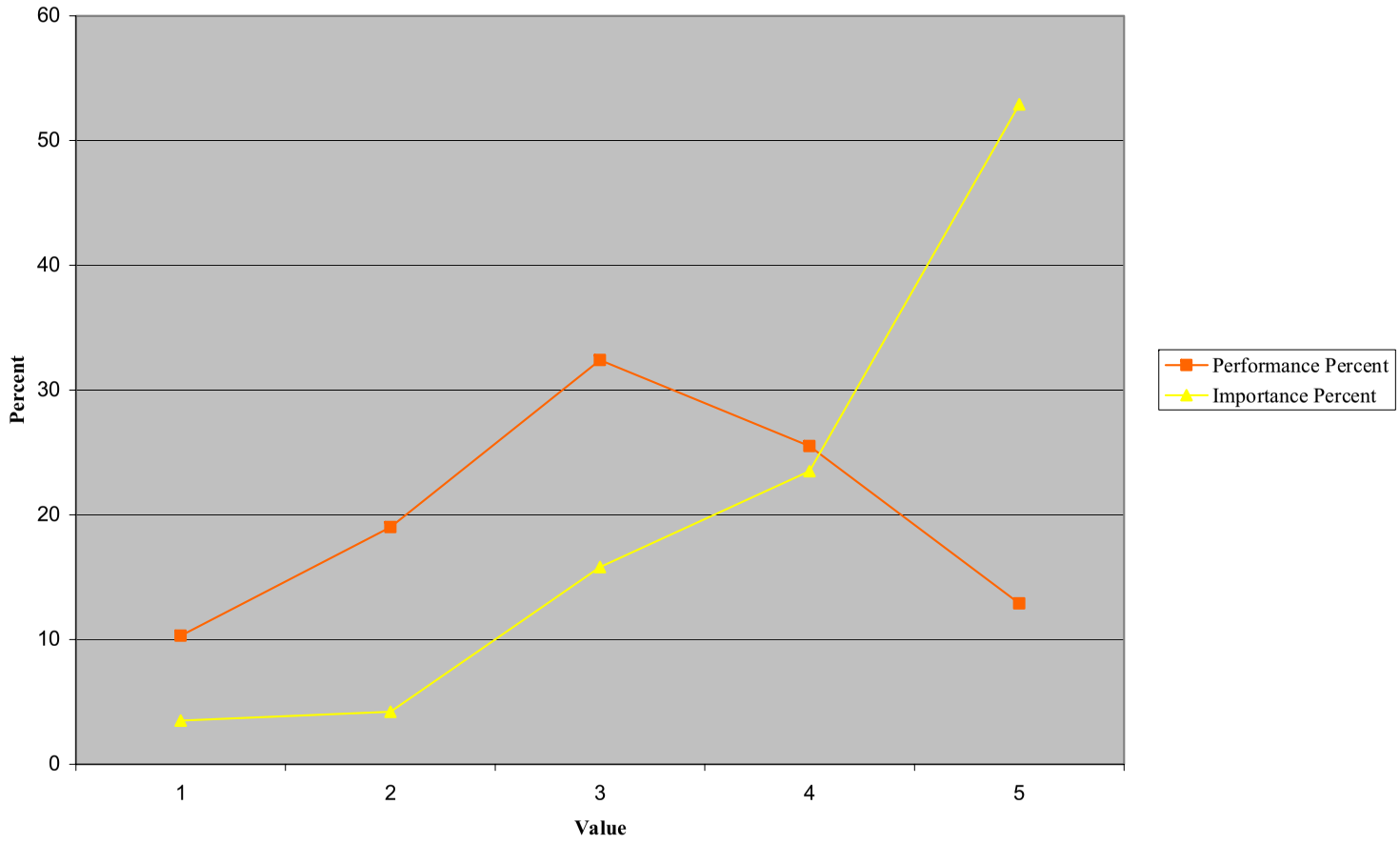
Appendix XII
Importance/Performance Comparisons

Access to Freeways

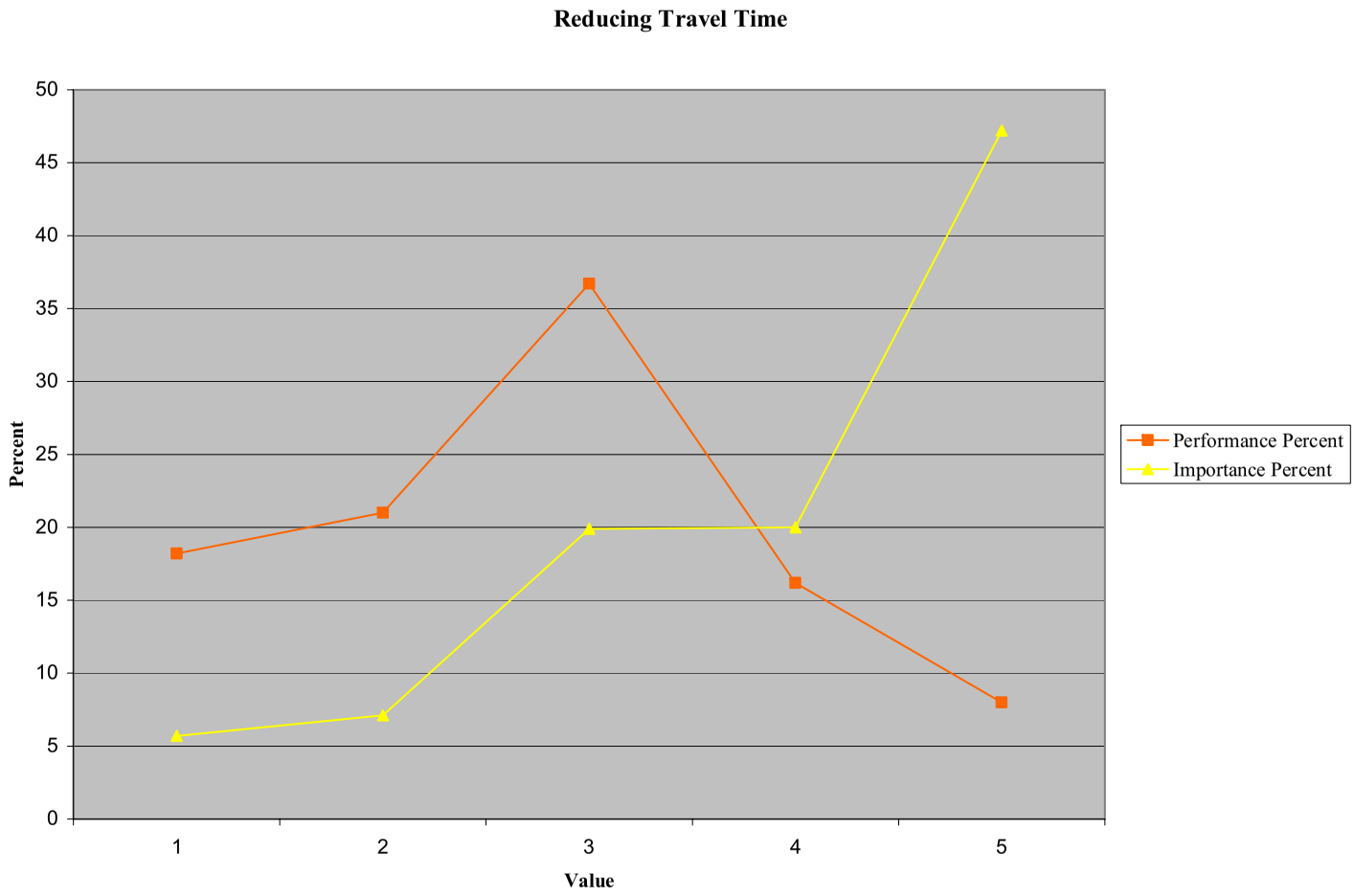


Appendix XII
Importance/Performance Comparisons

Improving Road Conditions

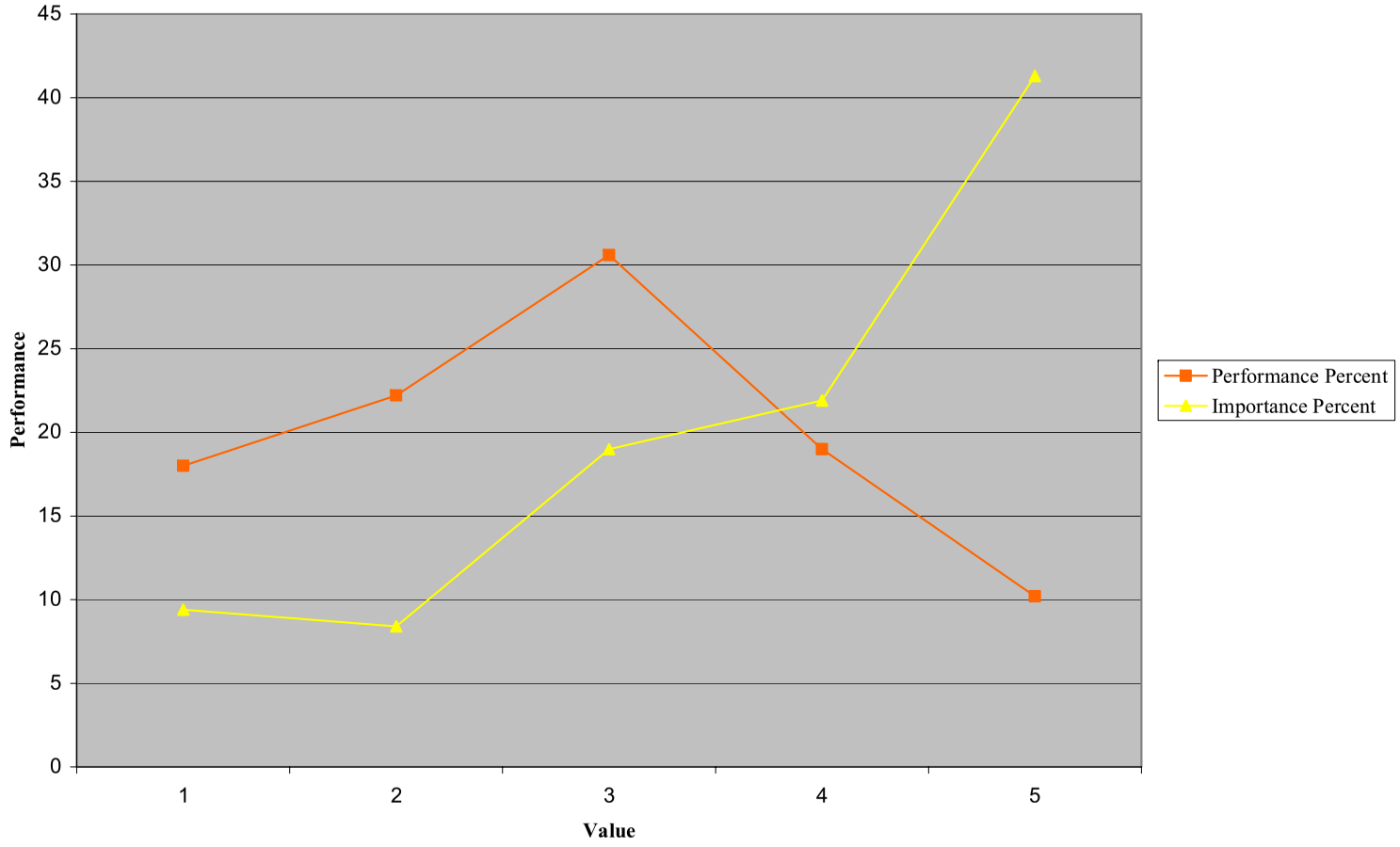


Appendix XII
Importance/Performance Comparisons

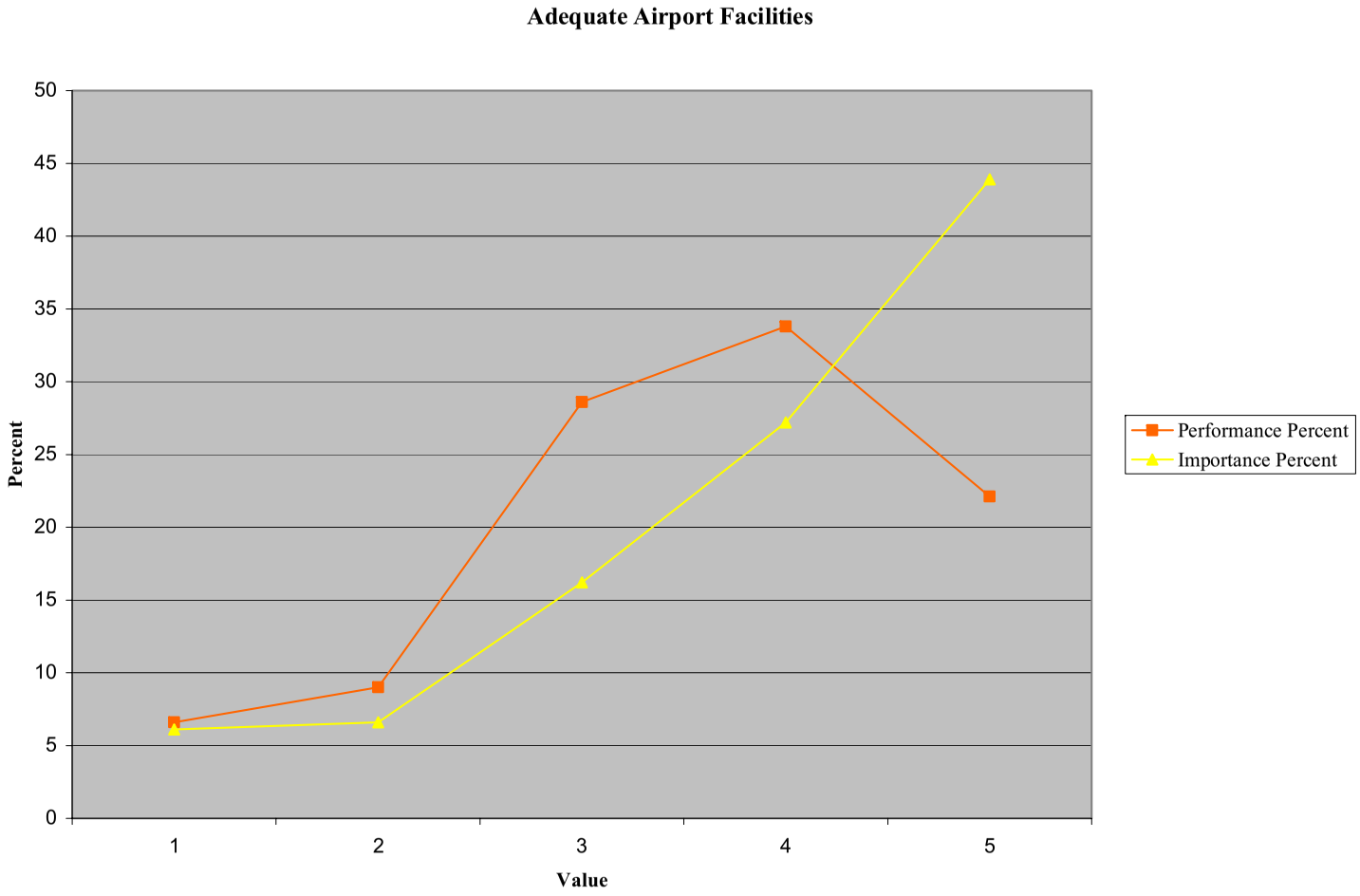


Appendix XII
Importance/Performance Comparisons

Providing Mass Public Transit

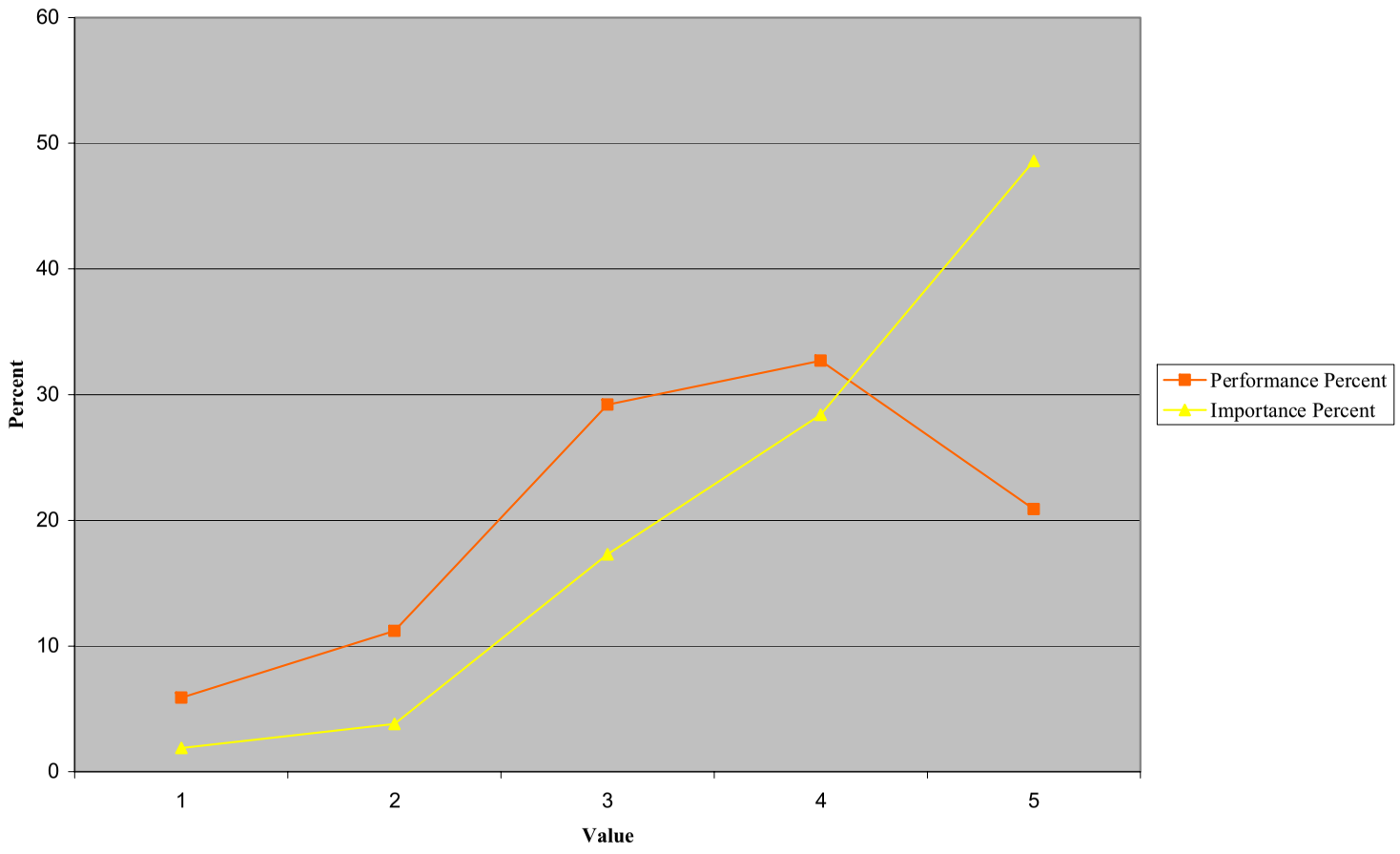


Appendix XII
Importance/Performance Comparisons



Appendix XII
Importance/Performance Comparisons

Parks and Recreation Programs



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-END OF REPORT-

Attachment 14

UER, “Clark County Monitoring Program: Community Survey”

(May 2007).

Clark County Monitoring Program

Winter 2007

APPLIED ANALYSIS

strategic solutions

UER
Urban Environmental Research, LLC

Clark County Monitoring Program: Community Survey
Winter 2007

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Importance/ Performance Comparisons

TO: MS. IRENE NAVIS, AICP
FROM: DR. SHEILA CONWAY; JEREMY AGUERO
SUBJECT: CLARK COUNTY MONITORING PROGRAM | Winter 2007
DATE:
CC: BRIAN GORDON/APPLIED ANALYSIS
DR. ALVIN MUSKATEL/UER;
JASON GRAY/STRATEGIC SOLUTIONS

This memorandum summarizes the key findings of the bi-annual Winter 2007 Clark County Monitoring Program Survey conducted by Urban Environmental Research, Applied Analysis and Strategic Solutions on behalf of the Nuclear Waste Division. A more detailed statistical assessment of our methodology and findings is available in the accompanying comprehensive assessment binder and will be posted to the Clark County Monitoring Program's website (www.monitoringprogram.com) upon your approval of this deliverable. The intent of this memorandum is to provide an executive level overview of our salient findings.

A. GENERAL OVERVIEW

During the month of May 2007, Strategic Solutions, in coordination with Urban Environmental Research and Applied Analysis, administered a 143-question telephone survey to 600 Southern Nevada households. The survey, which touches on a broad number of topics, has a margin of error of ±4 percent at the 95 percent confidence level. The principal purpose of the Clark County Monitoring Program, including this survey series, is to establish an analysis baseline from which the impacts of transporting high-level nuclear waste through the Las Vegas Valley, and ultimately storing the radioactive material at the proposed Yucca Mountain Nuclear Waste Repository, can be monitored, measured and assessed.

Generally speaking, the survey is segmented into seven areas of inquiry: 1) public service importance; 2) public service performance; 3) quality-of-life considerations; 4) general economic considerations; 5) property value impact considerations; 6) environmental considerations; and 7) local government interaction. In addition to these general areas of inquiry, information on the demographic and socio-economic profile of respondents is also routinely gathered.

It is easy to conceptualize how the transportation of high-level nuclear waste through a community might negatively impact property values. It is a bit more difficult to

identify the nexus to child welfare programs, homelessness, flood protection or crime enforcement. In absence of mitigating funds, it is likely that Nevada's state and local governments will be required to shift resources away from existing programs and into efforts aimed at ensuring threats, patent and latent, sourced to storage and transportation of high-level nuclear waste are addressed. Shifts away from existing public services would be expected to reduce the quality of life with the community and may also have far-reaching economic, fiscal and social implications. Analyzing these questions requires not only an understanding of resource allocations to specific programs but also the relative importance and effectiveness of those programs. The Clark County Monitoring Program survey series is designed to provide analysts this more comprehensive framework from which impact assessments can be appropriately derived.

B. KEY FINDINGS

- Strong public service importance and performance scores for fire and emergency medical services continue from Summer 2006.
- Notable trend in importance ratings for traffic and transportation service areas as reducing traffic congestion, improving road conditions, and access to freeways all decline in importance relative to Summer 2006.
- Notable increases in importance assigned to monitoring and reporting to the public on how well government services are being performed.
- Notable decrease in the importance of providing flood control.
- Concerns with regard to crime show signs of stabilization among residents.
- Drought continues to be a pressing environmental concern
- Notable increases in importance of increasing job opportunities and providing affordable housing for seniors
- More than half of respondents (55.4%) felt that now was a good time to buy a home, a significant increase from Summer 2006 (49.3%).

C. YUCCA MOUNTAIN QUESTIONS

- Opposition to the Yucca Mountain project grows from 71% to 76% indicating they would vote against the nuclear waste repository. 72% percent of respondents report that the storage site would have a negative impact on their quality of life, up from a low of 59% in 2005.
- Trust regarding the Yucca Mountain project remains a key concern. Roughly 74% of all respondents indicate that they "disagree" or "strongly disagree" that the U.S. Department of Energy can be trusted to ensure the public's safety as it relates to transportation and storage of high-level nuclear waste. 65% of respondents indicated the same in Summer 2006.
- Approximately 87% percent of respondents indicated an expectation that having a high-level nuclear waste transportation route near residential housing would have a negative impact on property values. This figure is not appreciably dissimilar from the 84% of respondents who indicated the same sentiment during Summer 2006.

- In terms of public service importance measures, Yucca Mountain-related considerations, including those related to preparing for man-made accidents or terrorist events; those examining potential impacts from Yucca Mountain nuclear waste shipments; and those relating to the communication of Clark County's views about Yucca Mountain to Federal decision makers all remained fairly consistent since Summer 2006. On a one-to-five rating scale, these considerations tend to receive above-average scores, but are valued significantly lower than more immediate public safety, emergency first responder, and economic concerns.
- As an urgent environmental concern, the Yucca Mountain facility's placement among major issues was materially unchanged. Approximately 1.6 percent of respondents identified the Yucca Mountain project as Southern Nevada's most pressing environmental concern; this was 0.3 percent lower than reported in the Summer 2006 series.
- Concerns about the repository are measurably higher than reported during the Summer 2006 cycle-as mean importance scores for all questions pertaining to Yucca Mountain increased during the current survey period.

D. PUBLIC SERVICE IMPORTANCE CONSIDERATIONS (FIGURES 1 & 2)

- Public service importance continued to be dominated by public safety considerations, which accounted for the top five and nine out of the top ten most highly-rated services. Traffic and transportation-related services also remained high on the list although declining measurably in terms of importance.
- On a relative scale, only modest movement was noted in the majority of services. The data demonstrate, however, that "increasing job opportunities" tracked up four places overall (in the last iteration it moved up six places). This finding, combined with an increased importance rating for "improving the business climate" (+2), suggest an overall increase in concern about the economic climate.
- The data suggest an increasing level of concern with youth/juvenile social service provision as "providing child protection services" (+1), "providing child welfare services" (+1) and "providing juvenile justice services" (+4) all tracked up in terms of service importance ranking compared to Summer 2006.

SCALE:

Importance Scale	Performance Scale
Very Important (4.0 -5.0)	Excellent (4.0 – 4.99)
Important (3.0 – 3.99)	Good (3.0 – 3.99)
Neither Important or Not Important (2.0 – 2.99)	Average (2.0 – 2.99)
Not Very Important (1.0 – 1.99)	Fair (1.0 – 1.99)
Not Important At All (< 1.0)	Poor (<1.0)

FIGURE 1 PUBLIC SERVICE IMPORTANCE SCORE SUMMARY

Public Service Importance Score Summary								
		Mean				Mean Change		
Service Category	**Descriptive Statistics**	**Summer '05**	**Winter '06**	**Summer '06**	**Winter '07**	**From Summer '05**	**From Winter '06**	**From Summer '06**
General Government	Road Maintenance	4.21	4.05	4.04	4.09	-0.12	0.04	0.05
	Revitalizing older neighborhoods	3.59	3.41	3.52	3.36	-0.23	-0.05	-0.16
	Flood control	4.09	3.88	3.86	3.70	-0.39	-0.18	-0.16
	Budget management	4.29	3.99	4.23	4.11	-0.18	0.12	-0.12
	Communicate Clark County's local government views about Yucca Mountain to federal decision makers	3.86	3.67	3.58	3.63	-0.23	-0.04	0.05
	Monitor and report to the public on how well government services are being performed	3.90	3.72	3.75	3.87	-0.03	0.15	0.12
	Water conservation programs	n/a	n/a	4.12	4.22	n/a	n/a	0.1
Social and Judicial Services	Providing child protection services	4.27	4.06	4.11	4.17	-0.1	0.11	0.06
	Providing child welfare services	4.15	3.98	3.98	3.99	-0.16	0.01	0.01
	Providing juvenile justice services	4.08	3.93	3.87	3.98	-0.1	0.05	0.11
	Providing attainable housing for working class families	n/a	3.72	3.77	3.76	n/a	0.04	-0.01
	Providing affordable housing for low income families	3.70	3.56	3.64	3.67	-0.03	0.11	0.03
	Providing shelter for the homeless	3.38	3.33	3.54	3.53	0.15	0.2	-0.01
	Providing affordable housing for seniors	4.12	3.92	3.91	4.02	-0.1	0.1	0.11
	Providing medical care for the poor	3.94	3.74	3.74	3.75	-0.19	0.01	0.01
	Providing 24 hour emergency trauma care	4.60	4.38	4.29	4.42	-0.18	0.04	0.13
Public Safety	Providing crime prevention programs	4.27	3.99	4.09	4.04	-0.23	0.05	-0.05
	Enforcing traffic laws	4.25	3.91	4.07	4.09	-0.16	0.18	0.02
	Maintaining a low crime rate	4.49	4.14	4.28	4.24	-0.25	0.1	-0.04
	Maintaining neighborhood police patrols	4.30	3.97	4.08	4.06	-0.24	0.09	-0.02
	Keeping police response times low	4.45	4.24	4.60	4.34	-0.11	0.1	-0.26
	Keeping fire department response times low	4.45	4.54	4.47	4.59	0.14	0.05	0.12
	Keeping paramedic and emergency	4.45	4.56	4.54	4.61	0.16	0.05	0.07

	medical response times low							
	Well trained paramedic and emergency medical response personnel	n/a	4.64	4.57	4.67	n/a	0.03	0.1
	Facilitate neighborhood watch programs	4.05	3.69	3.79	3.79	-0.26	0.1	0
	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	4.04	3.75	3.87	3.84	-0.2	0.09	-0.03
	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	4.18	3.92	4.01	4.03	-0.15	0.11	0.02
	Investigating criminal activity	4.47	4.03	4.24	4.18	-0.29	0.15	-0.06
	Providing fire protection & prevention services	4.59	4.32	4.26	4.33	-0.26	0.01	0.07
	Providing emergency medical services	4.66	4.44	4.43	4.51	-0.15	0.07	0.08
	Providing for neighborhood code enforcement services	3.81	3.54	3.58	3.51	-0.3	-0.03	-0.07
	Examining potential impacts from Yucca Mountain nuclear waste shipments	3.88	3.68	3.65	3.66	-0.22	-0.02	0.01
	Regional justice services and facilities	n/a	n/a	3.60	3.69	n/a	n/a	0.09
Community Development	Providing affordable housing	n/a	n/a	3.68	3.64	n/a	n/a	-0.04
	Managing growth	4.07	3.83	3.87	3.83	-0.24	0	-0.04
	Increasing job opportunities	4.07	3.95	3.82	3.84	-0.23	-0.11	0.02
	Improving the business climate	4.08	3.86	3.75	3.76	-0.32	-0.1	0.01
	Planning for commercial development	3.82	3.70	3.56	3.55	-0.27	-0.15	-0.01
	Reducing traffic congestion	4.37	4.02	4.06	3.97	-0.4	-0.05	-0.09
	Access to freeways	4.12	3.83	3.92	3.83	-0.29	0	-0.09
	Improving road conditions	4.29	3.97	4.04	3.95	-0.34	-0.02	-0.09
	Reducing travel time	4.01	3.77	3.83	3.82	-0.19	0.05	-0.01
	Providing mass public transit	3.86	3.67	3.64	3.69	-0.17	0.02	0.05
	Adequate airport facilities	n/a	n/a	3.91	3.87	n/a	n/a	-0.04
	Parks and recreation programs	n/a	n/a	4.02	4.04	n/a	n/a	0.02

FIGURE 2 PUBLIC SERVICE IMPORTANCE SCORE RANKING

	Ranking		
Descriptive Statistics	**Winter '07**	**Summer '06**	**Change**
Well trained paramedic and emergency medical response personnel	1	2	+1
Keeping paramedic and emergency medical response times low	2	3	+1
Keeping fire department response times low	3	4	+1
Providing emergency medical services	4	5	+1
Providing 24 hour emergency trauma care	5	6	+1
Keeping police response times low	6	1	-5
Providing fire protection & prevention services	7	8	+1
Maintaining a low crime rate	8	7	-1
Water conservation programs	9	11	+2
Investigating criminal activity	10	9	-1
Providing child protection services	11	12	+1
Budget management	12	10	-2

Enforcing traffic laws	13	15	+2
Road Maintenance	14	17	+3
Maintaining neighborhood police patrols	15	14	-1
Parks and recreation programs	16	19	+3
Providing crime prevention programs	17	13	-4
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	18	20	+2
Providing affordable housing for seniors	19	23	+4
Providing child welfare services	20	21	+1
Providing juvenile justice services	21	25	+4
Reducing traffic congestion	22	16	-6
Improving road conditions	23	18	-5
Adequate airport facilities	24	24	0
Monitor and report to the public on how well government services are being performed	25	33	+8
Increasing job opportunities	26	30	+4
Preparing for natural disasters (i.e. floods, earthquakes, etc.)	27	26	-1
Access to freeways	28	22	-6
Managing growth	29	27	-2
Reducing travel time	30	29	-1
Facilitate neighborhood watch programs	31	31	0
Improving the business climate	32	34	+2
Providing attainable housing for working class families	33	32	-1
Providing medical care for the poor	34	35	+1
Flood control	35	28	-7
Providing mass public transit	36	39	+3
Regional justice services and facilities	37	40	+3
Providing affordable housing for low income families	38	38	0
Examining potential impacts from Yucca Mountain nuclear waste shipments	39	37	-2
Providing affordable housing	40	36	-4
Communicate Clark County's local government views about Yucca Mountain to federal decision makers	41	41	0
Planning for commercial development	42	43	+1
Providing shelter for the homeless	43	44	+1
Providing for neighborhood code enforcement services	44	42	-2
Revitalizing older neighborhoods	45	45	0

FIGURE 3 GOVERNMENT SERVICE PERFORMANCE SCORE

Government Service Performance Rating					
		Mean		Disparity between Importance and Performance (Performance-Importance)	
Service Category	**Descriptive Statistics**	**Importance**	**Performance**	**Current Disparity**	**Summer '06 Disparity**
General Government	Road maintenance	4.09	2.94	-1.15	-0.83
	Revitalizing older neighborhoods	3.36	2.57	-0.79	-0.85
	Flood control	3.70	3.48	-0.22	-0.32
	Budget management	4.11	2.56	-1.55	-1.53
	Communicate Clark County's local government views about Yucca Mountain to federal decision makers	3.63	2.82	-0.81	-0.76
	Monitor and report to the public on how well government services are being performed	3.87	2.50	-1.37	-1.16
	Water conservation programs	4.22	3.22	-1	-0.81
Social and Judicial Services	Providing child protection services	4.17	2.84	-1.33	-1.35
	Providing welfare services	3.99	2.79	-1.2	-1.18
	Providing juvenile justice services	3.98	2.83	-1.15	-0.99
	Provide attainable housing for working class families	3.76	2.52	-1.24	-1.24
	Providing affordable housing for low income families	3.67	2.41	-1.26	-1.17
	Providing shelter for the homeless	3.53	2.19	-1.34	-1.31
	Providing affordable housing for seniors	4.02	2.62	-1.4	-1.21
	Providing medical care for the poor	3.75	2.59	-1.16	-1.06
	Providing 24 hour emergency trauma care	4.42	3.26	-1.16	-1.05
Public Safety	Providing crime prevention programs	4.04	3.04	-1	-1.1
	Enforcing traffic laws	4.09	2.99	-1.1	-1.08
	Maintaining a low crime rate	4.24	2.82	-1.42	-1.46
	Maintaining neighborhood police patrols	4.06	2.73	-1.33	-1.33
	Keeping police response times low	4.34	3.09	-1.25	-1.58
	Keeping fire department response times low	4.59	3.73	-0.86	-0.72
	Keeping paramedic and emergency medical response times low	4.61	3.83	-0.78	-0.82
	Well trained paramedic and emergency medical response personnel	4.67	3.93	-0.74	-0.72
	Facilitate neighborhood watch programs	3.79	2.80	-0.99	-0.92
	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	3.84	2.99	-0.85	-1
	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	4.03	2.95	-1.08	-1.11
	Investigating criminal activity	4.18	3.14	-1.04	-1.16
	Providing fire protection & prevention services	4.33	3.65	-0.68	-0.74
	Providing emergency medical services	4.51	3.77	-0.74	-0.84
	Providing for neighborhood code enforcement services	3.51	3.01	-0.5	-0.57
	Examining potential impacts from Yucca	3.66	2.79	-0.87	-0.9

	Mountain nuclear waste shipments				
	Regional justice services and facilities	3.69	3.07	-0.62	-0.5
Community Development	Providing affordable housing	3.64	2.55	-1.09	-1.12
	Managing growth	3.83	2.47	-1.36	-1.25
	Increasing job opportunities	3.84	2.91	-0.93	-0.86
	Improving the business climate	3.76	3.16	-0.6	-0.63
	Planning for commercial development	3.55	3.22	-0.33	-0.42
	Reducing traffic congestion	3.97	2.43	-1.54	-1.46
	Access to freeways	3.83	3.09	-0.74	-0.71
	Improving road conditions	3.95	2.90	-1.05	-0.93
	Reducing travel time	3.82	2.57	-1.25	-1.04
	Providing mass public transit	3.69	2.70	-0.99	-0.96
	Adequate airport facilities	3.87	3.38	-0.49	-0.32
	Parks and recreation programs	4.04	3.52	-0.52	-0.48

FIGURE 4 YUCCA MOUNTAIN SERVICE IMPORTANCE SCORE SUMMARY

Yucca Mountain Service Importance Score Summary		
Descriptive Statistics	**Public Service Importance Winter '07**	**Public Service Importance Summer '06**
Keeping local decision makers up to date on Yucca Mountain	3.94	3.89
Keeping the public up to date about Yucca Mountain	3.98	3.93
Reviewing technical, scientific studies about seismic, vulcanology, geology and hydrology	3.87	3.84
Identify public safety needs and impacts	4.04	3.96
Assess other government impacts	3.72	3.66
Assess impacts on the tourist sector	3.83	3.61
Assess impacts on the building, construction, and development sectors	3.79	3.57
Identify transportation impacts	3.85	3.68
Provide information to the public on all facts of Yucca Mountain	3.96	3.91

Appendix I

Importance Score for Selected Service

Appendix I
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)

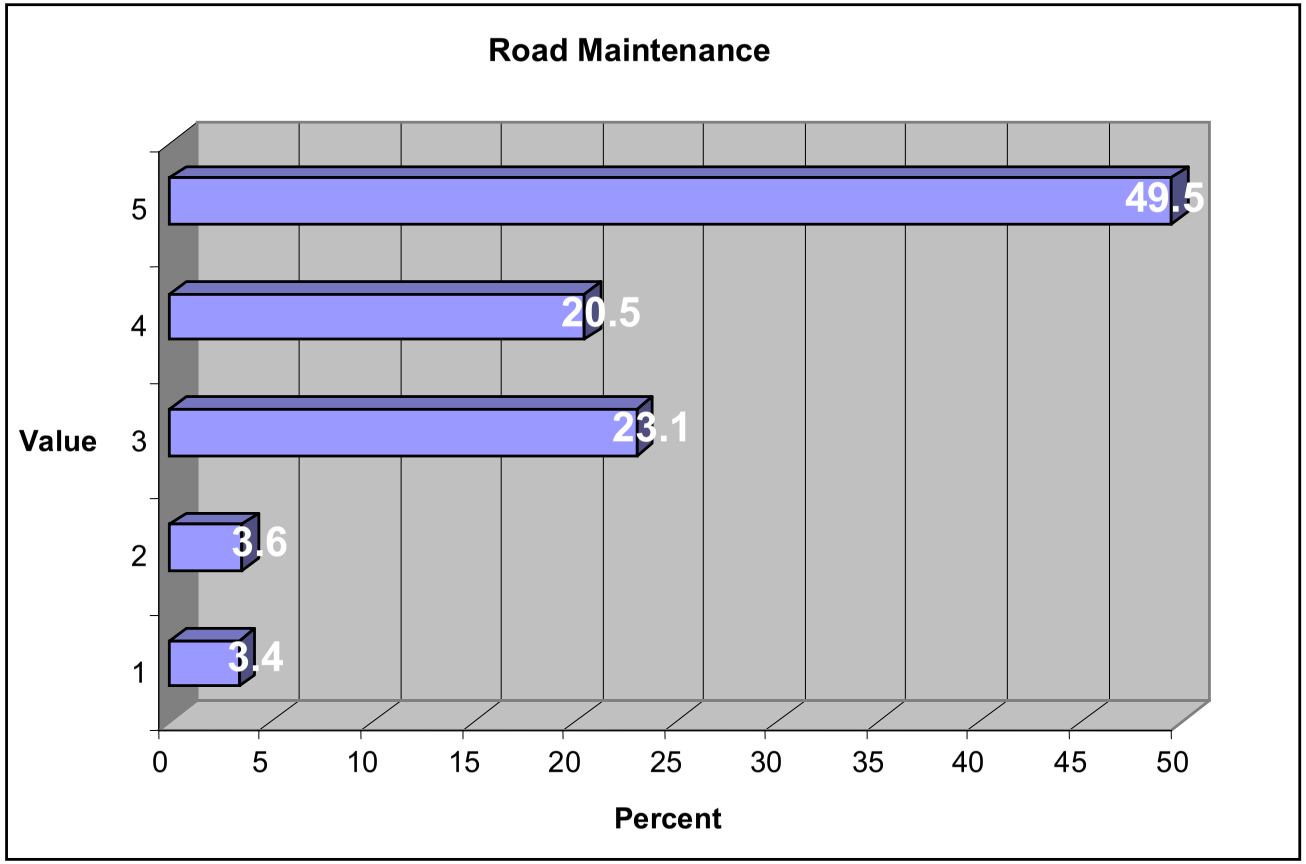
Importance Variable	N	Mean	Std. Error of Mean	Median	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
** General Government*											
Road Maintenance	598	4.09	0.044	4.00	1.081	-1.002	0.100	0.288	0.200	1	5
Revitalizing older neighborhoods	593	3.36	0.050	3.00	1.227	-0.218	0.100	-0.802	0.200	1	5
Flood control	595	3.70	0.051	4.00	1.247	-0.596	0.100	-0.654	0.200	1	5
Budget management	590	4.11	0.047	5.00	1.146	-1.189	0.101	0.527	0.201	1	5
Communicate Clark County's local government views about Yucca Mountain to federal decision makers	576	3.63	0.057	4.00	1.367	-0.608	0.102	-0.844	0.203	1	5
Monitor and report to the public on how well government services are being performed	595	3.87	0.049	4.00	1.199	-0.830	0.100	-0.214	0.200	1	5
Water conservation programs	597	4.22	0.044	5.00	1.086	-1.434	0.100	1.341	0.200	1	5
** Social and Judicial Services*											
Providing child protection services	593	4.17	0.047	5.00	1.141	-1.221	0.100	0.517	0.200	1	5
Providing child welfare services	591	3.99	0.050	4.00	1.220	-1.008	0.100	-0.007	0.201	1	5
Providing juvenile justice services	581	3.98	0.048	4.00	1.149	-0.926	0.101	-0.018	0.202	1	5
Providing attainable housing for working class families	591	3.76	0.055	4.00	1.326	-0.750	0.101	-0.643	0.201	1	5
Providing affordable housing for low income families	591	3.67	0.055	4.00	1.344	-0.643	0.101	-0.840	0.201	1	5
Providing shelter for the homeless	596	3.53	0.059	4.00	1.435	-0.557	0.100	-1.029	0.200	1	5
Providing affordable housing for seniors	588	4.02	0.049	4.00	1.181	-1.048	0.101	0.118	0.201	1	5
Providing medical care for the poor	594	3.75	0.056	4.00	1.364	-0.761	0.100	-0.709	0.200	1	5
Providing 24 hour emergency trauma care	596	4.42	0.040	5.00	0.967	-1.832	0.100	2.929	0.200	1	5

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)

Importance Variable	N	Mean	Std. Error of Mean	Median	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
** Public Safety*											
Providing crime prevention programs	595	4.04	0.045	4.00	1.105	-1.039	0.100	0.303	0.200	1	5
Enforcing traffic laws	600	4.09	0.045	4.00	1.094	-1.112	0.100	0.498	0.199	1	5
Maintaining a low crime rate	599	4.24	0.045	5.00	1.109	-1.415	0.100	1.065	0.199	1	5
Maintaining neighborhood police patrols	597	4.06	0.048	4.00	1.162	-1.170	0.100	0.486	0.200	1	5
Keeping police response times low	590	4.34	0.043	5.00	1.037	-1.681	0.101	2.205	0.201	1	5
Keeping fire department response times low	593	4.59	0.031	5.00	0.750	-2.033	0.100	4.149	0.200	1	5
Keeping paramedic and emergency medical response times low	592	4.61	0.030	5.00	0.727	-2.185	0.100	5.200	0.201	1	5
Well trained paramedic and emergency medical response personnel	590	4.67	0.026	5.00	0.626	-2.092	0.101	4.578	0.201	1	5
Facilitate neighborhood watch programs	586	3.79	0.048	4.00	1.171	-0.697	0.101	-0.366	0.201	1	5
Preparing for natural disasters (i.e. floods, earthquakes, etc.)	587	3.84	0.049	4.00	1.188	-0.781	0.101	-0.296	0.201	1	5
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	588	4.03	0.049	4.00	1.196	-1.087	0.101	0.230	0.201	1	5
Investigating criminal activity	594	4.18	0.042	4.00	1.015	-1.197	0.100	0.832	0.200	1	5
Providing fire protection & prevention services	596	4.33	0.038	5.00	0.928	-1.478	0.100	1.886	0.200	1	5
Providing emergency medical services	595	4.51	0.032	5.00	0.789	-1.705	0.100	2.795	0.200	1	5
Providing for neighborhood code enforcement services	571	3.51	0.052	4.00	1.242	-0.428	0.102	-0.714	0.204	1	5
	N	Mean	Std. Error	Median	Std. Deviation	Skewness	Std. Error	Kurtosis	Std. Error	Minimum	Maximum

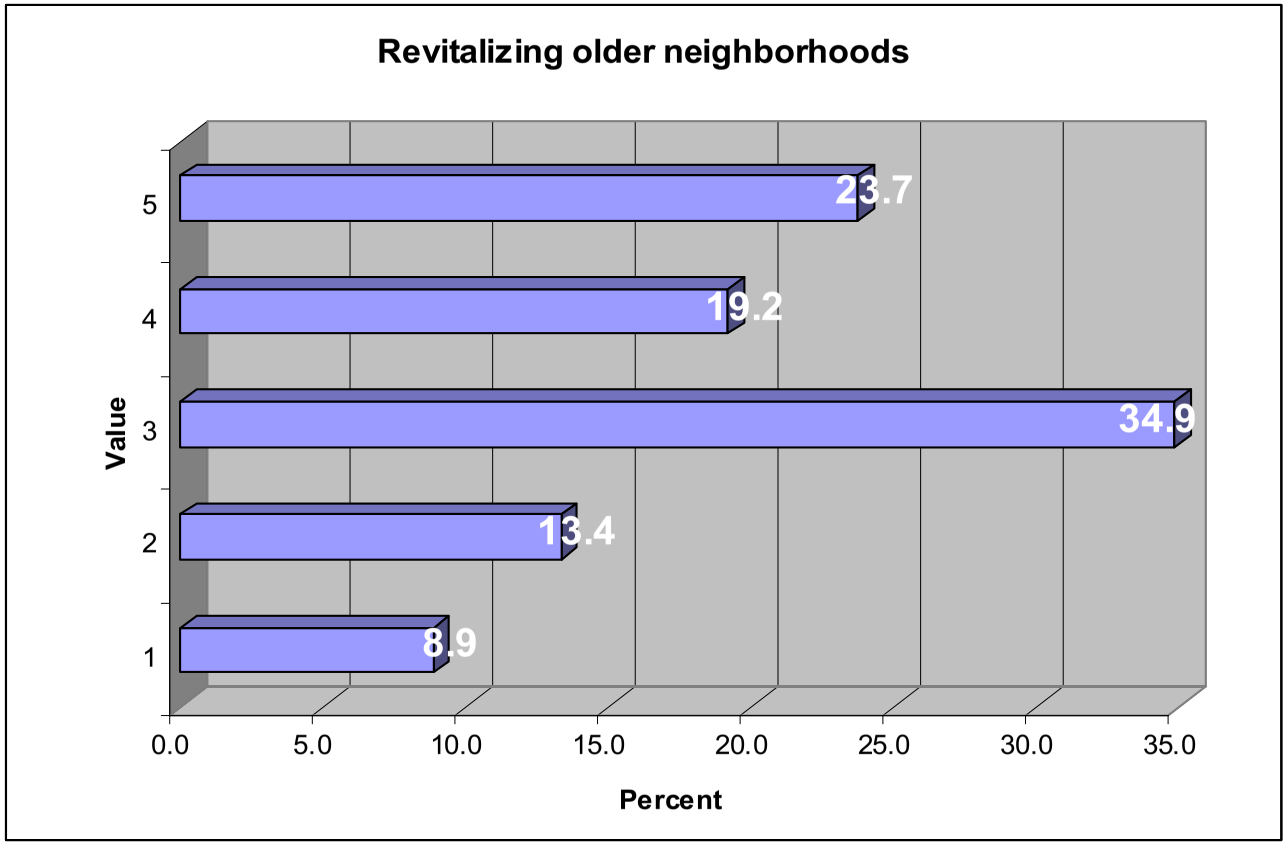
Importance Variable											
Examining potential impacts from Yucca Mountain nuclear waste shipments	571	3.66	0.059	4.00	1.417	-0.663	0.102	-0.894	0.204	1	5
Regional justice services and facilities	581	3.69	0.046	4.00	1.107	-0.542	0.101	-0.402	0.202	1	5
** Community Development*											
Providing affordable housing	590	3.64	0.057	4.00	1.387	-0.598	0.101	-0.934	0.201	1	5
Managing growth	595	3.83	0.056	4.00	1.367	-0.850	0.100	-0.582	0.200	1	5
Increasing job opportunities	593	3.84	0.050	4.00	1.224	-0.810	0.100	-0.357	0.200	1	5
Improving the business climate	588	3.76	0.045	4.00	1.080	-0.589	0.101	-0.314	0.201	1	5
Planning for commercial development	592	3.55	0.049	4.00	1.203	-0.482	0.100	-0.642	0.201	1	5
Reducing traffic congestion	599	3.97	0.054	5.00	1.310	-1.014	0.100	-0.253	0.199	1	5
Access to freeways	597	3.83	0.050	4.00	1.221	-0.891	0.100	-0.134	0.200	1	5
Improving road conditions	596	3.95	0.048	4.00	1.172	-0.958	0.100	0.048	0.200	1	5
Reducing travel time	590	3.82	0.052	4.00	1.275	-0.788	0.101	-0.520	0.201	1	5
Providing mass public transit	591	3.69	0.054	4.00	1.313	-0.608	0.101	-0.803	0.201	1	5
Adequate airport facilities	594	3.87	0.049	4.00	1.187	-0.854	0.100	-0.140	0.200	1	5
Parks and recreation programs	596	4.04	0.042	4.00	1.030	-1.024	0.100	0.606	0.200	1	5

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



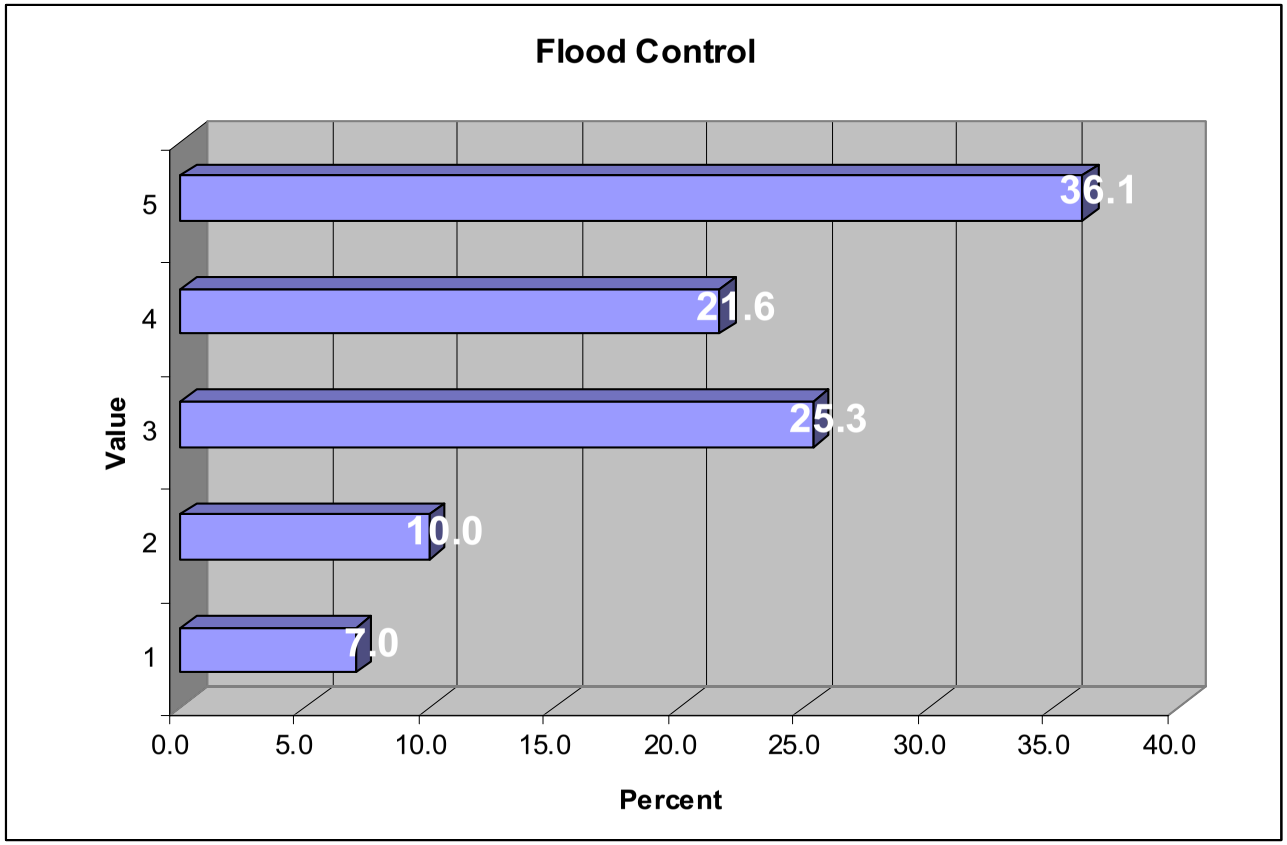
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



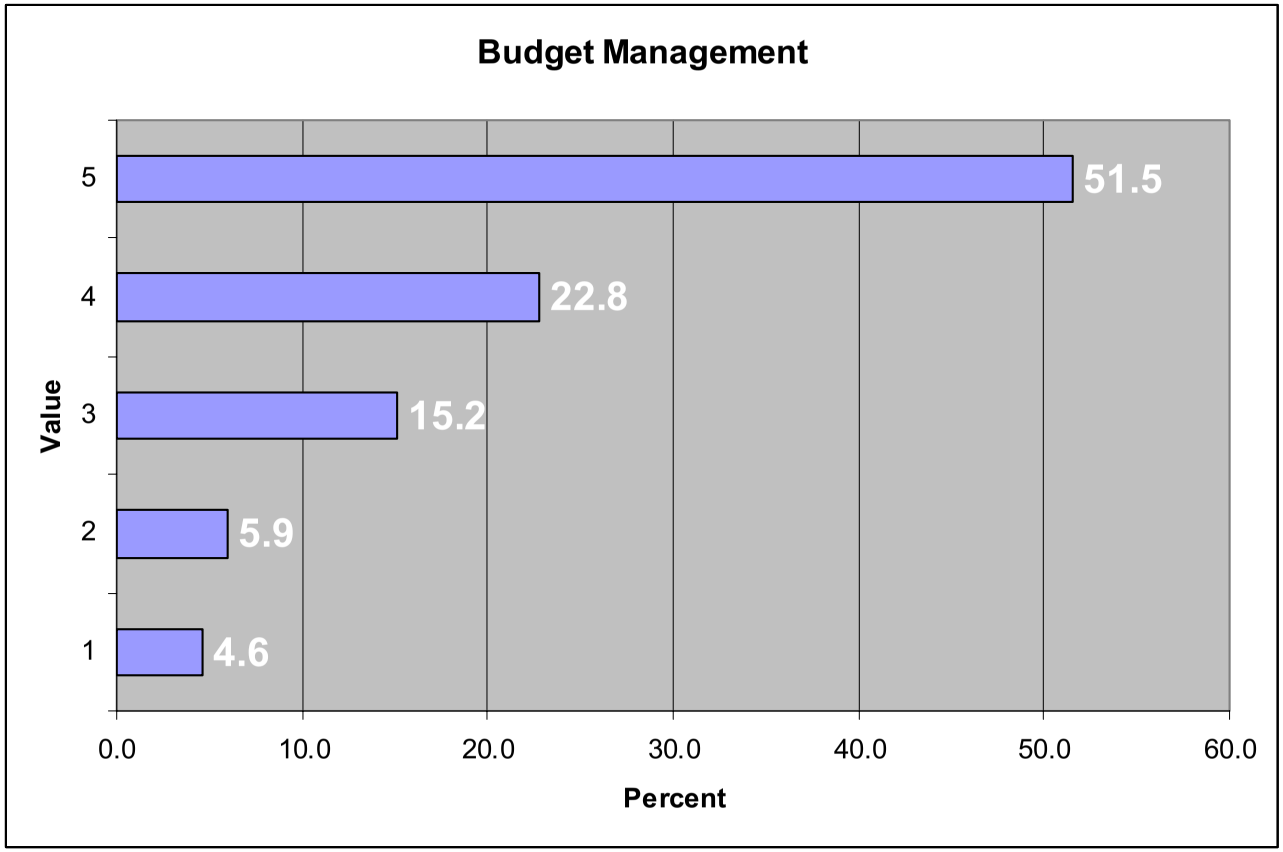
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



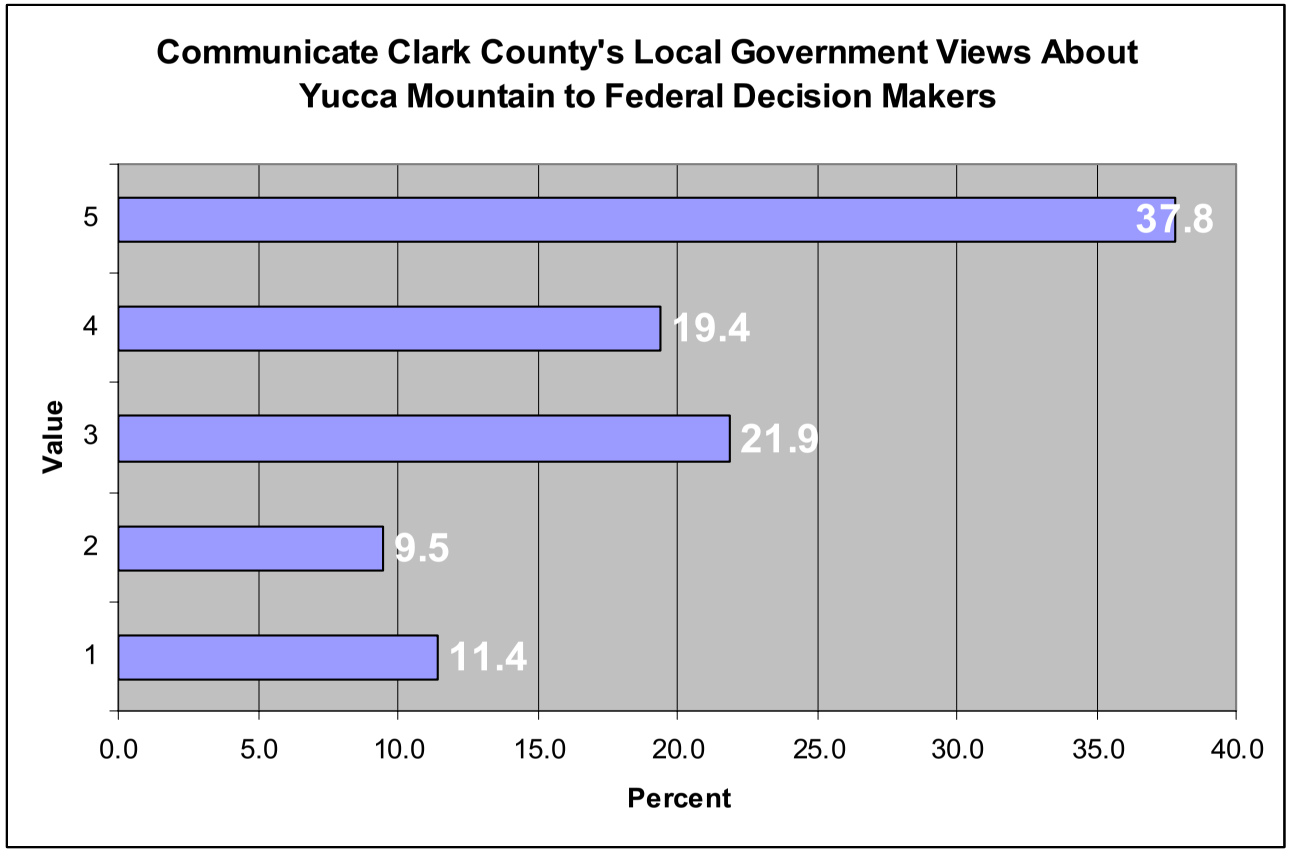
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



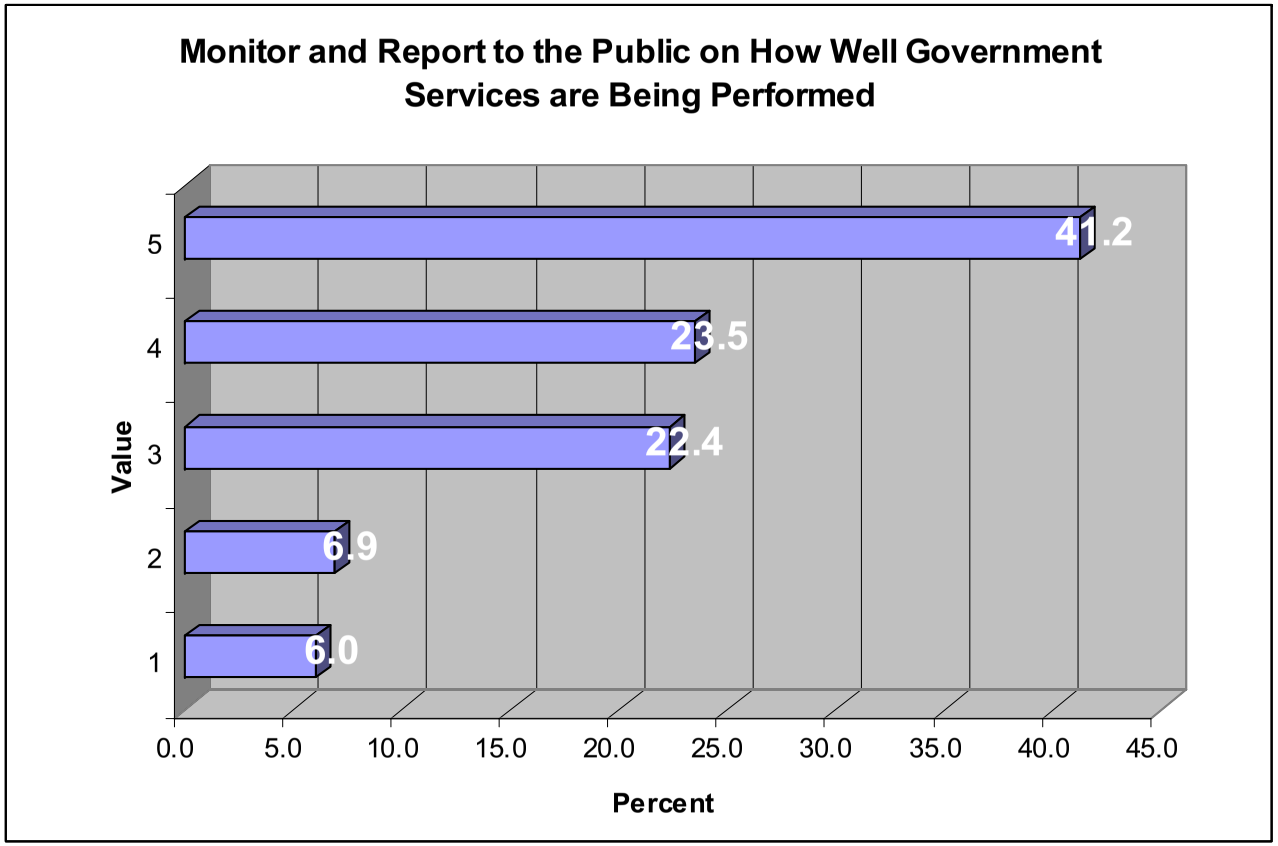
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



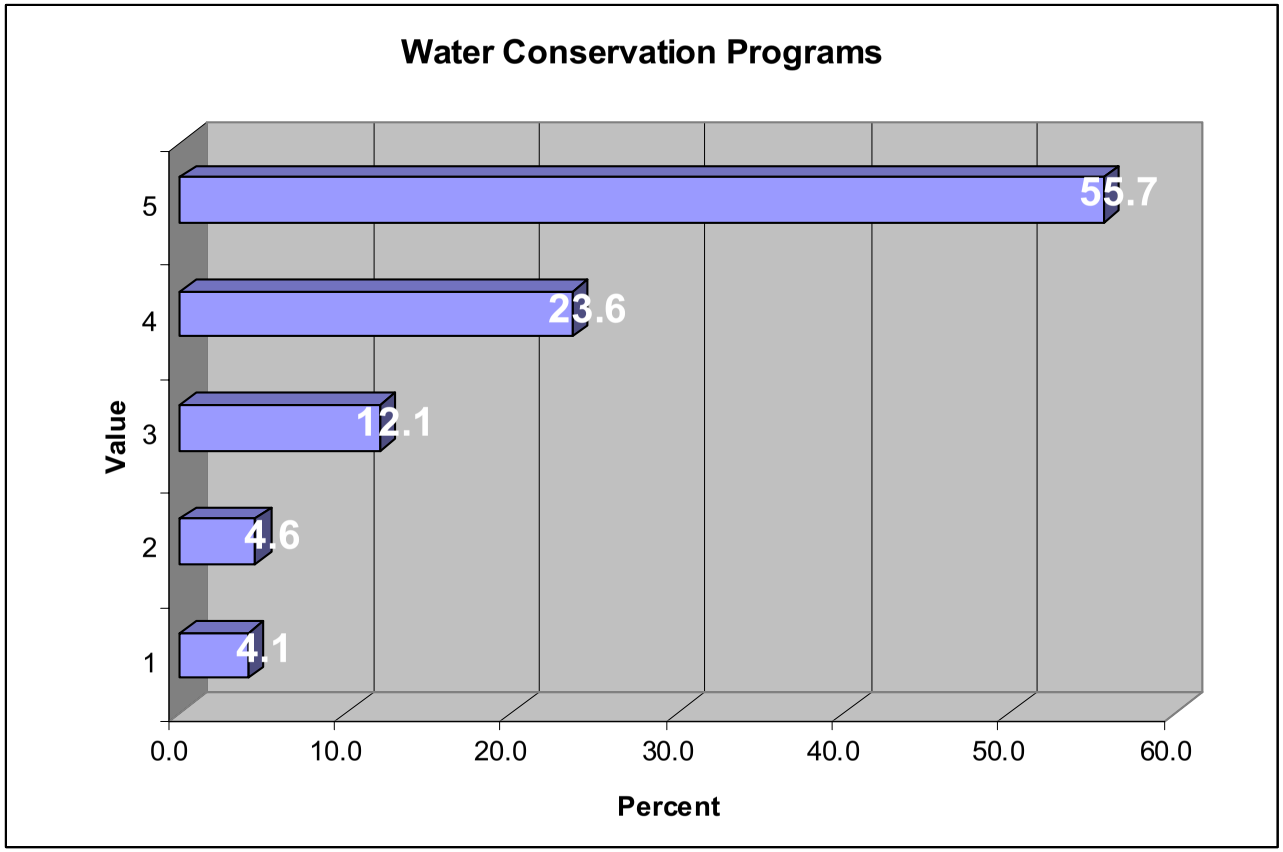
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



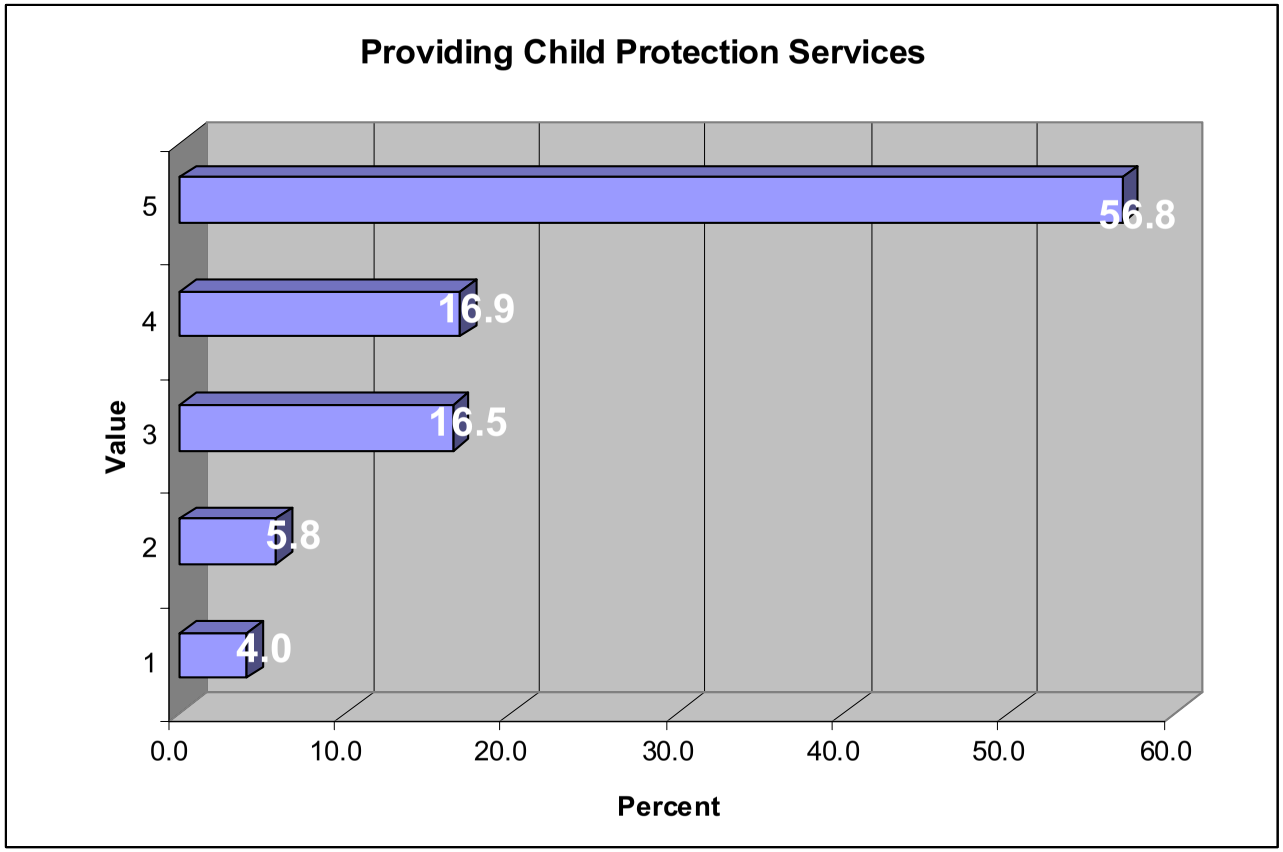
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



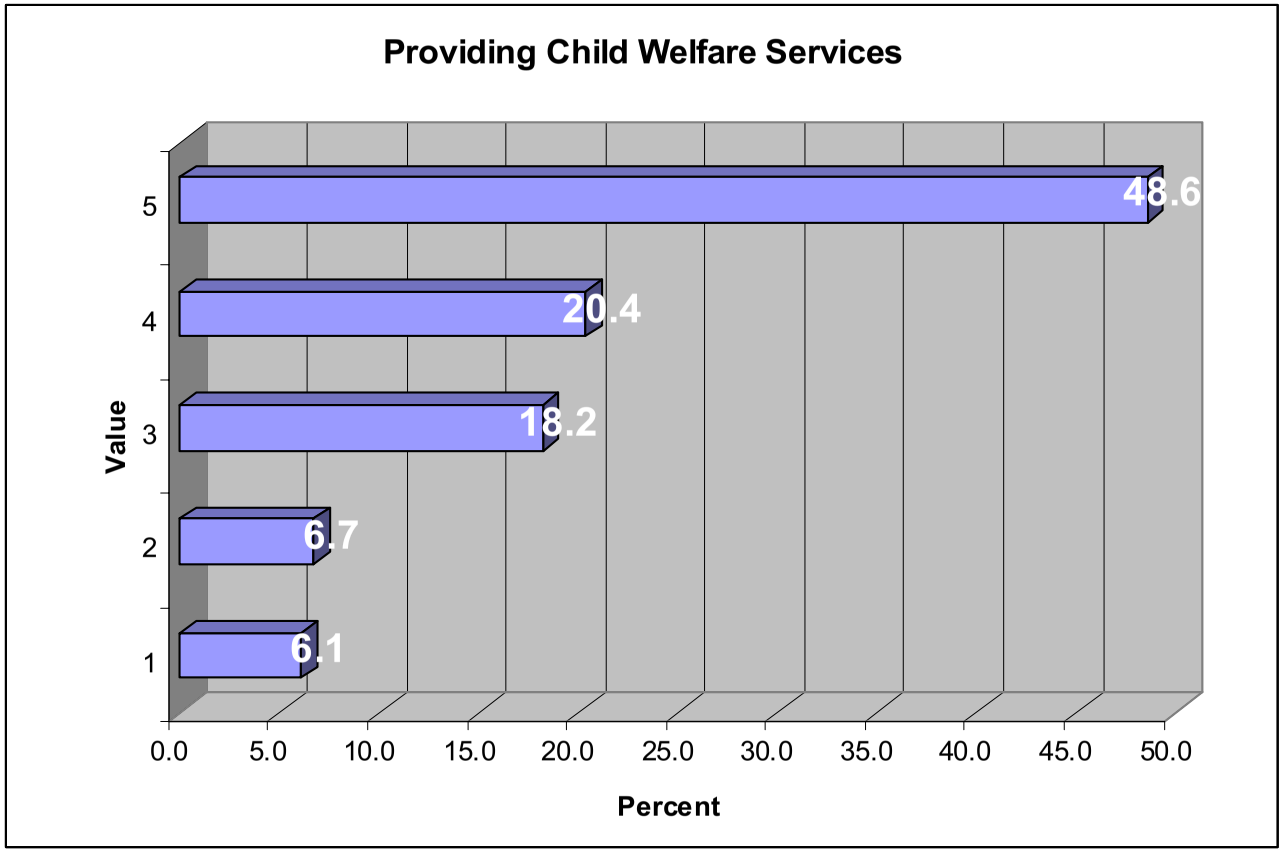
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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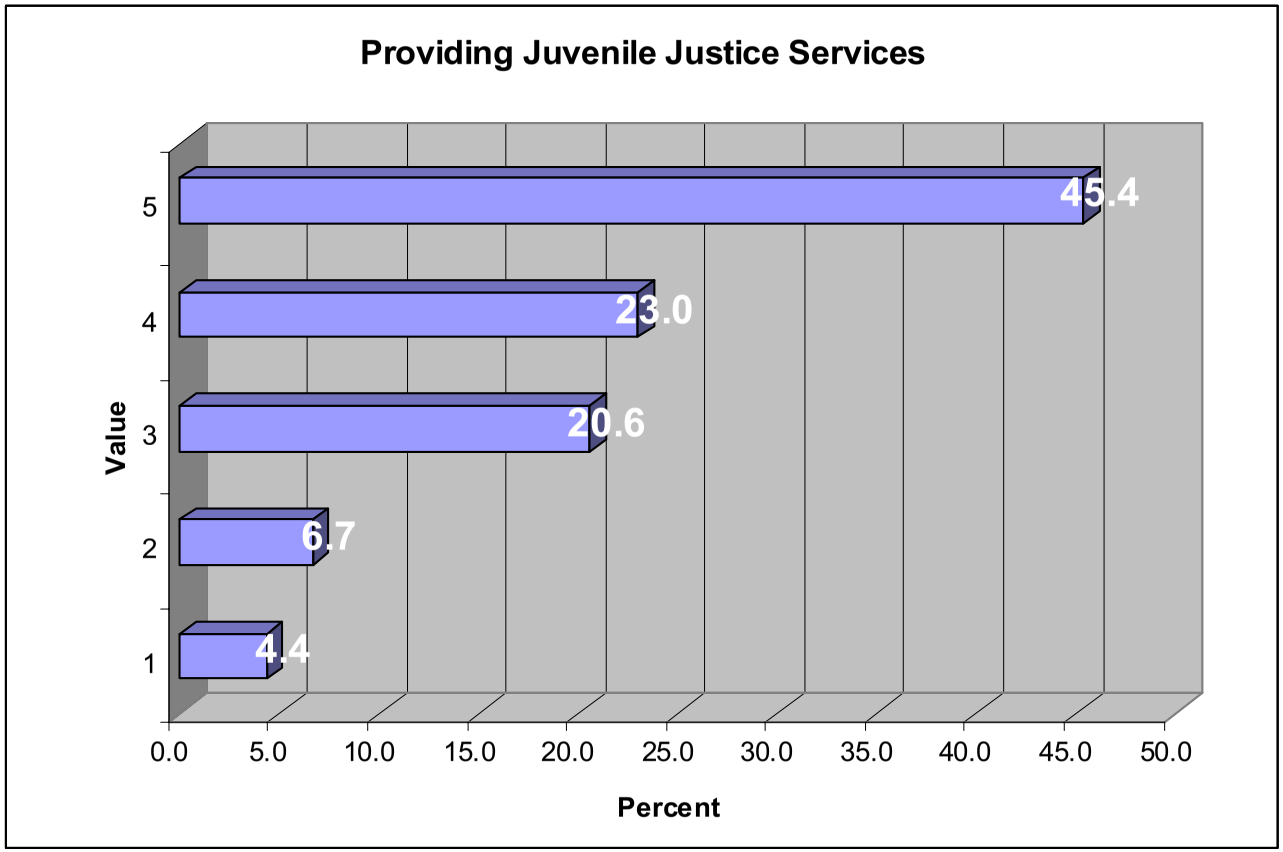
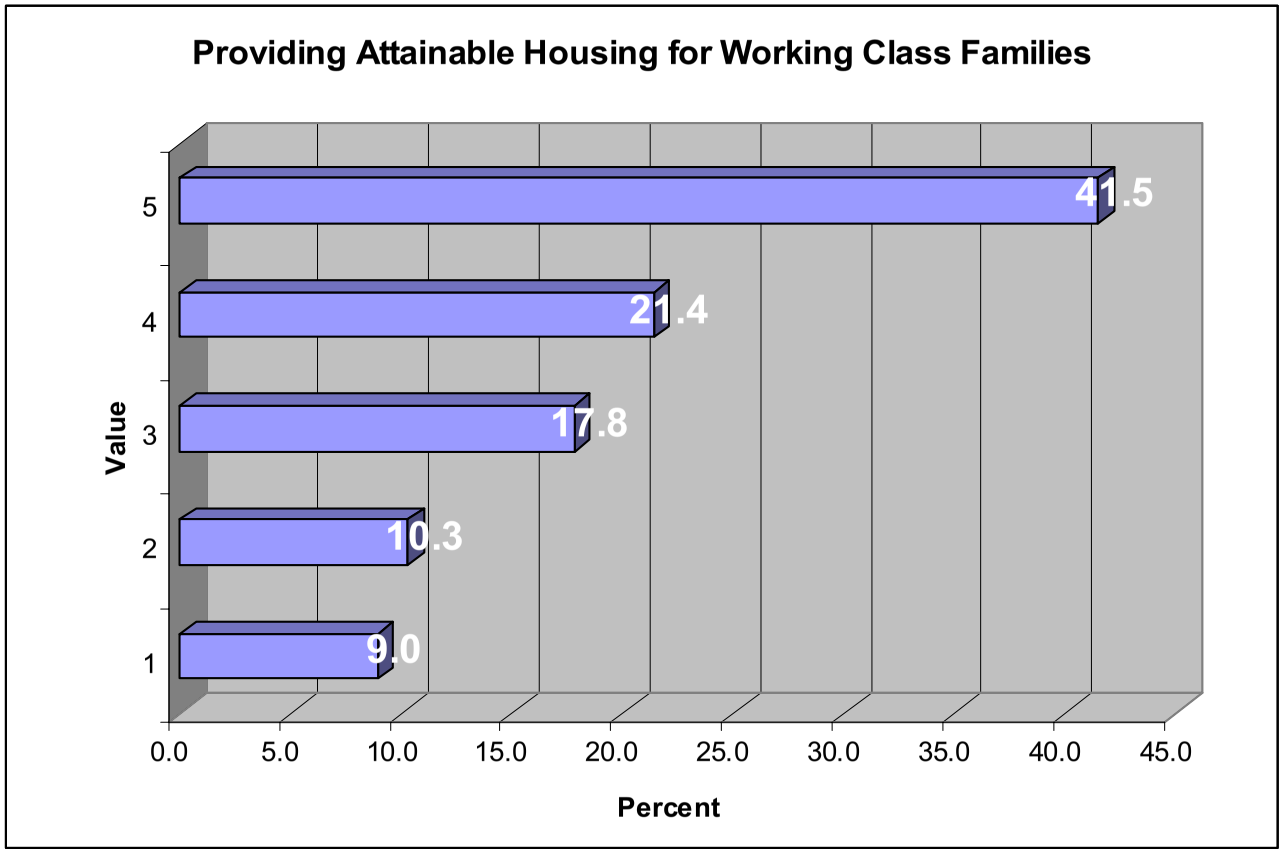
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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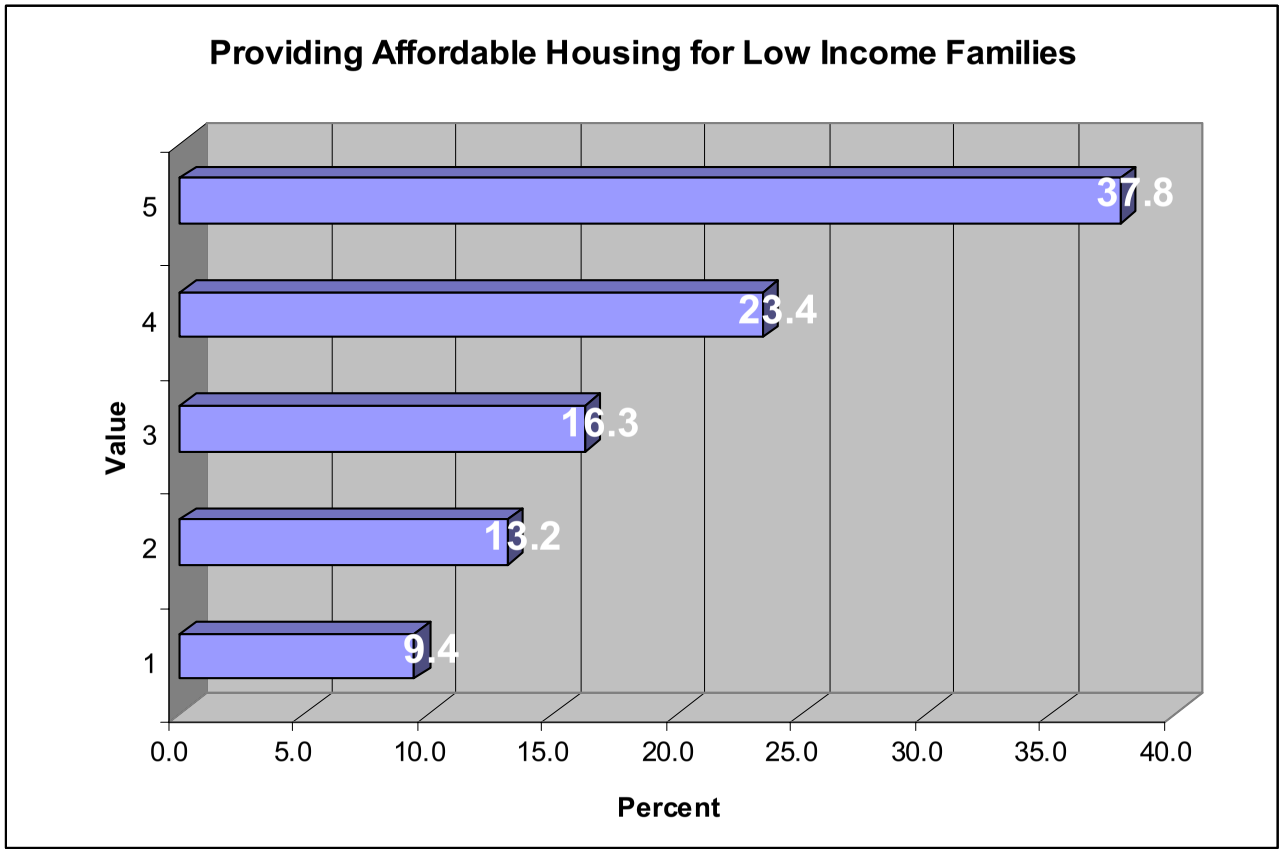
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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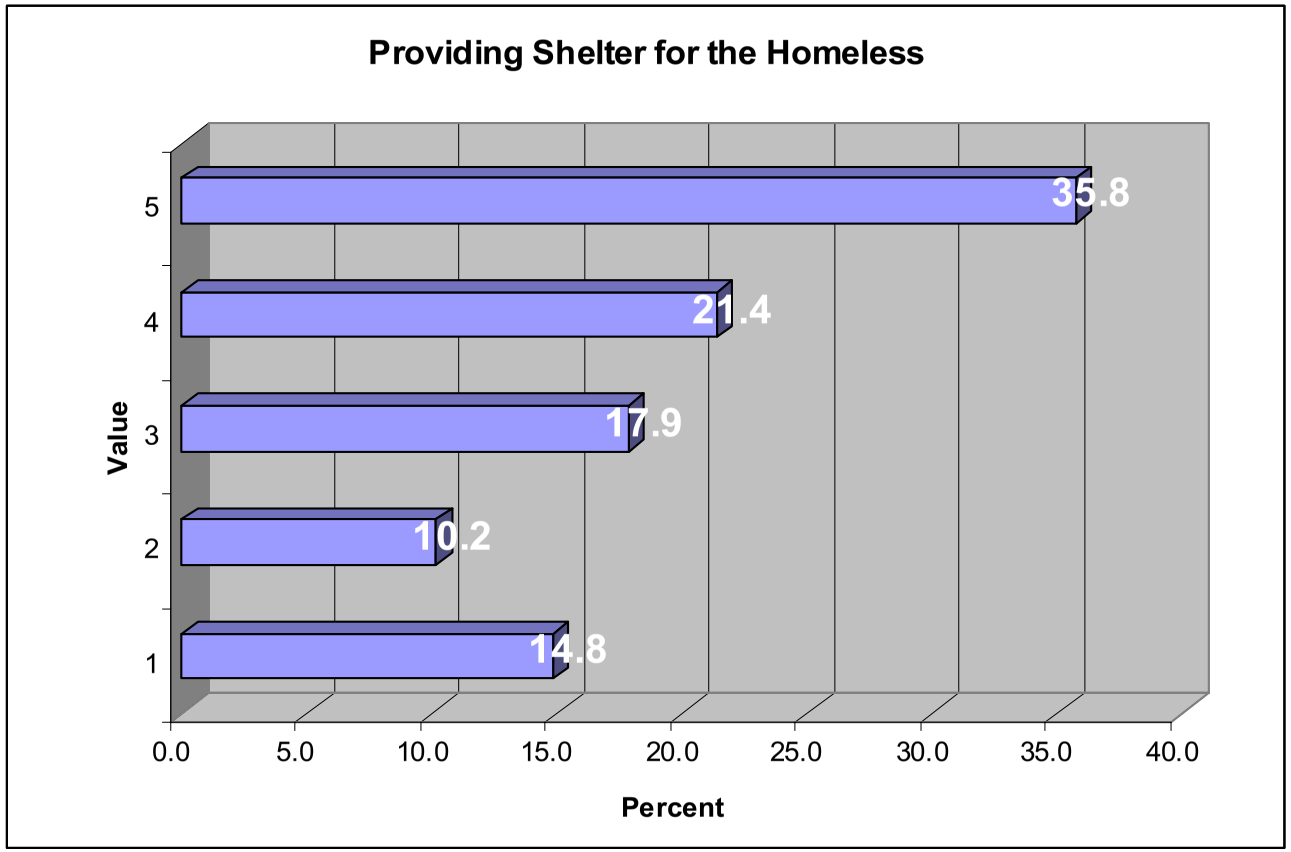
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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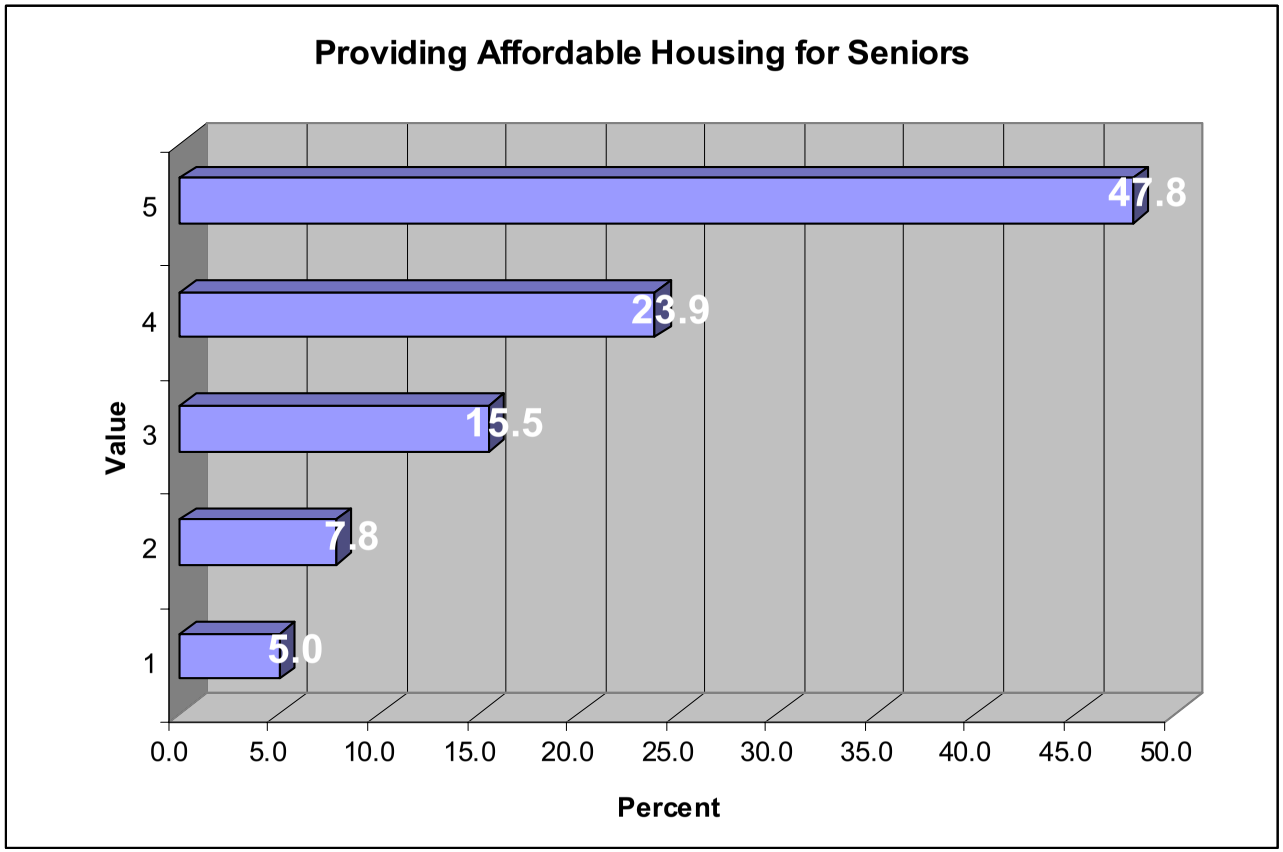
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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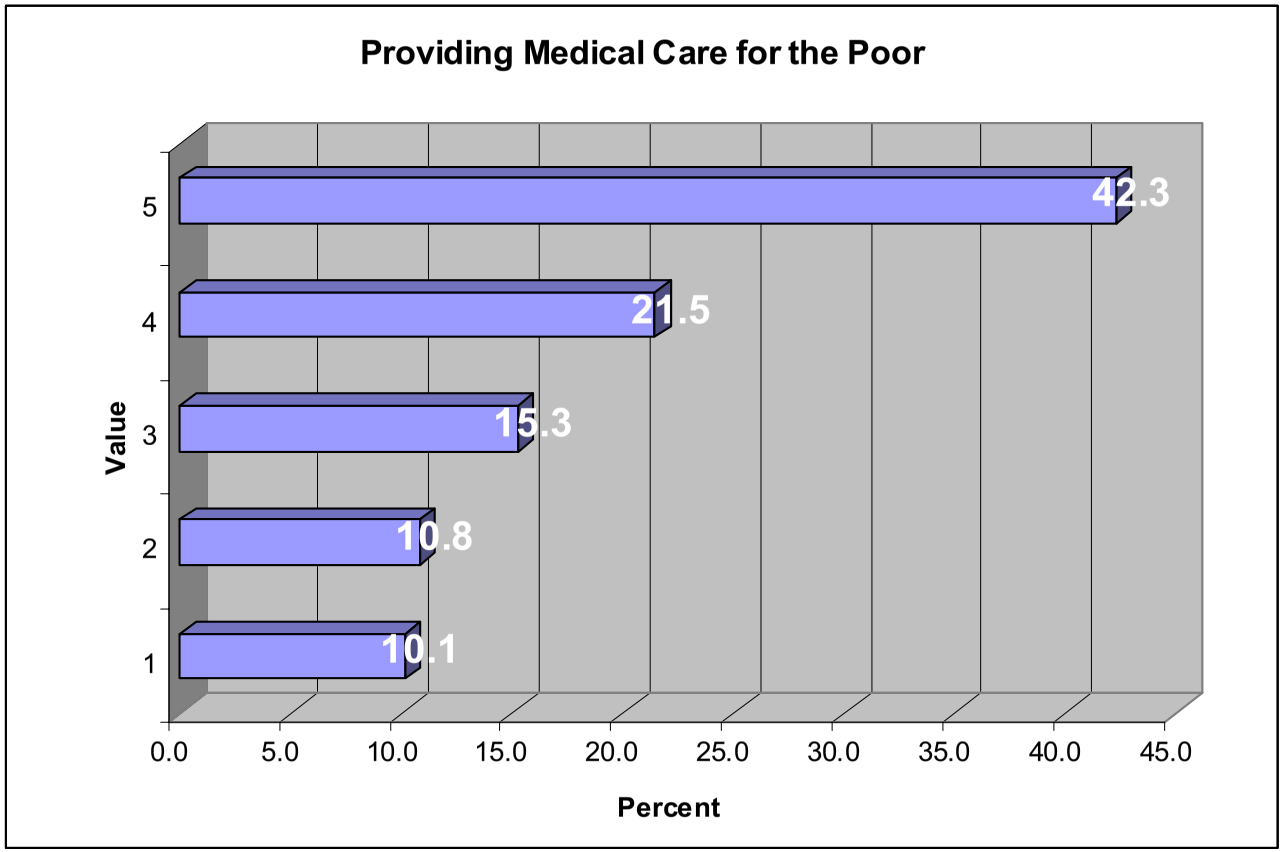
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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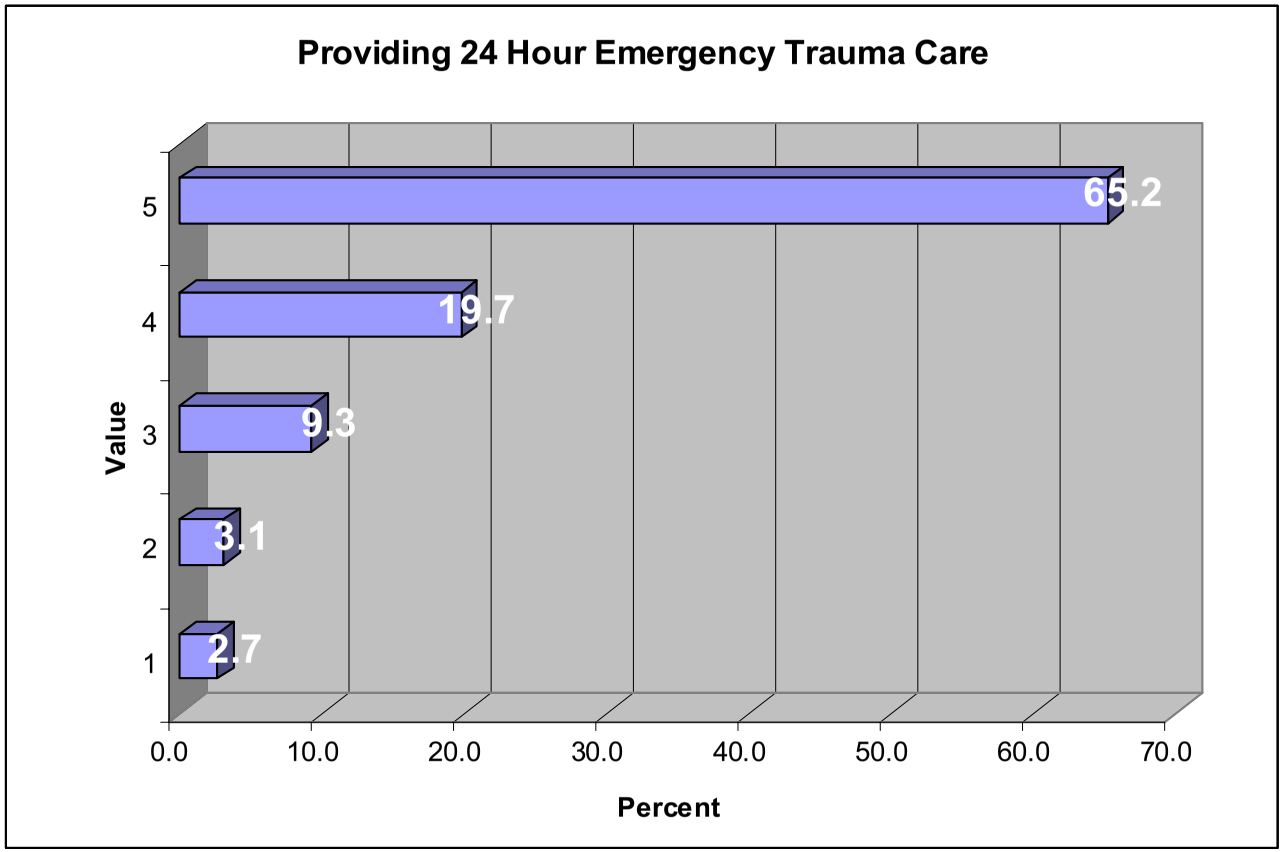
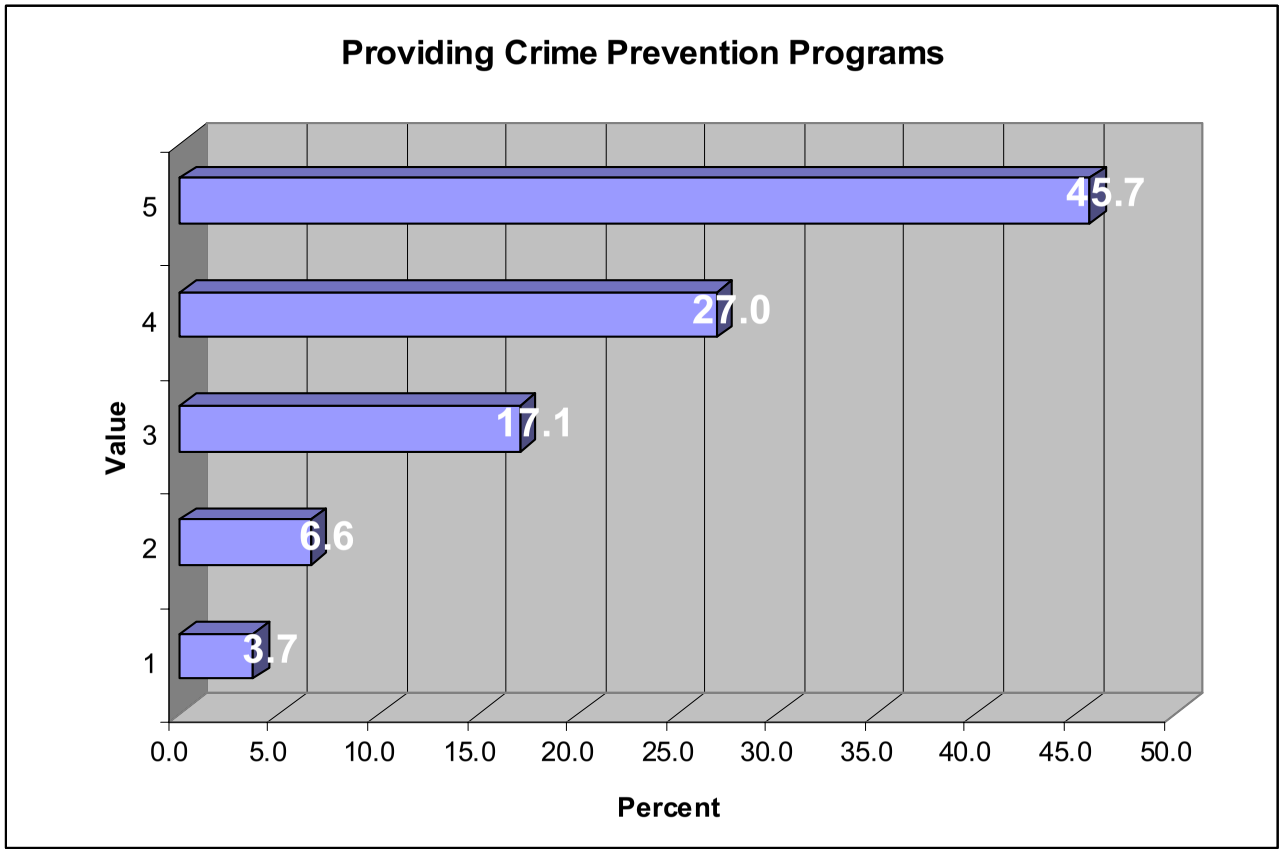
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



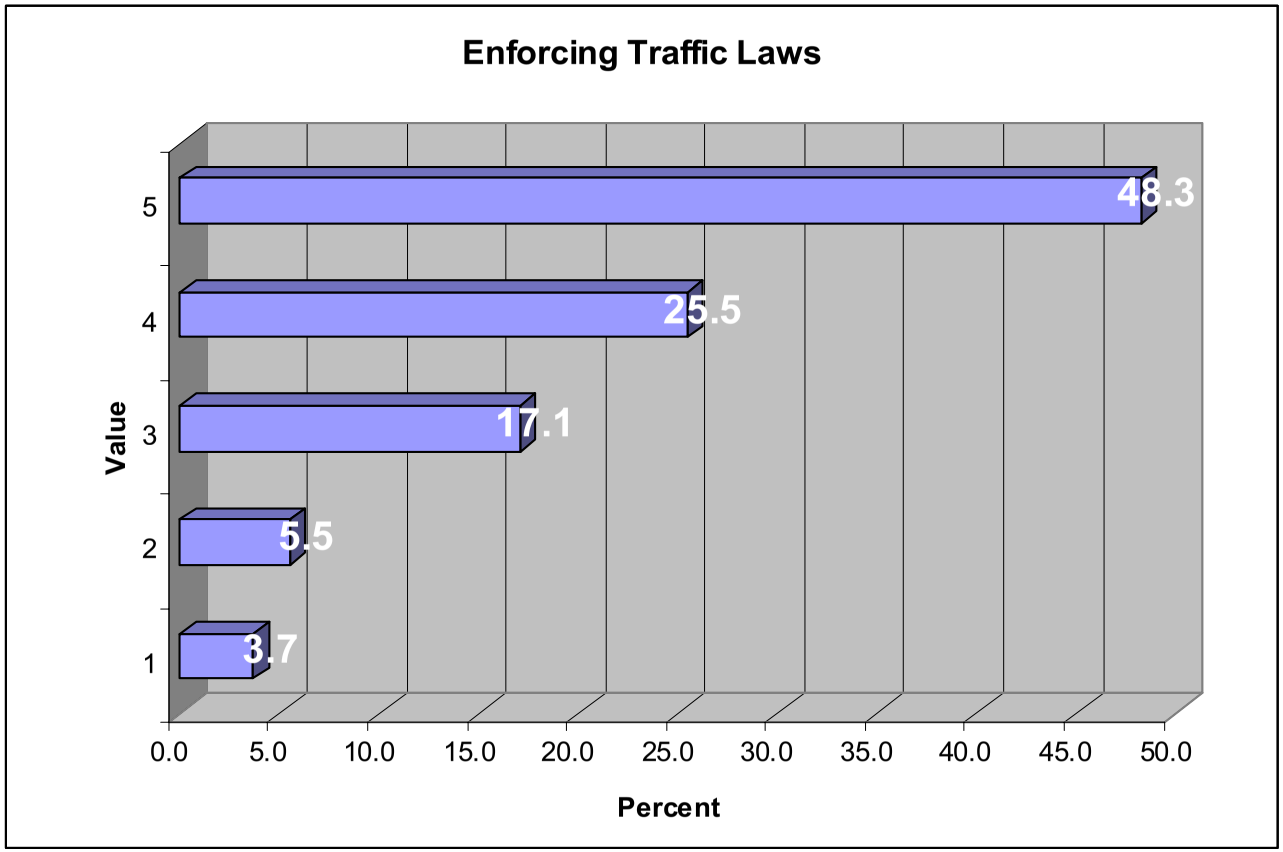
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



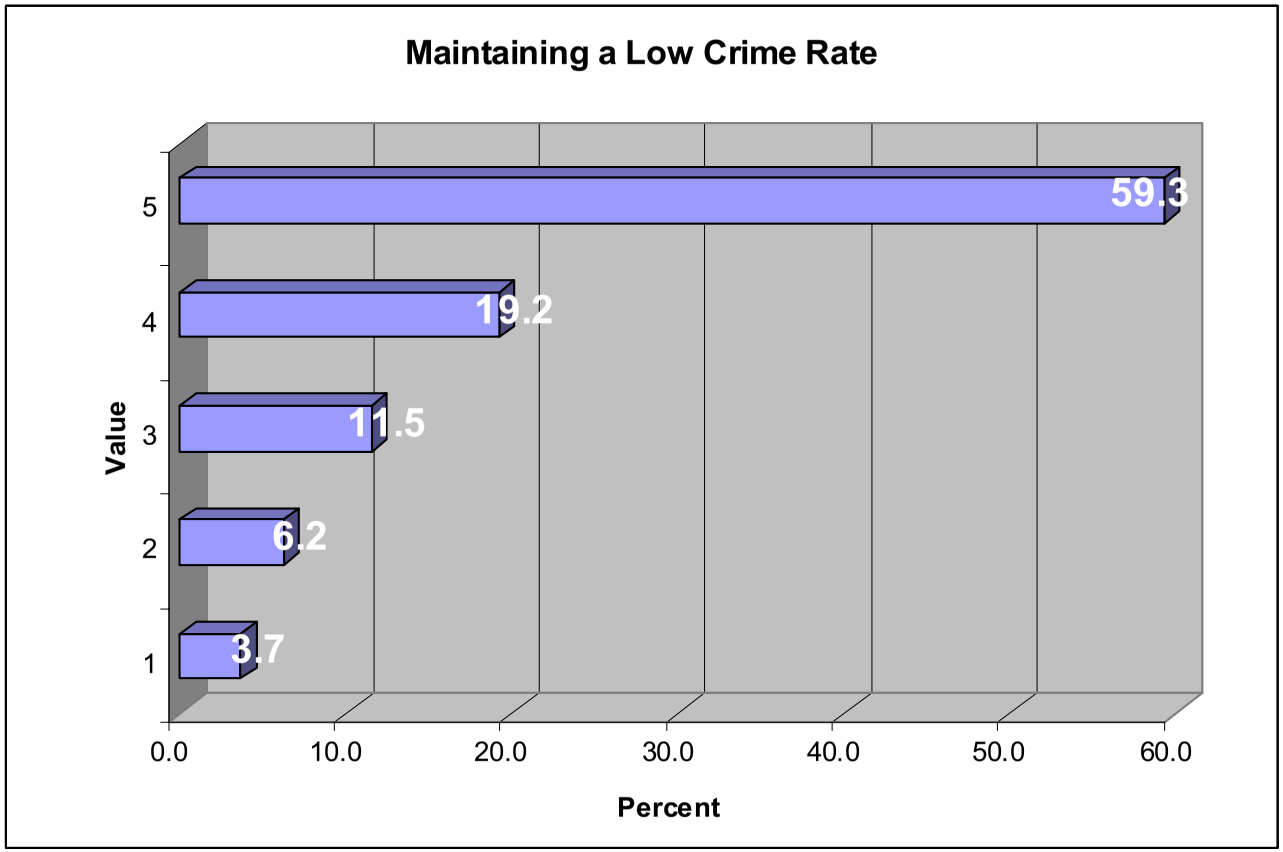
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



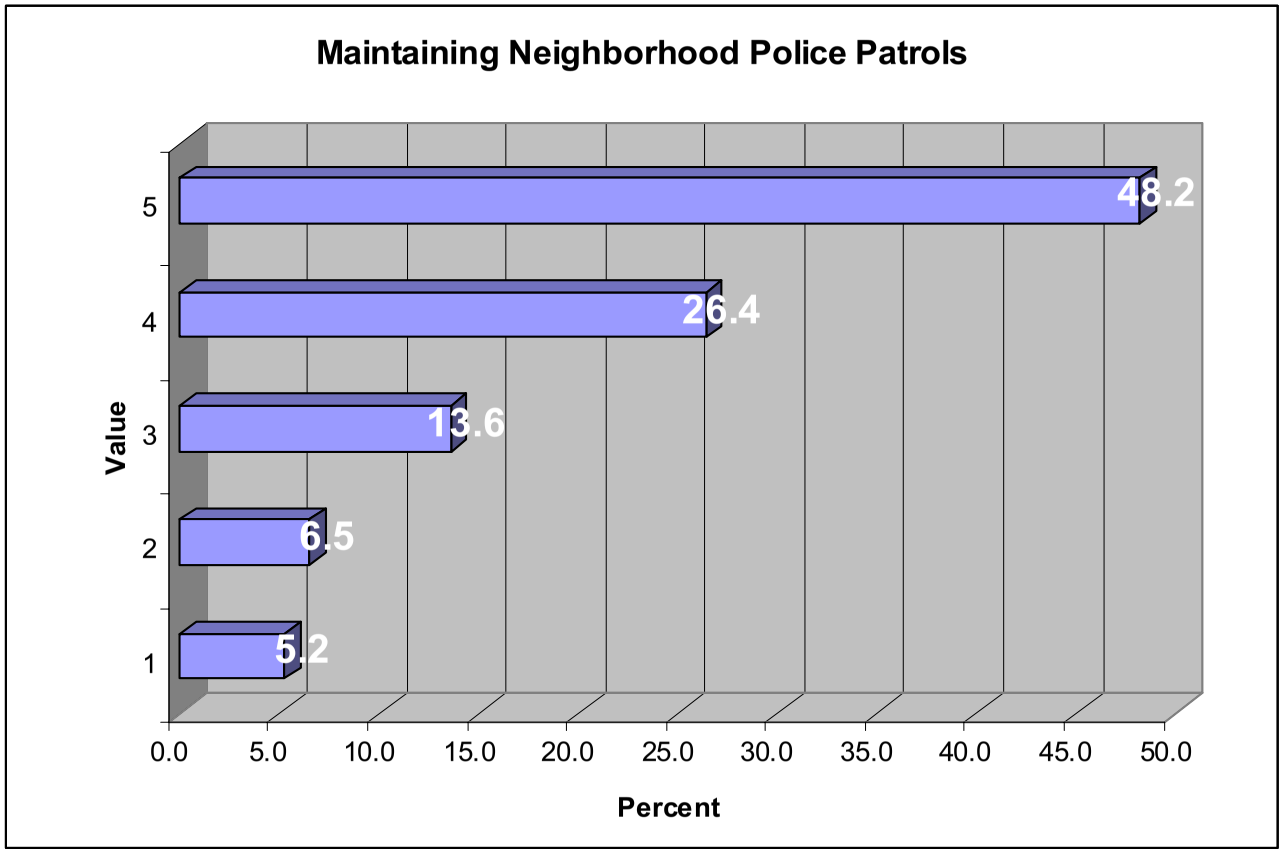
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



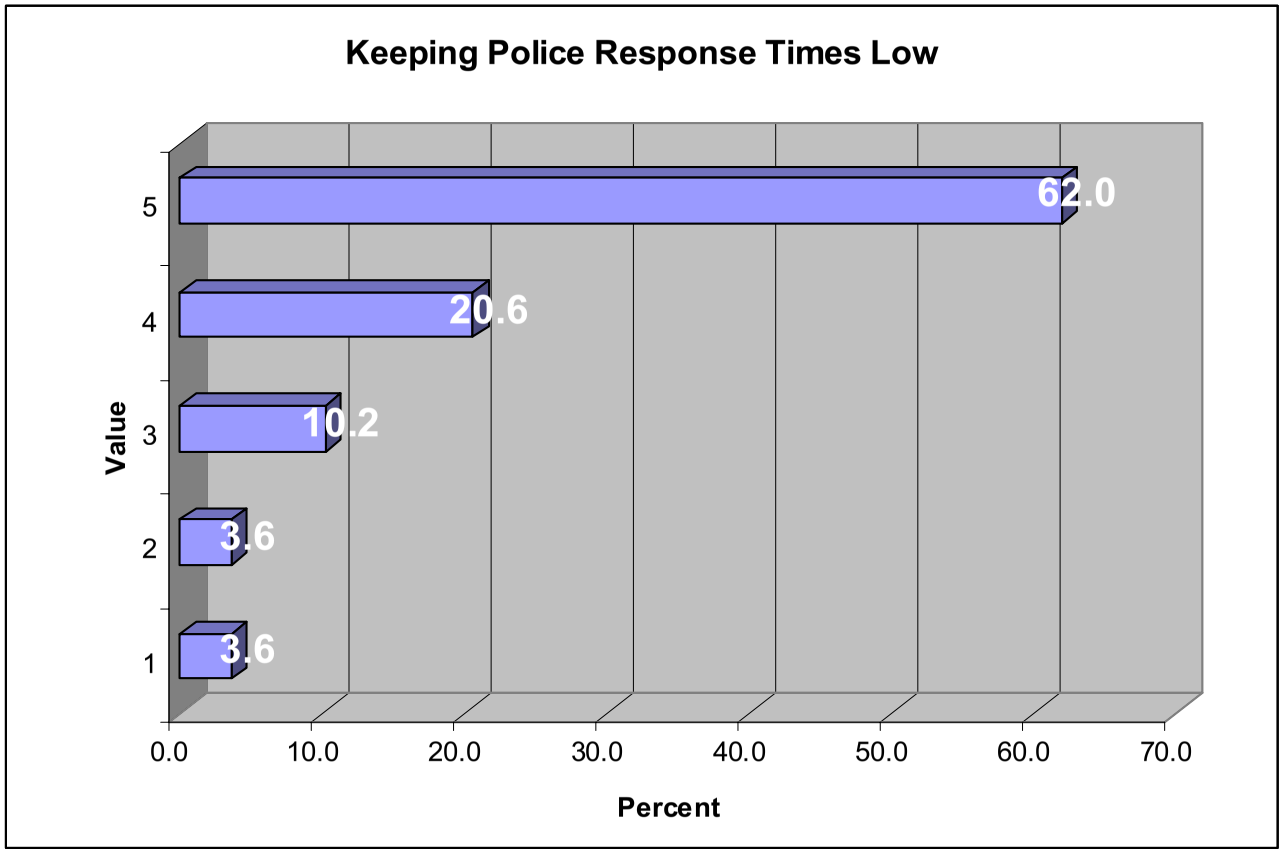
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



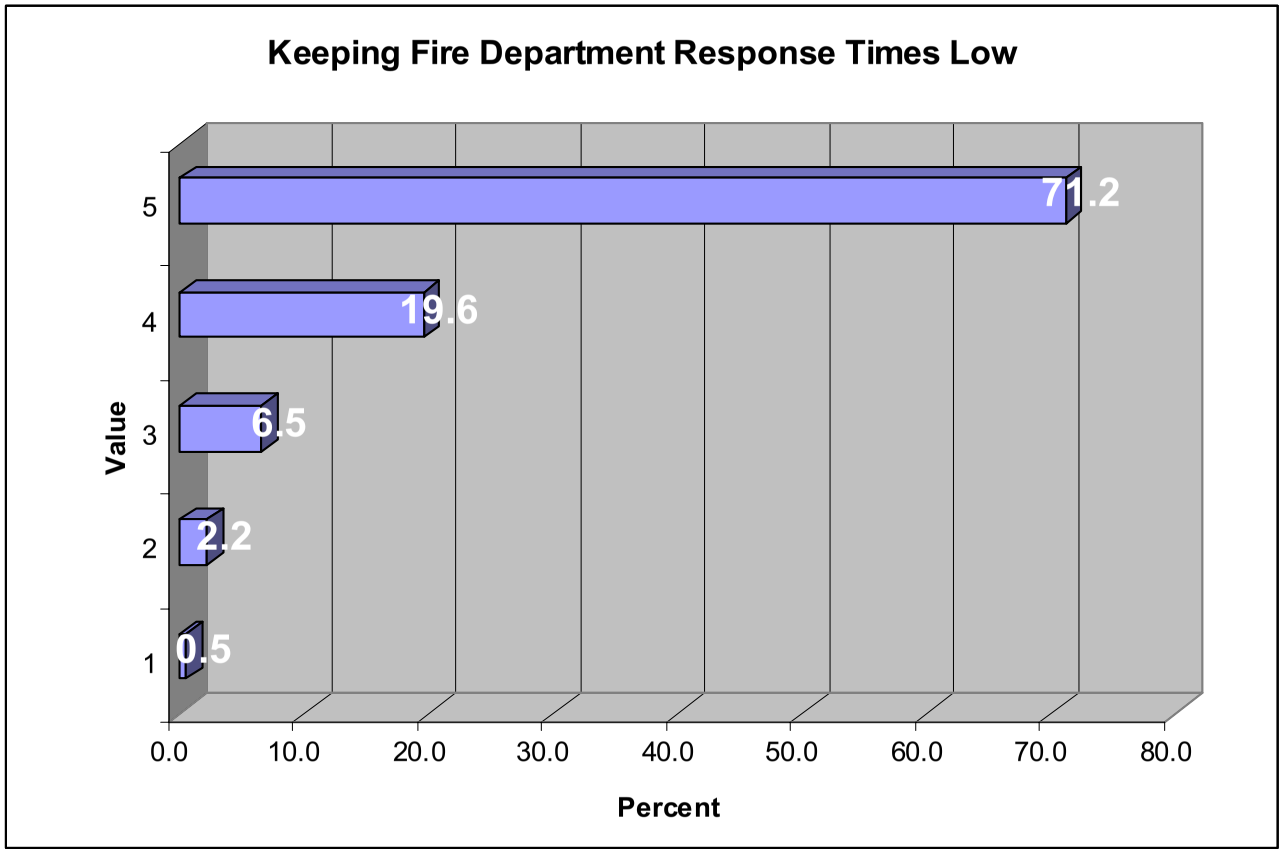
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



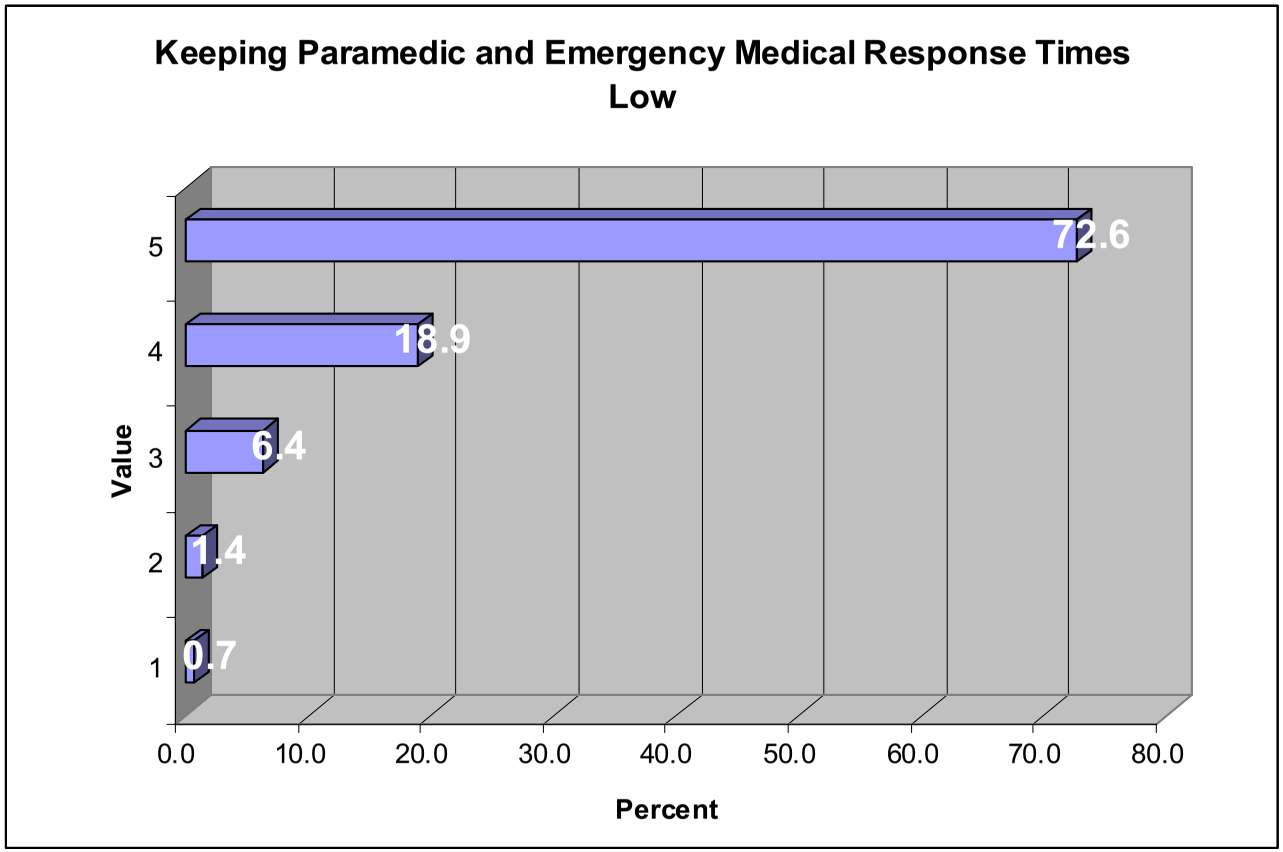
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



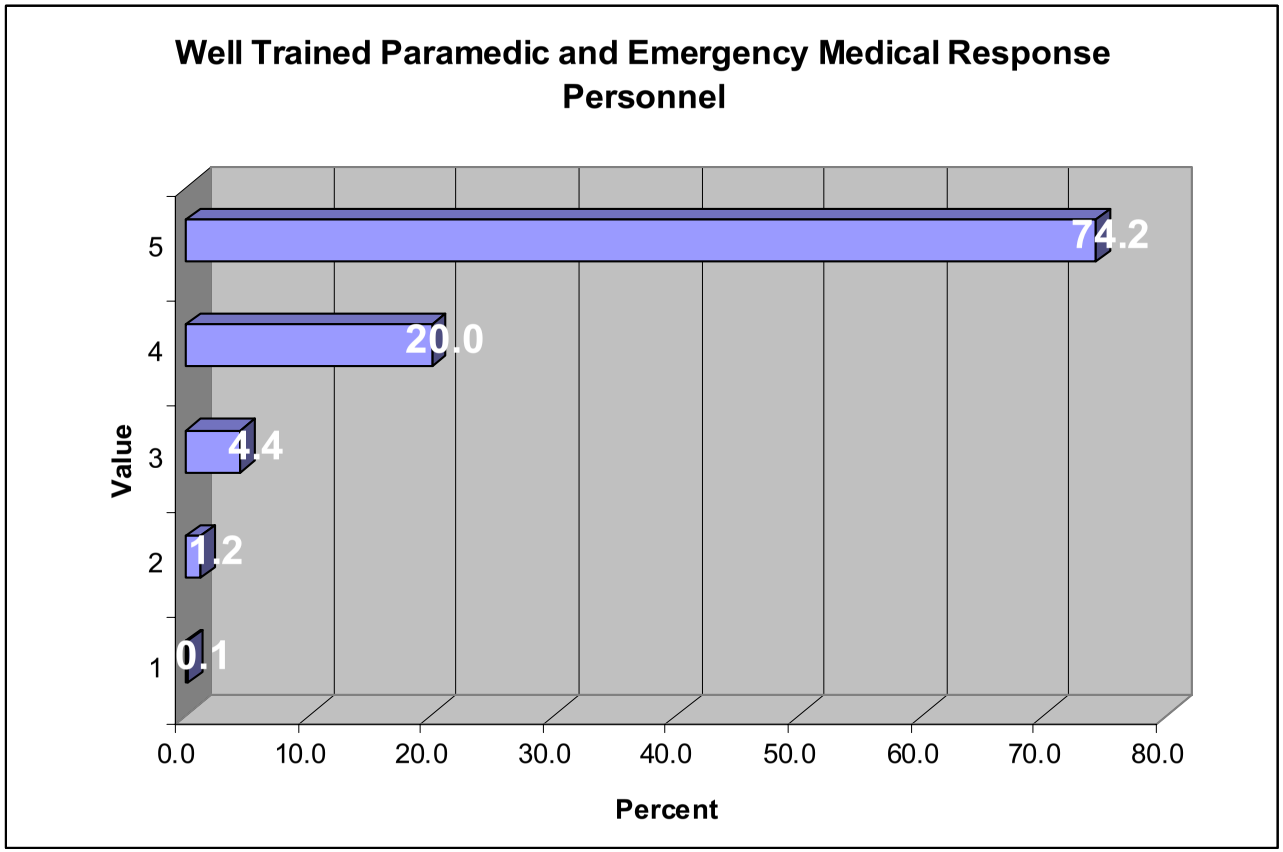
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



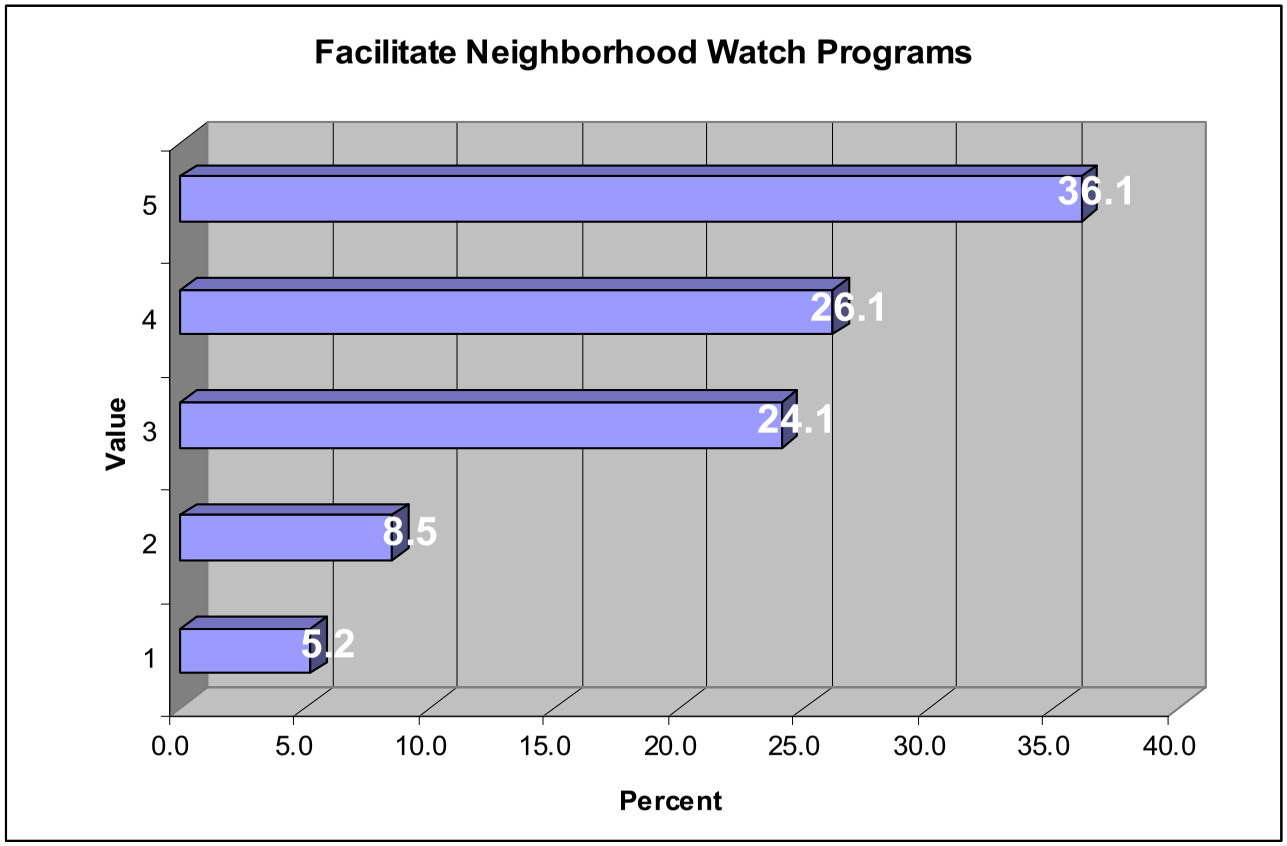
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



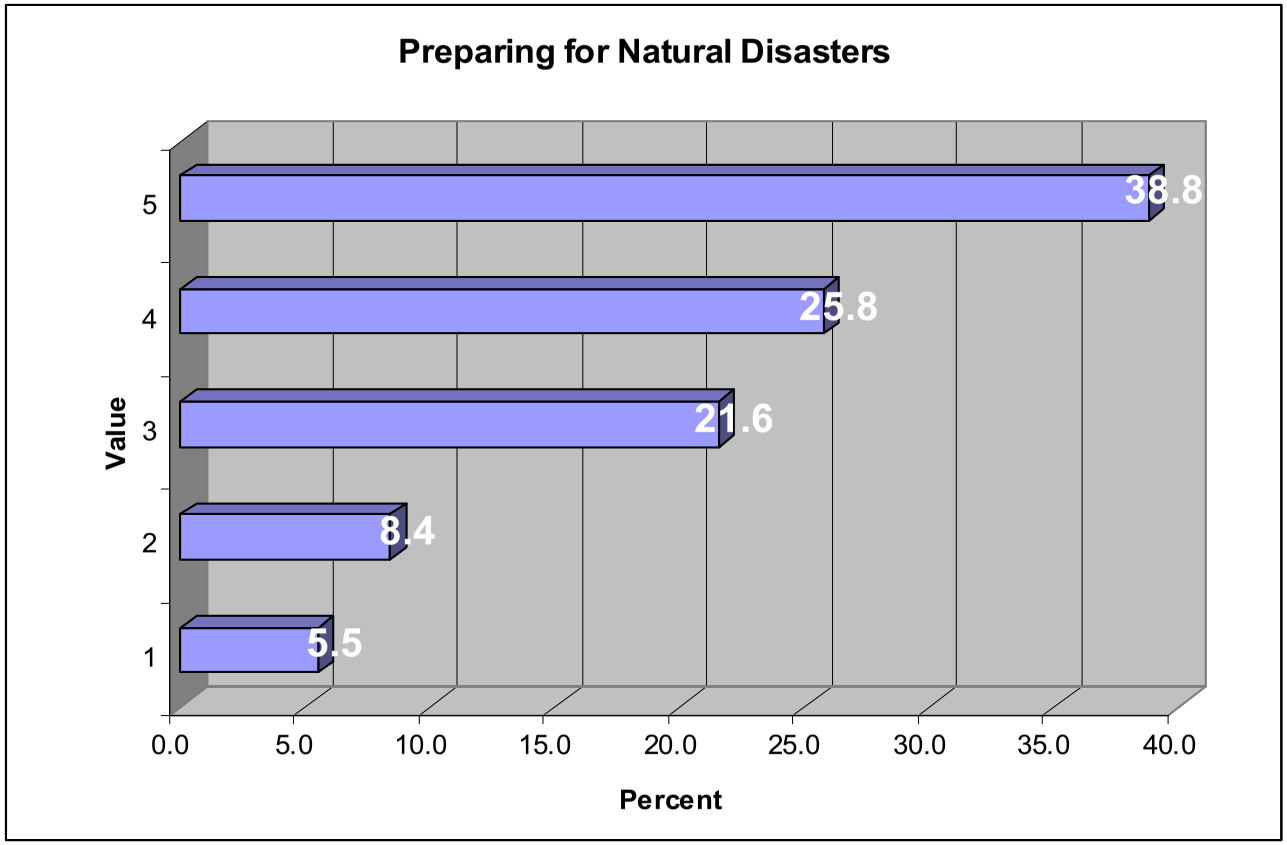
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



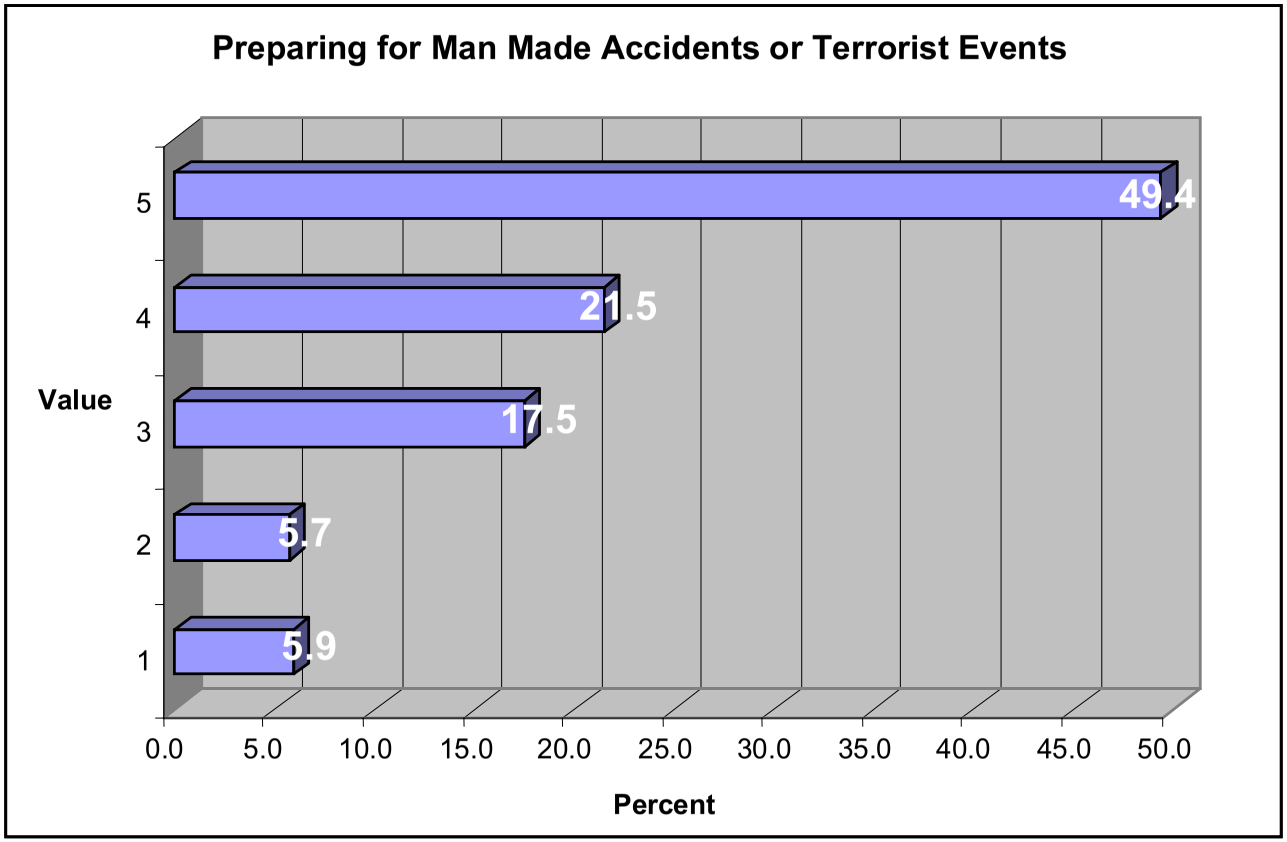
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



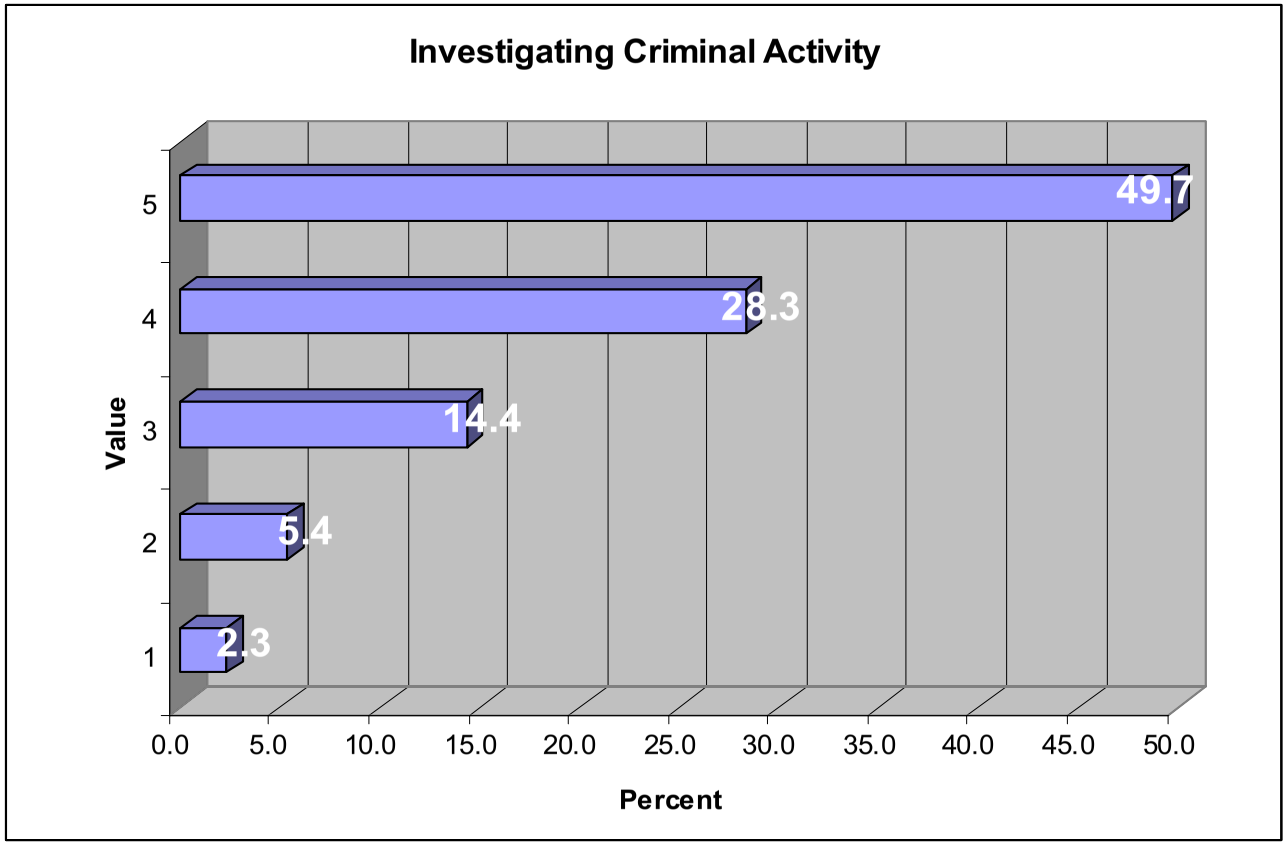
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



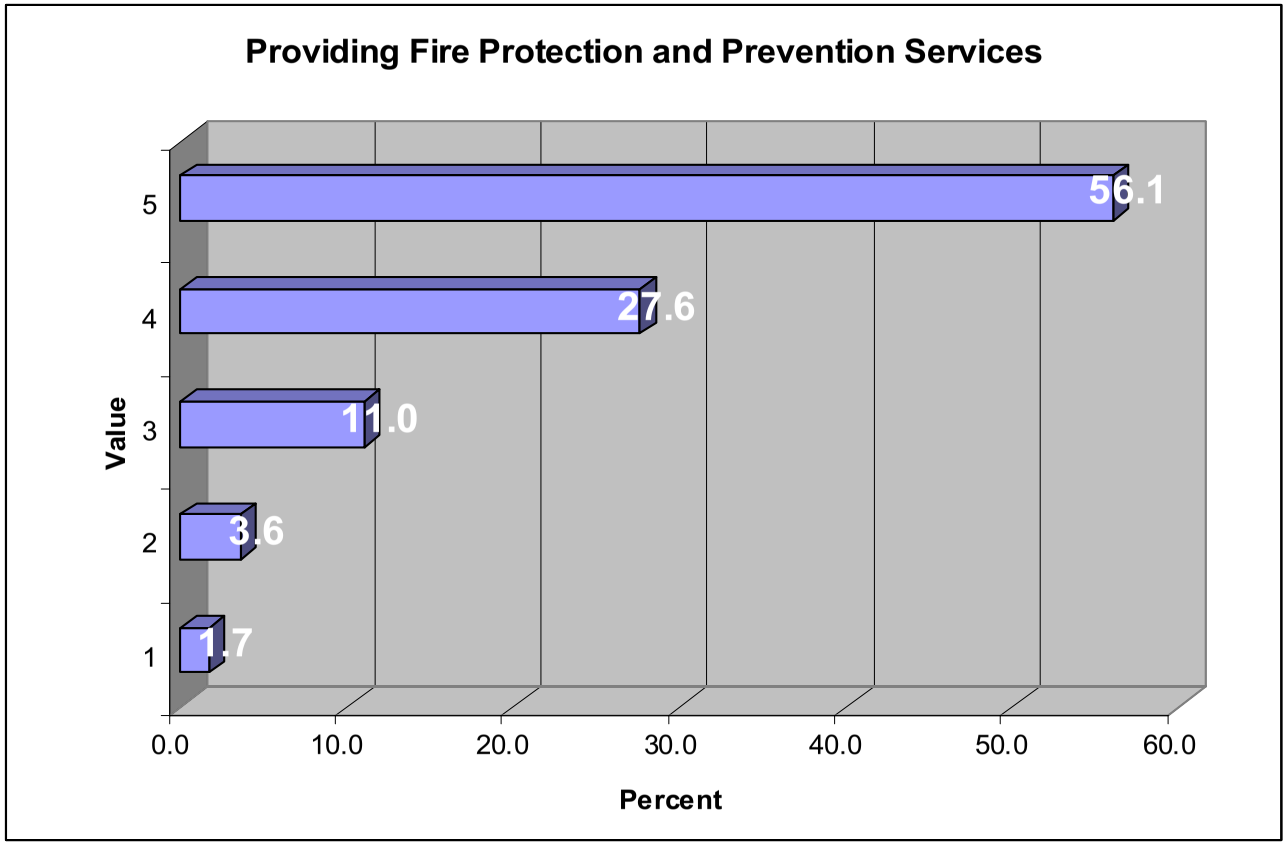
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



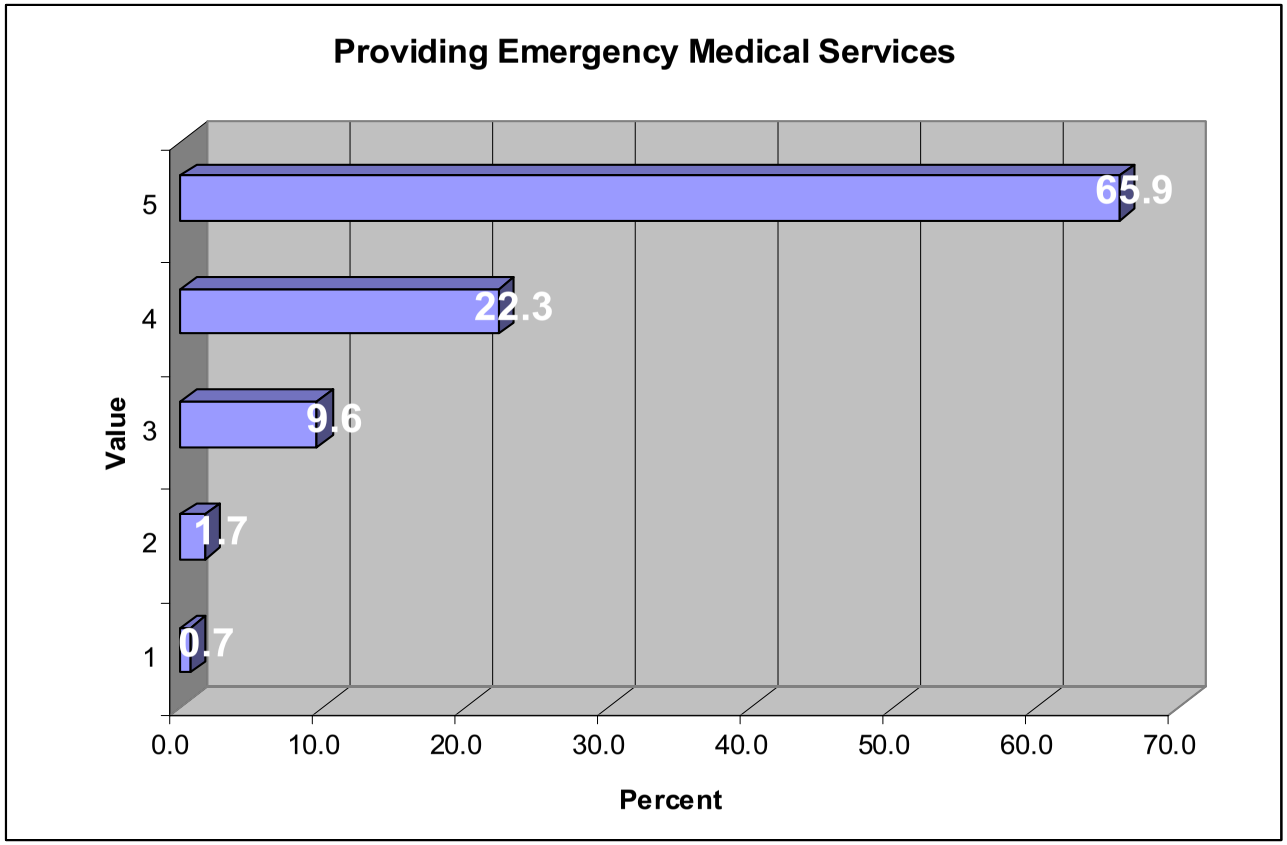
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



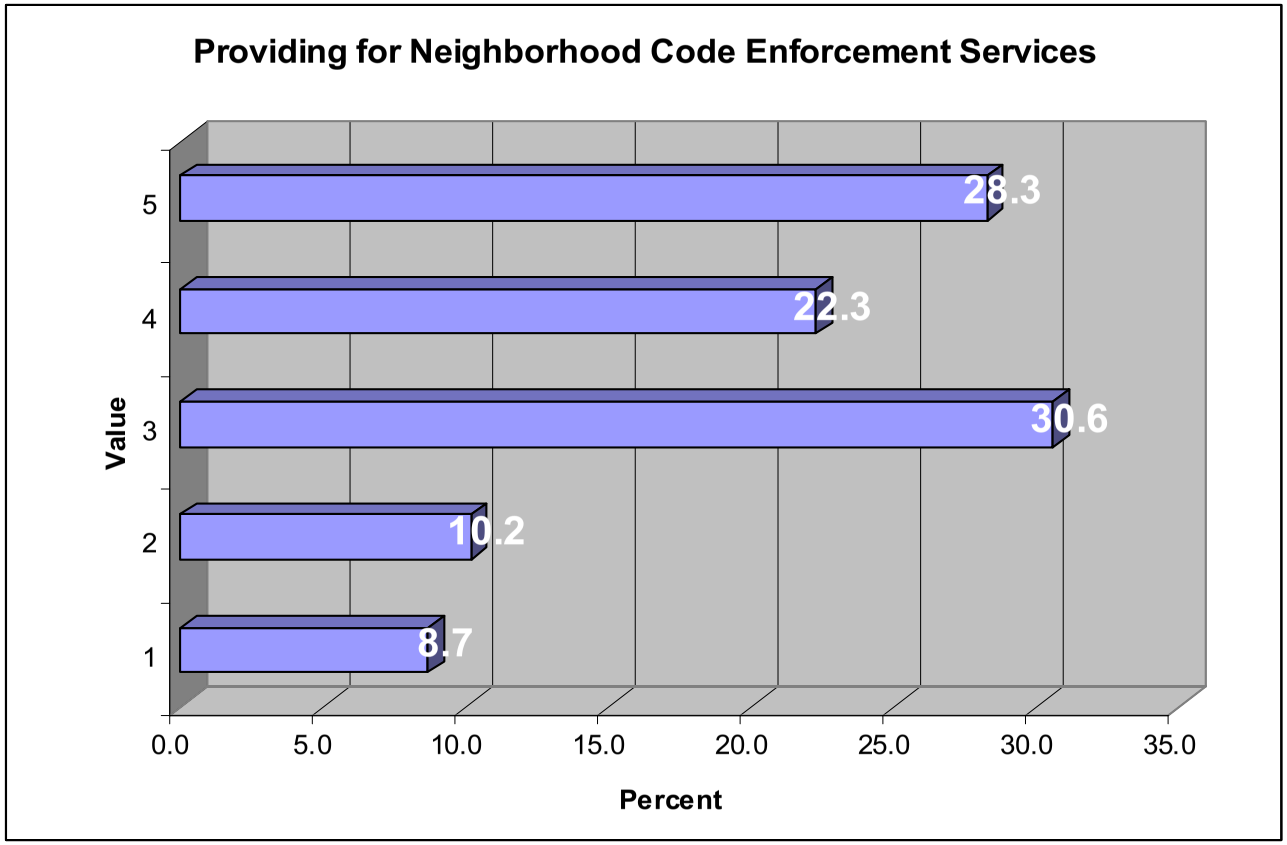
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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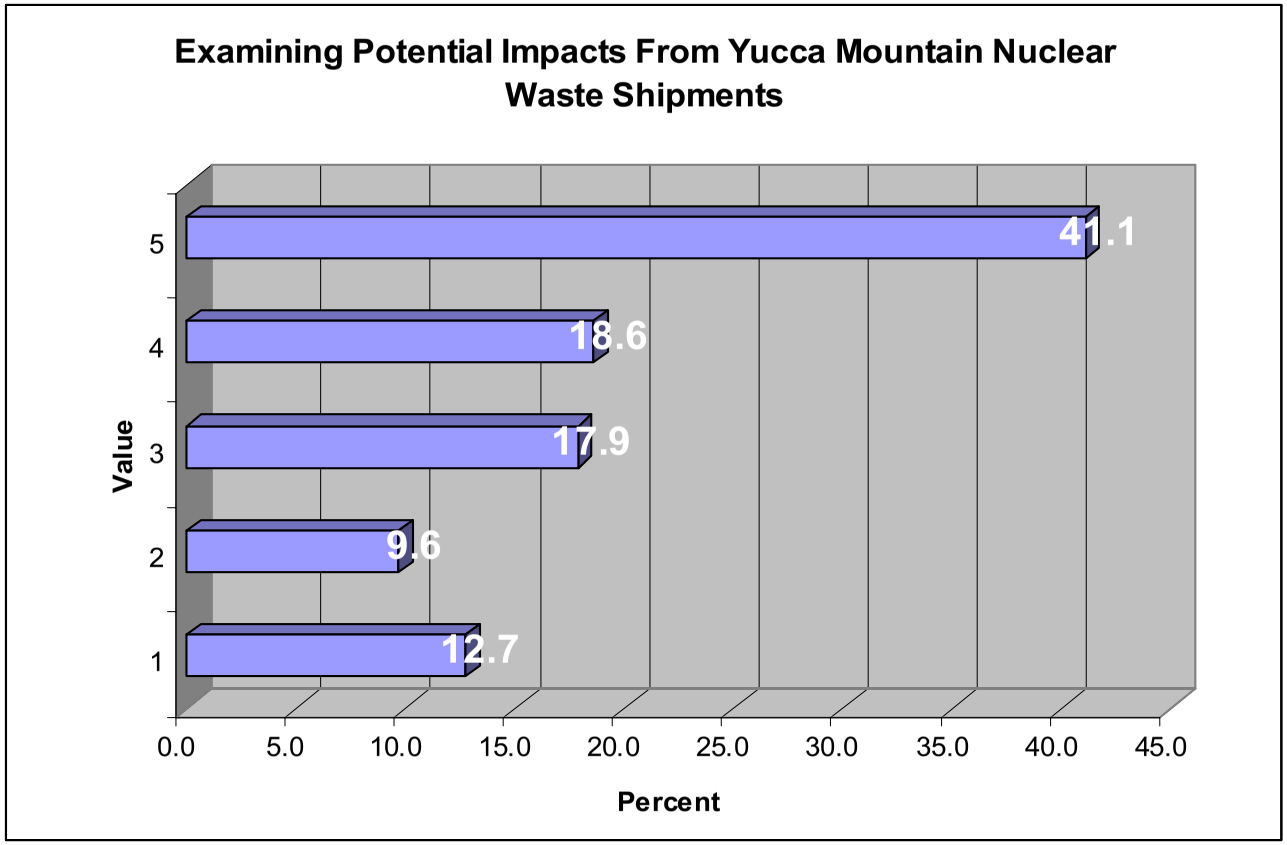
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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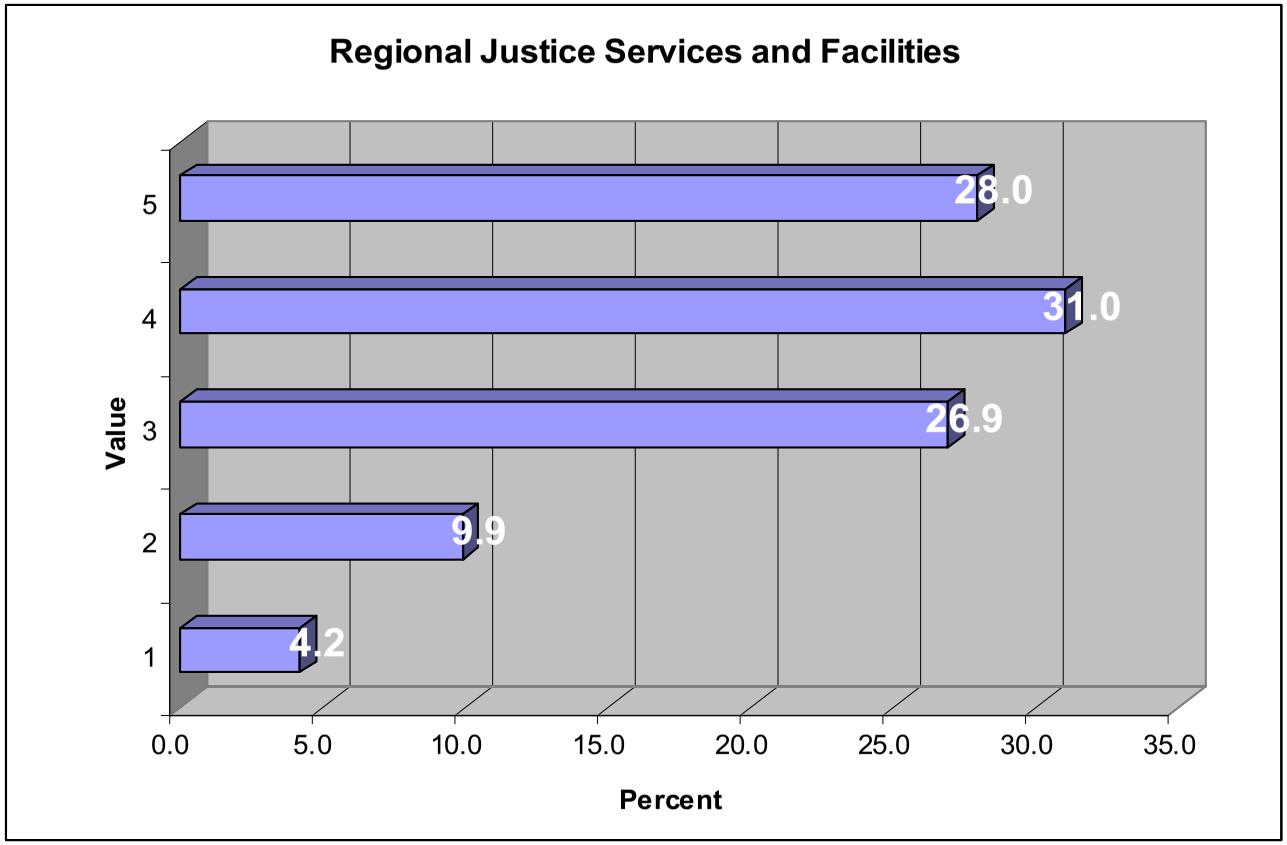
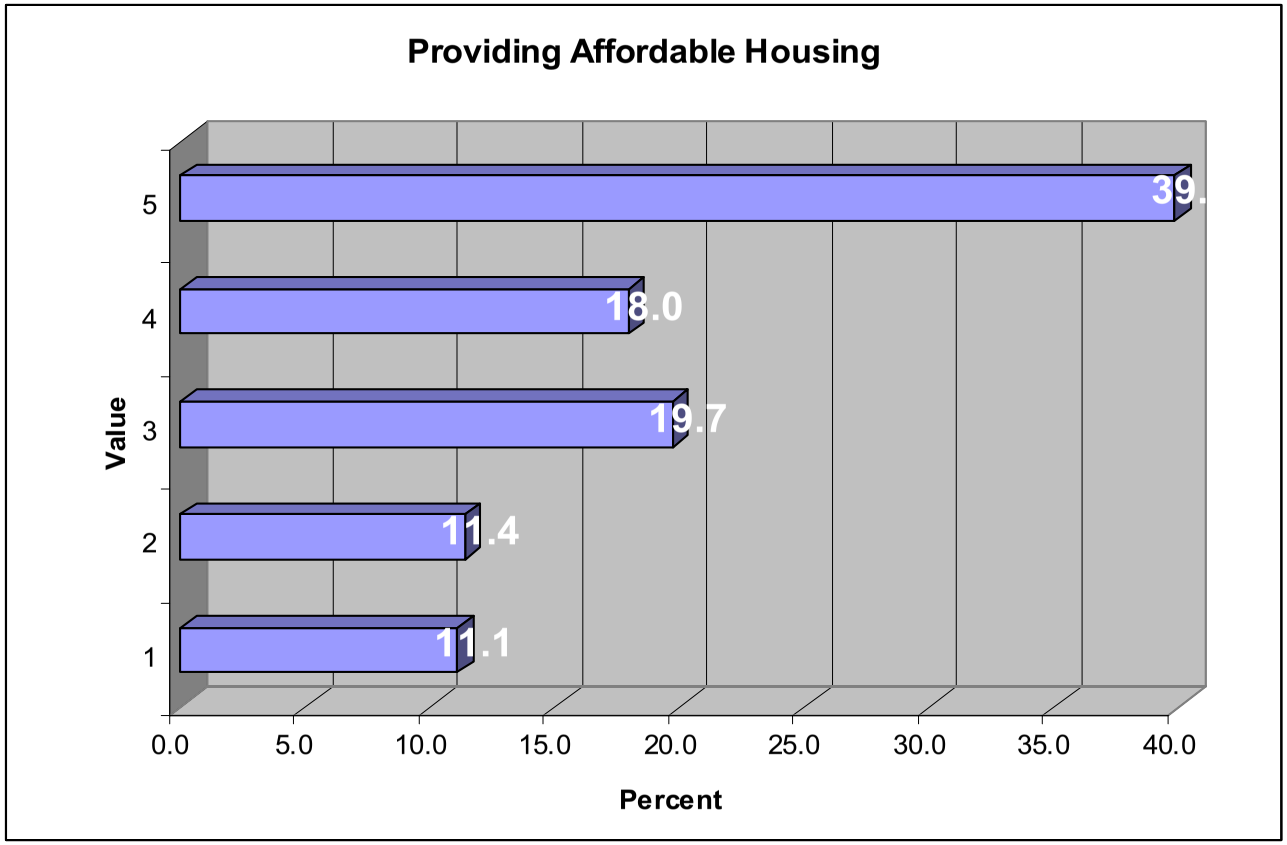
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



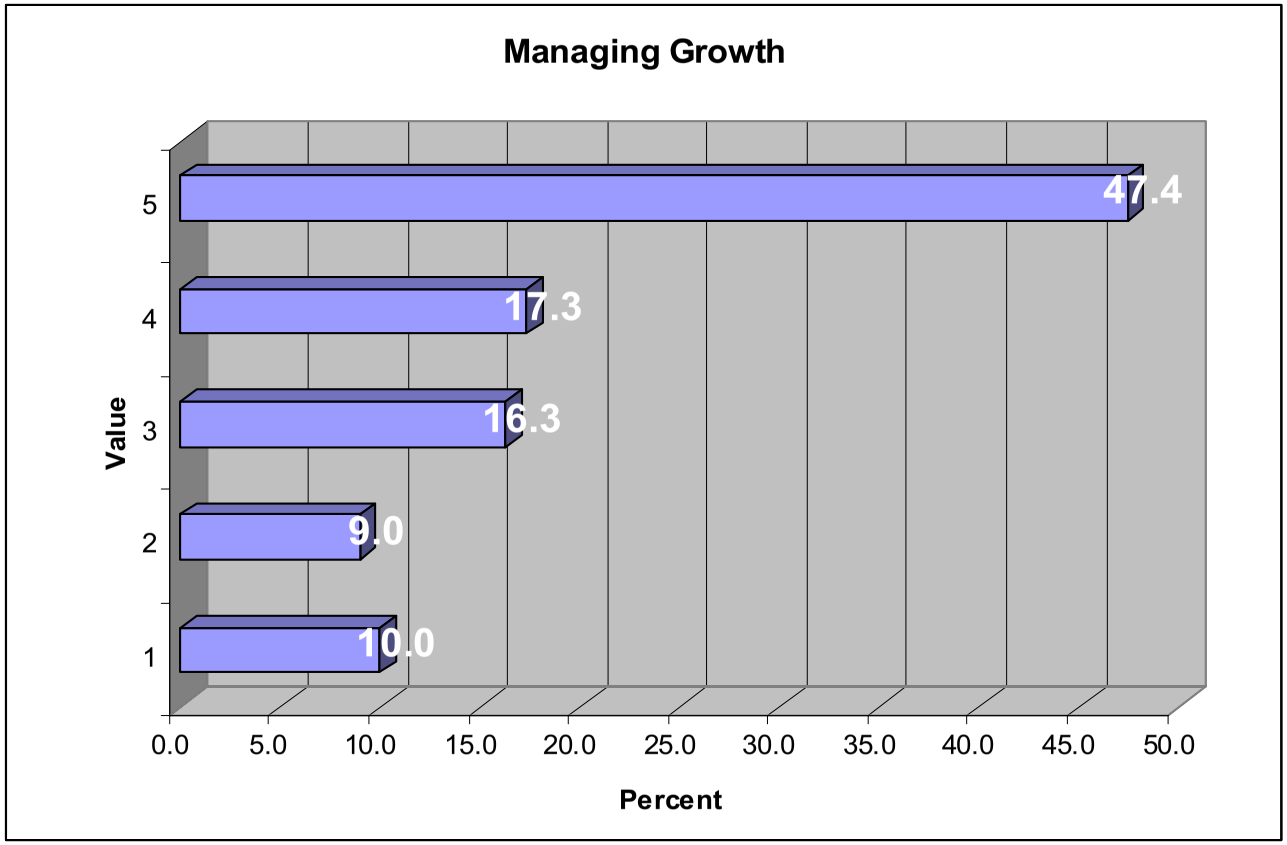
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



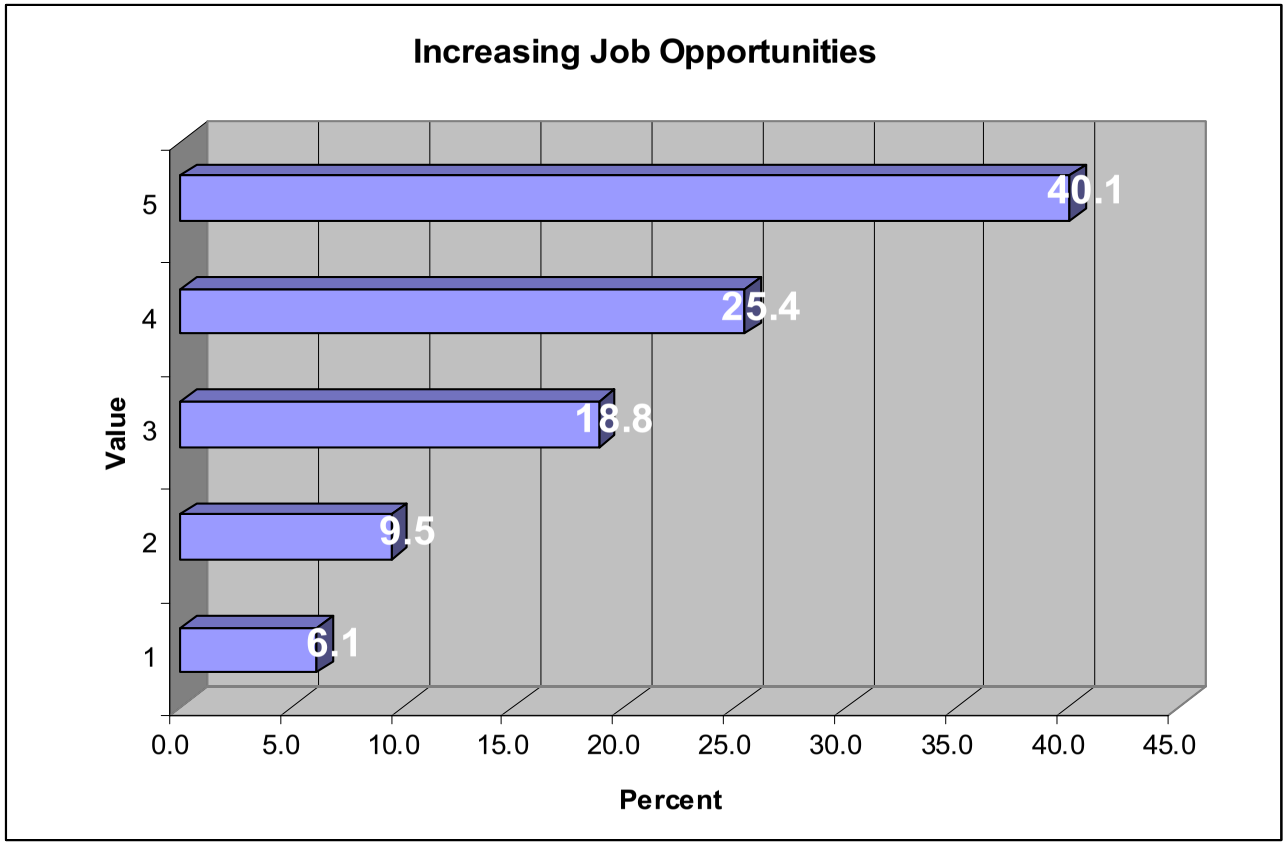
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



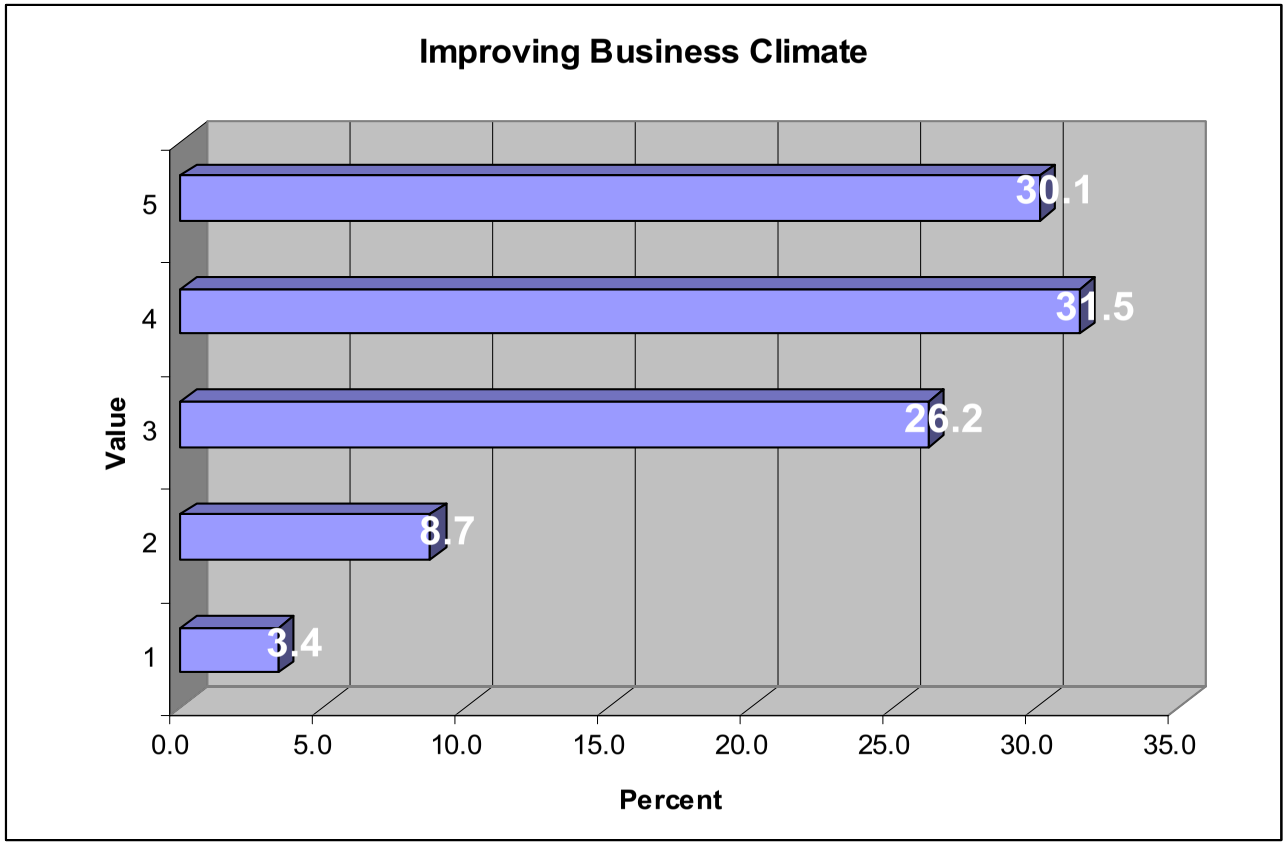
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



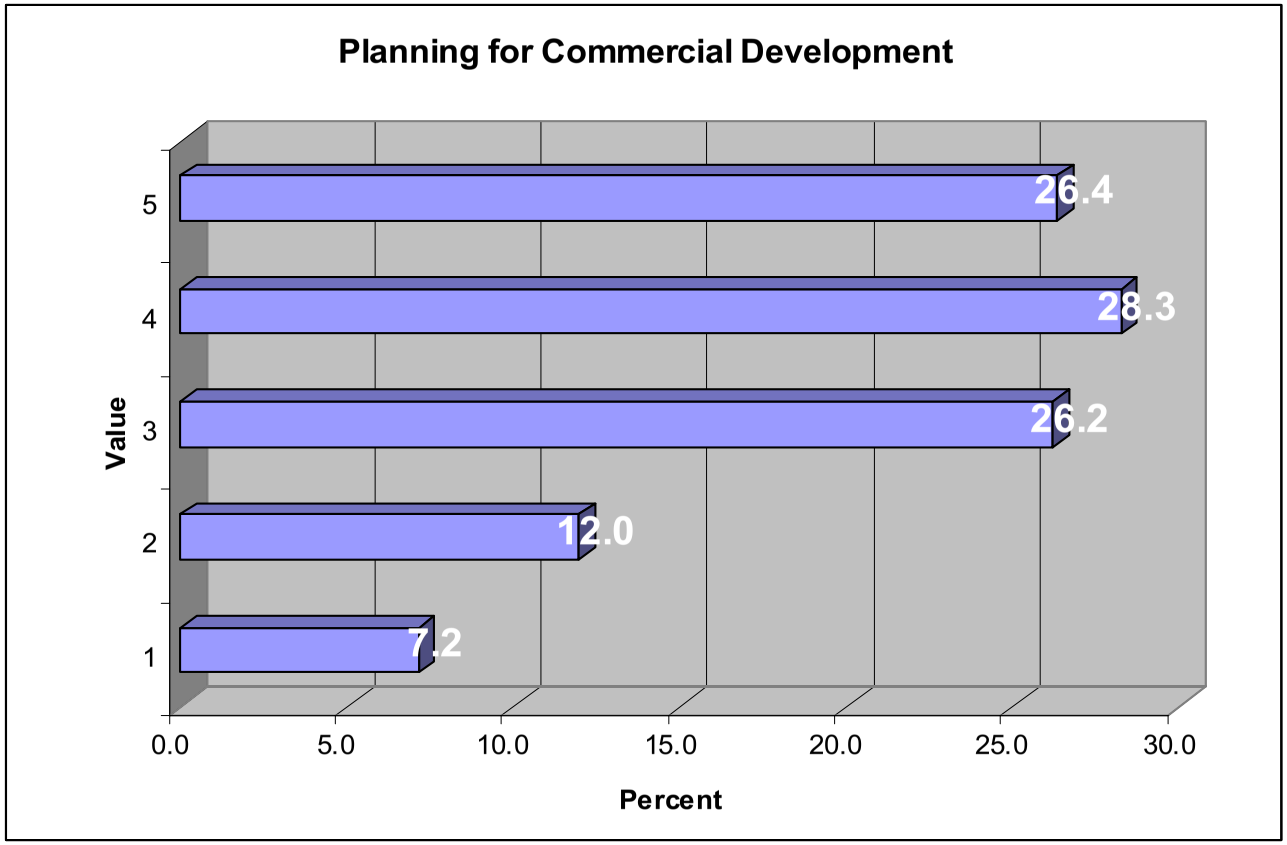
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



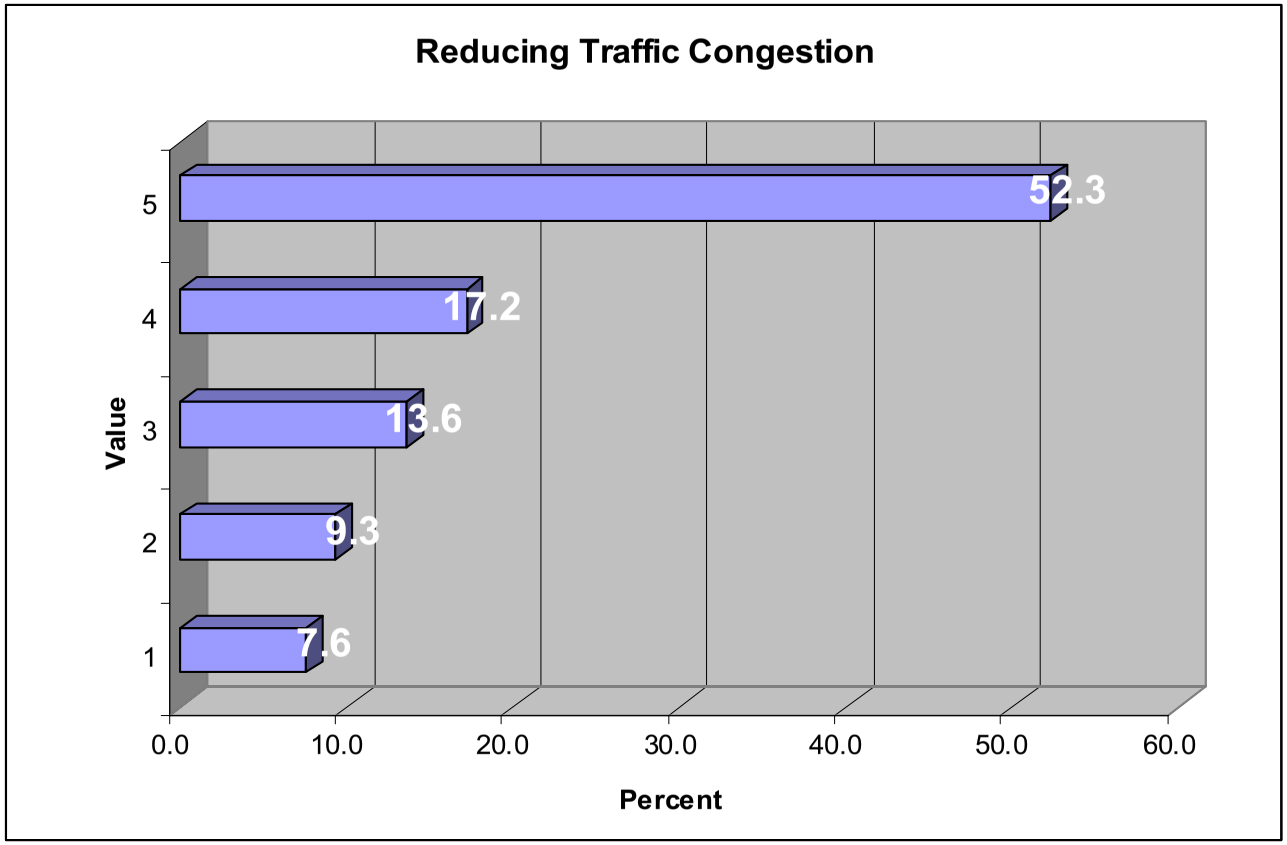
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



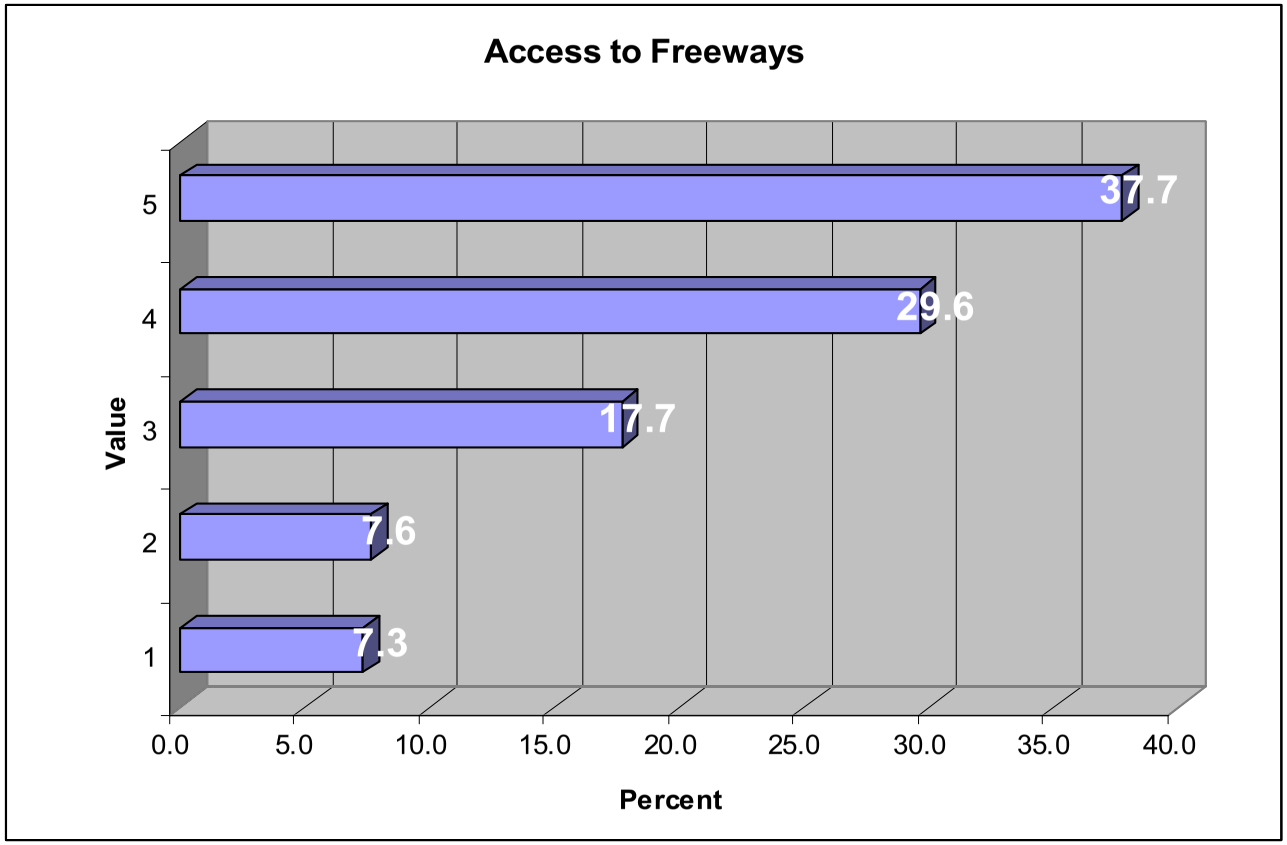
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



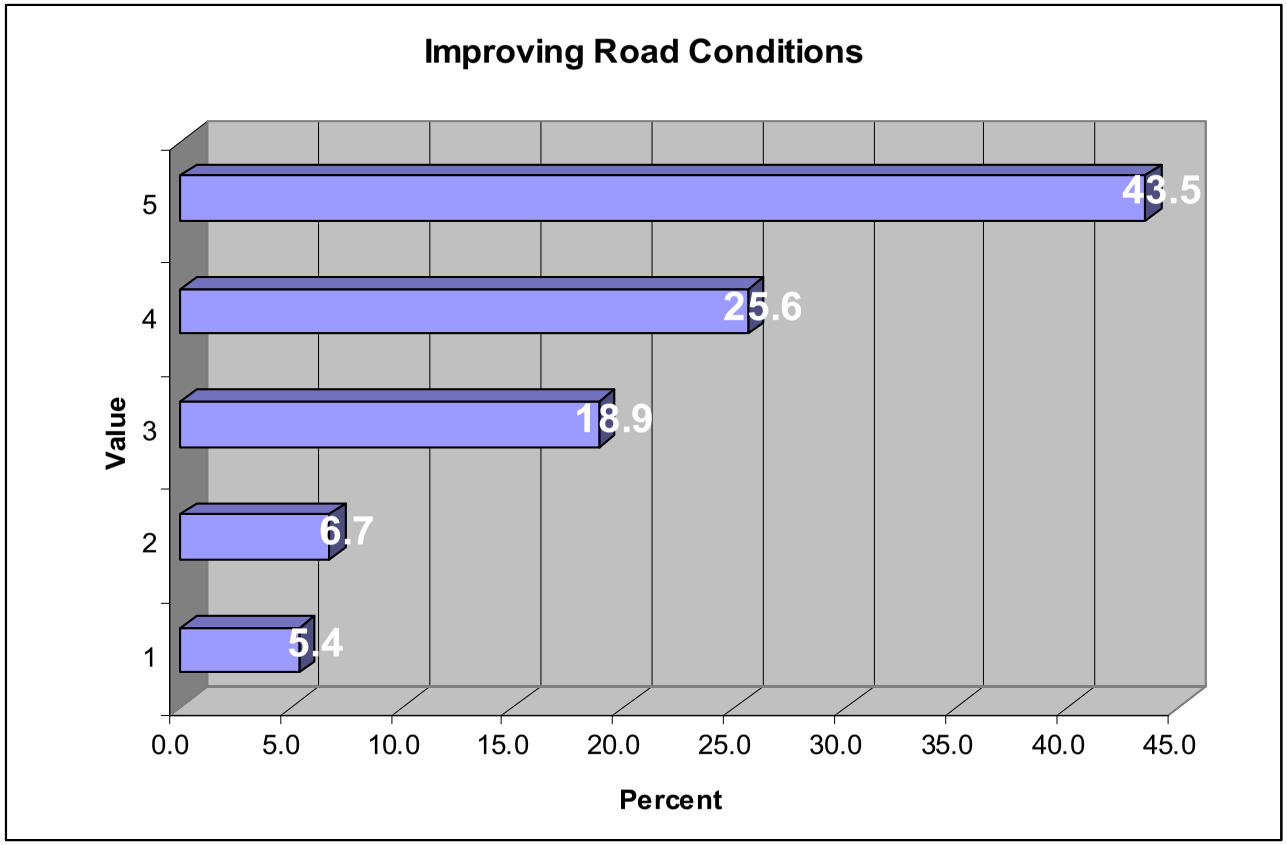
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



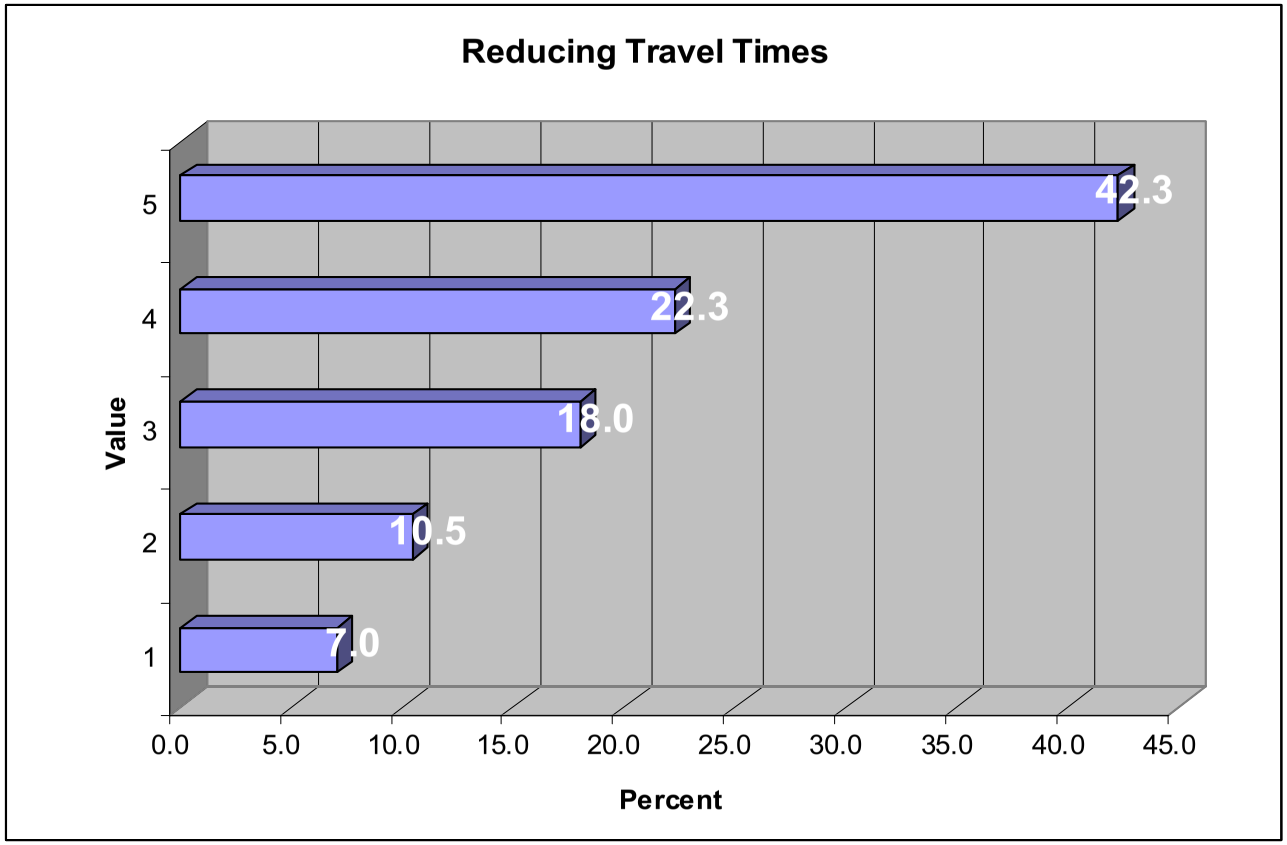
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



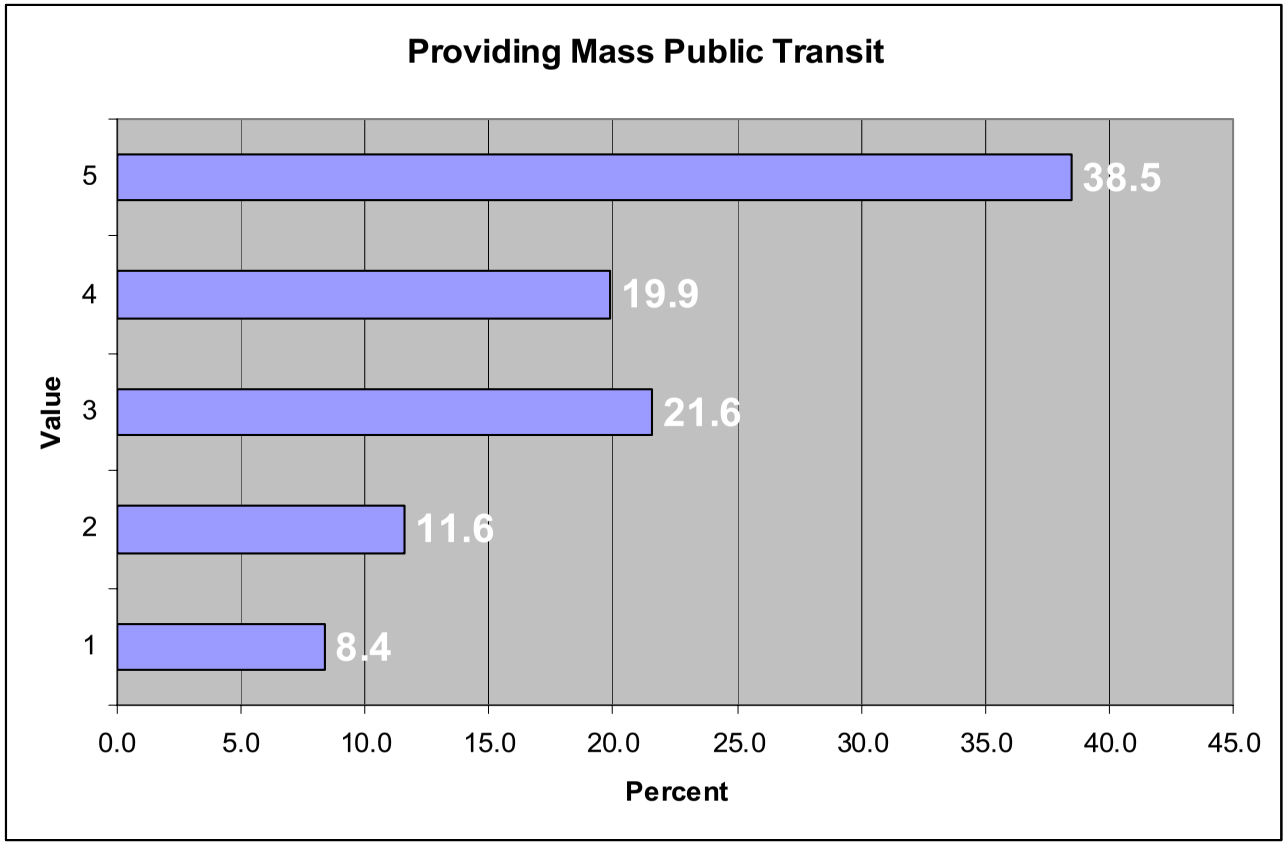
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



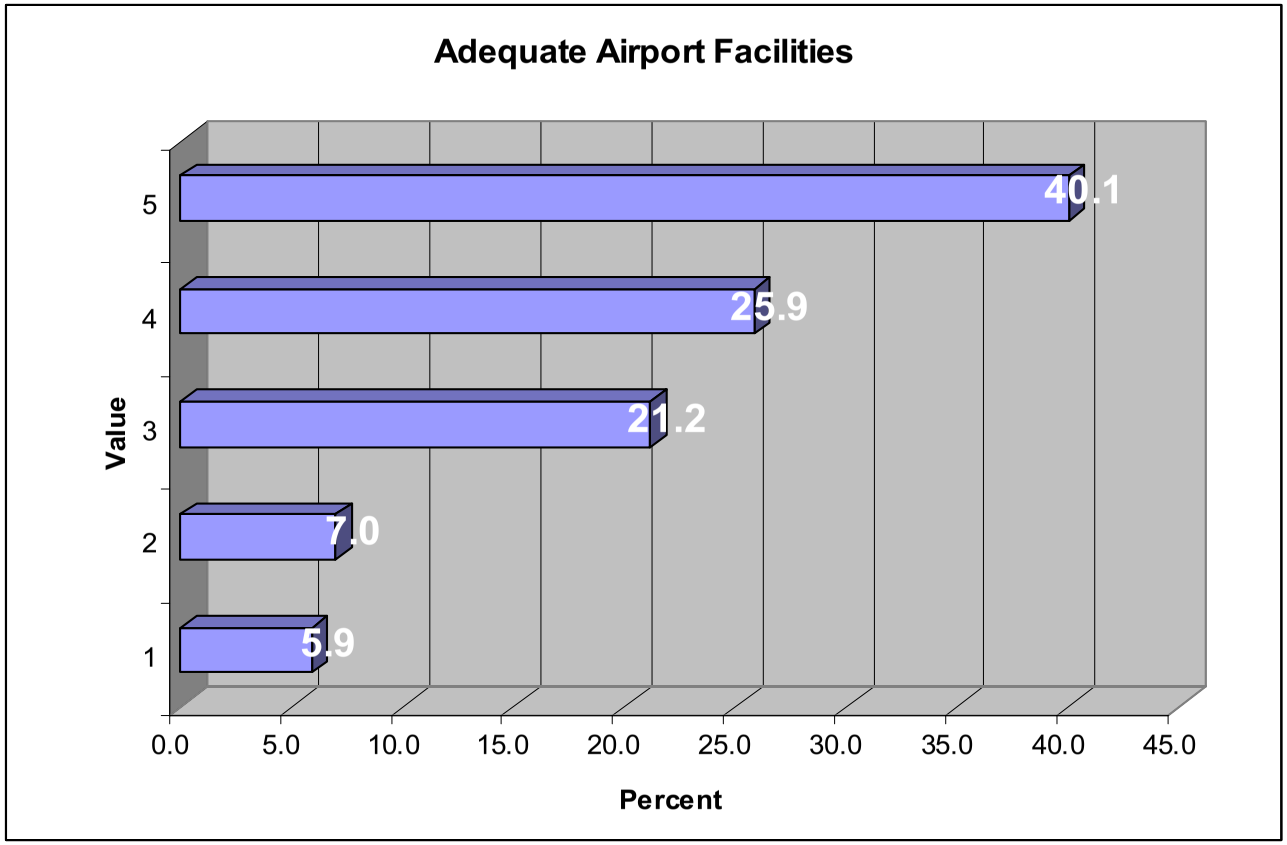
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



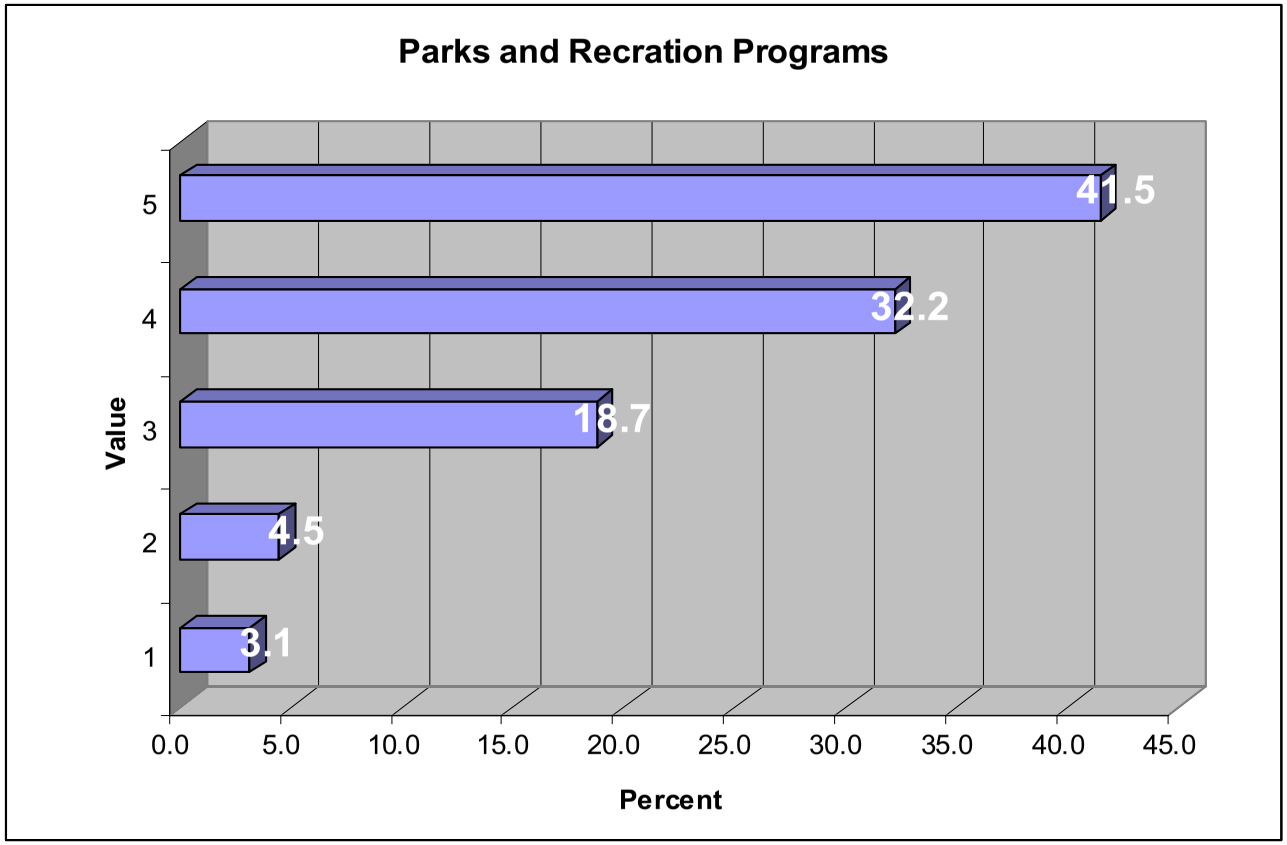
Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

Appendix I
Importance for Selected Services
Importance scores for General Government
Summary Statistics by Jurisdiction

Unincorporated Clark County		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local government views about Yucca Mountain to federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	241	240	241	238	227	239	239
	Missing	0	2	0	4	14	3	2
Mean		4.03	3.40	3.67	4.24	3.70	3.98	4.24
Std. Error of Mean		.073	.080	.080	.067	.089	.076	.070
Median		4.00	3.00	4.00	5.00	4.00	4.00	5.00
Mode		5	3	5	5	5	5	5
Std. Deviation		1.131	1.239	1.244	1.027	1.338	1.171	1.080
Skewness		-1.034	-.308	-.541	-1.314	-.740	-1.086	-1.516
Std. Error of Skewness		.157	.157	.157	.158	.161	.158	.157
Kurtosis		.338	-.735	-.709	.995	-.595	.457	1.661
Std. Error of Kurtosis		.312	.313	.312	.314	.322	.314	.314
Range		4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for General Government
Summary Statistics by Jurisdiction

City of Las Vegas		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local government views about Yucca Mountain to federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	181	179	180	180	180	182	182
	Missing	1	3	2	2	2	0	0
Mean		4.09	3.32	3.83	4.00	3.72	3.84	4.09
Std. Error of Mean		.075	.092	.090	.096	.103	.089	.088
Median		4.00	3.00	4.00	5.00	4.00	4.00	5.00
Mode		5	3	5	5	5	5	5
Std. Deviation		1.005	1.233	1.212	1.288	1.385	1.195	1.187
Skewness		-.785	-.125	-.757	-1.087	-.653	-.687	-1.134
Std. Error of Skewness		.181	.181	.181	.181	.181	.180	.180
Kurtosis		-.166	-.842	-.375	.017	-.898	-.515	.261
Std. Error of Kurtosis		.359	.361	.360	.360	.360	.358	.358
Range		4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for General Government
Summary Statistics by Jurisdiction

City of North Las Vegas		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local government views about Yucca Mountain to federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	64	64	64	63	62	63	64
	Missing	0	0	0	1	2	1	0
Mean		4.24	3.56	3.83	3.80	3.31	3.55	4.30
Std. Error of Mean		.140	.172	.147	.170	.181	.175	.121
Median		5.00	4.00	4.00	4.00	3.00	4.00	5.00
Mode		5	5	5	5	5	5	5
Std. Deviation		1.119	1.375	1.173	1.351	1.429	1.392	.965
Skewness		-1.260	-.617	-.595	-.870	-.273	-.534	-1.784
Std. Error of Skewness		.299	.300	.300	.301	.303	.301	.299
Kurtosis		.765	-.734	-.494	-.423	-1.135	-.952	3.634
Std. Error of Kurtosis		.590	.592	.592	.594	.598	.595	.590
Range		4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for General Government
Summary Statistics by Jurisdiction

City of Henderson		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local government views about Yucca Mountain to federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	84	83	84	82	80	84	84
	Missing	0	1	0	2	4	0	0
Mean		4.29	3.18	3.45	4.18	3.39	3.83	4.39
Std. Error of Mean		.110	.126	.141	.109	.151	.122	.102
Median		5.00	3.00	4.00	4.50	3.17	4.00	5.00
Mode		5	3	4	5	5	5	5
Std. Deviation		1.010	1.147	1.288	.991	1.354	1.116	.938
Skewness		-1.323	.060	-.459	-1.043	-.398	-.614	-1.809
Std. Error of Skewness		.263	.264	.263	.265	.269	.262	.262
Kurtosis		1.014	-.744	-.851	.540	-.954	-.447	3.061
Std. Error of Kurtosis		.521	.522	.521	.525	.531	.519	.519
Range		4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for General Government
Summary Statistics by Jurisdiction

Boulder City		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local government views about Yucca Mountain to federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	19	19	19	19	18	19	19
	Missing	0	0	0	0	1	0	0
Mean		3.83	3.20	3.39	4.02	3.77	3.84	4.28
Std. Error of Mean		.221	.188	.359	.231	.323	.273	.261
Median		4.00	3.00	3.19	4.00	4.00	4.00	5.00
Mode		3	3	5	5	5	5	5
Std. Deviation		.967	.822	1.548	.997	1.377	1.194	1.139
Skewness		-.364	-.103	-.401	-.640	-.950	-.794	-1.811
Std. Error of Skewness		.523	.523	.528	.528	.534	.523	.523
Kurtosis		.248	-.832	-1.269	-.619	-.193	.100	3.091
Std. Error of Kurtosis		1.012	1.012	1.023	1.023	1.033	1.012	1.012
Range		4	3	4	3	4	4	4
Minimum		1	2	1	2	1	1	1
Maximum		5	5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for General Government
Summary Statistics by Jurisdiction

Mesquite		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's local government views about Yucca Mountain to federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	8	8	7	8	8	8	8
	Missing	0	0	1	0	0	0	0
Mean		3.32	3.39	3.83	4.42	4.08	4.42	4.17
Std. Error of Mean		.507	.382	.472	.218	.340	.356	.363
Median		3.00	3.00	4.10	4.27	4.05	5.00	4.95
Mode		3	3	5	4(a)	5	5	5
Std. Deviation		1.467	1.075	1.290	.631	.957	1.029	1.023
Skewness		-.425	.391	-.487	-.569	-.196	-1.575	-.432
Std. Error of Skewness		.739	.755	.773	.739	.755	.739	.755
Kurtosis		-.470	-.651	-1.648	-.068	-2.247	1.437	-2.424
Std. Error of Kurtosis		1.449	1.488	1.533	1.449	1.488	1.449	1.488
Range		4	3	3	2	2	3	2
Minimum		1	2	2	3	3	2	3
Maximum		5	5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for Social and Judicial Services
Summary Statistics by Jurisdiction

Unincorporated Clark County		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	240	239	235	239	236	241	238	239	240
	Missing	2	3	7	3	6	1	4	2	2
Mean		4.22	4.07	4.00	3.91	3.80	3.56	4.12	3.82	4.49
Std. Error of Mean		.071	.075	.075	.084	.085	.091	.075	.086	.057
Median		5.00	5.00	4.00	4.00	4.00	4.00	5.00	4.00	5.00
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.098	1.157	1.151	1.300	1.307	1.418	1.156	1.337	.879
Skewness		-1.314	-1.080	-.907	-.924	-.862	-.598	-1.282	-.870	-1.994
Std. Error of Skewness		.157	.158	.159	.158	.159	.157	.158	.157	.157
Kurtosis		.898	.247	-.138	-.395	-.438	-.937	.749	-.452	4.076
Std. Error of Kurtosis		.313	.314	.317	.314	.316	.313	.315	.314	.313
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for Social and Judicial Services
Summary Statistics by Jurisdiction

City of Las Vegas		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	180	180	179	179	180	181	181	181	180
	Missing	2	3	4	3	2	1	2	1	2
Mean		4.12	3.94	3.99	3.60	3.52	3.47	3.99	3.65	4.44
Std. Error of Mean		.091	.093	.087	.106	.105	.112	.090	.106	.069
Median		5.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.219	1.253	1.157	1.414	1.416	1.505	1.207	1.424	.923
Skewness		-1.183	-.907	-1.053	-.606	-.425	-.468	-.982	-.675	-1.984
Std. Error of Skewness		.181	.181	.182	.181	.181	.180	.181	.180	.181
Kurtosis		.217	-.336	.380	-.953	-1.187	-1.241	-.108	-.921	3.966
Std. Error of Kurtosis		.360	.361	.361	.361	.360	.359	.360	.359	.360
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for Social and Judicial Services
Summary Statistics by Jurisdiction

City of North Las Vegas		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	63	62	61	61	63	64	59	63	64
	Missing	1	2	3	3	1	0	5	1	0
Mean		4.16	3.92	3.96	3.76	3.63	3.82	4.14	3.91	4.45
Std. Error of Mean		.150	.170	.153	.160	.171	.179	.146	.169	.134
Median		5.00	4.58	4.00	4.00	4.00	4.00	5.00	5.00	5.00
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.189	1.344	1.192	1.255	1.359	1.427	1.122	1.345	1.072
Skewness		-1.195	-1.025	-.770	-.672	-.538	-.934	-1.222	-.814	-1.946
Std. Error of Skewness		.302	.303	.306	.306	.301	.300	.311	.301	.299
Kurtosis		.437	-.086	-.538	-.568	-.932	-.481	.645	-.765	2.775
Std. Error of Kurtosis		.596	.598	.603	.603	.594	.592	.613	.594	.590
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

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Importance for Selected Services
Importance scores for Social and Judicial Services
Summary Statistics by Jurisdiction

City of Henderson		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	84	84	84	84	84	84	84	84	84
	Missing	0	0	0	0	0	0	0	0	0
Mean		4.23	4.01	4.01	3.81	3.83	3.41	3.79	3.62	4.23
Std. Error of Mean		.117	.129	.121	.126	.130	.139	.126	.147	.119
Median		5.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00
Mode		5	5	5	5	5	4	5	5	5
Std. Deviation		1.069	1.184	1.114	1.157	1.190	1.272	1.154	1.346	1.091
Skewness		-1.323	-1.073	-1.001	-.744	-.879	-.536	-.636	-.619	-1.268
Std. Error of Skewness		.262	.262	.262	.262	.262	.262	.262	.262	.262
Kurtosis		1.110	.357	.345	-.059	-.141	-.700	-.435	-.838	.631
Std. Error of Kurtosis		.519	.519	.519	.519	.519	.519	.519	.519	.519
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for Social and Judicial Services
Summary Statistics by Jurisdiction

Boulder City		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	18	19	14	19	19	18	19	18	19
	Missing	1	0	5	0	0	1	0	1	0
Mean		3.83	3.63	3.52	3.36	2.75	3.26	3.76	3.66	4.17
Std. Error of Mean		.260	.305	.313	.355	.318	.369	.273	.313	.221
Median		4.00	4.00	3.00	4.00	2.41	3.00	4.00	4.00	4.00
Mode		4	4	3	5	2	5	5	5	5
Std. Deviation		1.104	1.334	1.190	1.550	1.389	1.565	1.194	1.328	.964
Skewness		-.742	-.781	-.015	-.434	.351	-.140	-.669	-.740	-1.204
Std. Error of Skewness		.536	.523	.589	.523	.523	.536	.523	.536	.523
Kurtosis		-.027	-.388	-.889	-1.392	-1.081	-1.547	-.092	-.515	.923
Std. Error of Kurtosis		1.038	1.012	1.137	1.012	1.012	1.038	1.012	1.038	1.012
Range		4	4	4	4	4	4	4	4	3
Minimum		1	1	1	1	1	1	1	1	2
Maximum		5	5	5	5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for Social and Judicial Services
Summary Statistics by Jurisdiction

Mesquite		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	8	7	8	8	8	8	8	8	8
	Missing	0	1	0	0	0	0	0	0	0
Mean		3.75	3.53	4.16	3.49	3.91	3.49	3.72	4.23	3.95
Std. Error of Mean		.394	.540	.366	.491	.428	.620	.643	.429	.614
Median		4.00	4.00	4.00	3.31	4.00	4.00	5.00	5.00	5.00
Mode		4	4	4	5	5	5	5	5	5
Std. Deviation		1.109	1.476	1.031	1.421	1.237	1.793	1.810	1.242	1.778
Skewness		-.661	-1.284	-2.306	-.204	-1.065	-.790	-.987	-1.807	-1.404
Std. Error of Skewness		.755	.773	.755	.739	.739	.739	.755	.739	.739
Kurtosis		-.412	.764	9.683	-1.463	1.181	-1.383	-.999	3.562	.096
Std. Error of Kurtosis		1.488	1.533	1.488	1.449	1.449	1.449	1.488	1.449	1.449
Range		3	4	4	4	4	4	4	4	4
Minimum		2	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

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Unincorporated Clark County		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	241	242	242	240	238	241	239	239
	Missing	1	0	0	2	4	1	3	3
Mean		3.95	4.01	4.16	3.98	4.23	4.54	4.56	4.64
Std. Error of Mean		.074	.075	.074	.077	.070	.052	.054	.043
Median		4.00	4.00	5.00	4.00	5.00	5.00	5.00	5.00
Mode		5	5	5	5	5	5	5	5
Std. Deviation		1.154	1.168	1.151	1.200	1.088	.803	.840	.666
Skewness		-.941	-1.069	-1.261	-1.088	-1.453	-1.796	-2.164	-1.972
Std. Error of Skewness		.157	.157	.157	.157	.158	.157	.157	.157
Kurtosis		.011	.349	.611	.290	1.397	2.601	4.666	3.651
Std. Error of Kurtosis		.313	.312	.312	.313	.314	.313	.314	.314
Range		4	4	4	4	4	4	4	3
Minimum		1	1	1	1	1	1	1	2
Maximum		5	5	5	5	5	5	5	5

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Unincorporated Clark County (cont)	Facilitate neighborhood watch programs	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	Investigating criminal activity	Providing fire protection and prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	238	237	238	241	241	242	228	228	234
Missing	4	5	4	0	0	0	13	14	8
Mean	3.76	3.89	4.02	4.10	4.31	4.52	3.57	3.64	3.66
Std. Error of Mean	.077	.078	.082	.069	.060	.050	.080	.095	.075
Median	4.00	4.00	5.00	4.00	5.00	5.00	4.00	4.00	4.00
Mode	5	5	5	5	5	5	3	5	4
Std. Deviation	1.186	1.198	1.271	1.071	.924	.777	1.213	1.432	1.144
Skewness	-.690	-.805	-1.176	-1.100	-1.503	-1.696	-.448	-.675	-.552
Std. Error of Skewness	.158	.158	.158	.157	.157	.157	.161	.161	.159
Kurtosis	-.388	-.407	.258	.483	2.206	2.611	-.636	-.870	-.432
Std. Error of Kurtosis	.314	.315	.314	.312	.312	.312	.321	.321	.317
Range	4	4	4	4	4	4	4	4	4
Minimum	1	1	1	1	1	1	1	1	1
Maximum	5	5	5	5	5	5	5	5	5

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City of Las Vegas		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	180	182	182	182	179	178	178	178
	Missing	2	0	0	0	4	5	5	5
Mean		4.18	4.22	4.35	4.24	4.47	4.66	4.69	4.72
Std. Error of Mean		.082	.078	.082	.078	.069	.052	.049	.047
Median		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Mode		5	5	5	5	5	5	5	5
Std. Deviation		1.102	1.049	1.104	1.056	.922	.692	.647	.624
Skewness		-1.340	-1.219	-1.651	-1.475	-2.077	-2.643	-2.329	-2.459
Std. Error of Skewness		.181	.180	.180	.180	.182	.182	.182	.182
Kurtosis		1.088	.596	1.667	1.566	4.375	8.666	5.666	6.102
Std. Error of Kurtosis		.360	.358	.358	.358	.361	.363	.363	.363
Range		4	4	4	4	4	4	4	3
Minimum		1	1	1	1	1	1	1	2
Maximum		5	5	5	5	5	5	5	5

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City of Las Vegas (cont)	Facilitate neighborhood watch programs	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	Investigating criminal activity	Providing fire protection and prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
Valid	176	176	176	180	179	178	171	175	175
Missing	6	7	7	2	3	4	11	7	7
Mean	3.87	3.84	4.10	4.26	4.37	4.54	3.58	3.79	3.79
Std. Error of Mean	.088	.086	.085	.074	.070	.059	.096	.106	.083
Median	4.00	4.00	5.00	5.00	5.00	5.00	4.00	4.00	4.00
Mode	5	5	5	5	5	5	5	5	4
Std. Deviation	1.162	1.144	1.128	.994	.932	.785	1.261	1.404	1.096
Skewness	-.802	-.798	-1.081	-1.415	-1.565	-1.850	-.457	-.797	-.657
Std. Error of Skewness	.183	.183	.183	.181	.181	.182	.186	.183	.183
Kurtosis	-.178	-.080	.293	1.573	2.118	3.529	-.787	-.756	-.291
Std. Error of Kurtosis	.364	.365	.365	.360	.361	.362	.369	.365	.365
Range	4	4	4	4	4	4	4	4	4
Minimum	1	1	1	1	1	1	1	1	1
Maximum	5	5	5	5	5	5	5	5	5

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City of North Las Vegas		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	64	64	64	64	62	63	63	62
	Missing	0	0	0	0	2	1	1	2
Mean		3.98	3.93	3.95	3.70	4.12	4.46	4.49	4.72
Std. Error of Mean		.142	.148	.161	.194	.172	.109	.097	.076
Median		4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00
Mode		5	5	5	5	5	5	5	5
Std. Deviation		1.131	1.189	1.289	1.549	1.362	.863	.772	.597
Skewness		-.888	-.982	-1.061	-.713	-1.315	-1.672	-1.569	-2.922
Std. Error of Skewness		.300	.299	.300	.300	.303	.301	.301	.304
Kurtosis		-.097	.109	-.057	-1.140	.316	2.450	2.154	12.161
Std. Error of Kurtosis		.592	.590	.592	.592	.598	.594	.594	.599
Range		4	4	4	4	4	4	3	4
Minimum		1	1	1	1	1	1	2	1
Maximum		5	5	5	5	5	5	5	5

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City of North Las Vegas (cont)	Facilitate neighborhood watch programs	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	Investigating criminal activity	Providing fire protection and prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
Valid	63	64	63	63	64	64	63	61	61
Missing	1	0	1	2	0	0	2	3	3
Mean	3.79	3.58	3.79	4.08	4.17	4.31	3.41	3.35	3.62
Std. Error of Mean	.165	.183	.176	.144	.135	.114	.165	.206	.147
Median	4.00	4.00	4.00	4.72	5.00	5.00	3.00	3.72	4.00
Mode	5	5	5	5	5	5	3	5	3
Std. Deviation	1.309	1.466	1.396	1.136	1.077	.908	1.302	1.604	1.149
Skewness	-.974	-.681	-.828	-1.080	-.981	-.866	-.231	-.367	-.242
Std. Error of Skewness	.301	.299	.301	.302	.300	.300	.302	.307	.306
Kurtosis	-.114	-.886	-.607	.280	-.294	-.703	-.924	-1.430	-.982
Std. Error of Kurtosis	.594	.590	.595	.597	.592	.592	.597	.605	.603
Range	4	4	4	4	4	3	4	4	4
Minimum	1	1	1	1	1	2	1	1	1
Maximum	5	5	5	5	5	5	5	5	5

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City of Henderson		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	84	84	84	84	83	84	84	84
	Missing	0	0	0	0	1	0	0	0
Mean		4.15	4.14	4.45	4.15	4.51	4.72	4.70	4.65
Std. Error of Mean		.100	.101	.096	.099	.090	.057	.056	.062
Median		4.00	4.00	5.00	4.00	5.00	5.00	5.00	5.00
Mode		5	5	5	5	5	5	5	5
Std. Deviation		.918	.927	.880	.912	.818	.527	.510	.564
Skewness		-.787	-.913	-1.585	-.805	-1.863	-1.738	-1.437	-1.399
Std. Error of Skewness		.263	.262	.262	.262	.264	.262	.262	.263
Kurtosis		-.329	.386	2.078	-.263	3.353	2.219	1.146	1.039
Std. Error of Kurtosis		.521	.519	.519	.519	.522	.519	.519	.521
Range		3	4	4	3	4	2	2	2
Minimum		2	1	1	2	1	3	3	3
Maximum		5	5	5	5	5	5	5	5

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City of Henderson (cont)	Facilitate neighborhood watch programs	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	Investigating criminal activity	Providing fire protection and prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
Valid	82	83	84	83	84	84	82	81	83
Missing	2	1	0	1	0	0	2	3	1
Mean	3.69	3.89	4.05	4.34	4.44	4.55	3.30	3.69	3.65
Std. Error of Mean	.122	.115	.109	.081	.087	.086	.141	.142	.104
Median	4.00	4.00	4.00	4.00	5.00	5.00	3.00	4.00	4.00
Mode	3	5	5	5	5	5	3	5	4
Std. Deviation	1.107	1.051	.998	.743	.802	.785	1.272	1.279	.948
Skewness	-.250	-.577	-.835	-.928	-2.013	-2.355	-.489	-.667	-.470
Std. Error of Skewness	.265	.264	.262	.264	.262	.263	.266	.267	.264
Kurtosis	-.949	-.343	.294	.424	5.512	6.969	-.637	-.646	.116
Std. Error of Kurtosis	.525	.522	.519	.522	.519	.521	.526	.528	.522
Range	4	4	4	3	4	4	4	4	4
Minimum	1	1	1	2	1	1	1	1	1
Maximum	5	5	5	5	5	5	5	5	5

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Boulder City		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	19	19	19	19	19	19	19	19
	Missing	0	0	0	0	0	0	0	0
Mean		3.73	4.04	4.33	3.91	4.23	4.46	4.53	4.58
Std. Error of Mean		.182	.227	.154	.213	.233	.155	.138	.127
Median		4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00
Mode		4	5	4	4	5	5	5	5
Std. Deviation		.784	.992	.674	.929	1.017	.679	.602	.555
Skewness		.176	-.834	-.520	-.307	-.897	-.896	-.884	-.818
Std. Error of Skewness		.528	.523	.523	.523	.523	.523	.523	.523
Kurtosis		-.568	-.112	-.564	-.820	-.629	-.183	-.040	-.363
Std. Error of Kurtosis		1.023	1.012	1.012	1.012	1.012	1.012	1.012	1.012
Range		3	3	2	3	3	2	2	2
Minimum		2	2	3	2	2	3	3	3
Maximum		5	5	5	5	5	5	5	5

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Boulder City (cont)	Facilitate neighborhood watch programs	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	Investigating criminal activity	Providing fire protection and prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
Valid	19	19	19	19	19	19	19	18	19
Missing	0	0	0	0	0	0	0	1	0
Mean	3.84	3.81	4.13	3.95	4.09	4.50	3.38	3.41	3.51
Std. Error of Mean	.207	.247	.242	.218	.219	.147	.288	.324	.269
Median	4.00	4.00	4.41	4.00	4.00	5.00	3.00	3.00	3.00
Mode	3	5	5	3	4	5	3	3(a)	3
Std. Deviation	.892	1.077	1.055	.953	.957	.643	1.258	1.383	1.174
Skewness	.341	-.348	-.904	-.081	-1.041	-1.551	-.143	-.100	-.314
Std. Error of Skewness	.528	.523	.523	.523	.523	.523	.523	.534	.523
Kurtosis	-1.723	-1.116	-.395	-1.571	.581	4.844	-1.025	-1.209	-.413
Std. Error of Kurtosis	1.023	1.012	1.012	1.012	1.012	1.012	1.012	1.033	1.012
Range	2	3	3	3	3	3	4	4	4
Minimum	3	2	2	2	2	2	1	1	1
Maximum	5	5	5	5	5	5	5	5	5

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Mesquite		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	8	8	8	8	8	8	8	8
	Missing	0	0	0	0	0	0	0	0
Mean		3.95	4.53	4.42	4.47	4.71	4.34	4.76	4.58
Std. Error of Mean		.578	.184	.312	.289	.167	.424	.157	.182
Median		5.00	4.72	5.00	5.00	5.00	5.00	5.00	5.00
Mode		5	5	5	5	5	5	5	5
Std. Deviation		1.671	.532	.902	.836	.484	1.226	.453	.526
Skewness		-1.293	-.133	-1.130	-1.293	-1.139	-1.750	-1.529	-.403
Std. Error of Skewness		.739	.739	.739	.739	.739	.739	.739	.739
Kurtosis		.146	-2.721	-.683	.146	-1.022	1.760	.358	-2.529
Std. Error of Kurtosis		1.449	1.449	1.449	1.449	1.449	1.449	1.449	1.449
Range		4	1	2	2	1	3	1	1
Minimum		1	4	3	3	4	2	4	4
Maximum		5	5	5	5	5	5	5	5

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Mesquite (cont)	Facilitate neighborhood watch programs	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	Investigating criminal activity	Providing fire protection and prevention services	Providing emergency medical services	Providing for neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
Valid	8	8	8	8	8	8	8	7	8
Missing	0	0	0	0	0	0	0	1	0
Mean	4.00	4.02	4.02	4.31	4.47	4.71	3.87	3.76	3.58
Std. Error of Mean	.404	.333	.333	.445	.289	.167	.243	.384	.496
Median	4.00	4.00	4.00	5.00	5.00	5.00	4.00	4.00	4.00
Mode	5	5	5	5	5	5	4	4	4
Std. Deviation	1.169	.963	.963	1.253	.836	.484	.703	1.049	1.435
Skewness	-1.023	-.052	-.052	-1.669	-1.293	-1.139	.178	-1.341	-1.238
Std. Error of Skewness	.739	.739	.739	.755	.739	.739	.739	.773	.739
Kurtosis	-.034	-2.289	-2.289	1.410	.146	-1.022	-.183	4.877	.819
Std. Error of Kurtosis	1.449	1.449	1.449	1.488	1.449	1.449	1.449	1.533	1.449
Range	3	2	2	3	2	1	2	4	4
Minimum	2	3	3	2	3	4	3	1	1
Maximum	5	5	5	5	5	5	5	5	5

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Unincorporated Clark County		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion
N	Valid	239	240	242	237	237	242
	Missing	3	2	0	5	5	0
Mean		3.70	3.82	3.92	3.78	3.64	3.81
Std. Error of Mean		.092	.089	.078	.071	.077	.088
Median		4.00	4.00	4.00	4.00	4.00	4.00
Mode		5	5	5	4	4	5
Std. Deviation		1.421	1.378	1.217	1.089	1.178	1.369
Skewness		-.679	-.807	-.924	-.699	-.543	-.798
Std. Error of Skewness		.158	.157	.157	.158	.158	.157
Kurtosis		-.907	-.679	-.148	-.180	-.616	-.697
Std. Error of Kurtosis		.314	.313	.312	.315	.315	.312
Range		4	4	4	4	4	4
Minimum		1	1	1	1	1	1
Maximum		5	5	5	5	5	5

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Unincorporated Clark County (cont)	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	241	241	238	241	241	239
Missing	0	1	4	0	0	3
Mean	3.69	3.84	3.75	3.71	3.82	3.96
Std. Error of Mean	.083	.075	.085	.085	.076	.070
Median	4.00	4.00	4.00	4.00	4.00	4.00
Mode	5	5	5	5	5	5
Std. Deviation	1.281	1.157	1.305	1.316	1.185	1.090
Skewness	-.794	-.782	-.720	-.583	-.721	-1.067
Std. Error of Skewness	.157	.157	.158	.157	.157	.157
Kurtosis	-.389	-.169	-.673	-.859	-.445	.688
Std. Error of Kurtosis	.312	.313	.314	.312	.312	.314
Range	4	4	4	4	4	4
Minimum	1	1	1	1	1	1
Maximum	5	5	5	5	5	5

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City of Las Vegas		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion
N	Valid	178	180	179	179	181	182
	Missing	4	2	3	3	1	0
Mean		3.47	3.85	3.76	3.77	3.44	4.03
Std. Error of Mean		.106	.104	.093	.087	.098	.096
Median		4.00	4.00	4.00	4.00	4.00	5.00
Mode		5	5	5	5	5	5
Std. Deviation		1.421	1.403	1.247	1.166	1.320	1.292
Skewness		-.405	-.910	-.742	-.655	-.446	-1.123
Std. Error of Skewness		.182	.181	.182	.182	.181	.180
Kurtosis		-1.162	-.560	-.501	-.367	-.845	.022
Std. Error of Kurtosis		.362	.360	.361	.361	.359	.358
Range		4	4	4	4	4	4
Minimum		1	1	1	1	1	1
Maximum		5	5	5	5	5	5

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City of Las Vegas (cont)	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
Valid	182	182	181	178	180	181
Missing	0	0	1	4	3	1
Mean	3.92	4.03	3.88	3.73	3.87	4.10
Std. Error of Mean	.091	.087	.095	.097	.090	.075
Median	4.00	4.00	4.00	4.00	4.00	4.00
Mode	5	5	5	5	5	5
Std. Deviation	1.231	1.178	1.282	1.290	1.202	1.012
Skewness	-1.017	-1.052	-.879	-.740	-.871	-1.089
Std. Error of Skewness	.180	.180	.181	.182	.181	.181
Kurtosis	.069	.178	-.391	-.582	-.096	.742
Std. Error of Kurtosis	.358	.358	.359	.362	.361	.359
Range	4	4	4	4	4	4
Minimum	1	1	1	1	1	1
Maximum	5	5	5	5	5	5

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City of North Las Vegas		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion
N	Valid	63	64	61	62	64	64
	Missing	1	0	3	2	0	0
Mean		3.86	3.46	3.59	3.54	3.22	3.99
Std. Error of Mean		.173	.202	.165	.122	.146	.169
Median		4.00	4.00	4.00	4.00	3.00	5.00
Mode		5	5	5	3	3	5
Std. Deviation		1.373	1.612	1.289	.963	1.173	1.357
Skewness		-.987	-.529	-.525	-.180	-.257	-1.124
Std. Error of Skewness		.302	.300	.306	.304	.299	.299
Kurtosis		-.323	-1.338	-.704	-.432	-.541	-.032
Std. Error of Kurtosis		.596	.592	.603	.599	.590	.590
Range		4	4	4	4	4	4
Minimum		1	1	1	1	1	1
Maximum		5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

City of North Las Vegas (cont)	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	64	64	61	64	64	64
Missing	0	0	3	0	0	0
Mean	3.80	4.10	3.84	3.61	4.16	4.11
Std. Error of Mean	.150	.142	.166	.178	.138	.117
Median	4.00	4.24	4.00	4.00	5.00	4.00
Mode	5	5	5	5	5	5
Std. Deviation	1.205	1.141	1.297	1.424	1.106	.935
Skewness	-.944	-1.338	-.983	-.591	-1.387	-.849
Std. Error of Skewness	.299	.299	.306	.300	.299	.299
Kurtosis	.198	1.305	-.090	-.934	1.510	.473
Std. Error of Kurtosis	.590	.590	.603	.592	.590	.590
Range	4	4	4	4	4	4
Minimum	1	1	1	1	1	1
Maximum	5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

City of Henderson		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion
N	Valid	83	84	84	83	83	84
	Missing	2	0	0	1	1	0
Mean		3.76	3.99	3.96	3.91	3.76	4.29
Std. Error of Mean		.132	.116	.127	.101	.111	.121
Median		4.00	4.00	4.00	4.00	4.00	5.00
Mode		5	5	5	5	4	5
Std. Deviation		1.201	1.063	1.158	.923	1.014	1.108
Skewness		-.588	-.685	-.937	-.173	-.372	-1.484
Std. Error of Skewness		.265	.263	.263	.264	.264	.262
Kurtosis		-.595	-.459	.000	-1.167	-.608	1.182
Std. Error of Kurtosis		.524	.521	.521	.522	.522	.519
Range		4	4	4	3	4	4
Minimum		1	1	1	2	1	1
Maximum		5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

City of Henderson (cont)	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	84	83	83	81	81	84
Missing	0	2	1	4	3	0
Mean	4.06	4.06	3.93	3.77	3.99	4.07
Std. Error of Mean	.111	.134	.130	.136	.119	.105
Median	4.00	4.40	4.00	4.00	4.00	4.00
Mode	5	5	5	5	5	5
Std. Deviation	1.020	1.217	1.182	1.217	1.071	.964
Skewness	-.839	-1.241	-.874	-.562	-1.010	-.813
Std. Error of Skewness	.262	.265	.264	.268	.267	.262
Kurtosis	-.156	.521	-.073	-.827	.554	.050
Std. Error of Kurtosis	.519	.524	.522	.530	.528	.519
Range	4	4	4	4	4	4
Minimum	1	1	1	1	1	1
Maximum	5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

Boulder City		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion
N	Valid	19	19	19	19	19	19
	Missing	0	0	0	0	0	0
Mean		3.12	4.27	3.50	3.43	3.30	3.90
Std. Error of Mean		.327	.257	.291	.274	.245	.314
Median		3.00	5.00	3.45	3.64	3.18	4.86
Mode		3	5	5	4	4	5
Std. Deviation		1.430	1.125	1.257	1.184	1.058	1.373
Skewness		-.090	-1.309	-.308	-.351	.045	-.859
Std. Error of Skewness		.523	.523	.528	.528	.528	.523
Kurtosis		-1.013	.774	-.867	-.577	-1.257	-.697
Std. Error of Kurtosis		1.012	1.012	1.023	1.023	1.023	1.012
Range		4	4	4	4	3	4
Minimum		1	1	1	1	2	1
Maximum		5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

Boulder City (cont)	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	18	19	19	19	19	19
Missing	2	0	0	0	0	0
Mean	3.84	3.67	3.58	3.12	3.34	4.41
Std. Error of Mean	.270	.277	.279	.322	.319	.216
Median	4.00	4.00	3.64	3.00	3.59	5.00
Mode	5	4	5	3	3	5
Std. Deviation	1.133	1.195	1.205	1.389	1.393	.945
Skewness	-.513	-.788	-.062	-.048	-.573	-1.374
Std. Error of Skewness	.542	.528	.528	.528	.523	.523
Kurtosis	-1.088	-.072	-1.567	-.974	-.668	.700
Std. Error of Kurtosis	1.049	1.023	1.023	1.023	1.012	1.012
Range	3	4	3	4	4	3
Minimum	2	1	2	1	1	2
Maximum	5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

Mesquite		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion
N	Valid	8	8	8	8	8	8
	Missing	0	0	0	0	0	0
Mean		4.02	4.05	4.37	4.11	4.16	4.18
Std. Error of Mean		.354	.395	.177	.250	.261	.291
Median		4.00	4.00	4.00	4.00	4.00	4.00
Mode		5	5	4	4	4	5
Std. Deviation		1.025	1.142	.513	.724	.754	.841
Skewness		-.501	-1.232	.688	-.168	-.297	-.413
Std. Error of Skewness		.739	.739	.739	.739	.739	.739
Kurtosis		-.986	.736	-2.116	-.411	-.716	-1.375
Std. Error of Kurtosis		1.449	1.449	1.449	1.449	1.449	1.449
Range		3	3	1	2	2	2
Minimum		2	2	4	3	3	3
Maximum		5	5	5	5	5	5

Appendix I
Importance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

Mesquite (cont)	Access to freeways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	8	8	8	8	8	8
Missing	0	0	0	0	0	0
Mean	3.74	3.74	3.81	3.11	3.05	3.58
Std. Error of Mean	.411	.393	.472	.551	.528	.383
Median	4.00	4.00	4.00	3.00	3.00	3.73
Mode	5	4	5	3	3	3(a)
Std. Deviation	1.189	1.137	1.329	1.551	1.526	1.109
Skewness	-.332	-.464	-.295	-.248	-.116	-.089
Std. Error of Skewness	.739	.739	.755	.755	.739	.739
Kurtosis	-1.356	-.916	-2.079	-.982	-1.041	-1.070
Std. Error of Kurtosis	1.449	1.449	1.488	1.488	1.449	1.449
Range	3	3	3	4	4	3
Minimum	2	2	2	1	1	2
Maximum	5	5	5	5	5	5

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Appendix II

Performance Score for Selected Services

Appendix II
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)

Performance Variable	N	Mean	Std. Error of Mean	Median	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
** General Government*											
Road Maintenance	599	2.94	0.045	3.00	1.092	-0.087	0.100	-0.502	0.199	1	5
Revitalizing older neighborhoods	578	2.57	0.045	3.00	1.090	0.305	0.102	-0.524	0.203	1	5
Flood control	572	3.48	0.046	4.00	1.096	-0.442	0.102	-0.321	0.204	1	5
Budget management	589	2.56	0.046	3.00	1.125	0.208	0.101	-0.667	0.201	1	5
Communicate Clark County's local government views about Yucca Mountain to federal decision makers	572	2.82	0.052	3.00	1.243	0.138	0.102	-0.884	0.204	1	5
Monitor and report to the public on how well government services are being performed	585	2.50	0.043	3.00	1.049	0.335	0.101	-0.322	0.202	1	5
Water conservation programs	592	3.22	0.050	3.00	1.213	-0.350	0.100	-0.782	0.201	1	5
** Social and Judicial Services*										1	5
Providing child protection services	580	2.84	0.044	3.00	1.068	0.056	0.101	-0.455	0.203	1	5
Providing child welfare services	576	2.79	0.044	3.00	1.050	0.136	0.102	-0.325	0.203	1	5
Providing juvenile justice services	577	2.83	0.045	3.00	1.084	0.021	0.102	-0.465	0.203	1	5
Providing attainable housing for working class families	574	2.52	0.044	3.00	1.042	0.286	0.102	-0.405	0.204	1	5
Providing affordable housing for low income families	575	2.41	0.045	2.00	1.079	0.434	0.102	-0.463	0.203	1	5
Providing shelter for the homeless	585	2.19	0.046	2.00	1.120	0.644	0.101	-0.401	0.202	1	5
Providing affordable housing for seniors	577	2.62	0.047	3.00	1.123	0.261	0.102	-0.609	0.203	1	5
Providing medical care for the poor	583	2.59	0.050	3.00	1.213	0.272	0.101	-0.846	0.202	1	5
Providing 24 hour emergency trauma care	578	3.26	0.051	3.00	1.229	-0.323	0.102	-0.786	0.203	1	5

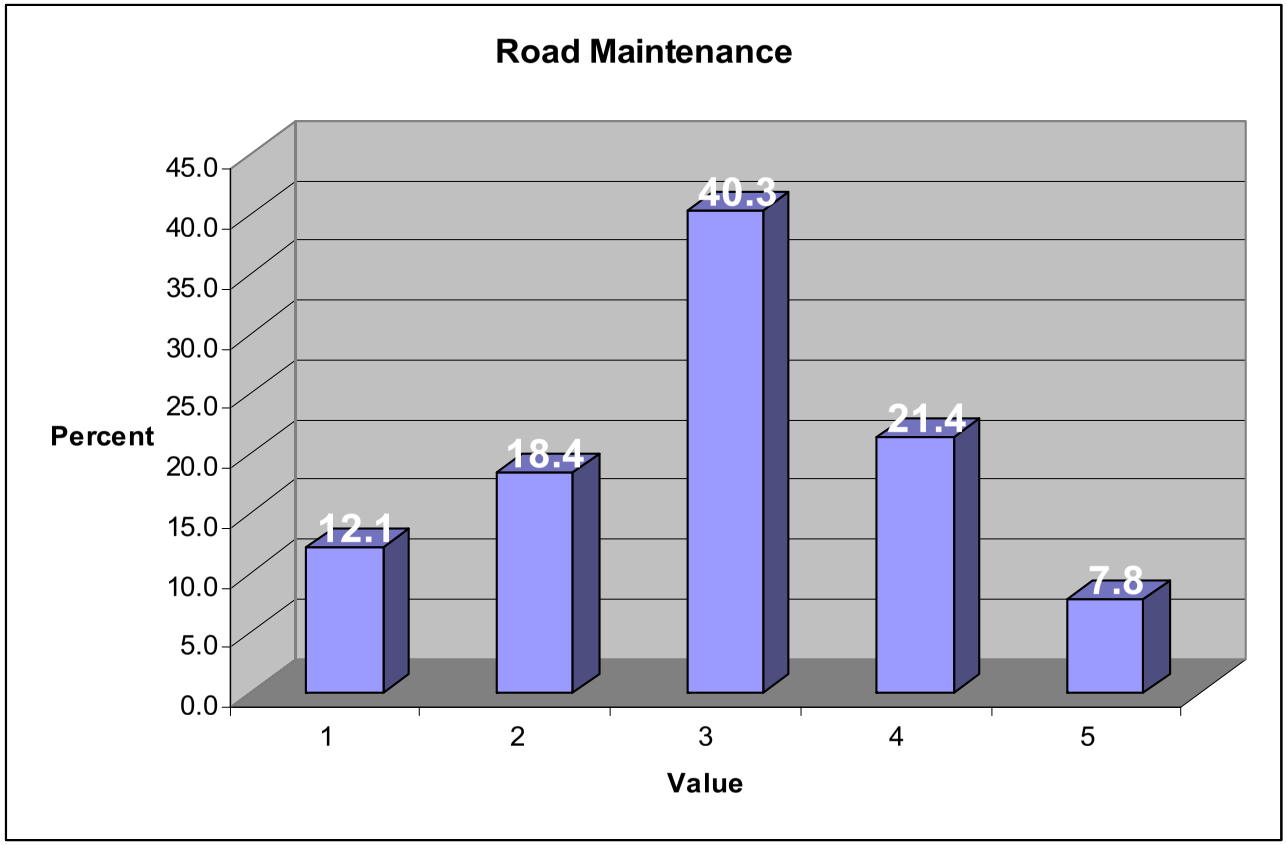
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)

Performance Variable	N	Mean	Std. Error of Mean	Median	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
** Public Safety*											
Providing crime prevention programs	583	3.04	0.042	3.00	1.018	-0.179	0.101	-0.114	0.202	1	5
Enforcing traffic laws	596	2.99	0.048	3.00	1.181	-0.086	0.100	-0.804	0.200	1	5
Maintaining a low crime rate	590	2.82	0.044	3.00	1.078	0.068	0.101	-0.557	0.201	1	5
Maintaining neighborhood police patrols	587	2.73	0.048	3.00	1.170	0.171	0.101	-0.713	0.201	1	5
Keeping police response times low	572	3.09	0.050	3.00	1.192	-0.248	0.102	-0.762	0.204	1	5
Keeping fire department response times low	576	3.73	0.043	4.00	1.037	-0.756	0.102	0.270	0.203	1	5
Keeping paramedic and emergency medical response times low	581	3.83	0.042	4.00	1.012	-0.836	0.101	0.484	0.202	1	5
Well trained paramedic and emergency medical response personnel	580	3.93	0.041	4.00	0.989	-0.919	0.101	0.694	0.203	1	5
Facilitate neighborhood watch programs	575	2.80	0.047	3.00	1.117	0.135	0.102	-0.512	0.203	1	5
Preparing for natural disasters (i.e. floods, earthquakes, etc.)	579	2.99	0.047	3.00	1.138	-0.061	0.102	-0.666	0.203	1	5
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	576	2.95	0.048	3.00	1.147	-0.010	0.102	-0.703	0.203	1	5
Investigating criminal activity	578	3.14	0.046	3.00	1.105	-0.131	0.102	-0.638	0.203	1	5
Providing fire protection & prevention services	579	3.65	0.042	4.00	1.017	-0.454	0.102	-0.287	0.203	1	5
Providing emergency medical services	579	3.77	0.042	4.00	1.020	-0.698	0.102	0.044	0.203	1	5
Providing for neighborhood code enforcement services	583	3.01	0.048	3.00	1.154	-0.059	0.101	-0.691	0.202	1	5
Examining potential impacts from Yucca Mountain nuclear waste shipments	573	2.79	0.053	3.00	1.265	0.083	0.102	-1.009	0.204	1	5

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)

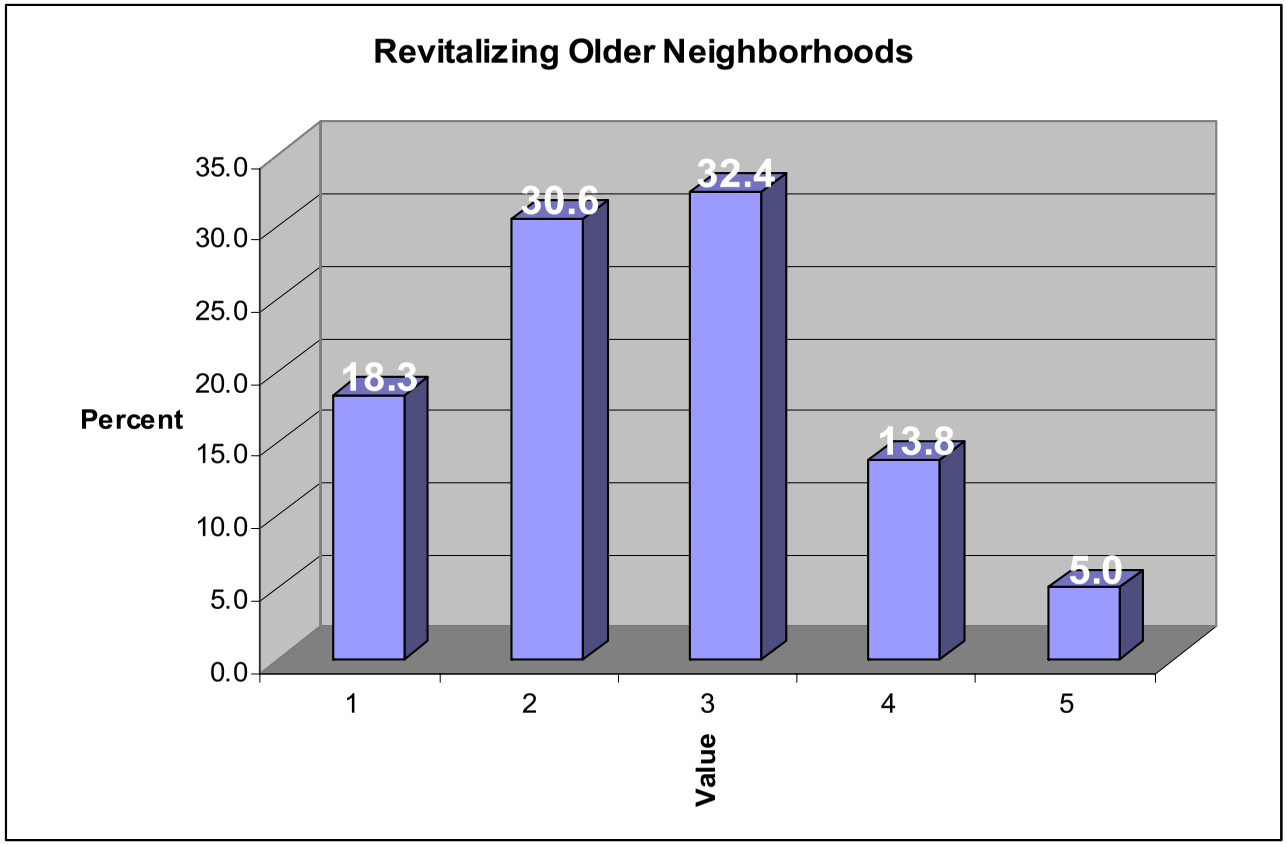
Performance Variable	N	Mean	Std. Error of Mean	Median	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
Regional justice services and facilities	581	3.07	0.046	3.00	1.110	-0.215	0.101	-0.563	0.202	1	5
** Community Development*											
Providing affordable housing	573	2.55	0.045	3.00	1.087	0.235	0.102	-0.523	0.204	1	5
Managing growth	588	2.47	0.050	2.00	1.221	0.397	0.101	-0.796	0.201	1	5
Increasing job opportunities	583	2.91	0.048	3.00	1.155	0.027	0.101	-0.708	0.202	1	5
Improving the business climate	581	3.16	0.045	3.00	1.078	-0.217	0.101	-0.420	0.202	1	5
Planning for commercial development	578	3.22	0.048	3.00	1.163	-0.259	0.102	-0.623	0.203	1	5
Reducing traffic congestion	591	2.43	0.049	2.00	1.201	0.494	0.101	-0.637	0.201	1	5
Access to freeways	588	3.09	0.048	3.00	1.173	-0.132	0.101	-0.759	0.201	1	5
Improving road conditions	596	2.90	0.048	3.00	1.172	-0.011	0.100	-0.756	0.200	1	5
Reducing travel time	587	2.57	0.046	3.00	1.106	0.235	0.101	-0.577	0.201	1	5
Providing mass public transit	581	2.70	0.053	3.00	1.286	0.241	0.101	-0.959	0.202	1	5
Adequate airport facilities	585	3.38	0.048	3.00	1.164	-0.428	0.101	-0.534	0.202	1	5
Parks and recreation programs	588	3.52	0.048	4.00	1.165	-0.583	0.101	-0.375	0.201	1	5

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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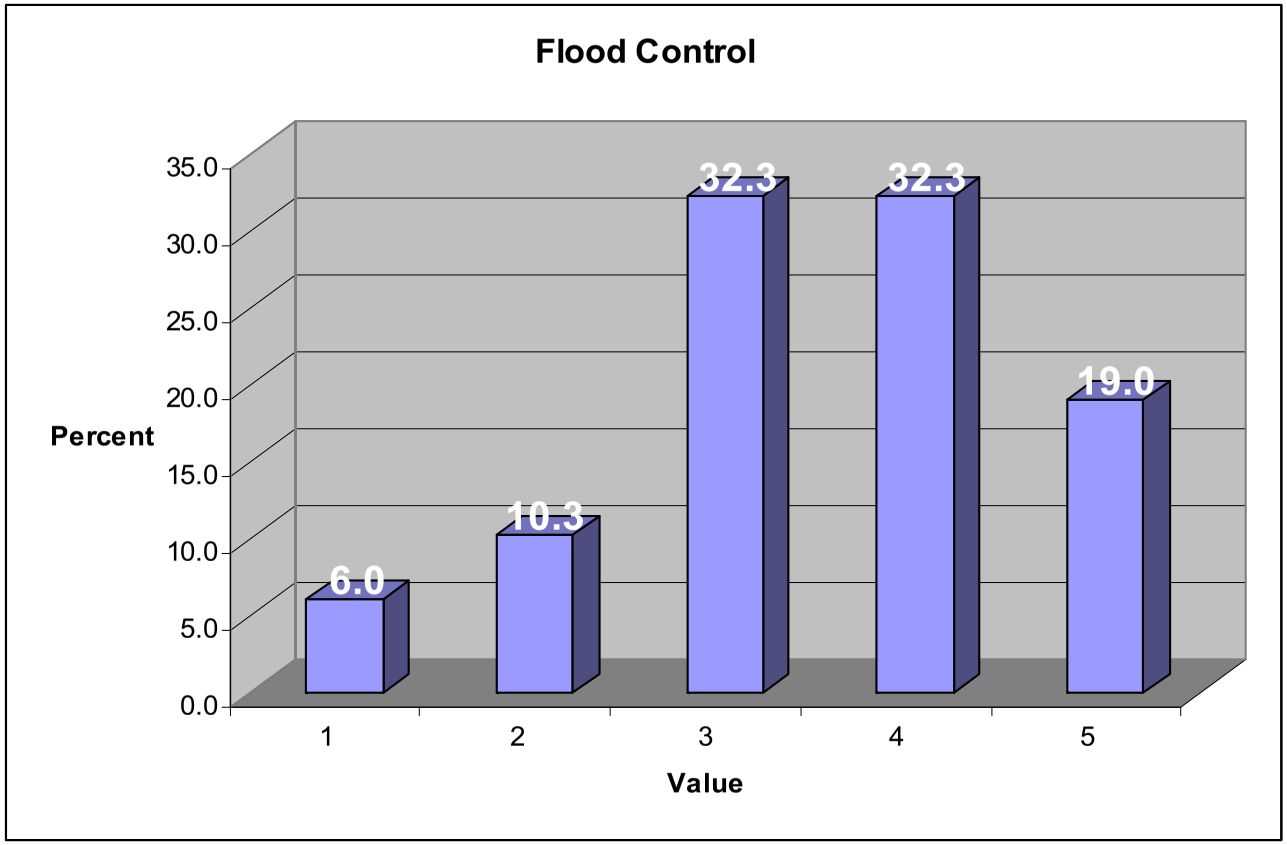
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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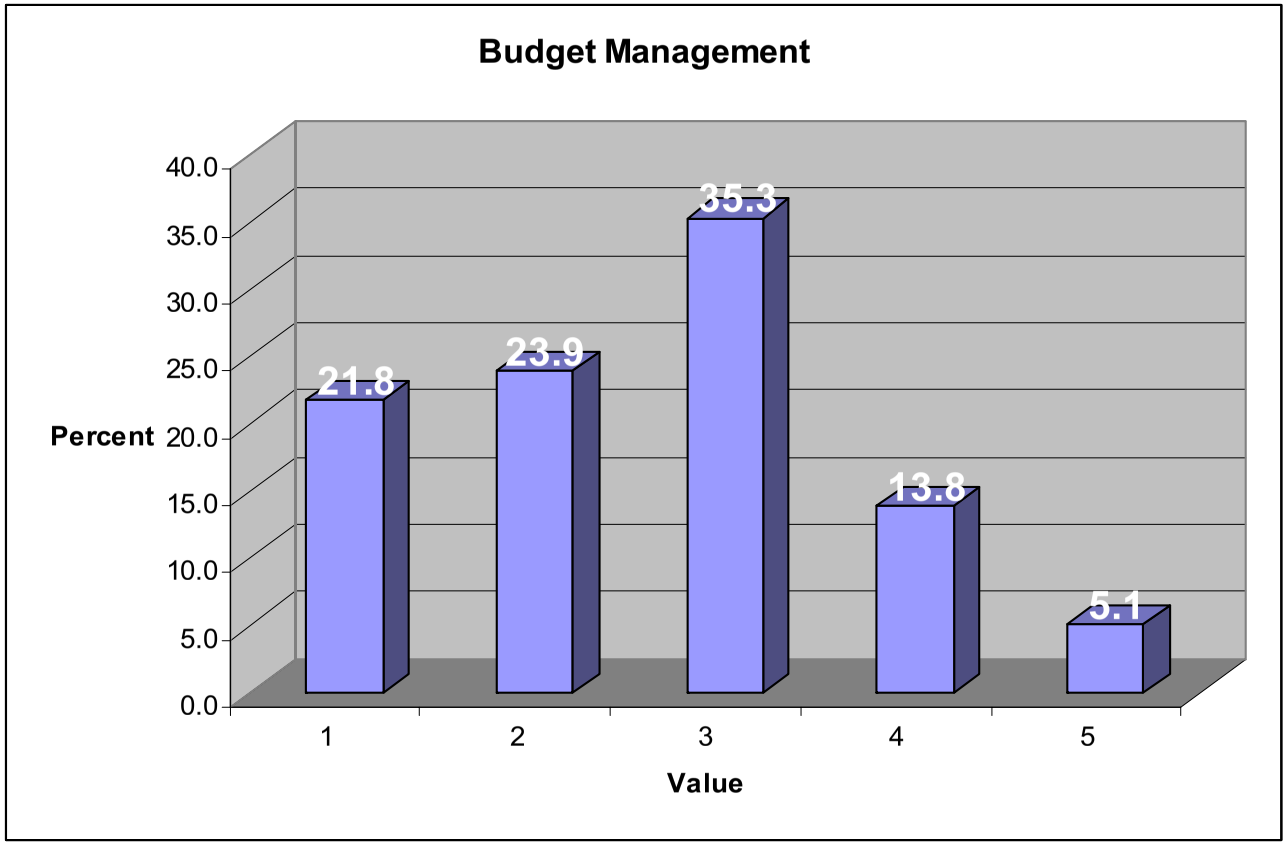
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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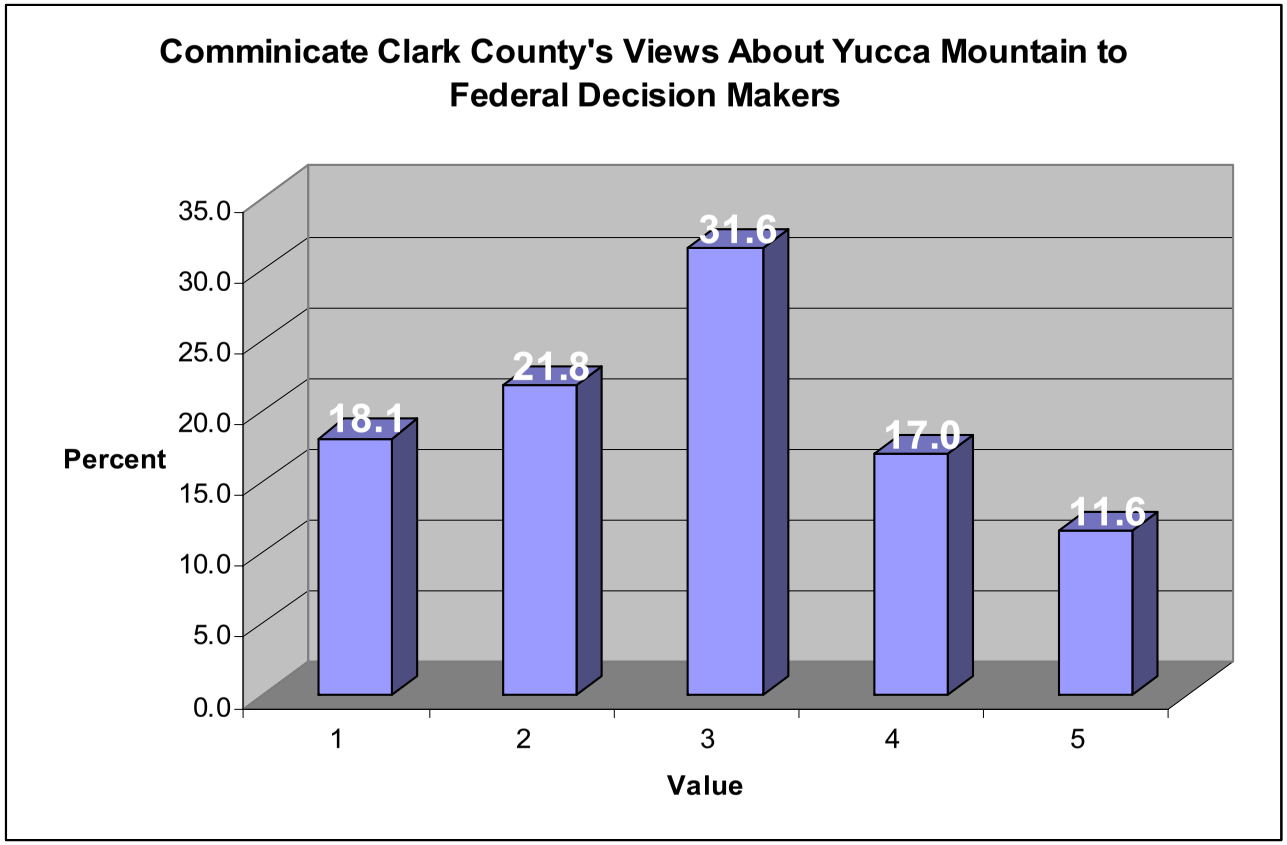
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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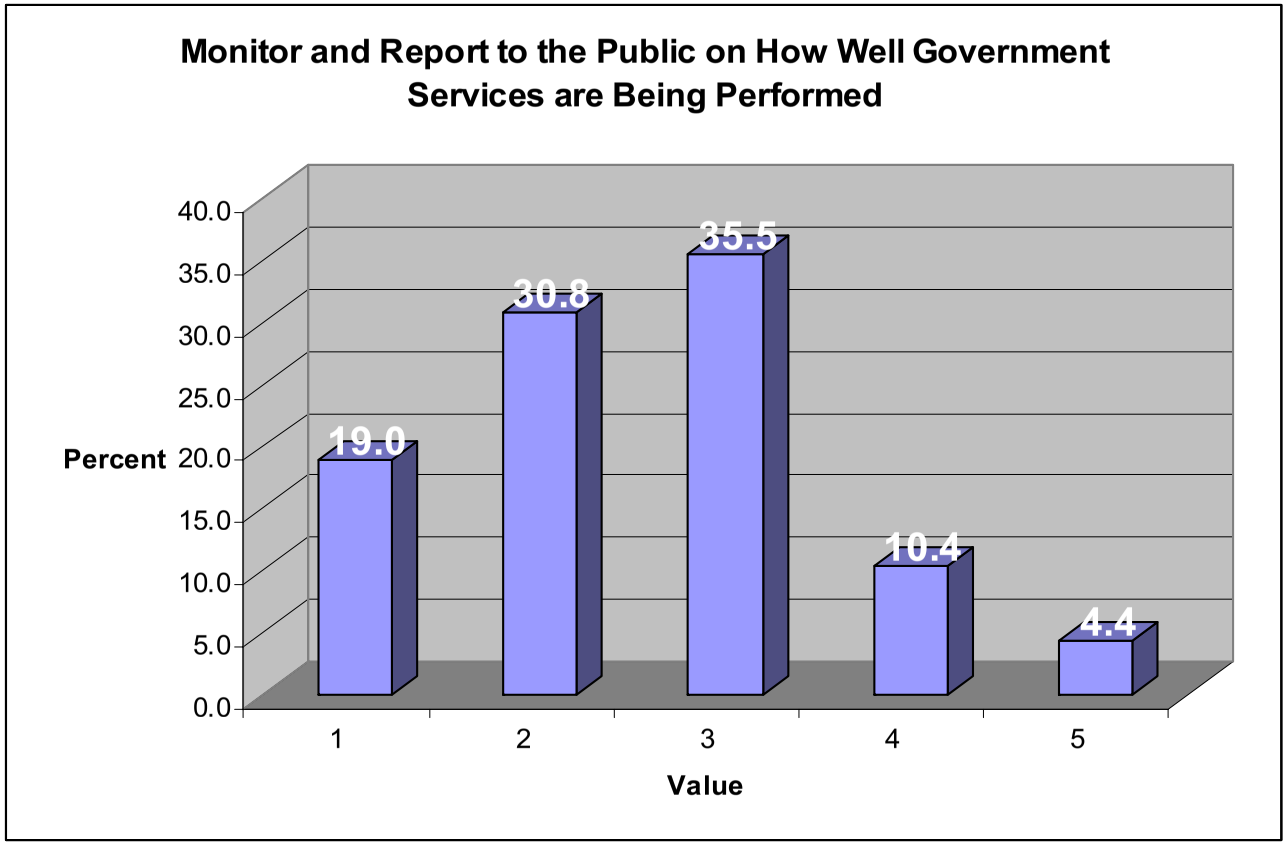
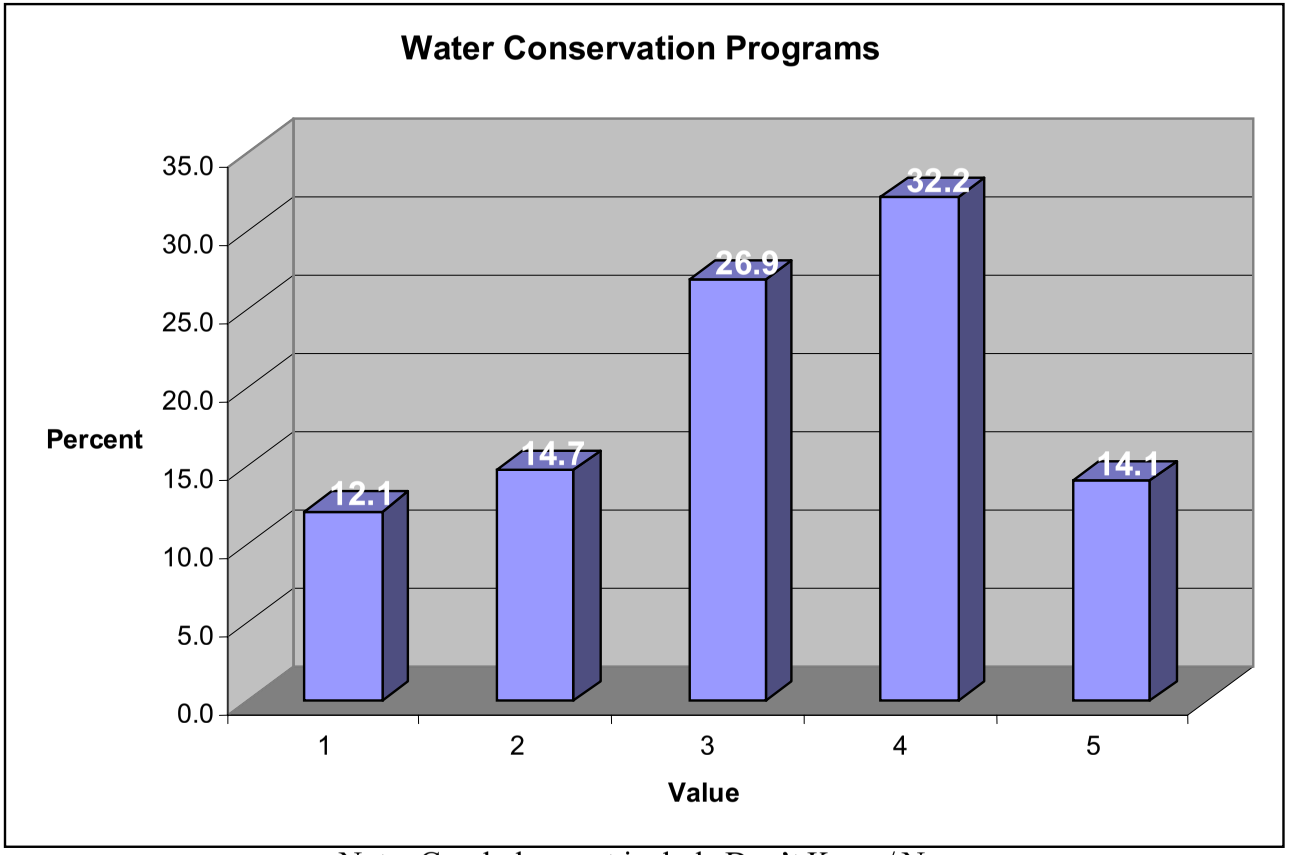
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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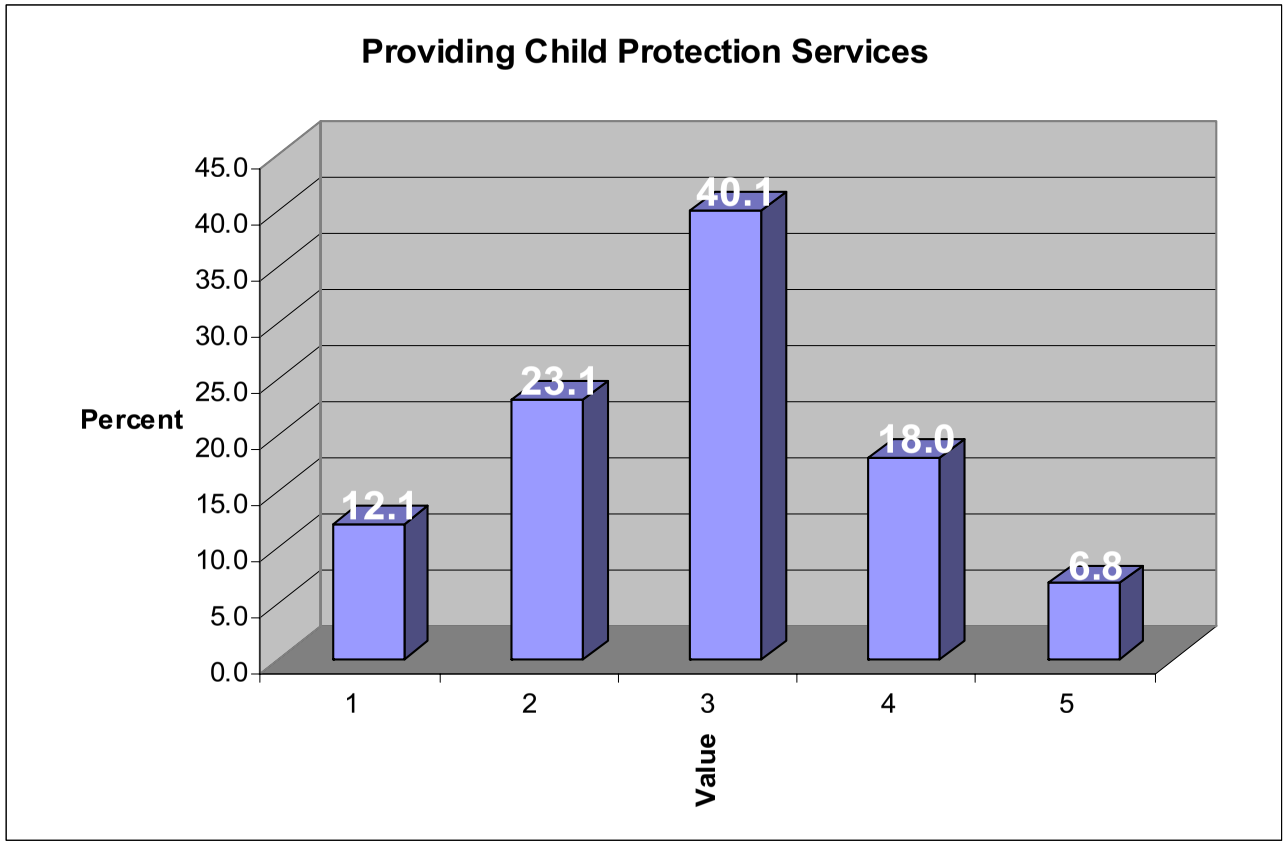
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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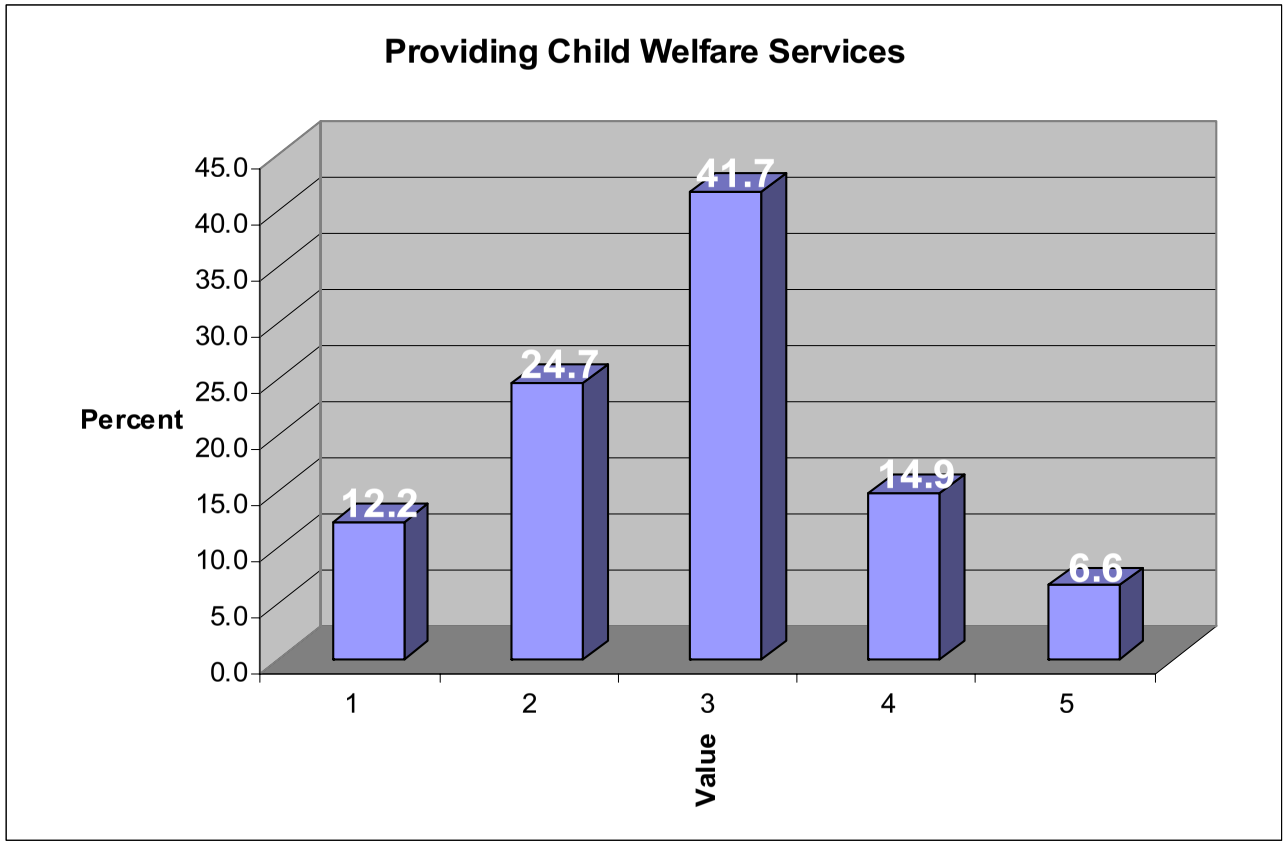
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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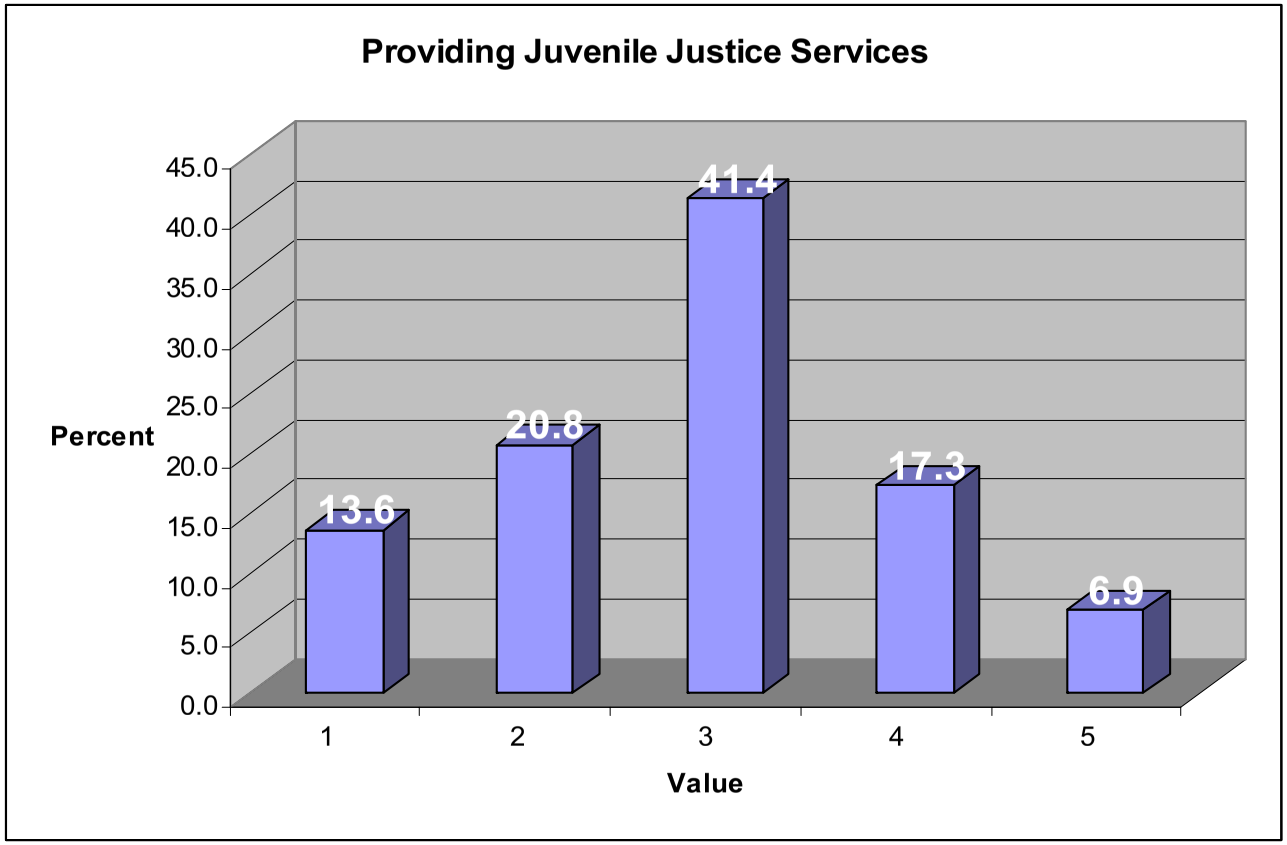
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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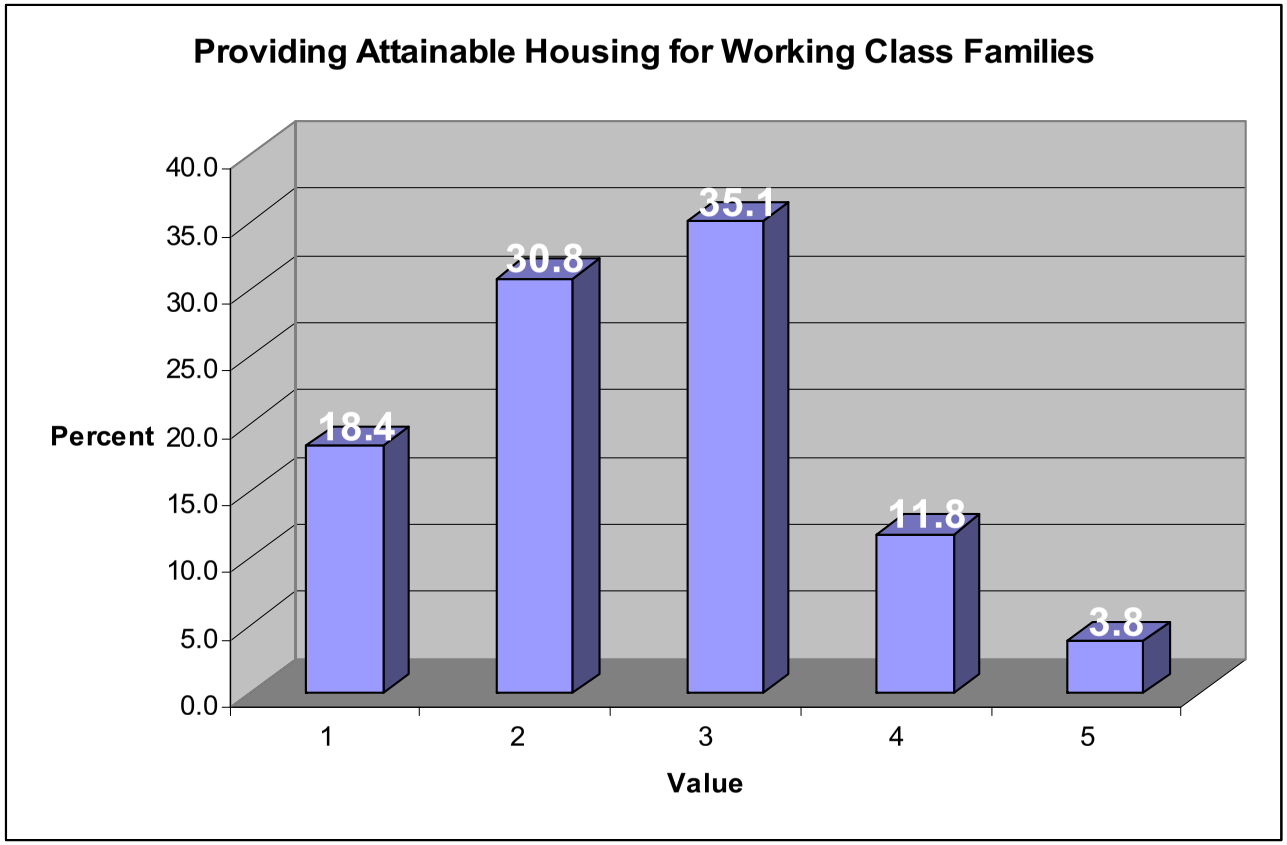
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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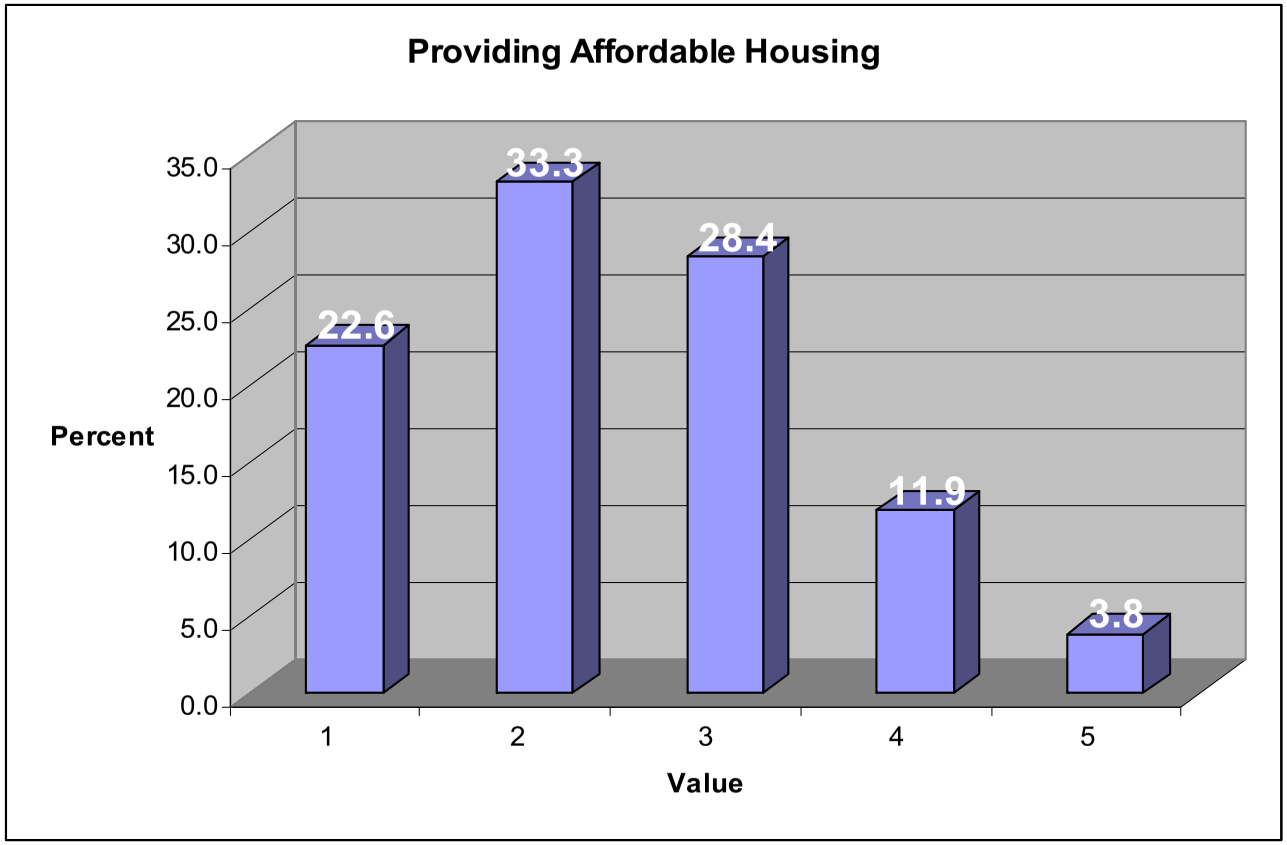
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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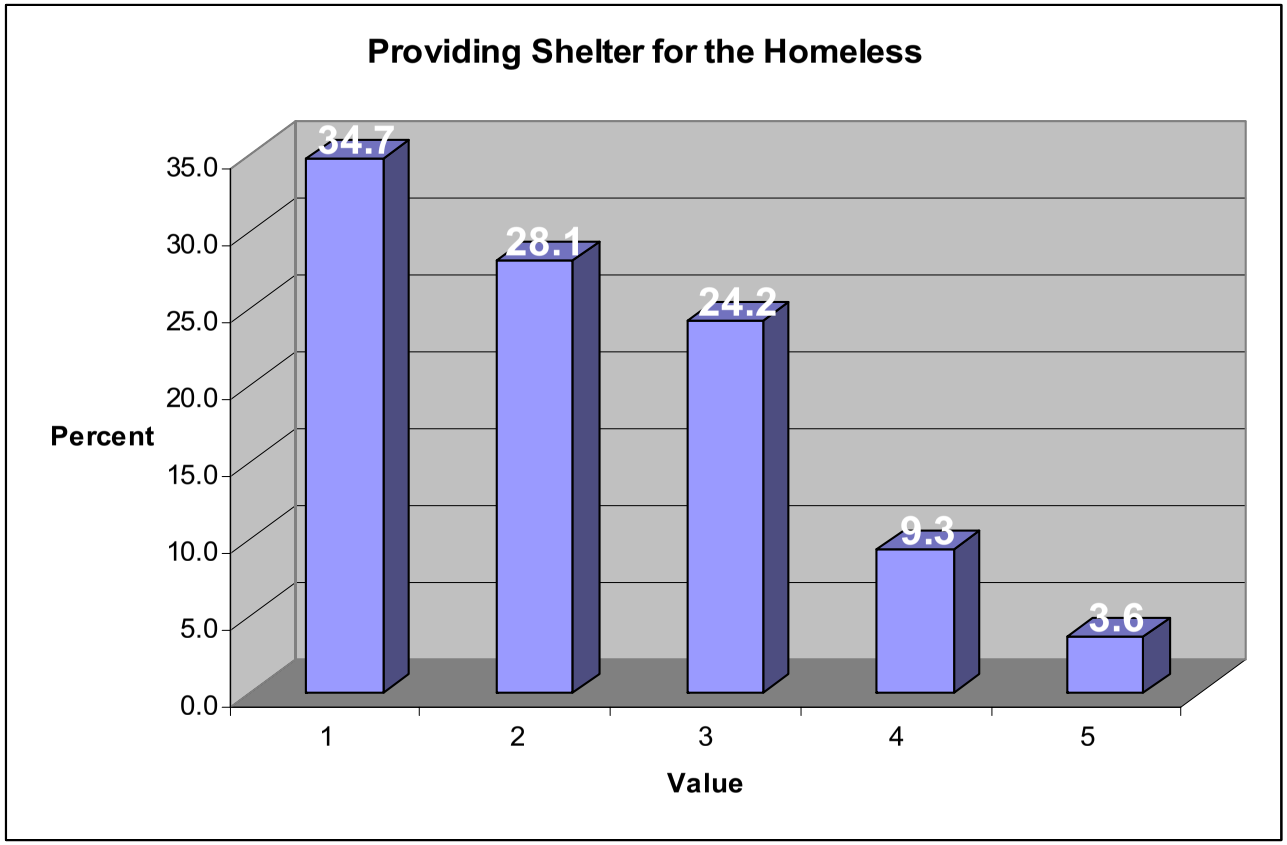
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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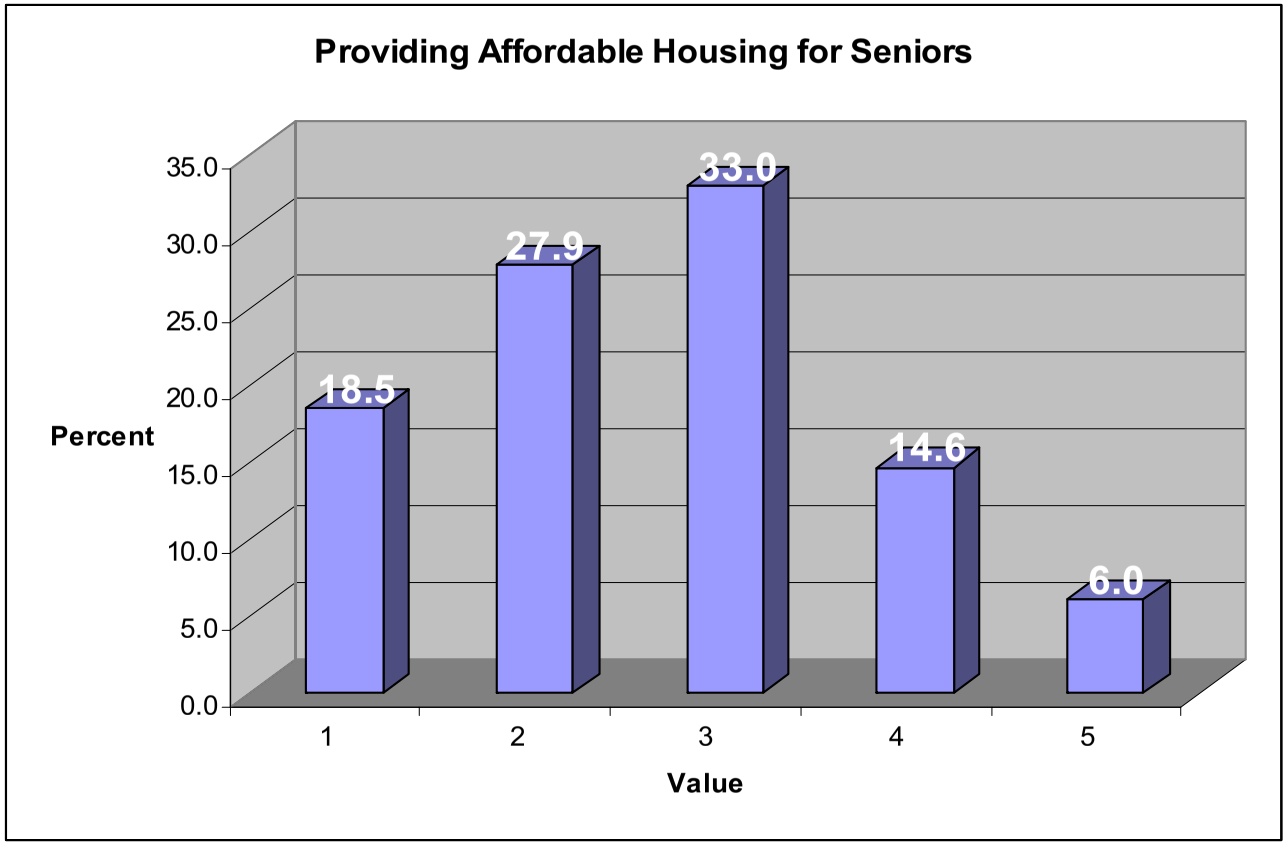
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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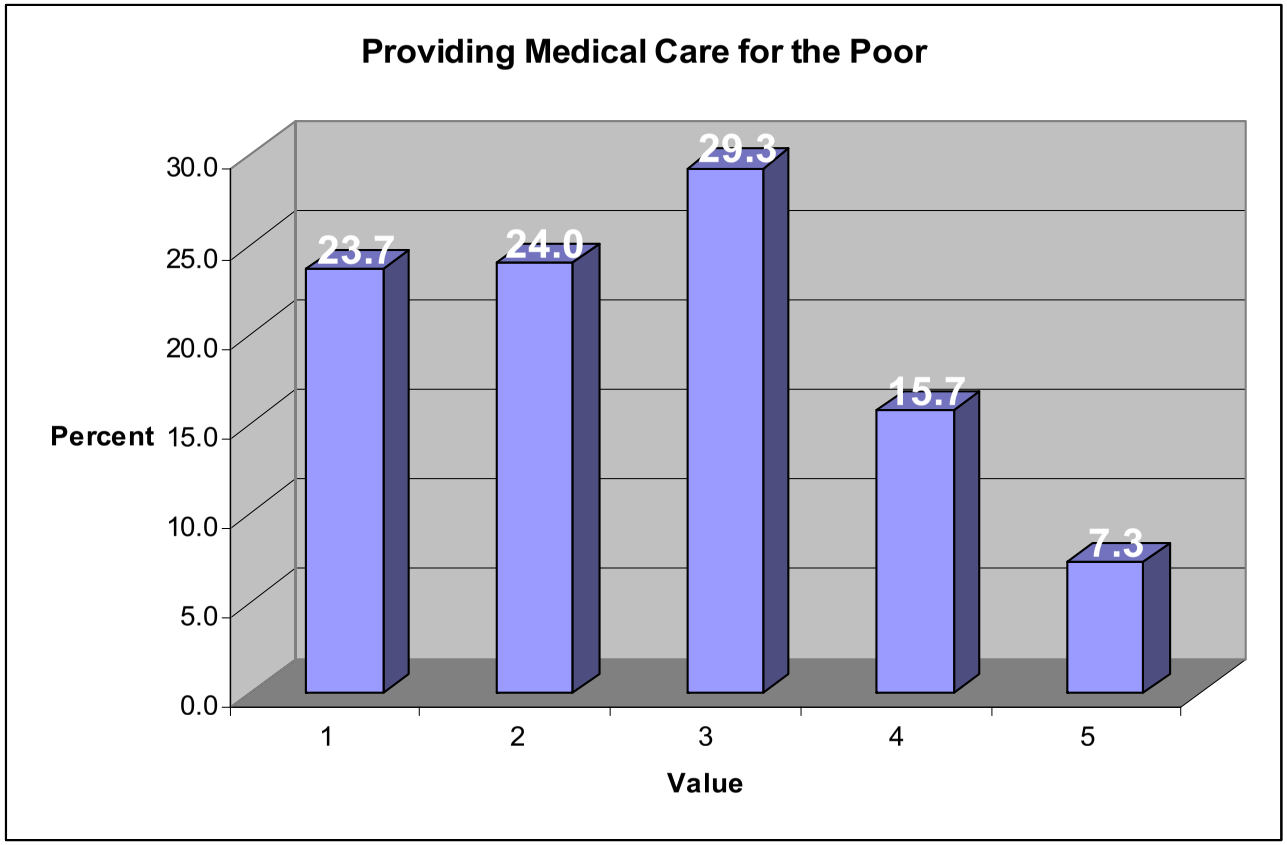
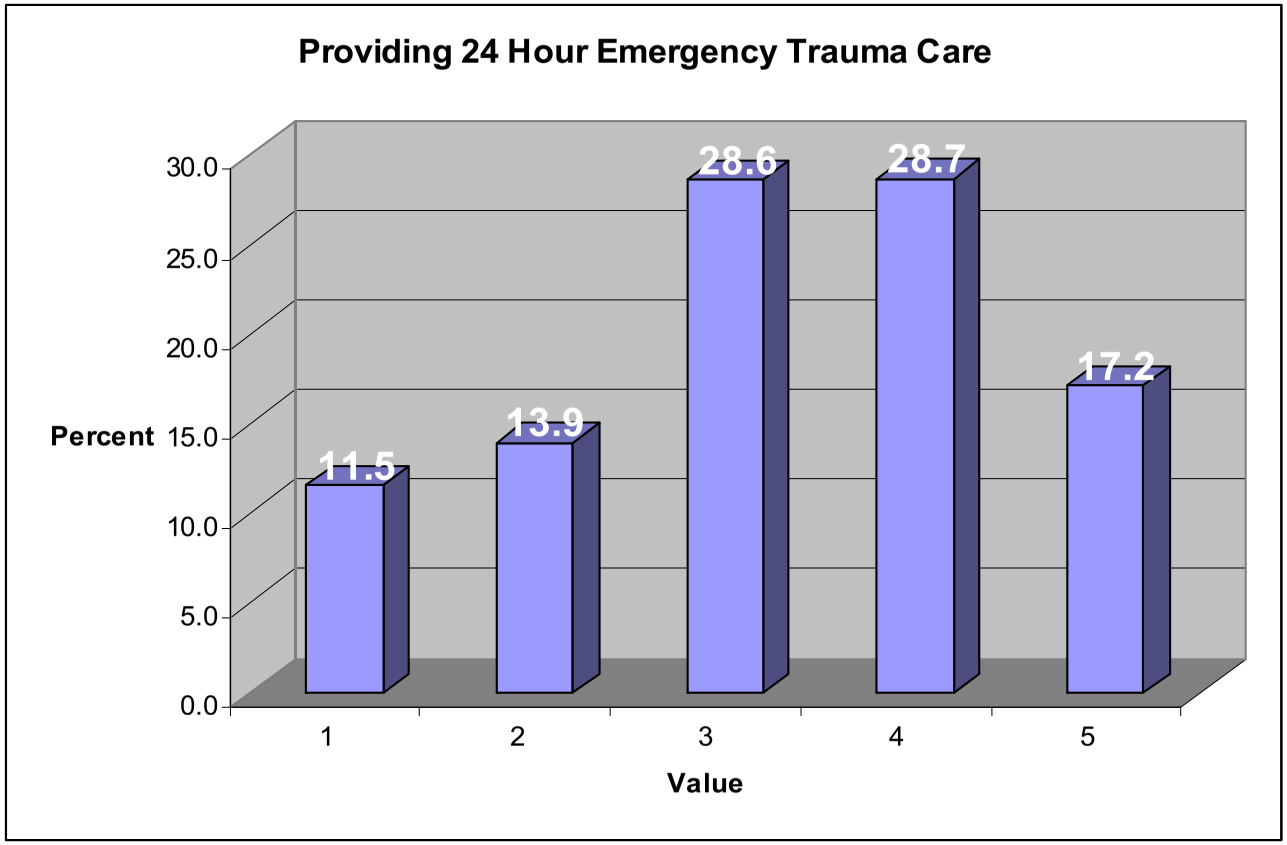
Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



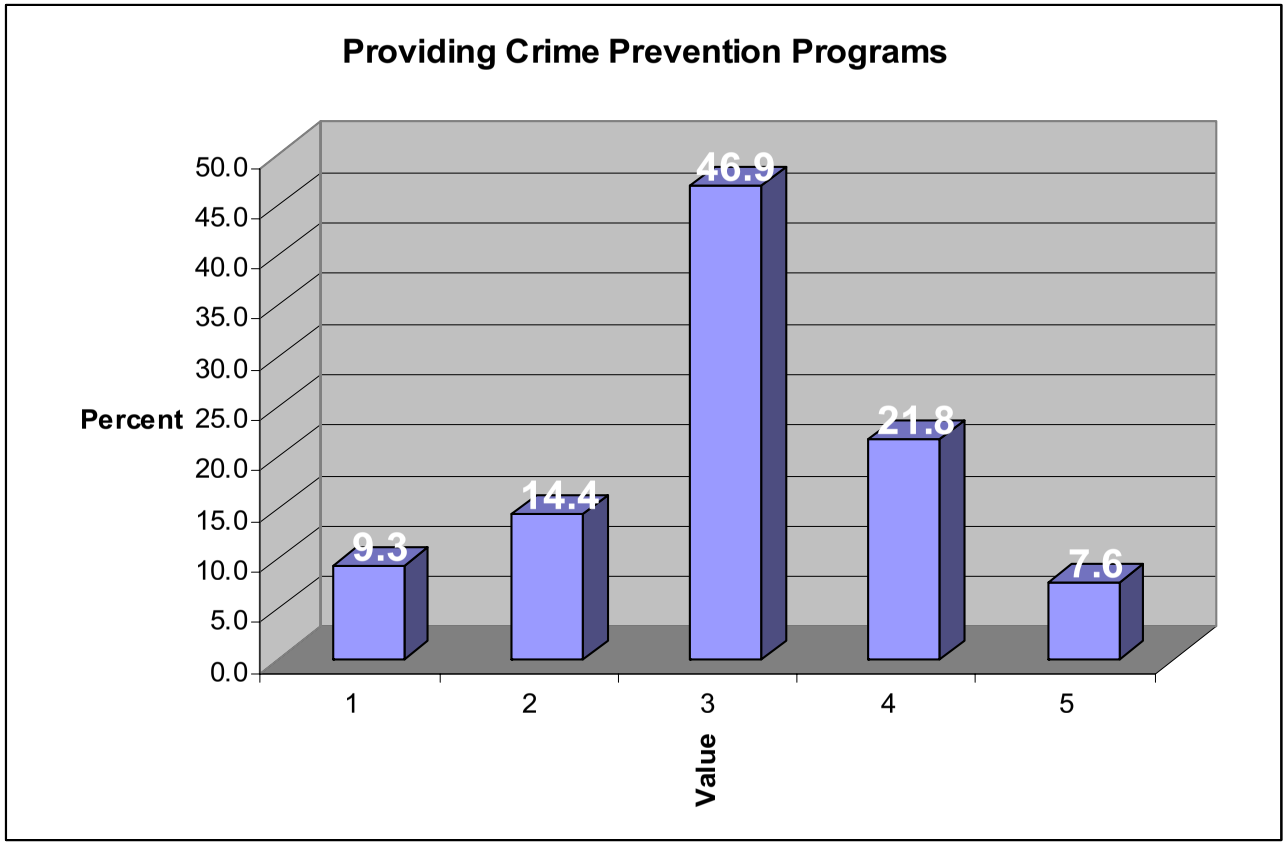
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



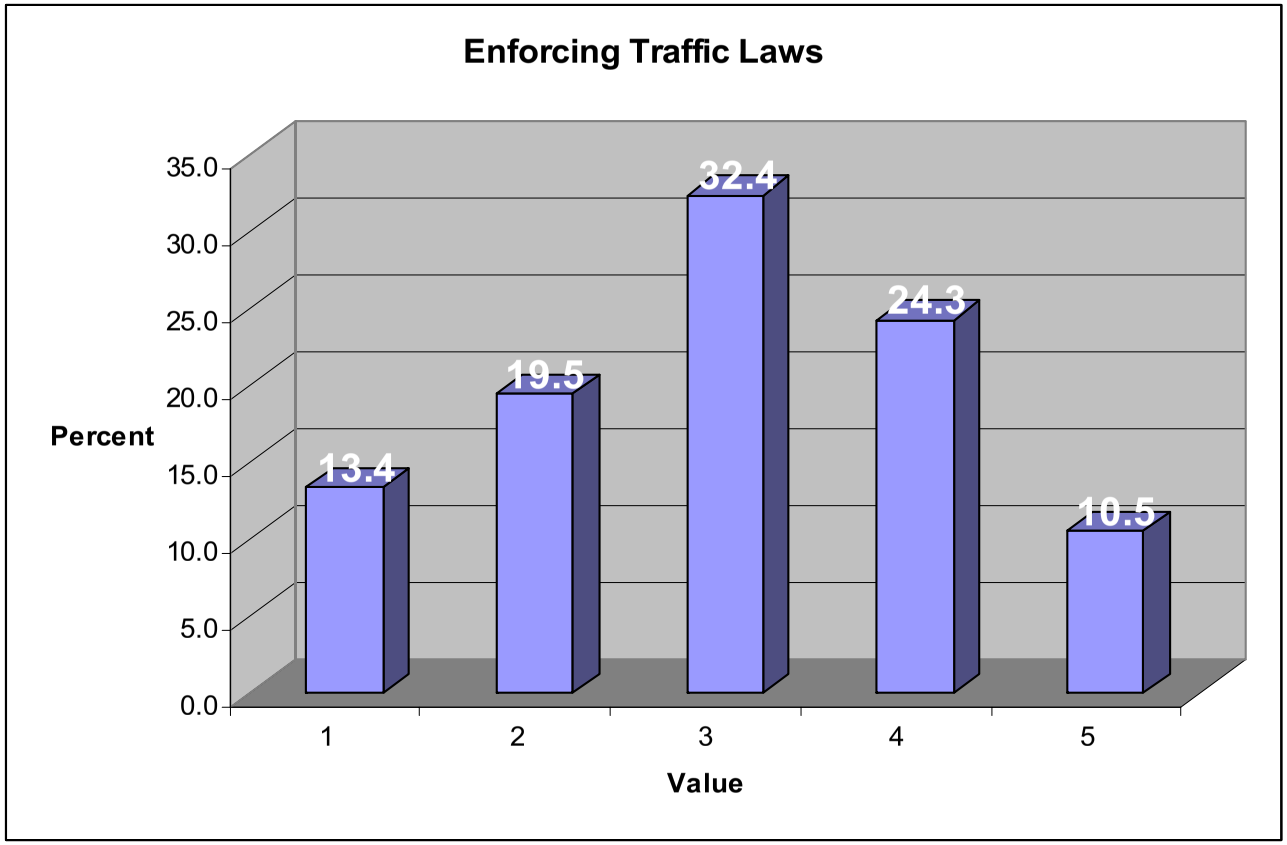
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



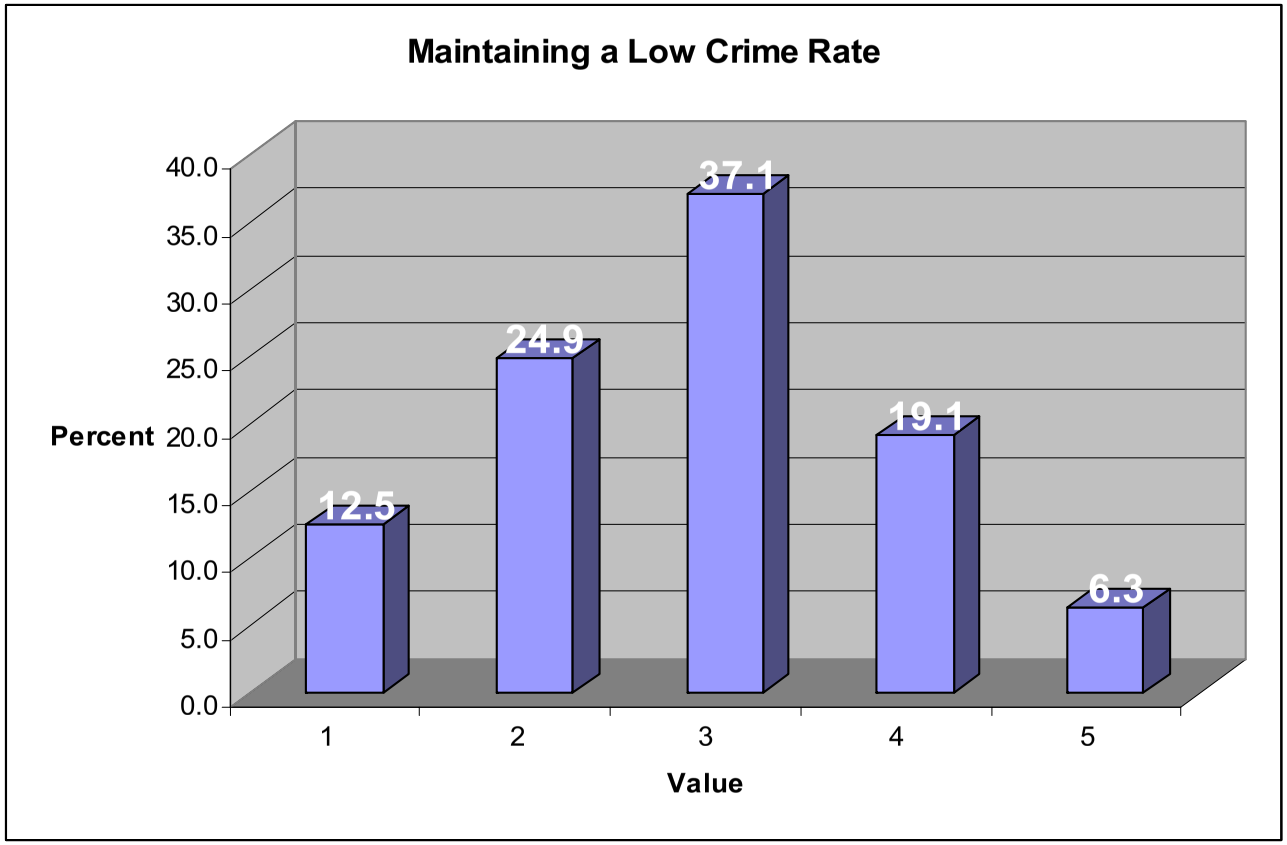
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



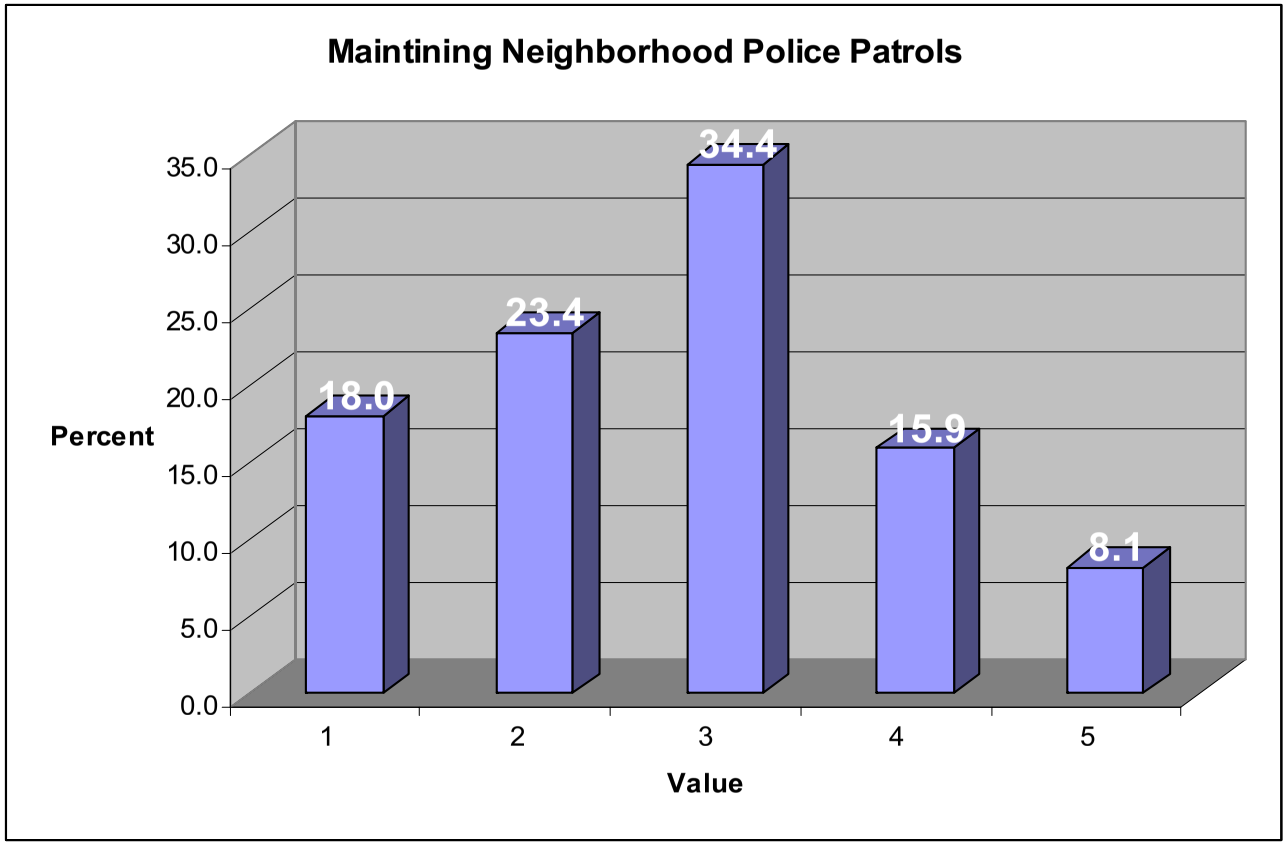
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



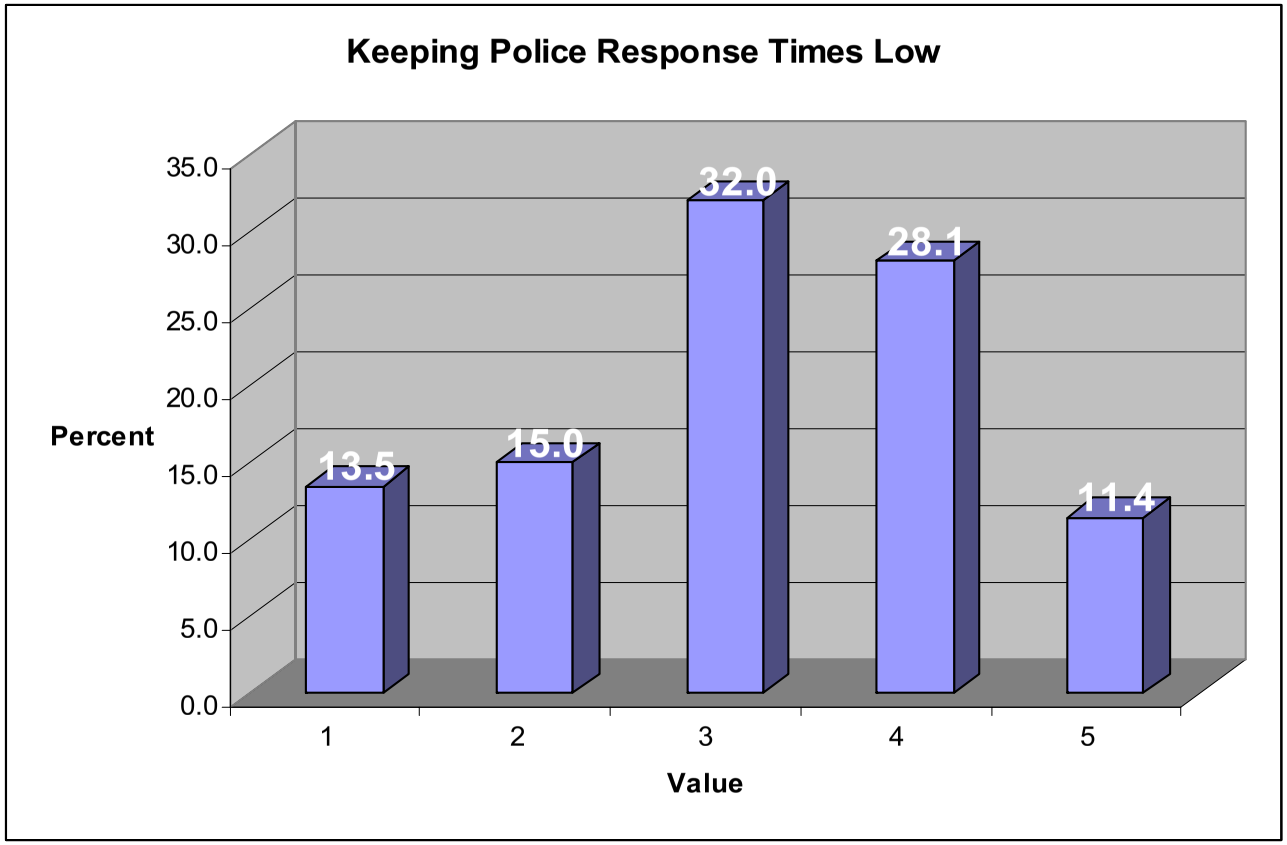
Note- Graph does not include Don't Know/ No

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



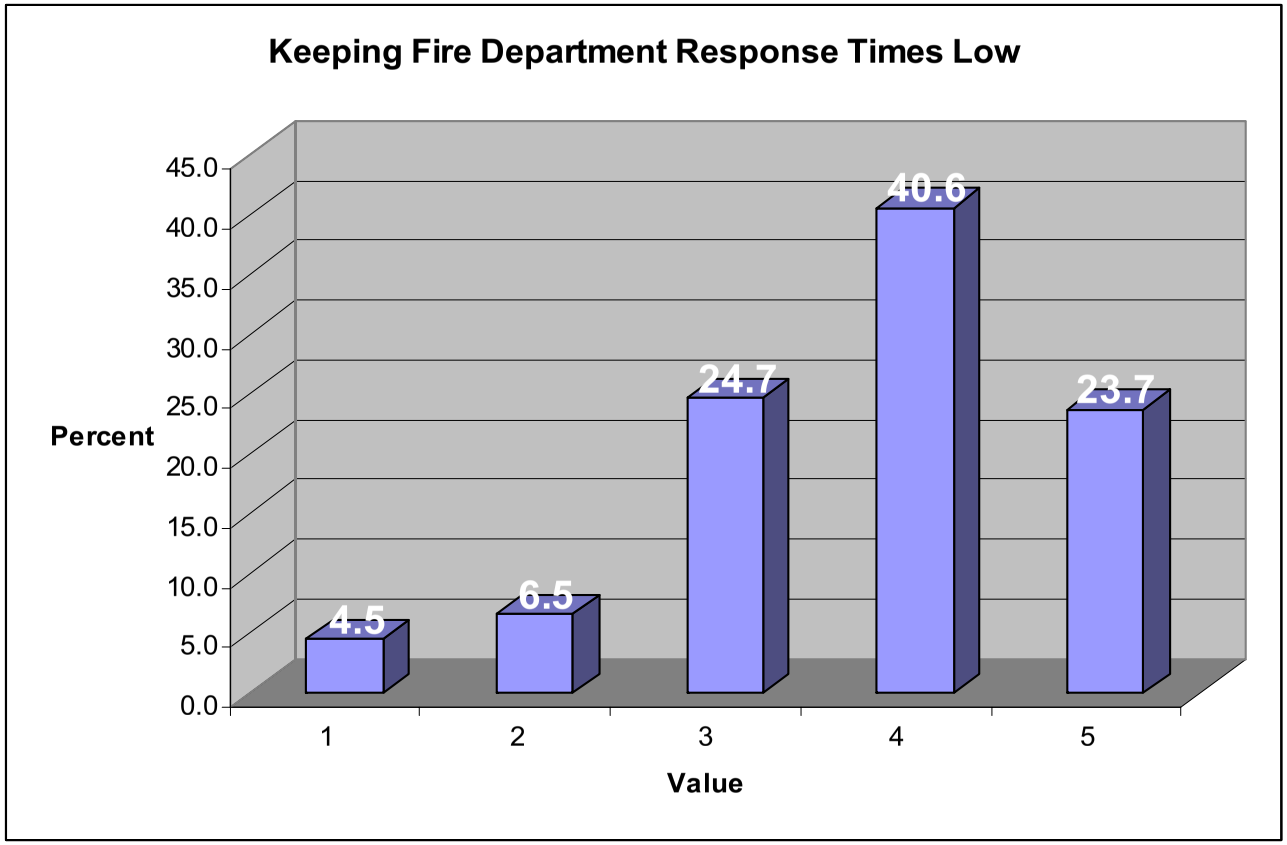
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



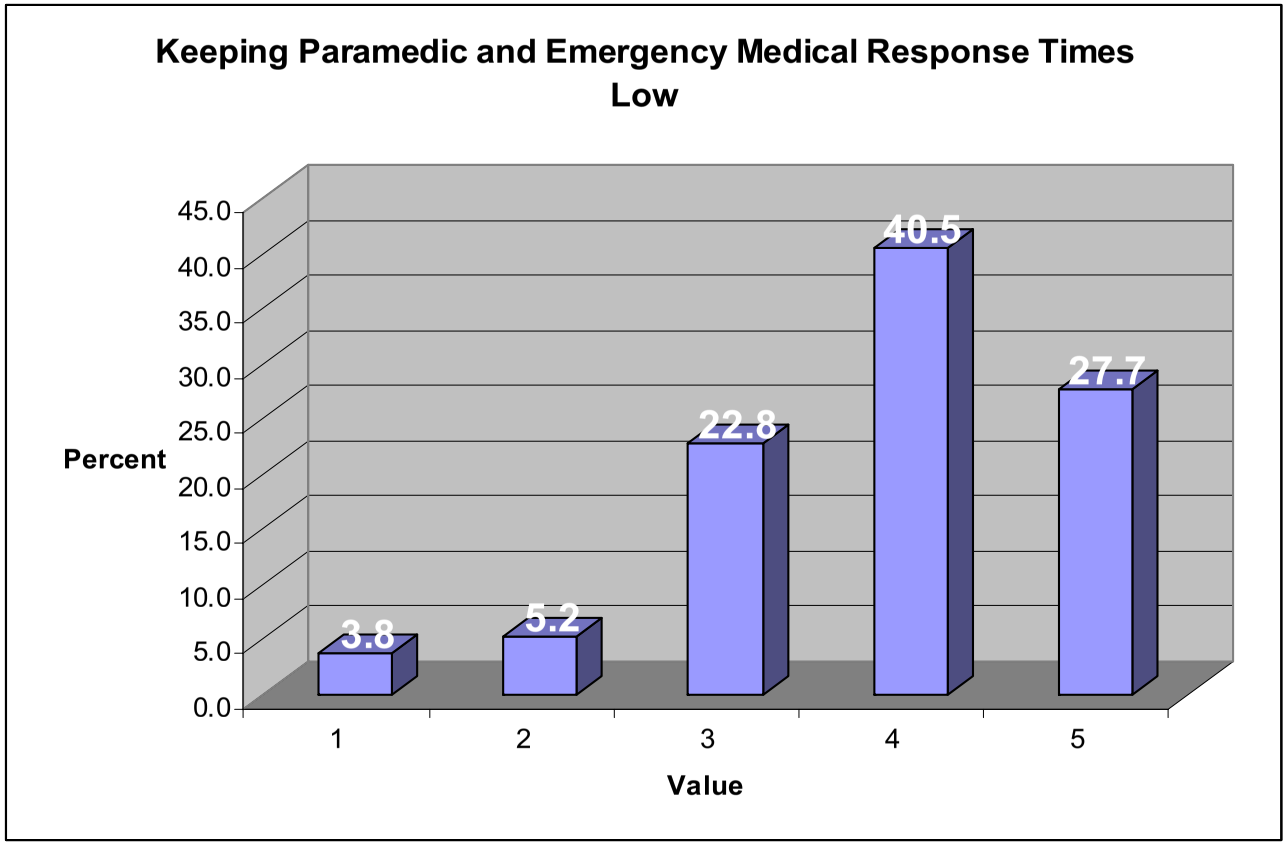
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



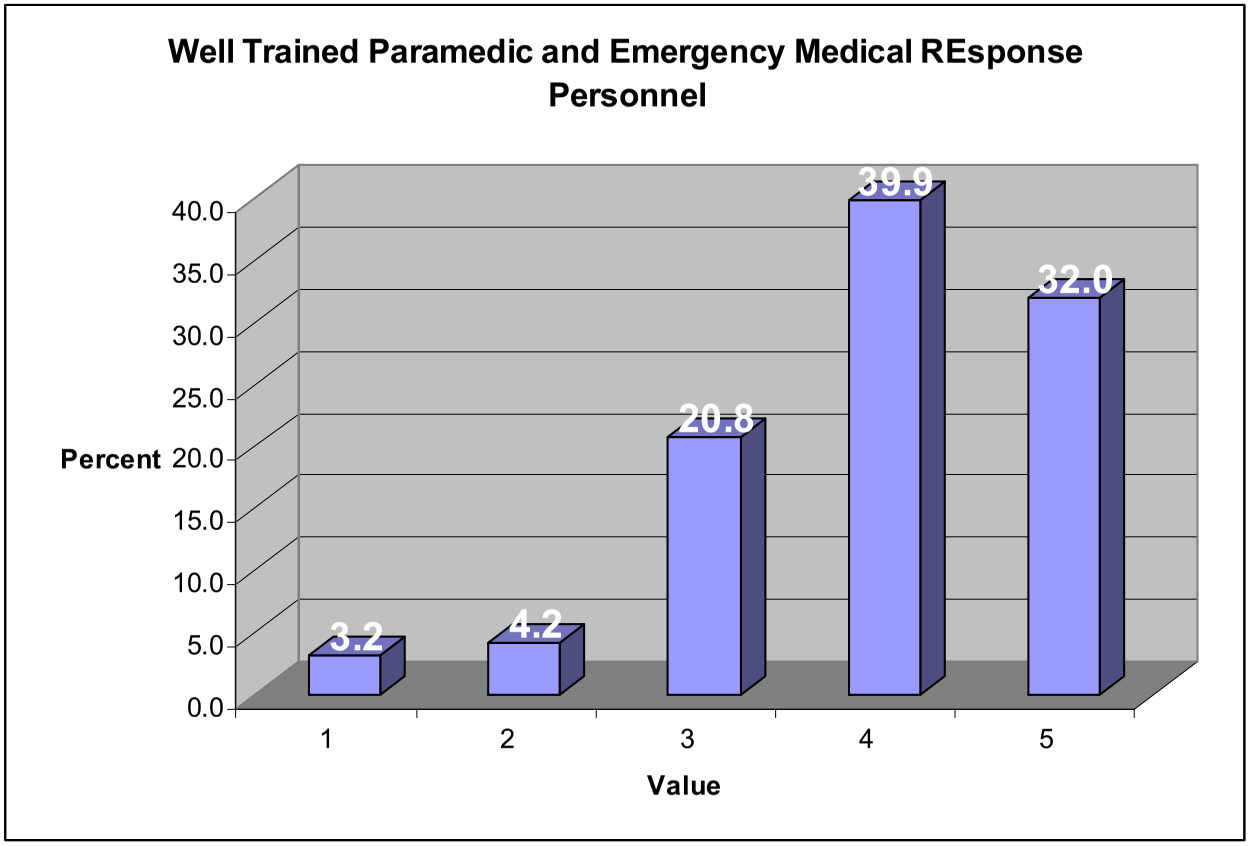
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



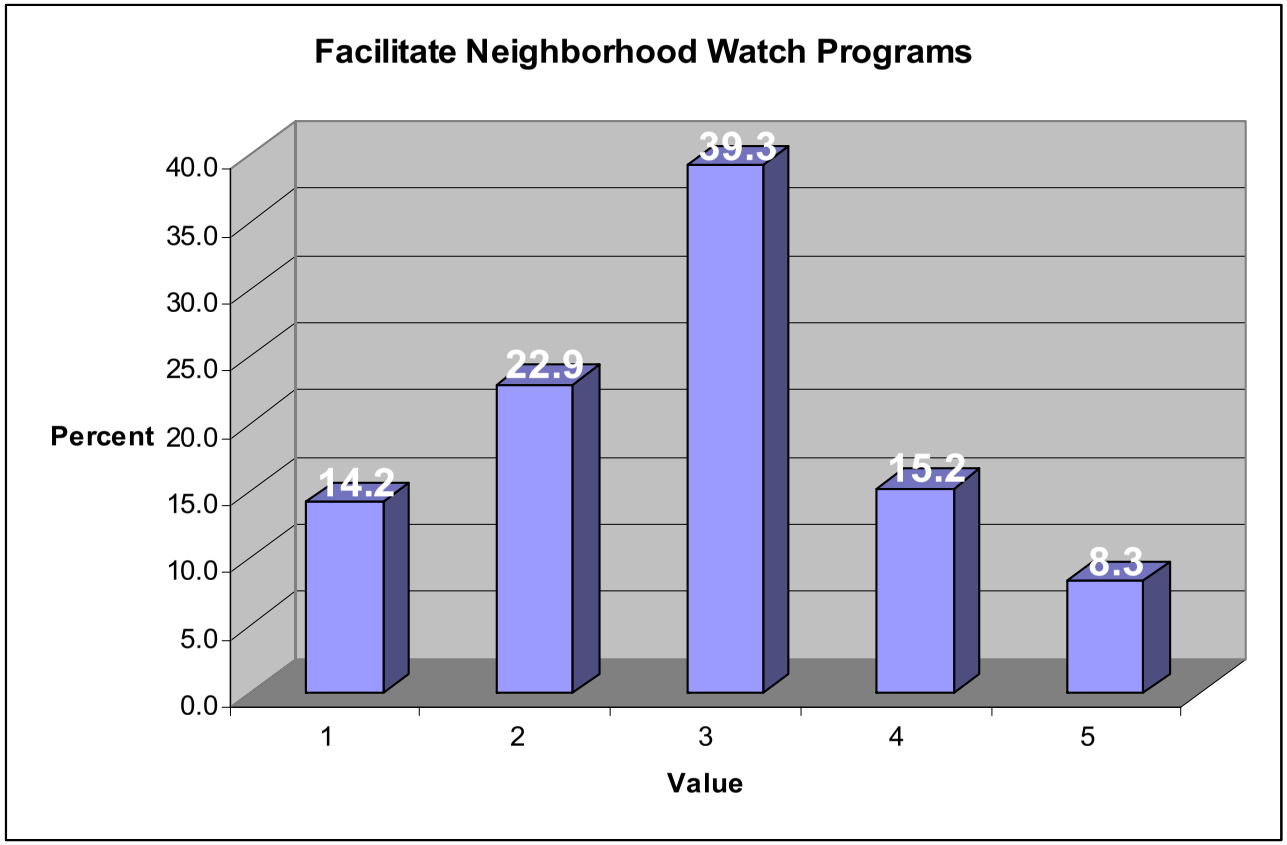
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



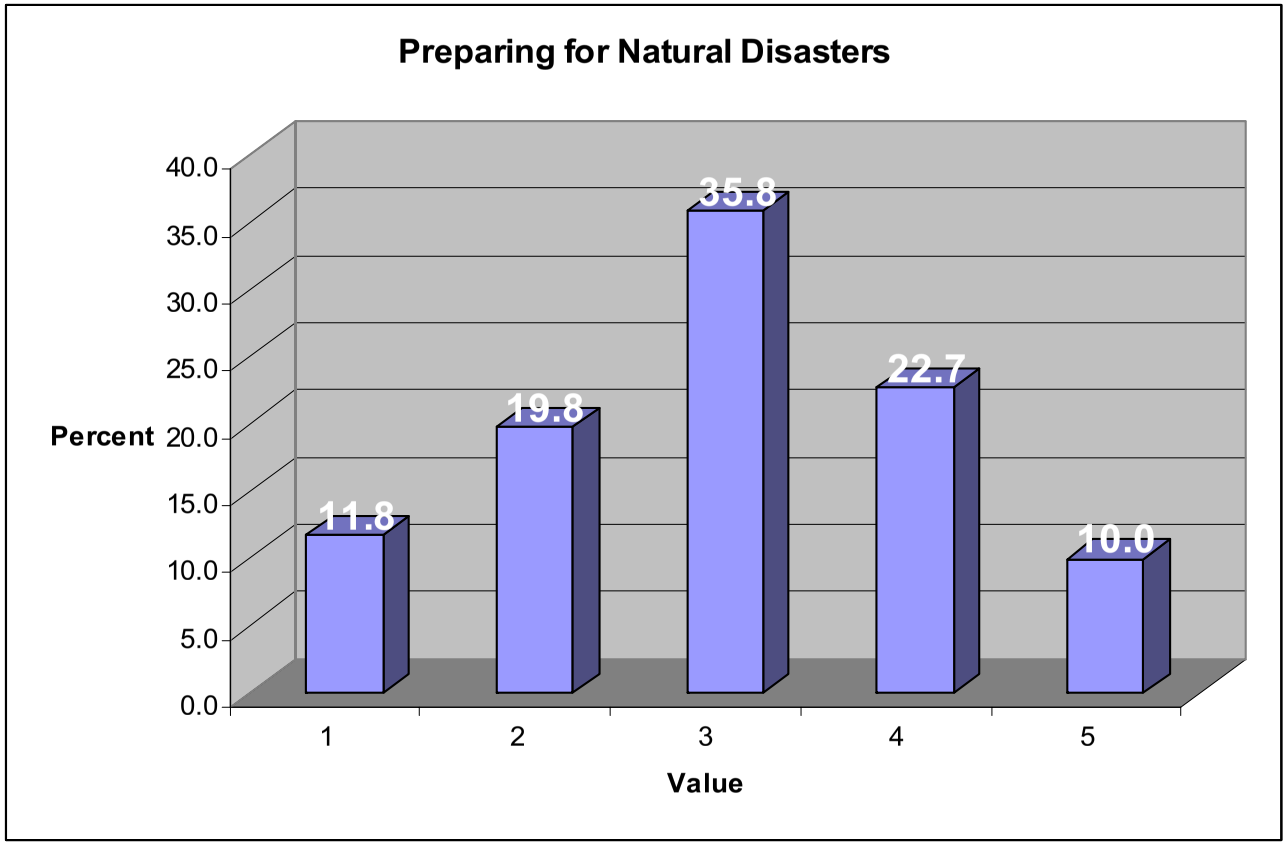
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



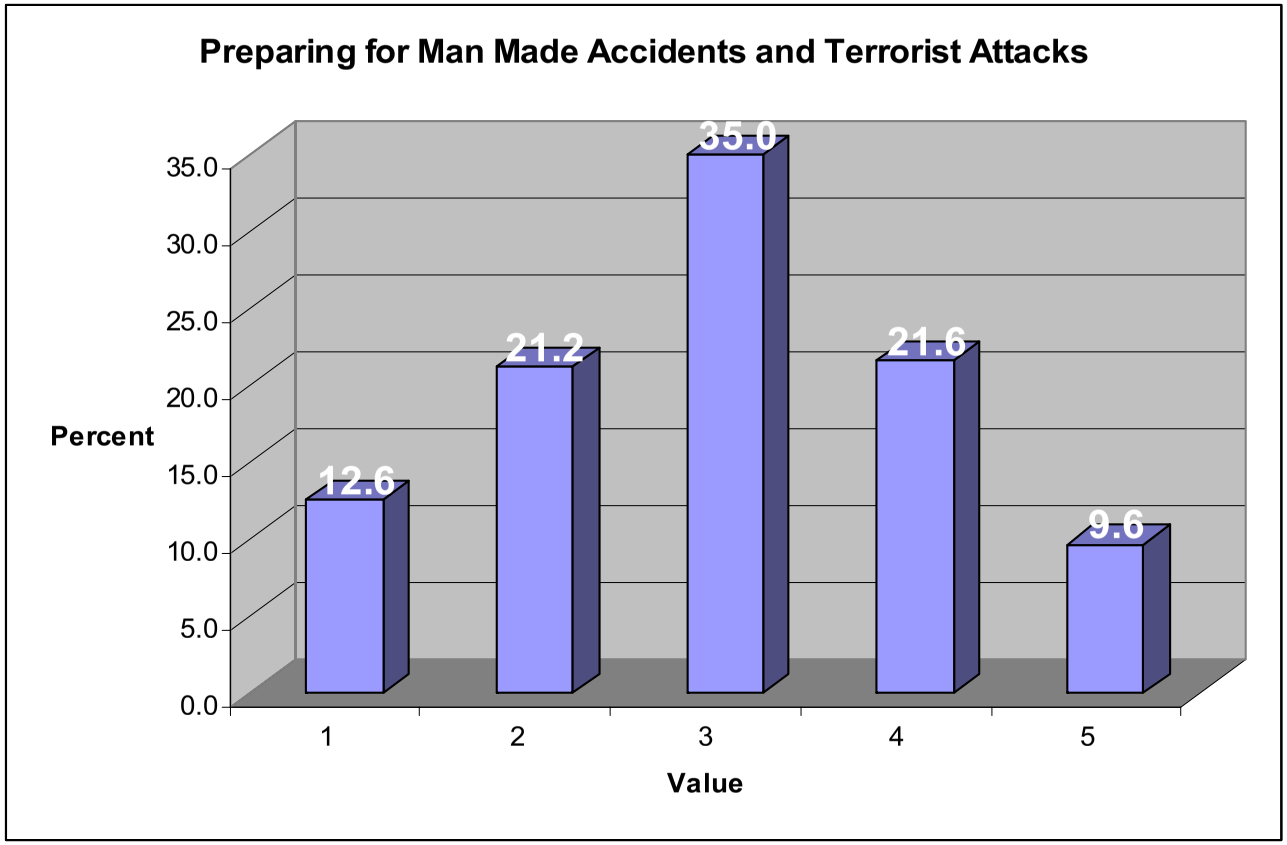
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



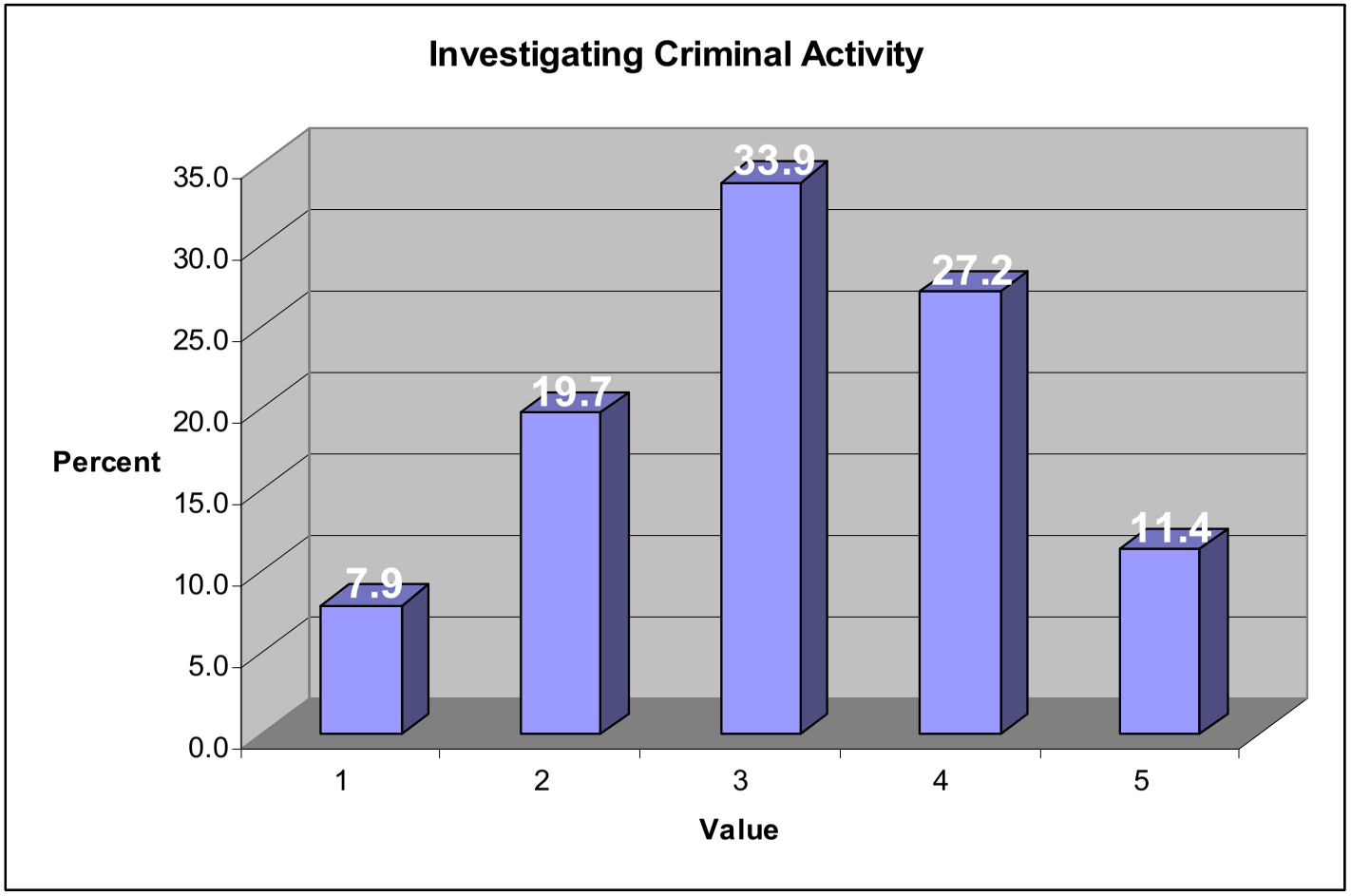
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



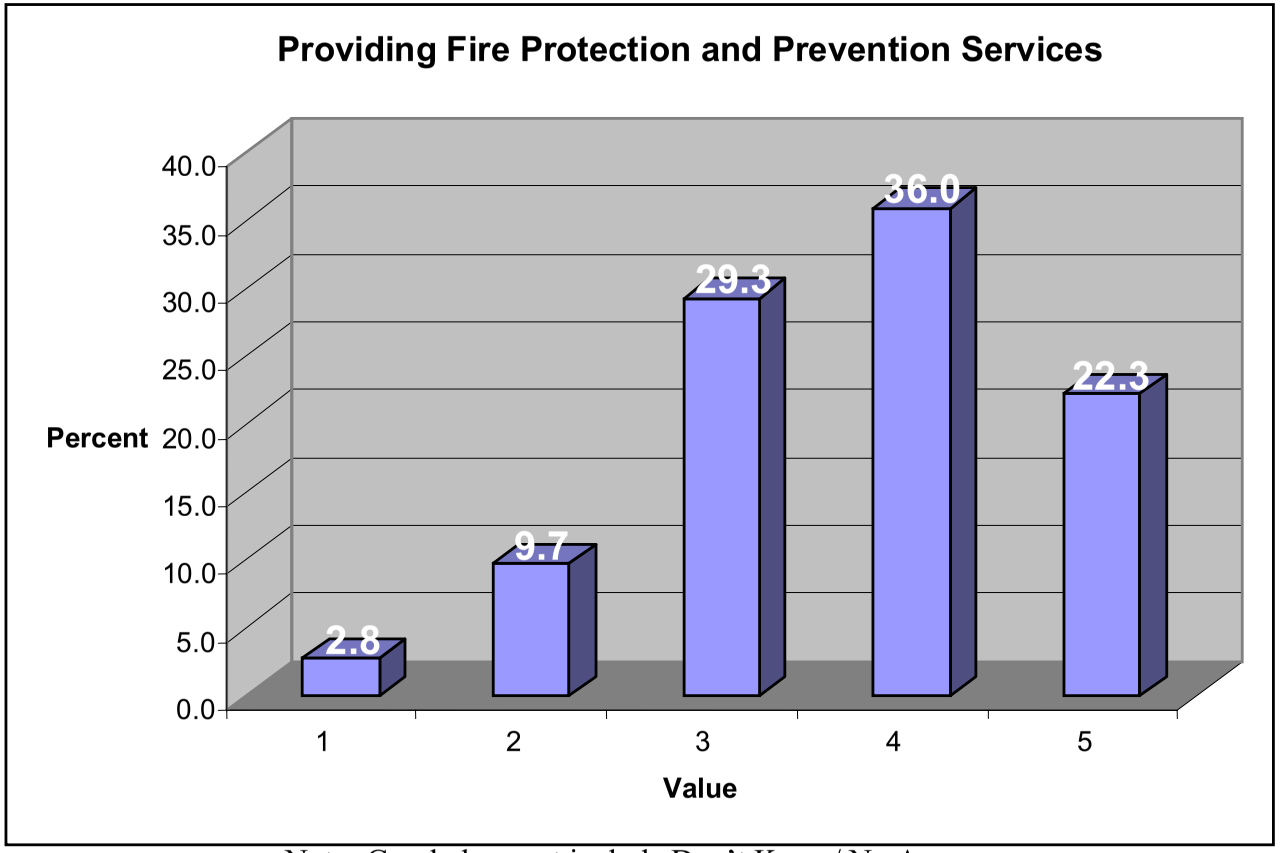
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



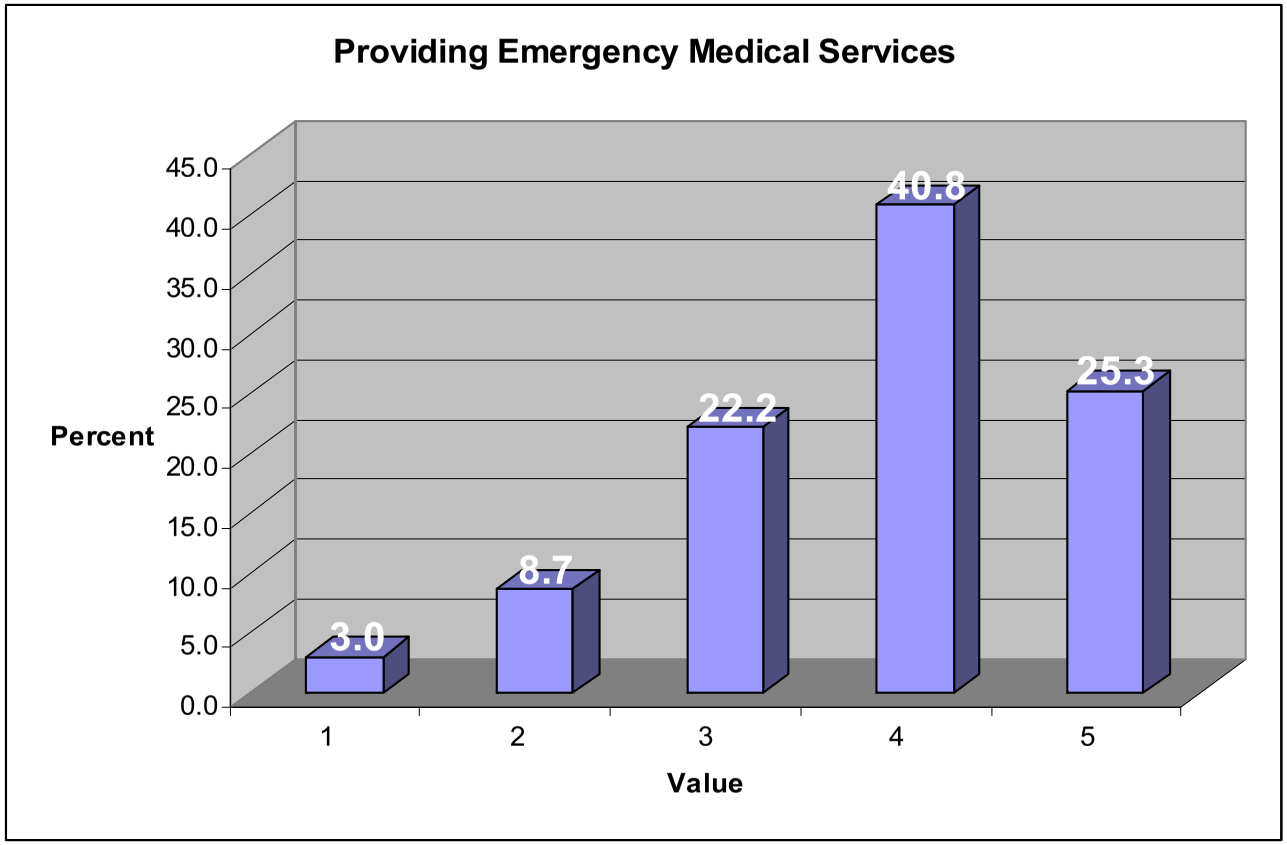
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



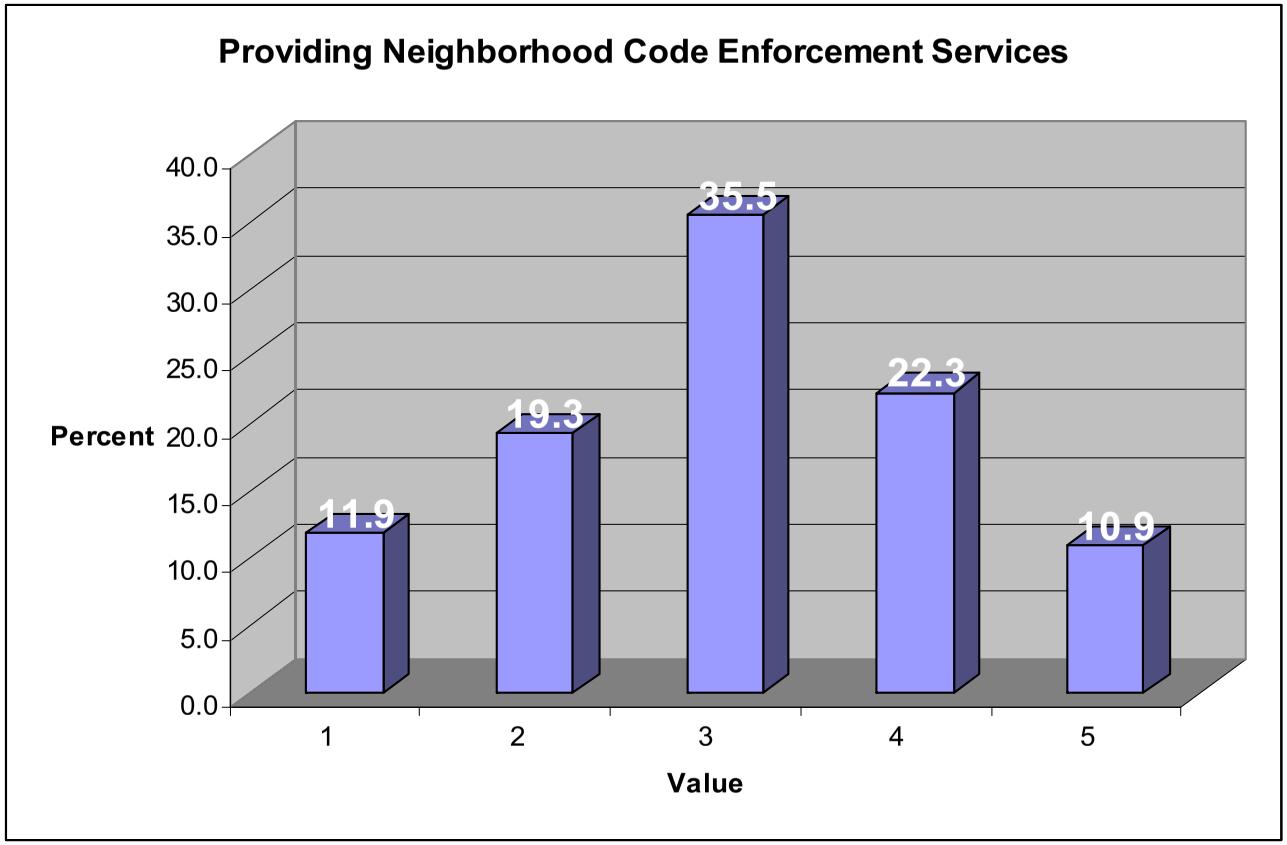
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



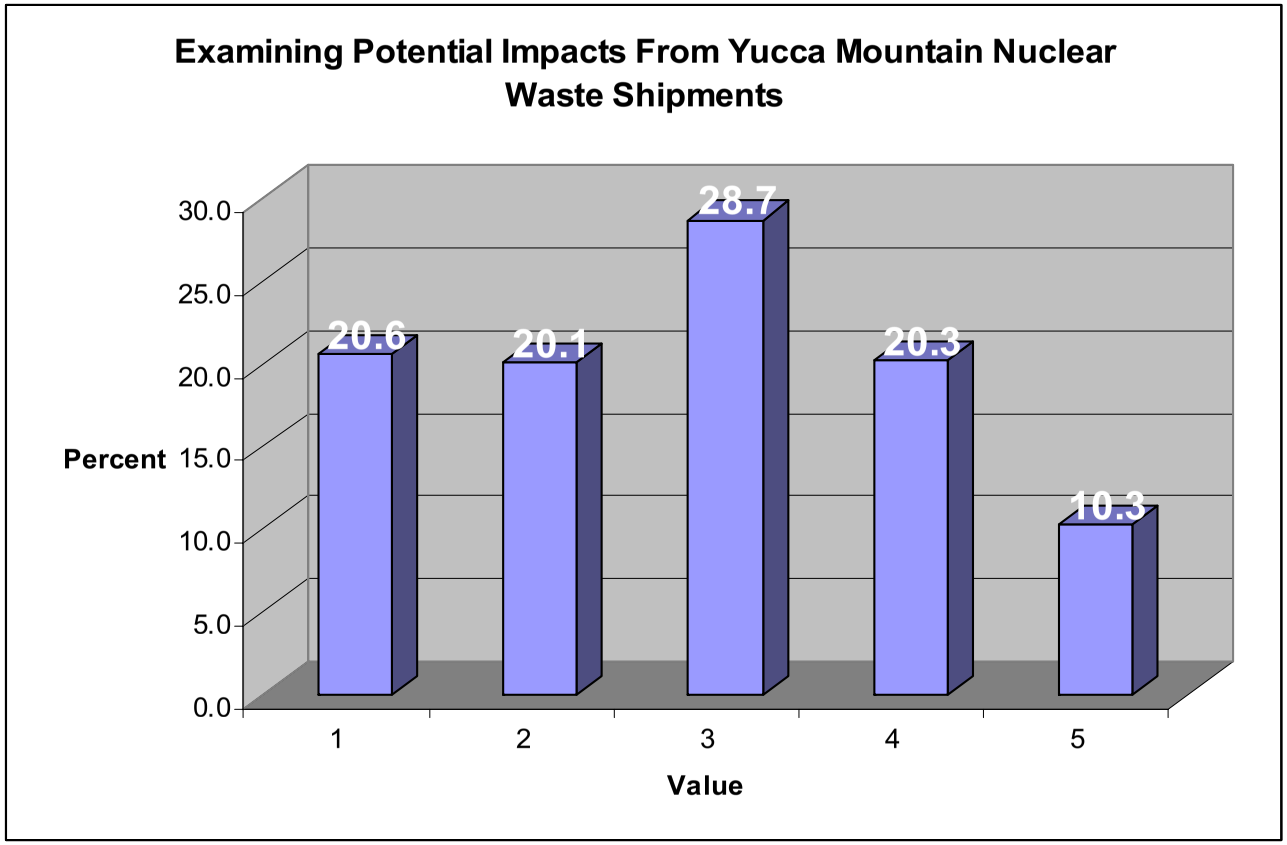
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



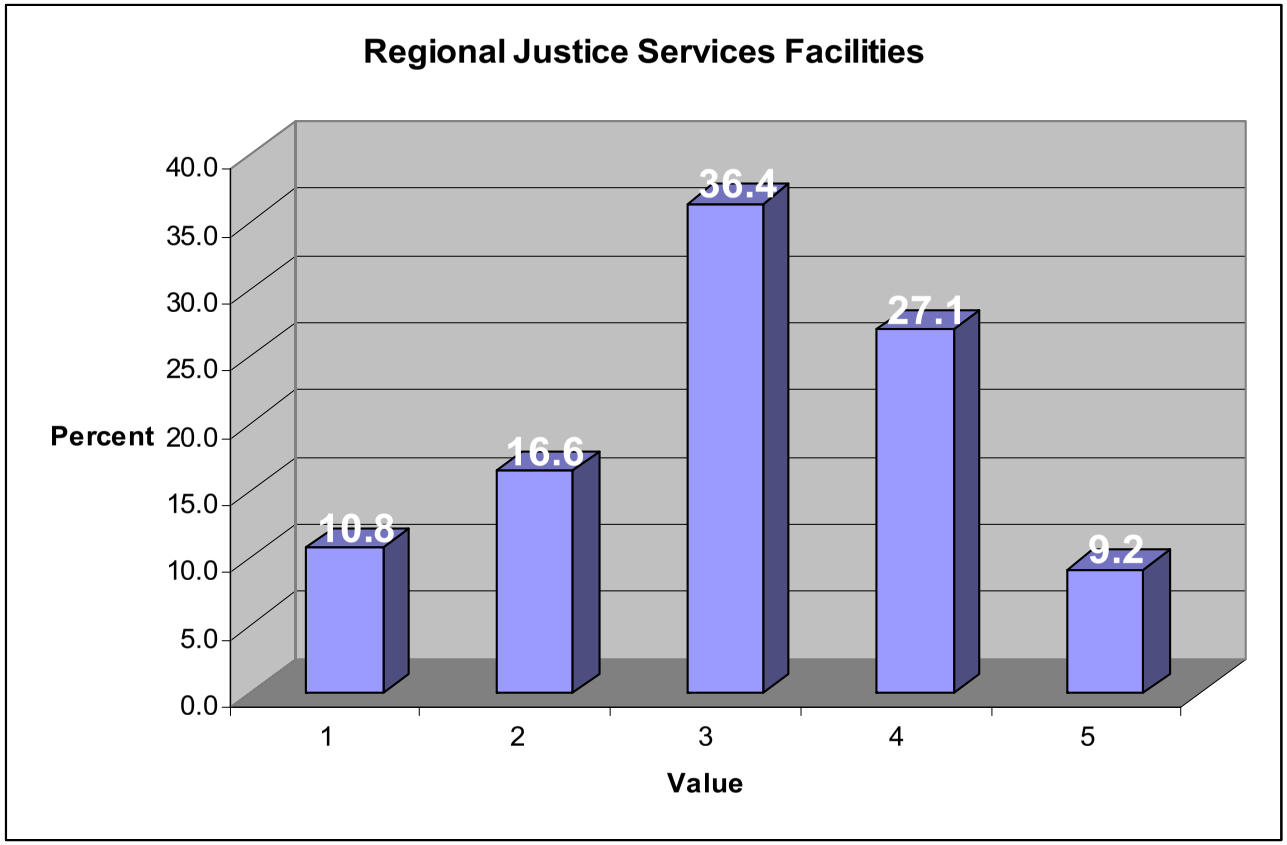
Note- Graph does not include Don't Know/ No Answer

ppendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



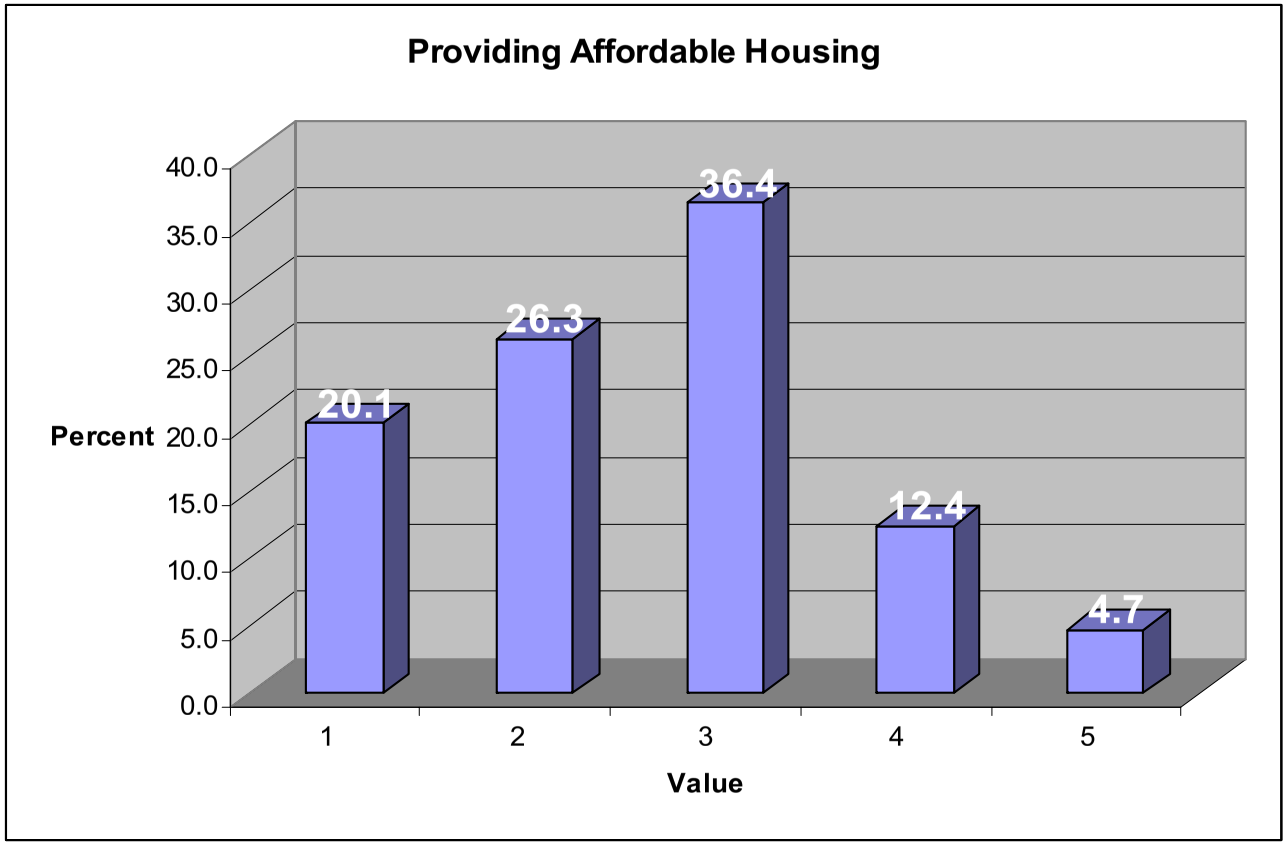
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



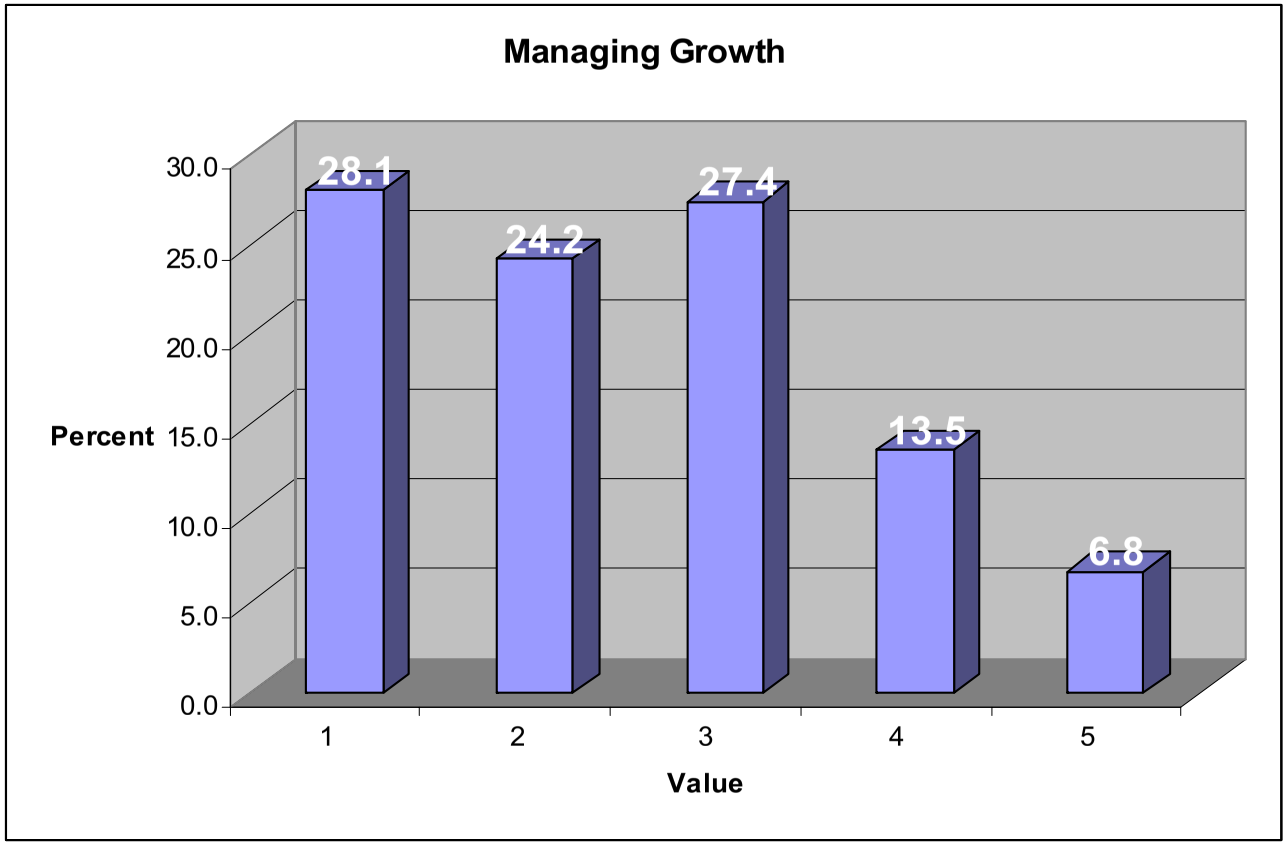
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



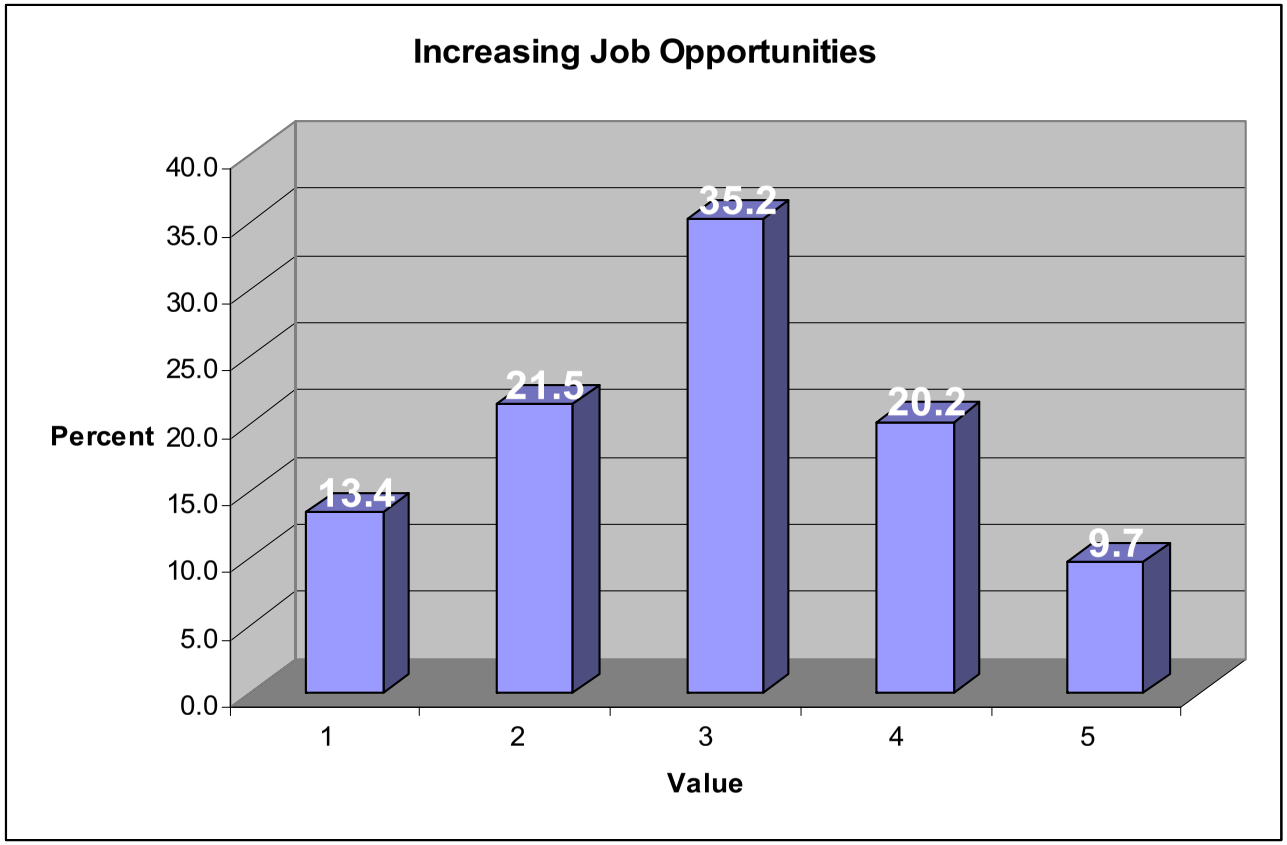
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



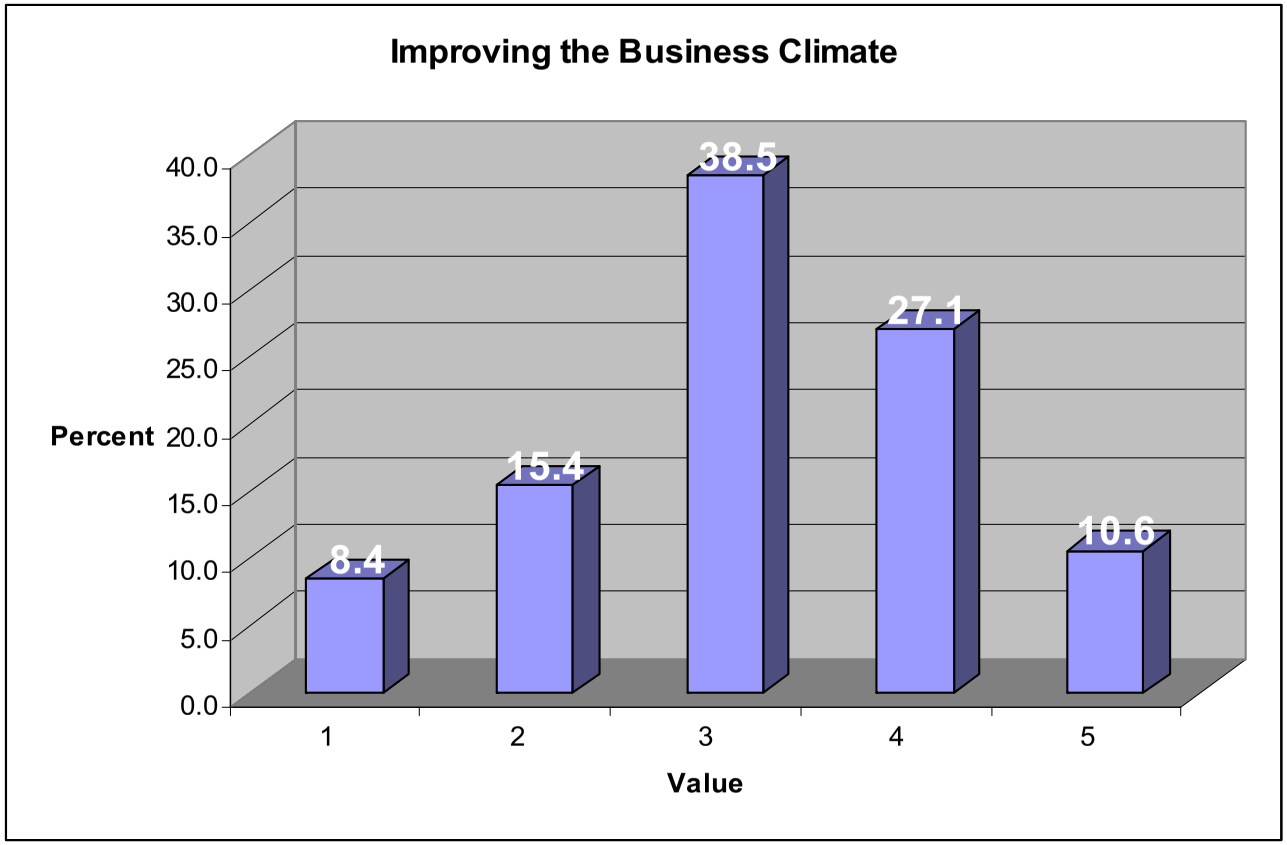
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



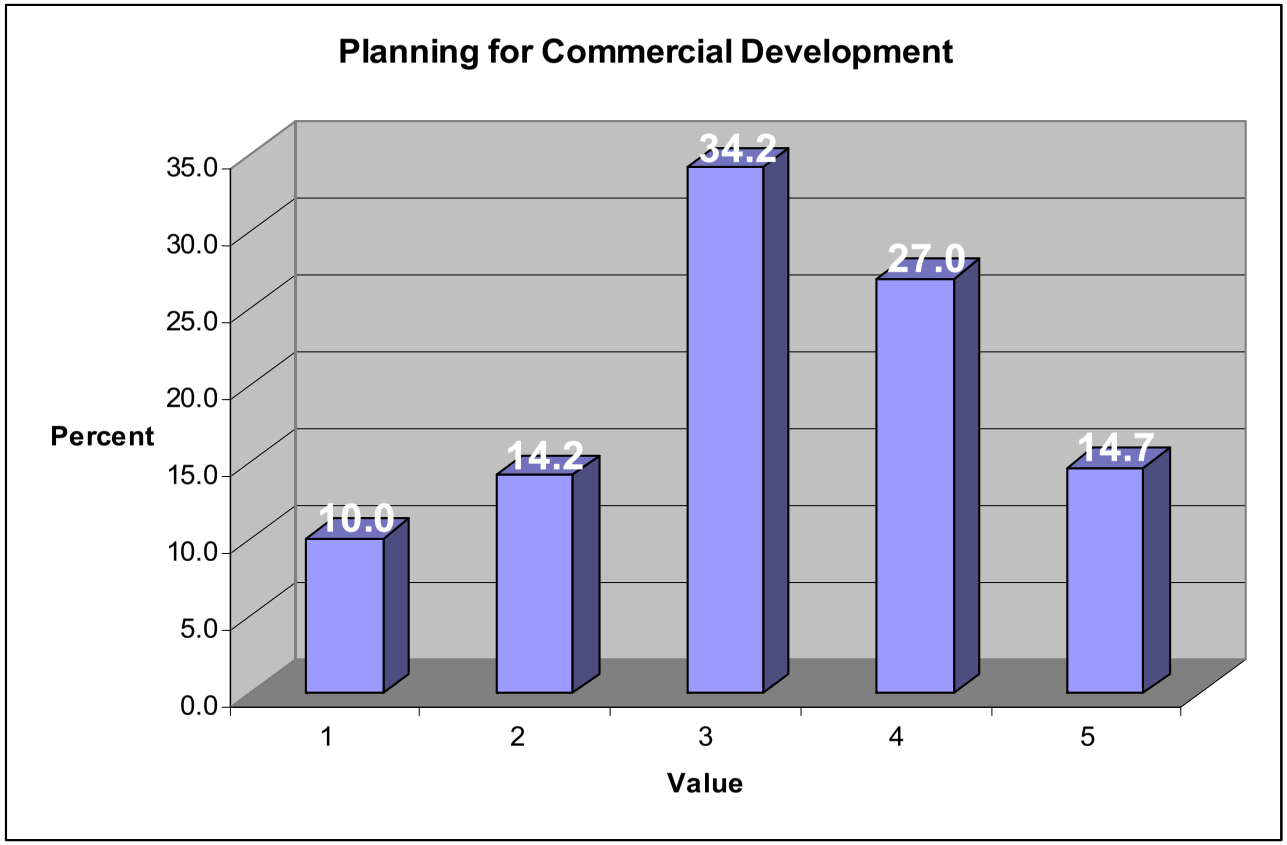
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



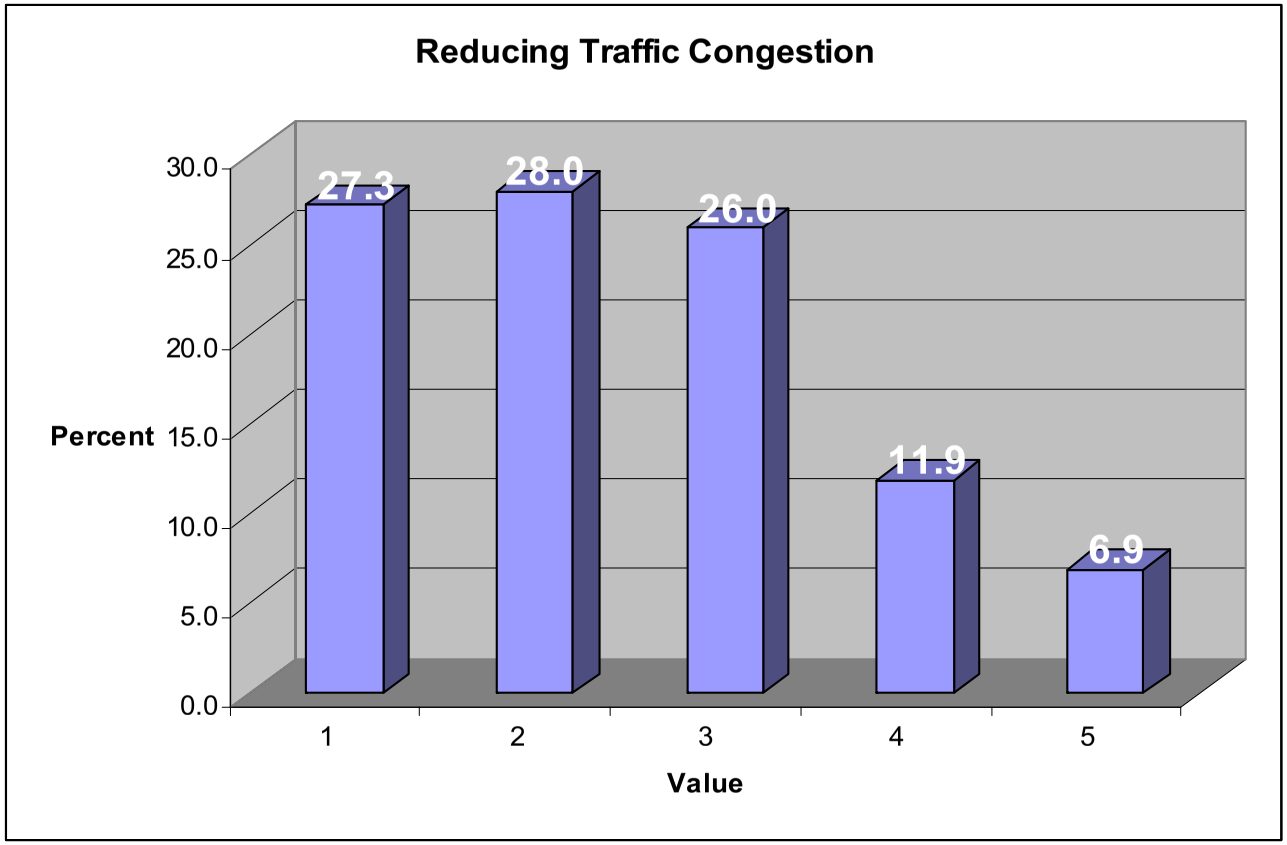
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



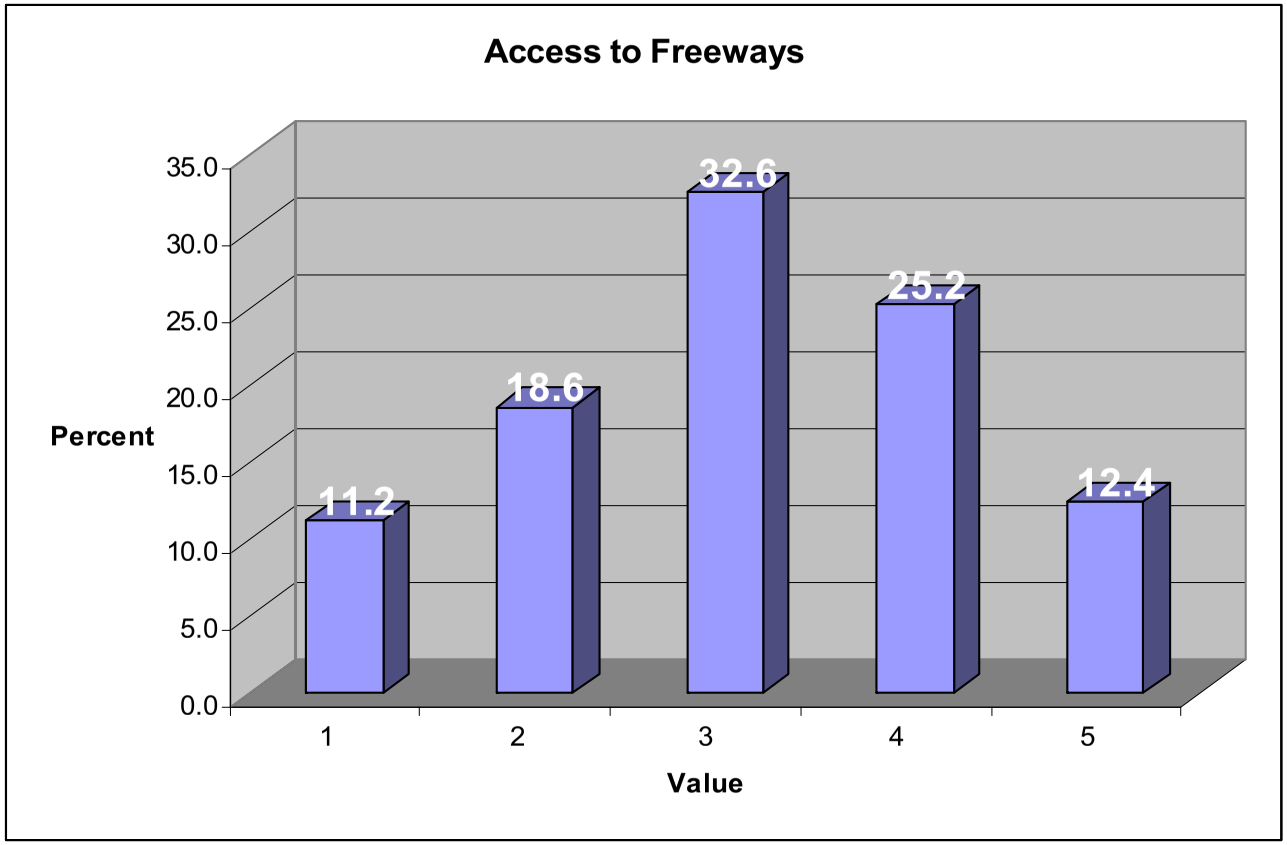
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



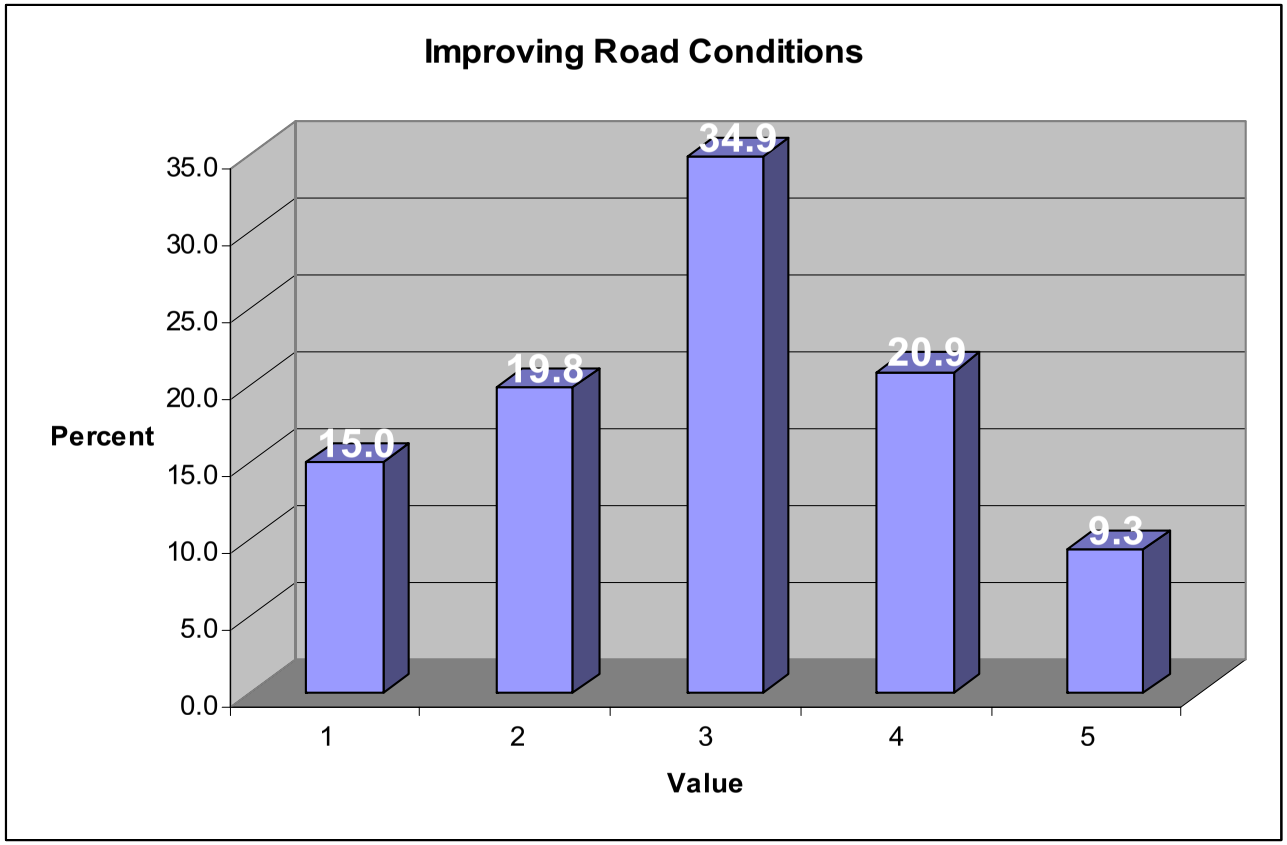
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



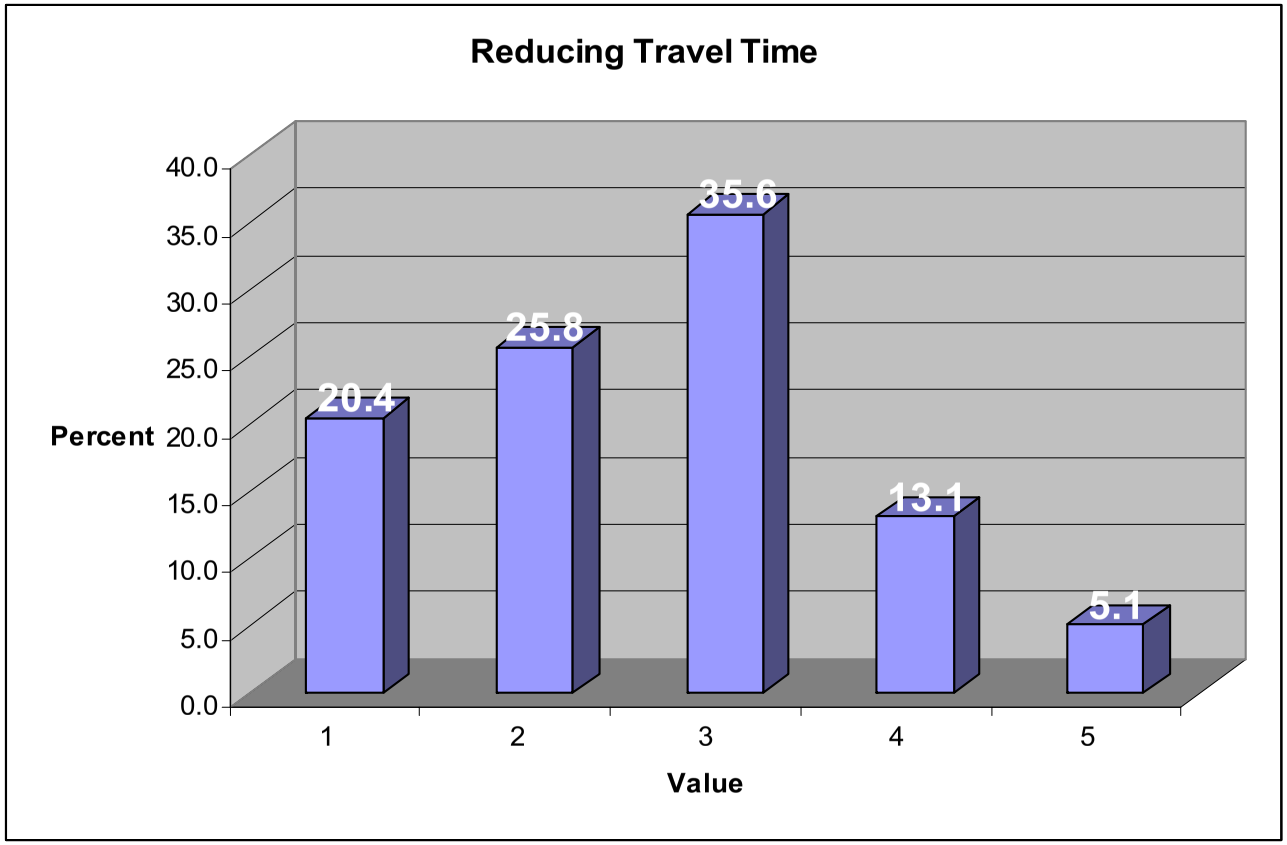
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



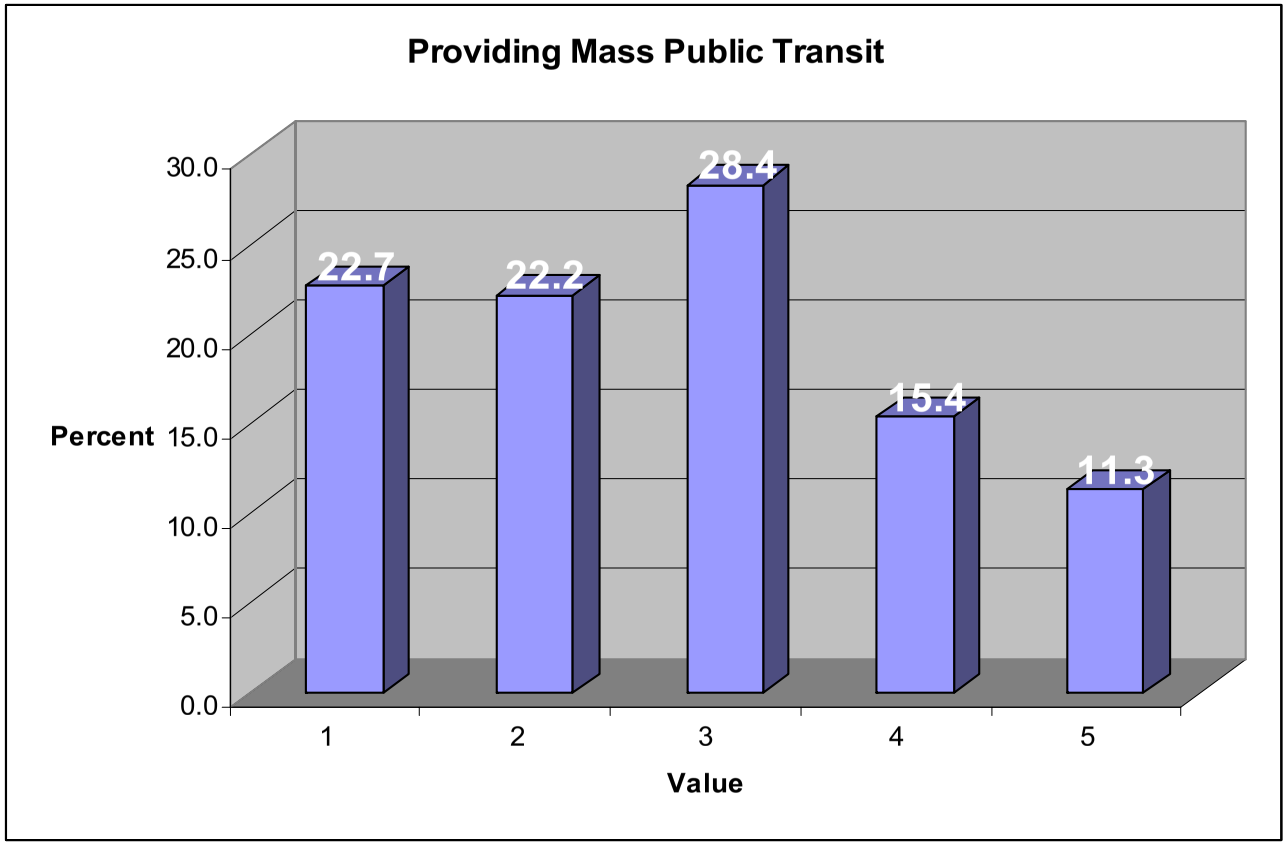
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



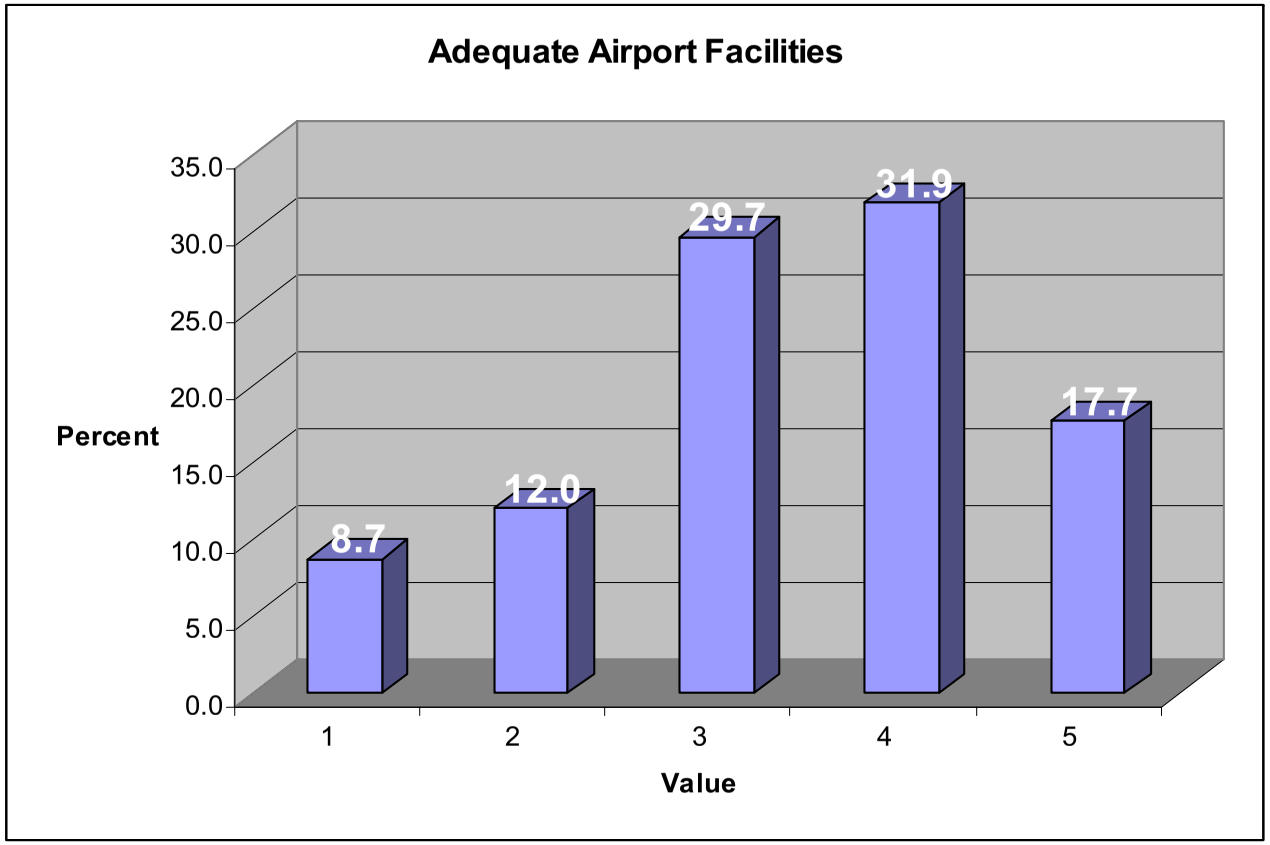
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



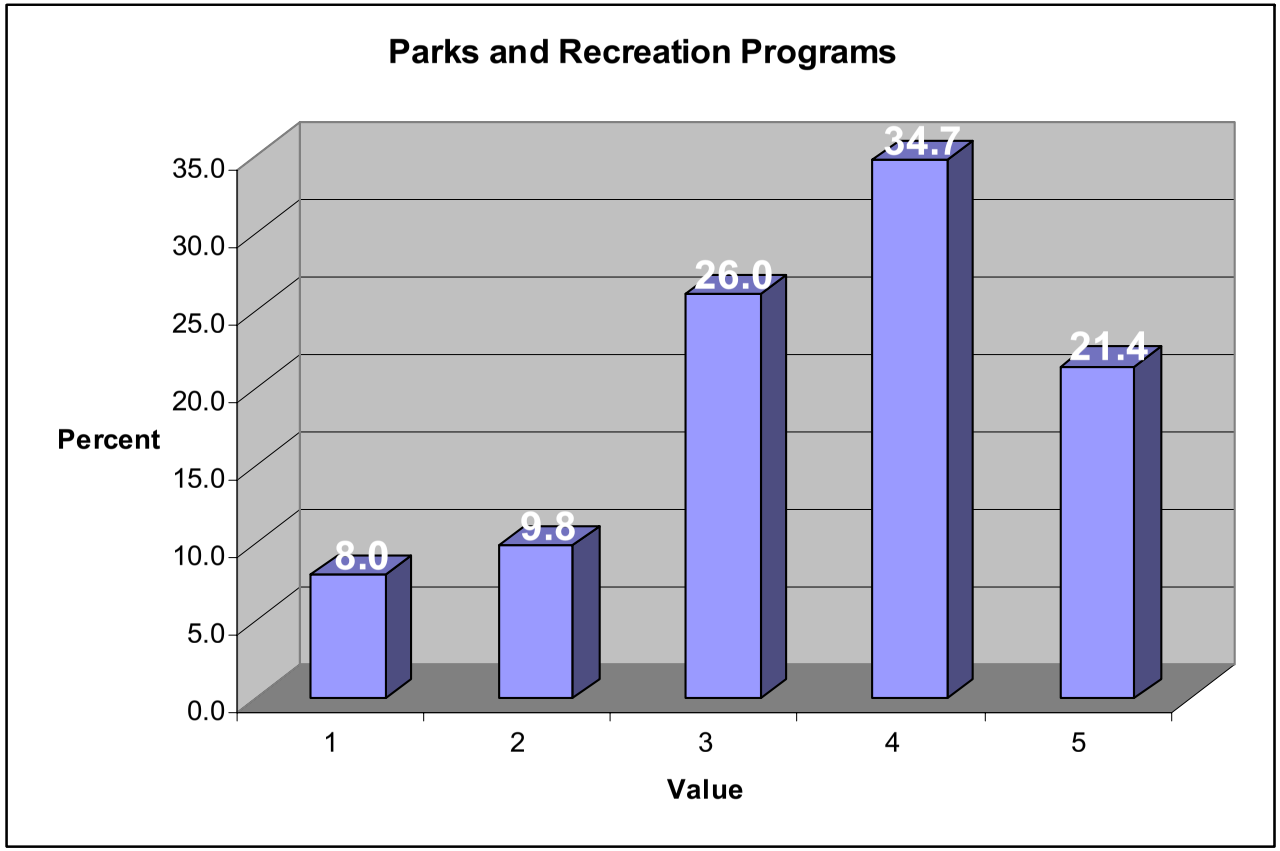
Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

Appendix II Continued
Performance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Note- Graph does not include Don't Know/ No Answer

Appendix II
Performance for Selected Services
Importance scores for General Government
Summary Statistics by Jurisdiction

Unincorporated Clark County		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's views about Yucca Mountain to federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	242	233	228	240	232	239	240
	Missing	0	8	14	2	10	3	2
Mean		2.98	2.59	3.41	2.58	2.89	2.56	3.24
Std. Error of Mean		.074	.072	.079	.075	.082	.071	.083
Median		3.00	3.00	4.00	3.00	3.00	3.00	3.00
Mode		3	3	4	3	3	3	3
Std. Deviation		1.153	1.094	1.186	1.156	1.246	1.097	1.290
Skewness		-.081	.349	-.492	.232	.138	.323	-.303
Std. Error of Skewness		.157	.159	.161	.157	.160	.157	.157
Kurtosis		-.638	-.435	-.475	-.684	-.836	-.291	-.910
Std. Error of Kurtosis		.312	.317	.321	.313	.318	.314	.313
Range		4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for General Government
Summary Statistics by Jurisdiction

City of Las Vegas		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's views about Yucca Mountain to federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	181	170	173	177	172	176	178
	Missing	1	12	9	5	10	6	4
Mean		2.91	2.59	3.57	2.50	2.77	2.45	3.11
Std. Error of Mean		.078	.081	.079	.083	.097	.078	.083
Median		3.00	3.00	4.00	2.00	3.00	2.00	3.00
Mode		3	3	4	3	3	2	3
Std. Deviation		1.048	1.054	1.043	1.103	1.272	1.037	1.105
Skewness		-.077	.177	-.302	.277	.133	.358	-.237
Std. Error of Skewness		.180	.186	.185	.183	.185	.183	.182
Kurtosis		-.401	-.521	-.599	-.665	-1.050	-.438	-.599
Std. Error of Kurtosis		.359	.370	.367	.363	.368	.364	.362
Range		4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for General Government
Summary Statistics by Jurisdiction

City of North Las Vegas		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's views about Yucca Mountain to federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	64	63	63	64	61	62	64
	Missing	0	1	1	0	3	3	0
Mean		2.87	2.34	3.60	2.53	2.68	2.57	3.33
Std. Error of Mean		.124	.134	.122	.151	.164	.125	.159
Median		3.00	2.00	4.00	3.00	3.00	3.00	4.00
Mode		3	2	4	3	3	3	4
Std. Deviation		.991	1.062	.970	1.206	1.280	.983	1.276
Skewness		-.312	.501	-.629	.214	.126	-.129	-.581
Std. Error of Skewness		.299	.301	.301	.300	.306	.305	.299
Kurtosis		-.265	-.464	.552	-.881	-1.032	-.744	-.749
Std. Error of Kurtosis		.590	.594	.594	.592	.603	.601	.590
Range		4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for General Government
Summary Statistics by Jurisdiction

City of Henderson		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's views about Yucca Mountain to federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	84	84	81	81	82	81	83
	Missing	0	0	3	3	3	3	2
Mean		2.90	2.58	3.45	2.63	2.84	2.50	3.39
Std. Error of Mean		.116	.124	.104	.113	.127	.117	.121
Median		3.00	3.00	3.00	3.00	3.00	2.00	4.00
Mode		3	3	3	3	3	2	4
Std. Deviation		1.064	1.136	.941	1.022	1.145	1.054	1.103
Skewness		-.190	.266	-.233	-.096	.089	.570	-.757
Std. Error of Skewness		.262	.262	.267	.267	.266	.267	.265
Kurtosis		-.433	-.634	.087	-.388	-.418	-.028	-.108
Std. Error of Kurtosis		.519	.519	.528	.528	.527	.528	.524
Range		4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for General Government
Summary Statistics by Jurisdiction

Boulder City		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's views about Yucca Mountain to federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	19	19	19	19	18	19	19
	Missing	0	0	0	0	1	0	0
Mean		3.10	2.79	3.61	2.55	2.45	2.27	2.84
Std. Error of Mean		.260	.265	.293	.244	.263	.207	.299
Median		3.00	3.00	3.86	3.00	2.00	2.00	3.00
Mode		3	2	5	3	2	3	4
Std. Deviation		1.137	1.157	1.278	1.066	1.121	.903	1.291
Skewness		.003	.450	-.529	.125	.491	-.145	-.123
Std. Error of Skewness		.523	.523	.523	.523	.534	.523	.528
Kurtosis		.139	-.314	-.500	-.542	-.644	-.982	-1.423
Std. Error of Kurtosis		1.012	1.012	1.012	1.012	1.033	1.012	1.023
Range		4	4	4	4	4	3	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	4	5

Appendix II
Performance for Selected Services
Importance scores for General Government
Summary Statistics by Jurisdiction

Mesquite		Road maintenance	Revitalizing older neighborhoods	Flood control	Budget management	Communicate Clark County's views about Yucca Mountain to federal decision makers	Monitor and report to the public on how well government services are being performed	Water conservation programs
N	Valid	8	8	7	8	7	8	8
	Missing	0	0	1	0	1	0	0
Mean		3.34	2.43	2.45	3.24	3.55	2.36	3.08
Std. Error of Mean		.457	.460	.420	.409	.497	.223	.502
Median		3.73	2.10	3.00	3.00	3.00	2.00	3.00
Mode		2	1	3	3	5	2	3(a)
Std. Deviation		1.321	1.330	1.147	1.184	1.358	.628	1.451
Skewness		.088	.462	.293	.689	.118	1.728	-.168
Std. Error of Skewness		.739	.739	.773	.739	.773	.755	.739
Kurtosis		-2.029	-.774	1.395	-.807	-2.175	3.265	-1.073
Std. Error of Kurtosis		1.449	1.449	1.533	1.449	1.533	1.488	1.449
Range		3	4	4	3	3	2	4
Minimum		2	1	1	2	2	2	1
Maximum		5	5	5	5	5	4	5

Appendix II
Performance for Selected Services
Importance scores for Social and Judicial Services
Summary Statistics by Jurisdiction

Unincorporated Clark County		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	234	236	232	234	235	234	233	237	232
	Missing	8	5	9	8	7	7	9	5	9
Mean		2.88	2.82	2.87	2.46	2.40	2.26	2.63	2.66	3.42
Std. Error of Mean		.070	.067	.075	.071	.075	.077	.074	.082	.081
Median		3.00	3.00	3.00	2.72	2.00	2.00	3.00	3.00	3.00
Mode		3	3	3	3	2	1	3	3	3
Std. Deviation		1.072	1.027	1.136	1.086	1.152	1.175	1.125	1.269	1.231
Skewness		.094	.088	.133	.268	.408	.610	.208	.257	-.480
Std. Error of Skewness		.159	.158	.160	.159	.159	.159	.159	.158	.160
Kurtosis		-.550	-.231	-.474	-.592	-.721	-.506	-.583	-.964	-.552
Std. Error of Kurtosis		.317	.315	.318	.317	.316	.317	.318	.315	.318
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Social and Judicial Services
Summary Statistics by Jurisdiction

City of Las Vegas		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	179	174	175	171	175	178	177	175	176
	Missing	3	8	7	11	8	4	5	7	6
Mean		2.79	2.77	2.75	2.60	2.44	2.16	2.58	2.56	3.07
Std. Error of Mean		.081	.084	.082	.078	.079	.083	.087	.089	.094
Median		3.00	3.00	3.00	3.00	2.00	2.00	3.00	3.00	3.00
Mode		3	3	3	3	2	1	3	3	3
Std. Deviation		1.080	1.114	1.081	1.021	1.040	1.113	1.156	1.182	1.246
Skewness		.138	.248	-.040	.269	.382	.575	.331	.228	-.187
Std. Error of Skewness		.182	.184	.183	.186	.184	.182	.183	.183	.183
Kurtosis		-.373	-.505	-.646	-.326	-.375	-.656	-.631	-.809	-.922
Std. Error of Kurtosis		.361	.366	.365	.369	.366	.362	.363	.365	.364
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

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Appendix II
Performance for Selected Services
Importance scores for Social and Judicial Services
Summary Statistics by Jurisdiction

City of North Las Vegas		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	62	62	63	63	61	64	60	61	61
	Missing	2	2	1	1	4	0	5	3	3
Mean		2.48	2.51	2.71	2.34	2.32	2.13	2.57	2.37	3.20
Std. Error of Mean		.126	.131	.130	.124	.131	.146	.142	.158	.167
Median		3.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00
Mode		3	3	3	2	3	1	2	1	4
Std. Deviation		.988	1.028	1.032	.985	1.022	1.164	1.093	1.232	1.308
Skewness		-.190	-.068	.113	.410	.109	.876	.315	.495	-.198
Std. Error of Skewness		.305	.305	.301	.302	.307	.300	.310	.307	.306
Kurtosis		-1.002	-1.104	-.415	-.305	-1.127	-.032	-.616	-.728	-1.151
Std. Error of Kurtosis		.601	.601	.594	.596	.606	.592	.611	.605	.603
Range		3	3	4	4	3	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		4	4	5	5	4	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Social and Judicial Services
Summary Statistics by Jurisdiction

City of Henderson		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	79	78	81	80	78	81	83	82	82
	Missing	5	6	3	4	6	3	1	2	2
Mean		3.16	3.01	3.05	2.68	2.36	2.14	2.68	2.61	3.19
Std. Error of Mean		.116	.114	.104	.106	.104	.102	.120	.117	.122
Median		3.00	3.00	3.00	3.00	2.00	2.00	3.00	3.00	3.00
Mode		3	3	3	3	2	2	3	3	4
Std. Deviation		1.030	1.004	.936	.950	.921	.919	1.097	1.060	1.110
Skewness		-.146	.149	-.252	.262	.865	.290	.138	.221	-.250
Std. Error of Skewness		.270	.272	.267	.269	.271	.267	.264	.265	.265
Kurtosis		-.008	.270	.221	.199	1.114	-.630	-.646	-.350	-.608
Std. Error of Kurtosis		.535	.538	.528	.532	.537	.528	.522	.525	.525
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Social and Judicial Services
Summary Statistics by Jurisdiction

Boulder City		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	19	19	17	19	19	19	16	19	19
	Missing	0	0	2	0	0	0	3	0	0
Mean		2.61	2.59	2.52	2.48	2.61	2.02	2.43	2.53	3.43
Std. Error of Mean		.252	.221	.282	.222	.274	.237	.229	.304	.269
Median		3.00	3.00	3.00	2.00	2.00	2.00	2.00	3.00	4.00
Mode		3	3	3	2	2	2	2	1	4
Std. Deviation		1.086	.954	1.167	.958	1.181	1.034	.931	1.329	1.162
Skewness		.115	.506	.148	.444	.563	1.065	1.162	.039	-.530
Std. Error of Skewness		.528	.528	.548	.528	.528	.523	.557	.523	.528
Kurtosis		-.087	1.078	-.409	.316	-.300	1.032	2.565	-1.601	-.503
Std. Error of Kurtosis		1.023	1.023	1.061	1.023	1.023	1.012	1.078	1.012	1.023
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Social and Judicial Services
Summary Statistics by Jurisdiction

Mesquite		Providing child protection services	Providing child welfare services	Providing juvenile justice services	Providing attainable housing for working class families	Providing affordable housing for low income families	Providing shelter for the homeless	Providing affordable housing for seniors	Providing medical care for the poor	Providing 24 hour emergency trauma care
N	Valid	8	7	8	8	8	8	8	8	8
	Missing	0	1	0	0	0	0	0	0	0
Mean		3.00	2.94	2.69	2.33	2.69	2.31	3.33	2.75	3.64
Std. Error of Mean		.298	.268	.377	.567	.536	.521	.439	.477	.394
Median		3.00	3.00	3.00	2.00	2.50	2.00	3.05	2.00	3.50
Mode		3	3	3	2	1(a)	2	3	2	3
Std. Deviation		.838	.734	1.062	1.594	1.507	1.507	1.236	1.342	1.108
Skewness		.000	.097	-.678	1.162	.540	1.220	-.168	1.117	-.574
Std. Error of Skewness		.755	.773	.755	.755	.755	.739	.755	.755	.755
Kurtosis		-1.479	-.336	-.170	-.031	-.765	.585	-.369	.036	1.862
Std. Error of Kurtosis		1.488	1.533	1.488	1.488	1.488	1.449	1.488	1.488	1.488
Range		2	2	3	4	4	4	4	4	4
Minimum		2	2	1	1	1	1	1	1	1
Maximum		4	4	4	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Public Services
Summary Statistics by Jurisdiction

Unincorporated Clark County		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	234	239	238	236	233	235	234	235
	Missing	8	3	4	5	8	7	7	6
Mean		3.07	2.98	2.81	2.78	3.06	3.68	3.86	3.98
Std. Error of Mean		.071	.081	.074	.077	.077	.073	.068	.064
Median		3.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00
Mode		3	3	3	3	3	4	4	4
Std. Deviation		1.082	1.257	1.148	1.181	1.171	1.114	1.043	.983
Skewness		-.161	-.081	.028	.133	-.314	-.732	-.869	-.868
Std. Error of Skewness		.159	.158	.158	.158	.159	.159	.159	.159
Kurtosis		-.302	-.967	-.800	-.694	-.740	-.026	.405	.399
Std. Error of Kurtosis		.317	.314	.314	.315	.317	.316	.317	.316
Range		4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Public Services
Summary Statistics by Jurisdiction

Unincorporated Clark County (cont)	Facilitate neighborhood watch programs	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents and terrorist events	Investigating criminal activity	Providing fire protection and prevention services	Providing emergency medical services	Providing neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	230	233	227	234	236	235	235	235	238
Missing	12	8	14	7	6	7	7	7	4
Mean	2.81	3.03	3.05	3.19	3.68	3.87	3.05	2.84	3.13
Std. Error of Mean	.078	.079	.079	.071	.071	.068	.076	.083	.078
Median	3.00	3.00	3.00	3.00	4.00	4.00	3.00	3.00	3.00
Mode	3	3	3	3	4	4	3	3	3
Std. Deviation	1.182	1.212	1.189	1.082	1.084	1.047	1.162	1.271	1.198
Skewness	.162	-.107	-.046	-.172	-.412	-.742	-.062	.012	-.324
Std. Error of Skewness	.161	.159	.161	.159	.158	.159	.159	.159	.158
Kurtosis	-.656	-.847	-.799	-.644	-.641	-.072	-.704	-1.036	-.681
Std. Error of Kurtosis	.320	.317	.321	.317	.316	.316	.316	.316	.314
Range	4	4	4	4	4	4	4	4	4
Minimum	1	1	1	1	1	1	1	1	1
Maximum	5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Public Services
Summary Statistics by Jurisdiction

City of Las Vegas		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	178	182	180	177	170	174	175	175
	Missing	4	0	2	5	12	9	7	7
Mean		2.95	2.89	2.79	2.59	3.03	3.79	3.88	3.99
Std. Error of Mean		.073	.085	.083	.089	.093	.080	.078	.073
Median		3.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00
Mode		3	3	3	3	3	4	4	4
Std. Deviation		.973	1.141	1.109	1.186	1.212	1.056	1.034	.964
Skewness		-.062	-.030	.112	.260	-.230	-.887	-.974	-.926
Std. Error of Skewness		.182	.180	.181	.182	.186	.184	.183	.183
Kurtosis		-.057	-.747	-.494	-.761	-.762	.536	.743	.818
Std. Error of Kurtosis		.362	.358	.360	.363	.370	.367	.365	.365
Range		4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Public Services
Summary Statistics by Jurisdiction

City of Las Vegas (cont)	Facilitate neighborhood watch programs	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents and terrorist events	Investigating criminal activity	Providing fire protection and prevention services	Providing emergency medical services	Providing neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	177	177	176	176	173	174	179	170	173
Missing	6	5	7	6	9	8	3	12	9
Mean	2.94	2.98	2.93	3.07	3.66	3.73	2.97	2.90	3.04
Std. Error of Mean	.083	.084	.086	.085	.070	.069	.086	.098	.082
Median	3.00	3.00	3.00	3.00	4.00	4.00	3.00	3.00	3.00
Mode	3	3	3	3	4	4	3	3	3
Std. Deviation	1.098	1.111	1.142	1.131	.922	.916	1.147	1.281	1.084
Skewness	.051	-.100	-.004	-.169	-.427	-.566	.054	.015	-.059
Std. Error of Skewness	.183	.183	.183	.183	.185	.184	.181	.186	.184
Kurtosis	-.501	-.615	-.795	-.587	.001	.111	-.644	-1.030	-.553
Std. Error of Kurtosis	.364	.363	.365	.364	.367	.366	.361	.370	.367
Range	4	4	4	4	4	4	4	4	4
Minimum	1	1	1	1	1	1	1	1	1
Maximum	5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Public Services
Summary Statistics by Jurisdiction

City of North Las Vegas		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	63	64	63	64	63	64	64	60
	Missing	1	0	1	0	2	0	0	4
Mean		3.08	2.96	2.75	2.53	3.01	3.59	3.66	3.79
Std. Error of Mean		.143	.143	.124	.160	.179	.123	.138	.126
Median		3.00	3.00	3.00	2.00	3.00	4.00	4.00	4.00
Mode		3	3	3	2	3	4	4	4
Std. Deviation		1.131	1.145	.988	1.278	1.416	.982	1.104	.977
Skewness		-.072	-.069	.301	.413	-.114	-.646	-.735	-.959
Std. Error of Skewness		.302	.299	.301	.300	.302	.299	.299	.309
Kurtosis		-.291	-.705	-.203	-.922	-1.244	.426	.205	1.219
Std. Error of Kurtosis		.596	.590	.594	.592	.597	.590	.590	.608
Range		4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Public Services
Summary Statistics by Jurisdiction

City of North Las Vegas (cont)	Facilitate neighborhood watch programs	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents and terrorist events	Investigating criminal activity	Providing fire protection and prevention services	Providing emergency medical services	Providing neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
Valid	64	62	63	64	63	64	62	63	62
Missing	0	2	2	0	1	0	2	1	2
Mean	2.69	2.78	2.60	3.25	3.48	3.42	2.99	2.51	2.86
Std. Error of Mean	.138	.151	.147	.171	.151	.154	.157	.173	.146
Median	3.00	3.00	3.00	3.00	4.00	4.00	3.00	2.00	3.00
Mode	3	3	3	5	4	4	3	1	3
Std. Deviation	1.103	1.187	1.159	1.366	1.200	1.229	1.237	1.369	1.150
Skewness	.336	.260	.184	-.152	-.405	-.478	-.215	.360	.209
Std. Error of Skewness	.300	.304	.302	.300	.301	.300	.304	.302	.304
Kurtosis	-.124	-.646	-.540	-1.191	-.727	-.786	-.911	-1.147	-.514
Std. Error of Kurtosis	.592	.599	.597	.592	.594	.592	.599	.596	.599
Range	4	4	4	4	4	4	4	4	4
Minimum	1	1	1	1	1	1	1	1	1
Maximum	5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Public Services
Summary Statistics by Jurisdiction

City of Henderson		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	83	84	81	83	79	77	80	83
	Missing	1	0	3	1	5	7	5	1
Mean		3.09	3.13	2.87	2.89	3.33	3.80	3.70	3.69
Std. Error of Mean		.099	.121	.100	.104	.114	.094	.096	.121
Median		3.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00
Mode		3	3	3	3	3	4	4	4
Std. Deviation		.903	1.106	.899	.952	1.010	.821	.859	1.100
Skewness		-.773	-.096	.042	.191	-.076	-.419	-.305	-.896
Std. Error of Skewness		.264	.262	.267	.264	.270	.274	.270	.264
Kurtosis		.495	-.510	-.134	.047	-.442	.171	.102	.493
Std. Error of Kurtosis		.522	.519	.528	.522	.535	.541	.533	.522
Range		4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Public Services
Summary Statistics by Jurisdiction

City of Henderson (cont)	Facilitate neighborhood watch programs	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents and terrorist events	Investigating criminal activity	Providing fire protection and prevention services	Providing emergency medical services	Providing neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	79	81	84	78	80	79	79	79	81
Missing	6	4	0	6	5	5	5	5	3
Mean	2.59	3.07	3.00	3.12	3.62	3.75	3.04	2.70	3.16
Std. Error of Mean	.109	.105	.112	.100	.102	.109	.123	.132	.101
Median	3.00	3.00	3.00	3.00	4.00	4.00	3.00	3.00	3.00
Mode	3	3	3	3	4	4	3	3	4
Std. Deviation	.966	.947	1.023	.886	.913	.973	1.093	1.173	.912
Skewness	-.156	.033	-.106	-.078	-.628	-.929	-.202	.126	-.737
Std. Error of Skewness	.271	.268	.263	.272	.270	.270	.270	.270	.267
Kurtosis	-.555	-.133	-.297	-.343	.772	1.105	-.323	-.666	-.085
Std. Error of Kurtosis	.536	.530	.521	.538	.533	.535	.535	.535	.528
Range	4	4	4	4	4	4	4	4	4
Minimum	1	1	1	1	1	1	1	1	1
Maximum	5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Public Services
Summary Statistics by Jurisdiction

Boulder City		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	18	19	19	19	19	19	19	18
	Missing	2	0	0	0	0	0	0	1
Mean		3.28	3.13	3.06	2.92	3.06	3.93	4.19	4.34
Std. Error of Mean		.166	.219	.235	.277	.263	.216	.147	.148
Median		3.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00
Mode		3	4	2	3	2	4	4	4
Std. Deviation		.696	.956	1.026	1.195	1.149	.931	.643	.630
Skewness		.107	-.545	.248	.275	.362	-.779	-.810	-.387
Std. Error of Skewness		.542	.523	.523	.528	.523	.528	.523	.536
Kurtosis		4.222	-.105	-.677	-.469	-1.092	.210	3.009	-.469
Std. Error of Kurtosis		1.049	1.012	1.012	1.023	1.012	1.023	1.012	1.038
Range		4	4	4	4	4	3	3	2
Minimum		1	1	1	1	1	2	2	3
Maximum		5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Public Services
Summary Statistics by Jurisdiction

Boulder City (cont)	Facilitate neighborhood watch programs	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents and terrorist events	Investigating criminal activity	Providing fire protection and prevention services	Providing emergency medical services	Providing neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	19	19	19	17	19	18	19	18	18
Missing	0	0	0	2	0	1	0	1	1
Mean	2.95	3.15	2.78	2.76	3.93	4.01	2.74	2.44	2.92
Std. Error of Mean	.204	.265	.248	.271	.178	.210	.290	.229	.235
Median	3.00	3.00	3.00	3.00	4.00	4.00	2.86	2.00	3.00
Mode	3	3	3	2	4	4	2	2	3
Std. Deviation	.879	1.146	1.084	1.116	.776	.895	1.268	.976	1.002
Skewness	.101	-.221	-.149	.534	.119	-.622	.196	.430	-.062
Std. Error of Skewness	.528	.528	.523	.551	.523	.534	.523	.534	.534
Kurtosis	-.320	-.047	-.164	-.075	-1.248	-.115	-1.023	-.685	.126
Std. Error of Kurtosis	1.023	1.023	1.012	1.065	1.012	1.033	1.012	1.033	1.033
Range	4	4	4	4	2	3	4	3	4
Minimum	1	1	1	1	3	2	1	1	1
Maximum	5	5	5	5	5	5	5	4	5

Appendix II
Performance for Selected Services
Importance scores for Public Services
Summary Statistics by Jurisdiction

Mesquite		Providing crime prevention programs	Enforcing traffic laws	Maintaining a low crime rate	Maintaining neighborhood police patrols	Keeping police response times low	Keeping fire department response times low	Keeping paramedic and emergency medical response times low	Well trained paramedic and emergency medical response personnel
N	Valid	8	8	8	8	8	8	8	8
	Missing	0	0	0	0	0	0	0	0
Mean		3.00	3.76	3.18	3.72	3.64	3.42	3.84	4.14
Std. Error of Mean		.349	.383	.280	.367	.402	.261	.287	.299
Median		3.00	4.00	3.00	4.00	4.00	3.00	4.00	4.00
Mode		3	3	3	4	4	3	4	5
Std. Deviation		.981	1.109	.811	1.032	1.131	.734	.831	.841
Skewness		.000	-.814	-.394	-1.158	-.631	.360	-.481	-.306
Std. Error of Skewness		.755	.739	.739	.755	.755	.755	.739	.755
Kurtosis		1.675	2.006	6.593	4.121	-.728	1.206	1.042	-1.423
Std. Error of Kurtosis		1.488	1.449	1.449	1.488	1.488	1.488	1.449	1.488
Range		4	4	4	4	3	3	3	2
Minimum		1	1	1	1	2	2	2	3
Maximum		5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Public Services
Summary Statistics by Jurisdiction

Mesquite (cont)	Facilitate neighborhood watch programs	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	Preparing for man made (such as hazardous or radiological materials) accidents and terrorist events	Investigating criminal activity	Providing fire protection and prevention services	Providing emergency medical services	Providing neighborhood code enforcement services	Examining potential impacts from Yucca Mountain nuclear waste shipments	Regional justice services and facilities
N	7	7	8	8	8	8	8	8	8
Missing	1	1	0	0	0	0	0	0	0
Mean	2.43	2.82	2.75	3.40	3.61	3.98	3.22	3.08	3.17
Std. Error of Mean	.522	.341	.354	.248	.310	.286	.295	.414	.192
Median	2.28	3.00	3.00	3.00	4.00	4.00	3.00	3.00	3.00
Mode	1(a)	3	3	3	4	4	3	3	3
Std. Deviation	1.427	.931	.997	.719	.898	.827	.854	1.165	.540
Skewness	.829	-.253	.118	.462	-.573	.046	.272	.594	3.651
Std. Error of Skewness	.773	.773	.755	.739	.739	.739	.739	.755	.755
Kurtosis	.402	5.649	2.707	1.278	.503	-1.407	.407	1.015	16.710
Std. Error of Kurtosis	1.533	1.533	1.488	1.449	1.449	1.449	1.449	1.488	1.488
Range	4	4	4	3	3	2	3	4	2
Minimum	1	1	1	2	2	3	2	1	3
Maximum	5	5	5	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

Unincorporated Clark County		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion
N	Valid	234	236	236	233	232	241
	Missing	8	6	5	9	10	0
Mean		2.49	2.45	2.92	3.15	3.17	2.47
Std. Error of Mean		.077	.080	.077	.078	.082	.079
Median		2.55	2.00	3.00	3.00	3.00	2.00
Mode		3	1	3	3	3	2
Std. Deviation		1.178	1.234	1.187	1.193	1.244	1.234
Skewness		.372	.409	.061	-.238	-.195	.557
Std. Error of Skewness		.159	.159	.158	.159	.160	.157
Kurtosis		-.636	-.774	-.721	-.752	-.820	-.578
Std. Error of Kurtosis		.317	.316	.315	.318	.319	.312
Range		4	4	4	4	4	4
Minimum		1	1	1	1	1	1
Maximum		5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

Unincorporated Clark County (cont)	Access to free ways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	239	241	236	236	237	239
Missing	3	0	6	5	5	3
Mean	3.04	2.91	2.58	2.80	3.39	3.50
Std. Error of Mean	.076	.078	.074	.086	.077	.072
Median	3.00	3.00	3.00	3.00	3.87	4.00
Mode	3	3	3	3	4	4
Std. Deviation	1.180	1.217	1.139	1.323	1.181	1.114
Skewness	-.104	-.027	.232	.184	-.446	-.653
Std. Error of Skewness	.158	.157	.158	.158	.158	.157
Kurtosis	-.746	-.879	-.673	-1.020	-.538	-.101
Std. Error of Kurtosis	.314	.312	.316	.315	.315	.314
Range	4	4	4	4	4	4
Minimum	1	1	1	1	1	1
Maximum	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

City of Las Vegas		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion
N	Valid	169	178	177	178	173	180
	Missing	14	4	5	4	9	2
Mean		2.59	2.37	2.95	3.17	3.27	2.36
Std. Error of Mean		.080	.091	.085	.080	.087	.087
Median		3.00	2.00	3.00	3.00	3.00	2.00
Mode		3	1	3	3	3	2
Std. Deviation		1.044	1.208	1.135	1.064	1.141	1.169
Skewness		.234	.426	.016	-.154	-.316	.552
Std. Error of Skewness		.187	.182	.183	.182	.185	.181
Kurtosis		-.379	-.914	-.658	-.376	-.558	-.496
Std. Error of Kurtosis		.372	.362	.363	.362	.367	.360
Range		4	4	4	4	4	4
Minimum		1	1	1	1	1	1
Maximum		5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

City of Las Vegas (cont)	Access to free ways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	176	180	181	171	178	174
Missing	6	2	2	11	5	8
Mean	3.04	2.82	2.47	2.61	3.35	3.45
Std. Error of Mean	.084	.085	.080	.095	.089	.091
Median	3.00	3.00	3.00	3.00	3.00	4.00
Mode	3	3	3	3	4	4
Std. Deviation	1.111	1.148	1.071	1.238	1.189	1.198
Skewness	-.171	.131	.256	.345	-.371	-.489
Std. Error of Skewness	.183	.181	.181	.186	.182	.184
Kurtosis	-.683	-.616	-.461	-.806	-.657	-.591
Std. Error of Kurtosis	.364	.360	.360	.369	.363	.366
Range	4	4	4	4	4	4
Minimum	1	1	1	1	1	1
Maximum	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

City of North Las Vegas		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion
N	Valid	63	63	62	62	64	62
	Missing	1	1	2	2	0	2
Mean		2.53	2.25	2.87	3.26	3.25	2.19
Std. Error of Mean		.132	.138	.148	.116	.134	.141
Median		3.00	2.00	3.00	3.00	3.00	2.00
Mode		3	3	2	3	4	1
Std. Deviation		1.049	1.097	1.165	.913	1.067	1.110
Skewness		.107	.636	.150	-.366	-.365	.491
Std. Error of Skewness		.302	.302	.304	.304	.300	.305
Kurtosis		-.647	-.003	-.821	.239	-.464	-.832
Std. Error of Kurtosis		.596	.596	.600	.599	.592	.601
Range		4	4	4	4	4	4
Minimum		1	1	1	1	1	1
Maximum		5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

City of North Las Vegas (cont)	Access to free ways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	64	64	61	64	62	64
Missing	0	0	4	0	2	0
Mean	3.17	2.60	2.35	2.53	3.34	3.61
Std. Error of Mean	.163	.144	.136	.167	.153	.160
Median	3.00	3.00	2.00	2.00	3.53	4.00
Mode	4	3	2	1	4	5
Std. Deviation	1.303	1.151	1.056	1.341	1.203	1.281
Skewness	-.103	-.056	.384	.398	-.512	-.554
Std. Error of Skewness	.300	.299	.307	.299	.304	.300
Kurtosis	-1.193	-.974	-.716	-1.081	-.475	-.720
Std. Error of Kurtosis	.592	.590	.606	.590	.599	.592
Range	4	4	4	4	4	4
Minimum	1	1	1	1	1	1
Maximum	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

City of Henderson		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion
N	Valid	81	84	82	81	82	81
	Missing	4	0	2	3	2	3
Mean		2.75	2.71	3.02	3.20	3.31	2.63
Std. Error of Mean		.103	.124	.122	.099	.120	.134
Median		3.00	3.00	3.00	3.00	3.00	3.00
Mode		3	3	3	3	3	3
Std. Deviation		.924	1.136	1.108	.888	1.089	1.209
Skewness		-.071	.113	-.255	-.159	-.514	.151
Std. Error of Skewness		.268	.262	.265	.267	.265	.267
Kurtosis		.119	-.691	-.434	.644	.086	-.924
Std. Error of Kurtosis		.530	.519	.525	.528	.525	.528
Range		4	4	4	4	4	4
Minimum		1	1	1	1	1	1
Maximum		5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

City of Henderson (cont)	Access to free ways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	84	83	84	83	81	84
Missing	0	2	0	2	3	0
Mean	3.39	3.15	2.71	2.85	3.58	3.62
Std. Error of Mean	.124	.117	.117	.139	.119	.124
Median	3.00	3.00	3.00	3.00	4.00	4.00
Mode	3	3	3	3	4	4
Std. Deviation	1.131	1.066	1.077	1.261	1.071	1.135
Skewness	-.362	-.029	.108	.044	-.664	-.811
Std. Error of Skewness	.263	.265	.262	.265	.267	.263
Kurtosis	-.320	-.463	-.339	-.880	.191	.190
Std. Error of Kurtosis	.521	.524	.519	.524	.528	.521
Range	4	4	4	4	4	4
Minimum	1	1	1	1	1	1
Maximum	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

Boulder City		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion
N	Valid	19	19	18	19	19	19
	Missing	0	0	1	0	0	0
Mean		2.28	3.27	2.32	2.92	2.82	2.31
Std. Error of Mean		.247	.351	.227	.226	.214	.304
Median		2.00	3.00	2.00	3.00	3.00	2.00
Mode		2	5	3	3	3	1
Std. Deviation		1.077	1.533	.954	.976	.934	1.310
Skewness		.487	-.136	-.040	-.090	.802	.880
Std. Error of Skewness		.523	.523	.540	.528	.523	.528
Kurtosis		-.284	-1.520	-.907	.370	.741	-.024
Std. Error of Kurtosis		1.012	1.012	1.044	1.023	1.012	1.023
Range		4	4	3	4	4	4
Minimum		1	1	1	1	1	1
Maximum		5	5	4	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

Boulder City (cont)	Access to free ways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	18	19	18	19	19	19
Missing	1	0	2	0	0	0
Mean	2.93	3.43	2.99	2.39	3.03	3.99
Std. Error of Mean	.275	.223	.250	.248	.216	.241
Median	3.00	3.14	3.00	2.14	3.00	4.00
Mode	3	3	3	3	3	5
Std. Deviation	1.166	.973	1.045	1.085	.943	1.051
Skewness	.218	-.246	.076	.260	-.270	-.611
Std. Error of Skewness	.536	.523	.542	.523	.523	.523
Kurtosis	-.032	.017	.201	-.524	-.386	-.835
Std. Error of Kurtosis	1.038	1.012	1.049	1.012	1.012	1.012
Range	4	4	4	4	4	3
Minimum	1	1	1	1	1	2
Maximum	5	5	5	5	5	5

Appendix II
Performance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

Mesquite		Providing affordable housing	Managing growth	Increasing job opportunities	Improving the business climate	Planning for commercial development	Reducing traffic congestion
N	Valid	7	8	8	8	8	8
	Missing	1	0	0	0	0	0
Mean		2.61	2.31	2.53	2.69	3.45	3.05
Std. Error of Mean		.370	.474	.479	.370	.420	.339
Median		2.73	2.00	2.00	2.00	3.00	3.00
Mode		2	2	2	2	3	3
Std. Deviation		1.012	1.333	1.349	1.071	1.216	.981
Skewness		-.037	.885	.436	.414	.281	-.131
Std. Error of Skewness		.773	.755	.755	.739	.739	.739
Kurtosis		-.497	-.113	-1.014	-1.640	-1.493	1.273
Std. Error of Kurtosis		1.533	1.488	1.488	1.449	1.449	1.449
Range		3	4	4	3	3	4
Minimum		1	1	1	1	2	1
Maximum		4	5	5	4	5	5

Appendix II
Performance for Selected Services
Importance scores for Community Development
Summary Statistics by Jurisdiction

Mesquite (cont)	Access to free ways	Improving road conditions	Reducing travel time	Providing mass public transit	Adequate airport facilities	Parks and recreation programs
N	8	8	8	8	8	8
Missing	0	0	0	0	0	0
Mean	2.54	2.74	3.31	2.67	2.74	2.61
Std. Error of Mean	.463	.461	.456	.475	.337	.393
Median	2.10	3.00	3.00	2.95	3.00	3.00
Mode	2	4	3	1(a)	3	3
Std. Deviation	1.340	1.334	1.284	1.337	.975	1.138
Skewness	.655	-.078	.081	.058	.656	.224
Std. Error of Skewness	.739	.739	.755	.755	.739	.739
Kurtosis	-.081	-1.183	-.582	-1.072	1.797	.550
Std. Error of Kurtosis	1.449	1.449	1.488	1.488	1.449	1.449
Range	4	4	4	4	4	4
Minimum	1	1	1	1	1	1
Maximum	5	5	5	5	5	5

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Appendix III

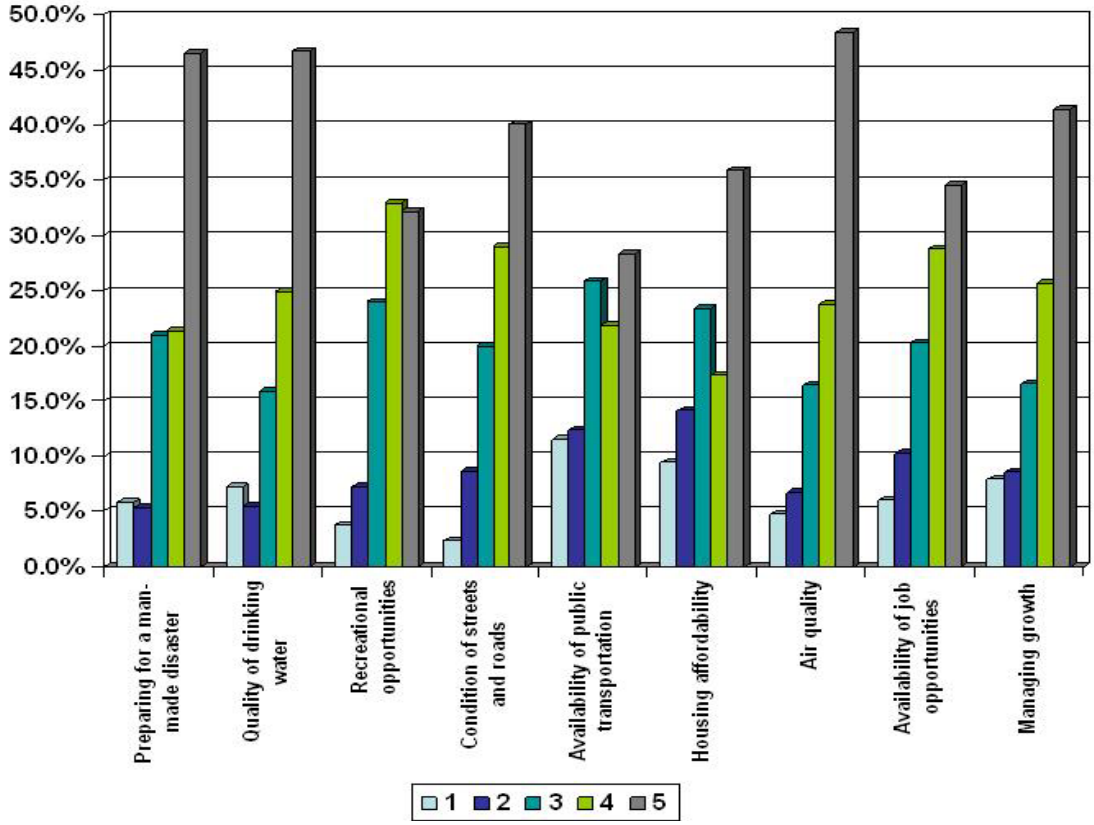
Quality of Life Considerations

Appendix III
Quality of Life Considerations
Summary Statistics

		Overall sense of preparedness in the event of a large scale natural or man-made emergency	Quality of drinking water	Recreational opportunities	Condition of streets and roads	Availability of public transportation	Housing affordability	Air quality	Availability of job opportunities	Managing growth
N	Valid	582	594	596	599	591	594	599	592	598
	Missing	17	5	3	1	9	6	1	8	2
Mean		3.98	3.99	3.83	3.96	3.44	3.56	4.04	3.76	3.84
Std. Error of Mean		.049	.050	.044	.044	.054	.055	.047	.049	.052
Median		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Mode		5	5	4	5	5	5	5	5	5
Std. Deviation		1.187	1.220	1.073	1.075	1.323	1.346	1.157	1.202	1.268
Variance		1.409	1.489	1.151	1.156	1.751	1.813	1.338	1.444	1.607
Skewness		-.978	-1.107	-.719	-.789	-.396	-.443	-1.078	-.717	-.886
Std. Error of Skewness		.101	.100	.100	.100	.101	.100	.100	.100	.100
Kurtosis		.064	.272	-.065	-.211	-.940	-1.028	.257	-.420	-.293
Std. Error of Kurtosis		.202	.200	.200	.199	.201	.200	.199	.200	.199
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations

	1	2	3	4	5	DK/ No answer	Total
Preparing for a man-made disaster	5.6	5.2	20.4	20.8	45.2	2.9	100.0
Quality of drinking water	7.1	5.3	15.6	24.7	46.3	0.9	100.0
Recreational opportunities	3.6	7.1	23.9	32.8	32.0	0.6	100.0
Condition of streets and roads	2.3	8.6	20.0	28.9	40.0	0.2	100.0
Availability of public transportation	11.3	12.1	25.5	21.6	28.0	1.5	100.0
Housing affordability	9.3	13.9	23.2	17.1	35.6	0.9	100.0
Air Quality	4.7	6.7	16.4	23.8	48.3	0.2	100.0
Availability of job opportunities	5.9	10.1	20.1	28.5	34.1	1.3	100.0
Managing growth	7.9	7.9	7.9	7.9	7.9	7.9	100.0

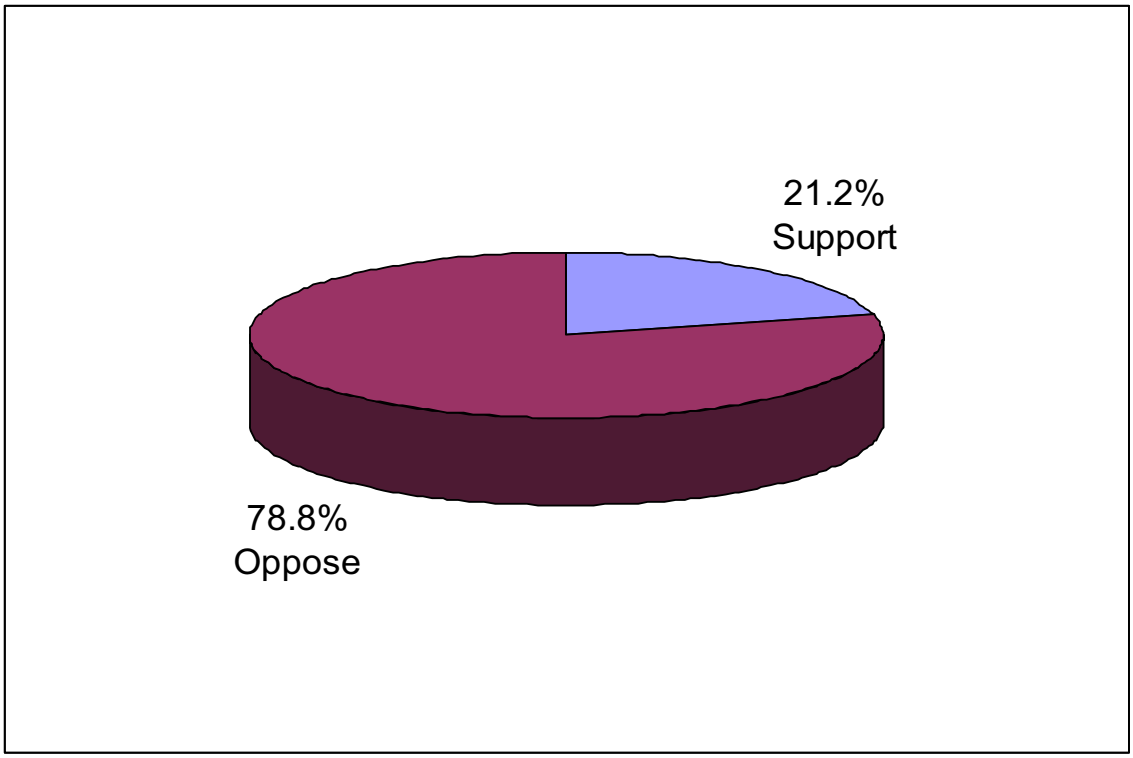


Note- Graph does not include Don't Know/ No Answer

Appendix III
Quality of Life Considerations

The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain. If given the opportunity to vote on this matter, would you support or oppose locating a nuclear waste repository at Yucca Mountain

	Frequency	Percent
Support	123	20.5
Oppose	457	76.2
Total	580	96.7
DK/No answer	20	3.3
Total	600	100.0

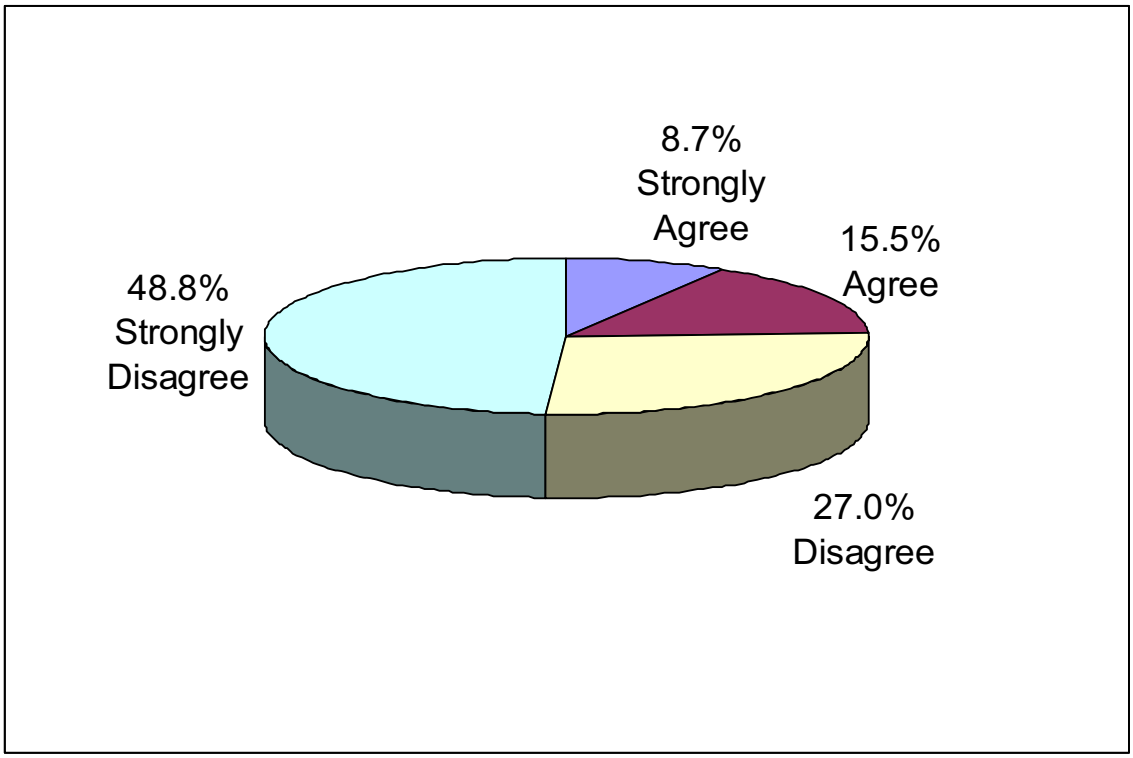


Note- Graph does not include Don't Know/ No Answer

Appendix III
Quality of Life Considerations

The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you agree or disagree with this claim?

	Frequency	Percent
Strongly agree	51	8.5
Agree	90	15.1
Disagree	158	26.3
Strongly disagree	285	47.5
Total	583	97.3
DK/No answer	16	2.7
Total	600	100.0

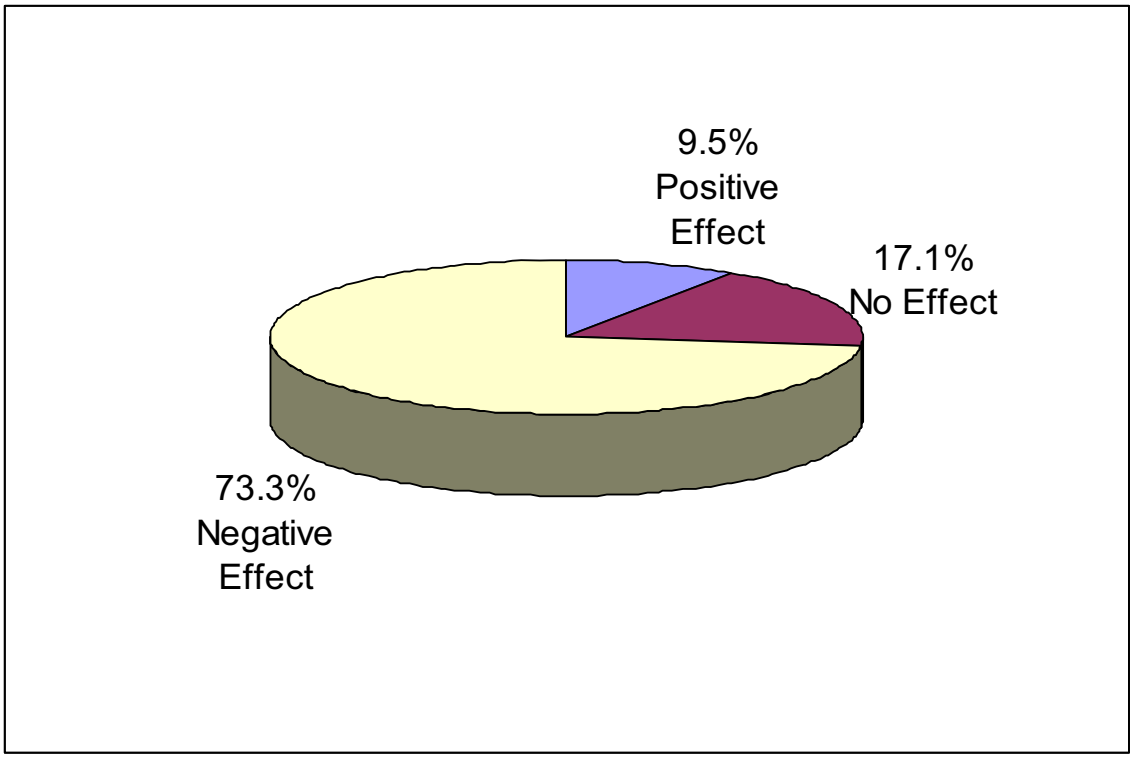


Note- Graph does not include Don't Know/ No Answer

Appendix III
Quality of Life Considerations

Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative affect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.

	Frequency	Percent
Positive effect	56	9.3
No effect	100	16.7
Negative effect	430	71.7
Total	586	97.8
DK/No answer	13	2.2
Total	600	100.0

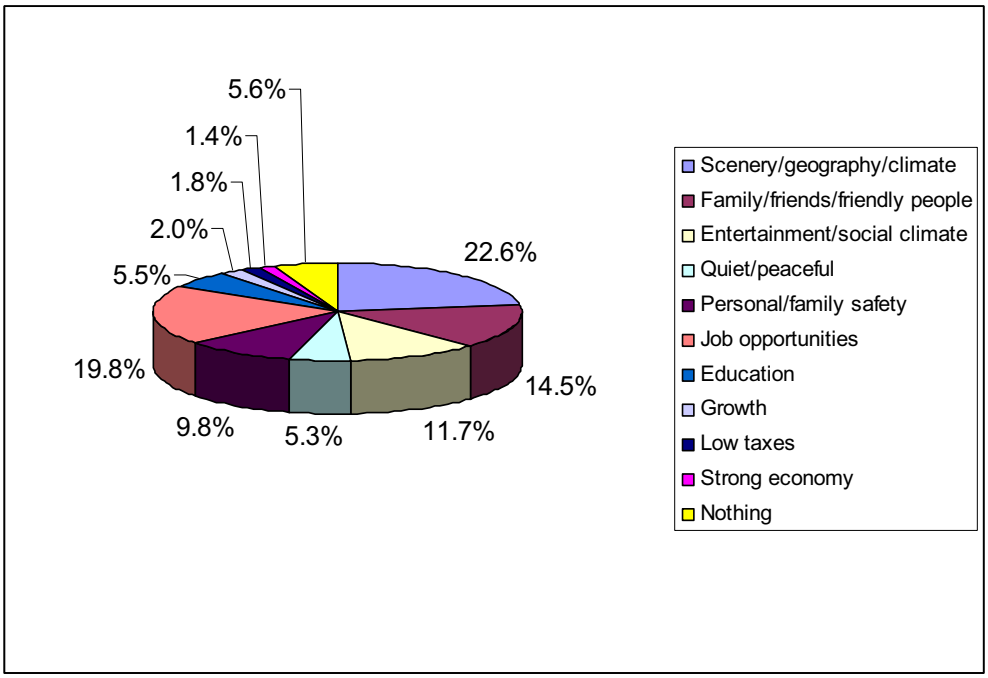


Note- Graph does not include Don't Know/ No Answer

Appendix III
Quality of Life Considerations

Generally speaking, what aspect of living in Clark County, if any, has the greatest positive impact on your quality of life?

	Frequency	Percent
Scenery/geography/climate	131	21.9
Family/friends/friendly people	84	14.0
Entertainment/social climate	68	11.3
Quiet/peaceful	31	5.1
Personal/family safety	57	9.5
Job opportunities	115	19.2
Education	32	5.3
Growth	12	2.0
Low taxes	10	1.7
Strong economy	8	1.3
Nothing	32	5.4
Total	580	96.7
DK/No answer	20	3.3
Total	600	100.0

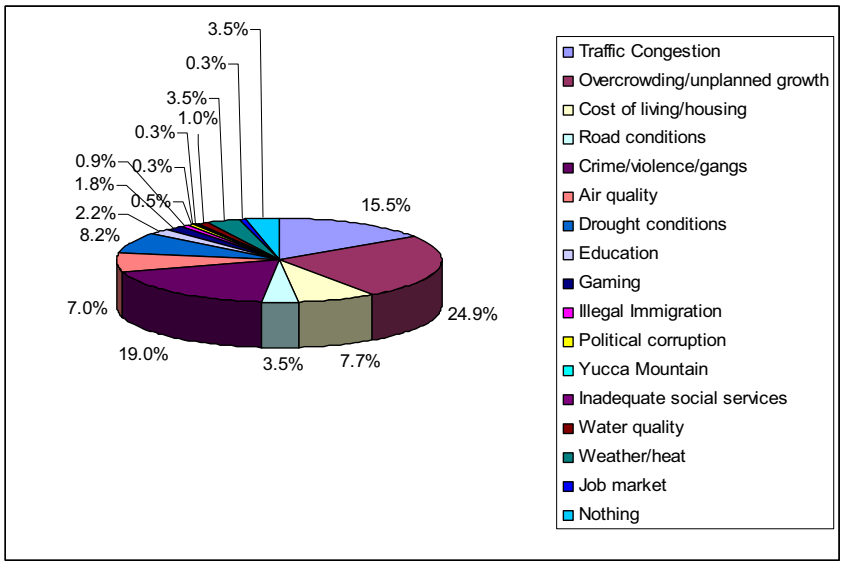


Note- Graph does not include Don't Know/ No Answer

Appendix III
Quality of Life Considerations

Generally speaking, what aspect of living in Clark County, if any, has the greatest negative impact on your quality of life?

	Frequency	Percent
Traffic Congestion	91	15.3
Overcrowding/unplanned growth	147	24.4
Cost of living/housing	45	7.6
Road conditions	20	3.4
Crime/violence/gangs	112	18.6
Air quality	41	6.8
Drought conditions	48	8.0
Education	13	2.1
Gaming	11	1.8
Illegal Immigration	5	.9
Political corruption	3	.5
Yucca Mountain	2	.3
Inadequate social services	2	.3
Water quality	6	.9
Weather/heat	21	3.5
Job market	2	.3
Nothing	20	3.4
Total	589	98.2
DK/No answer	11	1.8
Total	600	100.0

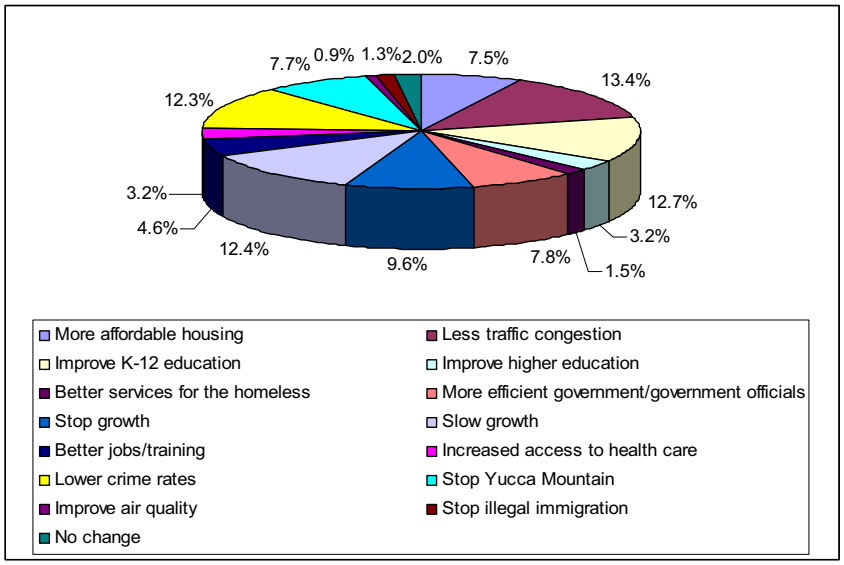


Note- Graph does not include Don't Know/ No Answer

Appendix III
Quality of Life Considerations

In thinking about all of the issues we have talked about today, if you could make one major change locally to improve the quality of life in Clark County, what would it be?

	Frequency	Percent
More affordable housing	45	7.4
Less traffic congestion	80	13.3
Improve K-12 education	76	12.6
Improve higher education	19	3.1
Better services for the homeless	9	1.5
More efficient government/government officials	47	7.8
Stop growth	57	9.5
Slow growth	74	12.3
Better jobs/training	27	4.5
Increased access to health care	19	3.2
Lower crime rates	73	12.2
Stop Yucca Mountain	46	7.7
Improve air quality	5	.9
Stop illegal immigration	8	1.3
No change	12	2.0
Total	596	99.3
DK/No answer	4	.7
Total	600	100.0

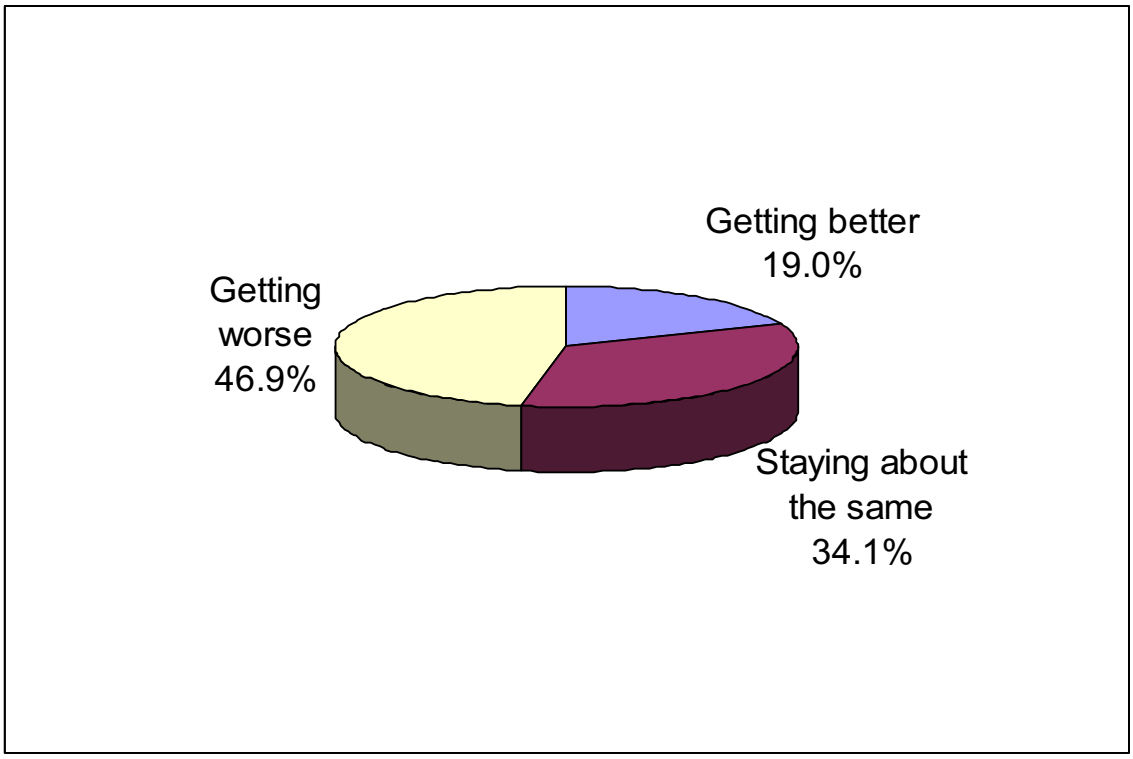


Note- Graph does not include Don't Know/ No Answer

Appendix III
Quality of Life Considerations

Overall would you say the quality of life in Clark County is getting better, staying the same, or getting worse?

	Frequency	Percent
Getting better	112	18.7
Staying about the same	201	33.6
Getting worse	277	46.3
Total	591	98.6
DK/No answer	9	1.4
Total	600	100.0



Note- Graph does not include Don't Know/ No Answer

Appendix III
Quality of Life Considerations
Summary Statistic by Jurisdiction

Unincorporated Clark County		Overall sense of preparedness in the event of a large scale natural or man-made emergency	Quality of drinking water	Recreational opportunities	Condition of streets and roads	Availability of public transportation	Housing affordability	Air quality	Availability of job opportunities	Managing growth
N	Valid	233	240	241	241	239	240	241	240	241
	Missing	9	2	0	0	2	2	1	2	0
Mean		4.12	3.97	3.91	3.93	3.52	3.65	4.03	3.83	3.84
Std. Error of Mean		.069	.080	.071	.072	.088	.089	.074	.076	.081
Median		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.057	1.243	1.096	1.119	1.361	1.380	1.154	1.177	1.259
Skewness		-1.117	-1.066	-.822	-.765	-.499	-.525	-1.031	-.833	-.828
Std. Error of Skewness		.160	.157	.157	.157	.157	.157	.157	.157	.157
Kurtosis		.607	.106	.053	-.363	-.915	-1.080	.155	-.159	-.382
Std. Error of Kurtosis		.318	.313	.312	.312	.313	.313	.313	.313	.312
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations
Summary Statistic by Jurisdiction

City of Las Vegas		Overall sense of preparedness in the event of a large scale natural or man-made emergency	Quality of drinking water	Recreational opportunities	Condition of streets and roads	Availability of public transportation	Housing affordability	Air quality	Availability of job opportunities	Managing growth
N	Valid	179	179	180	182	178	181	182	180	181
	Missing	3	4	2	0	4	2	0	2	1
Mean		3.83	4.01	3.77	3.91	3.28	3.28	3.97	3.68	3.84
Std. Error of Mean		.094	.093	.080	.080	.098	.100	.088	.092	.096
Median		4.00	4.00	4.00	4.00	3.00	3.00	4.00	4.00	4.00
Mode		5	5	4	5	3	3	5	5	5
Std. Deviation		1.264	1.245	1.078	1.080	1.305	1.338	1.189	1.233	1.287
Skewness		-.755	-1.192	-.825	-.674	-.277	-.197	-.991	-.723	-.873
Std. Error of Skewness		.181	.182	.181	.180	.182	.181	.180	.181	.181
Kurtosis		-.422	.427	.261	-.475	-.939	-1.075	.041	-.382	-.371
Std. Error of Kurtosis		.361	.361	.360	.358	.362	.360	.358	.360	.359
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations
Summary Statistic by Jurisdiction

City of North Las Vegas		Overall sense of preparedness in the event of a large scale natural or man-made emergency	Quality of drinking water	Recreational opportunities	Condition of streets and roads	Availability of public transportation	Housing affordability	Air quality	Availability of job opportunities	Managing growth
N	Valid	62	64	63	64	63	63	64	62	64
	Missing	3	0	1	0	1	1	0	2	0
Mean		3.86	3.67	3.80	3.88	3.43	3.55	3.88	3.64	3.56
Std. Error of Mean		.188	.169	.137	.149	.178	.170	.161	.161	.181
Median		4.81	4.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.473	1.357	1.088	1.194	1.414	1.350	1.293	1.268	1.449
Skewness		-1.013	-.881	-.574	-.785	-.288	-.575	-.880	-.471	-.683
Std. Error of Skewness		.305	.299	.301	.299	.302	.301	.299	.304	.299
Kurtosis		-.472	-.292	-.464	-.316	-1.235	-.763	-.304	-1.010	-.902
Std. Error of Kurtosis		.601	.590	.595	.590	.596	.594	.590	.599	.590
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations
Summary Statistic by Jurisdiction

City of Henderson		Overall sense of preparedness in the event of a large scale natural or man-made emergency	Quality of drinking water	Recreational opportunities	Condition of streets and roads	Availability of public transportation	Housing affordability	Air quality	Availability of job opportunities	Managing growth
N	Valid	82	84	84	84	83	83	84	84	84
	Missing	2	0	0	0	1	1	0	0	0
Mean		3.96	4.18	3.80	4.16	3.55	3.84	4.30	3.80	4.01
Std. Error of Mean		.121	.110	.110	.094	.130	.130	.111	.126	.118
Median		4.00	4.05	4.00	4.00	4.00	4.00	5.00	4.00	4.00
Mode		5	5	4	5	4	5	5	5	5
Std. Deviation		1.095	1.013	1.006	.860	1.185	1.183	1.016	1.156	1.085
Skewness		-.828	-1.160	-.547	-.950	-.551	-.684	-1.619	-.714	-1.186
Std. Error of Skewness		.265	.262	.262	.262	.264	.264	.262	.262	.262
Kurtosis		.074	.579	-.251	1.056	-.478	-.497	2.194	-.282	.988
Std. Error of Kurtosis		.525	.519	.519	.519	.522	.522	.519	.519	.519
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations
Summary Statistic by Jurisdiction

Boulder City		Overall sense of preparedness in the event of a large scale natural or man-made emergency	Quality of drinking water	Recreational opportunities	Condition of streets and roads	Availability of public transportation	Housing affordability	Air quality	Availability of job opportunities	Managing growth
N	Valid	19	19	19	19	19	19	19	18	19
	Missing	0	0	0	0	0	0	0	2	0
Mean		3.76	3.76	3.51	4.09	3.07	3.51	4.07	3.35	4.17
Std. Error of Mean		.307	.234	.220	.207	.272	.306	.228	.278	.258
Median		4.00	3.86	3.59	4.00	3.00	3.00	4.00	3.00	5.00
Mode		5	3	3(a)	4	3	3(a)	5	3	5
Std. Deviation		1.325	1.024	.960	.904	1.189	1.337	.998	1.167	1.126
Skewness		-.639	-.238	-.007	-.969	.187	-.099	-.826	.123	-.894
Std. Error of Skewness		.528	.523	.523	.523	.523	.523	.523	.542	.523
Kurtosis		-.801	-.258	-.760	.693	-.705	-1.249	.613	-.962	-.809
Std. Error of Kurtosis		1.023	1.012	1.012	1.012	1.012	1.012	1.012	1.049	1.012
Range		4	4	3	3	4	4	4	4	3
Minimum		1	1	2	2	1	1	1	1	2
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations
Summary Statistic by Jurisdiction

Mesquite		Overall sense of preparedness in the event of a large scale natural or man-made emergency	Quality of drinking water	Recreational opportunities	Condition of streets and roads	Availability of public transportation	Housing affordability	Air quality	Availability of job opportunities	Managing growth
N	Valid	8	8	8	8	8	8	8	8	8
	Missing	0	0	0	0	0	0	0	0	0
Mean		4.52	4.89	3.91	4.20	3.94	4.60	4.78	4.55	3.76
Std. Error of Mean		.229	.114	.392	.340	.458	.342	.194	.343	.536
Median		5.00	5.00	4.00	4.91	4.00	5.00	5.00	5.00	4.00
Mode		5	5	5	5	4	5	5	5	5
Std. Deviation		.645	.330	1.134	.983	1.324	.961	.560	.966	1.550
Skewness		-1.083	-3.124	-.448	-.512	-1.715	-2.440	-2.966	-2.193	-1.245
Std. Error of Skewness		.755	.739	.739	.739	.739	.755	.739	.755	.739
Kurtosis		.897	10.217	-1.254	-2.131	3.032	6.032	10.791	4.841	.501
Std. Error of Kurtosis		1.488	1.449	1.449	1.449	1.449	1.488	1.449	1.488	1.449
Range		2	1	3	2	4	3	2	3	4
Minimum		3	4	2	3	1	2	3	2	1
Maximum		5	5	5	5	5	5	5	5	5

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Appendix IV

General Economic Considerations

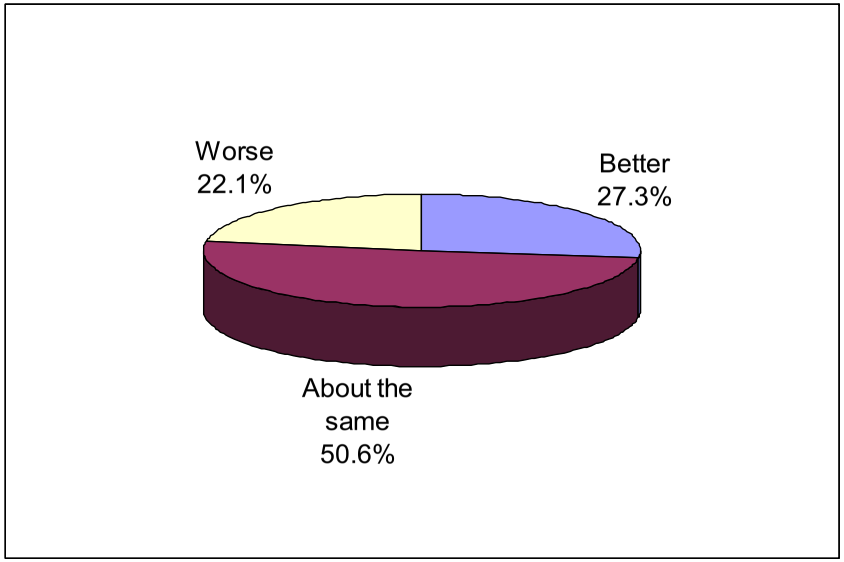
Appendix IV
General Economic Conditions
(Summary Statistics)

		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse of financially than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?
N	Valid	598	593	581	584
	Missing	2	7	19	16
Mean		1.95	1.75	2.19	1.81
Std. Error of Mean		.029	.027	.031	.024
Median		2.00	2.00	2.00	2.00
Mode		2	2	2	2
Std. Deviation		.701	.648	.755	.587
Skewness		.071	.299	.197	.063
Std. Error of Skewness		.100	.100	.101	.101
Kurtosis		-.963	-.718	-.312	-.332
Std. Error of Kurtosis		.200	.200	.202	.202
Range		2	2	3	2
Minimum		1	1	1	1
Maximum		3	3	4	3

Appendix IV
General Economic Conditions

We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse of financially than you were a year ago, or about the same?

	Frequency	Percent
Better	163	27.2
About the same	303	50.5
Worse	132	22.1
Total	598	99.7
DK/No answer	2	.3
Total	600	100.0

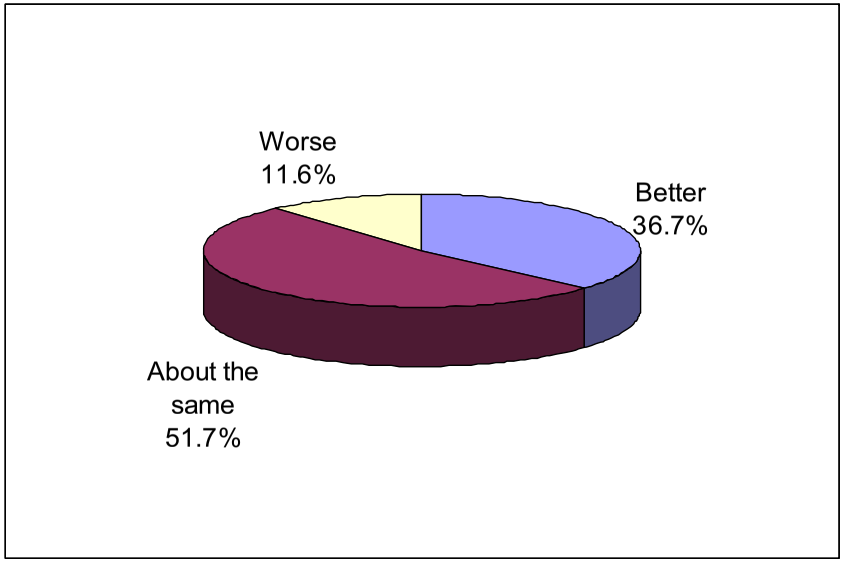


Note- Graph does not include Don't Know/ No Answer

Appendix IV
General Economic Conditions

Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?

	Frequency	Percent
Better	218	36.3
About the same	307	51.1
Worse	69	11.4
Total	593	98.9
DK/No answer	7	1.1
Total	600	100.0

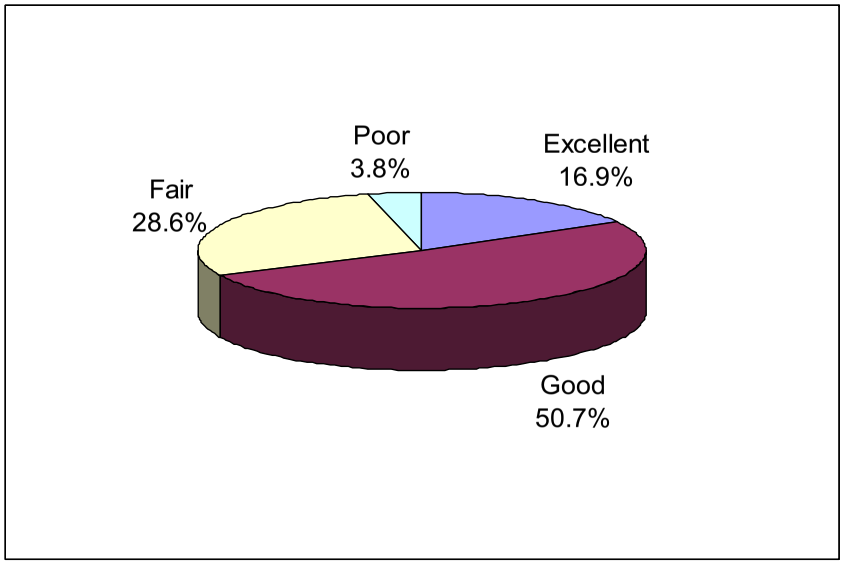


Note- Graph does not include Don't Know/ No Answer

Appendix IV
General Economic Conditions

Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?

	Frequency	Percent
Excellent	98	16.4
Good	295	49.1
Fair	166	27.7
Poor	22	3.7
Total	581	96.9
DK/No answer	19	3.1
Total	600	100.0

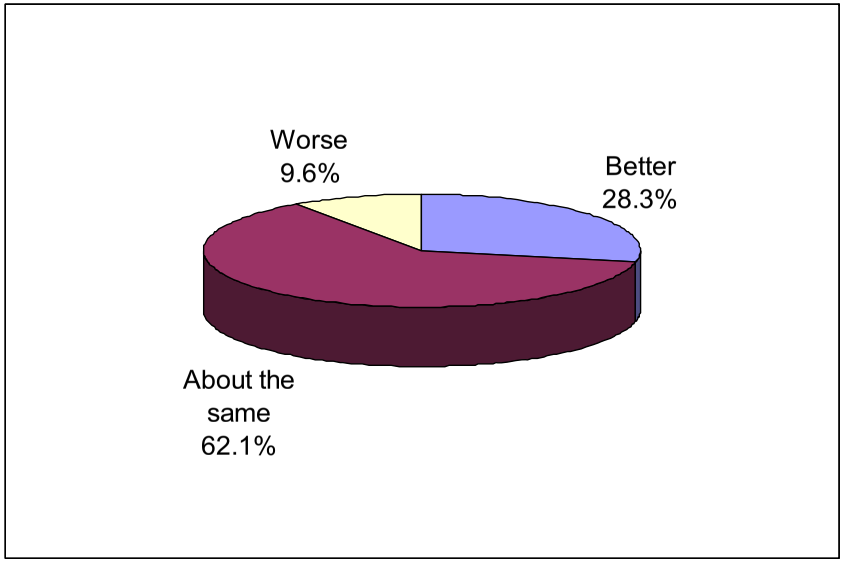


Note- Graph does not include Don't Know/ No Answer

Appendix IV
General Economic Conditions

And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?

	Frequency	Percent
Better	165	27.6
About the same	363	60.5
Worse	56	9.4
Total	584	97.4
DK/No answer	16	2.6
Total	600	100.0

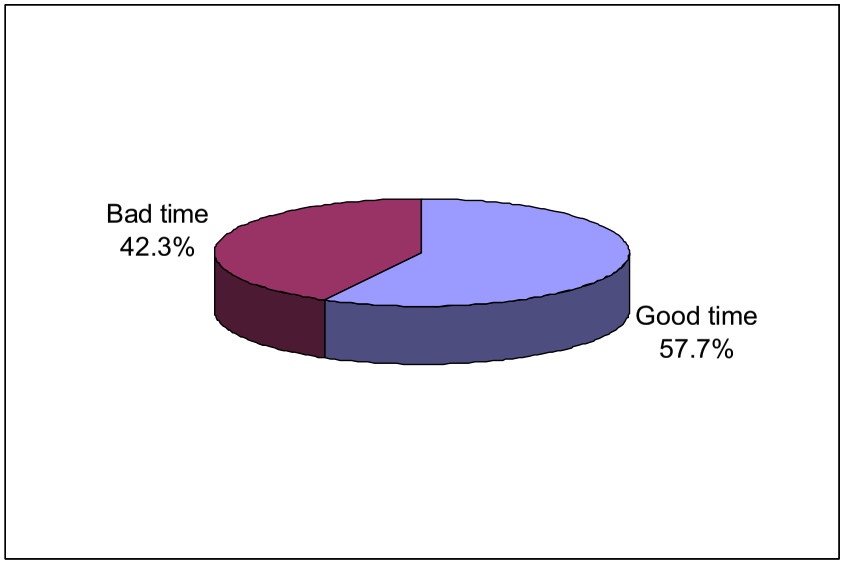


Note- Graph does not include Don't Know/ No Answer

Appendix IV
General Economic Conditions

Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?

	Frequency	Percent
Good time	332	55.4
Bad time	244	40.7
Total	576	96.1
DK/No answer	23	3.9
Total	600	100.0



Note- Graph does not include Don't Know/ No Answer

Appendix IV
General Economic Conditions
Summary Statistic by Jurisdiction

Unincorporated Clark County		Would you say that you, and any family members living with you, are better or worse of financially than you were a year ago, or about the same?	Do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?	Would you say that business conditions in Clark County are excellent, good, fair, or poor?	A year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	242	241	236	236	235
	Missing	0	1	6	6	7
Mean		2.03	1.69	2.23	1.86	1.46
Std. Error of Mean		.046	.041	.049	.040	.033
Median		2.00	2.00	2.00	2.00	1.00
Mode		2	2	2	2	1
Std. Deviation		.717	.643	.757	.621	.499
Skewness		-.047	.393	.101	.104	.175
Std. Error of Skewness		.157	.157	.158	.158	.159
Kurtosis		-1.044	-.699	-.407	-.468	-1.986
Std. Error of Kurtosis		.312	.313	.316	.316	.317
Range		2	2	3	2	1
Minimum		1	1	1	1	1
Maximum		3	3	4	3	2

Appendix IV
General Economic Conditions
Summary Statistic by Jurisdiction

City of Las Vegas		.Would you say that you, and any family members living with you, are better or worse of financially than you were a year ago, or about the same?	Do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?	Would you say that business conditions in Clark County are excellent, good, fair, or poor?	A year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	181	177	174	174	173
	Missing	2	5	8	8	9
Mean		1.86	1.76	2.16	1.80	1.37
Std. Error of Mean		.050	.049	.056	.043	.037
Median		2.00	2.00	2.00	2.00	1.00
Mode		2	2	2	2	1
Std. Deviation		.668	.653	.738	.574	.484
Skewness		.166	.297	.368	.024	.540
Std. Error of Skewness		.181	.182	.184	.184	.184
Kurtosis		-.763	-.721	.065	-.258	-1.728
Std. Error of Kurtosis		.360	.363	.366	.366	.367
Range		2	2	3	2	1
Minimum		1	1	1	1	1
Maximum		3	3	4	3	2

Appendix IV
General Economic Conditions
Summary Statistic by Jurisdiction

City of North Las Vegas		Would you say that you, and any family members living with you, are better or worse of financially than you were a year ago, or about the same?	Do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?	Would you say that business conditions in Clark County are excellent, good, fair, or poor?	A year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	64	64	61	63	62
	Missing	0	0	4	2	2
Mean		2.04	1.91	2.13	1.89	1.50
Std. Error of Mean		.085	.079	.096	.069	.064
Median		2.00	2.00	2.00	2.00	1.22
Mode		2	2	2	2	1
Std. Deviation		.680	.636	.744	.548	.504
Skewness		-.049	.071	.178	-.072	.018
Std. Error of Skewness		.299	.299	.307	.302	.304
Kurtosis		-.771	-.462	-.310	.331	-2.067
Std. Error of Kurtosis		.590	.590	.606	.597	.599
Range		2	2	3	2	1
Minimum		1	1	1	1	1
Maximum		3	3	4	3	2

Appendix IV
General Economic Conditions
Summary Statistic by Jurisdiction

City of Henderson		Would you say that you, and any family members living with you, are better or worse of financially than you were a year ago, or about the same?	Do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?	Would you say that business conditions in Clark County are excellent, good, fair, or poor?	A year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	84	84	83	84	81
	Missing	0	0	2	0	3
Mean		1.80	1.71	2.10	1.65	1.32
Std. Error of Mean		.076	.072	.081	.064	.052
Median		2.00	2.00	2.00	2.00	1.00
Mode		2	2	2	2	1
Std. Deviation		.699	.657	.740	.585	.470
Skewness		.290	.383	.201	.256	.774
Std. Error of Skewness		.263	.262	.265	.263	.267
Kurtosis		-.909	-.713	-.309	-.662	-1.437
Std. Error of Kurtosis		.521	.519	.524	.521	.528
Range		2	2	3	2	1
Minimum		1	1	1	1	1
Maximum		3	3	4	3	2

Appendix IV
General Economic Conditions
Summary Statistic by Jurisdiction

Boulder City		Would you say that you, and any family members living with you, are better or worse of financially than you were a year ago, or about the same?	A year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	A year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	19	19	19	19	17
	Missing	0	0	0	0	2
Mean		2.05	1.97	2.37	1.92	1.53
Std. Error of Mean		.171	.129	.175	.064	.124
Median		2.00	2.00	3.00	2.00	1.95
Mode		2	2	3	2	2
Std. Deviation		.745	.557	.764	.279	.515
Skewness		-.078	-.027	-.773	-3.362	-.116
Std. Error of Skewness		.523	.528	.523	.523	.548
Kurtosis		-1.056	.927	-.757	10.385	-2.268
Std. Error of Kurtosis		1.012	1.023	1.012	1.012	1.061
Range		2	2	2	1	1
Minimum		1	1	1	1	1
Maximum		3	3	3	2	2

Appendix IV
General Economic Conditions
Summary Statistic by Jurisdiction

Mesquite		Would you say that you, and any family members living with you, are better or worse of financially than you were a year ago, or about the same?	Do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	A year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	8	8	8	8	8
	Missing	0	0	0	0	0
Mean		1.95	1.89	2.75	1.71	1.83
Std. Error of Mean		.267	.250	.373	.167	.143
Median		2.00	2.00	2.91	2.00	2.00
Mode		2	2	2	2	2
Std. Deviation		.771	.724	1.079	.484	.402
Skewness		.100	.168	-.139	-1.139	-2.192
Std. Error of Skewness		.739	.739	.739	.739	.755
Kurtosis		-.908	-.411	-1.149	-1.022	3.698
Std. Error of Kurtosis		1.449	1.449	1.449	1.449	1.488
Range		2	2	3	1	1
Minimum		1	1	1	1	1
Maximum		3	3	4	2	2

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Appendix IV
General Economic Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse of financially than you were a year ago, or about the same?

		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse of financially than you were a year ago, or about the same?			Total
		Better	About the same	Worse	
Respondent Jurisdiction:	Unincorporated Clark County	58	118	66	242
		24.0%	48.8%	27.3%	100.0%
	City of Las Vegas	54	97	29	180
		30.0%	53.9%	16.1%	100.0%
	City of North Las Vegas	13	35	16	64
		20.3%	54.7%	25.0%	100.0%
	City of Henderson	30	40	14	84
		35.7%	47.6%	16.7%	100.0%
	Boulder City	5	9	5	19
		26.3%	47.4%	26.3%	100.0%
	Mesquite	2	4	2	8
		25.0%	50.0%	25.0%	100.0%
Total		162	303	132	597
		27.1%	50.8%	22.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.170(a)	10	.214
Likelihood Ratio	13.272	10	.209
Linear-by-Linear Association	2.389	1	.122
N of Valid Cases	597		

Appendix IV
General Economic Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?

		Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?			Total
		Better	About the same	Worse	
Respondent Jurisdiction:	Unincorporated Clark County	99	118	24	241
		41.1%	49.0%	10.0%	100.0%
	City of Las Vegas	65	91	21	177
		36.7%	51.4%	11.9%	100.0%
	City of North Las Vegas	16	38	10	64
		25.0%	59.4%	15.6%	100.0%
	City of Henderson	34	41	9	84
		40.5%	48.8%	10.7%	100.0%
	Boulder City	3	13	2	18
		16.7%	72.2%	11.1%	100.0%
	Mesquite	2	4	2	8
		25.0%	50.0%	25.0%	100.0%
Total		219	305	68	592
		37.0%	51.5%	11.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.654(a)	10	.309
Likelihood Ratio	11.901	10	.292
Linear-by-Linear Association	3.280	1	.070
N of Valid Cases	592		

Appendix IV
General Economic Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?

		Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?				Total
		Excellent	Good	Fair	Poor	
Respondent Jurisdiction:	Unincorporated Clark County	38	115	75	9	237
		16.0%	48.5%	31.6%	3.8%	100.0%
	City of Las Vegas	28	97	41	7	173
		16.2%	56.1%	23.7%	4.0%	100.0%
	City of North Las Vegas	12	31	16	2	61
		19.7%	50.8%	26.2%	3.3%	100.0%
	City of Henderson	17	43	21	2	83
		20.5%	51.8%	25.3%	2.4%	100.0%
	Boulder City	3	6	10	0	19
		15.8%	31.6%	52.6%	.0%	100.0%
	Mesquite	1	3	2	3	9
		11.1%	33.3%	22.2%	33.3%	100.0%
Total		99	295	165	23	582
		17.0%	50.7%	28.4%	4.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	32.043(a)	15	.006
Likelihood Ratio	20.228	15	.163
Linear-by-Linear Association	.008	1	.930
N of Valid Cases	582		

Appendix IV
General Economic Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?

		And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?			Total
		Better	About the same	Worse	
Respondent Jurisdiction:	Unincorporated Clark County	65	141	31	237
		27.4%	59.5%	13.1%	100.0%
	City of Las Vegas	49	110	15	174
		28.2%	63.2%	8.6%	100.0%
	City of North Las Vegas	13	43	6	62
		21.0%	69.4%	9.7%	100.0%
	City of Henderson	34	45	5	84
		40.5%	53.6%	6.0%	100.0%
	Boulder City	2	18	0	20
		10.0%	90.0%	.0%	100.0%
	Mesquite	2	6	0	8
		25.0%	75.0%	.0%	100.0%
Total		165	363	57	585
		28.2%	62.1%	9.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.495(a)	10	.034
Likelihood Ratio	22.238	10	.014
Linear-by-Linear Association	2.668	1	.102
N of Valid Cases	585		

Appendix IV
General Economic Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?

		Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?		Total
		Good time	Bad time	
Respondent Jurisdiction:	Unincorporated Clark County	127	107	234
		54.3%	45.7%	100.0%
	City of Las Vegas	109	64	173
		63.0%	37.0%	100.0%
	City of North Las Vegas	31	31	62
		50.0%	50.0%	100.0%
	City of Henderson	55	26	81
		67.9%	32.1%	100.0%
	Boulder City	8	9	17
		47.1%	52.9%	100.0%
	Mesquite	1	7	8
		12.5%	87.5%	100.0%
Total		331	244	575
		57.6%	42.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.549(a)	5	.008
Likelihood Ratio	16.076	5	.007
Linear-by-Linear Association	.000	1	.999
N of Valid Cases	575		

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Appendix V

Property Value Considerations

Appendix V
Property Value Conditions
(Summary Statistics)

		Amusement Park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/freeway	Hotel-casino	Polluting manufacturing facility	High level nuclear waste transportation route
N	Valid	590	596	589	581	594	593	584	589	594
	Missing	9	3	10	19	5	6	15	11	6
Mean		1.88	2.41	1.12	1.66	2.61	1.94	1.81	1.09	1.16
Std. Error of Mean		.036	.027	.016	.032	.025	.037	.036	.016	.018
Median		2.00	3.00	1.00	1.00	3.00	2.00	2.00	1.00	1.00
Mode		1	3	1	1	3	1	1	1	1
Std. Deviation		.873	.671	.400	.773	.619	.894	.859	.380	.444
Skewness		.227	-.696	3.430	.678	-1.363	.115	.367	4.203	2.910
Std. Error of Skewness		.101	.100	.101	.101	.100	.100	.101	.101	.100
Kurtosis		-1.651	-.612	11.445	-1.015	.723	-1.742	-1.548	17.032	7.879
Std. Error of Kurtosis		.201	.200	.201	.202	.200	.200	.202	.201	.200
Range		2	2	2	2	2	2	2	2	2
Minimum		1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	3	3

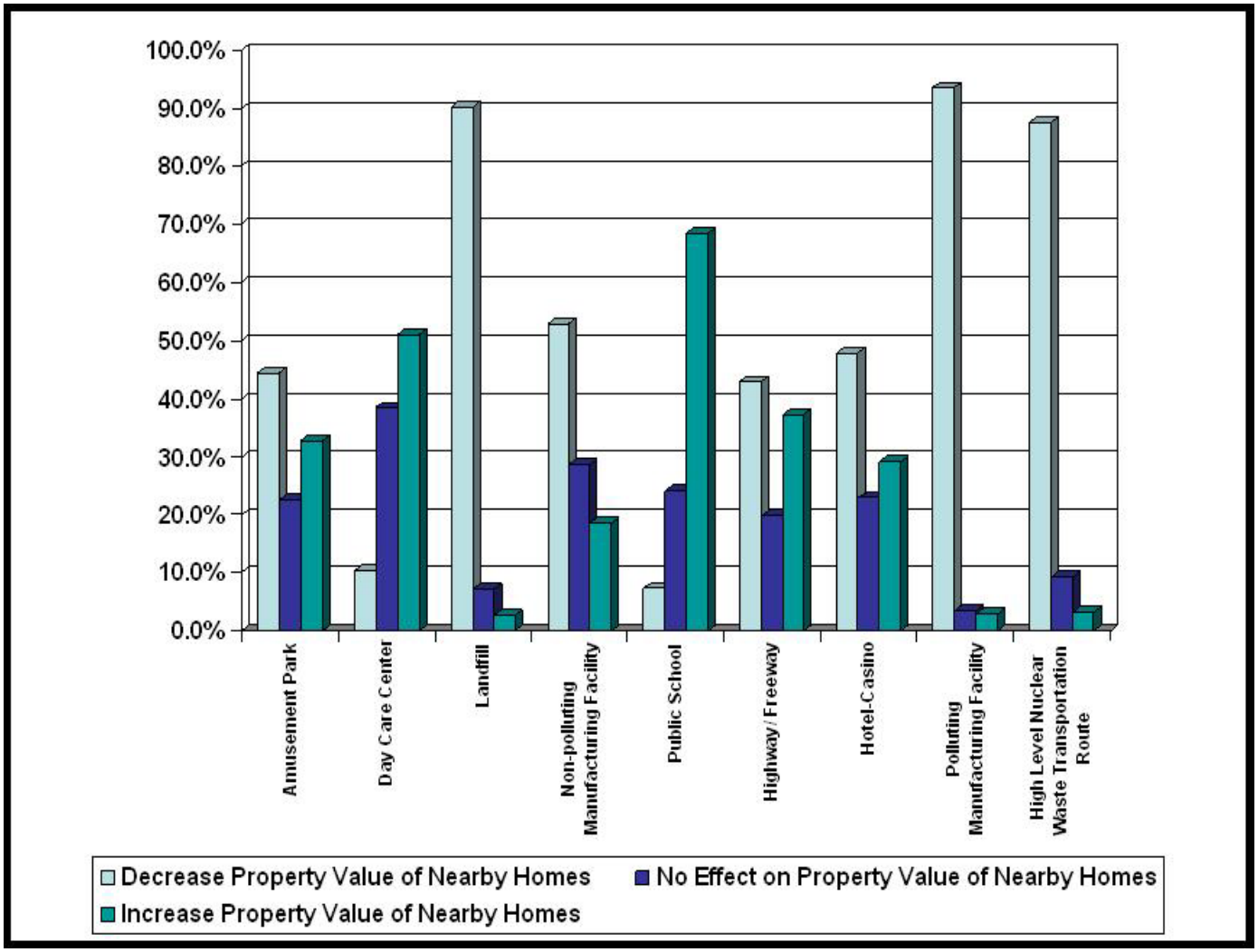
Appendix V
Property Value Conditions

Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative affect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.

	Frequency	Percent
Positive effect	56	9.3
No effect	100	16.7
Negative effect	430	71.7
Total	586	97.8
DK/No answer	13	2.2
Total	600	100.0

Appendix V
Property Value Conditions

	Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	DK/No answer	Total
Amusement Park	43.8	22.3	32.4	1.6	100.0
Day care Center	10.4	38.3	50.8	0.6	100.0
Landfill	88.8	6.9	2.6	1.7	100.0
Non-polluting manufacturing facility	51.3	27.6	18.0	3.1	100.0
Public School	7.2	23.9	68.0	0.9	100.0
Highway/ Freeway	42.6	19.6	36.8	1.1	100.0
Hotel/Casino	46.6	22.3	28.5	2.6	100.0
Polluting Manufacturing Facility	91.9	3.5	2.9	1.8	100.0
High-level nuclear Waste Transportation Route	86.6	9.2	3.2	1.0	100.0



Note- Graph does not include Don't Know/ No Answer

Appendix V
Property Value Conditions
Summary Statistic by Jurisdiction

Unincorporated Clark County		Positive or negative effect of Yucca Mountain on quality of life	Amusement Park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/freeway	Hotel-casino	Polluting manufacturing facility	High level nuclear waste transportation route
N	Valid	236	240	241	240	232	240	240	240	236	238
	Missing	6	2	0	2	10	2	2	2	6	4
Mean		2.71	1.98	2.46	1.19	1.64	2.65	1.99	1.85	1.10	1.14
Std. Error of Mean		.038	.057	.044	.033	.050	.038	.058	.058	.026	.029
Median		3.00	2.00	3.00	1.00	1.00	3.00	2.00	2.00	1.00	1.00
Mode		3	1	3	1	1	3	1	1	1	1
Std. Deviation		.591	.888	.684	.507	.760	.581	.893	.903	.392	.443
Skewness		-1.932	.031	-.876	2.666	.716	-1.436	.013	.298	4.006	3.206
Std. Error of Skewness		.159	.157	.157	.157	.160	.157	.157	.157	.159	.158
Kurtosis		2.533	-1.738	-.435	6.090	-.921	1.056	-1.752	-1.713	15.496	9.592
Std. Error of Kurtosis		.316	.313	.312	.313	.319	.313	.313	.313	.316	.314
Range		2	2	2	2	2	2	2	2	2	2
Minimum		1	1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	3	3	3

Appendix V
Property Value Conditions
Summary Statistic by Jurisdiction

City of Las Vegas		Positive or negative effect of Yucca Mountain on quality of life	Amusement Park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/freeway	Hotel-casino	Polluting manufacturing facility	High level nuclear waste transportation route
N	Valid	179	177	181	178	178	181	181	179	180	182
	Missing	4	5	1	4	4	1	1	4	2	0
Mean		2.60	1.83	2.32	1.10	1.66	2.53	1.96	1.83	1.09	1.18
Std. Error of Mean		.051	.064	.049	.024	.058	.050	.066	.062	.028	.034
Median		3.00	2.00	2.00	1.00	1.00	3.00	2.00	2.00	1.00	1.00
Mode		3	1	2	1	1	3	1	1	1	1
Std. Deviation		.682	.854	.661	.320	.779	.669	.888	.834	.370	.460
Skewness		-1.425	.340	-.464	3.250	.676	-1.118	.085	.335	4.412	2.596
Std. Error of Skewness		.182	.182	.180	.182	.182	.181	.181	.182	.181	.180
Kurtosis		.621	-1.549	-.731	10.538	-1.032	.025	-1.735	-1.483	19.021	6.176
Std. Error of Kurtosis		.361	.363	.359	.362	.362	.359	.359	.361	.360	.358
Range		2	2	2	2	2	2	2	2	2	2
Minimum		1	1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	3	3	3

Appendix V
Property Value Conditions
Summary Statistic by Jurisdiction

City of North Las Vegas		Positive or negative effect of Yucca Mountain on quality of life	Amusement Park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/freeway	Hotel-casino	Polluting manufacturing facility	High level nuclear waste transportation route
N	Valid	61	63	64	62	62	64	63	60	64	64
	Missing	3	1	0	2	2	0	1	4	0	0
Mean		2.66	1.85	2.51	1.04	1.69	2.61	1.79	1.73	1.16	1.10
Std. Error of Mean		.082	.106	.087	.029	.099	.082	.115	.104	.063	.038
Median		3.00	2.00	3.00	1.00	1.49	3.00	1.00	2.00	1.00	1.00
Mode		3	1	3	1	1	3	1	1	1	1
Std. Deviation		.642	.840	.694	.230	.777	.656	.912	.803	.501	.307
Skewness		-1.680	.287	-1.087	6.592	.610	-1.477	.444	.525	3.065	2.673
Std. Error of Skewness		.306	.301	.299	.304	.304	.300	.301	.309	.299	.300
Kurtosis		1.571	-1.530	-.092	48.149	-1.072	.937	-1.675	-1.246	8.398	5.310
Std. Error of Kurtosis		.603	.595	.590	.599	.599	.592	.595	.609	.590	.592
Range		2	2	2	2	2	2	2	2	2	1
Minimum		1	1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	3	3	2

Appendix V
Property Value Conditions
Summary Statistic by Jurisdiction

City of Henderson		Positive or negative effect of Yucca Mountain on quality of life	Amusement Park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/freeway	Hotel-casino	Polluting manufacturing facility	High level nuclear waste transportation route
N	Valid	84	83	82	82	82	83	83	81	82	83
	Missing	0	2	2	2	2	2	2	3	2	2
Mean		2.52	1.82	2.43	1.02	1.62	2.76	1.91	1.76	1.04	1.12
Std. Error of Mean		.077	.099	.065	.018	.085	.054	.097	.091	.030	.041
Median		3.00	1.20	2.00	1.00	1.00	3.00	2.00	2.00	1.00	1.00
Mode		3	1	3	1	1	3	1	1	1	1
Std. Deviation		.707	.901	.588	.166	.767	.495	.879	.817	.272	.376
Skewness		-1.152	.357	-.464	10.911	.766	-1.952	.187	.475	7.255	3.444
Std. Error of Skewness		.262	.265	.265	.266	.265	.265	.265	.267	.265	.265
Kurtosis		-.041	-1.690	-.665	126.280	-.876	3.126	-1.694	-1.339	51.895	12.161
Std. Error of Kurtosis		.519	.524	.525	.526	.525	.524	.524	.528	.525	.524
Range		2	2	2	2	2	2	2	2	2	2
Minimum		1	1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	3	3	3

Appendix V
Property Value Conditions
Summary Statistic by Jurisdiction

Boulder City		Positive or negative effect of Yucca Mountain on quality of life	Amusement Park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/freeway	Hotel-casino	Polluting manufacturing facility	High level nuclear waste transportation route
N	Valid	19	19	19	19	19	19	18	16	19	19
	Missing	0	0	0	0	0	0	1	3	0	0
Mean		2.51	1.58	2.21	1.27	1.86	2.30	1.85	1.77	1.02	1.43
Std. Error of Mean		.173	.184	.172	.133	.217	.189	.225	.237	.036	.177
Median		3.00	1.00	2.00	1.00	1.41	2.86	1.23	1.00	1.00	1.00
Mode		3	1	2	1	1	3	1	1	1	1
Std. Deviation		.748	.803	.750	.575	.949	.825	.953	.960	.156	.773
Skewness		-1.214	.950	-.372	2.140	.298	-.650	.329	.519	6.828	1.472
Std. Error of Skewness		.528	.523	.523	.528	.523	.523	.536	.557	.523	.523
Kurtosis		.085	-.685	-1.023	4.099	-1.949	-1.189	-1.952	-1.852	49.865	.558
Std. Error of Kurtosis		1.023	1.012	1.012	1.023	1.012	1.012	1.038	1.078	1.012	1.012
Range		2	2	2	2	2	2	2	2	1	2
Minimum		1	1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	3	2	3

Appendix V
Property Value Conditions
Summary Statistic by Jurisdiction

Mesquite		Positive or negative effect of Yucca Mountain on quality of life	Amusement Park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/freeway	Hotel-casino	Polluting manufacturing facility	High level nuclear waste transportation route
N	Valid	8	8	8	8	8	8	8	8	8	8
	Missing	0	0	0	0	0	0	0	0	0	0
Mean		2.73	1.71	2.24	1.00	1.73	2.66	1.84	1.67	1.18	1.24
Std. Error of Mean		.236	.278	.272	.000	.279	.175	.364	.298	.142	.157
Median		3.00	1.73	2.00	1.00	1.95	3.00	1.00	1.09	1.00	1.00
Mode		3	1	3	1	1	3	1	1	1	1
Std. Deviation		.684	.806	.788	.000	.786	.506	1.052	.861	.412	.453
Skewness		-2.627	.662	-.502		.596	-.809	.403	.833	2.024	1.529
Std. Error of Skewness		.739	.739	.739	.739	.755	.739	.739	.739	.739	.739
Kurtosis		6.980	-.877	-.899		-.754	-1.875	-2.529	-1.011	2.694	.358
Std. Error of Kurtosis		1.449	1.449	1.449	1.449	1.488	1.449	1.449	1.449	1.449	1.449
Range		2	2	2	0	2	1	2	2	1	1
Minimum		1	1	1	1	1	2	1	1	1	1
Maximum		3	3	3	1	3	3	3	3	2	2

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative affect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.

		Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative affect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.			Total
		Positive effect	No effect	Negative effect	
Respondent Jurisdiction:	Unincorporated Clark County	17	32	161	210
		8.1%	15.2%	76.7%	100.0%
	City of Las Vegas	23	40	146	209
		11.0%	19.1%	69.9%	100.0%
	City of North Las Vegas	6	12	39	57
		10.5%	21.1%	68.4%	100.0%
	City of Henderson	7	20	52	79
		8.9%	25.3%	65.8%	100.0%
	Boulder City	3	5	14	22
		13.6%	22.7%	63.6%	100.0%
	Mesquite	2	1	7	10
		20.0%	10.0%	70.0%	100.0%
Total		58	110	419	587
		9.9%	18.7%	71.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.864(a)	10	.642
Likelihood Ratio	7.605	10	.667
Linear-by-Linear Association	3.285	1	.070
N of Valid Cases	587		

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Amusement Park

		For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Amusement Park			Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Respondent Jurisdiction:	Unincorporated Clark County	89	51	72	212
		42.0%	24.1%	34.0%	100.0%
	City of Las Vegas	106	48	53	207
		51.2%	23.2%	25.6%	100.0%
	City of North Las Vegas	27	17	15	59
		45.8%	28.8%	25.4%	100.0%
	City of Henderson	42	16	20	78
		53.8%	20.5%	25.6%	100.0%
	Boulder City	15	4	4	23
		65.2%	17.4%	17.4%	100.0%
	Mesquite	4	4	2	10
		40.0%	40.0%	20.0%	100.0%
Total		283	140	166	589
		48.0%	23.8%	28.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.255(a)	10	.338
Likelihood Ratio	11.041	10	.354
Linear-by-Linear Association	4.960	1	.026
N of Valid Cases	589		

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Day care center

		For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Day care center			Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Respondent Jurisdiction:	Unincorporated Clark County	25	70	118	213
		11.7%	32.9%	55.4%	100.0%
	City of Las Vegas	29	100	83	212
		13.7%	47.2%	39.2%	100.0%
	City of North Las Vegas	9	18	33	60
		15.0%	30.0%	55.0%	100.0%
	City of Henderson	3	38	36	77
		3.9%	49.4%	46.8%	100.0%
	Boulder City	4	11	8	23
		17.4%	47.8%	34.8%	100.0%
	Mesquite	1	5	4	10
		10.0%	50.0%	40.0%	100.0%
Total		71	242	282	595
		11.9%	40.7%	47.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.344(a)	10	.013
Likelihood Ratio	23.965	10	.008
Linear-by-Linear Association	.746	1	.388
N of Valid Cases	595		

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Landfill

		For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Landfill			Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Respondent Jurisdiction:	Unincorporated Clark County	181	20	11	212
		85.4%	9.4%	5.2%	100.0%
	City of Las Vegas	189	18	1	208
		90.9%	8.7%	.5%	100.0%
	City of North Las Vegas	55	2	1	58
		94.8%	3.4%	1.7%	100.0%
	City of Henderson	74	1	1	76
		97.4%	1.3%	1.3%	100.0%
	Boulder City	16	5	1	22
		72.7%	22.7%	4.5%	100.0%
	Mesquite	10	0	0	10
		100.0%	.0%	.0%	100.0%
Total		525	46	15	586
		89.6%	7.8%	2.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	25.819(a)	10	.004
Likelihood Ratio	27.860	10	.002
Linear-by-Linear Association	3.994	1	.046
N of Valid Cases	586		

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Non-polluting manufacturing facility

		For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Non-polluting manufacturing facility			Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Respondent Jurisdiction:	Unincorporated Clark County	113	57	38	208
		54.3%	27.4%	18.3%	100.0%
	City of Las Vegas	115	57	37	209
		55.0%	27.3%	17.7%	100.0%
	City of North Las Vegas	29	17	11	57
		50.9%	29.8%	19.3%	100.0%
	City of Henderson	40	21	16	77
		51.9%	27.3%	20.8%	100.0%
	Boulder City	11	3	9	23
		47.8%	13.0%	39.1%	100.0%
	Mesquite	4	2	3	9
		44.4%	22.2%	33.3%	100.0%
Total		312	157	114	583
		53.5%	26.9%	19.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.414(a)	10	.588
Likelihood Ratio	7.653	10	.663
Linear-by-Linear Association	2.285	1	.131
N of Valid Cases	583		

a 4 cells (22.2%) have expected count less than 5. The minimum expected count is 1.76.

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Public school

		For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Public school			Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Respondent Jurisdiction:	Unincorporated Clark County	16	56	140	212
		7.5%	26.4%	66.0%	100.0%
	City of Las Vegas	24	63	124	211
		11.4%	29.9%	58.8%	100.0%
	City of North Las Vegas	8	12	39	59
		13.6%	20.3%	66.1%	100.0%
	City of Henderson	3	18	57	78
		3.8%	23.1%	73.1%	100.0%
	Boulder City	4	5	14	23
		17.4%	21.7%	60.9%	100.0%
	Mesquite	0	4	6	10
		.0%	40.0%	60.0%	100.0%
Total		55	158	380	593
		9.3%	26.6%	64.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.986(a)	10	.224
Likelihood Ratio	14.089	10	.169
Linear-by-Linear Association	.144	1	.704
N of Valid Cases	593		

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Highway/freeway

		For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Highway/freeway			Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Respondent Jurisdiction:	Unincorporated Clark County	87	45	81	213
		40.8%	21.1%	38.0%	100.0%
	City of Las Vegas	94	47	72	213
		44.1%	22.1%	33.8%	100.0%
	City of North Las Vegas	30	9	20	59
		50.8%	15.3%	33.9%	100.0%
	City of Henderson	34	15	29	78
		43.6%	19.2%	37.2%	100.0%
	Boulder City	13	2	7	22
		59.1%	9.1%	31.8%	100.0%
	Mesquite	6	0	4	10
		60.0%	.0%	40.0%	100.0%
Total		264	118	213	595
		44.4%	19.8%	35.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.190(a)	10	.610
Likelihood Ratio	10.366	10	.409
Linear-by-Linear Association	1.288	1	.256
N of Valid Cases	595		

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Hotel-casino

		For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Hotel-casino			Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Respondent Jurisdiction:	Unincorporated Clark County	109	39	64	212
		51.4%	18.4%	30.2%	100.0%
	City of Las Vegas	96	61	52	209
		45.9%	29.2%	24.9%	100.0%
	City of North Las Vegas	28	16	14	58
		48.3%	27.6%	24.1%	100.0%
	City of Henderson	39	23	15	77
		50.6%	29.9%	19.5%	100.0%
	Boulder City	12	3	5	20
		60.0%	15.0%	25.0%	100.0%
	Mesquite	4	2	4	10
		40.0%	20.0%	40.0%	100.0%
Total		288	144	154	586
		49.1%	24.6%	26.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.954(a)	10	.288
Likelihood Ratio	12.200	10	.272
Linear-by-Linear Association	.361	1	.548
N of Valid Cases	586		

a 4 cells (22.2%) have expected count less than 5. The minimum expected count is 2.46.

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Polluting manufacturing facility

		For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: Polluting manufacturing facility			Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Respondent Jurisdiction:	Unincorporated Clark County	193	10	7	210
		91.9%	4.8%	3.3%	100.0%
	City of Las Vegas	198	6	6	210
		94.3%	2.9%	2.9%	100.0%
	City of North Las Vegas	52	4	4	60
		86.7%	6.7%	6.7%	100.0%
	City of Henderson	76	0	1	77
		98.7%	.0%	1.3%	100.0%
	Boulder City	22	1	0	23
		95.7%	4.3%	.0%	100.0%
	Mesquite	9	1	0	10
		90.0%	10.0%	.0%	100.0%
Total		550	22	18	590
		93.2%	3.7%	3.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.416(a)	10	.326
Likelihood Ratio	14.239	10	.162
Linear-by-Linear Association	1.059	1	.303
N of Valid Cases	590		

Appendix V
Property Value Conditions
Jurisdiction Cross- Tabulation

Respondent Jurisdiction: * For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: High level nuclear waste transportation route

		For each item please tell me if you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes: High level nuclear waste transportation route			Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Respondent Jurisdiction:	Unincorporated Clark County	187	16	9	212
		88.2%	7.5%	4.2%	100.0%
	City of Las Vegas	184	23	6	213
		86.4%	10.8%	2.8%	100.0%
	City of North Las Vegas	52	7	0	59
		88.1%	11.9%	.0%	100.0%
	City of Henderson	70	7	1	78
		89.7%	9.0%	1.3%	100.0%
	Boulder City	18	2	3	23
		78.3%	8.7%	13.0%	100.0%
	Mesquite	8	2	0	10
		80.0%	20.0%	.0%	100.0%
Total		519	57	19	595
		87.2%	9.6%	3.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.036(a)	10	.171
Likelihood Ratio	13.135	10	.216
Linear-by-Linear Association	.142	1	.706
N of Valid Cases	595		

Appendix VI

Environmental Considerations

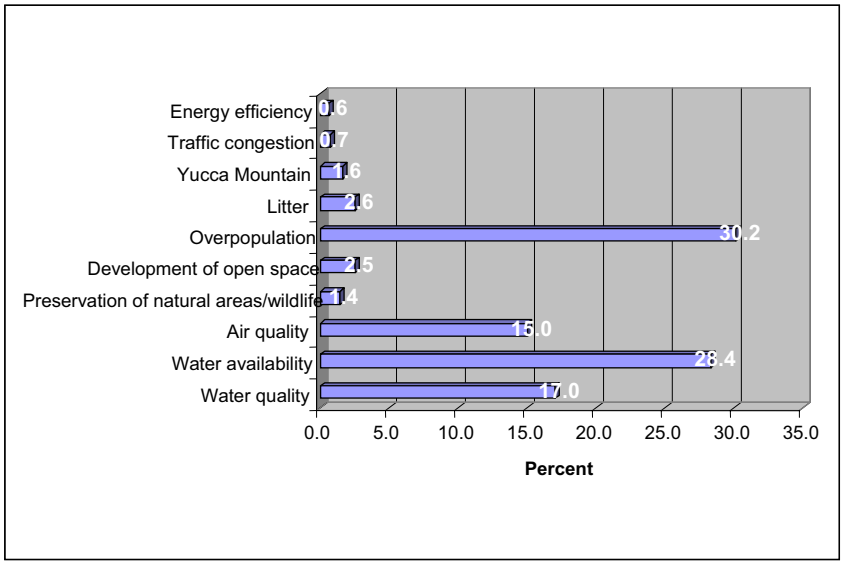
Appendix VI
Environmental Considerations
Summary Statistics

		How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	594	600	593	598
	Missing	6	0	7	2
Mean		2.69	1.53	3.06	2.96
Std. Error of Mean		.034	.032	.039	.033
Median		3.00	1.00	3.00	3.00
Mode		3	1	4	3
Std. Deviation		.823	.793	.950	.805
Skewness		-.098	1.649	-.497	-.296
Std. Error of Skewness		.100	.100	.100	.100
Kurtosis		-.563	2.393	-.977	-.608
Std. Error of Kurtosis		.200	.199	.200	.199
Range		3	3	3	3
Minimum		1	1	1	1
Maximum		4	4	4	4

Appendix VI
Environmental Considerations

In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?

	Frequency	Percent
Water quality	102	17.0
Water availability	170	28.3
Air quality	90	15.0
Preservation of natural areas/wildlife	9	1.4
Development of open space	15	2.5
Overpopulation	181	30.2
Litter	15	2.6
Yucca Mountain	10	1.6
Traffic congestion	4	.7
Energy efficiency	4	.6
Total	599	99.8
DK/No answer	1	.2
Total	600	100.0

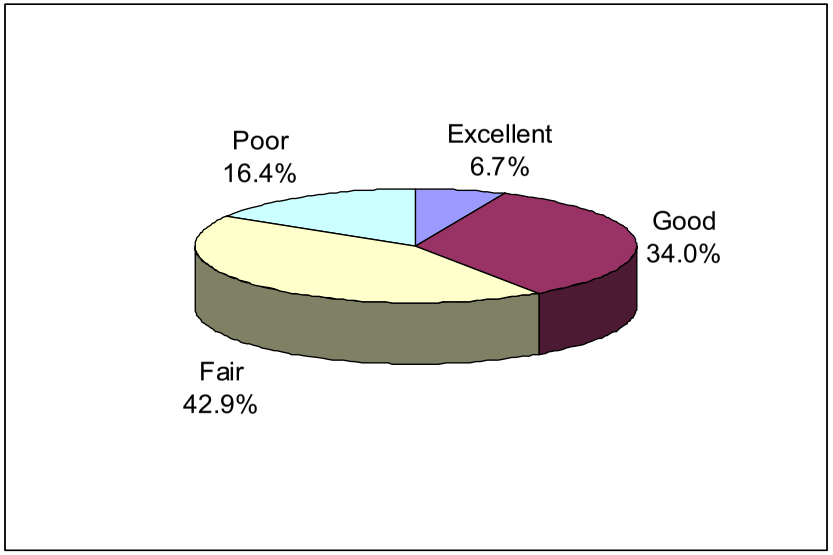


Note- Graph does not include Don't Know/ No Answer

Appendix VI
Environmental Considerations

How would you rate local government's performance in preserving natural areas within Clark County?

	Frequency	Percent
Excellent	40	6.6
Good	202	33.6
Fair	255	42.5
Poor	97	16.2
Total	594	99.1
DK/No answer	6	.9
Total	600	100.0

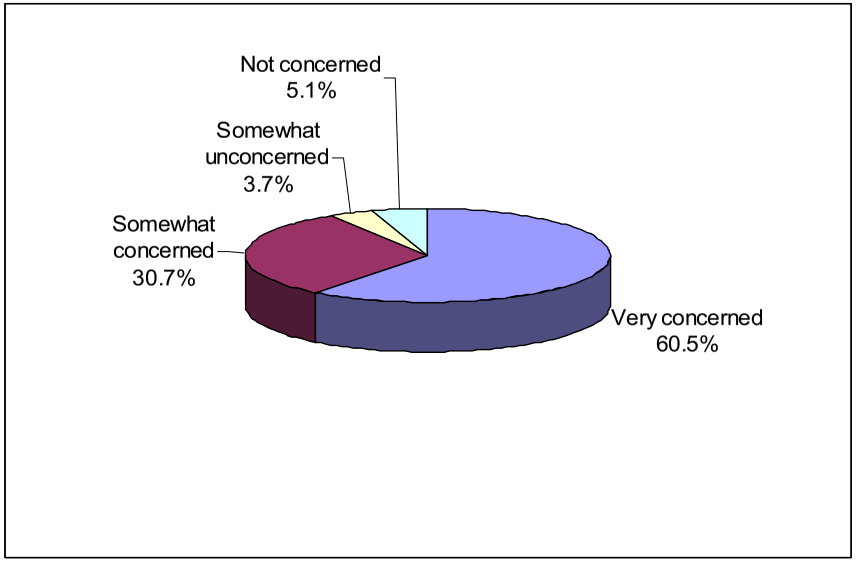


Note- Graph does not include Don't Know/ No Answer

Appendix VI
Environmental Considerations

Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?

	Frequency	Percent
Very concerned	363	60.5
Somewhat concerned	184	30.7
Somewhat unconcerned	22	3.7
Not concerned	30	5.1
Total	600	100.0

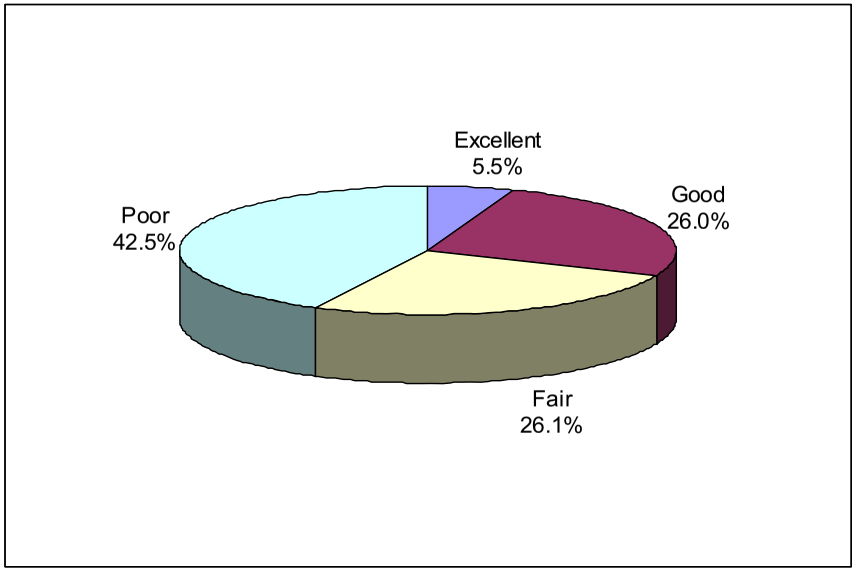


Note- Graph does not include Don't Know/ No Answer

Appendix VI
Environmental Considerations

In general, how would you rate the quality of Clark County's drinking water?

	Frequency	Percent
Excellent	32	5.4
Good	154	25.7
Fair	155	25.8
Poor	252	42.0
Total	593	98.8
DK/No answer	7	1.2
Total	600	100.0

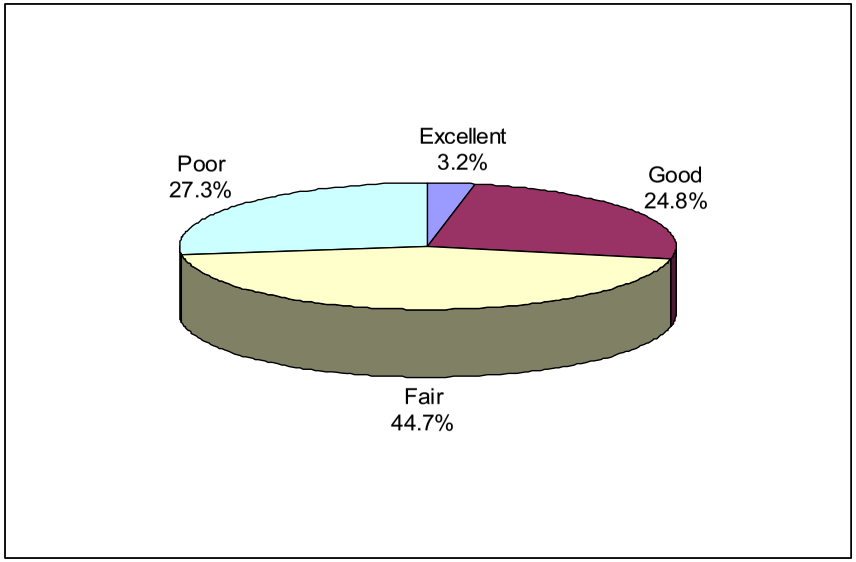


Note- Graph does not include Don't Know/ No Answer

Appendix VI
Environmental Considerations

In general, how would you rate Clark County's air quality?

		Frequency	Percent
Valid	Excellent	19	3.2
	Good	149	24.8
	Fair	267	44.5
	Poor	164	27.3
	Total	598	99.7
Missing	DK/No answer	2	.3
Total		600	100.0



Note- Graph does not include Don't Know/ No Answer

Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

Unincorporated Clark County		In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?	How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	241	239	242	241	242
	Missing	0	3	0	1	0
Mean		3.47	2.85	1.51	2.98	2.97
Std. Error of Mean		.148	.051	.049	.061	.050
Median		2.00	3.00	1.00	3.00	3.00
Mode		2	3	1	4	3
Std. Deviation		2.292	.794	.758	.941	.773
Skewness		.679	-.104	1.631	-.346	-.282
Std. Error of Skewness		.157	.157	.157	.157	.157
Kurtosis		-.671	-.674	2.523	-1.080	-.495
Std. Error of Kurtosis		.312	.314	.312	.313	.312
Range		9	3	3	3	3
Minimum		1	1	1	1	1
Maximum		10	4	4	4	4

Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

City of Las Vegas		In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?	How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	182	180	182	176	181
	Missing	0	3	0	6	1
Mean		3.87	2.62	1.54	3.09	2.95
Std. Error of Mean		.157	.061	.063	.072	.060
Median		3.00	3.00	1.00	3.00	3.00
Mode		6	3	1	4	3
Std. Deviation		2.121	.813	.845	.952	.814
Skewness		.321	.003	1.764	-.543	-.134
Std. Error of Skewness		.180	.181	.180	.183	.181
Kurtosis		-1.165	-.531	2.554	-.956	-.986
Std. Error of Kurtosis		.358	.361	.358	.364	.359
Range		9	3	3	3	3
Minimum		1	1	1	1	1
Maximum		10	4	4	4	4

Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

City of North Las Vegas		In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?	How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	64	64	64	64	64
	Missing	0	0	0	0	0
Mean		3.97	2.75	1.56	3.08	3.04
Std. Error of Mean		.284	.113	.115	.121	.103
Median		3.00	3.00	1.00	3.00	3.00
Mode		6	3	1	4	3
Std. Deviation		2.276	.909	.918	.969	.821
Skewness		.042	-.484	1.651	-.549	-.430
Std. Error of Skewness		.299	.299	.299	.299	.299
Kurtosis		-1.550	-.422	1.752	-.982	-.527
Std. Error of Kurtosis		.590	.590	.590	.590	.590
Range		8	3	3	3	3
Minimum		1	1	1	1	1
Maximum		9	4	4	4	4

Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

City of Henderson		In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?	How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	84	84	84	84	84
	Missing	0	0	0	0	0
Mean		3.34	2.43	1.59	3.14	2.95
Std. Error of Mean		.212	.076	.070	.104	.093
Median		2.00	2.00	2.00	3.00	3.00
Mode		2	2	1	4	3
Std. Deviation		1.943	.698	.640	.951	.846
Skewness		.474	-.054	.880	-.783	-.586
Std. Error of Skewness		.262	.263	.262	.262	.263
Kurtosis		-1.504	-.206	.957	-.472	-.085
Std. Error of Kurtosis		.519	.521	.519	.519	.521
Range		5	3	3	3	3
Minimum		1	1	1	1	1
Maximum		6	4	4	4	4

Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

Boulder City		In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?	How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	19	19	19	19	19
	Missing	0	0	0	0	0
Mean		2.64	2.20	1.24	3.01	2.75
Std. Error of Mean		.447	.220	.128	.221	.206
Median		2.00	2.00	1.00	3.00	3.00
Mode		1	3	1	4	2
Std. Deviation		1.954	.961	.559	.967	.899
Skewness		.958	.125	2.383	-.389	.103
Std. Error of Skewness		.523	.523	.523	.523	.523
Kurtosis		-.570	-1.018	5.299	-1.110	-.955
Std. Error of Kurtosis		1.012	1.012	1.012	1.012	1.012
Range		5	3	2	3	3
Minimum		1	1	1	1	1
Maximum		6	4	3	4	4

Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

Mesquite		In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?	How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	8	8	8	8	8
	Missing	0	0	0	0	0
Mean		4.31	3.02	1.95	3.57	2.86
Std. Error of Mean		.669	.310	.447	.326	.308
Median		5.00	3.00	1.28	4.00	3.00
Mode		6	4	1	4	3
Std. Deviation		1.883	.897	1.292	.943	.892
Skewness		-.246	-.050	1.109	-2.272	-1.026
Std. Error of Skewness		.755	.739	.739	.739	.739
Kurtosis		-2.339	-1.915	-.439	5.222	2.038
Std. Error of Kurtosis		1.488	1.449	1.449	1.449	1.449
Range		4	2	3	3	3
Minimum		2	2	1	1	1
Maximum		6	4	4	4	4

Appendix VI
Environmental Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * How would you rate local government's performance in preserving natural areas within Clark County?

		How would you rate local government's performance in preserving natural areas within Clark County?				Total
		Excellent	Good	Fair	Poor	
Respondent Jurisdiction:	Unincorporated Clark County	8	74	106	52	240
		3.3%	30.8%	44.2%	21.7%	100.0%
	City of Las Vegas	13	68	74	25	180
		7.2%	37.8%	41.1%	13.9%	100.0%
	City of North Las Vegas	8	13	31	12	64
		12.5%	20.3%	48.4%	18.8%	100.0%
	City of Henderson	6	39	35	4	84
		7.1%	46.4%	41.7%	4.8%	100.0%
	Boulder City	5	6	7	1	19
		26.3%	31.6%	36.8%	5.3%	100.0%
	Mesquite	0	3	2	3	8
		.0%	37.5%	25.0%	37.5%	100.0%
Total		40	203	255	97	595
		6.7%	34.1%	42.9%	16.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	44.665(a)	15	.000
Likelihood Ratio	43.393	15	.000
Linear-by-Linear Association	13.682	1	.000
N of Valid Cases	595		

Appendix VI
Environmental Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?

		Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?				Total
		Very concerned	Somewhat concerned	Somewhat unconcerned	Not concerned	
Respondent Jurisdiction:	Unincorporated Clark County	147	75	10	10	242
		60.7%	31.0%	4.1%	4.1%	100.0%
	City of Las Vegas	114	52	4	13	183
		62.3%	28.4%	2.2%	7.1%	100.0%
	City of North Las Vegas	42	14	4	5	65
		64.6%	21.5%	6.2%	7.7%	100.0%
	City of Henderson	41	38	4	1	84
		48.8%	45.2%	4.8%	1.2%	100.0%
	Boulder City	16	2	1	0	19
		84.2%	10.5%	5.3%	.0%	100.0%
	Mesquite	4	2	0	2	8
		50.0%	25.0%	.0%	25.0%	100.0%
Total		364	183	23	31	601
		60.6%	30.4%	3.8%	5.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	29.804(a)	15	.013
Likelihood Ratio	29.355	15	.014
Linear-by-Linear Association	.210	1	.647
N of Valid Cases	601		

Appendix VI
Environmental Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * In general, how would you rate the quality of Clark County's drinking water?

		In general, how would you rate the quality of Clark County's drinking water?				Total
		Excellent	Good	Fair	Poor	
Respondent Jurisdiction:	Unincorporated Clark County	13	70	66	91	240
		5.4%	29.2%	27.5%	37.9%	100.0%
	City of Las Vegas	9	45	44	78	176
		5.1%	25.6%	25.0%	44.3%	100.0%
	City of North Las Vegas	4	17	15	29	65
		6.2%	26.2%	23.1%	44.6%	100.0%
	City of Henderson	6	15	24	39	84
		7.1%	17.9%	28.6%	46.4%	100.0%
	Boulder City	1	6	5	8	20
		5.0%	30.0%	25.0%	40.0%	100.0%
	Mesquite	0	1	0	7	8
		.0%	12.5%	.0%	87.5%	100.0%
Total		33	154	154	252	593
		5.6%	26.0%	26.0%	42.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.048(a)	15	.599
Likelihood Ratio	15.025	15	.450
Linear-by-Linear Association	3.237	1	.072
N of Valid Cases	593		

Appendix VI
Environmental Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * In general, how would you rate Clark County's air quality?

		In general, how would you rate Clark County's air quality?				Total
		Excellent	Good	Fair	Poor	
Respondent Jurisdiction:	Unincorporated Clark County	6	57	116	62	241
		2.5%	23.7%	48.1%	25.7%	100.0%
	City of Las Vegas	4	54	72	52	182
		2.2%	29.7%	39.6%	28.6%	100.0%
	City of North Las Vegas	2	14	27	21	64
		3.1%	21.9%	42.2%	32.8%	100.0%
	City of Henderson	6	15	41	22	84
		7.1%	17.9%	48.8%	26.2%	100.0%
	Boulder City	1	8	6	5	20
		5.0%	40.0%	30.0%	25.0%	100.0%
	Mesquite	1	1	5	2	9
		11.1%	11.1%	55.6%	22.2%	100.0%
Total		20	149	267	164	600
		3.3%	24.8%	44.5%	27.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.472(a)	15	.291
Likelihood Ratio	16.122	15	.374
Linear-by-Linear Association	.379	1	.538
N of Valid Cases	600		

Appendix VII

Yucca Mountain Considerations

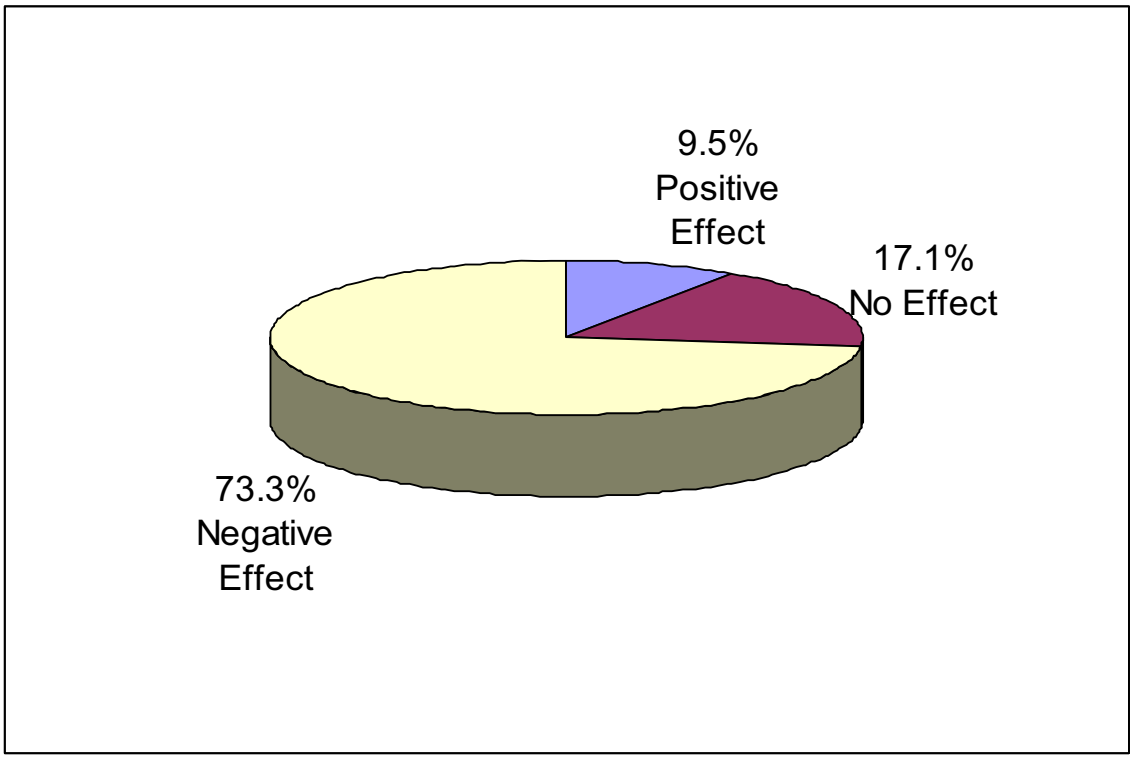
Appendix VII
Yucca Mountain Considerations
Summary Statistics

		Keeping local Decision makers up to date about Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies including seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourism sector	Assess impacts to the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	574	581	577	589	578	581	575	580	586
	Missing	25	19	22	11	21	18	24	19	13
Mean		3.94	3.98	3.87	4.04	3.72	3.83	3.79	3.85	3.96
Std. Error of Mean		.057	.057	.055	.050	.052	.053	.051	.053	.058
Median		5.00	5.00	4.00	5.00	4.00	4.00	4.00	4.00	5.00
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.366	1.368	1.326	1.224	1.258	1.278	1.213	1.281	1.415
Skewness		-1.024	-1.094	-.902	-1.141	-.633	-.827	-.734	-.798	-1.048
Std. Error of Skewness		.102	.101	.102	.101	.102	.101	.102	.101	.101
Kurtosis		-.280	-.148	-.398	.257	-.632	-.402	-.372	-.517	-.352
Std. Error of Kurtosis		.204	.202	.203	.201	.203	.202	.203	.203	.201
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations

Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative affect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.

	Frequency	Percent
Positive effect	56	9.3
No effect	100	16.7
Negative effect	430	71.7
Total	586	97.8
DK/No answer	13	2.2
Total	600	100.0

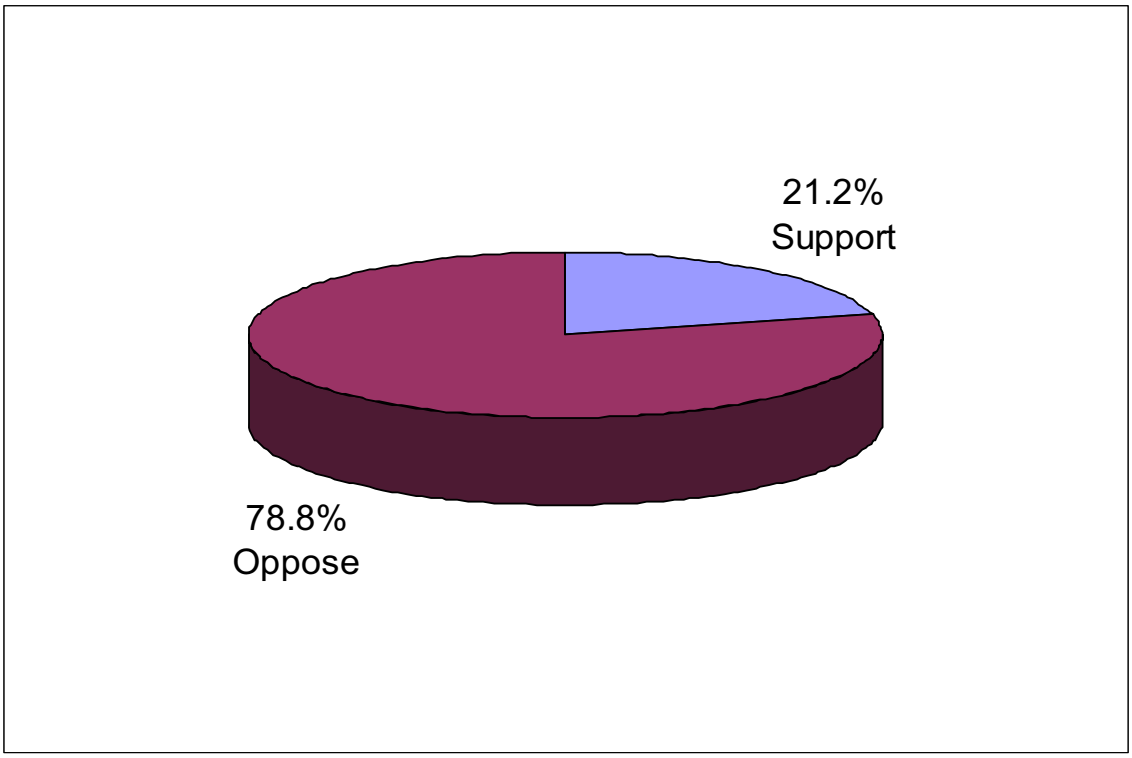


Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations

The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain. If given the opportunity to vote on this matter, would you support or oppose locating a nuclear waste repository at Yucca Mountain

	Frequency	Percent
Support	123	20.5
Oppose	457	76.2
Total	580	96.7
DK/No answer	20	3.3
Total	600	100.0

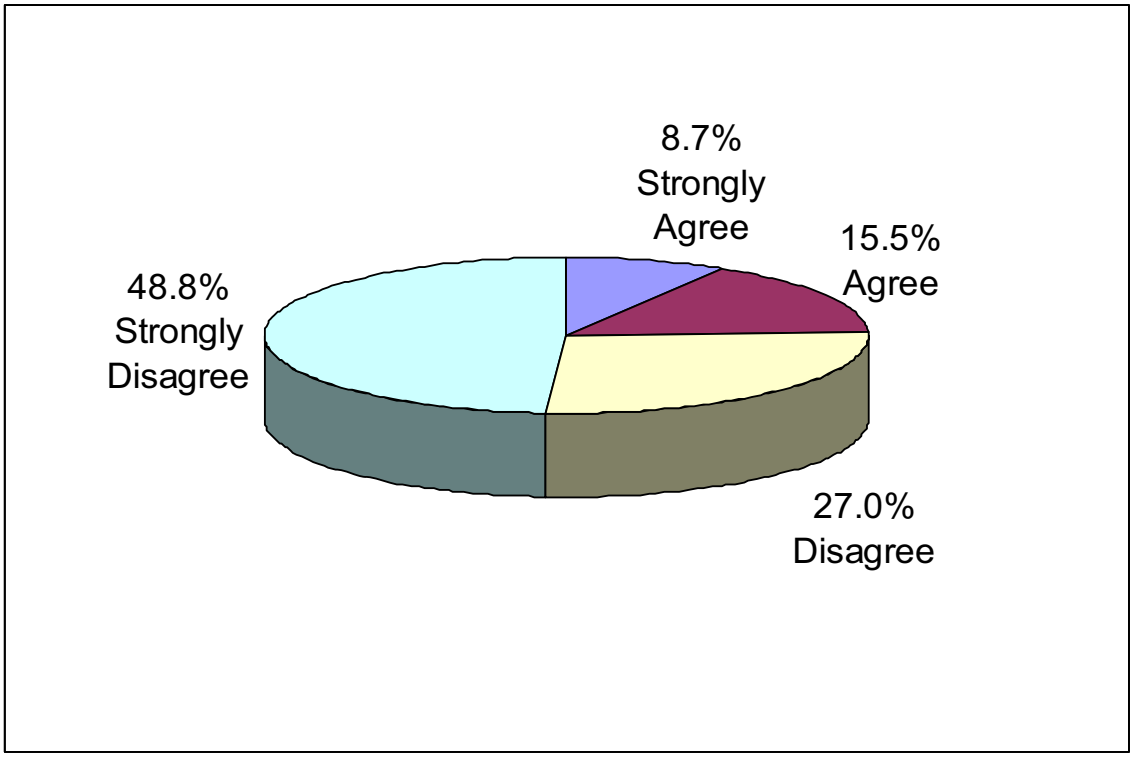


Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations

The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you agree or disagree with this claim?

	Frequency	Percent
Strongly agree	51	8.5
Agree	90	15.1
Disagree	158	26.3
Strongly disagree	285	47.5
Total	583	97.3
DK/No answer	16	2.7
Total	600	100.0



Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations

Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Keeping local Decision makers up to date about Yucca Mountain

	Frequency	Percent
1	59	9.8
2	39	6.4
3	84	14.0
4	89	14.8
5	304	50.7
Total	574	95.8
DK/No answer	25	4.2
Total	600	100.0

Appendix VII
Yucca Mountain Considerations

Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Keeping the public up to date about Yucca Mountain

	Frequency	Percent
1	61	10.2
2	34	5.7
3	80	13.3
4	85	14.2
5	321	53.5
Total	581	96.9
DK/No answer	19	3.1
Total	600	100.0

Appendix VII
Yucca Mountain Considerations

Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Reviewing technical, scientific studies including seismic, vulcanology, geology, and hydrology

	Frequency	Percent
1	53	8.8
2	43	7.2
3	103	17.2
4	105	17.5
5	274	45.7
Total	577	96.3
DK/No answer	22	3.7
Total	600	100.0

Appendix VII
Yucca Mountain Considerations

Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Identify public safety needs and impacts

	Frequency	Percent
1	38	6.4
2	37	6.1
3	89	14.8
4	123	20.5
5	302	50.4
Total	589	98.2
DK/No answer	11	1.8
Total	600	100.0

Appendix VII
Yucca Mountain Considerations

Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Assess other government impacts

	Frequency	Percent
1	42	7.0
2	56	9.4
3	140	23.3
4	125	20.8
5	215	35.9
Total	578	96.4
DK/No answer	21	3.6
Total	600	100.0

Appendix VII
Yucca Mountain Considerations

Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Assess impacts on the tourism sector

	Frequency	Percent
1	46	7.7
2	47	7.8
3	115	19.1
4	127	21.3
5	246	41.0
Total	581	96.9
DK/No answer	18	3.1
Total	600	100.0

Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Assess impacts to the building, construction, and development sectors

	Frequency	Percent
1	38	6.3
2	44	7.3
3	138	23.0
4	139	23.2
5	217	36.2
Total	575	96.0
DK/No answer	24	4.0
Total	600	100.0

Appendix VII
Yucca Mountain Considerations

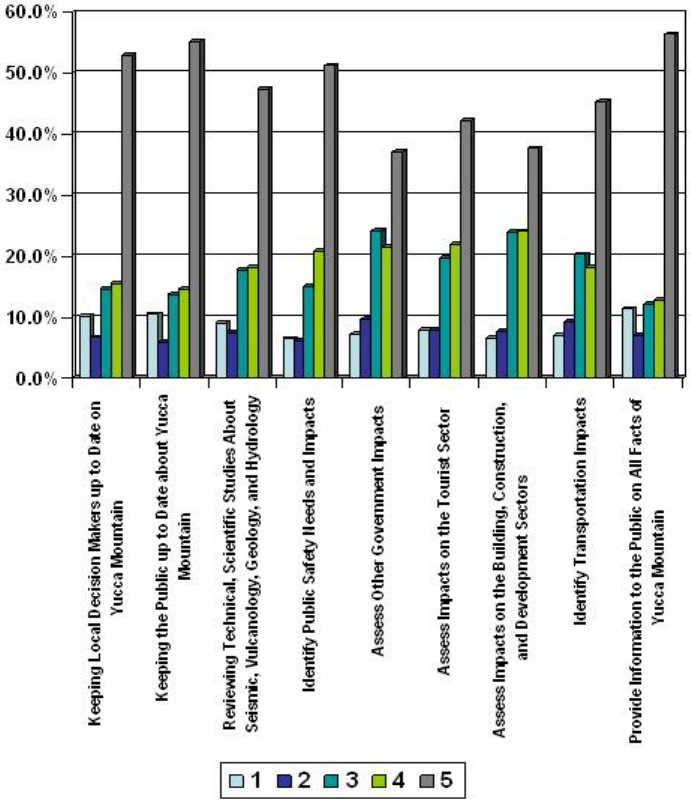
Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Identify transportation impacts

		Frequency	Percent
	1	41	6.8
	2	54	9.0
	3	118	19.6
	4	105	17.5
	5	263	43.8
	Total	580	96.8
	DK/No answer	19	3.2
Total		600	100.0

Appendix VII
Yucca Mountain Considerations

Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Provide information to the public on all facts of Yucca Mountain

		Frequency	Percent
	1	67	11.2
	2	42	7.0
	3	72	12.0
	4	75	12.5
	5	331	55.2
	Total	586	97.8
DK/No answer		13	2.2
Total		600	100.0



Note- Graph does not include Don't Know/ No Answer

Appendix VII
Yucca Mountain Considerations
Jurisdiction

Unincorporated Clark County		Keeping local Decision makers up to date about Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies including seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourism sector	Assess impacts to the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	229	231	237	238	234	237	235	234	234
	Missing	12	11	4	4	8	5	7	8	8
Mean		3.85	3.97	3.83	4.06	3.71	3.80	3.85	3.87	3.97
Std. Error of Mean		.092	.093	.088	.082	.085	.086	.081	.085	.092
Median		4.00	5.00	4.00	5.00	4.00	4.00	4.00	4.00	5.00
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.399	1.406	1.363	1.266	1.304	1.320	1.241	1.302	1.408
Skewness		-.901	-1.077	-.902	-1.242	-.657	-.823	-.902	-.892	-1.065
Std. Error of Skewness		.161	.160	.158	.158	.159	.158	.159	.159	.159
Kurtosis		-.520	-.262	-.393	.404	-.673	-.495	-.141	-.330	-.311
Std. Error of Kurtosis		.320	.319	.315	.314	.317	.315	.317	.317	.317
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdiction

City of Las Vegas		Keeping local Decision makers up to date about Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies including seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourism sector	Assess impacts to the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	175	177	175	178	173	173	171	174	179
	Missing	7	5	8	4	9	9	11	8	3
Mean		3.95	3.99	3.76	3.90	3.70	3.72	3.65	3.74	3.89
Std. Error of Mean		.107	.104	.104	.094	.095	.100	.097	.102	.107
Median		5.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.412	1.383	1.373	1.253	1.251	1.318	1.265	1.352	1.428
Skewness		-1.060	-1.145	-.720	-.902	-.586	-.689	-.571	-.679	-.982
Std. Error of Skewness		.183	.183	.184	.182	.185	.185	.186	.184	.181
Kurtosis		-.299	-.059	-.779	-.194	-.632	-.645	-.612	-.782	-.472
Std. Error of Kurtosis		.365	.363	.366	.362	.367	.367	.369	.366	.361
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdiction

City of North Las Vegas		Keeping local Decision makers up to date about Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies including seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourism sector	Assess impacts to the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	60	63	62	63	63	63	62	63	63
	Missing	4	2	2	2	2	2	3	2	1
Mean		3.87	3.85	4.04	4.19	3.87	4.04	3.88	4.12	3.95
Std. Error of Mean		.185	.191	.154	.150	.140	.149	.140	.147	.199
Median		4.00	5.00	5.00	5.00	4.00	4.29	4.00	5.00	5.00
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.439	1.512	1.212	1.187	1.105	1.180	1.100	1.166	1.581
Skewness		-1.066	-1.043	-.919	-1.247	-.465	-1.104	-.458	-1.060	-1.122
Std. Error of Skewness		.308	.302	.304	.302	.302	.302	.305	.302	.301
Kurtosis		-.235	-.451	-.492	.318	-1.016	.426	-1.029	-.231	-.477
Std. Error of Kurtosis		.608	.597	.599	.597	.597	.597	.601	.597	.595
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdiction

City of Henderson		Keeping local Decision makers up to date about Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies including seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourism sector	Assess impacts to the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	83	83	76	83	82	82	82	83	83
	Missing	2	1	8	1	3	2	2	1	1
Mean		4.19	4.07	4.07	4.09	3.67	3.84	3.75	3.74	4.04
Std. Error of Mean		.127	.128	.144	.125	.139	.138	.134	.134	.143
Median		5.00	5.00	5.00	4.00	4.00	4.00	4.00	4.00	5.00
Mode		5	5	5	5	5	5	5	5	5
Std. Deviation		1.159	1.170	1.261	1.140	1.259	1.248	1.216	1.221	1.301
Skewness		-1.222	-1.033	-1.321	-1.275	-.736	-.794	-.638	-.530	-1.066
Std. Error of Skewness		.265	.264	.275	.264	.266	.266	.265	.264	.264
Kurtosis		.324	.180	.733	.939	-.429	-.424	-.552	-.831	-.144
Std. Error of Kurtosis		.524	.522	.543	.522	.527	.526	.525	.522	.522
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdiction

Boulder City		Keeping local Decision makers up to date about Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies including seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourism sector	Assess impacts to the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	19	19	19	19	19	19	18	18	19
	Missing	0	0	0	0	0	0	1	1	0
Mean		3.92	3.92	3.92	4.20	3.54	4.29	4.12	4.15	3.81
Std. Error of Mean		.279	.293	.274	.236	.302	.181	.181	.225	.354
Median		4.00	5.00	4.00	5.00	3.00	4.00	4.00	4.86	5.00
Mode		5	5	5	5	5	5	4	5	5
Std. Deviation		1.220	1.279	1.182	1.019	1.305	.783	.772	.959	1.547
Skewness		-.743	-.479	-.532	-1.003	-.266	-.935	-.226	-.326	-.910
Std. Error of Skewness		.523	.523	.528	.528	.528	.528	.534	.534	.523
Kurtosis		-.668	-1.632	-1.299	-.152	-1.064	.737	-1.198	-1.972	-.641
Std. Error of Kurtosis		1.012	1.012	1.023	1.023	1.023	1.023	1.033	1.033	1.012
Range		4	3	3	3	4	3	2	2	4
Minimum		1	2	2	2	1	2	3	3	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdiction

Mesquite		Keeping local Decision makers up to date about Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies including seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourism sector	Assess impacts to the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	8	8	8	8	8	8	8	8	8
	Missing	0	0	0	0	0	0	0	0	0
Mean		4.52	4.57	4.42	4.60	4.04	4.13	3.89	4.22	4.41
Std. Error of Mean		.319	.326	.218	.217	.425	.307	.265	.326	.317
Median		5.00	5.00	4.27	5.00	4.00	4.00	4.00	4.05	5.00
Mode		5	5	4(a)	5	4(a)	5	4	5	5
Std. Deviation		.898	.943	.631	.628	1.230	.887	.747	.919	.893
Skewness		-2.255	-2.272	-.569	-1.466	-1.657	-.302	.198	-1.210	-1.840
Std. Error of Skewness		.755	.739	.739	.739	.739	.739	.755	.755	.755
Kurtosis		6.429	5.222	-.068	2.087	3.020	-1.766	-.586	2.030	4.759
Std. Error of Kurtosis		1.488	1.449	1.449	1.449	1.449	1.449	1.488	1.488	1.488
Range		3	3	2	2	4	2	2	3	3
Minimum		2	2	3	3	1	3	3	2	2
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative affect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.

		Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative affect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.			Total
		Positive effect	No effect	Negative effect	
Respondent Jurisdiction:	Unincorporated Clark County	17	34	185	236
		7.2%	14.4%	78.4%	100.0%
	City of Las Vegas	20	32	127	179
		11.2%	17.9%	70.9%	100.0%
	City of North Las Vegas	5	10	46	61
		8.2%	16.4%	75.4%	100.0%
	City of Henderson	10	20	54	84
		11.9%	23.8%	64.3%	100.0%
	Boulder City	3	4	12	19
		15.8%	21.1%	63.2%	100.0%
	Mesquite	1	0	7	8
		12.5%	.0%	87.5%	100.0%
Total		56	100	431	587
		9.5%	17.0%	73.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.581(a)	10	.391
Likelihood Ratio	11.692	10	.306
Linear-by-Linear Association	4.196	1	.041
N of Valid Cases	587		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain. If given the opportunity to vote on this matter, would you support or oppose locating a nuclear waste repository at Yucca Mountain

		The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain. If given the opportunity to vote on this matter, would you support or oppose locating a nuclear waste repository at Yucca Mountain		Total
		Support	Oppose	
Respondent Jurisdiction:	Unincorporated Clark County	36	201	237
		15.2%	84.8%	100.0%
	City of Las Vegas	47	132	179
		26.3%	73.7%	100.0%
	City of North Las Vegas	16	42	58
		27.6%	72.4%	100.0%
	City of Henderson	19	61	80
		23.8%	76.3%	100.0%
	Boulder City	3	14	17
		17.6%	82.4%	100.0%
	Mesquite	1	7	8
		12.5%	87.5%	100.0%
Total		122	457	579
		21.1%	78.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.122(a)	5	.072
Likelihood Ratio	10.312	5	.067
Linear-by-Linear Association	2.071	1	.150
N of Valid Cases	579		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you agree or disagree with this claim?

		The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you agree or disagree with this claim?				Total
		Strongly agree	Agree	Disagree	Strongly disagree	
Respondent Jurisdiction:	Unincorporated Clark County	21	35	67	111	234
		9.0%	15.0%	28.6%	47.4%	100.0%
	City of Las Vegas	20	23	49	88	180
		11.1%	12.8%	27.2%	48.9%	100.0%
	City of North Las Vegas	5	9	12	34	60
		8.3%	15.0%	20.0%	56.7%	100.0%
	City of Henderson	5	15	26	36	82
		6.1%	18.3%	31.7%	43.9%	100.0%
	Boulder City	0	5	3	11	19
		.0%	26.3%	15.8%	57.9%	100.0%
	Mesquite	0	3	1	5	9
		.0%	33.3%	11.1%	55.6%	100.0%
Total		51	90	158	285	584
		8.7%	15.4%	27.1%	48.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.295(a)	15	.503
Likelihood Ratio	16.448	15	.353
Linear-by-Linear Association	.278	1	.598
N of Valid Cases	584		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Keeping local Decision makers up to date about Yucca Mountain

		Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Keeping local Decision makers up to date about Yucca Mountain					Total
		1	2	3	4	5	
Respondent Jurisdiction:	Unincorporated Clark County	27	14	40	34	114	229
		11.8%	6.1%	17.5%	14.8%	49.8%	100.0%
	City of Las Vegas	20	12	22	25	97	176
		11.4%	6.8%	12.5%	14.2%	55.1%	100.0%
	City of North Las Vegas	9	2	7	13	30	61
		14.8%	3.3%	11.5%	21.3%	49.2%	100.0%
	City of Henderson	2	7	11	12	50	82
		2.4%	8.5%	13.4%	14.6%	61.0%	100.0%
	Boulder City	0	3	4	4	9	20
		.0%	15.0%	20.0%	20.0%	45.0%	100.0%
	Mesquite	0	0	0	2	5	7
		.0%	.0%	.0%	28.6%	71.4%	100.0%
Total		58	38	84	90	305	575
		10.1%	6.6%	14.6%	15.7%	53.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.698(a)	20	.304
Likelihood Ratio	28.029	20	.109
Linear-by-Linear Association	4.479	1	.034
N of Valid Cases	575		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Keeping the public up to date about Yucca Mountain

		Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Keeping the public up to date about Yucca Mountain					Total
		1	2	3	4	5	
Respondent Jurisdiction:	Unincorporated Clark County	26	15	29	31	130	231
		11.3%	6.5%	12.6%	13.4%	56.3%	100.0%
	City of Las Vegas	20	10	20	29	98	177
		11.3%	5.6%	11.3%	16.4%	55.4%	100.0%
	City of North Las Vegas	11	2	5	13	32	63
		17.5%	3.2%	7.9%	20.6%	50.8%	100.0%
	City of Henderson	4	3	20	11	45	83
		4.8%	3.6%	24.1%	13.3%	54.2%	100.0%
	Boulder City	0	4	5	0	10	19
		.0%	21.1%	26.3%	.0%	52.6%	100.0%
	Mesquite	0	0	1	0	7	8
		.0%	.0%	12.5%	.0%	87.5%	100.0%
Total		61	34	80	84	322	581
		10.5%	5.9%	13.8%	14.5%	55.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	37.436(a)	20	.010
Likelihood Ratio	40.292	20	.005
Linear-by-Linear Association	.438	1	.508
N of Valid Cases	581		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Reviewing technical, scientific studies including seismic, vulcanology, geology, and hydrology

		Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Reviewing technical, scientific studies including seismic, vulcanology, geology, and hydrology					Total
		1	2	3	4	5	
Respondent Jurisdiction:	Unincorporated Clark County	28	11	47	43	109	238
		11.8%	4.6%	19.7%	18.1%	45.8%	100.0%
	City of Las Vegas	17	18	33	28	79	175
		9.7%	10.3%	18.9%	16.0%	45.1%	100.0%
	City of North Las Vegas	2	9	9	10	33	63
		3.2%	14.3%	14.3%	15.9%	52.4%	100.0%
	City of Henderson	7	3	10	16	41	77
		9.1%	3.9%	13.0%	20.8%	53.2%	100.0%
	Boulder City	0	3	4	3	9	19
		.0%	15.8%	21.1%	15.8%	47.4%	100.0%
	Mesquite	0	0	0	4	4	8
		.0%	.0%	.0%	50.0%	50.0%	100.0%
Total		54	44	103	104	275	580
		9.3%	7.6%	17.8%	17.9%	47.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	28.790(a)	20	.092
Likelihood Ratio	32.062	20	.043
Linear-by-Linear Association	3.435	1	.064
N of Valid Cases	580		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Identify public safety needs and impacts

		Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Identify public safety needs and impacts					Total
		1	2	3	4	5	
Respondent Jurisdiction:	Unincorporated Clark County	19	14	28	50	128	239
		7.9%	5.9%	11.7%	20.9%	53.6%	100.0%
	City of Las Vegas	13	10	39	34	81	177
		7.3%	5.6%	22.0%	19.2%	45.8%	100.0%
	City of North Las Vegas	2	7	7	9	38	63
		3.2%	11.1%	11.1%	14.3%	60.3%	100.0%
	City of Henderson	4	4	11	23	40	82
		4.9%	4.9%	13.4%	28.0%	48.8%	100.0%
	Boulder City	0	2	3	4	10	19
		.0%	10.5%	15.8%	21.1%	52.6%	100.0%
	Mesquite	0	0	0	2	5	7
		.0%	.0%	.0%	28.6%	71.4%	100.0%
Total		38	37	88	122	302	587
		6.5%	6.3%	15.0%	20.8%	51.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.942(a)	20	.245
Likelihood Ratio	26.164	20	.160
Linear-by-Linear Association	1.167	1	.280
N of Valid Cases	587		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Assess other government impacts

		Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Assess other government impacts					Total
		1	2	3	4	5	
Respondent Jurisdiction:	Unincorporated Clark County	21	21	55	46	91	234
		9.0%	9.0%	23.5%	19.7%	38.9%	100.0%
	City of Las Vegas	13	15	49	33	64	174
		7.5%	8.6%	28.2%	19.0%	36.8%	100.0%
	City of North Las Vegas	0	8	15	14	24	61
		.0%	13.1%	24.6%	23.0%	39.3%	100.0%
	City of Henderson	7	8	15	26	26	82
		8.5%	9.8%	18.3%	31.7%	31.7%	100.0%
	Boulder City	1	3	6	2	6	18
		5.6%	16.7%	33.3%	11.1%	33.3%	100.0%
	Mesquite	0	1	0	4	4	9
		.0%	11.1%	.0%	44.4%	44.4%	100.0%
Total		42	56	140	125	215	578
		7.3%	9.7%	24.2%	21.6%	37.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.542(a)	20	.312
Likelihood Ratio	28.768	20	.092
Linear-by-Linear Association	.132	1	.716
N of Valid Cases	578		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Assess impacts on the tourism sector

		Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Assess impacts on the tourism sector					Total
		1	2	3	4	5	
Respondent Jurisdiction:	Unincorporated Clark County	22	21	42	52	101	238
		9.2%	8.8%	17.6%	21.8%	42.4%	100.0%
	City of Las Vegas	16	15	40	34	69	174
		9.2%	8.6%	23.0%	19.5%	39.7%	100.0%
	City of North Las Vegas	4	3	13	13	31	64
		6.3%	4.7%	20.3%	20.3%	48.4%	100.0%
	City of Henderson	5	8	16	19	34	82
		6.1%	9.8%	19.5%	23.2%	41.5%	100.0%
	Boulder City	0	0	2	8	8	18
		.0%	.0%	11.1%	44.4%	44.4%	100.0%
	Mesquite	0	0	2	2	4	8
		.0%	.0%	25.0%	25.0%	50.0%	100.0%
Total		47	47	115	128	247	584
		8.0%	8.0%	19.7%	21.9%	42.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.038(a)	20	.774
Likelihood Ratio	18.493	20	.555
Linear-by-Linear Association	2.613	1	.106
N of Valid Cases	584		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Assess impacts to the building, construction, and development sectors

		Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Assess impacts to the building, construction, and development sectors					Total
		1	2	3	4	5	
Respondent Jurisdiction:	Unincorporated Clark County	18	16	44	62	94	234
		7.7%	6.8%	18.8%	26.5%	40.2%	100.0%
	City of Las Vegas	15	12	51	33	60	171
		8.8%	7.0%	29.8%	19.3%	35.1%	100.0%
	City of North Las Vegas	0	7	16	13	25	61
		.0%	11.5%	26.2%	21.3%	41.0%	100.0%
	City of Henderson	5	9	19	20	30	83
		6.0%	10.8%	22.9%	24.1%	36.1%	100.0%
	Boulder City	0	0	4	8	6	18
		.0%	.0%	22.2%	44.4%	33.3%	100.0%
	Mesquite	0	0	2	4	2	8
		.0%	.0%	25.0%	50.0%	25.0%	100.0%
Total		38	44	136	140	217	575
		6.6%	7.7%	23.7%	24.3%	37.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.228(a)	20	.158
Likelihood Ratio	32.601	20	.037
Linear-by-Linear Association	.069	1	.792
N of Valid Cases	575		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Identify transportation impacts

		Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Identify transportation impacts					Total
		1	2	3	4	5	
Respondent Jurisdiction:	Unincorporated Clark County	20	15	48	43	109	235
		8.5%	6.4%	20.4%	18.3%	46.4%	100.0%
	City of Las Vegas	16	18	37	27	76	174
		9.2%	10.3%	21.3%	15.5%	43.7%	100.0%
	City of North Las Vegas	1	9	5	13	34	62
		1.6%	14.5%	8.1%	21.0%	54.8%	100.0%
	City of Henderson	4	11	19	17	31	82
		4.9%	13.4%	23.2%	20.7%	37.8%	100.0%
	Boulder City	0	0	7	2	9	18
		.0%	.0%	38.9%	11.1%	50.0%	100.0%
	Mesquite	0	0	1	3	4	8
		.0%	.0%	12.5%	37.5%	50.0%	100.0%
Total		41	53	117	105	263	579
		7.1%	9.2%	20.2%	18.1%	45.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	29.245(a)	20	.083
Likelihood Ratio	34.700	20	.022
Linear-by-Linear Association	.327	1	.567
N of Valid Cases	579		

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Provide information to the public on all facts of Yucca Mountain

		Please rank the following in terms of the importance of each activity, where one is "low" and five is "high": Provide information to the public on all facts of Yucca Mountain					Total
		1	2	3	4	5	
Respondent Jurisdiction:	Unincorporated Clark County	26	17	29	28	134	234
		11.1%	7.3%	12.4%	12.0%	57.3%	100.0%
	City of Las Vegas	22	14	22	28	95	181
		12.2%	7.7%	12.2%	15.5%	52.5%	100.0%
	City of North Las Vegas	11	3	3	7	39	63
		17.5%	4.8%	4.8%	11.1%	61.9%	100.0%
	City of Henderson	5	7	14	9	48	83
		6.0%	8.4%	16.9%	10.8%	57.8%	100.0%
	Boulder City	3	0	4	1	11	19
		15.8%	.0%	21.1%	5.3%	57.9%	100.0%
	Mesquite	0	0	0	2	5	7
		.0%	.0%	.0%	28.6%	71.4%	100.0%
Total		67	41	72	75	332	587
		11.4%	7.0%	12.3%	12.8%	56.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.328(a)	20	.501
Likelihood Ratio	23.304	20	.274
Linear-by-Linear Association	.539	1	.463
N of Valid Cases	587		

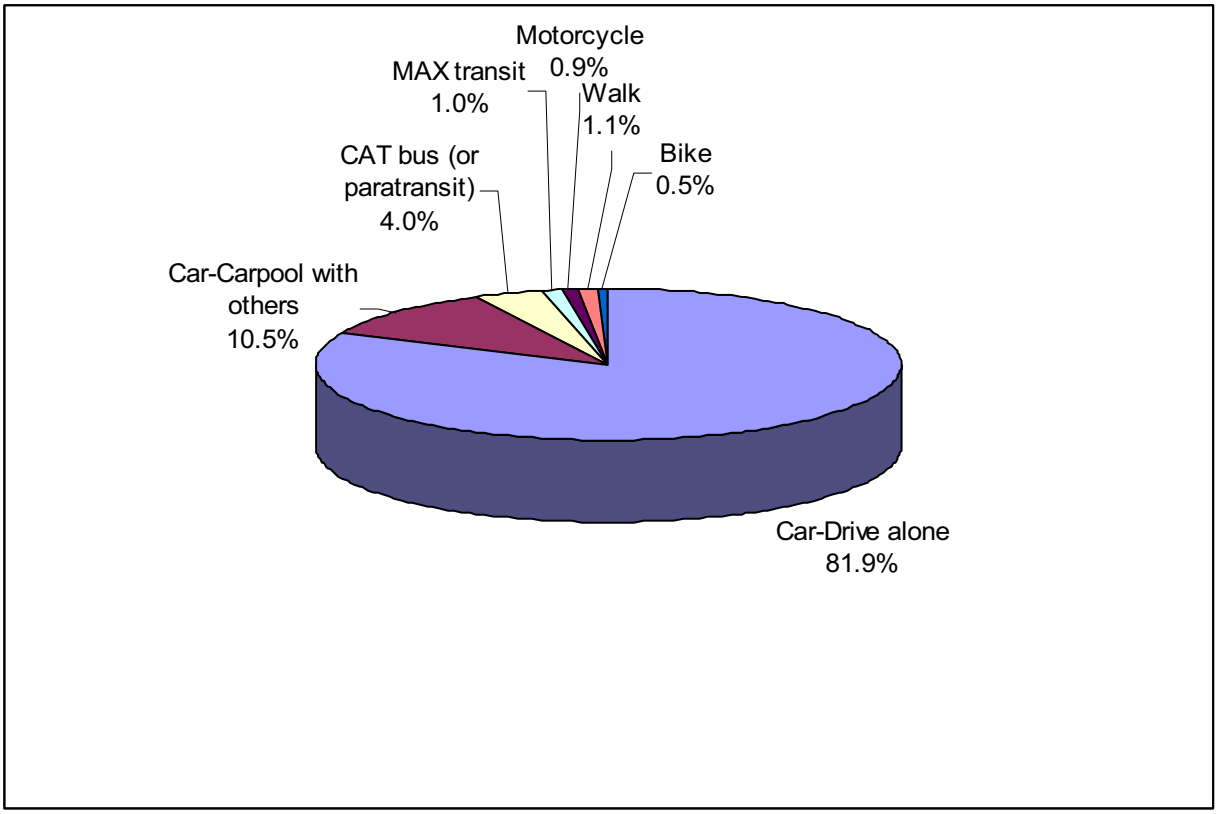
Appendix VIII

Community Profile

Appendix VIII
Community Profile

What is your most frequently used mode of transportation?

	Frequency	Percent
Car-Drive alone	491	81.9
Car-Carpool with others	63	10.5
CAT bus (or paratransit)	24	4.0
MAX transit	6	1.0
Motorcycle	6	.9
Walk	7	1.1
Bike	3	.5
Total	600	100.0

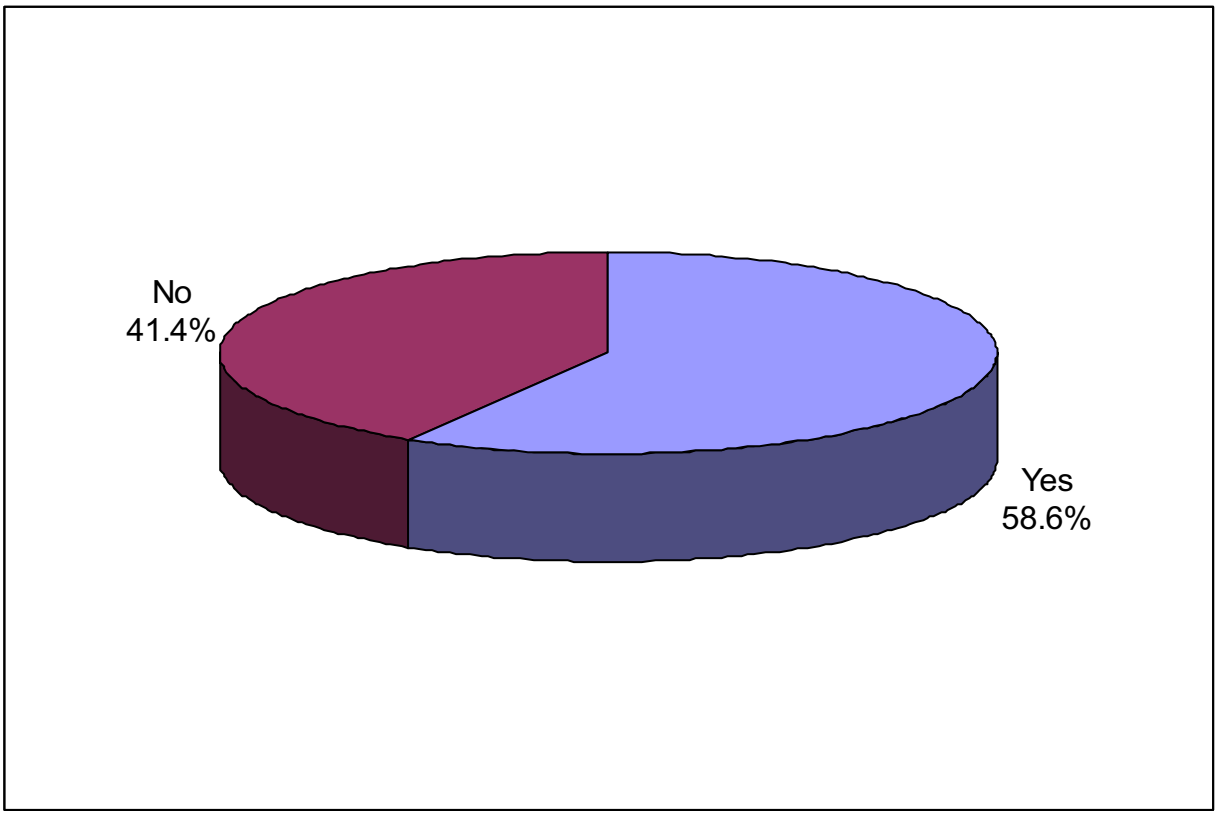


Note- Graph does not include Don't Know/ No Answer

Appendix VIII
Community Profile

Do you currently commute on a daily basis?

	Frequency	Percent
Yes	351	58.6
No	248	41.4
Total	600	100.0



Note- Graph does not include Don't Know/ No Answer

Appendix VIII
Community Profile
Jurisdictional Cross-tabulation

Respondent Jurisdiction: * What is your most frequently used mode of transportation?

		What is your most frequently used mode of transportation?							Total
		Car-Drive alone	Car-Carpool with others	CAT bus (or paratransit)	MAX transit	Motorcycle	Walk	Bike	
Respondent Jurisdiction:	Unincorporated Clark County	189	30	11	4	0	4	3	241
		78.4%	12.4%	4.6%	1.7%	.0%	1.7%	1.2%	100.0%
	City of Las Vegas	158	13	7	2	1	1	0	182
		86.8%	7.1%	3.8%	1.1%	.5%	.5%	.0%	100.0%
	City of North Las Vegas	51	6	5	0	1	2	0	65
		78.5%	9.2%	7.7%	.0%	1.5%	3.1%	.0%	100.0%
	City of Henderson	72	11	0	0	2	0	0	85
		84.7%	12.9%	.0%	.0%	2.4%	.0%	.0%	100.0%
	Boulder City	18	0	1	0	0	0	0	19
		94.7%	.0%	5.3%	.0%	.0%	.0%	.0%	100.0%
	Mesquite	3	4	0	0	2	0	0	9
		33.3%	44.4%	.0%	.0%	22.2%	.0%	.0%	100.0%
Total		491	64	24	6	6	7	3	601
		81.7%	10.6%	4.0%	1.0%	1.0%	1.2%	.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	82.477(a)	30	.000
Likelihood Ratio	57.943	30	.002
Linear-by-Linear Association	.120	1	.729
N of Valid Cases	601		

Appendix VIII
Community Profile
Jurisdictional Cross-tabulation

Respondent Jurisdiction: * Do you currently commute on a daily basis?

			Do you currently commute on a daily basis?		
			Yes	No	Total
Respondent Jurisdiction:	Unincorporated Clark County	Count	152	89	241
		% within Respondent Jurisdiction:	63.1%	36.9%	100.0%
	City of Las Vegas	Count	100	83	183
		% within Respondent Jurisdiction:	54.6%	45.4%	100.0%
	City of North Las Vegas	Count	37	27	64
		% within Respondent Jurisdiction:	57.8%	42.2%	100.0%
	City of Henderson	Count	51	33	84
		% within Respondent Jurisdiction:	60.7%	39.3%	100.0%
	Boulder City	Count	9	10	19
		% within Respondent Jurisdiction:	47.4%	52.6%	100.0%
	Mesquite	Count	3	6	9
		% within Respondent Jurisdiction:	33.3%	66.7%	100.0%
Total		Count	352	248	600
		% within Respondent Jurisdiction:	58.7%	41.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.695(a)	5	.244
Likelihood Ratio	6.653	5	.248
Linear-by-Linear Association	2.363	1	.124
N of Valid Cases	600		

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Appendix IX

Local Government Interaction

Appendix IX
Local Government Interaction
Summary Statistics

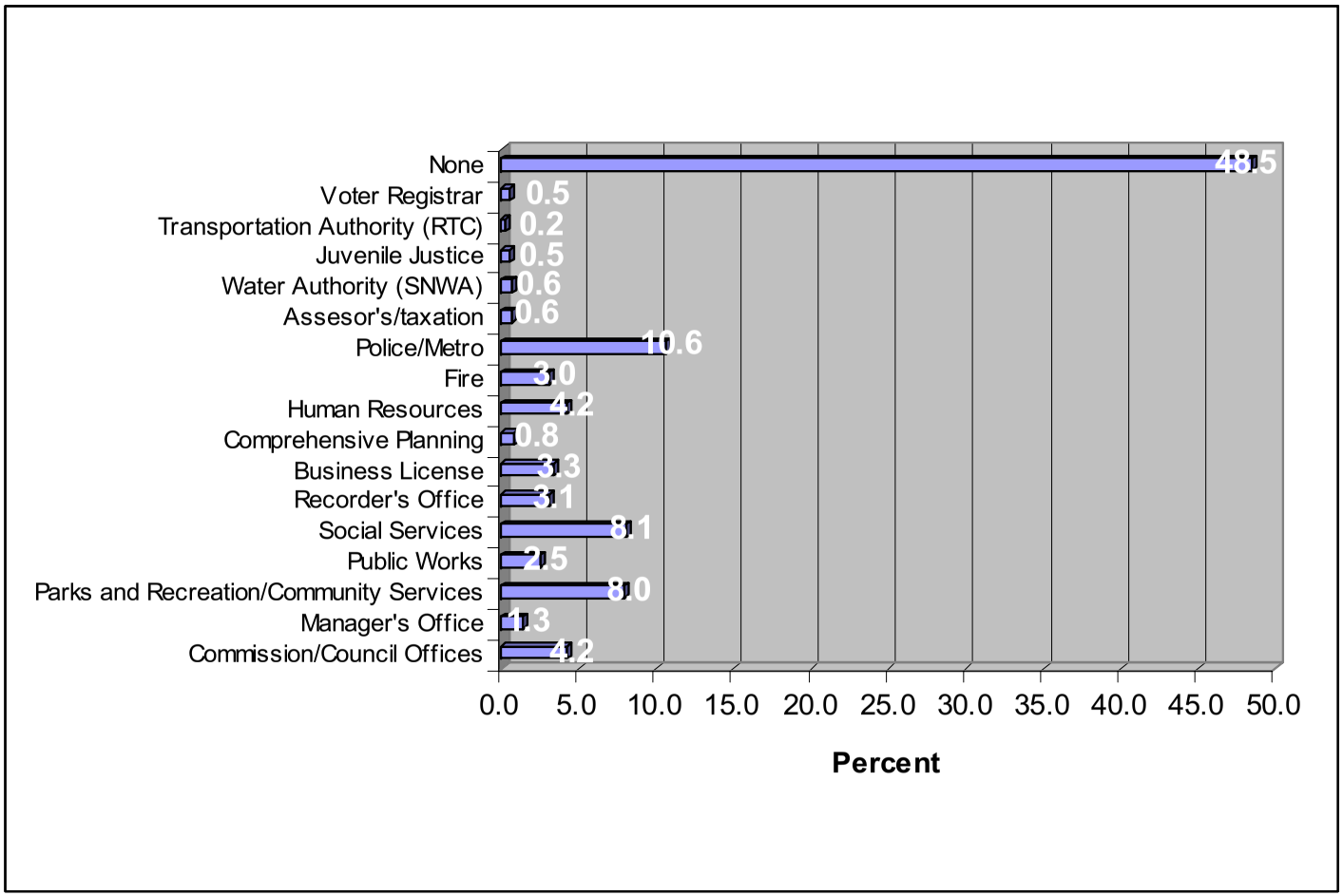
		Timeliness of response	Courtesy	Competency in handling your issue	Professionalism	Have you ever visited your local government's website?	In any given month, how often would you say you visit your local government's website?
N	Valid	294	291	290	294	579	238
	Missing	306	308	310	306	20	362
Mean		2.26	1.99	2.23	2.03	1.58	3.62
Std. Error of Mean		.055	.054	.058	.055	.021	.066
Median		2.00	2.00	2.00	2.00	2.00	4.00
Mode		2	2	2	2	2	4
Std. Deviation		.951	.922	.992	.947	.494	1.010
Skewness		.319	.618	.359	.591	-.322	-1.066
Std. Error of Skewness		.142	.143	.143	.142	.101	.158
Kurtosis		-.802	-.482	-.905	-.574	-1.903	.706
Std. Error of Kurtosis		.283	.285	.285	.283	.203	.314
Range		3	3	3	3	1	4
Minimum		1	1	1	1	1	1
Maximum		4	4	4	4	2	5

Appendix IX
Local Government Interaction

Which local government department, if any, have you interacted with in the past year?

	Frequency	Percent
Commission/Council Offices	24	4.1
Manager's Office	8	1.3
Parks and Recreation/Community Services	46	7.7
Public Works	14	2.4
Social Services	47	7.8
Recorder's Office	18	3.0
Business License	19	3.2
Comprehensive Planning	4	.7
Human Resources	24	4.0
Fire	17	2.9
Police/Metro	61	10.1
Assessor's/taxation	4	.6
Water Authority (SNWA)	4	.6
Juvenile Justice	3	.4
Transportation Authority (RTC)	1	.2
Voter Registrar	3	.4
None	279	46.6
DK/No answer	23	3.9
Total	600	100.0

Appendix IX
Local Government Interaction

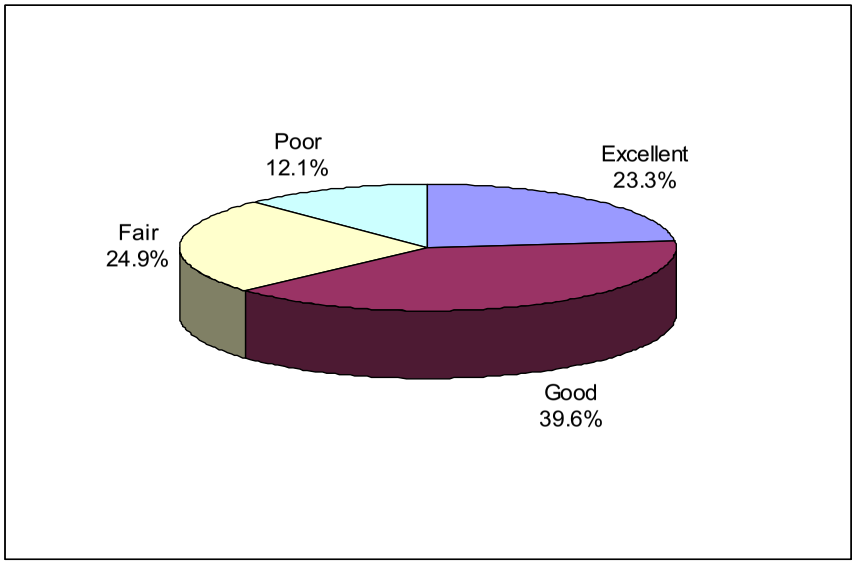


Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction

Timeliness of response

	Frequency	Percent
Excellent	69	11.4
Good	116	19.4
Fair	73	12.2
Poor	36	5.9
Total	294	49.0
DK/No answer	3	.5
Total	600	100.0

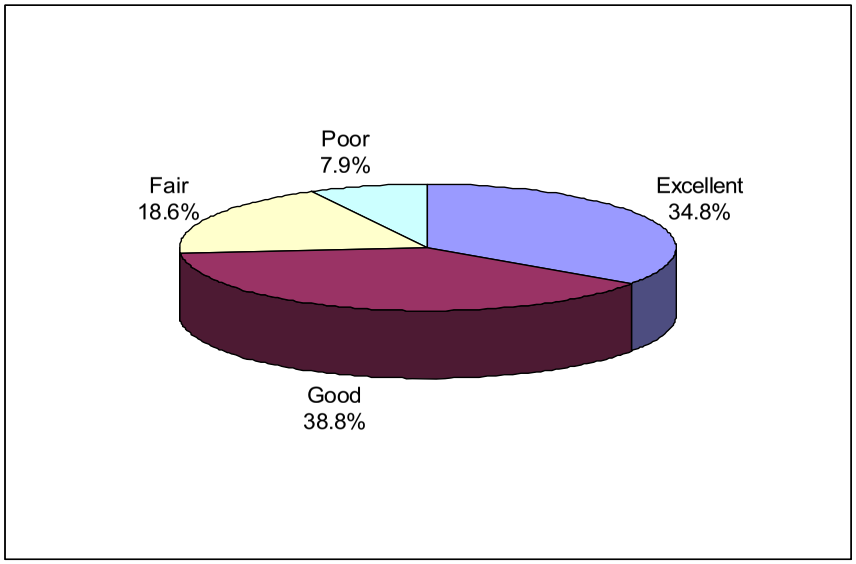


Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction

Courtesy

	Frequency	Percent
Excellent	101	16.9
Good	113	18.8
Fair	54	9.0
Poor	23	3.8
Total	291	48.6
DK/No answer	6	.9
Total	600	100.0

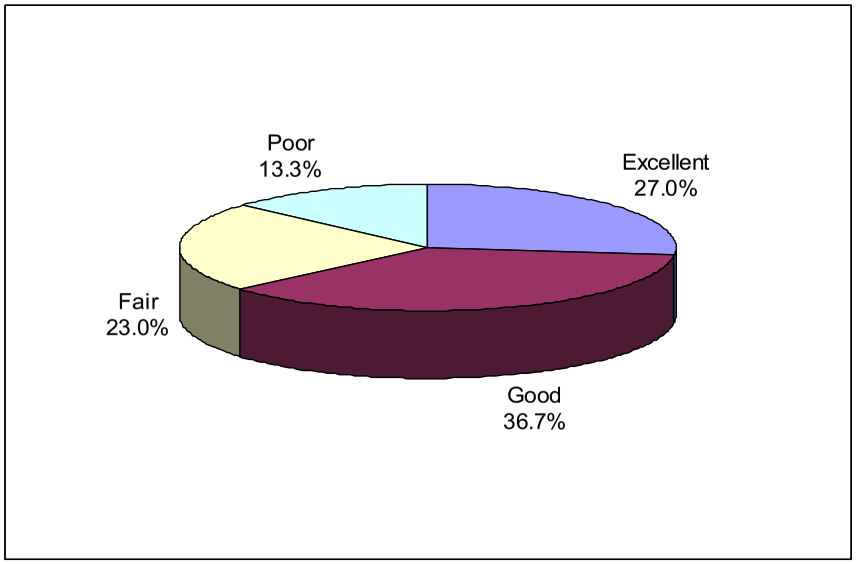


Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction

Competency in handling your issue

	Frequency	Percent
Excellent	78	13.1
Good	106	17.7
Fair	67	11.1
Poor	39	6.4
Total	290	48.4
DK/No answer	7	1.1
Total	600	100.0

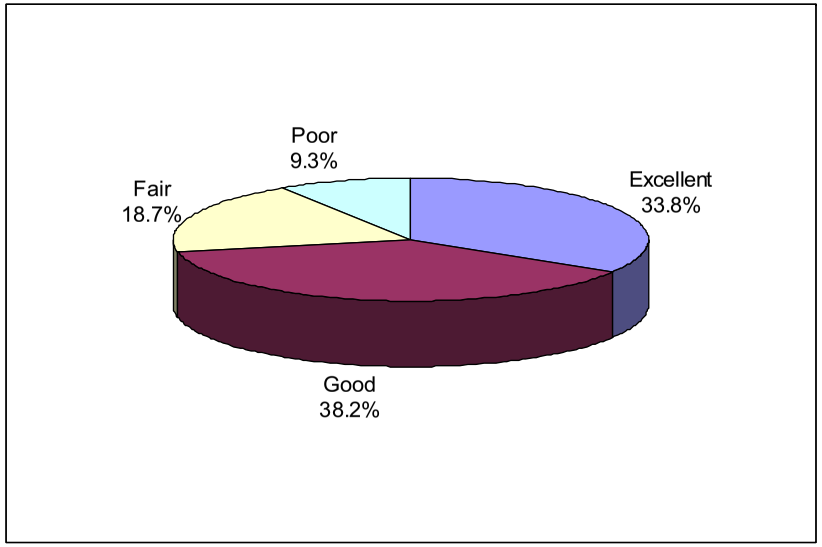


Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction

Professionalism

	Frequency	Percent
Excellent	99	16.6
Good	112	18.7
Fair	55	9.2
Poor	27	4.5
Total	294	49.0
DK/No answer	3	.5
Total	600	100.0

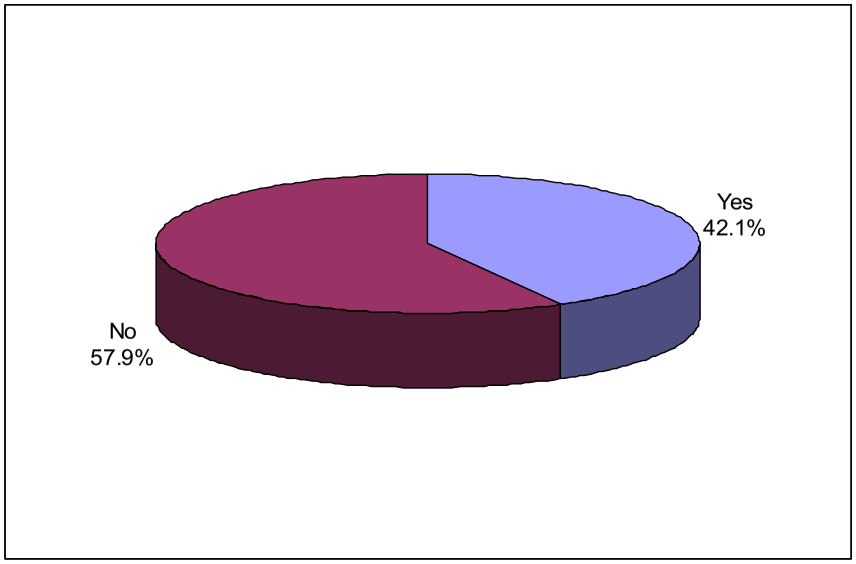


Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction

Have you ever visited your local government's website?

	Frequency	Percent
Yes	244	40.7
No	336	56.0
Total	579	96.6
DK/No answer	20	3.4
Total	600	100.0

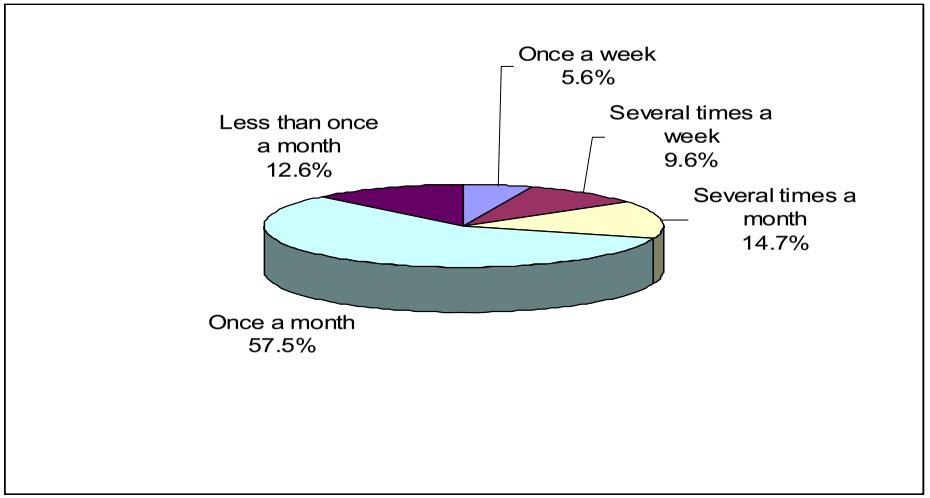


Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction

In any given month, how often would you say you visit your local government's website?

		Frequency	Percent	Valid Percent	Cumulative Percent
	Once a week	13	2.2	5.6	5.6
	Several times a week	23	3.8	9.6	15.2
	Several times a month	35	5.8	14.7	29.9
	Once a month	137	22.8	57.5	87.4
	Less than once a month	30	5.0	12.6	100.0
	Total	238	39.6	100.0	
Missing	DK/No answer	6	1.0		
	System	356	59.3		
	Total	362	60.4		
Total		600	100.0		



Note- Graph does not include Don't Know/ No Answer

Appendix IX
Local Government Interaction
Jurisdictional Summary Statistics

Unincorporated Clark County		Timeliness of response	Courtesy	Competency in handling your issue	Professionalism	In any given month, how often would you say you visit your local government's website?
N	Valid	112	109	109	112	93
	Missing	130	132	132	130	149
Mean		2.24	2.02	2.24	2.06	3.35
Std. Error of Mean		.086	.083	.091	.086	.117
Median		2.00	2.00	2.00	2.00	4.00
Mode		2	2	2	2	4
Std. Deviation		.914	.863	.954	.910	1.130
Skewness		.437	.459	.339	.612	-.827
Std. Error of Skewness		.229	.231	.231	.229	.250
Kurtosis		-.530	-.515	-.778	-.332	-.247
Std. Error of Kurtosis		.453	.459	.459	.453	.495
Range		3	3	3	3	4
Minimum		1	1	1	1	1
Maximum		4	4	4	4	5

Appendix IX
Local Government Interaction
Jurisdictional Summary Statistics

City of Las Vegas		Timeliness of response	Courtesy	Competency in handling your issue	Professionalism	In any given month, how often would you say you visit your local government's website?
N	Valid	87	87	86	87	79
	Missing	95	95	96	95	103
Mean		2.35	2.01	2.21	2.02	3.90
Std. Error of Mean		.103	.102	.111	.102	.102
Median		2.00	2.00	2.00	2.00	4.00
Mode		2	1	2	1	4
Std. Deviation		.967	.950	1.033	.950	.905
Skewness		.186	.549	.362	.410	-1.198
Std. Error of Skewness		.258	.258	.259	.258	.271
Kurtosis		-.901	-.682	-1.020	-.968	1.817
Std. Error of Kurtosis		.510	.510	.513	.510	.535
Range		3	3	3	3	4
Minimum		1	1	1	1	1
Maximum		4	4	4	4	5

Appendix IX
Local Government Interaction
Jurisdictional Summary Statistics

City of North Las Vegas		Timeliness of response	Courtesy	Competency in handling your issue	Professionalism	In any given month, how often would you say you visit your local government's website?
N	Valid	37	37	37	37	18
	Missing	28	28	28	28	46
Mean		2.38	2.09	2.45	2.17	3.86
Std. Error of Mean		.163	.163	.171	.183	.184
Median		2.00	2.00	2.35	2.00	4.00
Mode		2	2	3	2	4
Std. Deviation		.984	.988	1.033	1.104	.784
Skewness		.244	.574	.005	.599	-.980
Std. Error of Skewness		.390	.390	.390	.390	.535
Kurtosis		-.870	-.610	-1.109	-.921	1.621
Std. Error of Kurtosis		.763	.763	.763	.763	1.036
Range		3	3	3	3	3
Minimum		1	1	1	1	2
Maximum		4	4	4	4	5

Appendix IX
Local Government Interaction
Jurisdictional Summary Statistics

City of Henderson		Timeliness of response	Courtesy	Competency in handling your issue	Professionalism	In any given month, how often would you say you visit your local government's website?
N	Valid	42	42	42	42	38
	Missing	42	42	42	42	46
Mean		1.96	1.74	1.97	1.87	3.55
Std. Error of Mean		.155	.145	.149	.148	.147
Median		2.00	1.80	2.00	2.00	4.00
Mode		1	1	2	1	4
Std. Deviation		1.001	.939	.965	.954	.909
Skewness		.550	1.326	.782	1.015	-1.349
Std. Error of Skewness		.367	.367	.367	.367	.381
Kurtosis		-.951	1.078	-.244	.263	1.284
Std. Error of Kurtosis		.719	.719	.719	.719	.746
Range		3	3	3	3	4
Minimum		1	1	1	1	1
Maximum		4	4	4	4	5

Appendix IX
Local Government Interaction
Jurisdictional Summary Statistics

Boulder City		Timeliness of response	Courtesy	Competency in handling your issue	Professionalism	In any given month, how often would you say you visit your local government's website?
N	Valid	13	13	13	13	9
	Missing	7	7	7	7	10
Mean		2.38	1.89	2.27	2.00	3.75
Std. Error of Mean		.246	.205	.251	.247	.253
Median		2.00	2.00	2.00	2.00	4.00
Mode		2	2	2	2	4
Std. Deviation		.870	.726	.889	.875	.748
Skewness		.517	.900	.577	.416	-.608
Std. Error of Skewness		.626	.626	.626	.626	.726
Kurtosis		.129	2.703	.269	-.419	1.846
Std. Error of Kurtosis		1.211	1.211	1.211	1.211	1.420
Range		3	3	3	3	3
Minimum		1	1	1	1	2
Maximum		4	4	4	4	5

Appendix IX
Local Government Interaction
Jurisdictional Summary Statistics

Mesquite		Timeliness of response	Courtesy	Competency in handling your issue	Professionalism	In any given month, how often would you say you visit your local government's website?
N	Valid	4	4	4	4	0
	Missing	4	4	4	4	8
Mean		2.16	2.93	2.66	2.27	
Std. Error of Mean		.446	.660	.643	.379	
Median		2.05	3.05	2.10	2.05	
Mode		2(a)	3(a)	2	2	
Std. Deviation		.887	1.314	1.280	.755	
Skewness		-.487	-1.391	.347	-.603	
Std. Error of Skewness		1.020	1.020	1.020	1.020	
Range		2	3	3	2	
Minimum		1	1	1	1	
Maximum		3	4	4	3	

Appendix IX
Local Government Interaction
Jurisdictional Cross-tabulation

Respondent Jurisdiction: * Which local government department, if any, have you interacted with in the past year?

		Which local government department, if any, have you interacted with in the past year?																	Total
		Commiiss./ Councils	Manager's Office	Recreation/ Community Services	Public Works	Social Services	Recorder's Office	Business License	Comprehensive Planning	Human Resources	Fire	Police/Metro	Assessor's/ taxation	Water Authority (SNWA)	Juvenile Justice	Authority (RTC)	Voter Registrar	None	
Respondent Jurisdiction	Unincorporated Clark County	9	3	22	6	18	6	12	0	11	7	17	0	2	0	0	0	117	230
		3.9%	1.3%	9.6%	2.6%	7.8%	2.6%	5.2%	.0%	4.8%	3.0%	7.4%	.0%	.9%	.0%	.0%	.0%	50.9%	100.0%
	City of Las Vegas	5	3	10	1	15	7	4	1	6	4	22	2	2	2	1	2	87	174
		2.9%	1.7%	5.7%	.6%	8.6%	4.0%	2.3%	.6%	3.4%	2.3%	12.6%	1.1%	1.1%	1.1%	.6%	1.1%	50.0%	100.0%
	City of North Las Vegas	3	0	3	2	7	0	2	2	5	2	9	0	0	0	0	1	25	61
		4.9%	.0%	4.9%	3.3%	11.5%	.0%	3.3%	3.3%	8.2%	3.3%	14.8%	.0%	.0%	.0%	.0%	1.6%	41.0%	100.0%
	City of Henderson	4	2	8	2	4	4	2	0	2	3	11	1	0	1	0	0	39	83
		4.8%	2.4%	9.6%	2.4%	4.8%	4.8%	2.4%	.0%	2.4%	3.6%	13.3%	1.2%	.0%	1.2%	.0%	.0%	47.0%	100.0%
	Boulder City	3	0	3	2	2	0	0	0	0	2	0	0	0	0	0	0	7	19
		15.8%	.0%	15.8%	10.5%	10.5%	.0%	.0%	.0%	.0%	10.5%	.0%	.0%	.0%	.0%	.0%	.0%	36.8%	100.0%
	Mesquite	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	4	8
		.0%	.0%	.0%	25.0%	.0%	.0%	.0%	.0%	.0%	.0%	25.0%	.0%	.0%	.0%	.0%	.0%	50.0%	100.0%
Total		24	8	46	15	46	17	20	3	24	18	61	3	4	3	1	3	279	575
		4.2%	1.4%	8.0%	2.6%	8.0%	3.0%	3.5%	.5%	4.2%	3.1%	10.6%	.5%	.7%	.5%	.2%	.5%	48.5%	100.0%

Appendix IX
Local Government Interaction
Jurisdictional Cross-tabulation

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	93.182(a)	80	.149
Likelihood Ratio	88.532	80	.241
Linear-by-Linear Association	1.537	1	.215
N of Valid Cases	575		

Appendix IX
Local Government Interaction
Jurisdictional Cross-tabulation

Respondent Jurisdiction: * Timeliness of response

		Timeliness of response				Total
		Excellent	Good	Fair	Poor	
Respondent Jurisdiction:	Unincorporated Clark County	23	52	24	13	112
		20.5%	46.4%	21.4%	11.6%	100.0%
	City of Las Vegas	18	32	25	12	87
		20.7%	36.8%	28.7%	13.8%	100.0%
	City of North Las Vegas	7	14	9	6	36
		19.4%	38.9%	25.0%	16.7%	100.0%
	City of Henderson	18	10	10	3	41
		43.9%	24.4%	24.4%	7.3%	100.0%
	Boulder City	1	7	3	2	13
		7.7%	53.8%	23.1%	15.4%	100.0%
	Mesquite	1	2	2	0	5
		20.0%	40.0%	40.0%	.0%	100.0%
Total		68	117	73	36	294
		23.1%	39.8%	24.8%	12.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.157(a)	15	.255
Likelihood Ratio	17.929	15	.266
Linear-by-Linear Association	.323	1	.570
N of Valid Cases	294		

Appendix IX
Local Government Interaction
Jurisdictional Cross-tabulation

Respondent Jurisdiction: * Courtesy

		Courtesy				Total
		Excellent	Good	Fair	Poor	
Respondent Jurisdiction:	Unincorporated Clark County	34	46	24	6	110
		30.9%	41.8%	21.8%	5.5%	100.0%
	City of Las Vegas	31	30	19	7	87
		35.6%	34.5%	21.8%	8.0%	100.0%
	City of North Las Vegas	12	14	7	4	37
		32.4%	37.8%	18.9%	10.8%	100.0%
	City of Henderson	21	15	2	4	42
		50.0%	35.7%	4.8%	9.5%	100.0%
	Boulder City	3	8	1	0	12
		25.0%	66.7%	8.3%	.0%	100.0%
	Mesquite	1	0	2	2	5
		20.0%	.0%	40.0%	40.0%	100.0%
Total		102	113	55	23	293
		34.8%	38.6%	18.8%	7.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	25.311(a)	15	.046
Likelihood Ratio	26.012	15	.038
Linear-by-Linear Association	.110	1	.740
N of Valid Cases	293		

Appendix IX
Local Government Interaction
Jurisdictional Cross-tabulation

Respondent Jurisdiction: * Competency in handling your issue

		Competency in handling your issue				Total
		Excellent	Good	Fair	Poor	
Respondent Jurisdiction:	Unincorporated Clark County	26	43	27	13	109
		23.9%	39.4%	24.8%	11.9%	100.0%
	City of Las Vegas	26	28	20	12	86
		30.2%	32.6%	23.3%	14.0%	100.0%
	City of North Las Vegas	8	10	12	6	36
		22.2%	27.8%	33.3%	16.7%	100.0%
	City of Henderson	16	16	6	4	42
		38.1%	38.1%	14.3%	9.5%	100.0%
	Boulder City	2	7	3	1	13
		15.4%	53.8%	23.1%	7.7%	100.0%
	Mesquite	0	2	0	2	4
		.0%	50.0%	.0%	50.0%	100.0%
Total		78	106	68	38	290
		26.9%	36.6%	23.4%	13.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	16.765(a)	15	.333
Likelihood Ratio	16.998	15	.319
Linear-by-Linear Association	.054	1	.817
N of Valid Cases	290		

Appendix IX
Local Government Interaction
Jurisdictional Cross-tabulation

Respondent Jurisdiction: * Professionalism

		Professionalism				Total
		Excellent	Good	Fair	Poor	
Respondent Jurisdiction:	Unincorporated Clark County	33	50	19	10	112
		29.5%	44.6%	17.0%	8.9%	100.0%
	City of Las Vegas	33	26	24	5	88
		37.5%	29.5%	27.3%	5.7%	100.0%
	City of North Las Vegas	12	14	4	7	37
		32.4%	37.8%	10.8%	18.9%	100.0%
	City of Henderson	17	16	4	4	41
		41.5%	39.0%	9.8%	9.8%	100.0%
	Boulder City	4	5	3	0	12
		33.3%	41.7%	25.0%	.0%	100.0%
	Mesquite	0	2	2	0	4
		.0%	50.0%	50.0%	.0%	100.0%
Total		99	113	56	26	294
		33.7%	38.4%	19.0%	8.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.675(a)	15	.117
Likelihood Ratio	23.220	15	.080
Linear-by-Linear Association	.111	1	.739
N of Valid Cases	294		

Appendix IX
Local Government Interaction
Jurisdictional Cross-tabulation

Respondent Jurisdiction: * Have you ever visited your local government's website?

		Have you ever visited your local government's website?		Total
		Yes	No	
Respondent Jurisdiction:	Unincorporated Clark County	98	134	232
		42.2%	57.8%	100.0%
	City of Las Vegas	80	98	178
		44.9%	55.1%	100.0%
	City of North Las Vegas	18	45	63
		28.6%	71.4%	100.0%
	City of Henderson	38	42	80
		47.5%	52.5%	100.0%
	Boulder City	9	10	19
		47.4%	52.6%	100.0%
	Mesquite	0	6	6
		.0%	100.0%	100.0%
Total		243	335	578
		42.0%	58.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.862(a)	5	.054
Likelihood Ratio	13.251	5	.021
Linear-by-Linear Association	.248	1	.618
N of Valid Cases	578		

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Appendix IX
Local Government Interaction
Jurisdictional Cross-tabulation

Respondent Jurisdiction: * In any given month, how often would you say you visit your local government's website?

		In any given month, how often would you say you visit your local government's website?					Total
		Once a week	Several times a week	Several times a month	Once a month	Less than once a month	
Respondent Jurisdiction:	Unincorporated Clark County	10	11	17	48	8	94
		10.6%	11.7%	18.1%	51.1%	8.5%	100.0%
	City of Las Vegas	2	5	9	46	17	79
		2.5%	6.3%	11.4%	58.2%	21.5%	100.0%
	City of North Las Vegas	0	2	2	12	3	19
		.0%	10.5%	10.5%	63.2%	15.8%	100.0%
	City of Henderson	2	5	5	26	2	40
		5.0%	12.5%	12.5%	65.0%	5.0%	100.0%
	Boulder City	0	0	2	5	1	8
		.0%	.0%	25.0%	62.5%	12.5%	100.0%
	Mesquite	0	0	0	0	0	0
		.	.	.	.	.	.
Total		14	23	35	137	31	240
		5.8%	9.6%	14.6%	57.1%	12.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.763(a)	20	.411
Likelihood Ratio	22.761	20	.301
Linear-by-Linear Association	2.224	1	.136
N of Valid Cases	240		

Appendix X

Local Distribution Summary

Appendix X
Local Distribution Summary

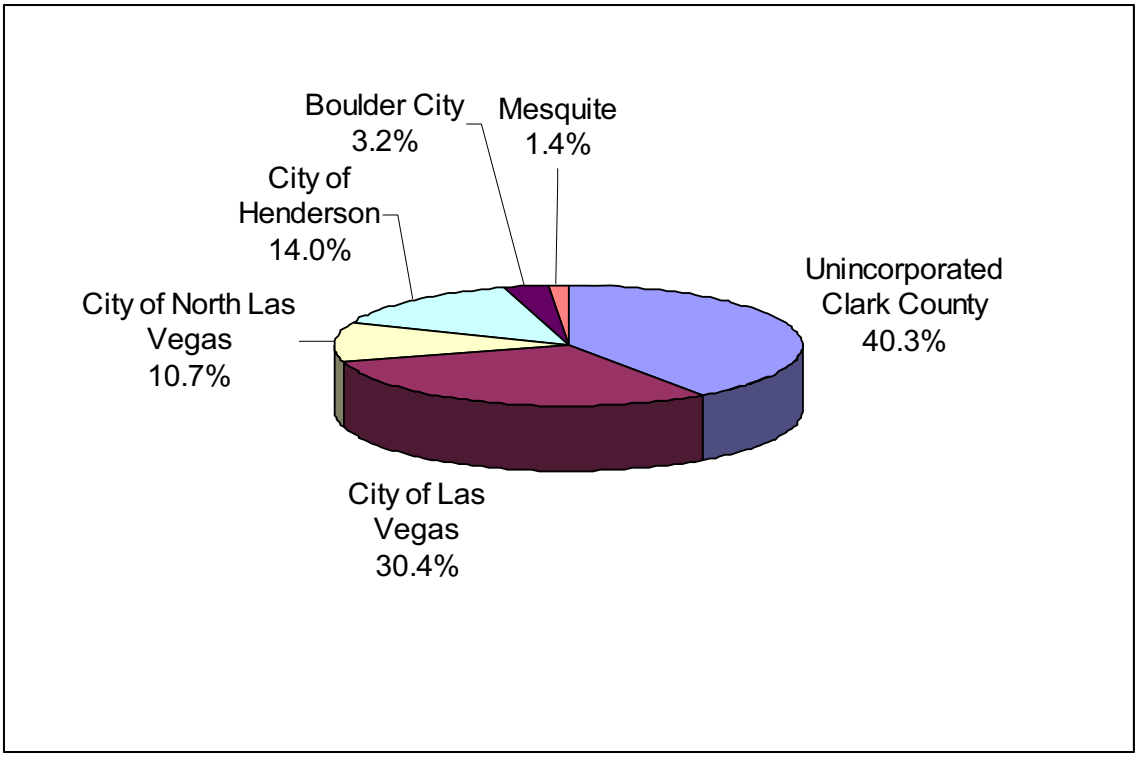
Respondent zip code:

Zip Code	Frequency	Percent	Zip Code	Frequency	Percent
89000	2	.3	89120	14	2.3
89002	4	.7	89121	33	5.5
89005	16	2.7	89122	17	2.9
89011	25	4.1	89123	24	4.0
89012	39	6.4	89124	1	.2
89014	7	1.2	89128	22	3.6
89015	11	1.8	89129	5	.9
89016	1	.2	89130	9	1.5
89018	3	.5	89131	2	.3
89019	4	.7	89132	2	.3
89021	3	.4	89134	38	6.3
89025	2	.3	89135	2	.3
89027	5	.9	89138	2	.3
89029	1	.2	89139	8	1.3
89030	8	1.4	89141	5	.9
89031	0	.1	89142	6	1.0
89032	50	8.3	89143	2	.4
89040	4	.7	89144	3	.5
89044	1	.2	89145	14	2.3
89046	0	.1	89146	2	.3
89052	5	.9	89147	25	4.1
89074	5	.8	89148	9	1.5
89084	3	.4	89149	2	.3
89086	2	.3	89156	9	1.5
89101	1	.2	89161	0	.1
89102	6	1.1	89169	3	.5
89103	16	2.7	89183	3	.5
89104	8	1.3	89302	0	.1
89105	4	.6	89412	0	.1
89106	6	.9	89444	0	.1
89107	18	3.0	98110	1	.2
89108	14	2.4	Refused	6	.9
89109	3	.5	Total	600	100.0
89110	9	1.5			
89113	4	.7			
89115	3	.5			
89117	17	2.8			
89118	8	1.3			
89119	17	2.8			

Appendix X
Local Distribution Summary

Respondent Jurisdiction:

	Frequency	Percent
Unincorporated Clark County	242	40.3
City of Las Vegas	182	30.4
City of North Las Vegas	64	10.7
City of Henderson	84	14.0
Boulder City	19	3.2
Mesquite	8	1.4
Total	600	100.0



Note- Graph does not include Don't Know/ No Answer

Appendix XI

Respondent Demographic Profile

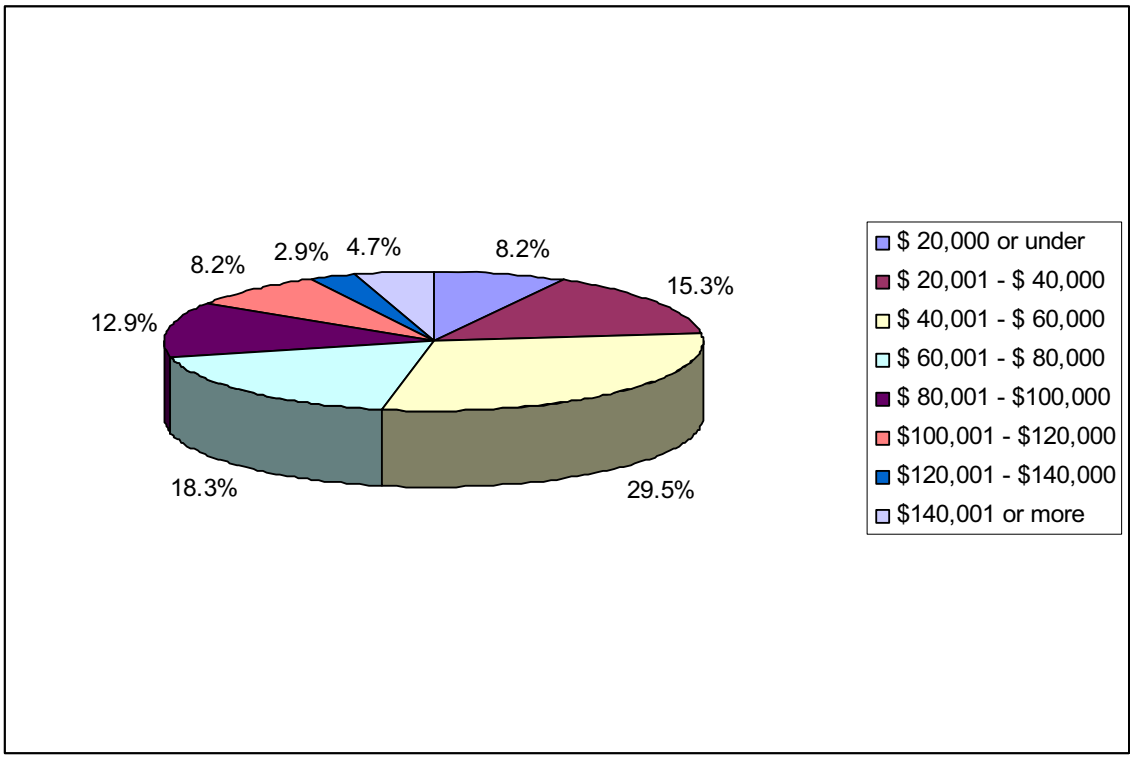
Appendix XI
Respondent Demographic Profile
Summary Statistics

		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?
N	Valid	520	598	598
	Missing	80	1	2
Mean		3.72	2.62	3.72
Std. Error of Mean		.076	.037	.058
Median		3.00	3.00	4.00
Mode		3	3	5
Std. Deviation		1.742	.897	1.408
Skewness		.647	-.094	-.126
Std. Error of Skewness		.107	.100	.100
Kurtosis		.009	-.759	-1.165
Std. Error of Kurtosis		.214	.199	.199
Range		7	3	5
Minimum		1	1	1
Maximum		8	4	6

Appendix XI
Respondent Demographic Profile

Which category best describes your total household income before taxes?

	Frequency	Percent
$ 20,000 or under	42	7.1
$ 20,001 - $ 40,000	80	13.3
$ 40,001 - $ 60,000	154	25.6
$ 60,001 - $ 80,000	95	15.9
$ 80,001 - $100,000	67	11.2
$100,001 - $120,000	43	7.1
$120,001 - $140,000	15	2.5
$140,001 or more	24	4.1
Total	520	86.7
Refused/No answer	80	13.3
Total	600	100.0

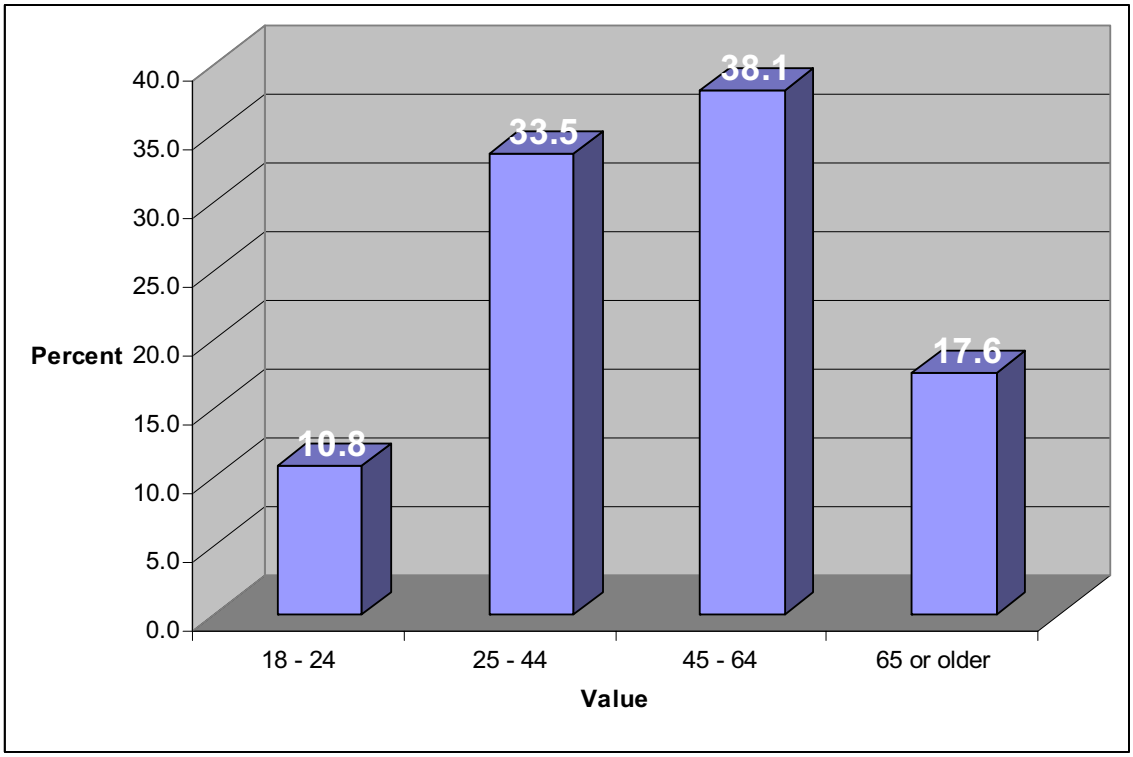


Note- Graph does not include Don't Know/ No Answer

Appendix XI
Respondent Demographic Profile

In what age group do you fall?

	Frequency	Percent
18 - 24	65	10.8
25 - 44	200	33.4
45 - 64	228	38.0
65 or older	105	17.6
Total	598	99.8
Refused/No answer	1	.2
Total	600	100.0

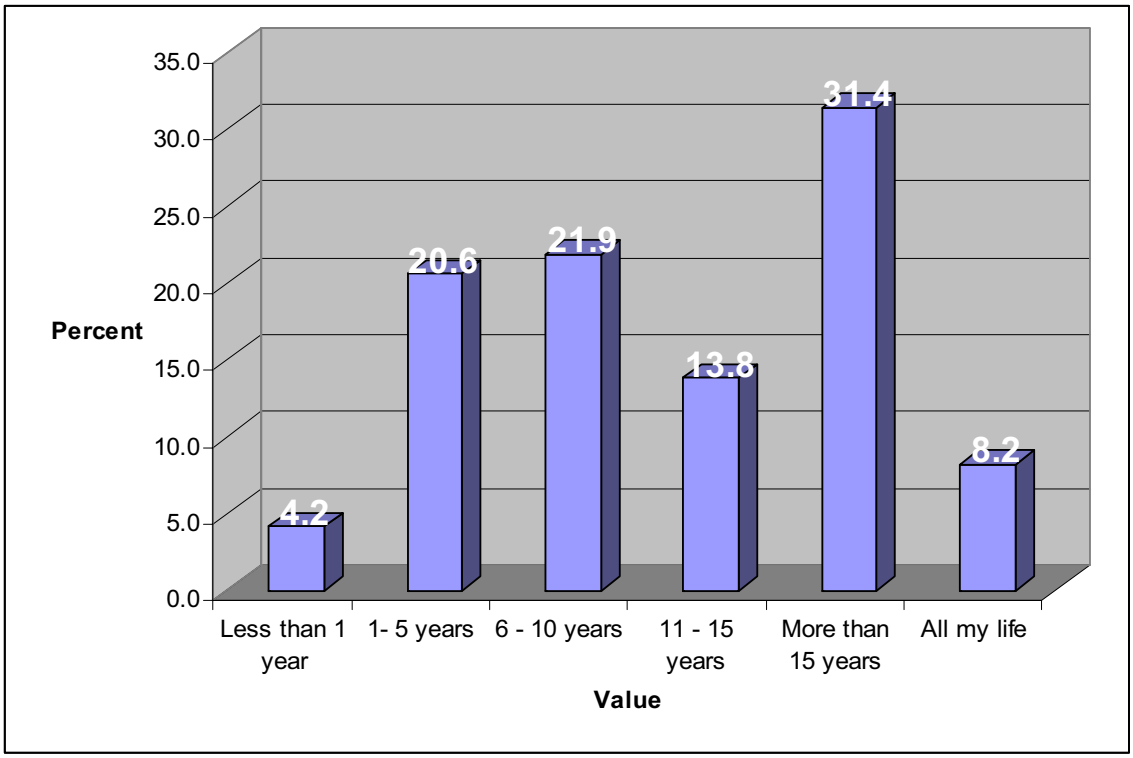


Note- Graph does not include Don't Know/ No Answer

Appendix XI
Respondent Demographic Profile

How long have you lived in Clark County?

	Frequency	Percent
Less than 1 year	25	4.1
1- 5 years	123	20.5
6 - 10 years	131	21.8
11 - 15 years	83	13.8
More than 15 years	188	31.3
All my life	49	8.2
Total	598	99.7
Refused/No answer	2	.3
Total	600	100.0

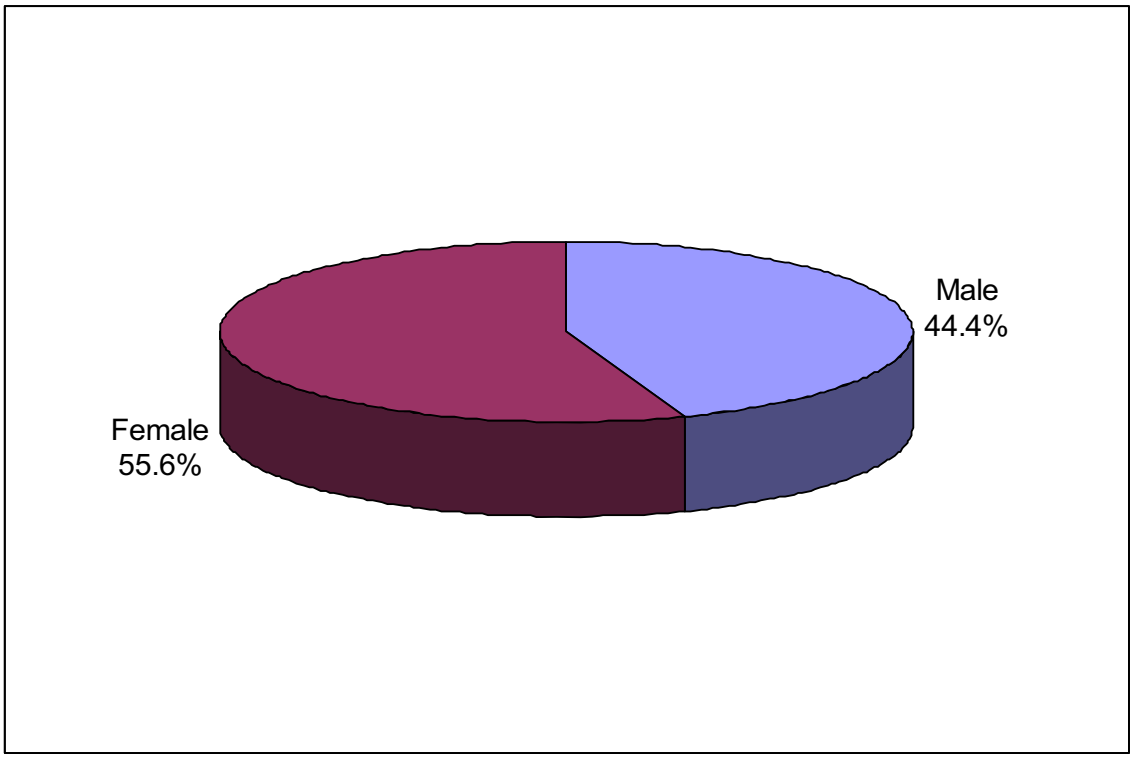


Note- Graph does not include Don't Know/ No Answer

Appendix XI
Respondent Demographic Profile

Gender observation

	Frequency	Percent
Male	266	44.4
Female	334	55.6
Total	600	100.0



Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

Unincorporated Clark County		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	208	242	240	242
	Missing	34	0	2	0
Mean		3.53	2.42	3.79	1.55
Std. Error of Mean		.116	.059	.091	.032
Median		3.00	2.00	4.00	2.00
Mode		3	3	5	2
Std. Deviation		1.674	.924	1.413	.499
Skewness		.743	.031	-.101	-.182
Std. Error of Skewness		.169	.157	.157	.157
Kurtosis		.108	-.842	-1.194	-1.983
Std. Error of Kurtosis		.336	.312	.313	.312
Range		7	3	5	1
Minimum		1	1	1	1
Maximum		8	4	6	2

Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

City of Las Vegas		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	157	182	182	182
	Missing	25	0	0	0
Mean		4.03	2.99	3.90	1.57
Std. Error of Mean		.145	.052	.099	.037
Median		4.00	3.00	4.00	2.00
Mode		3	3	5	2
Std. Deviation		1.824	.706	1.335	.496
Skewness		.657	.010	-.417	-.287
Std. Error of Skewness		.194	.180	.180	.180
Kurtosis		-.149	-.979	-.997	-1.939
Std. Error of Kurtosis		.385	.358	.358	.358
Range		7	2	5	1
Minimum		1	2	1	1
Maximum		8	4	6	2

Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

City of North Las Vegas		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	54	64	64	64
	Missing	10	0	0	0
Mean		3.50	2.48	3.66	1.65
Std. Error of Mean		.214	.116	.188	.060
Median		4.00	2.00	4.00	2.00
Mode		4	2	2	2
Std. Deviation		1.568	.927	1.507	.479
Skewness		-.044	.087	-.023	-.667
Std. Error of Skewness		.325	.299	.299	.299
Kurtosis		-1.057	-.796	-1.313	-1.606
Std. Error of Kurtosis		.640	.590	.590	.590
Range		5	3	5	1
Minimum		1	1	1	1
Maximum		6	4	6	2

Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

City of Henderson		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	77	83	84	84
	Missing	7	1	0	0
Mean		3.80	2.44	3.27	1.51
Std. Error of Mean		.217	.102	.152	.055
Median		3.00	2.00	3.00	1.97
Mode		3	2	2	2
Std. Deviation		1.905	.931	1.399	.503
Skewness		.672	.219	.208	-.023
Std. Error of Skewness		.274	.264	.262	.262
Kurtosis		-.064	-.778	-.972	-2.049
Std. Error of Kurtosis		.541	.522	.519	.519
Range		7	3	5	1
Minimum		1	1	1	1
Maximum		8	4	6	2

Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

Boulder City		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	16	19	19	19
	Missing	3	0	0	0
Mean		3.65	2.94	3.83	1.44
Std. Error of Mean		.278	.183	.255	.117
Median		4.00	3.00	3.23	1.00
Mode		3	3	3	1
Std. Deviation		1.118	.790	1.114	.510
Skewness		-.444	.117	.360	.269
Std. Error of Skewness		.561	.528	.523	.523
Kurtosis		1.215	-1.323	-1.039	-2.168
Std. Error of Kurtosis		1.085	1.023	1.012	1.012
Range		5	2	4	1
Minimum		1	2	2	1
Maximum		6	4	6	2

Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

Mesquite		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	8	8	8	8
	Missing	0	0	0	0
Mean		3.45	2.77	2.76	1.60
Std. Error of Mean		.668	.334	.610	.180
Median		3.95	2.09	2.00	2.00
Mode		5	2	2	2
Std. Deviation		1.880	.965	1.764	.522
Skewness		.055	.567	1.363	-.515
Std. Error of Skewness		.755	.739	.739	.739
Kurtosis		-.795	-1.984	1.145	-2.393
Std. Error of Kurtosis		1.488	1.449	1.449	1.449
Range		6	2	5	1
Minimum		1	2	1	1
Maximum		7	4	6	2

Appendix XI
Respondent Demographic Profile
Jurisdictional Cross-tabulation

Respondent Jurisdiction: * Which category best describes your total household income before taxes?

		Which category best describes your total household income before taxes?								Total
		Under 20k	20-40k	40-60k	60-80k	80-100k	100-120k	$120,001 - $140,000	Over 140k	
Respondent Jurisdiction:	Unincorporated Clark County	16	43	61	36	23	14	9	5	207
		7.7%	20.8%	29.5%	17.4%	11.1%	6.8%	4.3%	2.4%	100.0%
	City of Las Vegas	8	20	48	28	23	16	2	14	159
		5.0%	12.6%	30.2%	17.6%	14.5%	10.1%	1.3%	8.8%	100.0%
	City of North Las Vegas	7	10	9	12	10	6	0	0	54
		13.0%	18.5%	16.7%	22.2%	18.5%	11.1%	.0%	.0%	100.0%
	City of Henderson	9	5	28	13	7	7	3	6	78
		11.5%	6.4%	35.9%	16.7%	9.0%	9.0%	3.8%	7.7%	100.0%
	Boulder City	1	0	6	5	3	0	0	0	15
		6.7%	.0%	40.0%	33.3%	20.0%	.0%	.0%	.0%	100.0%
	Mesquite	2	2	0	2	2	0	0	0	8
		25.0%	25.0%	.0%	25.0%	25.0%	.0%	.0%	.0%	100.0%
Total		43	80	152	96	68	43	14	25	521
		8.3%	15.4%	29.2%	18.4%	13.1%	8.3%	2.7%	4.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	55.881(a)	35	.014
Likelihood Ratio	66.794	35	.001
Linear-by-Linear Association	.148	1	.701
N of Valid Cases	521		

Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

Respondent Jurisdiction: * In what age group do you fall?

		In what age group do you fall?				Total
		18 - 24	25 - 44	45 - 64	65 or older	
Respondent Jurisdiction:	Unincorporated Clark County	43	84	84	30	241
		17.8%	34.9%	34.9%	12.4%	100.0%
	City of Las Vegas	0	46	92	45	183
		.0%	25.1%	50.3%	24.6%	100.0%
	City of North Las Vegas	9	24	21	10	64
		14.1%	37.5%	32.8%	15.6%	100.0%
	City of Henderson	12	35	23	13	83
		14.5%	42.2%	27.7%	15.7%	100.0%
	Boulder City	0	6	8	5	19
		.0%	31.6%	42.1%	26.3%	100.0%
	Mesquite	0	5	1	3	9
		.0%	55.6%	11.1%	33.3%	100.0%
Total		64	200	229	106	599
		10.7%	33.4%	38.2%	17.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	66.778(a)	15	.000
Likelihood Ratio	87.056	15	.000
Linear-by-Linear Association	1.660	1	.198
N of Valid Cases	599		

Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

Respondent Jurisdiction: * How long have you lived in Clark County?

		How long have you lived in Clark County?						Total
		Less than 1 year	1- 5 years	6 - 10 years	11 - 15 years	More than 15 years	All my life	
Respondent Jurisdiction:	Unincorporated Clark County	8	48	56	29	75	24	240
		3.3%	20.0%	23.3%	12.1%	31.3%	10.0%	100.0%
	City of Las Vegas	6	29	37	25	74	11	182
		3.3%	15.9%	20.3%	13.7%	40.7%	6.0%	100.0%
	City of North Las Vegas	3	19	7	12	16	7	64
		4.7%	29.7%	10.9%	18.8%	25.0%	10.9%	100.0%
	City of Henderson	7	22	20	14	17	4	84
		8.3%	26.2%	23.8%	16.7%	20.2%	4.8%	100.0%
	Boulder City	0	1	9	3	6	1	20
		.0%	5.0%	45.0%	15.0%	30.0%	5.0%	100.0%
	Mesquite	2	4	2	0	0	2	10
		20.0%	40.0%	20.0%	.0%	.0%	20.0%	100.0%
Total		26	123	131	83	188	49	600
		4.3%	20.5%	21.8%	13.8%	31.3%	8.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	51.299(a)	25	.001
Likelihood Ratio	53.106	25	.001
Linear-by-Linear Association	7.745	1	.005
N of Valid Cases	600		

Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

Respondent Jurisdiction: * Gender observation:

		Gender observation:		Total
		Male	Female	
Respondent Jurisdiction:	Unincorporated Clark County	110	132	242
		45.5%	54.5%	100.0%
	City of Las Vegas	78	104	182
		42.9%	57.1%	100.0%
	City of North Las Vegas	22	42	64
		34.4%	65.6%	100.0%
	City of Henderson	42	43	85
		49.4%	50.6%	100.0%
	Boulder City	11	8	19
		57.9%	42.1%	100.0%
	Mesquite	3	5	8
		37.5%	62.5%	100.0%
Total		266	334	600
		44.3%	55.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.311(a)	5	.379
Likelihood Ratio	5.355	5	.374
Linear-by-Linear Association	.112	1	.738
N of Valid Cases	600		

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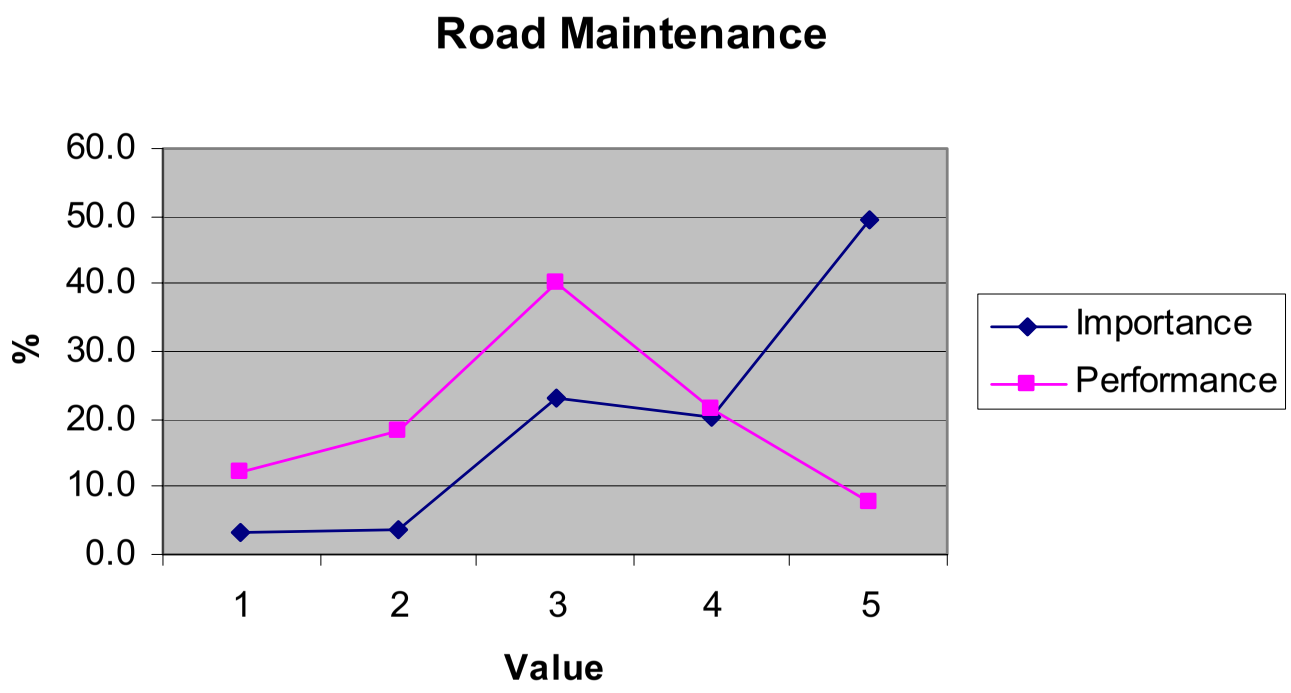
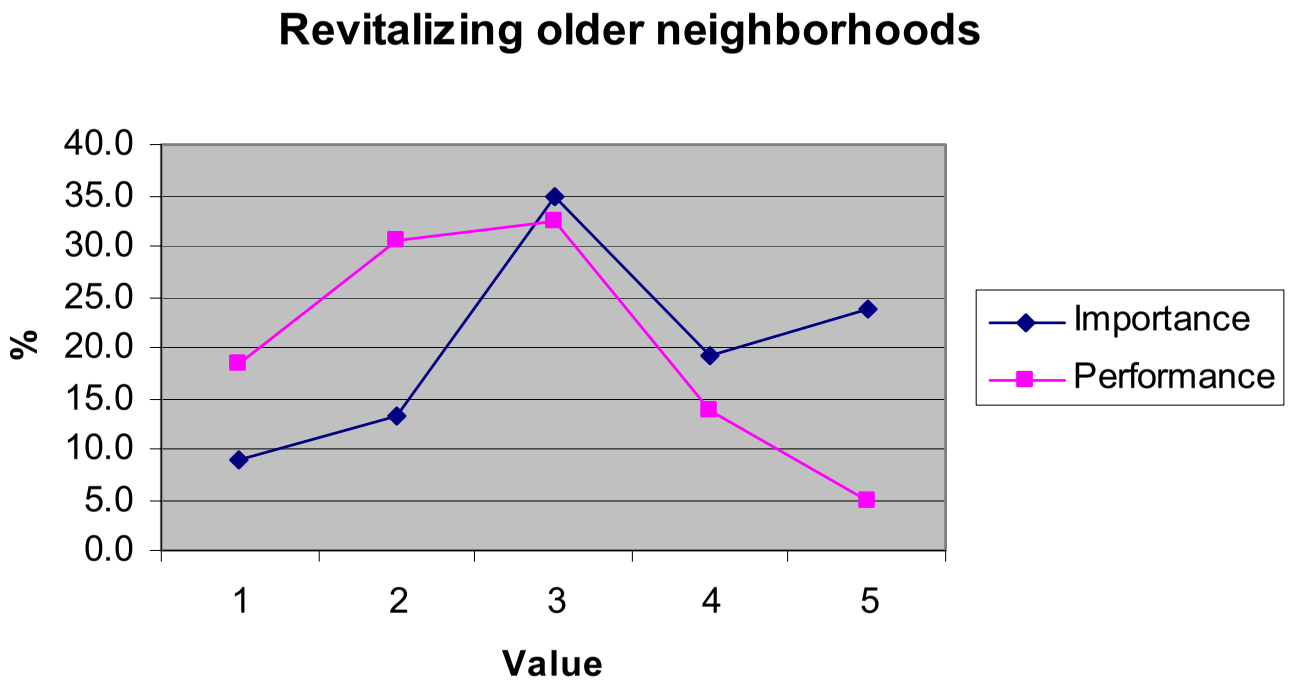
Appendix XII

Importance/Performance Comparisons

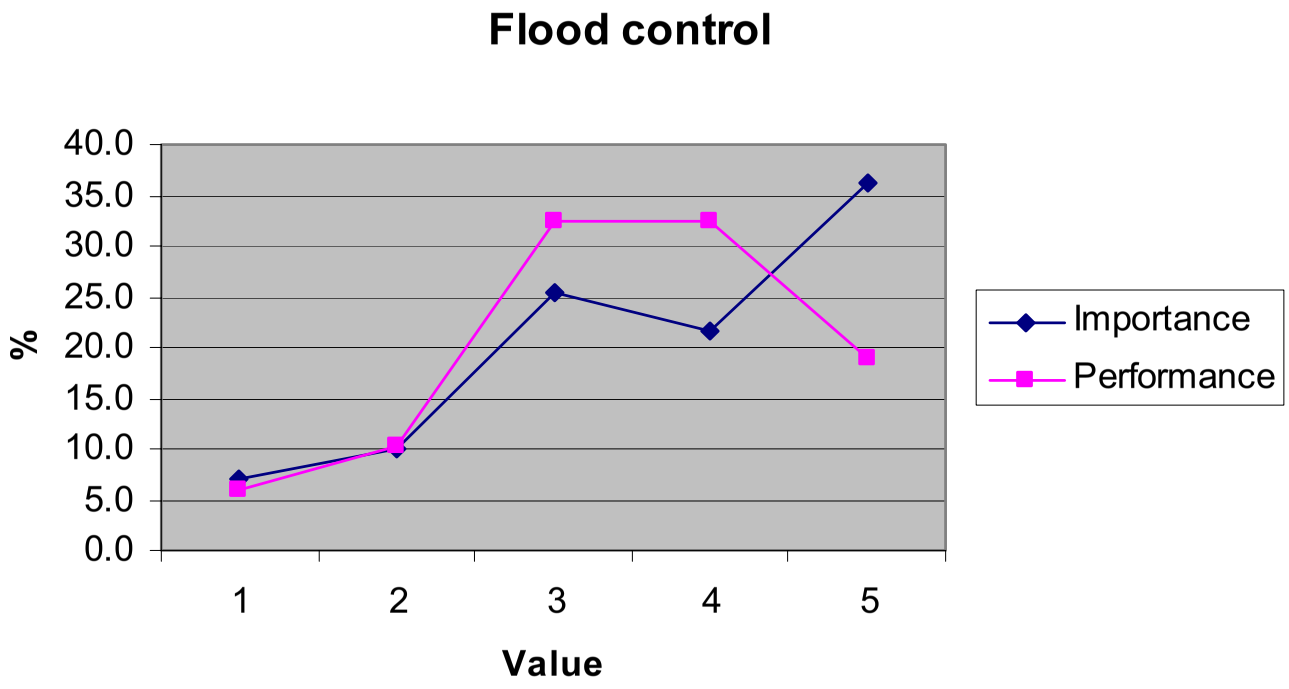
Appendix XII
Importance/Performance Comparisons



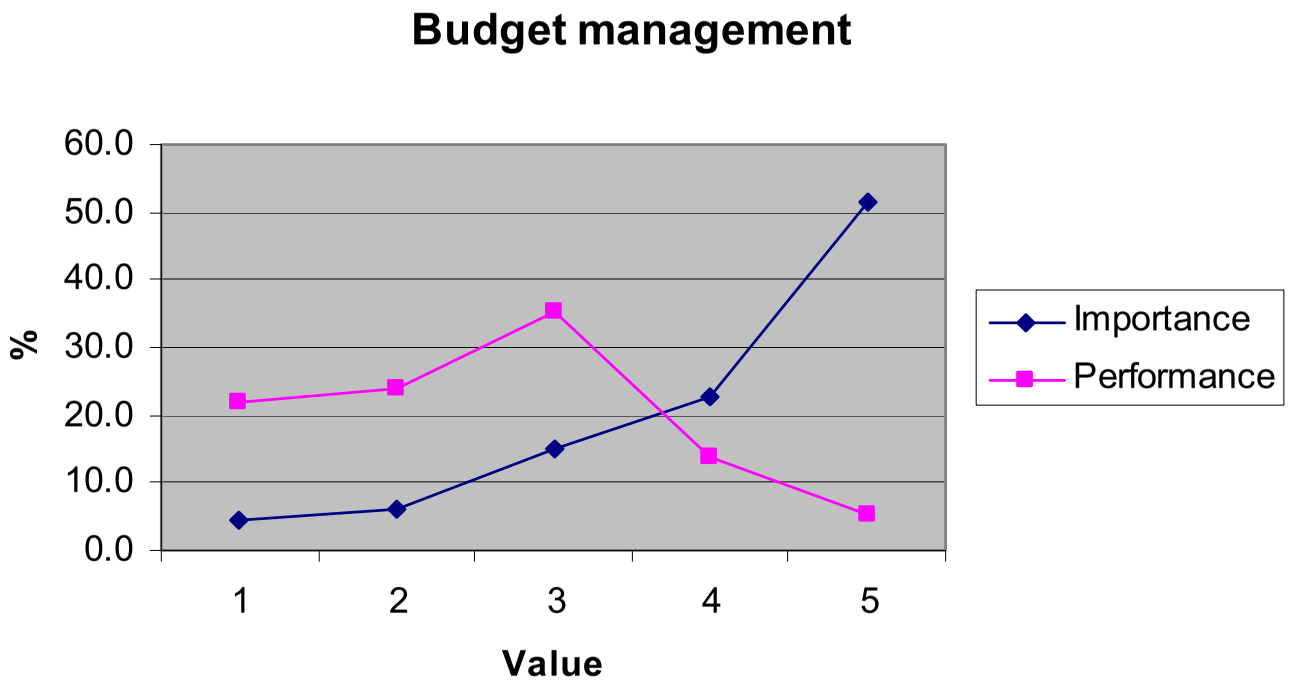
Appendix XII
Importance/Performance Comparisons



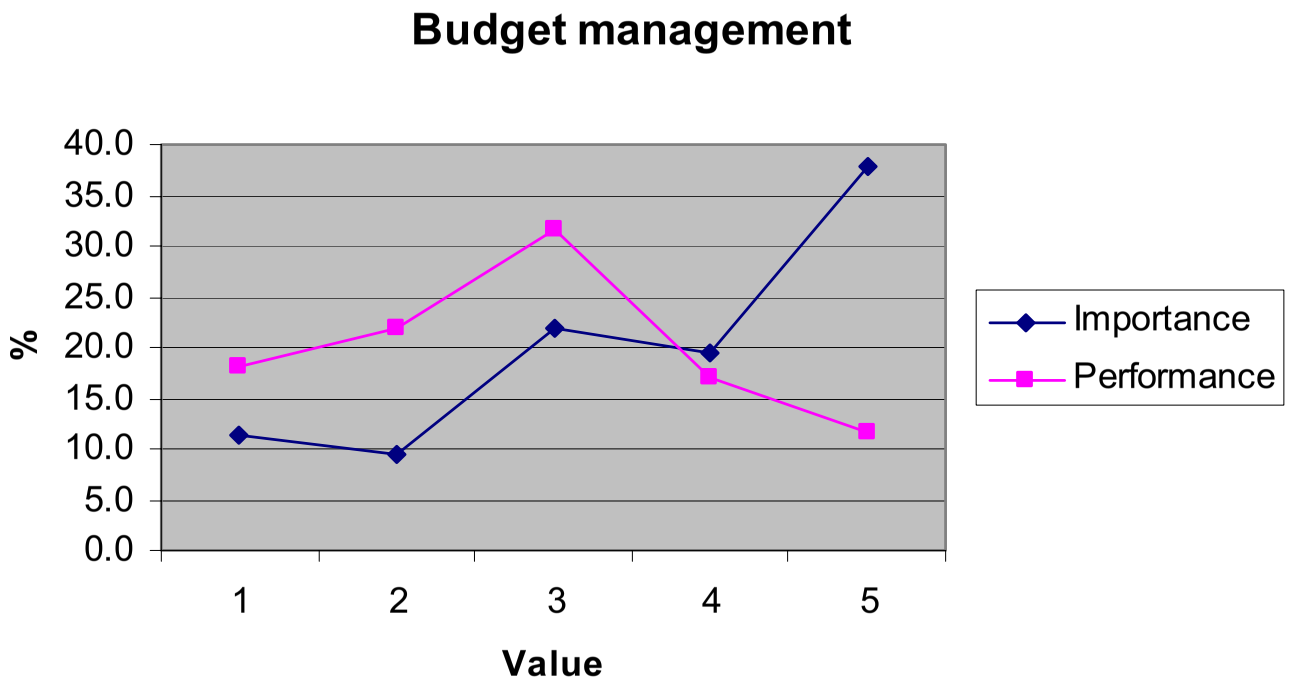
Appendix XII
Importance/Performance Comparisons



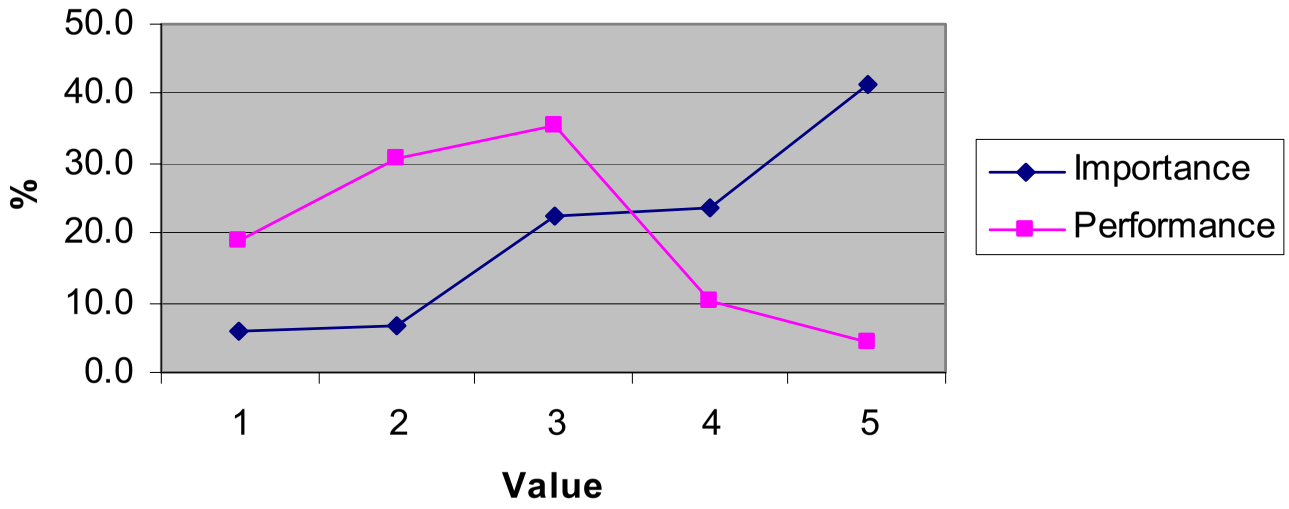
Appendix XII
Importance/Performance Comparisons



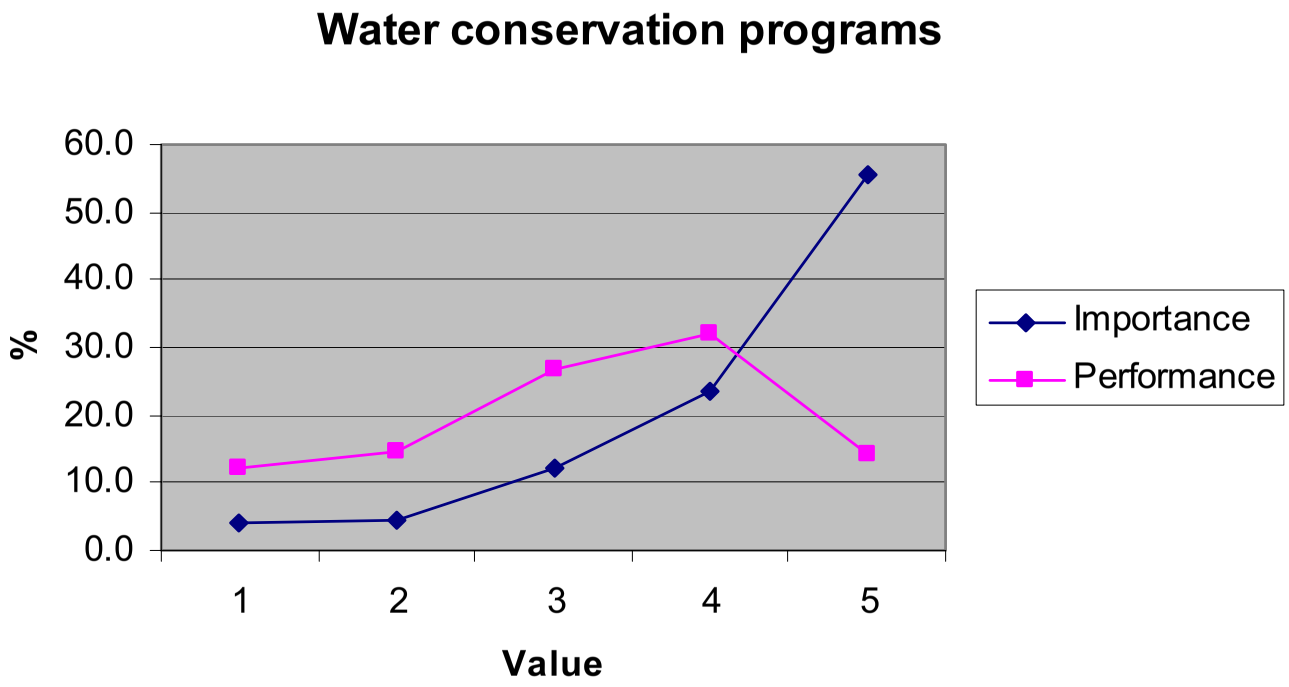
Appendix XII
Importance/Performance Comparisons



Monitor and report to the public on how well government services are being performed



Appendix XII
Importance/Performance Comparisons



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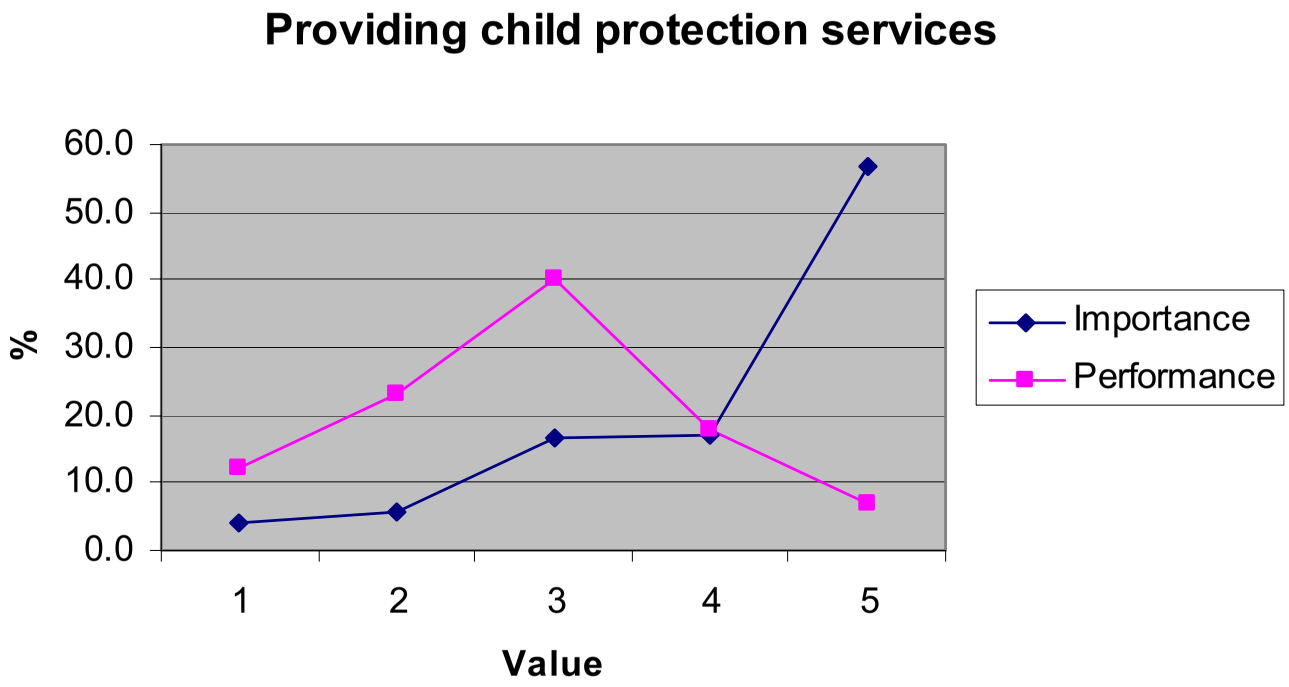
Importance/Performance Comparisons



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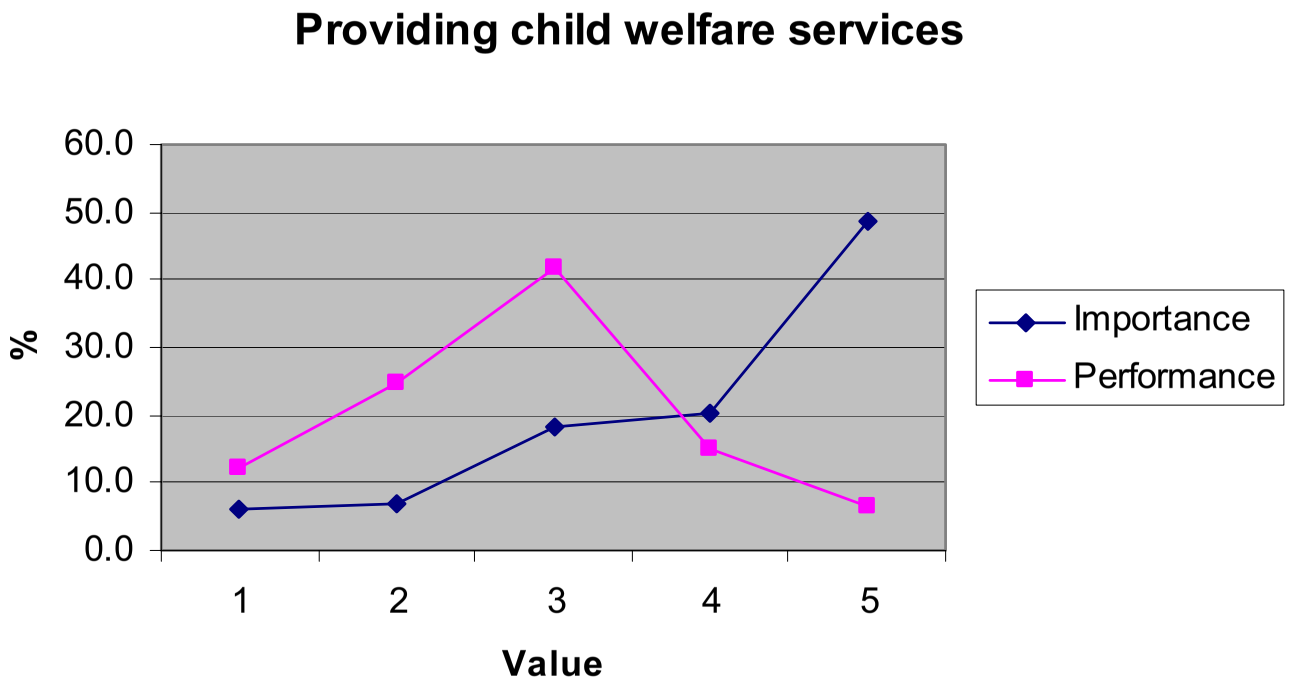
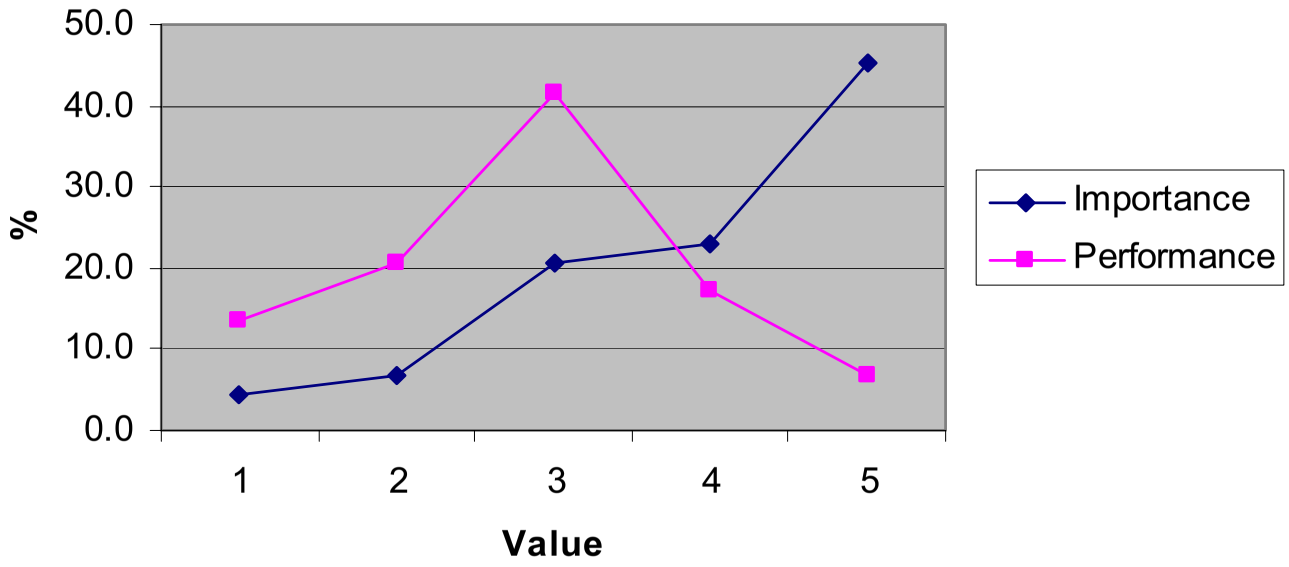
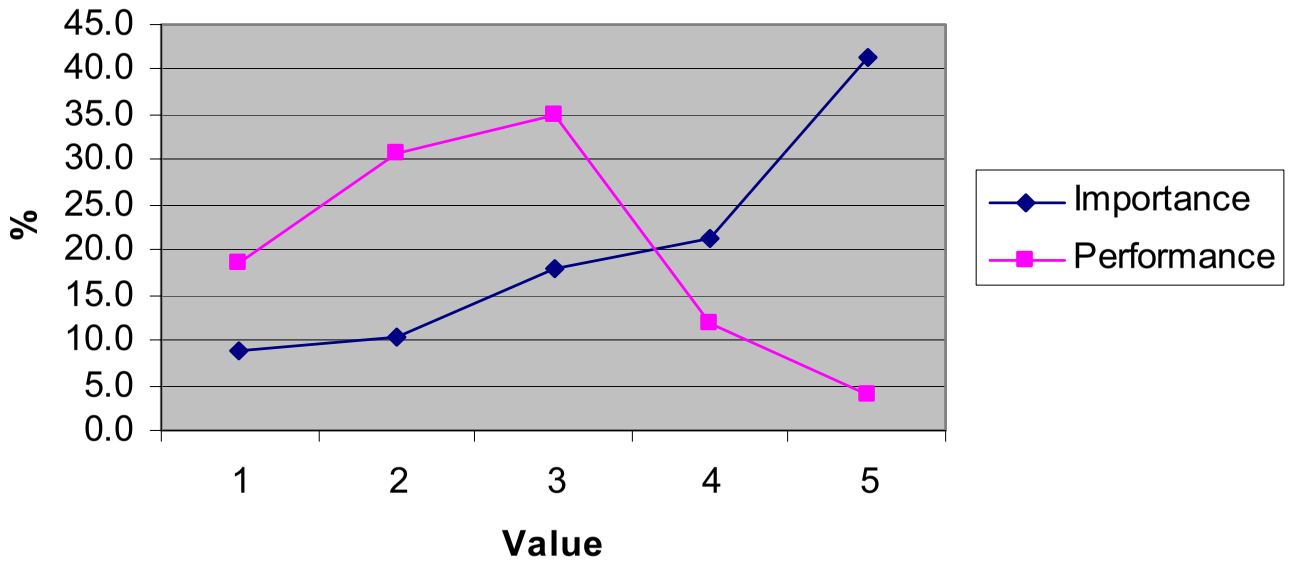
Importance/Performance Comparisons



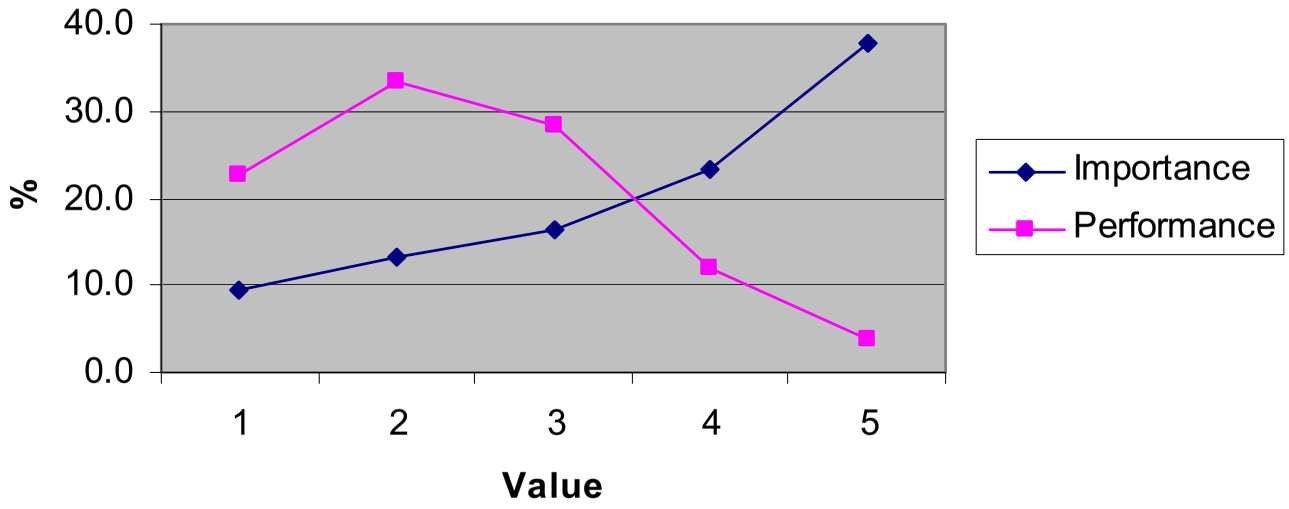
Providing juvenile justice services



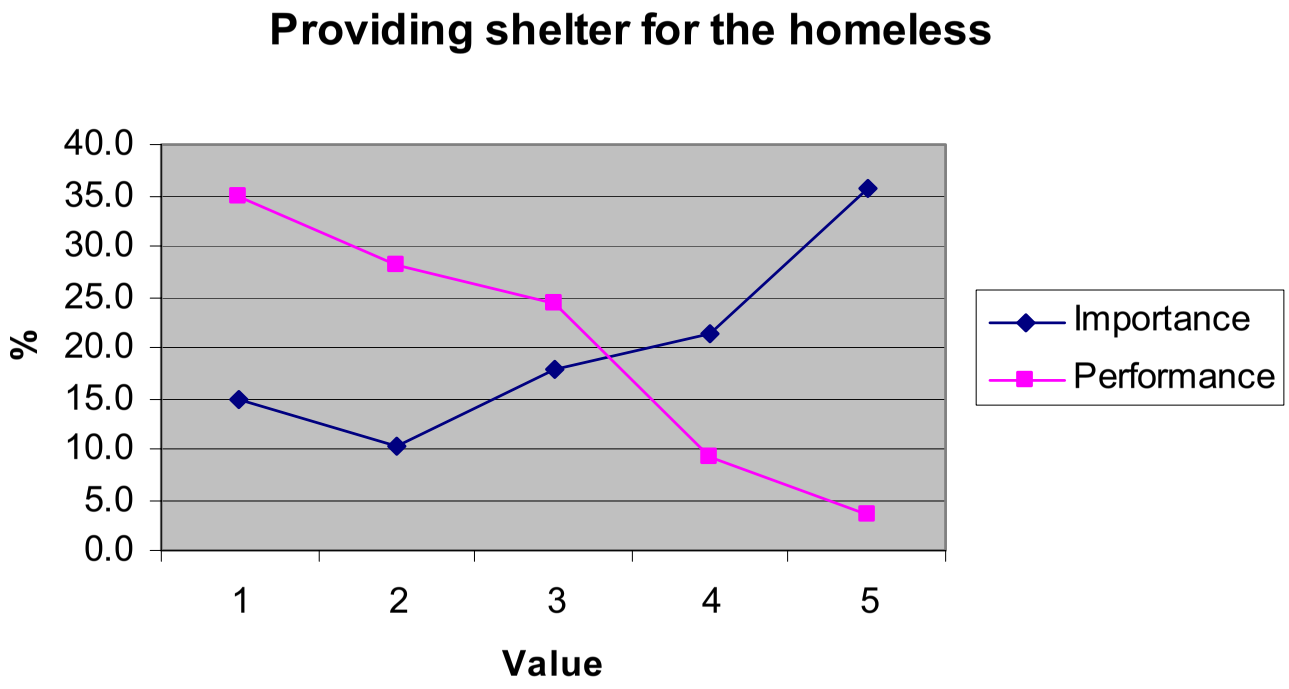
Providing attainable housing for working class



Providing affordable housing for low income individuals



Appendix XII
Importance/Performance Comparisons



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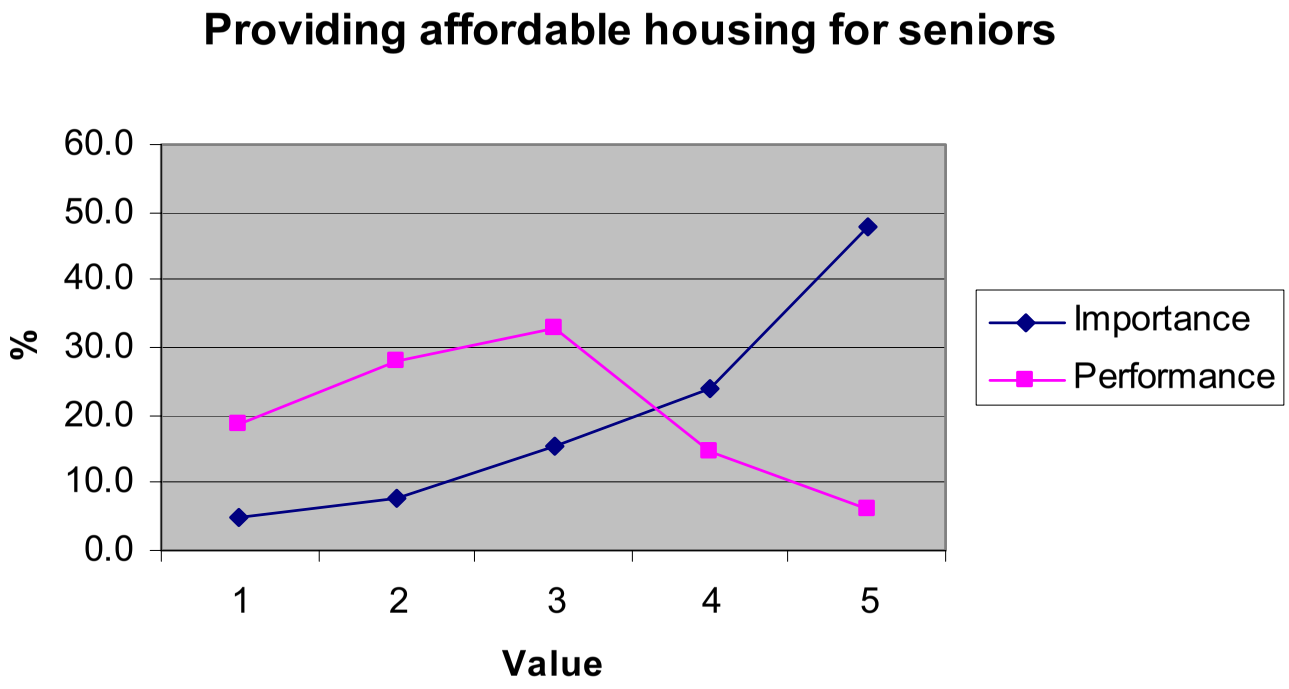
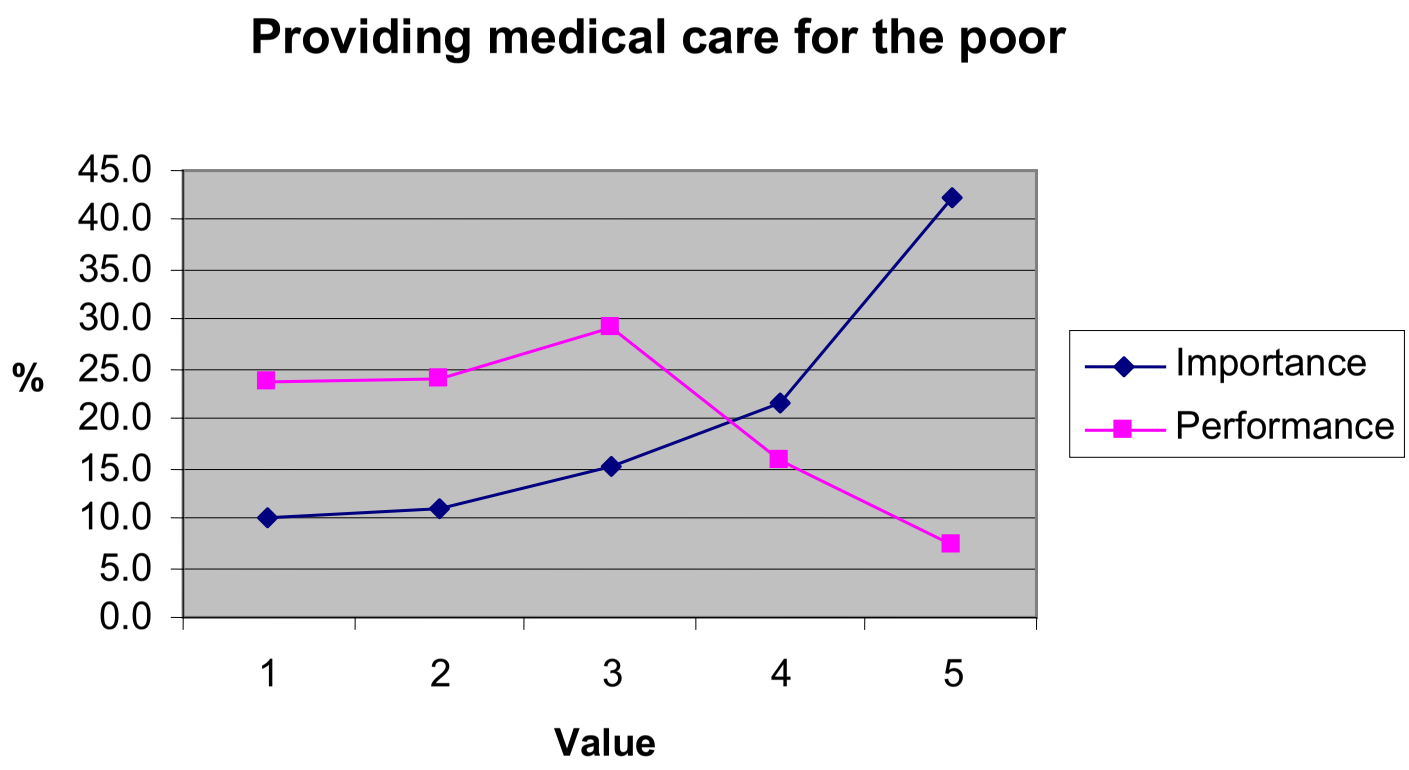
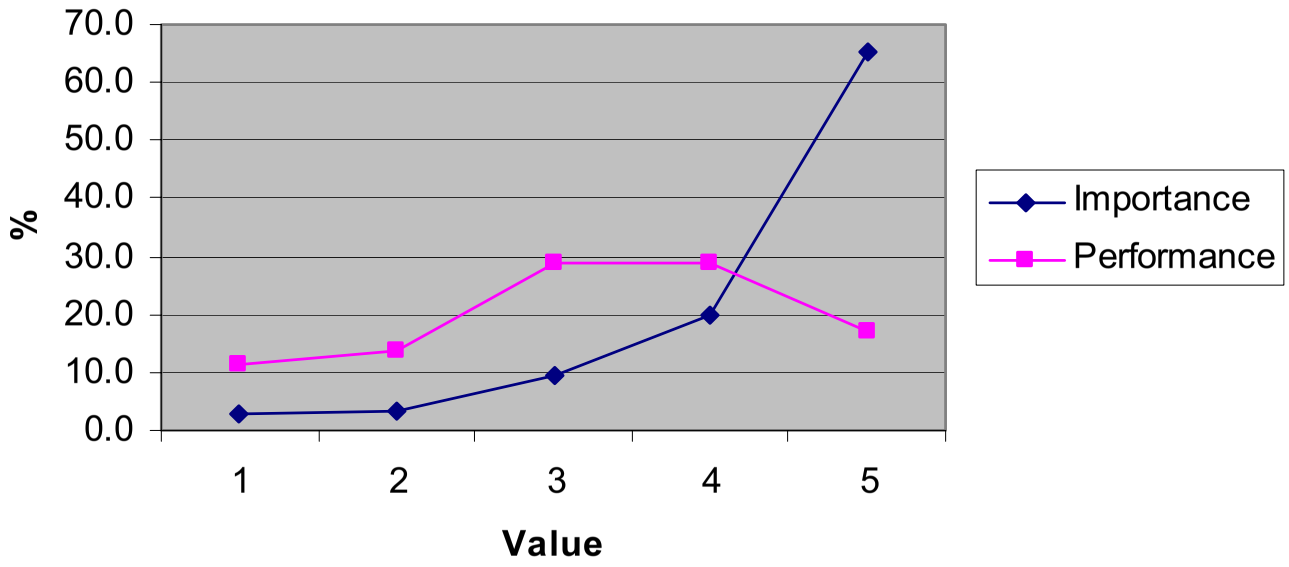



Providing medical care for the poor
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
%
1
2
3
4
5
Value
Importance
Performance

Providing 24 hour emergency trauma care



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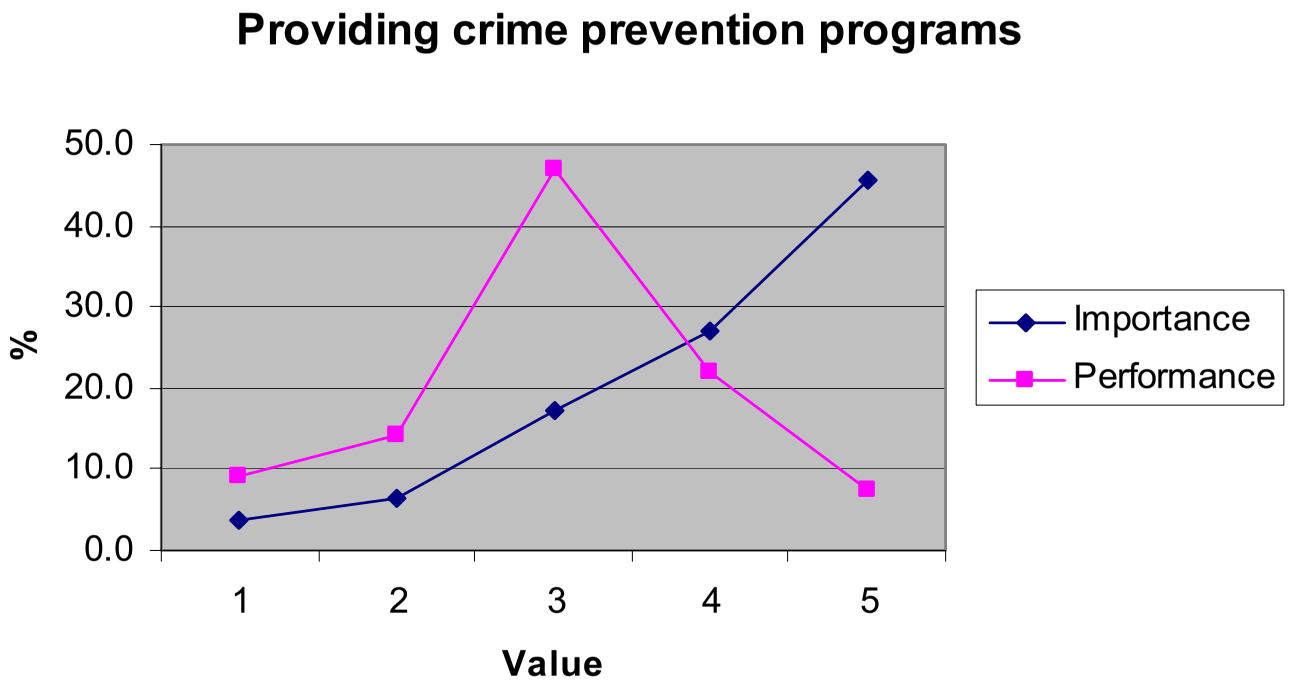

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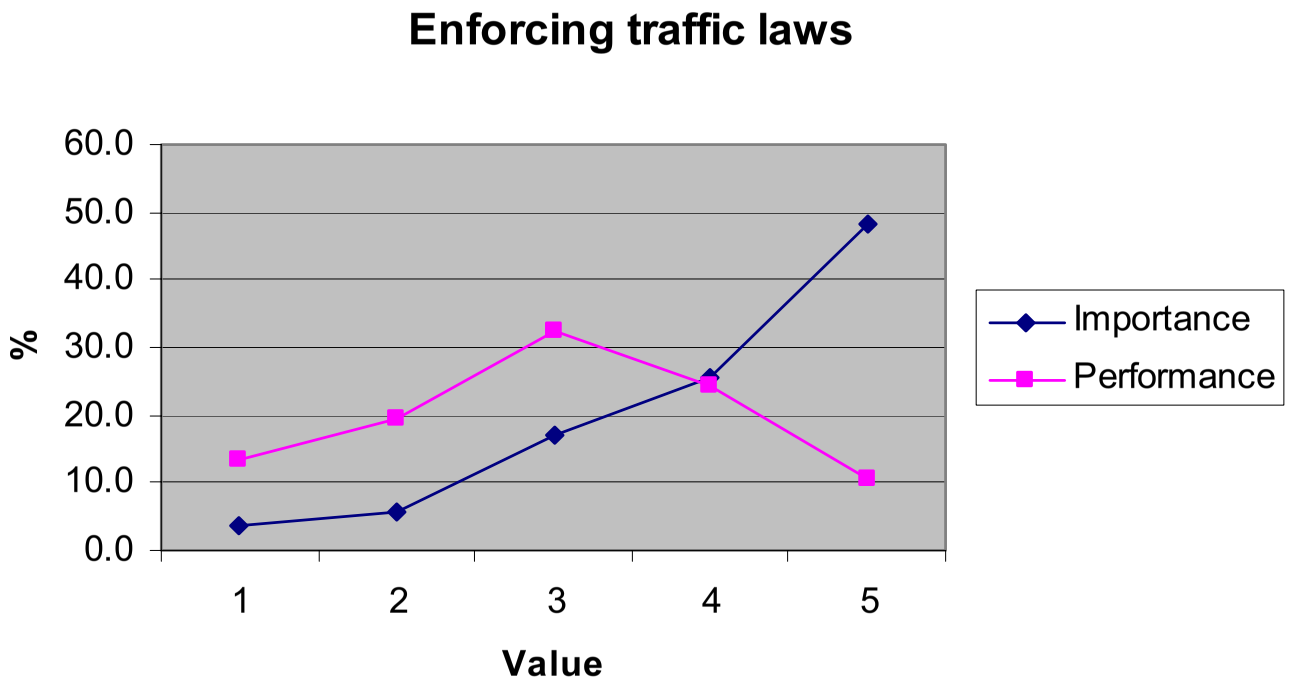

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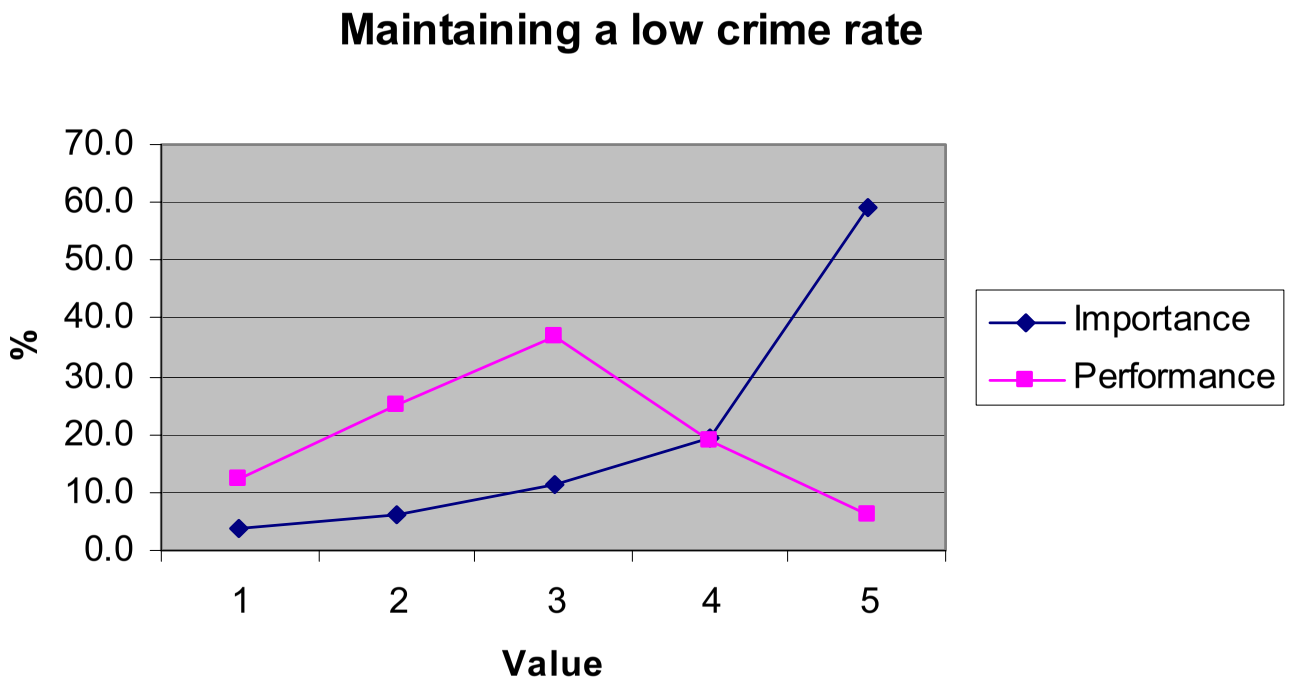
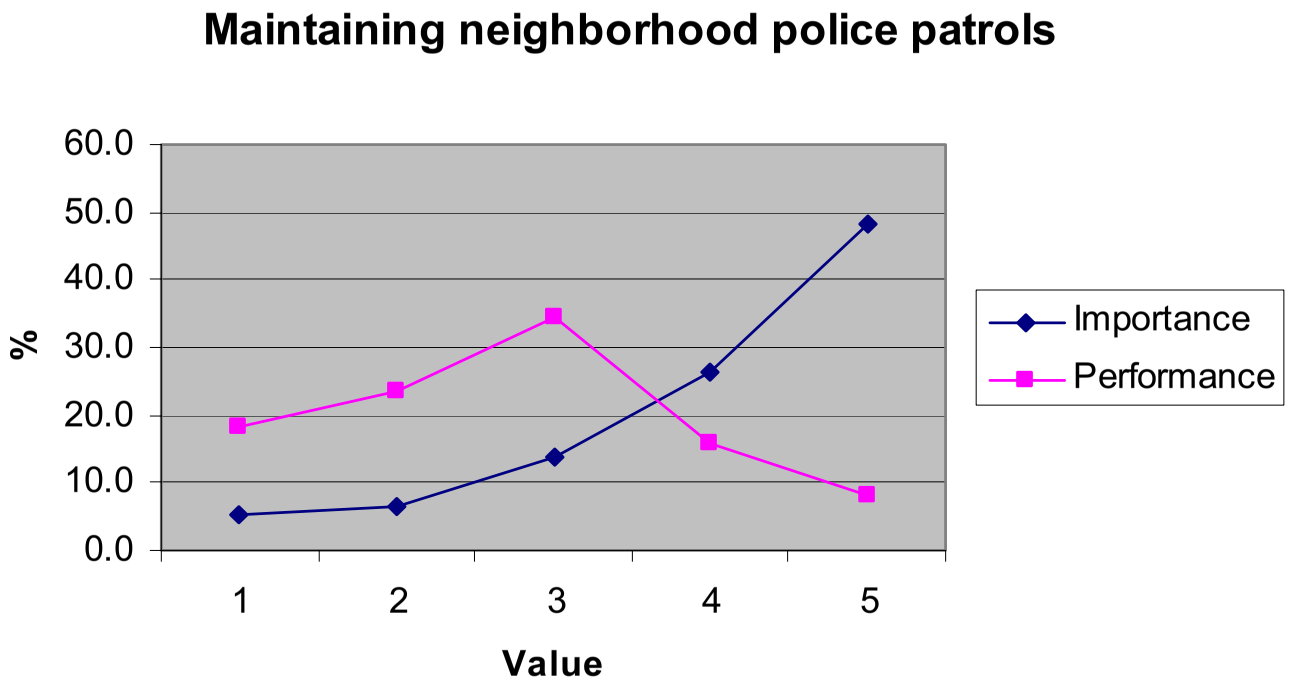
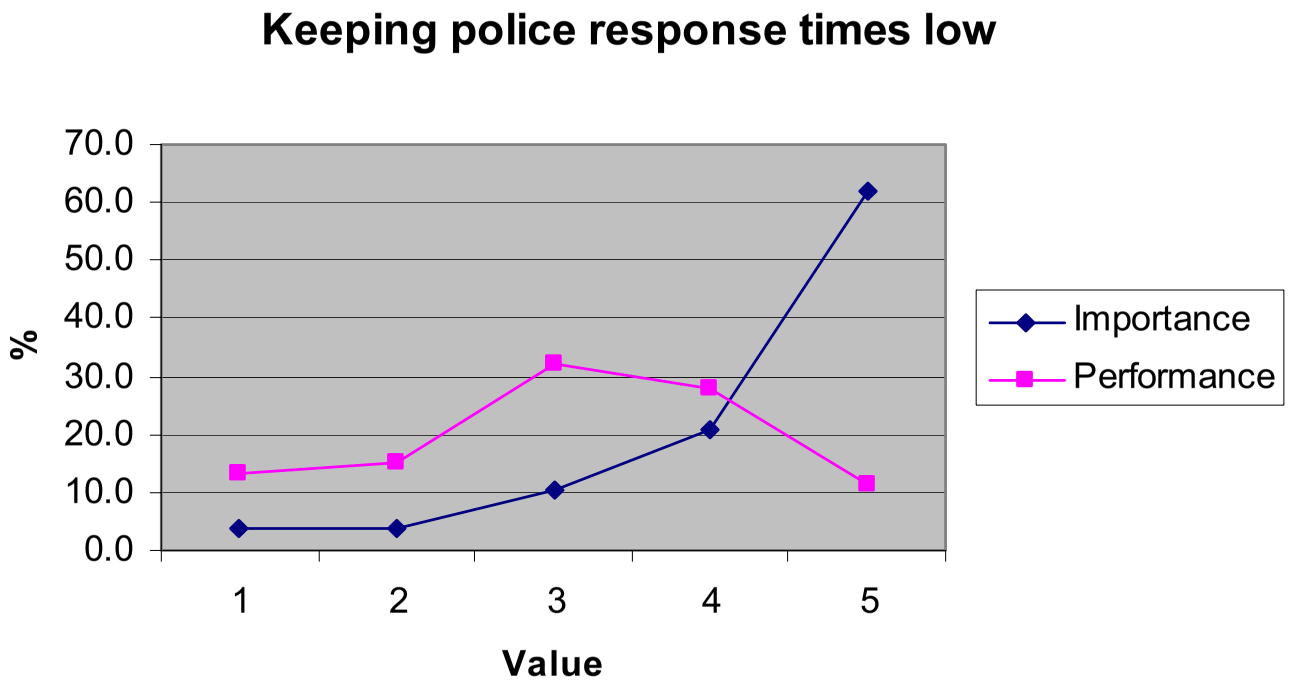
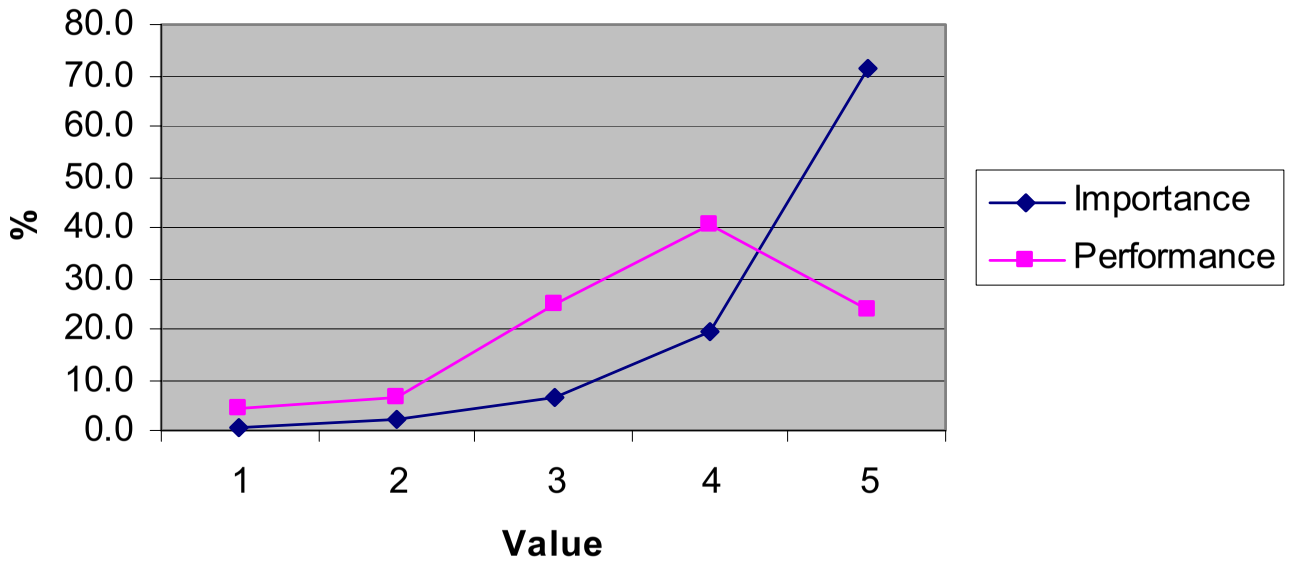
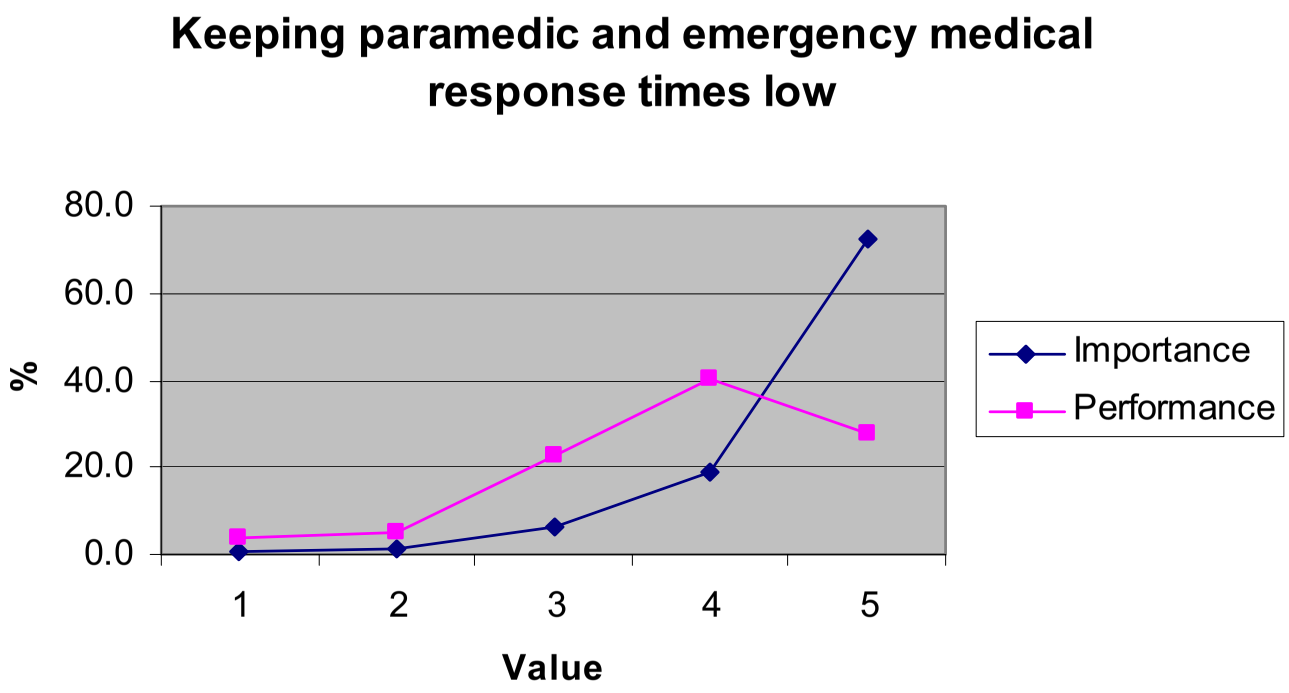


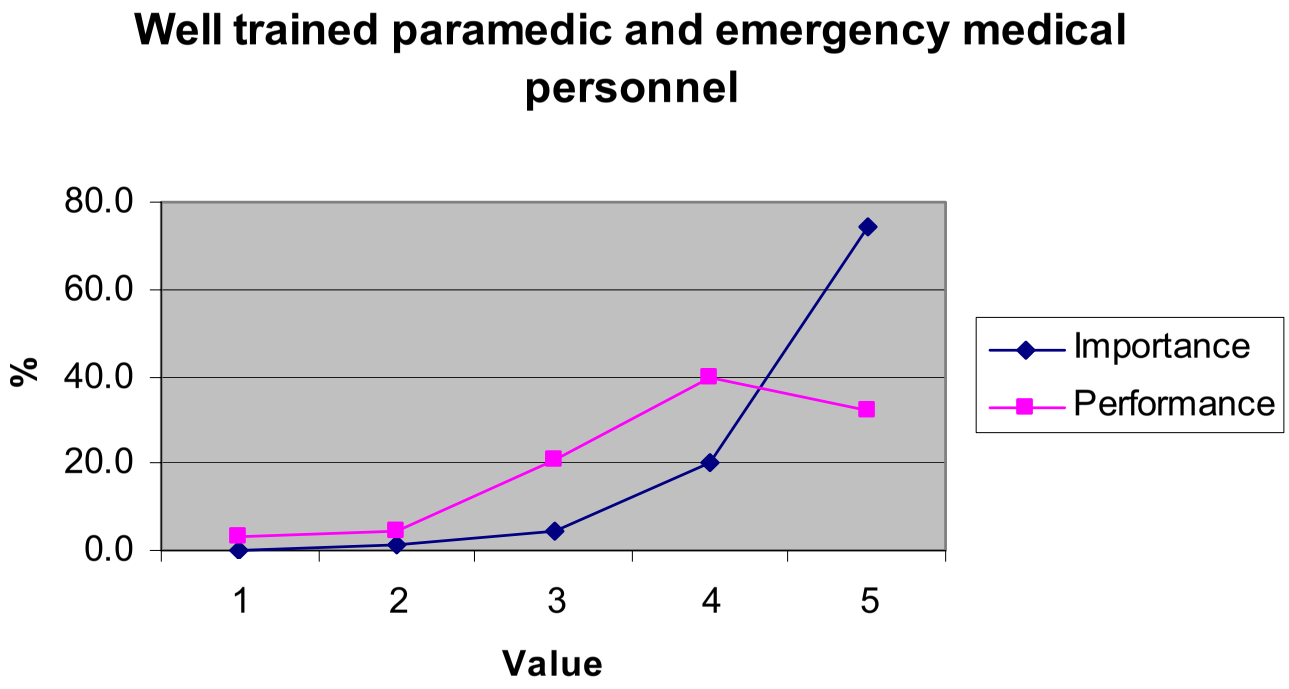

Maintaining neighborhood police patrols
60.0
50.0
40.0
30.0
20.0
10.0
0.0
%
1
2
3
4
5
Value
Importance
Performance


Keeping police response times low
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
%
1
2
3
4
5
Value
Importance
Performance

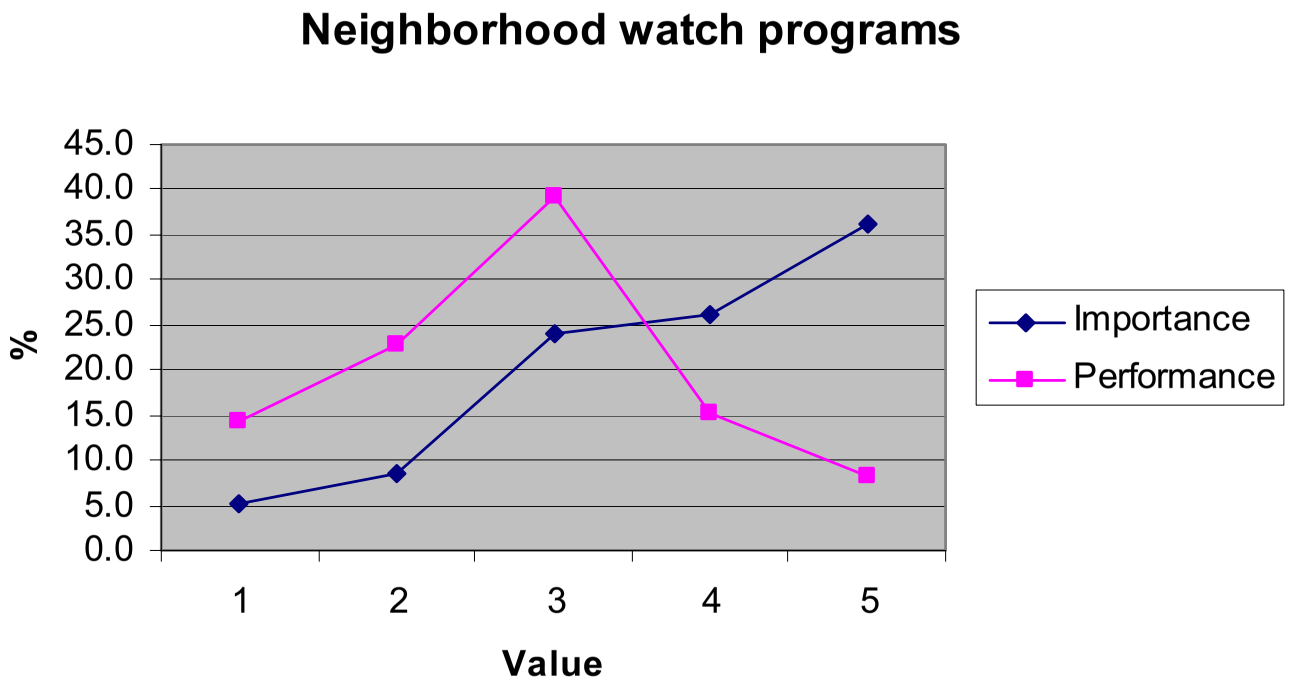
Keeping fire department response times low




Keeping paramedic and emergency medical response times low
80.0
60.0
40.0
20.0
0.0
%
1
2
3
4
5
Value
Importance
Performance


Well trained paramedic and emergency medical personnel
80.0
60.0
40.0
20.0
0.0
%
1
2
3
4
5
Value
Importance
Performance

Appendix XII
Importance/Performance Comparisons



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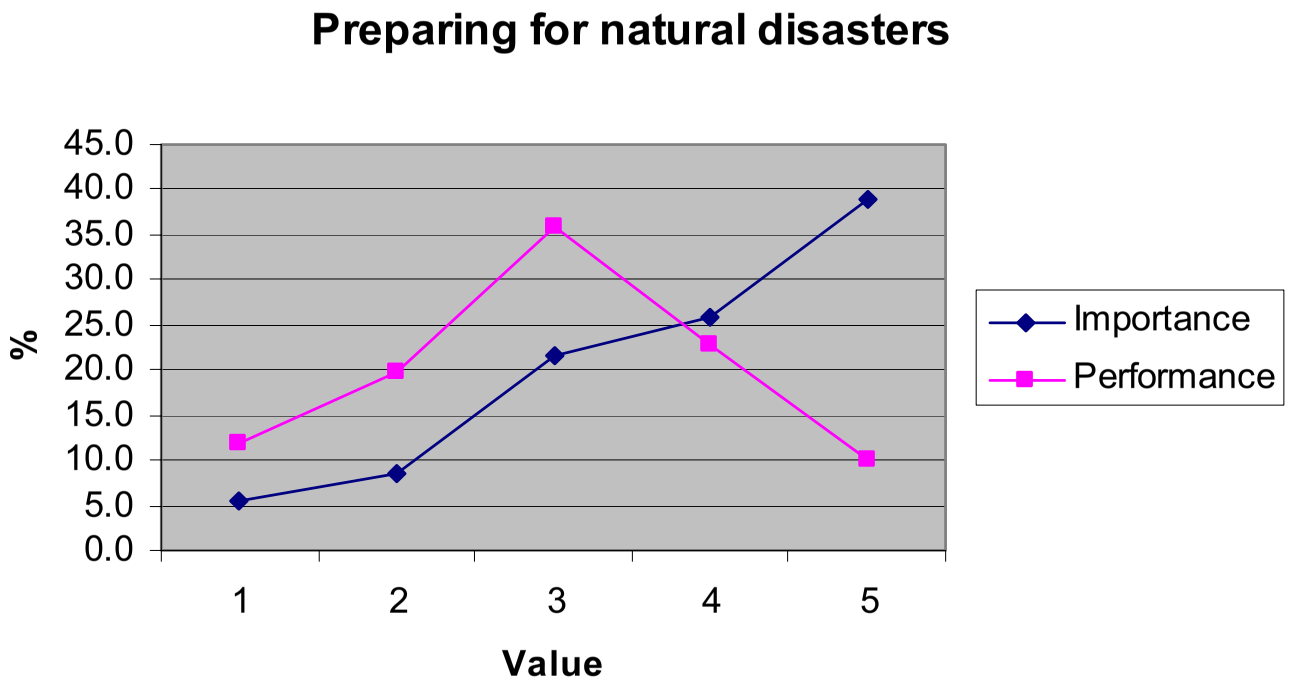

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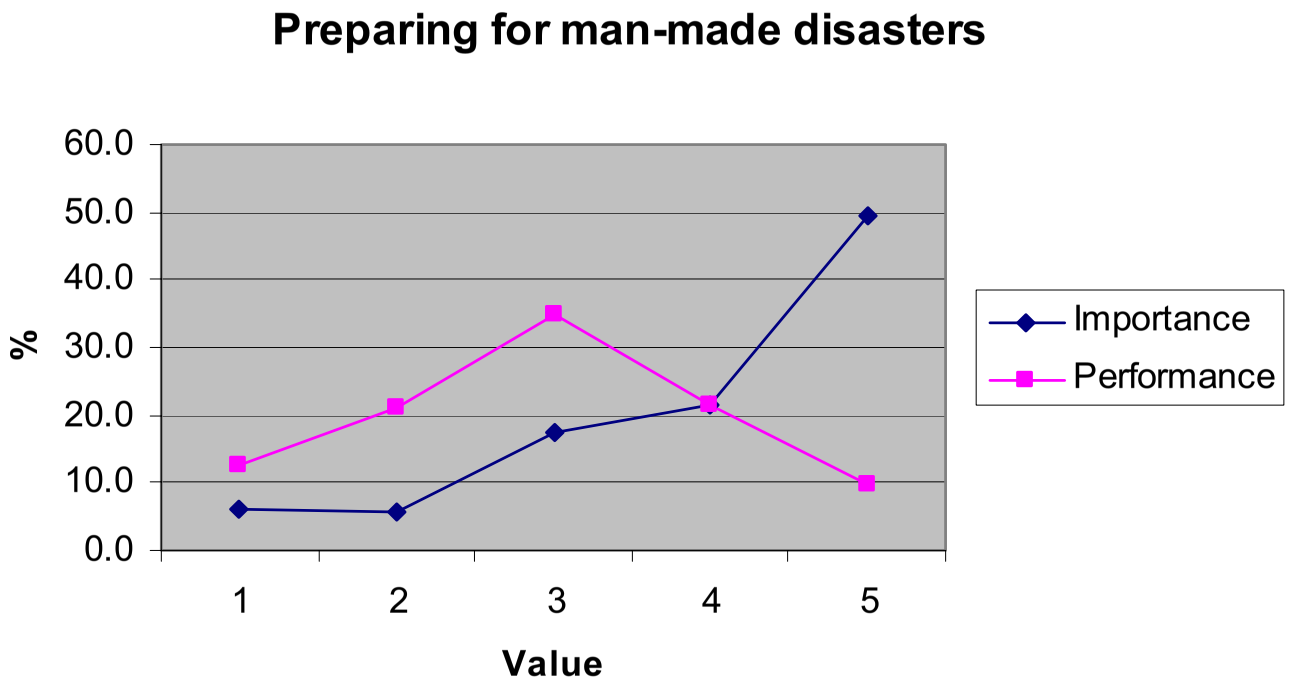

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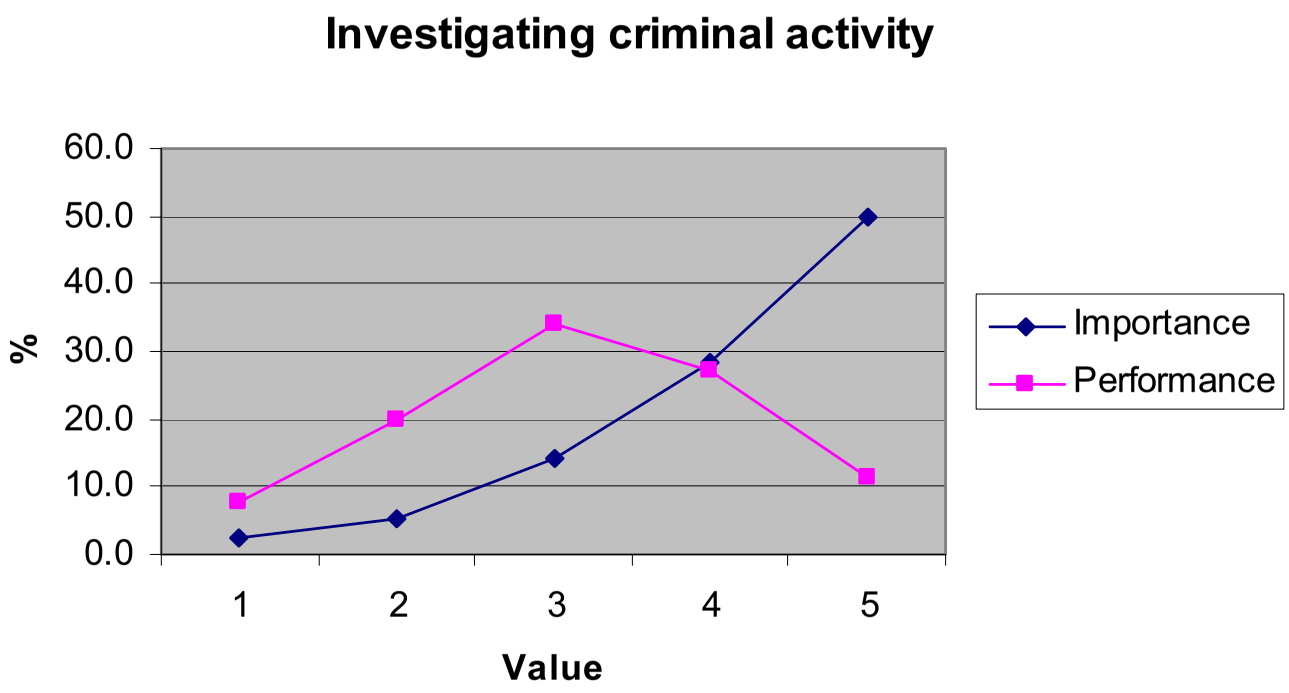
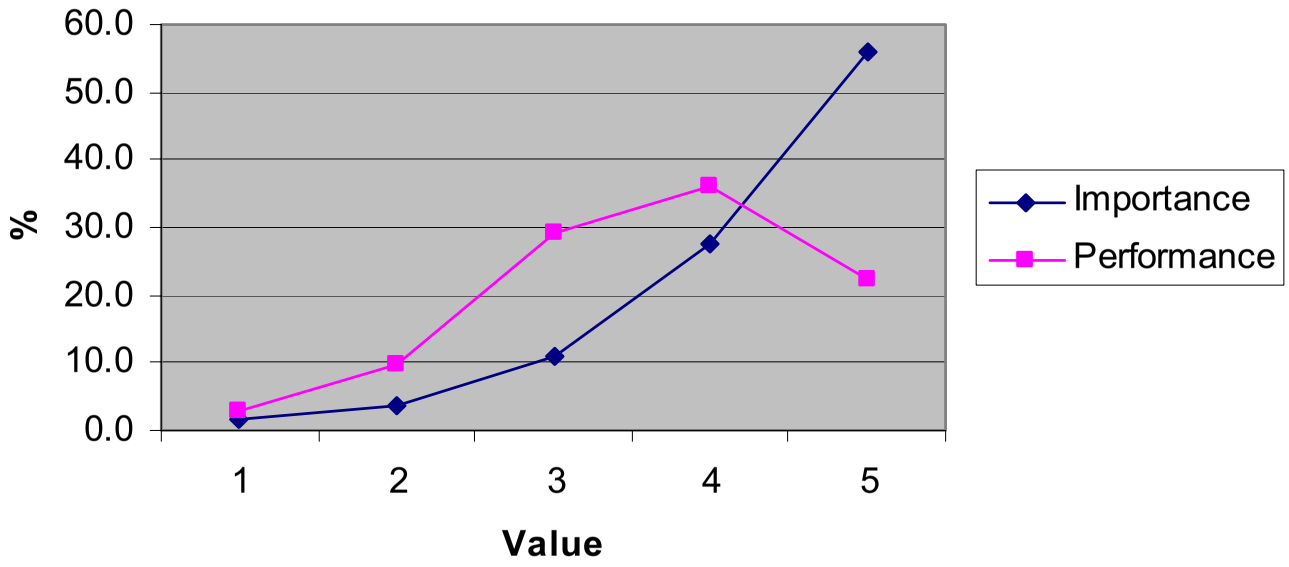


Appendix XII
Importance/Performance Comparisons

Providing fire protection and prevention services



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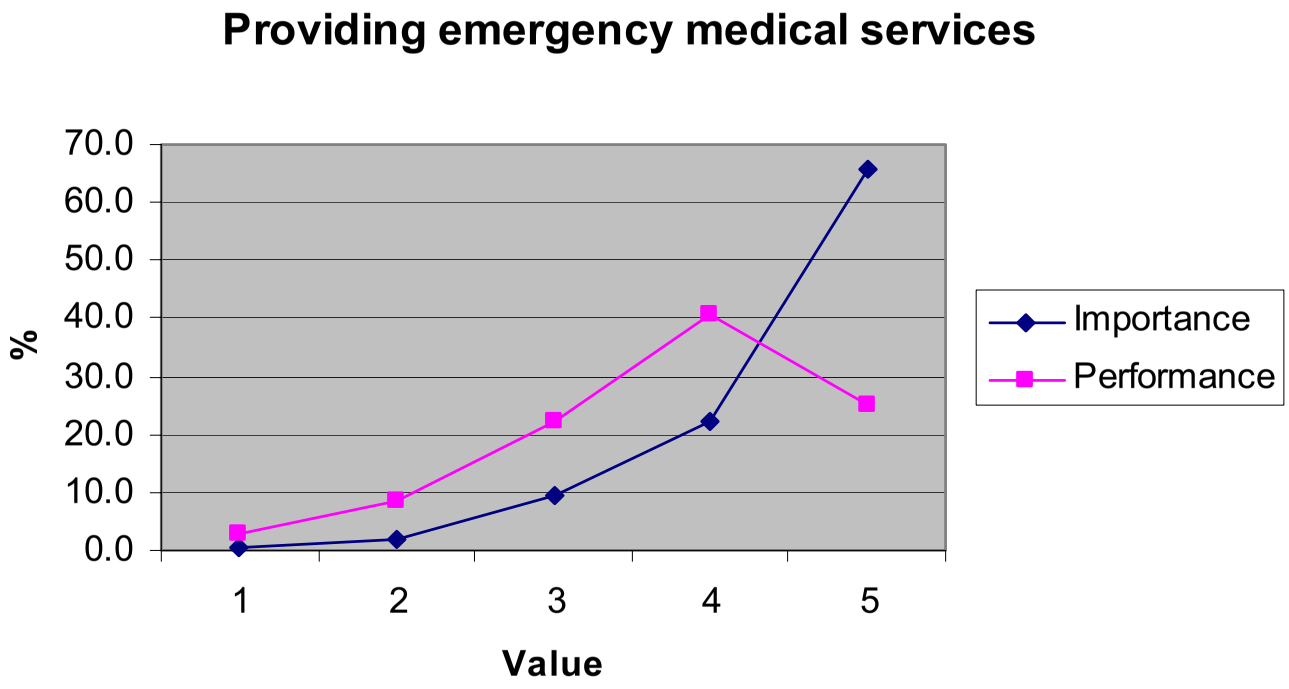
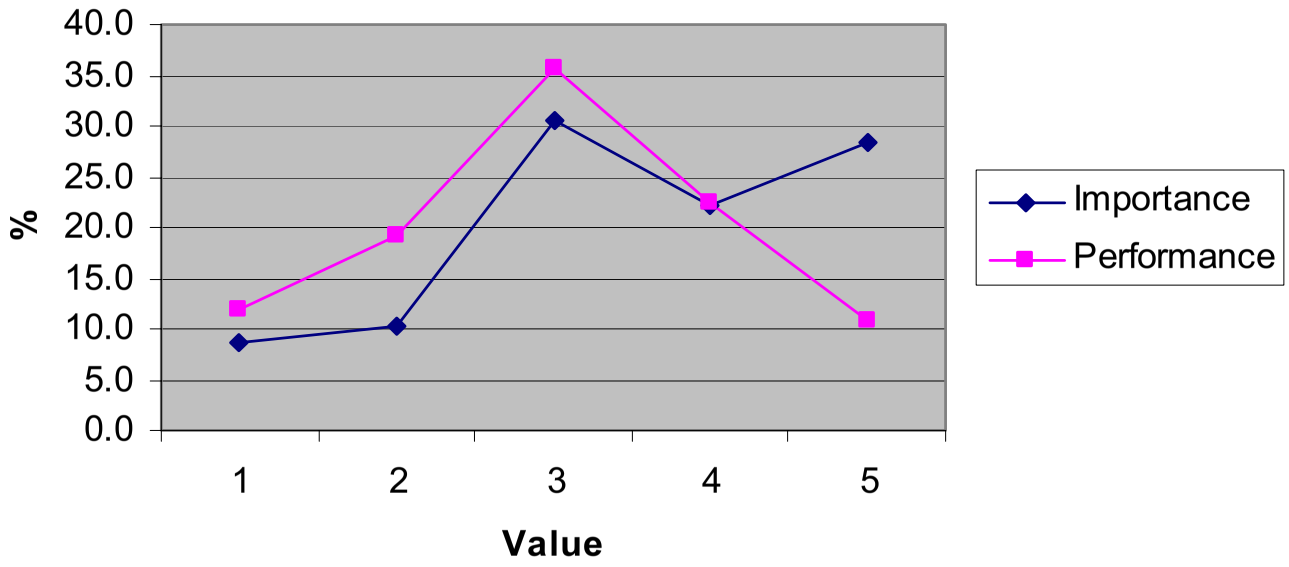
Importance/Performance Comparisons



Providing for neighborhood code enforcement



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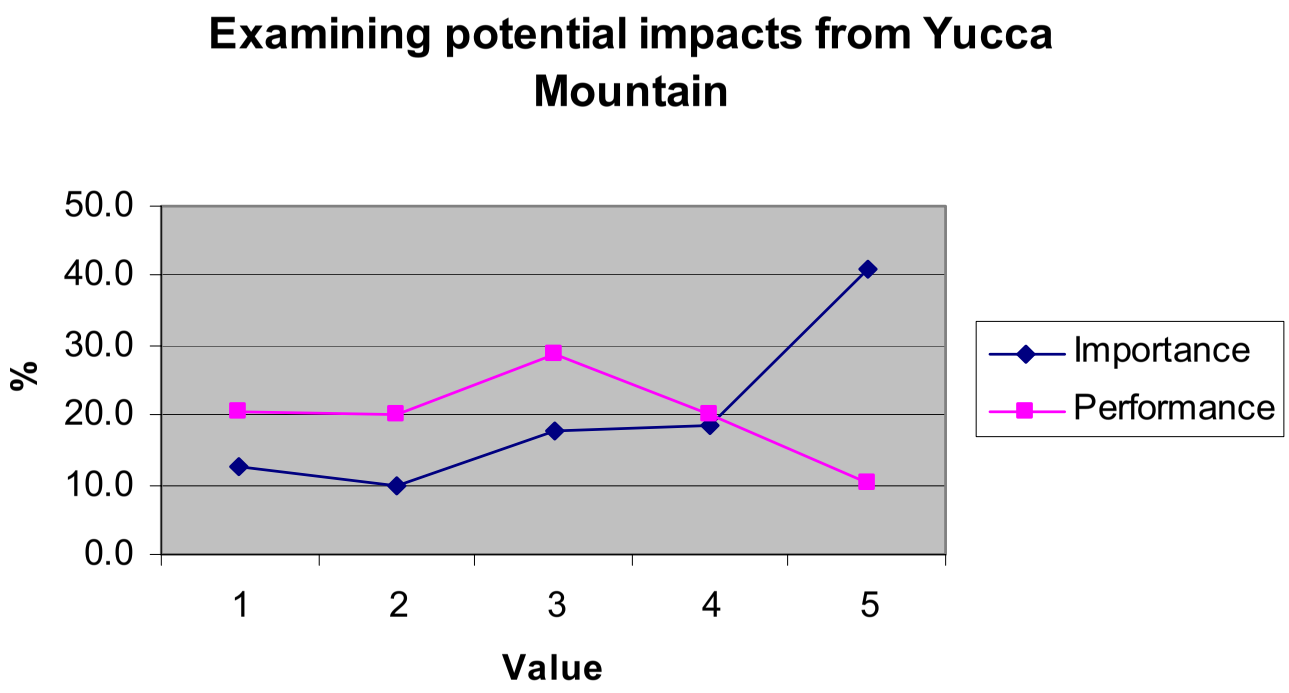
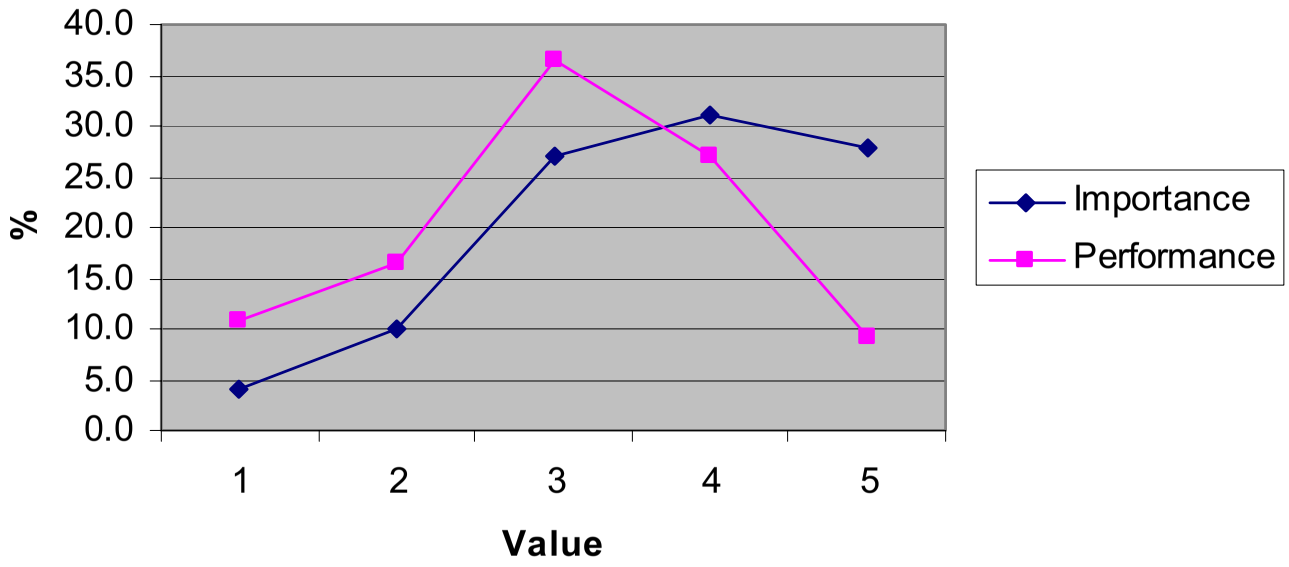
Importance/Performance Comparisons



Regional justice services and facilities



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-END OF REPORT-

Attachment 15

UER, “Clark County Monitoring Program: Community Survey”

(Feb 2006)

Clark County Monitoring Program

Winter/2006

APPLIED ANALYSIS

strategic solutions

UER
Urban Environmental Research, LLC

TO: MS. IRENE NAVIS, AICP
FROM: DR. SHEILA CONWAY; JEREMY AGUERO
SUBJECT: CLARK COUNTY MONITORING PROGRAM | WINTER 2006
DATE: APRIL 6, 2006
CC: BRIAN GORDON/APPLIED ANALYSIS
DR. ALVIN MUSKATEL/UER;
JASON GRAY/STRATEGIC SOLUTIONS

This memorandum summarizes the key findings of the bi-annual Winter 2006 Clark County Monitoring Program Survey conducted by Urban Environmental Research, Applied Analysis and Strategic Solutions on behalf of the Nuclear Waste Division. A more detailed statistical assessment of our methodology and findings is available in the accompanying comprehensive assessment binder and will be posted to the Clark County Monitoring Program's website (www.monitoringprogram.com) upon your approval of this deliverable. The intent of this memorandum is to provide an executive level overview of our salient findings.

A. GENERAL OVERVIEW

During the month of February 2006, Strategic Solutions, in coordination with Urban Environmental Research and Applied Analysis, administered a 137-question telephone survey to 607 Southern Nevada households. The survey, which touches on a broad number of topics, has a margin of error of ±4 percent at the 95 percent confidence level. The principal purpose of the Clark County Monitoring Program, including this survey series, is to establish an analysis baseline from which the impacts of transporting high-level nuclear waste through the Las Vegas Valley, and ultimately storing the radioactive material at the proposed Yucca Mountain Nuclear Waste Repository, can be monitored, measured and assessed.

Generally speaking, the survey is segmented into seven areas of inquiry: 1) public service importance; 2) public service performance; 3) quality-of-life considerations; 4) general economic considerations; 5) property value impact considerations; 6) environmental considerations; and 7) local government interaction. In addition to these general areas of inquiry, information on the demographic and socio-economic profile of respondents is also routinely gathered.

It is easy to conceptualize how the transportation of high-level nuclear waste through a community might negatively impact property values. It is a bit more difficult to identify the nexus to child welfare programs, homelessness, flood protection or crime enforcement. In absence of mitigating funds, it is likely that Nevada's state and local governments will be required to shift resources away from existing programs and into efforts aimed at ensuring threats, patent and latent, sourced to storage and transportation of high-level nuclear waste are addressed. Shifts away from existing public services would be expected to reduce the quality of life with the community and may also have far-reaching economic, fiscal and social implications. Analyzing these questions requires not only an understanding of resource allocations to specific programs but also the relative importance and effectiveness of those programs. The Clark County Monitoring Program survey series is designed to provide analysts this more comprehensive framework from which impact assessments can be appropriately derived.

B. KEY FINDINGS

- Strong public service importance and performance scores for fire and emergency medical services.
- Economic conditions showing signs of weakening.
- Notable increases in the importance assigned to child-related public service categories.
- Crime appears to be an increasing concern among respondents.
- Drought remains the most pressing environmental issue.
- Housing market weakening; housing affordability /attainability not cited as a primary area of concern.

C. YUCCA MOUNTAIN QUESTIONS

- Respondents overwhelmingly oppose the Yucca Mountain project, with 71.4 percent indicating that given the opportunity to vote on the matter, they would vote against it. More than two-thirds of respondents indicated a belief that the facility will have a negative impact on their quality of life. When asked the same question in the Summer 2005 survey, 59 percent of respondents expected a negative impact.

- Trust regarding the Yucca Mountain project remains a key concern. Roughly 66 percent of all respondents indicate that they "disagree" or "strongly disagree" that the U.S. Department of Energy can be trusted to ensure the public's safety as it relates to transportation and storage of high-level nuclear waste.

- When asked what one change would most improve the quality of life in Southern Nevada, one out every nine respondents indicated "stop Yucca Mountain." While some technical changes were made to this question, the

number responding similarly in the Summer 2005 survey was one out of every 11 respondents.

- Approximately 83 percent of respondents indicated an expectation that having a high-level nuclear waste transportation route near residential housing would have a negative impact on property values. This figure is consistent with those reported previously. Nuclear waste transportation remains in the same general perception category as a landfill or polluting manufacturing facility.

- In terms of public service importance measures, Yucca Mountain-related considerations, including those related to preparing for man-made accidents or terrorist events; those examining potential impacts from Yucca Mountain nuclear waste shipments; and those relating to the communication of Clark County's views about Yucca Mountain to Federal decision makers all remained fairly consistent. On a one-to-five rating scale, these considerations tend to receive above-average scores, but are valued significantly lower than more immediate public safety, transportation and economic concerns.

- As an urgent environmental concern, the Yucca Mountain facility's placement among major issues was materially unchanged. Approximately 1.9 percent of respondents identified the Yucca Mountain project as Southern Nevada's most pressing environmental concern; this was 0.1 percent higher than reported in the Summer 2005 series.

D. PUBLIC SERVICE IMPORTANCE CONSIDERATIONS (FIGURES 1 & 2)

- Public service importance continued to be dominated by public safety considerations, which accounted for four of the top five and seven out of the top ten most highly-rated services. Traffic and transportation-related services also remained high on the list.

- On a relative scale, only modest movement was noted in the majority of services. We did note, however, that "increasing job opportunities" tracked up six places overall. This, combined with reduced optimism regarding economic conditions and significant movement in job availability as a quality-of-life factor (both discussed later), may be an early indication of softening in the economy.

- Also increasing on an ordinal basis was "providing child protective services" and "providing child welfare services." This may be partially the result of increased media coverage in these areas, although the direction of this relationship is unclear. A closer examination of this service area is warranted.

FIGURE 1 PUBLIC SERVICE IMPORTANCE SCORE SUMMARY

Public Service Importance Score Summary

Descriptive Statistics	Service Category	Winter '06	Mean Summer '05	Change
Well trained paramedic and emergency medical response personnel	Public Safety	4.64	n/a	n/a
Keeping paramedic and emergency medical response times low	Public Safety	4.56	4.45	0.11
Keeping fire department response times low	Public Safety	4.54	4.45	0.09
Providing emergency medical services	Public Safety	4.44	4.66	-0.22
Providing 24 hour emergency trauma care	Social and Judicial Services	4.38	4.6	-0.22
Providing fire protection and prevention services	Public Safety	4.32	4.59	-0.27
Keeping police response times low	Public Safety	4.24	4.45	-0.21
Maintaining a low crime rate	Public Safety	4.14	4.49	-0.35
Providing child protection services	Social and Judicial Services	4.06	4.27	-0.21
Road maintenance	General Government	4.05	4.21	-0.16
Investigating criminal activity	Public Safety	4.03	4.47	-0.43
Reducing traffic congestion	Community Development	4.02	4.37	-0.34
Budget management	General Government	3.99	4.29	-0.3
Providing crime prevention programs	Public Safety	3.99	4.27	-0.28
Providing child welfare services	Social and Judicial Services	3.98	4.15	-0.17
Improving road conditions	Community Development	3.97	4.29	-0.32
Maintaining neighborhood police patrols	Public Safety	3.97	4.3	-0.33
Increasing job opportunities	Community Development	3.95	4.07	-0.12
Providing juvenile justice services	Social and Judicial Services	3.93	4.08	-0.15
Providing affordable housing for seniors	Social and Judicial Services	3.92	4.12	-0.2
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	Public Safety	3.92	4.18	-0.27
Enforcing traffic laws	Public Safety	3.91	4.25	-0.34
Flood control	General Government	3.88	4.09	-0.21
Improving the business climate	Community Development	3.86	4.08	-0.22
Access to freeways	Community Development	3.83	4.12	-0.29
Managing growth	Community Development	3.8	4.07	-0.26
Reducing travel time	Community Development	3.77	4.01	-0.25

Preparing for natural disasters, (i.e. floods, earthquakes, etc)	Public Safety	3.75	4.04	-0.29
Providing medical care for the poor	Social and Judicial Services	3.74	3.94	-0.21
Provide attainable housing for working class families	Social and Judicial Services	3.72	n/a	n/a
Monitor and report to the public on how well government services are being performed	General Government	3.72	3.9	-0.18
Planning for commercial development	Community Development	3.7	3.82	-0.12
Facilitate neighborhood watch programs	Public Safety	3.69	4.05	-0.35
Examining potential impacts from Yucca Mountain nuclear waste shipments	Public Safety	3.68	3.88	-0.21
Providing mass public transit	Community Development	3.67	3.86	-0.19
Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	General Government	3.59	3.77	-0.18
Providing affordable housing for low income families	Social and Judicial Services	3.56	3.7	-0.14
Providing for neighborhood code enforcement services	Public Safety	3.54	3.81	-0.27
Evaluating impacts to property values as a result of the proposed shipment of nuclear waste to Yucca Mountain	Community Development	3.54	3.78	-0.24
Evaluating impacts to Southern Nevada's tourism economy as a result of the proposed shipment of nuclear waste to Yucca Mountain	Community Development	3.5	3.74	-0.24
Revitalizing older neighborhoods	General Government	3.41	3.59	-0.18
Providing shelter for the homeless	Social and Judicial Services	3.33	3.38	-0.05

FIGURE 2 PUBLIC SERVICE IMPORTANCE RANKING

Descriptive Statistics	Ranking Winter '06	Ranking Summer '05	Change
Well trained paramedic and emergency medical response personnel	1	n/a	n/a
Keeping paramedic and emergency medical response times low	2	6	4
Keeping fire department response times low	3	6	3
Providing emergency medical services	4	1	-3
Providing 24 hour emergency trauma care	5	2	-3
Providing fire protection and prevention services	6	3	-3
Keeping police response times low	7	8	1
Maintaining a low crime rate	8	4	-4
Providing child protection services	9	13	4

Road maintenance	10	16	6
Investigating criminal activity	11	5	-6
Reducing traffic congestion	12	9	-3
Budget management	13	11	-2
Providing crime prevention programs	14	14	0
Providing child welfare services	15	18	3
Improving road conditions	16	12	-4
Maintaining neighborhood police patrols	17	10	-7
Increasing job opportunities	18	24	6
Providing juvenile justice services	19	22	3
Providing affordable housing for seniors	20	19	-1
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	21	17	-4
Enforcing traffic laws	22	15	-7
Flood control	23	21	-2
Improving the business climate	24	23	-1
Access to freeways	25	20	-5
Managing growth	26	25	-1
Reducing travel time	27	28	1
Preparing for natural disasters, (i.e. floods, earthquakes, etc)	28	27	-1
Providing medical care for the poor	29	29	0
Provide attainable housing for working class families	30	n/a	n/a
Monitor and report to the public on how well government services are being performed	31	30	-1
Planning for commercial development	32	33	1
Facilitate neighborhood watch programs	33	26	-7
Examining potential impacts from Yucca Mountain nuclear waste shipments	34	31	-3
Providing mass public transit	35	32	-3
Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	36	36	0
Providing affordable housing for low income families	37	39	2
Providing for neighborhood code enforcement services	38	34	-4
Evaluating impacts to property values as a result of the proposed shipment of nuclear waste to Yucca Mountain	39	35	-4
Evaluating impacts to Southern Nevada's tourism economy as a result of the proposed shipment of nuclear waste to Yucca Mountain	40	37	-3
Revitalizing older neighborhoods	41	40	-2
Providing shelter for the homeless	42	41	-2

E. PUBLIC SERVICE PERFORMANCE (FIGURES 3 & 4)

- Public service performance scores were highest in the areas of fire and emergency response, flood control and economic development. Lower scores were assigned to a broader cross section of services including those related to housing affordability, traffic congestion and Yucca Mountain impact assessments.

- "Providing 24-hour emergency trauma care" was the only service in both the highest importance quartile and the lowest performance quartile. Over crowding at many area hospitals is becoming a recurring theme and long emergency room wait times appear to be an area of acute concern for local residents.

- "Maintaining a low crime rate" was the only public service to be in the highest importance quartile and the second-lowest performance quartile. It is likely that additional police officers will first increase the overall crime (more officers, more arrests), but lower crime rates over time. Even adjusted for tourist visitation, Southern Nevada's crime rates remain significantly higher than national averages, a concern that may be impacting the response profile.

- Traffic-related service areas also posted higher-than-average importance scores but lower-than-average performance scores. "Reducing traffic congestion" was the 12th highest ranked public service in terms of importance (second quartile) and the 3rd lowest in terms of performance (fourth quartile). This having been said, respondents seem to be more concerned with the flow of traffic than the time each trip takes. "Reducing travel times" was in the third quartile for both importance and performance.

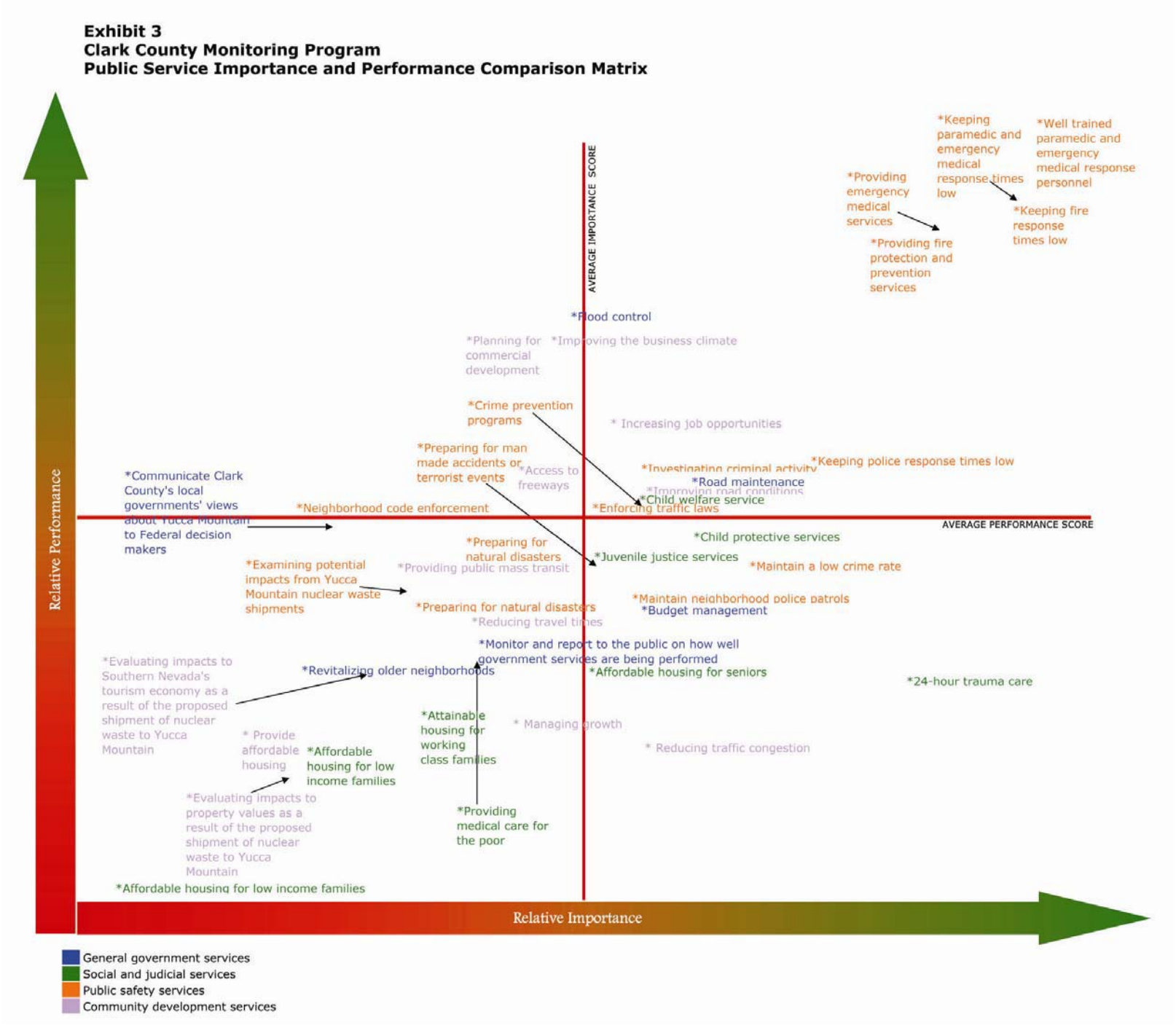
FIGURE 3 PUBLIC SERVICE IMPORTANCE AND PERFORMANCE SCORE SUMMARY

	Mean	
Descriptive Statistics	**Importance**	**Performance**
Well trained paramedic and emergency medical response personnel	4.64	3.93
Keeping paramedic and emergency medical response times low	4.56	3.76
Keeping fire department response times low	4.54	3.73
Providing emergency medical services	4.44	3.65
Providing 24 hour emergency trauma care	4.38	2.55
Providing fire protection and prevention services	4.32	3.58
Keeping police response times low	4.24	3.01
Maintaining a low crime rate	4.14	2.76
Providing child protection services	4.06	2.82
Road maintenance	4.05	2.96
Investigating criminal activity	4.03	2.99
Reducing traffic congestion	4.02	2.38
Budget management	3.99	2.71
Providing crime prevention programs	3.99	2.9
Providing child welfare services	3.98	2.9
Improving road conditions	3.97	2.93
Maintaining neighborhood police patrols	3.97	2.68
Increasing job opportunities	3.95	3.06
Providing juvenile justice services	3.93	2.79
Providing affordable housing for seniors	3.92	2.56

Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	3.92	2.76
Enforcing traffic laws	3.91	2.9
Flood control	3.88	3.44
Improving the business climate	3.86	3.27
Access to freeways	3.83	2.98
Managing growth	3.8	2.45
Reducing travel time	3.77	2.67
Preparing for natural disasters, (i.e. floods, earthquakes, etc)	3.75	2.81
Providing medical care for the poor	3.74	2.56
Provide attainable housing for working class families	3.72	2.48
Monitor and report to the public on how well government services are being performed	3.72	2.57
Planning for commercial development	3.7	3.26
Facilitate neighborhood watch programs	3.69	2.69
Examining potential impacts from Yucca Mountain nuclear waste shipments	3.68	2.69
Providing mass public transit	3.67	2.76
Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers	3.59	2.83
Providing affordable housing for low income families	3.56	2.39
Providing for neighborhood code enforcement services	3.54	2.86
Evaluating impacts to property values as a result of the proposed shipment of nuclear waste to Yucca Mountain	3.54	2.33
Evaluating impacts to Southern Nevada's tourism economy as a result of the proposed shipment of nuclear waste to Yucca Mountain	3.5	2.55
Providing affordable housing	3.47	2.43
Revitalizing older neighborhoods	3.41	2.56
Providing shelter for the homeless	3.33	2.1

Importance Scale	**Performance Scale**
Very Important (4.0 - 5.0)	Excellent (4.0 - 4.99)
Important (3.0 - 3.99)	Good (3.0 - 3.99)
Neither Important or Not Important (2.0 -2.99)	Average (2.0 - 2.99)
Not Very Important (1.0 - 1.99)	Fair (1.0 - 1.99)
Not Important At All (<1.0)	Poor (<1.0)

FIGURE 4 PUBLIC SERVICE IMPORTANCE AND PERFORMANCE MATRIX



F. QUALITY OF LIFE CONSIDERATIONS (FIGURE 5)

- Nearly 38 percent of all respondents indicated a general erosion in Clark County's quality of life. More than 56 percent of respondents identified "crime"; "overcrowding/unplanned growth"; or "traffic congestion" as the most pressing quality of life concern. Crime was the number one concern, cited by one in five respondents.

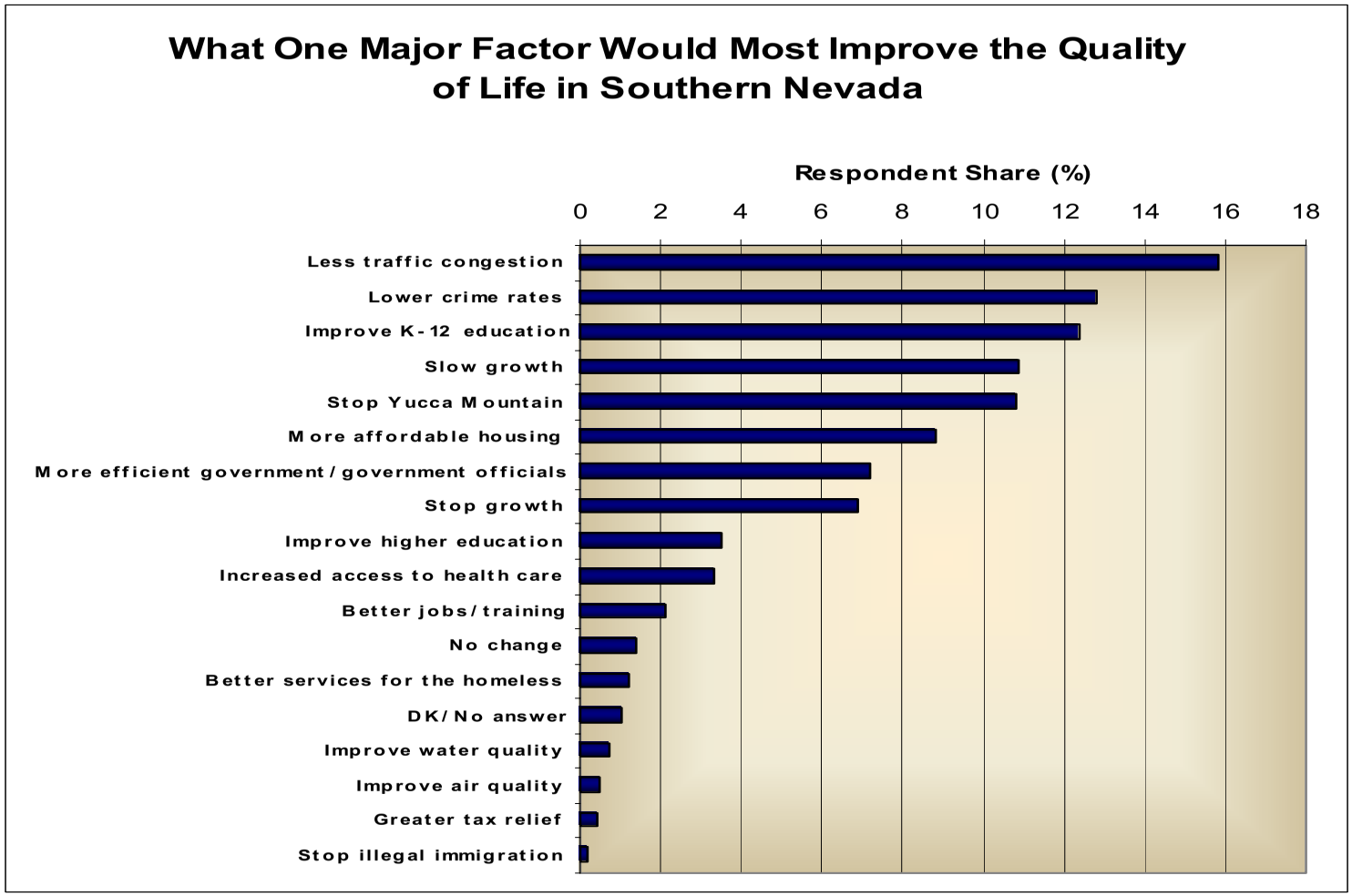
- When asked about factors positively impacting respondents' quality of life, availability of job opportunities moved from the middle of the pack to the highest score in the Winter 2006 series. Some categories did change during the period; however, several categories previously generating higher scores (e.g., air quality, managing growth and the condition of the streets and roads) reported lower relative values. As noted earlier, this adds to the concern that economic conditions may be softening. When asked what aspect of living in Clark County, if any has the greatest positive impact on your quality of life, one in five responded "job opportunities" second only to "scenery/geography/climate."

- "Water availability" ranked as the most urgent environmental concern during the quarter, stealing the top spot from "overpopulation." These two categories accounted for more than 52 percent of all responses.

- Concerns over drought conditions may be escalating. Approximately 52 percent of respondents reported that they were "very concerned" about the drought and its impact on Clark County, nearly five percentage points higher than reported in the Summer 2005 series. More than 88 percent of all respondents noted that they were "concerned" or "very concerned" about the drought.

- Winter months tend to increase concerns over air quality. During the Winter 2006 survey, 76.1 percent of respondents reported that Clark County's air quality was "fair" or "poor." This number is number is 10.2 percentage points higher than the 65.9 percent reported prior.

FIGURE 5 QUALTY OF LIFE FACTORS

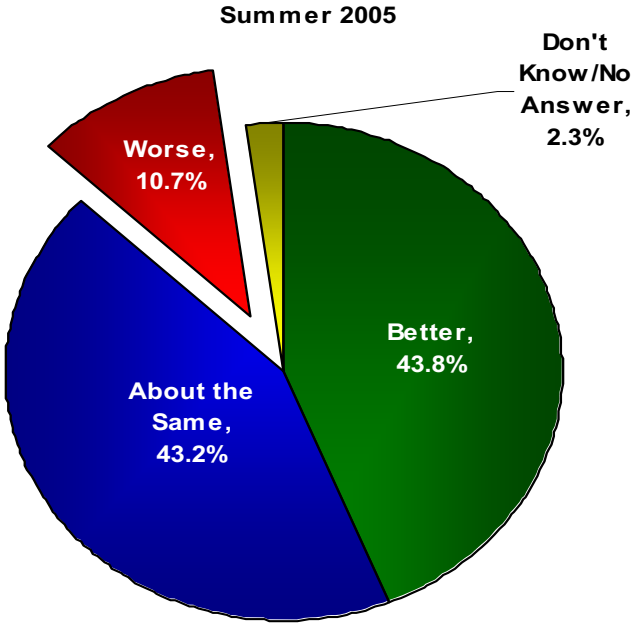


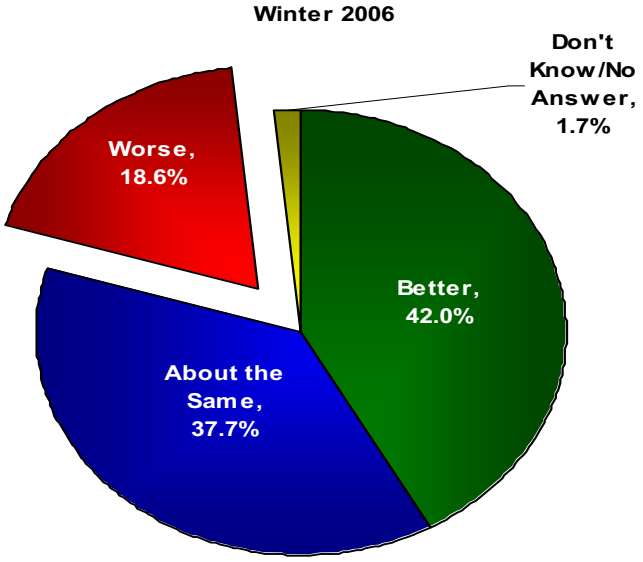
G. ECONOMIC CONSIDERATIONS (FIGURE 6)

- While the number of respondents indicating that their financial condition improved during the past 12 months increased, so did the percentage of respondents indicating that there position worsened. Of greater concern are the economic expectations of respondents. Those indicating an expectation that their financial position will be worse one year out increased from 10.7 percent in the Summer 2005 survey to 18.6 percent in the Winter 2006 survey. Similar declines were noted when respondents were asked about business conditions. As noted previously in this summary, the frequency and consistency of this type of response is a concern.

- The percentage of respondents indicating it was a good time to buy a home remained above 50 percent but slid from 54.7 percent to 51.0 percent. This sentiment combined with lower population immigration figures and robust residential permitting appears to be fertile ground for a supply-demand imbalance in the residential construction sector.

Figure 6 Clark County Monitoring Program Financial Expectations (One Year From Today





H. LOCAL GOVERNMENT INTERACTIONS

- Local government interaction statistics were generally unremarkable in comparison to those reported previously. Fifty percent of respondents reported local government's timeliness of responses as "good" or "excellent;" courtesy and professionalism scores were above 60 percent. Competency reported the highest "poor" score at 14.7 percent, although nearly 59 percent of all respondents indicated that local government competency was "good" or "excellent."

- Those reporting visiting the local government website (41.0 percent) were materially unchanged.

- The metropolitan police department remained the most common point of contact with local governments, while 54.5 percent of respondents report no direct interaction with local governments.

APPENDICES

Appendix I:	Importance Score for Selected Services
Appendix II:	Performance Score for Selected Services
Appendix III:	Quality of Life Considerations
Appendix IV:	General Economic Considerations
Appendix V:	Property Value Considerations
Appendix VI:	Environmental Considerations
Appendix VII:	Commute Profile
Appendix VIII:	Local Government Interaction
Appendix IX:	Local Distribution Summary
Appendix X:	Respondent Demographic Profile
Appendix XI:	Importance/Performance Comparisons
Appendix XII:	Research Methods and Limitations
Appendix XIII:	Longitudinal Analysis
Appendix XIV:	Instrument Modifications

Appendix I
Importance Score for Selected Services

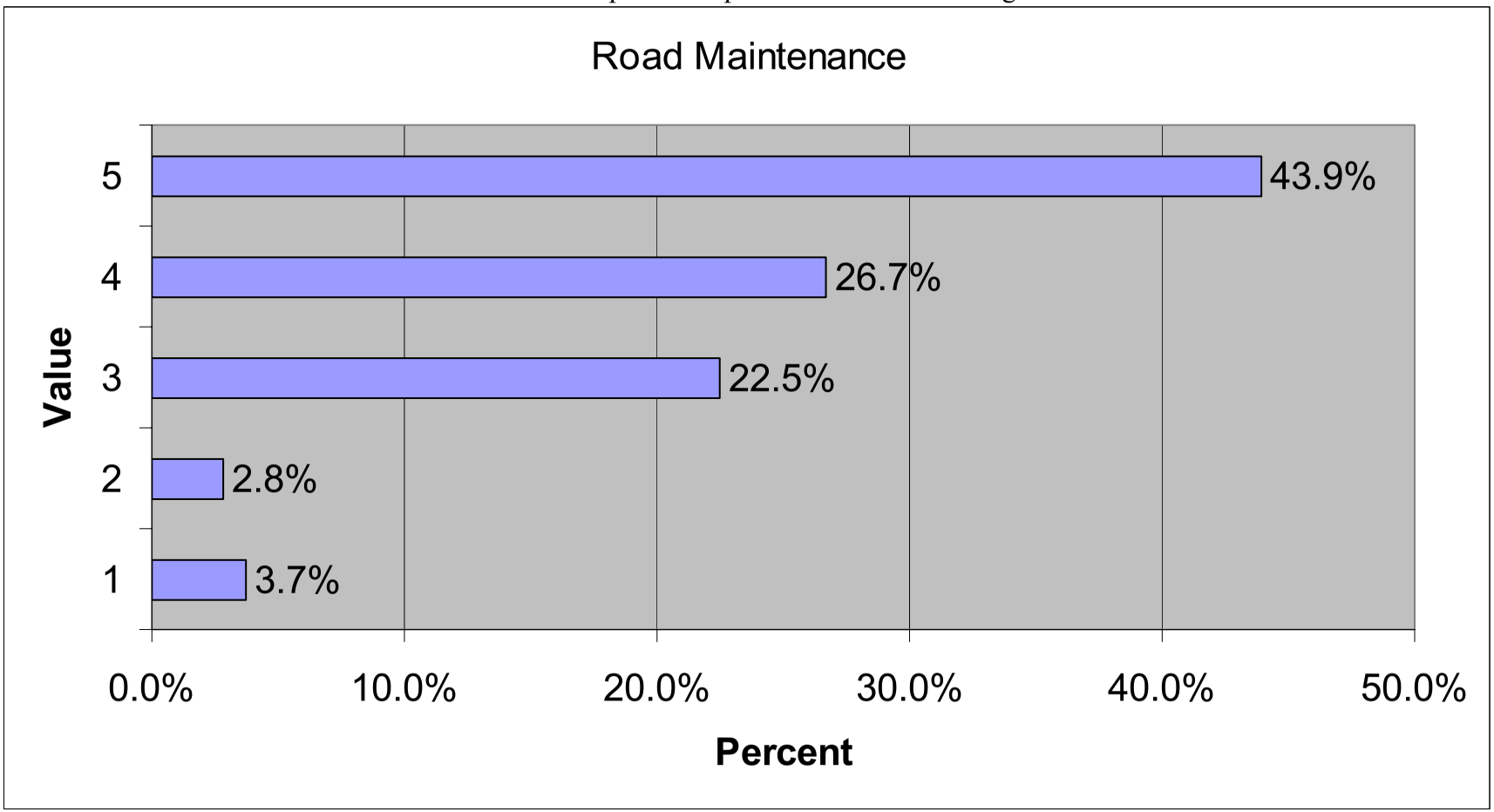
Appendix 1
Importance for Selected Services
Ranking 1-5 (1 being low 5 Being high)

Importance Variable	N	Mean	Median	Std. Error of Mean	Min	Max	Std. Deviation	Kurtosis	Std Error of Kurtosis	Skewness	Std Error of Skewness
**General Government Services*											
Road Maintenance	606	4.05	4	0.043	1	5	1.053	0.530	0.198	-1.003	0.099
Revitalizing older neighborhoods	588	3.41	3	0.052	1	5	1.257	-0.881	0.201	-0.321	0.101
Flood Control	607	3.88	4	0.050	1	5	1.233	-0.152	0.198	-0.909	0.099
Budget management	594	3.99	4	0.049	1	5	1.183	0.121	0.200	-0.999	0.100
Communicate Clark County's local governments' views about Yucca Mountain to federal decision makers	584	3.59	4	0.060	1	1	1.450	-0.968	0.202	-0.620	0.101
Monitor and report to the public on how well government services are being performed	598	3.72	4	0.049	1	1	1.202	-0.514	0.200	-0.614	0.100
**Social and Judicial Services*											
Providing Child Protection Services	589	4.06	5	0.050	1	5	1.205	0.207	0.201	-1.120	0.101
Providing Child Welfare Services	583	3.98	4	0.049	1	5	1.189	-0.297	0.202	-0.891	0.101
Providing Juvenile Justice Services	577	3.93	4	0.049	1	5	1.172	-0.122	0.203	-0.897	0.102
Providing Attainable Housing for Working Class Families	600	3.72	4	0.055	1	5	1.338	-0.746	0.199	-0.702	0.100
Providing Affordable housing for Low Income Families	596	3.56	4	0.058	1	5	1.409	-1.060	0.200	-0.511	0.100
Providing shelter for the homeless	595	3.33	3	0.058	1	5	1.403	-1.169	0.200	-0.309	0.100
Providing affordable housing for seniors	599	3.92	4	0.051	1	5	1.251	-0.285	0.199	-0.914	0.100
Providing medical care for the poor	595	3.74	4	0.054	1	5	1.326	-0.685	0.200	-0.700	0.100
Providing 24-hour emergency trauma care	600	4.38	5	0.041	1	5	0.997	1.988	0.199	-1.645	0.100
Public Safety											
Providing crime prevention programs	599	3.99	4	0.047	1	5	1.141	0.094	0.199	-0.972	0.100
Enforcing traffic laws	607	3.91	4	0.049	1	5	1.200	-0.421	0.198	-0.794	0.099
Maintaining a low crime rate	606	4.14	5	0.050	1	5	1.221	0.470	0.198	-1.268	0.099
Maintaining neighborhood police patrols	604	3.97	4	0.049	1	5	1.197	-0.277	0.199	-0.892	0.099
Keeping police response times low	592	4.24	5	0.044	1	5	1.077	1.061	0.201	-1.374	0.100
Keeping fire department response times low	593	4.54	5	0.033	1	5	0.792	3.928	0.200	-1.965	0.100
Keeping paramedic and emergency response times low	598	4.56	5	0.031	1	5	0.763	3.164	0.199	-1.865	0.100
Well trained paramedic and emergency response personnel	593	4.64	5	0.029	1	5	0.702	3.755	0.200	-2.044	0.100

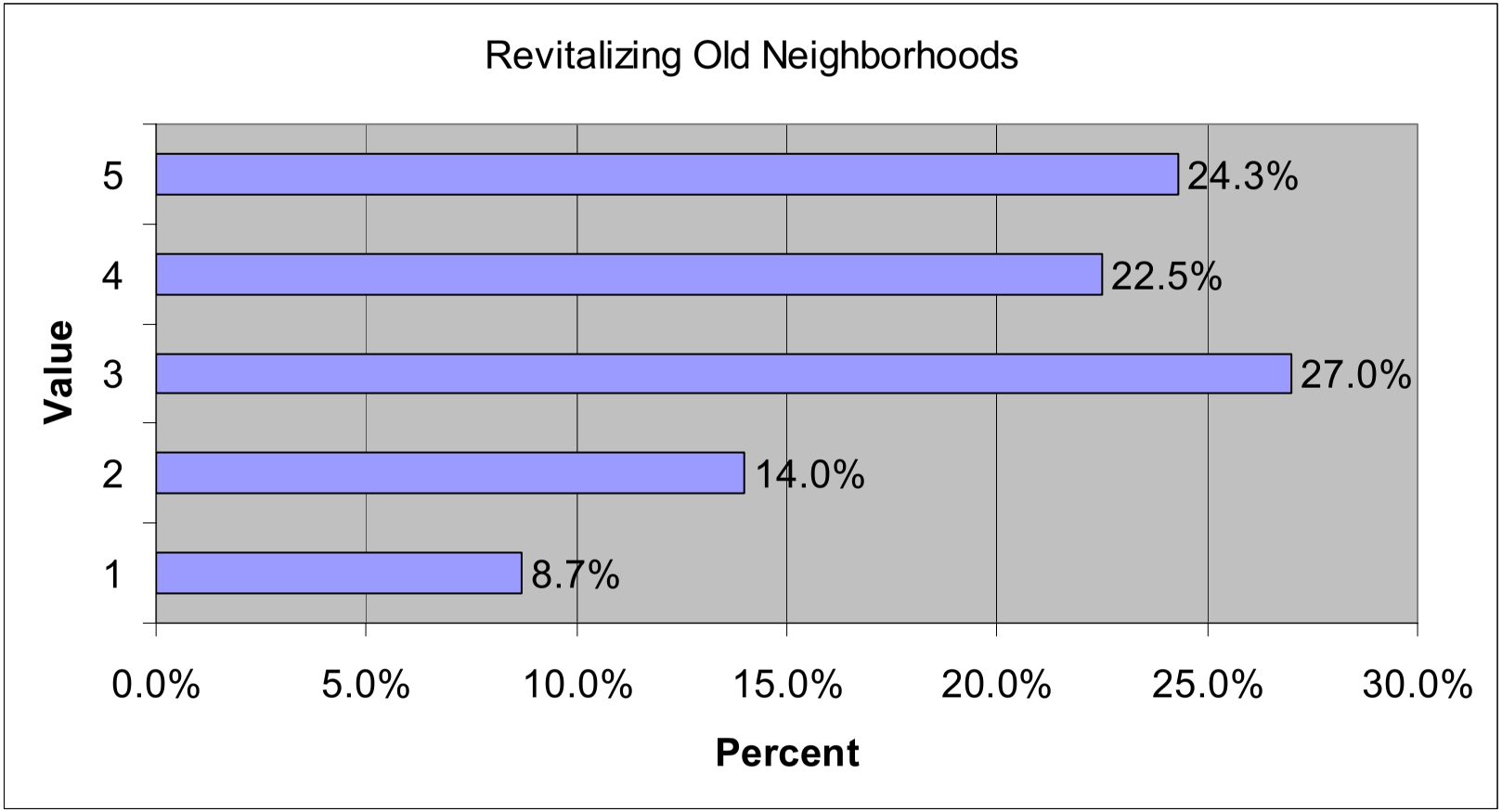
Appendix 1
Importance for Selected Services
Ranking 1-5 (1 being low 5 Being high)

Importance Variable	N	Mean	Median	Std. Error of Mean	Min	Max	Std. Deviation	Kurtosis	Std Error of Kurtosis	Skewness	Std Error of Skewness
**Public Safety (continued)*											
Facilitate neighborhood watch programs	591	3.69	4	0.048	1	5	1.164	-0.392	0.201	-0.609	0.100
Preparing for natural disasters	597	3.75	4	0.053	1	5	1.301	-0.478	0.200	-0.781	0.100
Preparing for man-made accidents or terrorist events	597	3.92	4	0.052	1	5	1.282	-0.193	0.200	-0.597	0.100
Investigating criminal activity	592	4.03	4	0.045	1	5	1.104	0.039	0.200	-0.959	0.100
Providing fire protection and prevention services	600	4.32	5	0.037	1	5	0.900	0.581	0.199	-1.195	0.100
Providing emergency medical services	606	4.44	5	0.035	1	5	0.856	2.184	0.198	-1.606	0.099
Providing for neighborhood code enforcement services	571	3.54	4	0.049	1	5	1.182	-0.778	0.204	-0.324	0.102
Examining potential impacts from Yucca Mountain nuclear waste shipments	581	3.68	4	0.059	1	5	1.421	-0.859	0.202	-0.690	0.101
**Community Development*											
Providing affordable housing	601	3.47	3	0.047	1	5	1.365	-1.078	0.211	-0.367	0.100
Managing growth	602	3.80	4	0.053	1	5	1.295	-0.494	0.209	-0.810	0.100
Increasing job opportunities	597	3.95	4	0.048	1	5	1.179	-0.082	0.200	-0.921	0.100
Improving the business climate	594	3.86	4	0.043	1	5	1.057	-0.480	0.200	-0.557	0.100
Planning for commercial development	590	3.70	4	0.046	1	5	1.113	-0.217	0.201	-0.608	0.101
Evaluating impacts to property values as a result of the proposed shipment of nuclear waste to Yucca Mountain	571	3.54	4	0.060	1	5	1.441	-1.120	0.204	-0.487	0.102
Evaluating impacts to Southern Nevada's tourism economy as a result of proposed shipment of nuclear waste to Yucca Mountain	576	3.50	4	0.061	1	5	1.453	-1.159	0.203	-0.467	0.102
Reducing traffic congestion	605	4.02	5	0.051	1	5	1.261	-0.016	0.198	-1.091	0.099
Access to freeways	603	3.83	4	0.047	1	5	1.153	-0.482	0.199	-0.661	0.100
Improving road conditions	607	3.97	4	0.044	1	5	1.078	-0.101	0.198	-0.802	0.990
Reducing travel time	600	3.77	4	0.048	1	5	1.185	-0.464	0.199	-0.647	0.100
Providing mass public transit	599	3.67	4	0.052	1	5	1.272	-0.623	0.199	-0.641	0.100

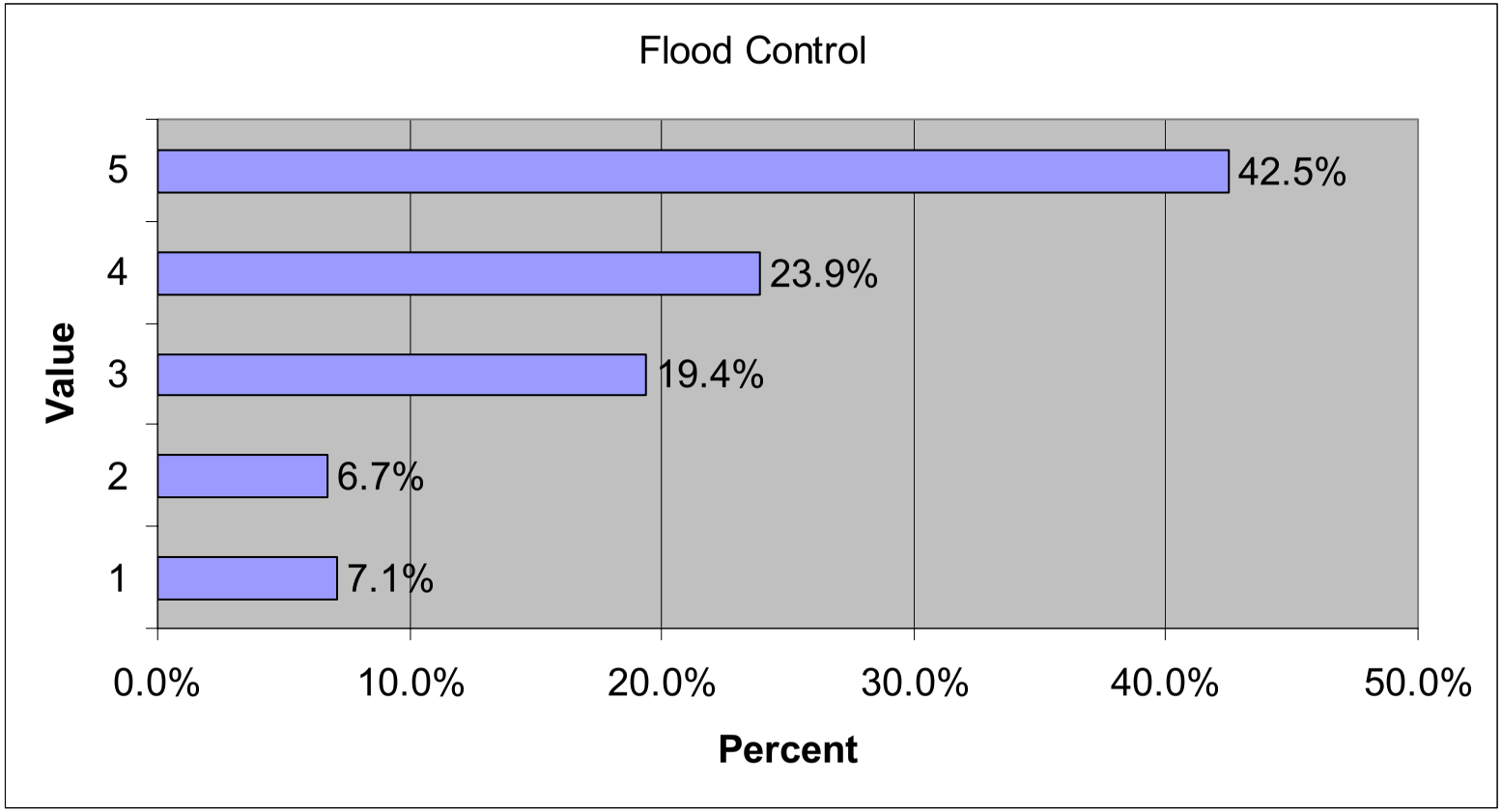
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Road Maintenance



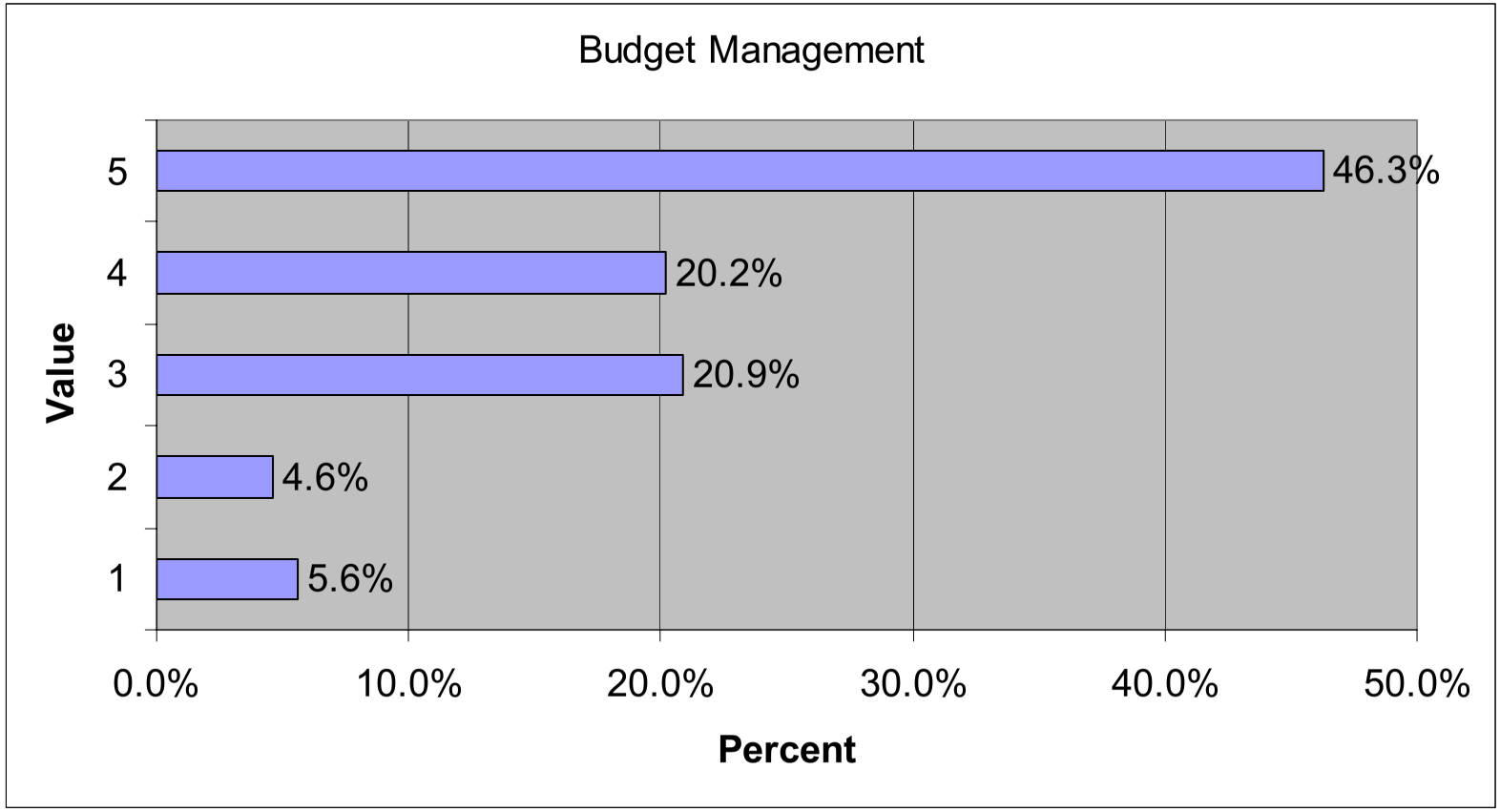
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Revitalizing Old Neighborhoods



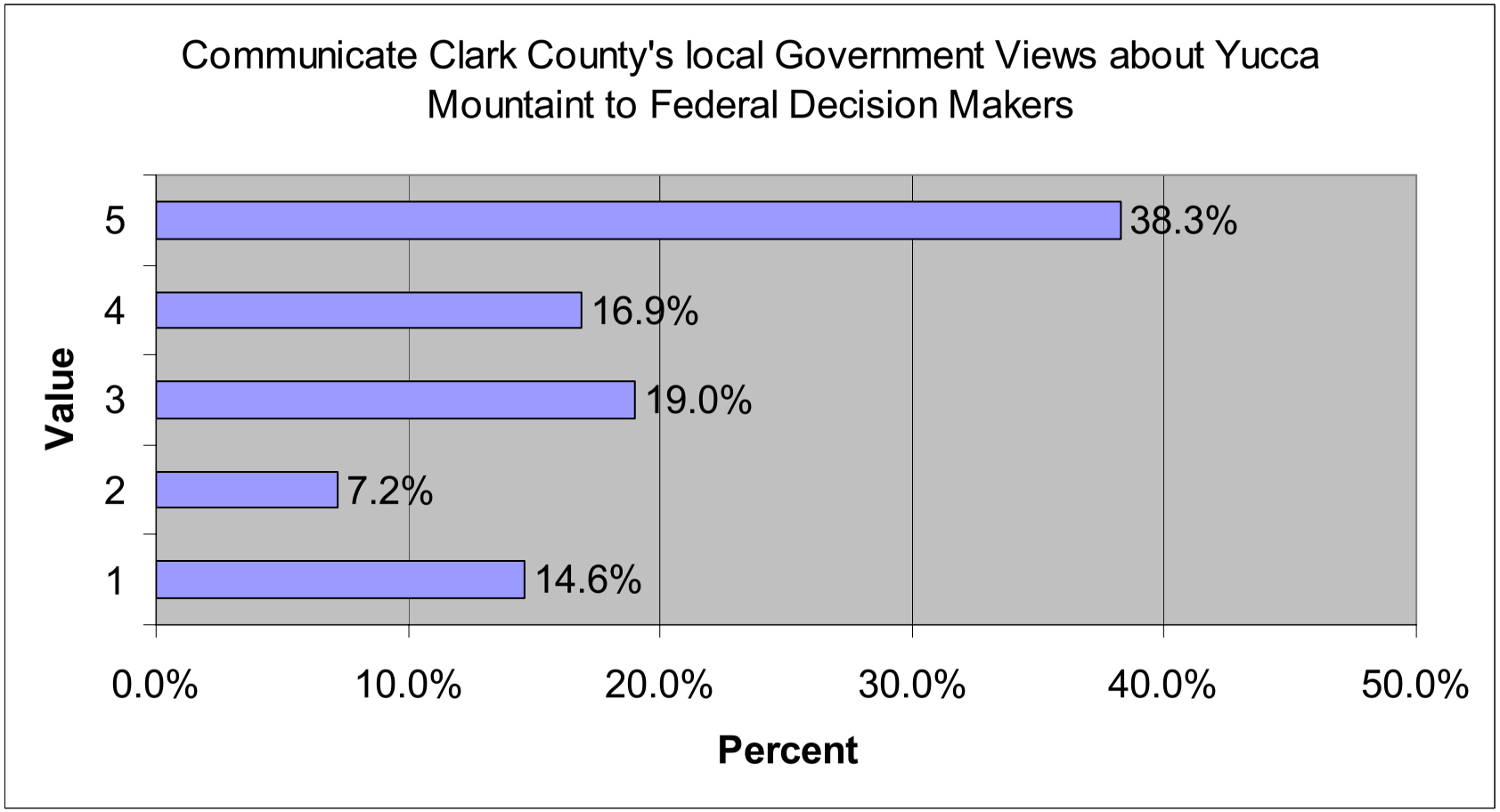
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Flood Control



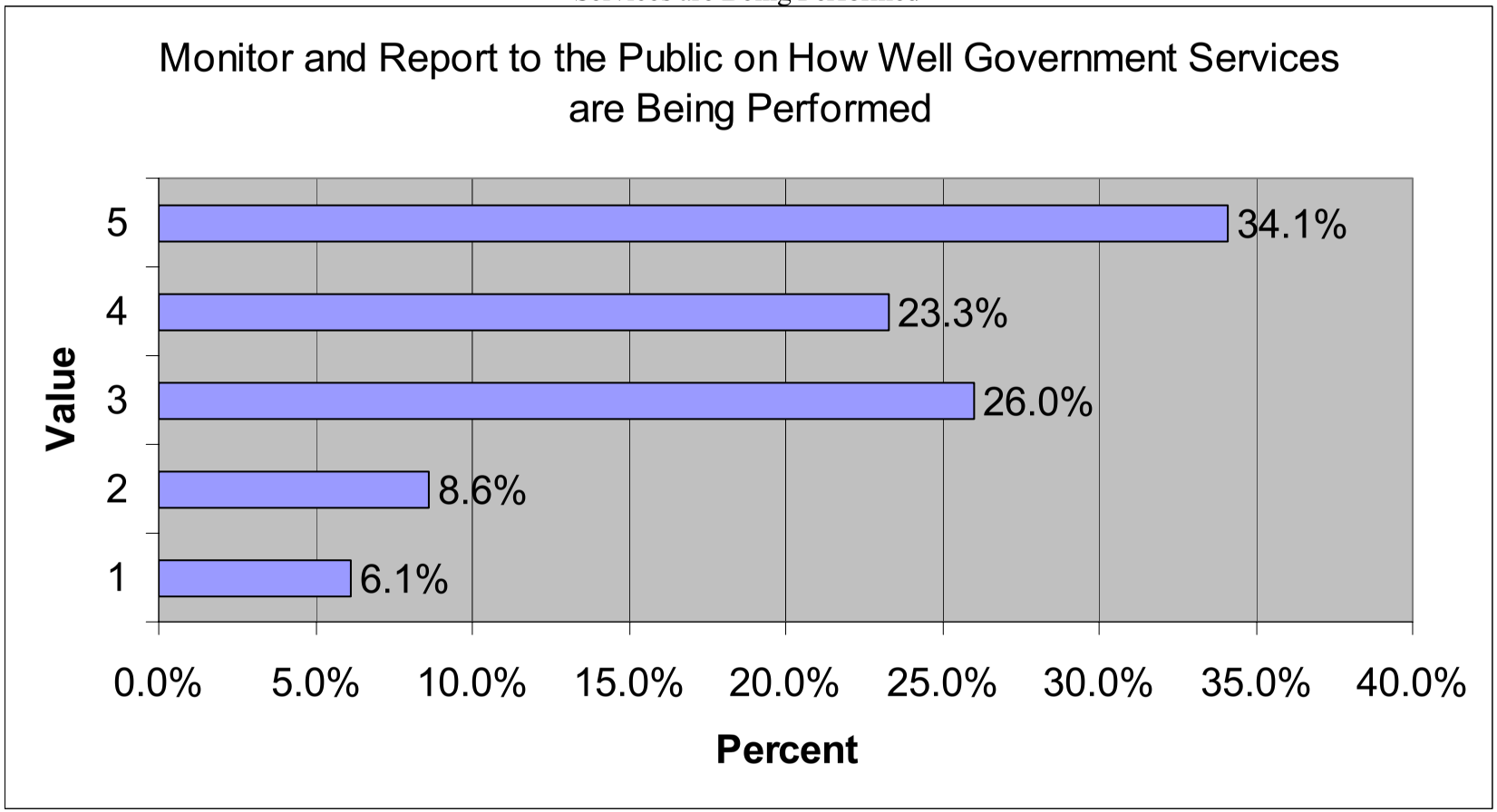
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Budget Management



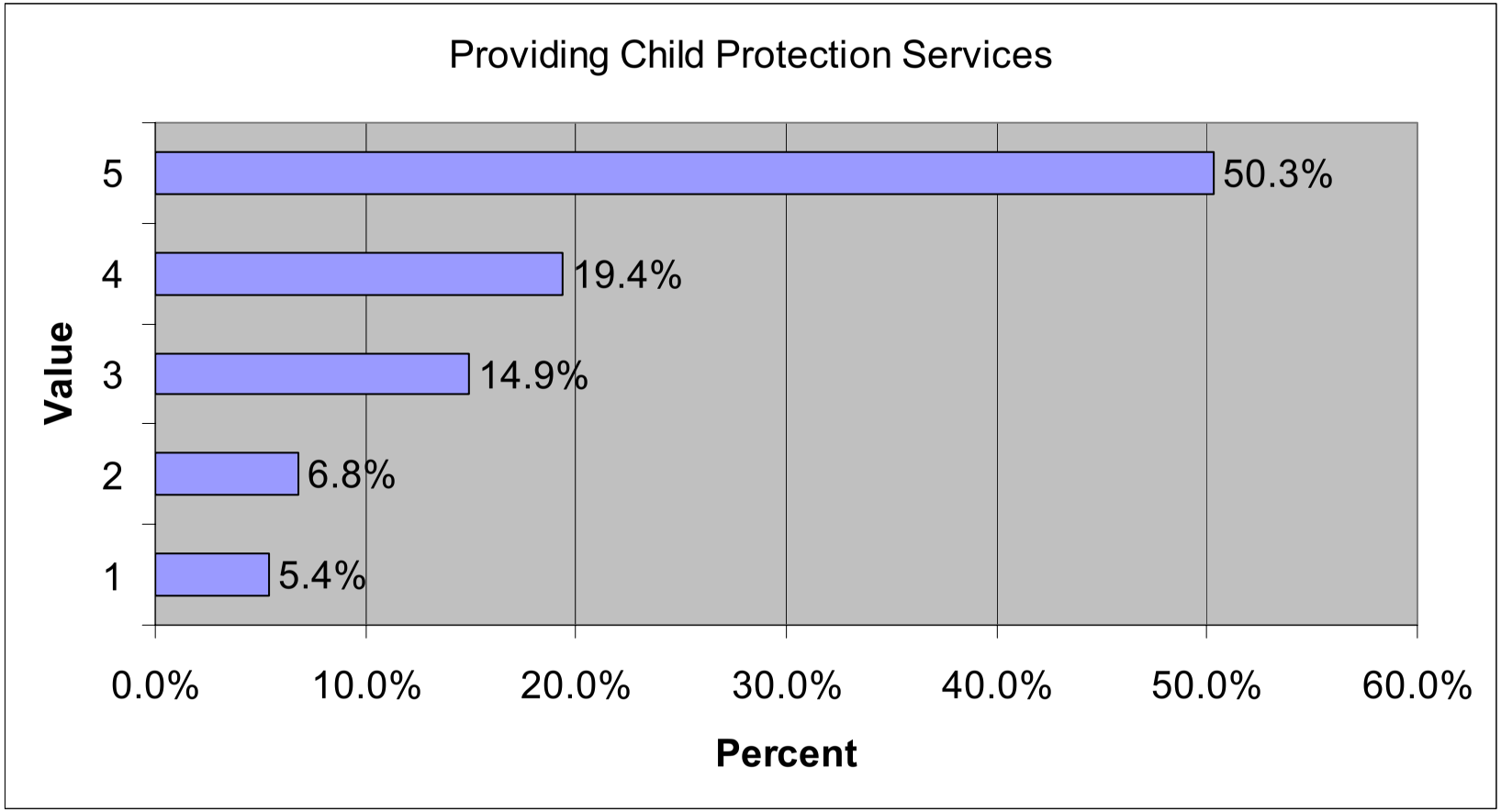
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Communicate Clark County’s Local Government Views about Yucca Mountain to Federal Decision Makers



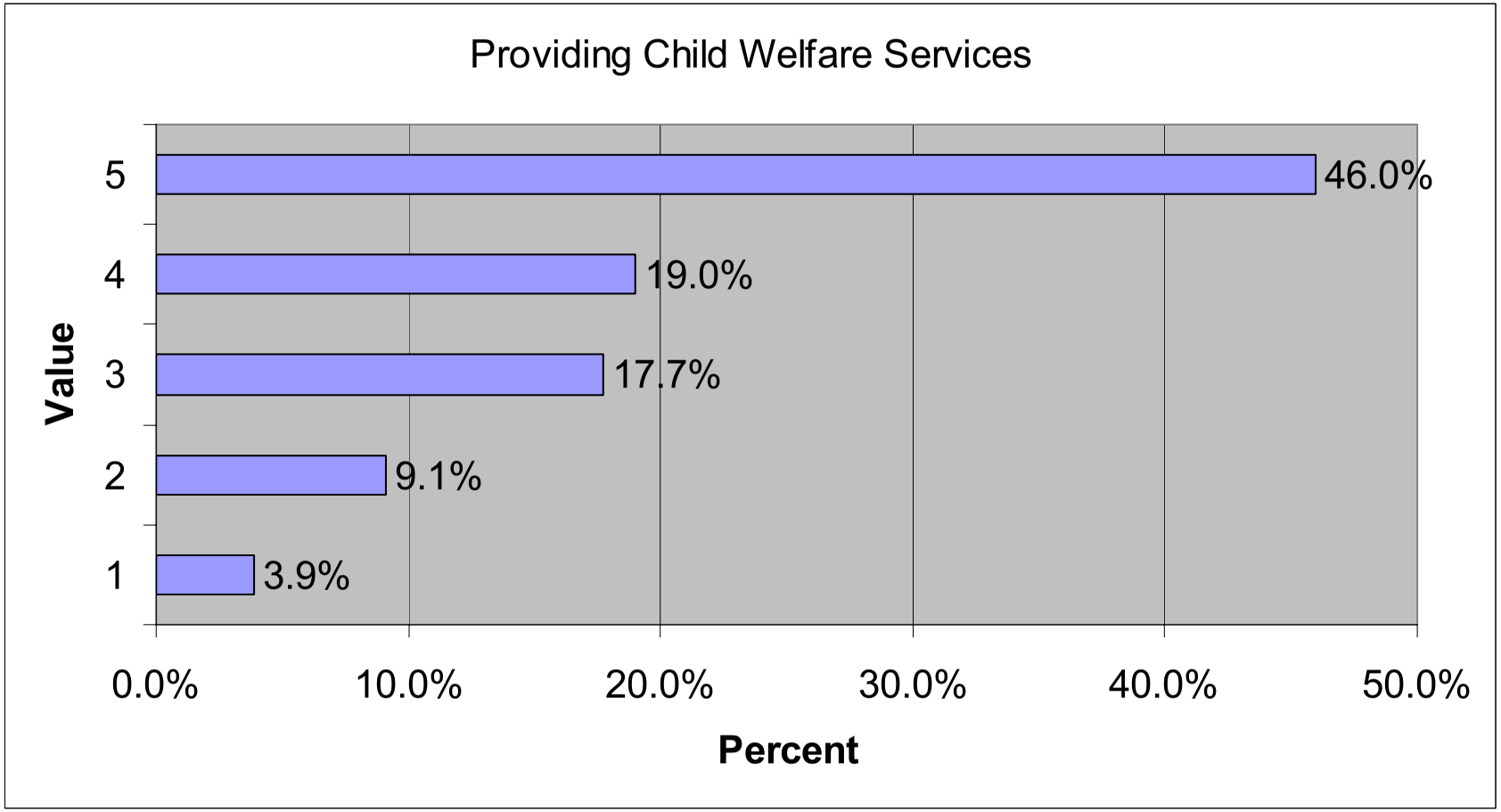
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Monitor and Report to the Public on How Well Government Services are Being Performed



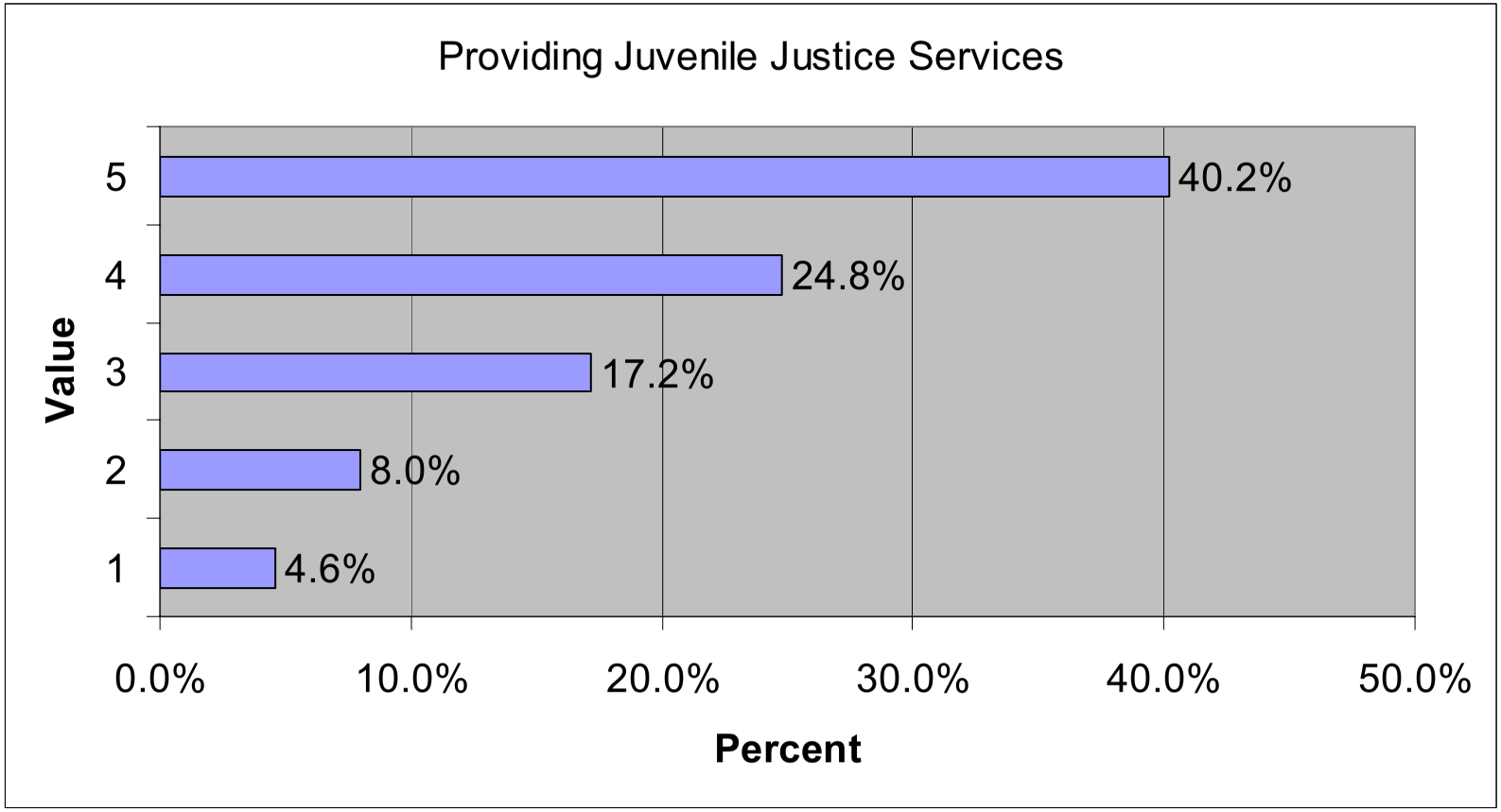
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Providing Child Protection Services



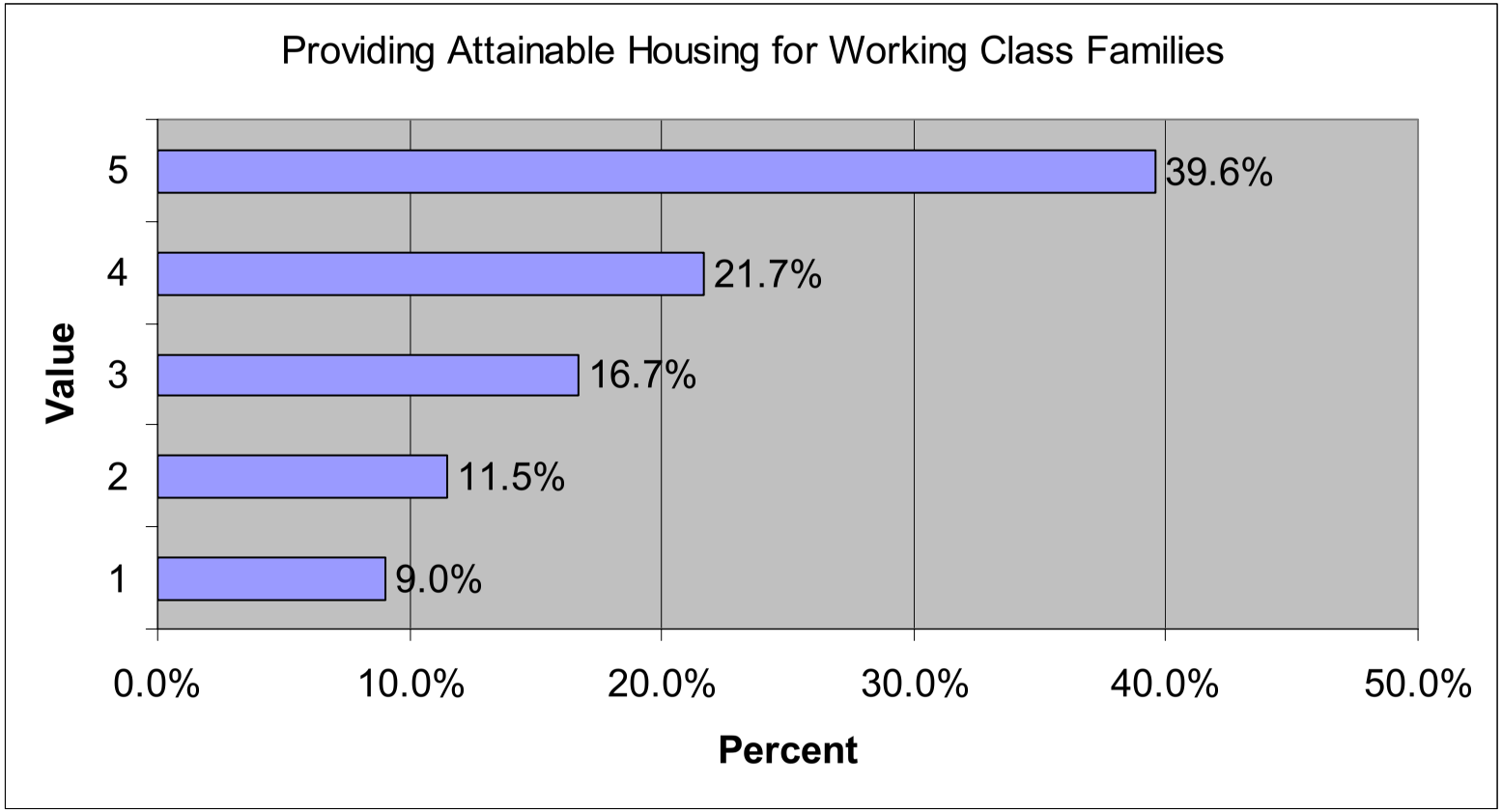
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Providing Child Welfare Services



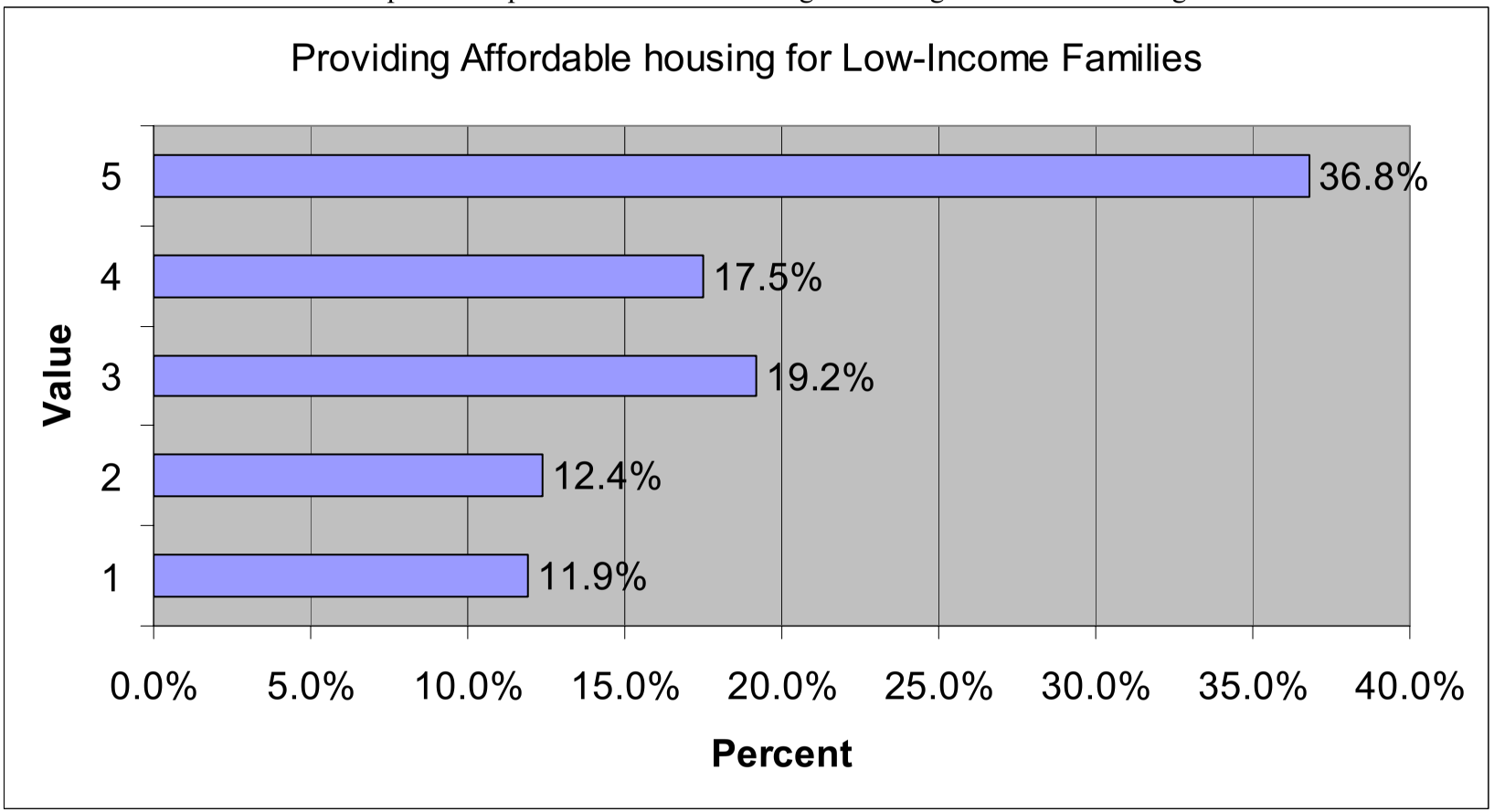
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Providing Juvenile Justice Services



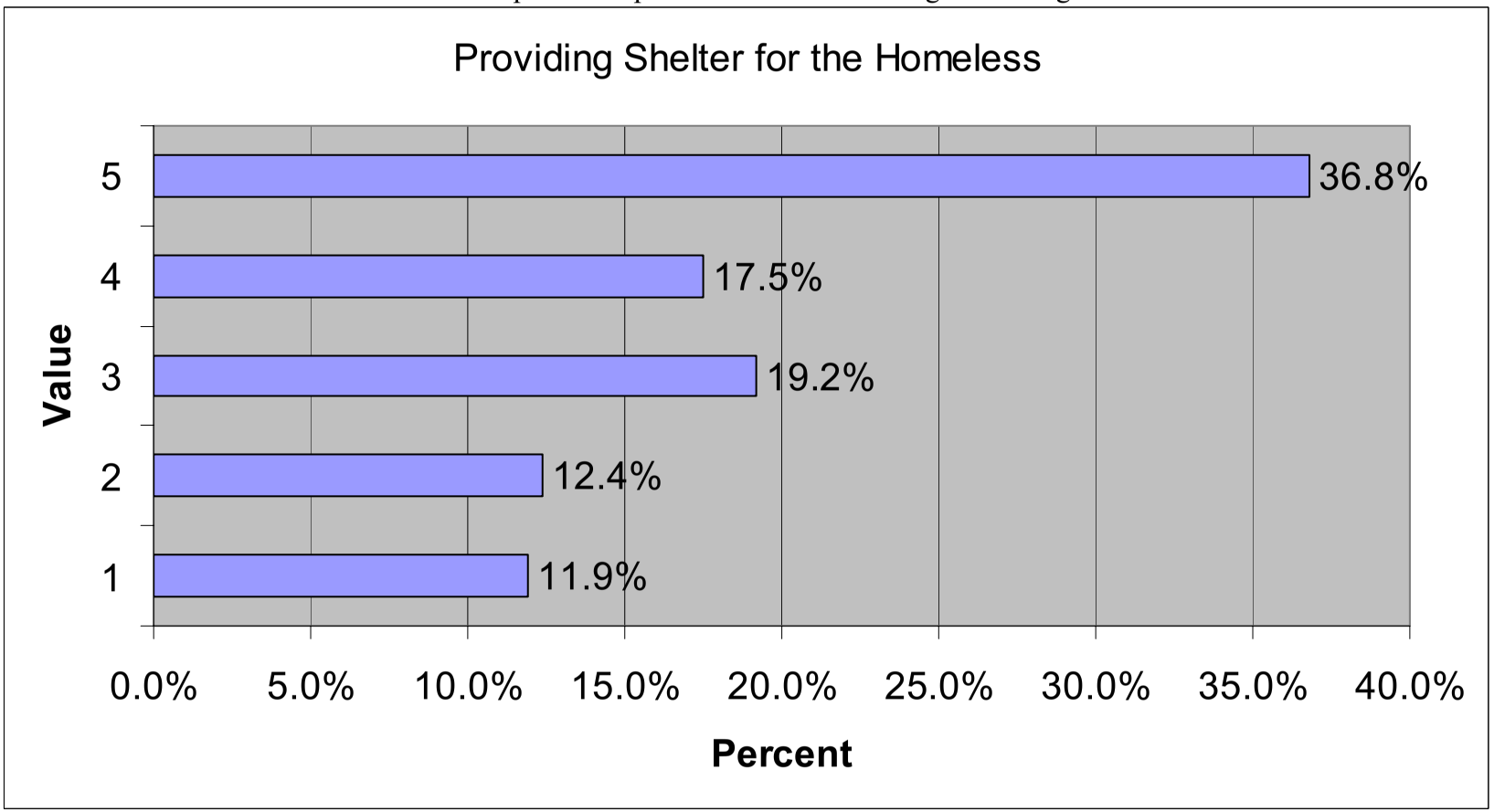
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Providing Attainable Housing for Working Class Families



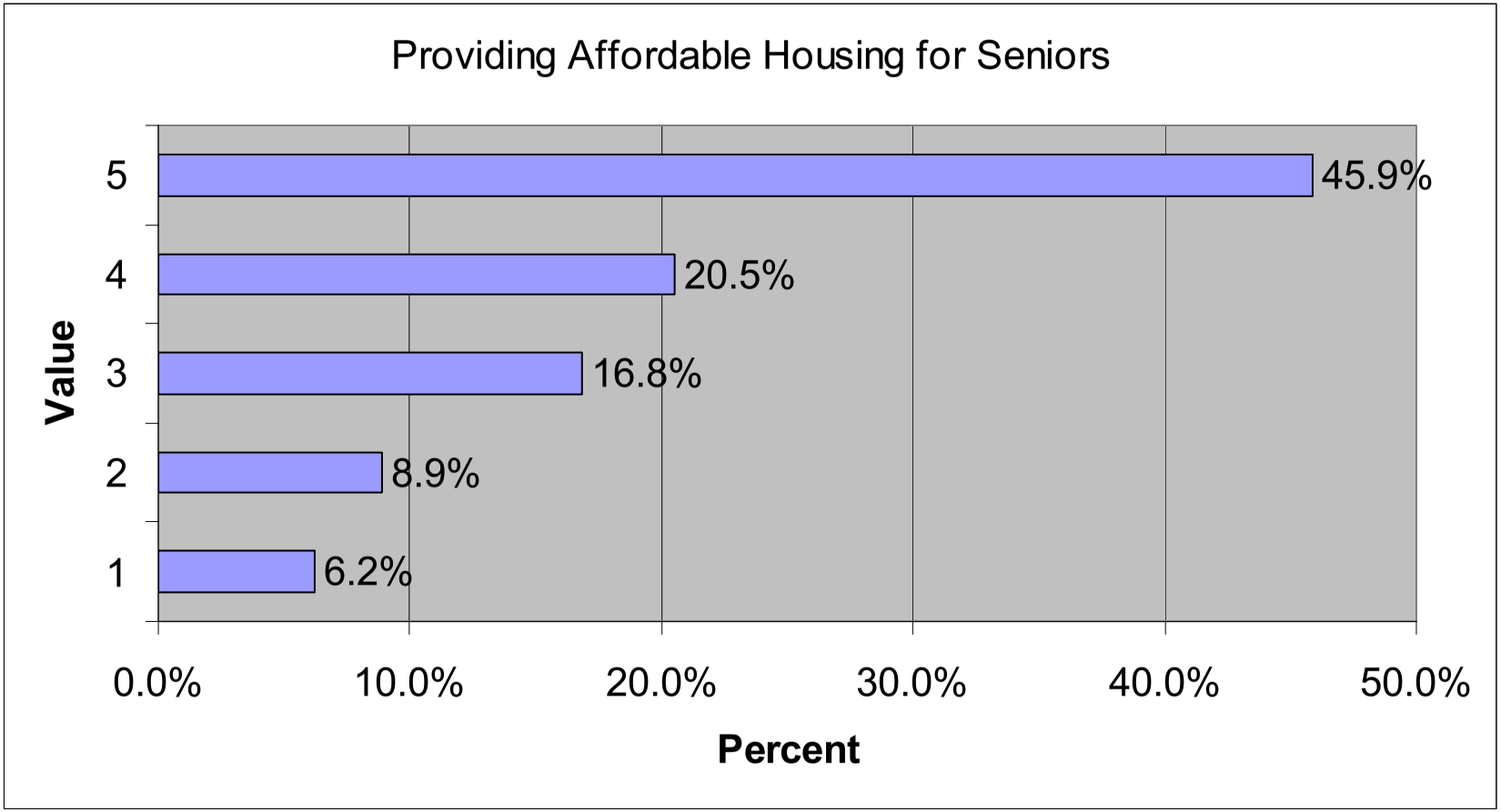
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Providing Affordable Housing for Low-Income Families



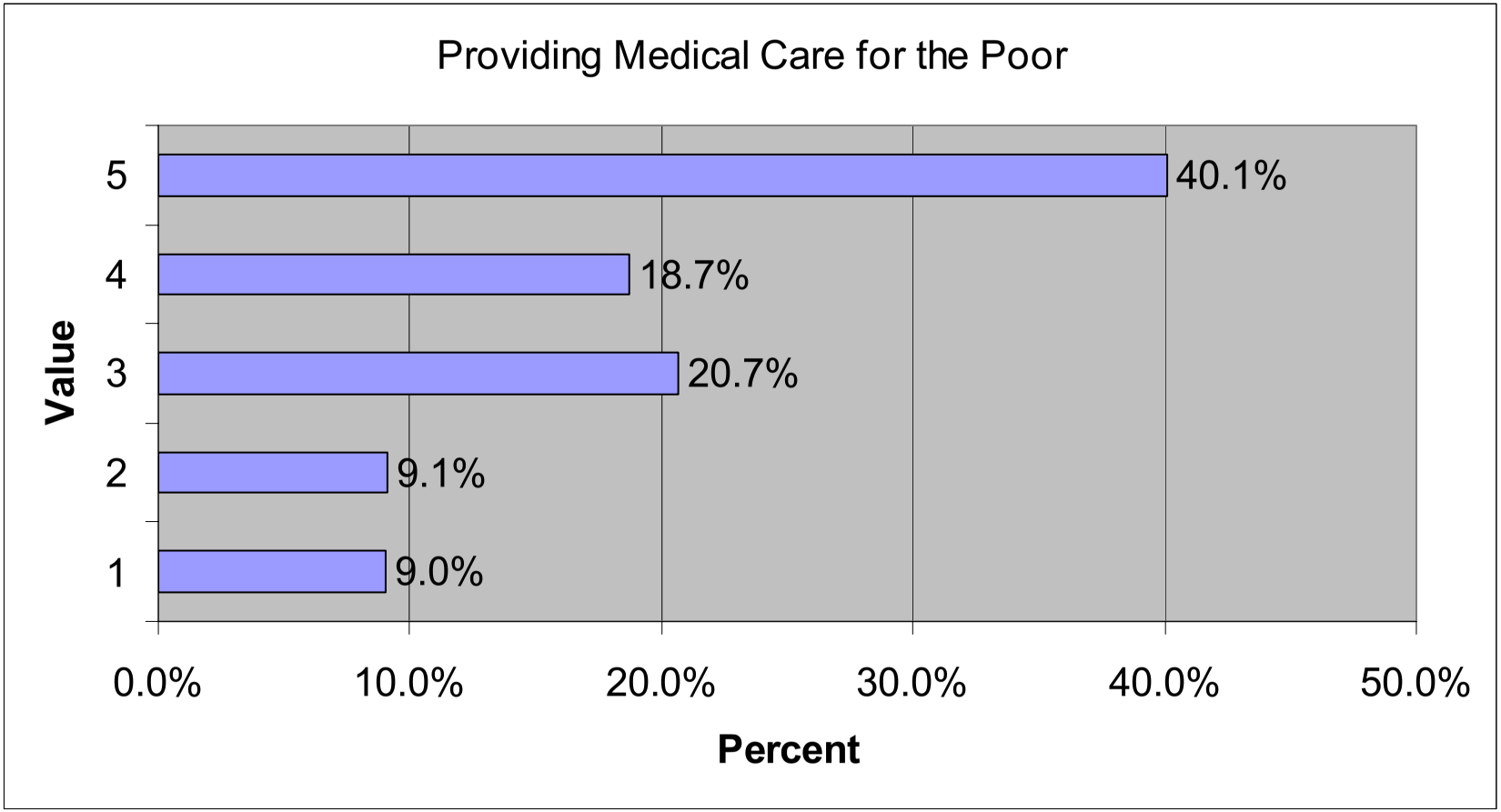
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Providing Shelter for the Homeless



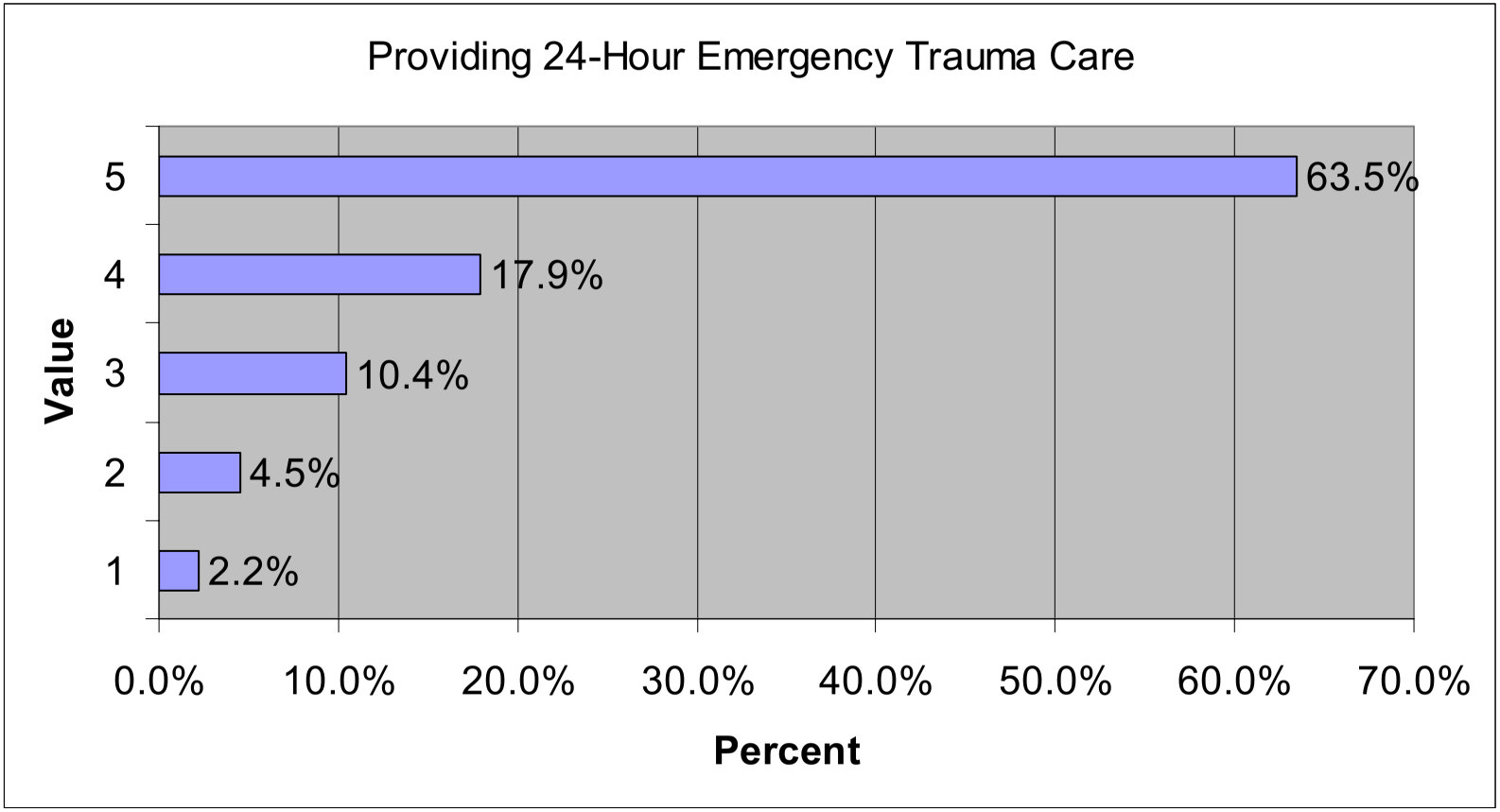
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Providing Affordable Housing for Seniors



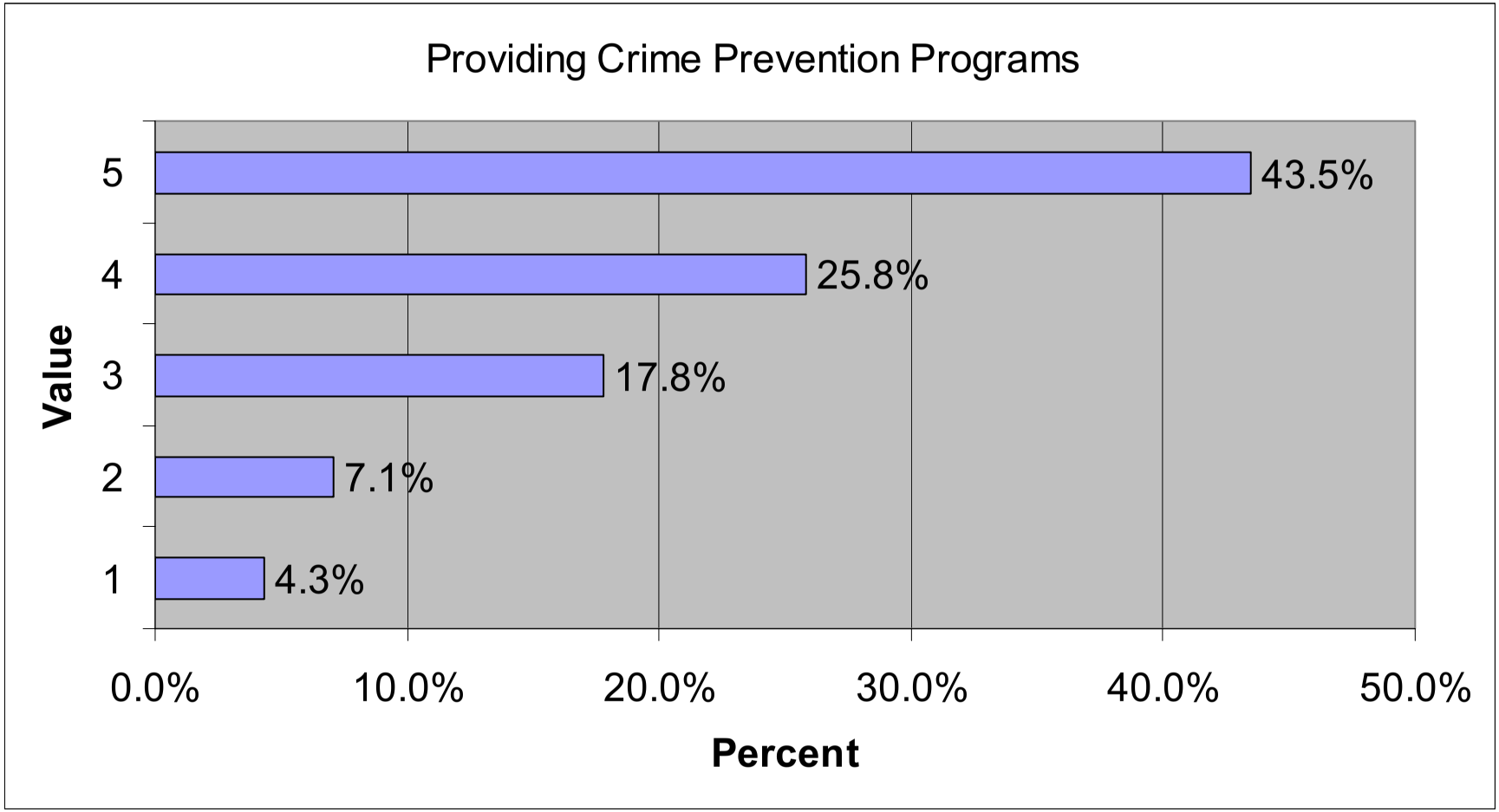
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Providing Medical Care for the Poor



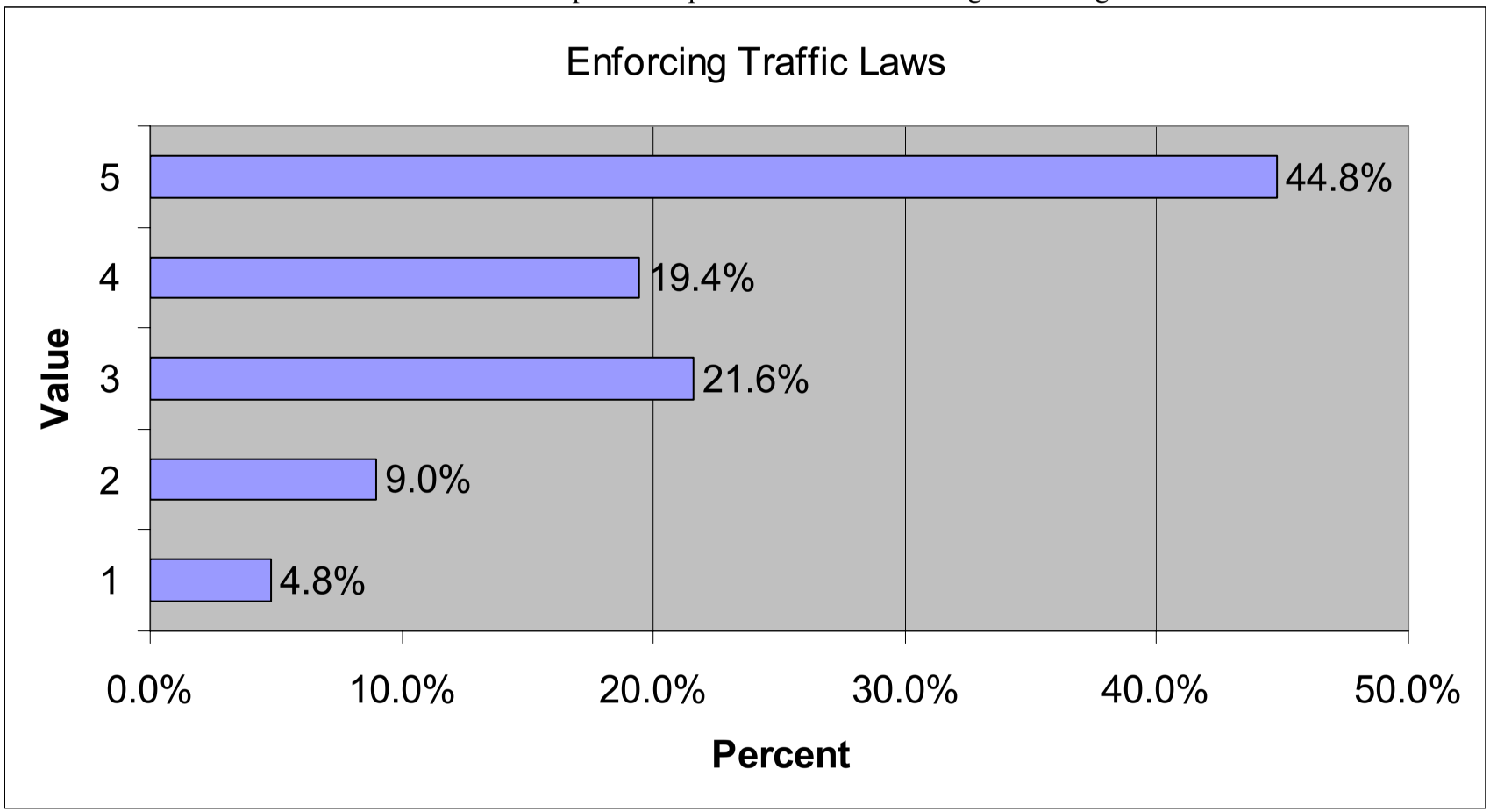
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Providing 24-Hour Emergency Trauma Care



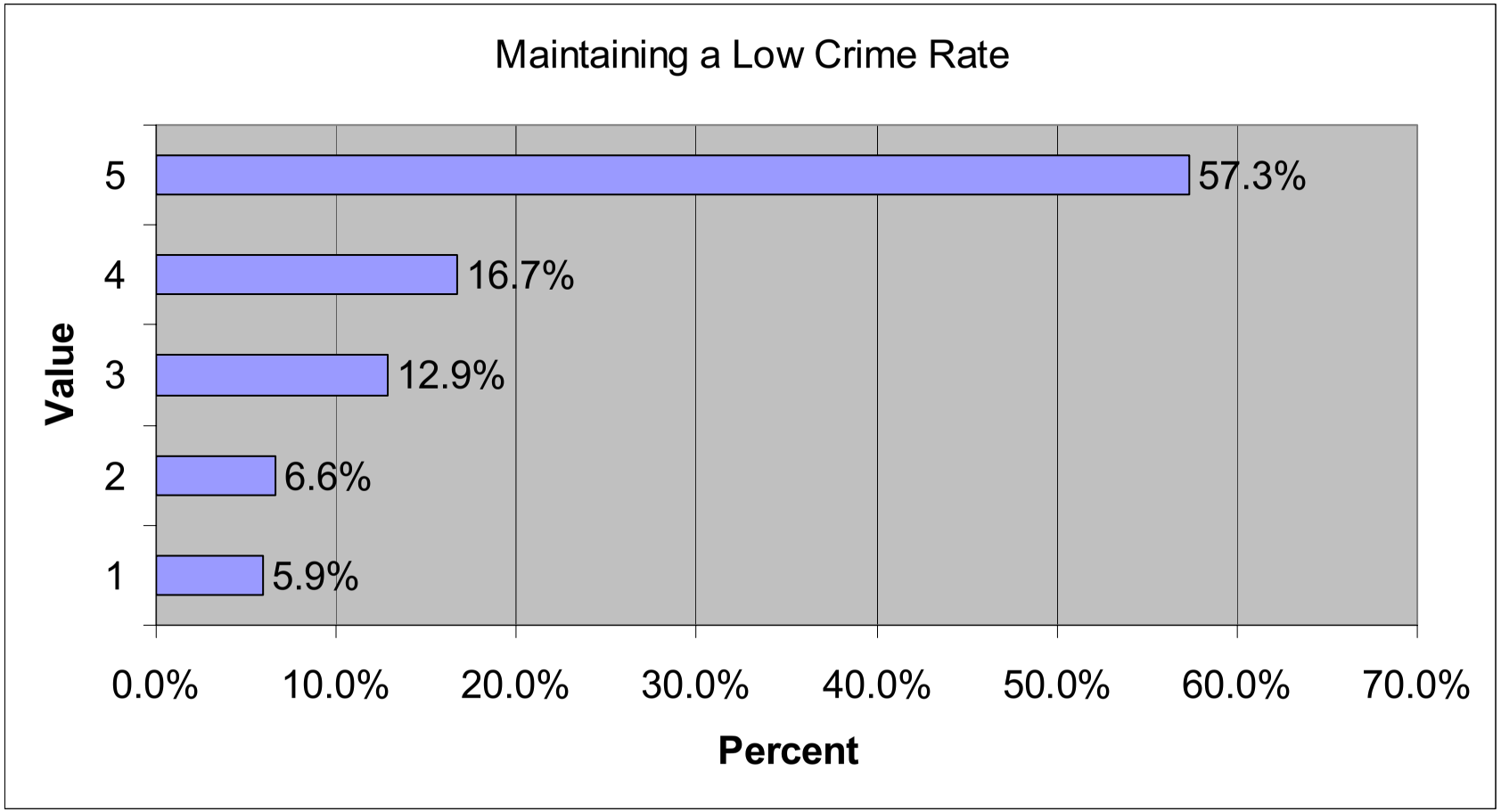
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Providing Crime Prevention Programs



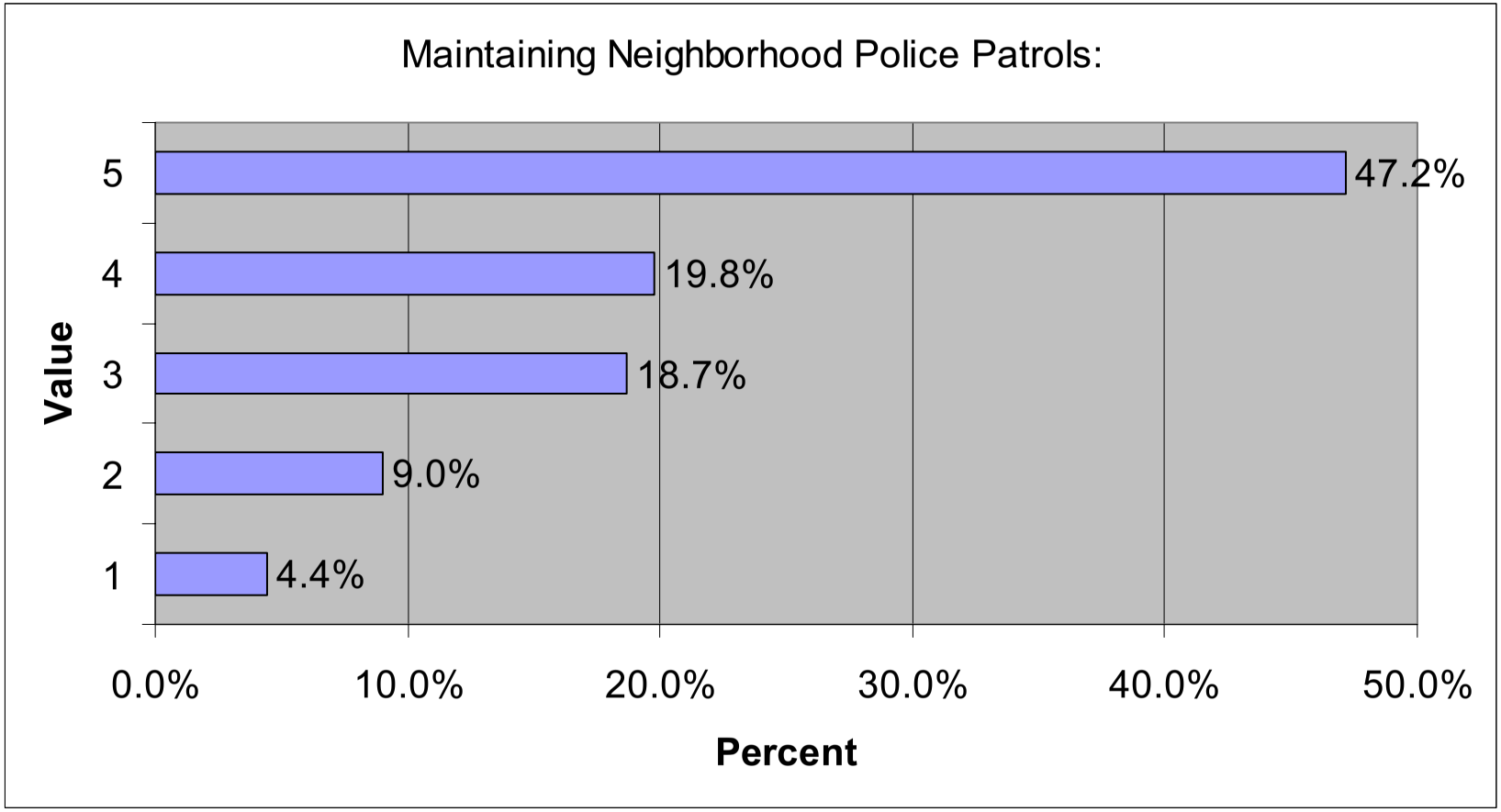
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Enforcing Traffic Laws



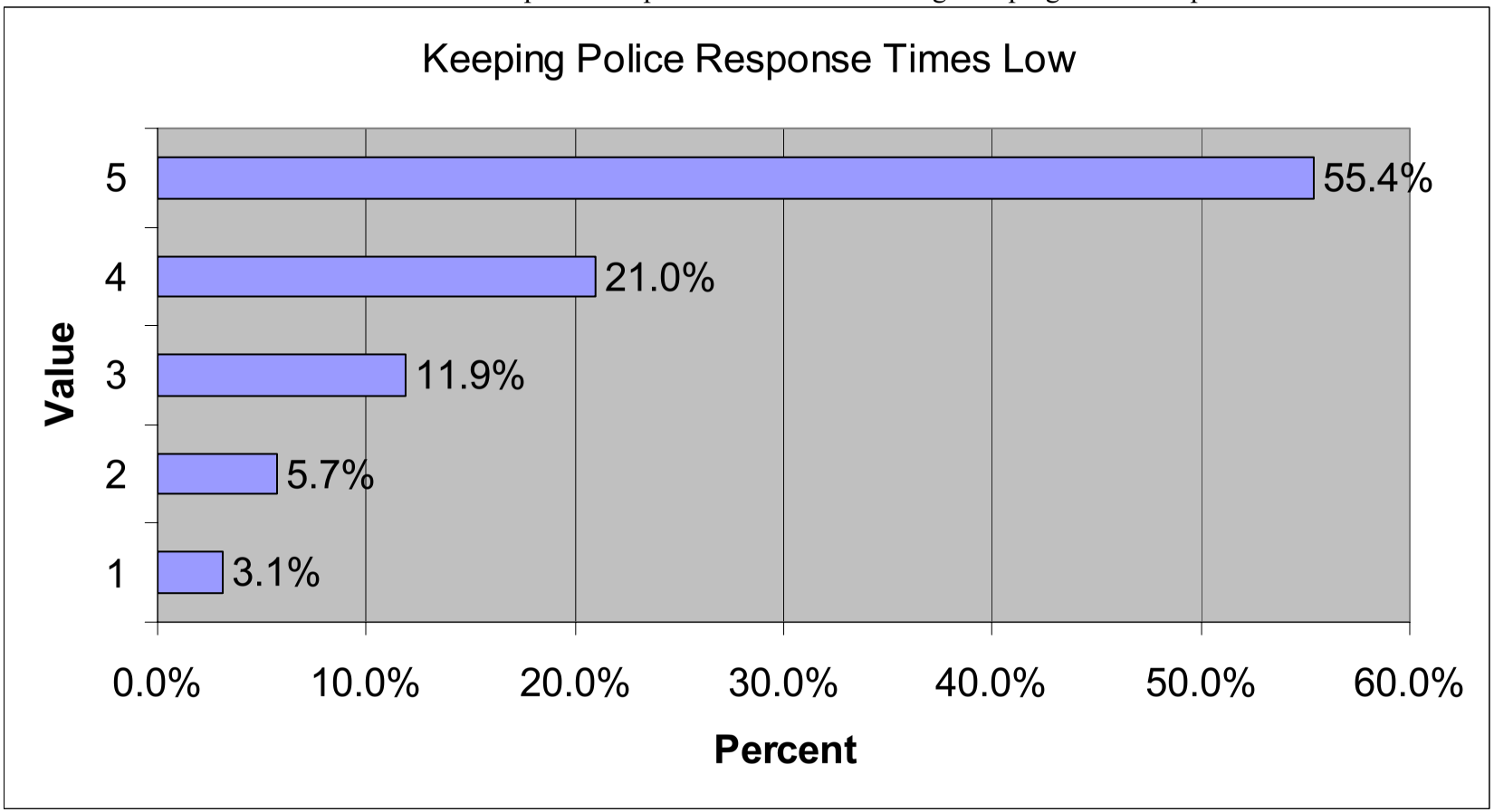
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Maintaining a Low Crime Rate



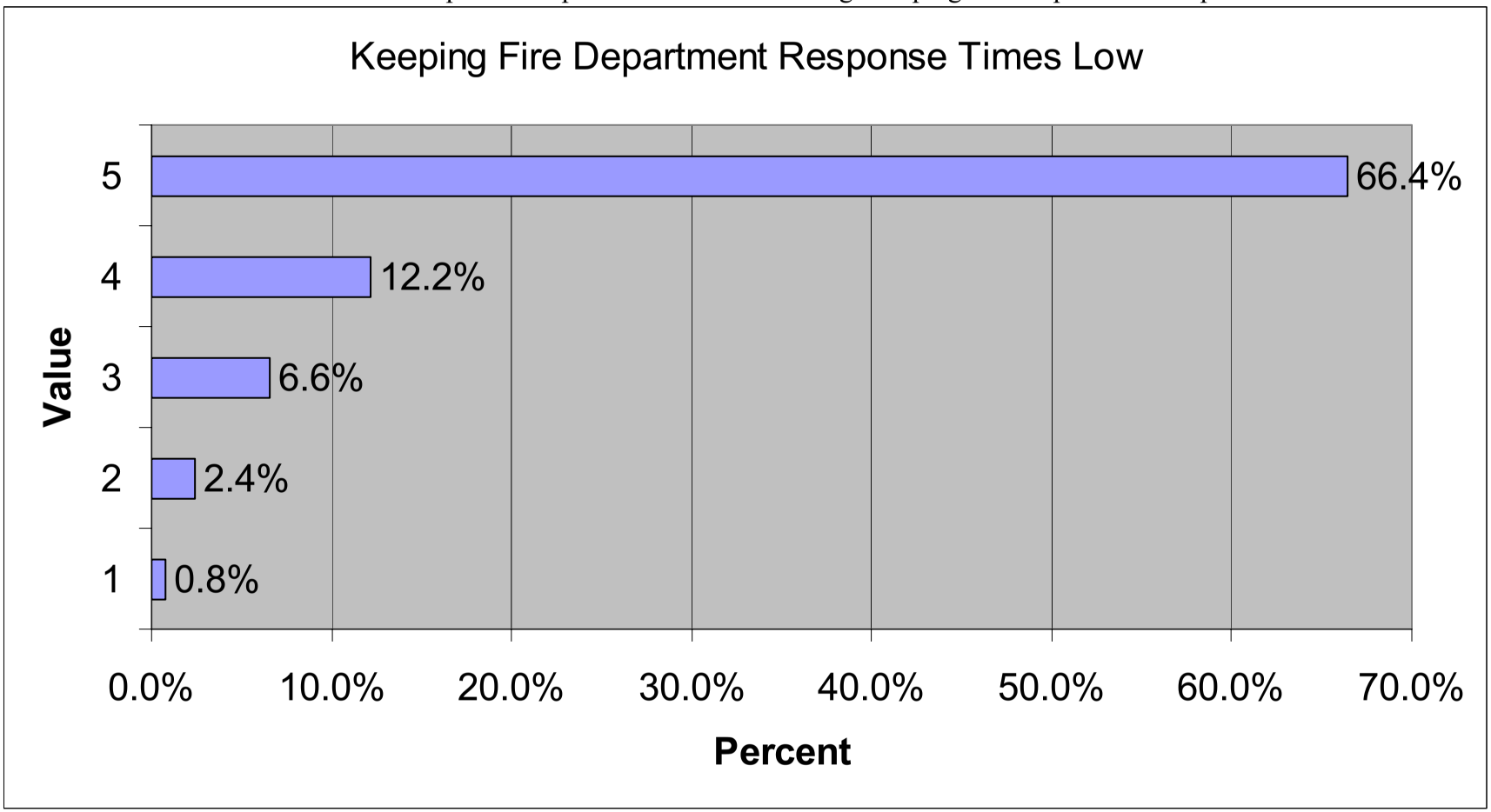
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Maintaining Neighborhood Police Patrols



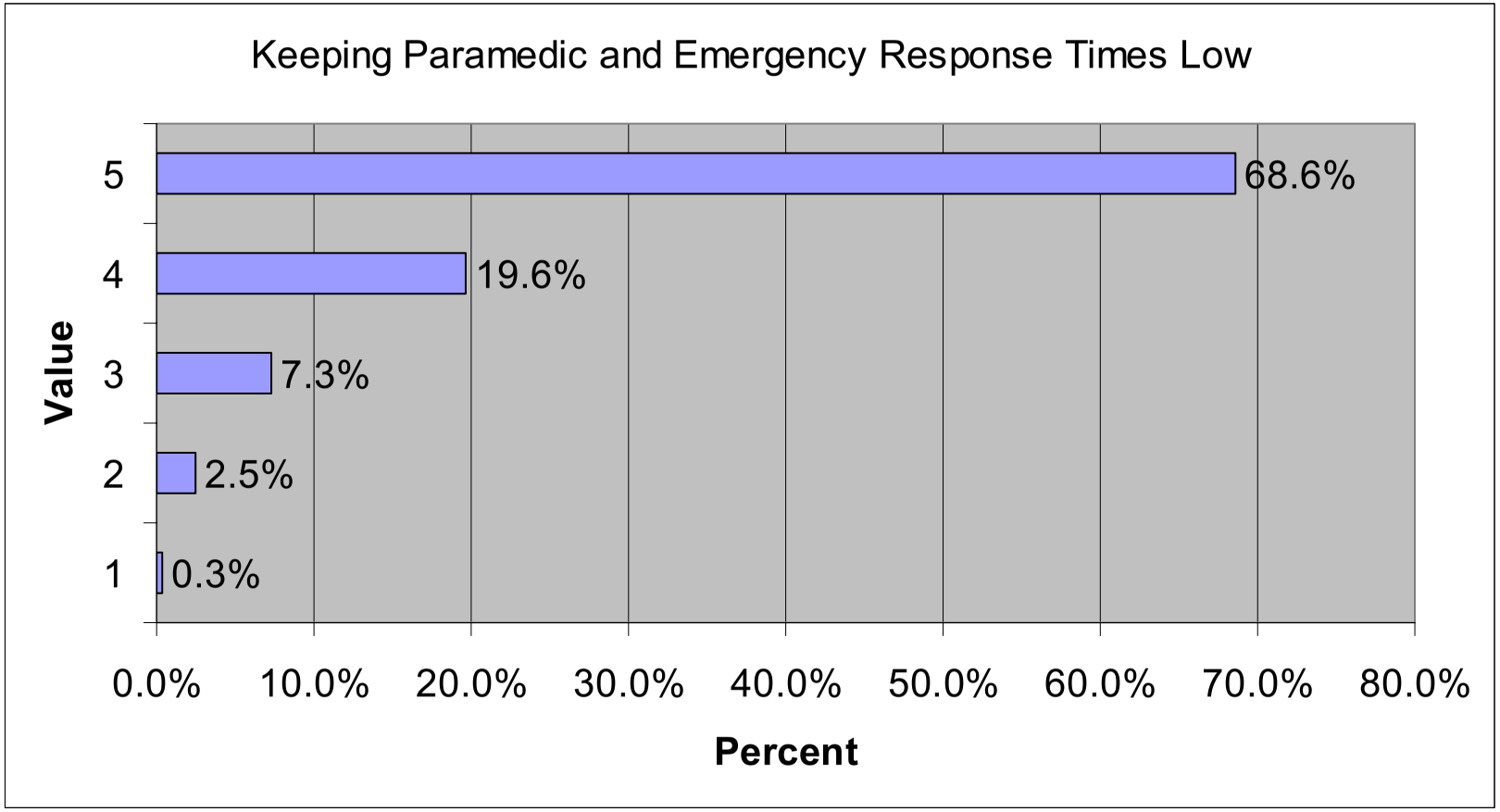
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Keeping Police Response Times Low



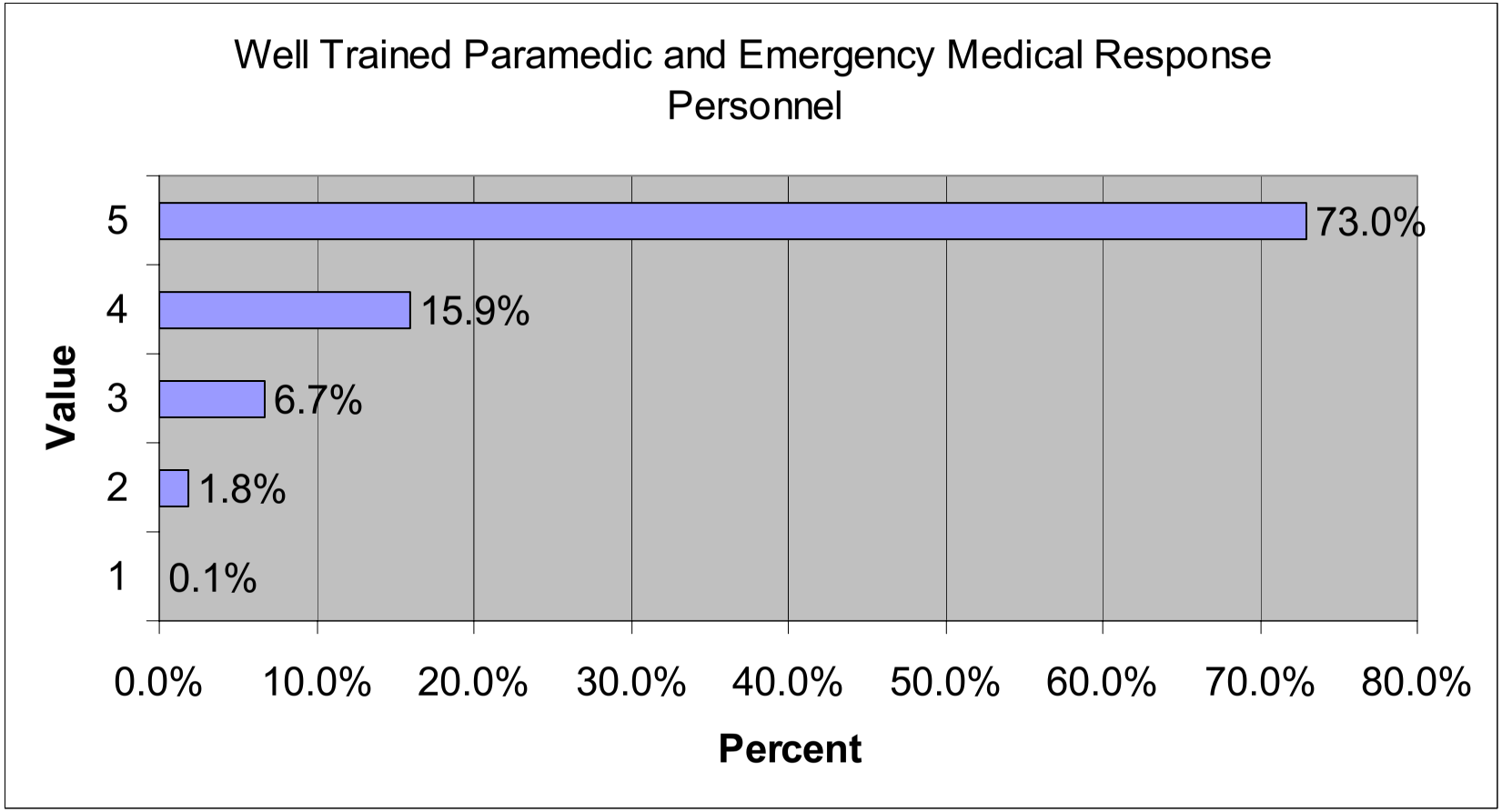
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Keeping Fire Department Response Times Low



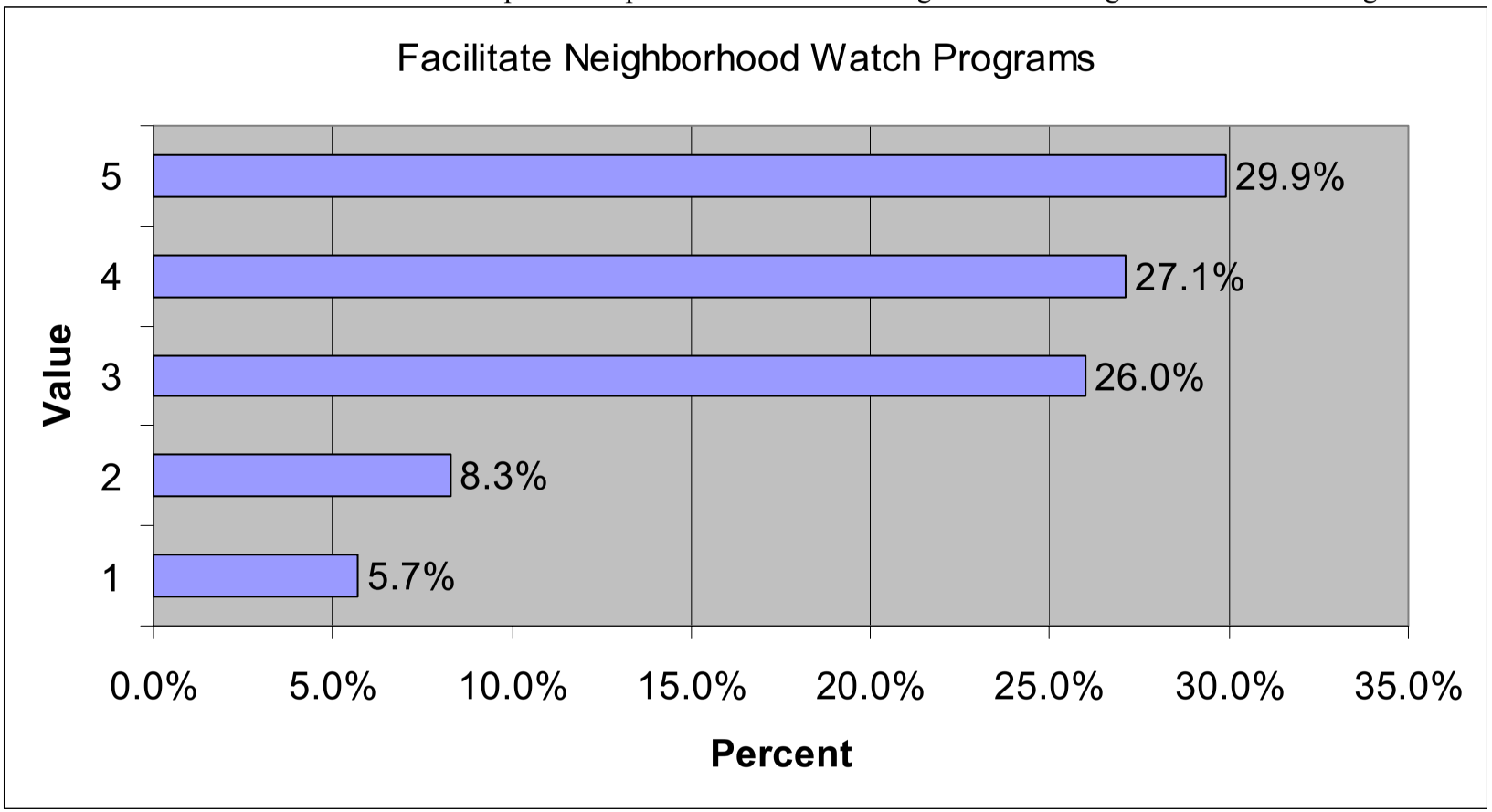
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Keeping Paramedic and Emergency Response Times Low



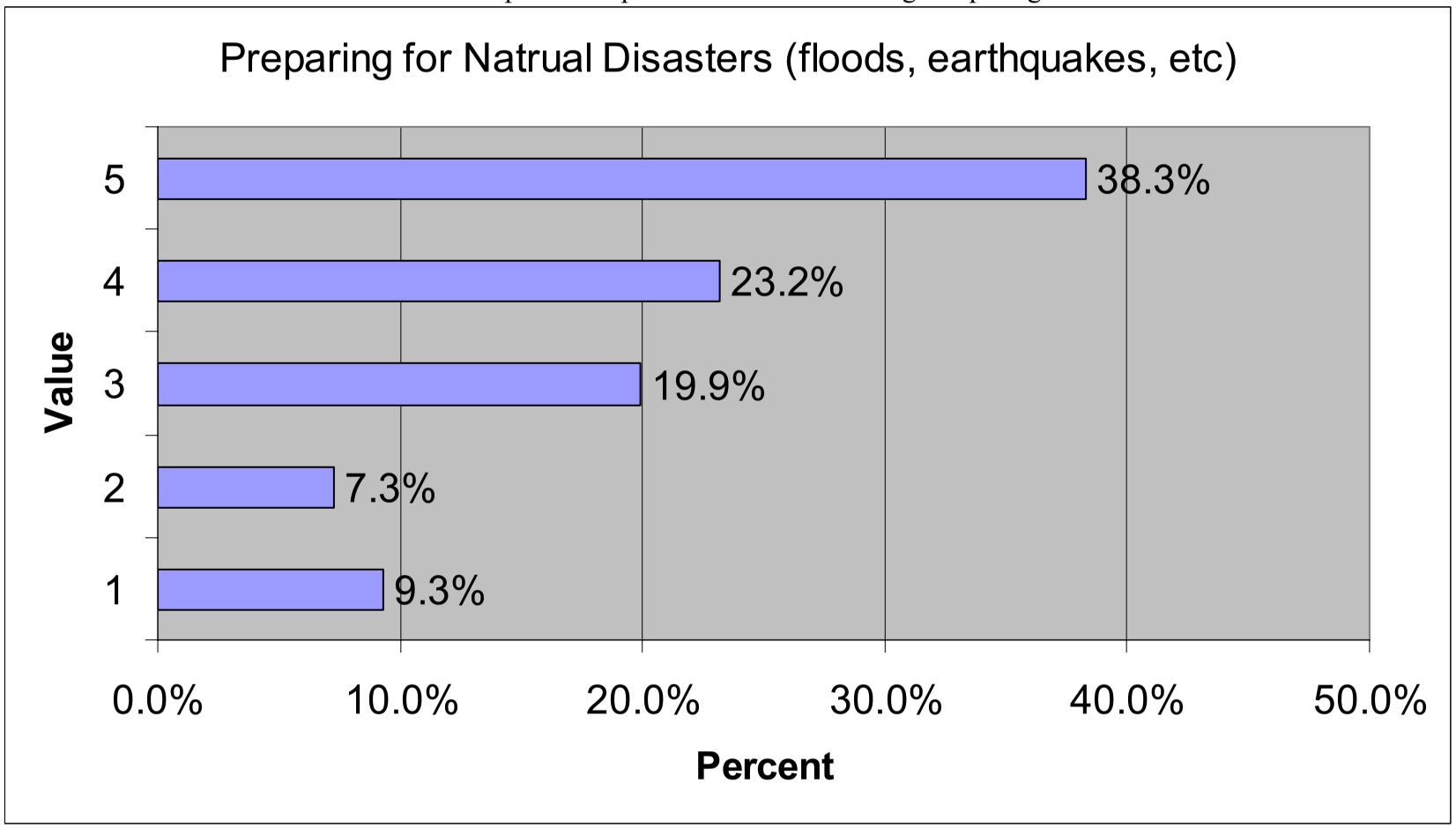
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Well Trained Paramedic and Emergency Medical Response Personnel:



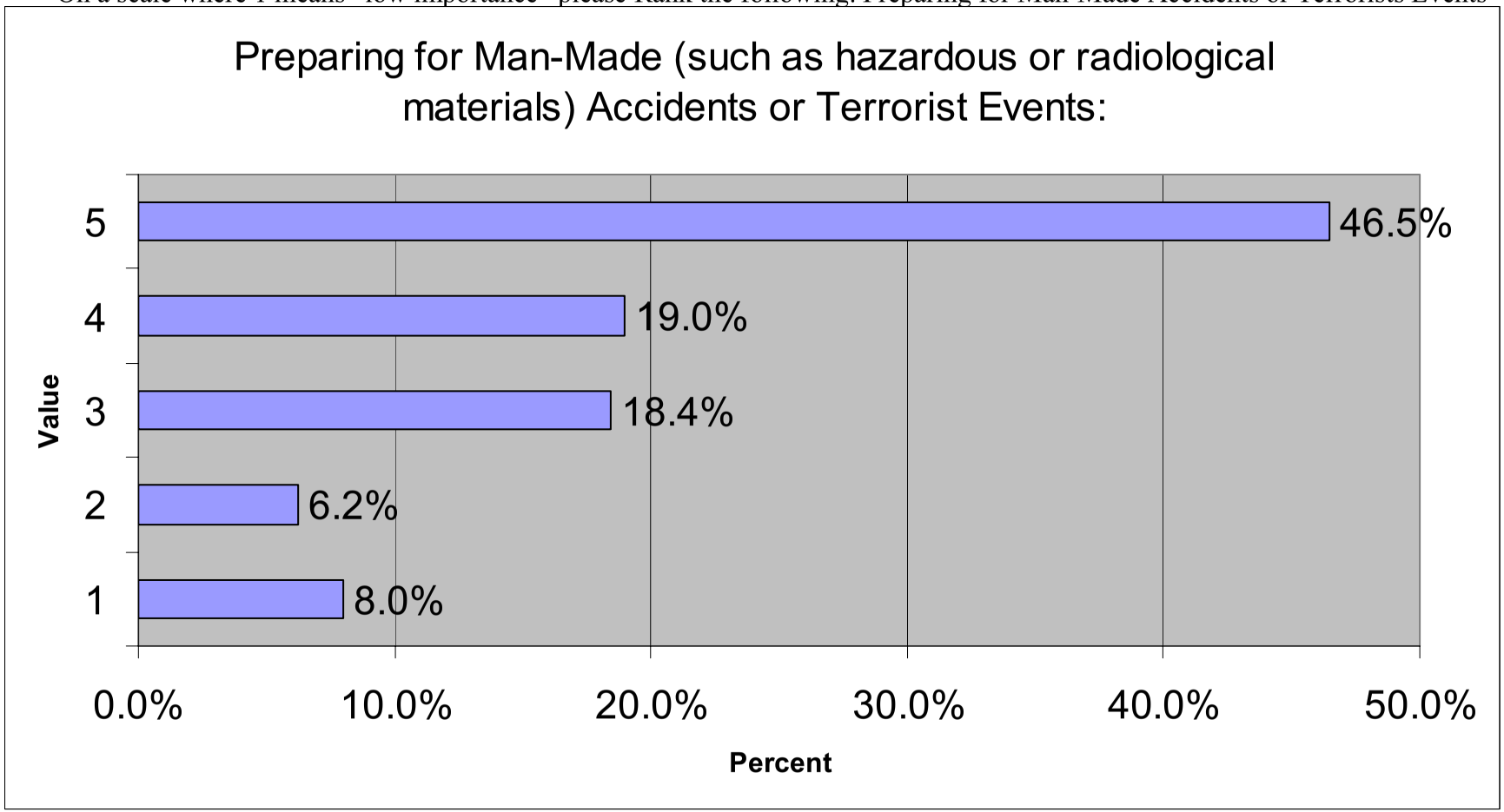
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Facilitate Neighborhood Watch Programs



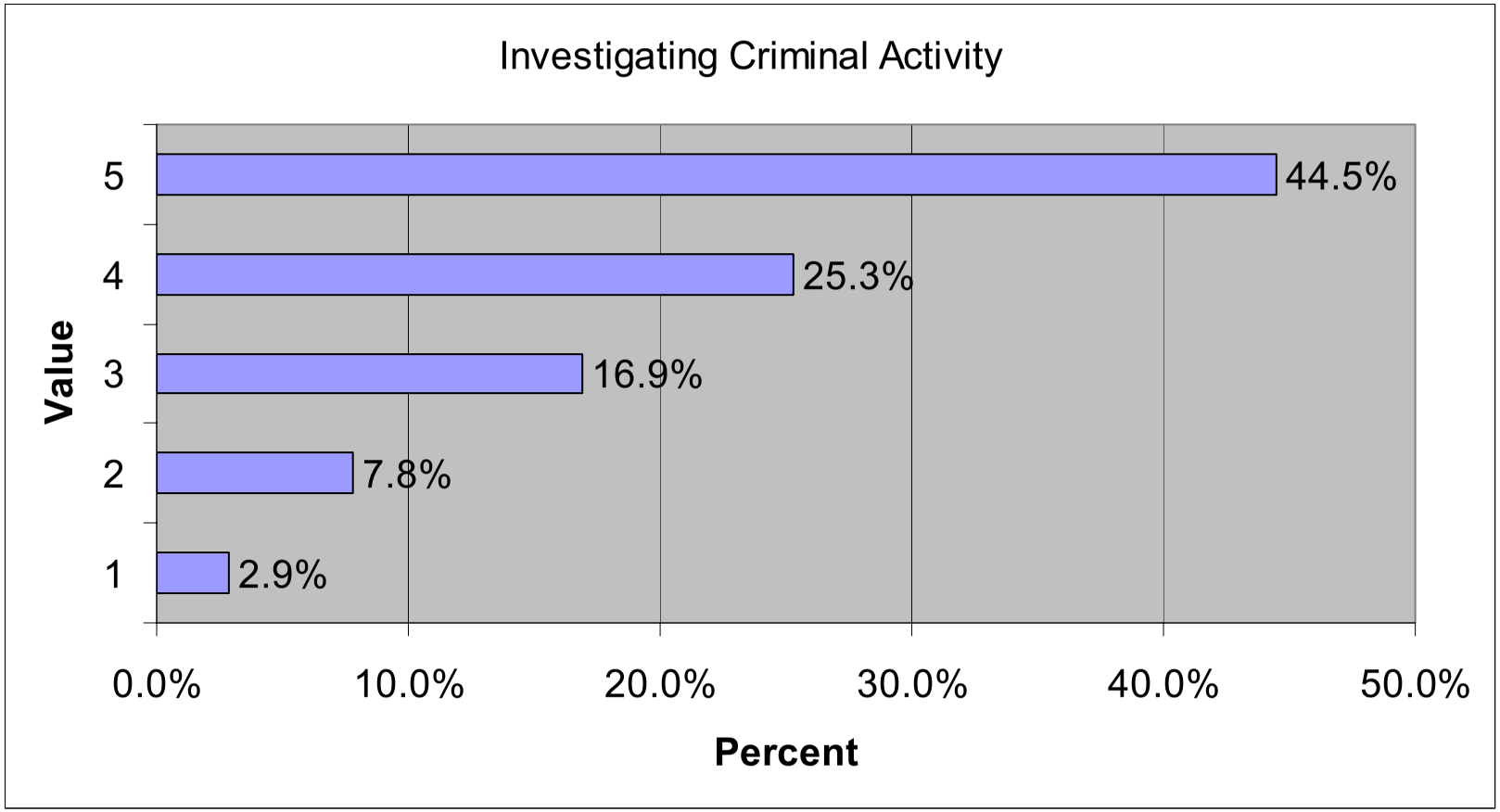
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Preparing for Natural Disasters



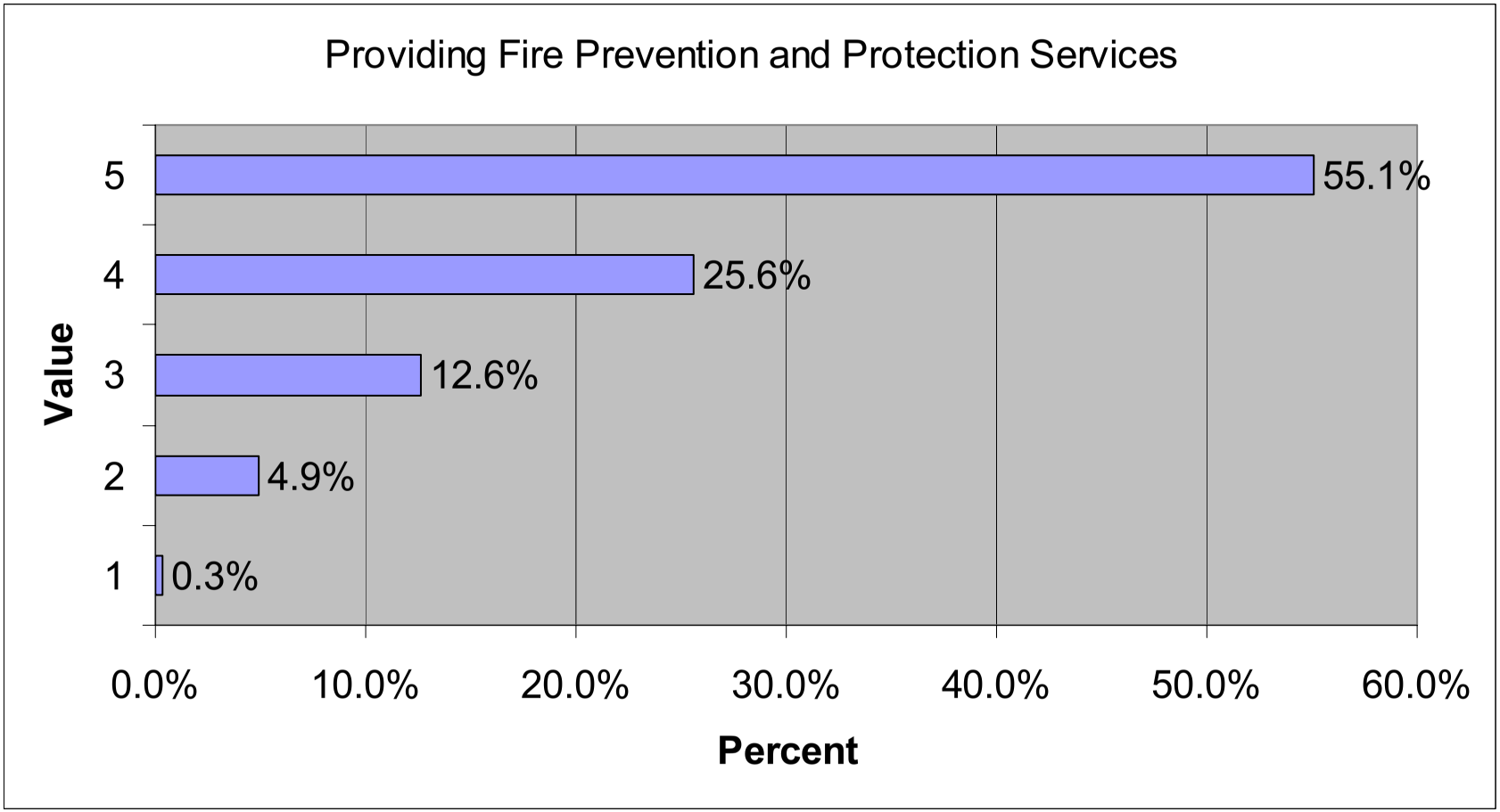
Appendix I
Importance scores for selected variables
On a scale where 1 means "low importance" please Rank the following: Preparing for Man-Made Accidents or Terrorists Events



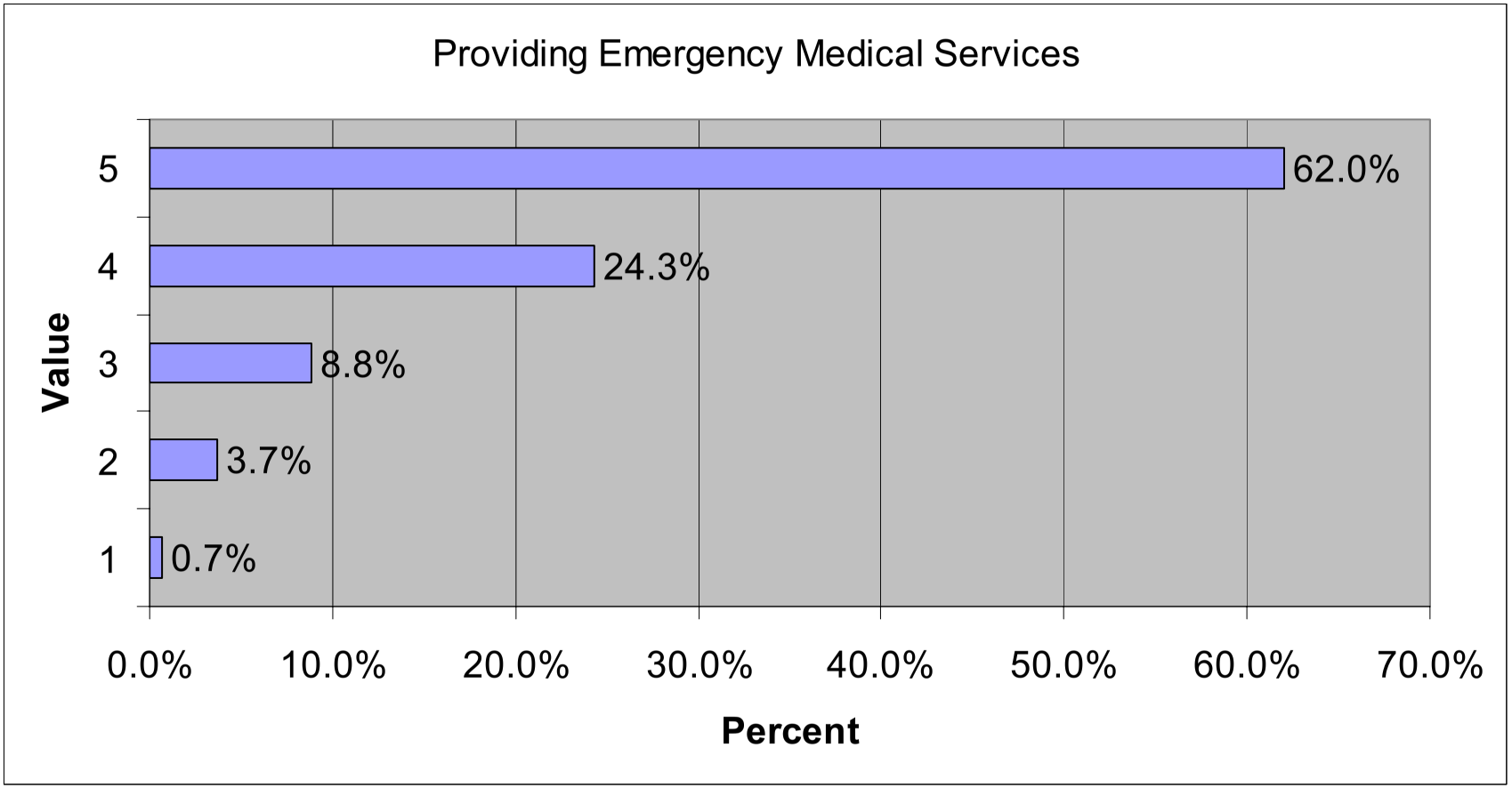
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Investigating Criminal Activity



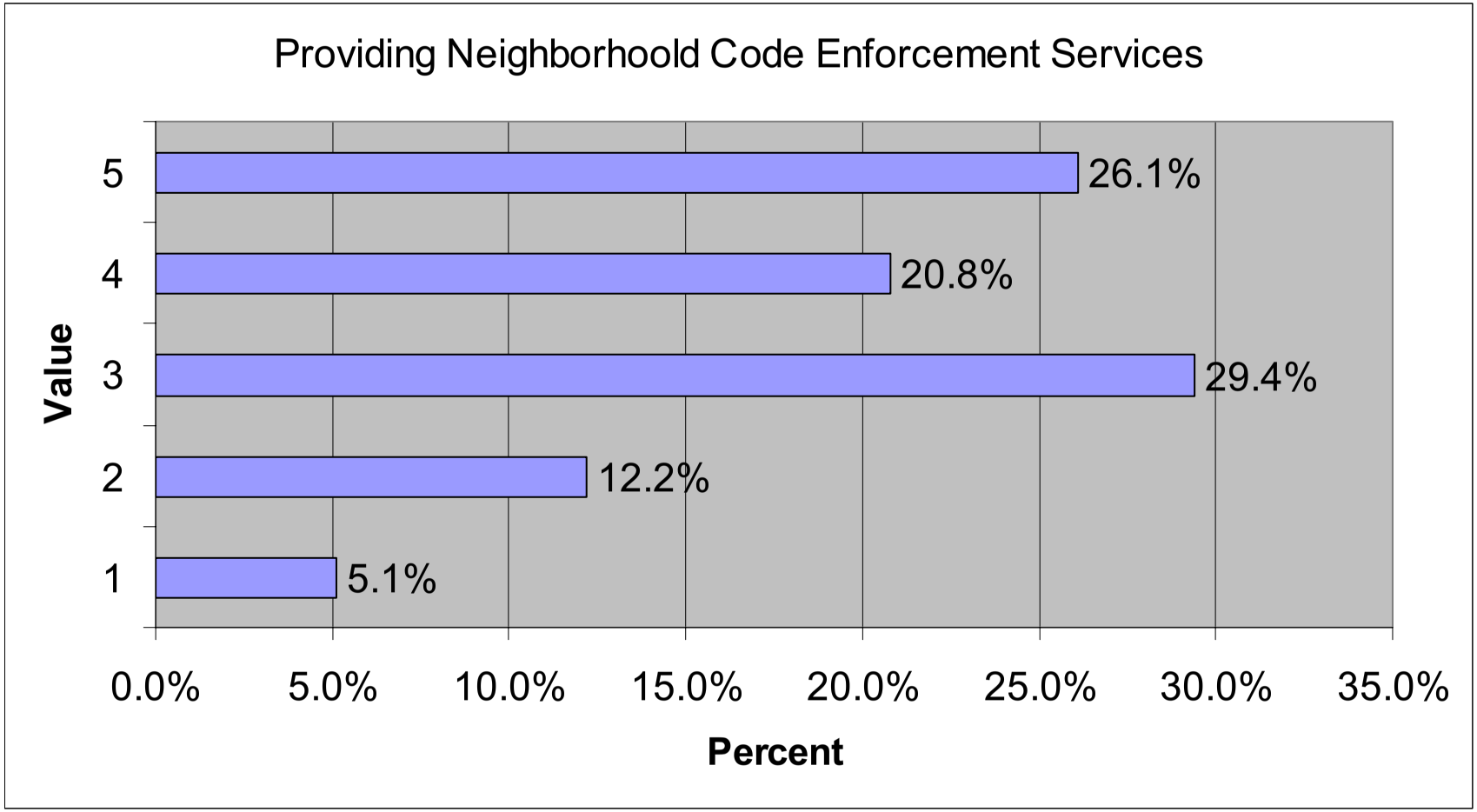
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Providing Fire Protection and Prevention Services



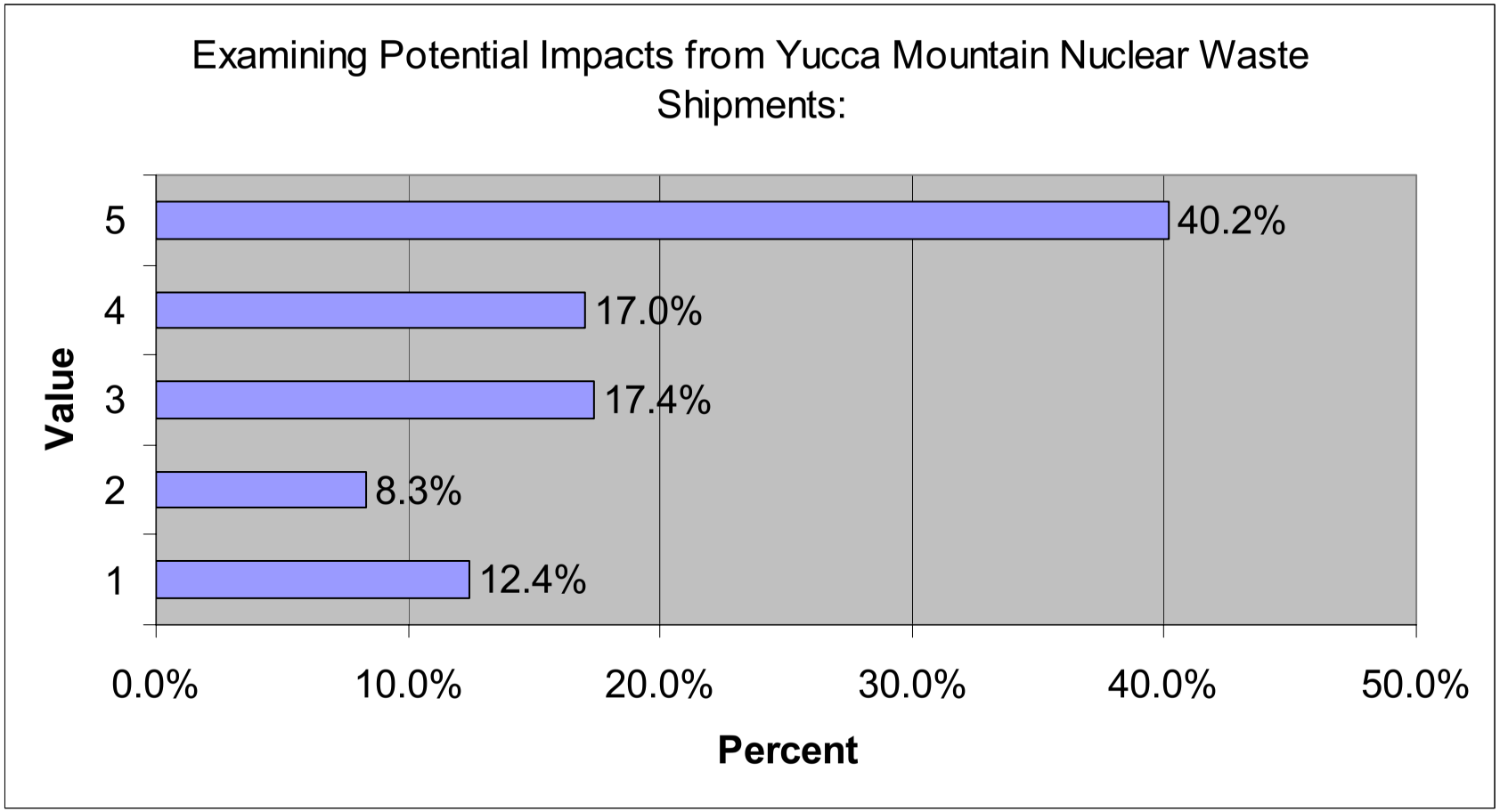
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Providing Emergency Medical Services



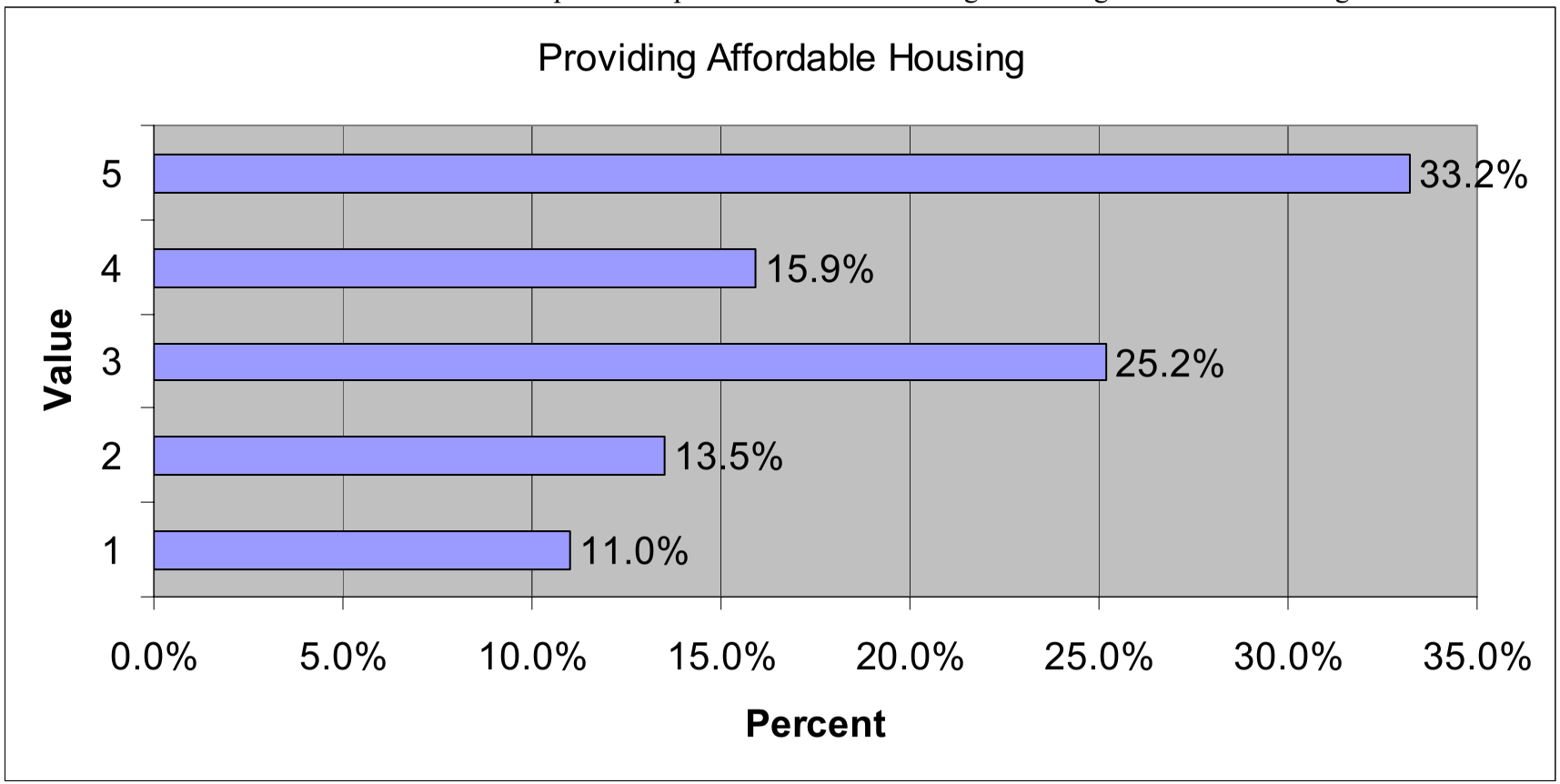
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Providing Neighborhood Code Enforcement Services



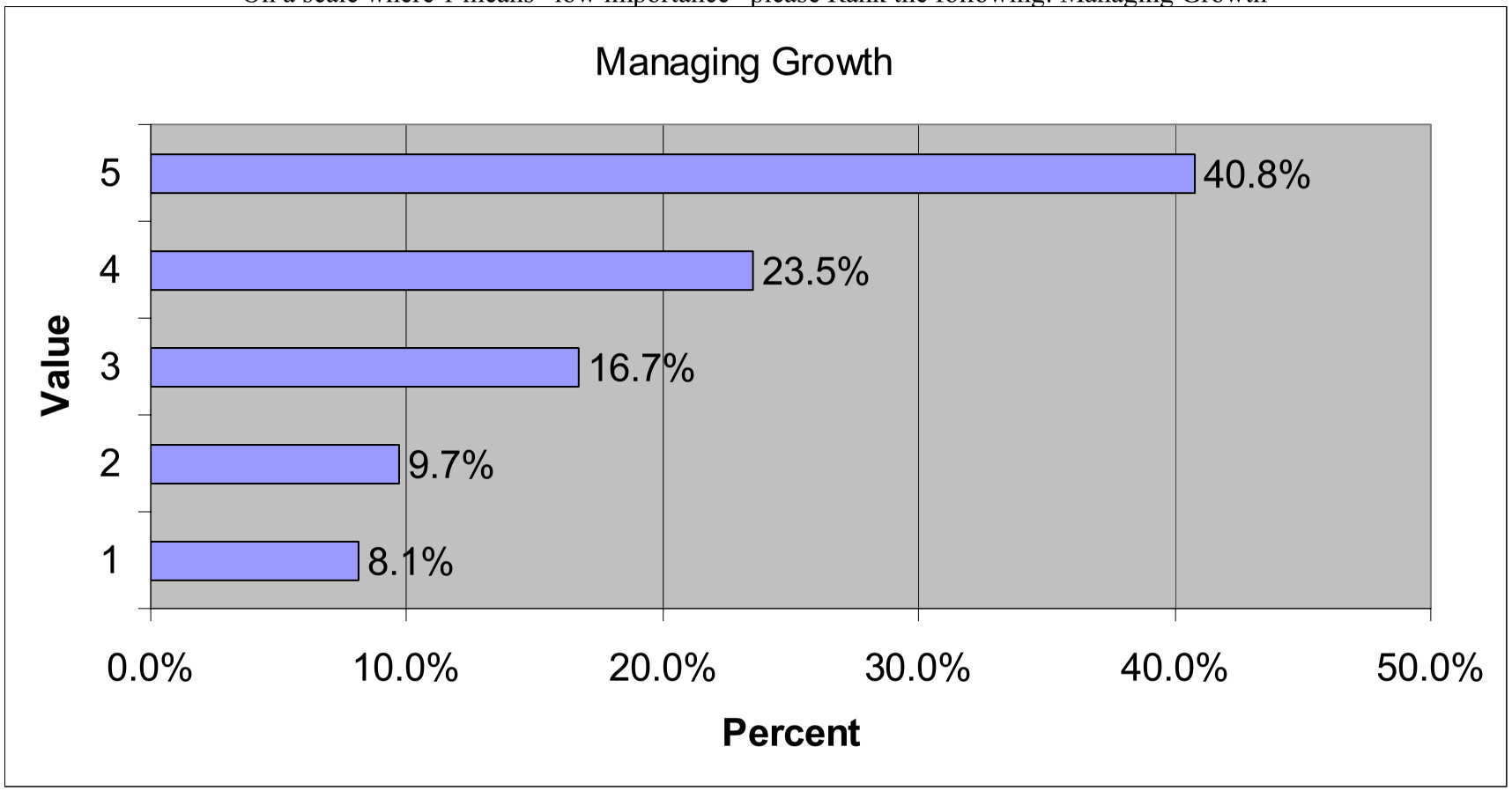
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Examining Potential Impacts from Yucca Mountain Nuclear Waste Shipments



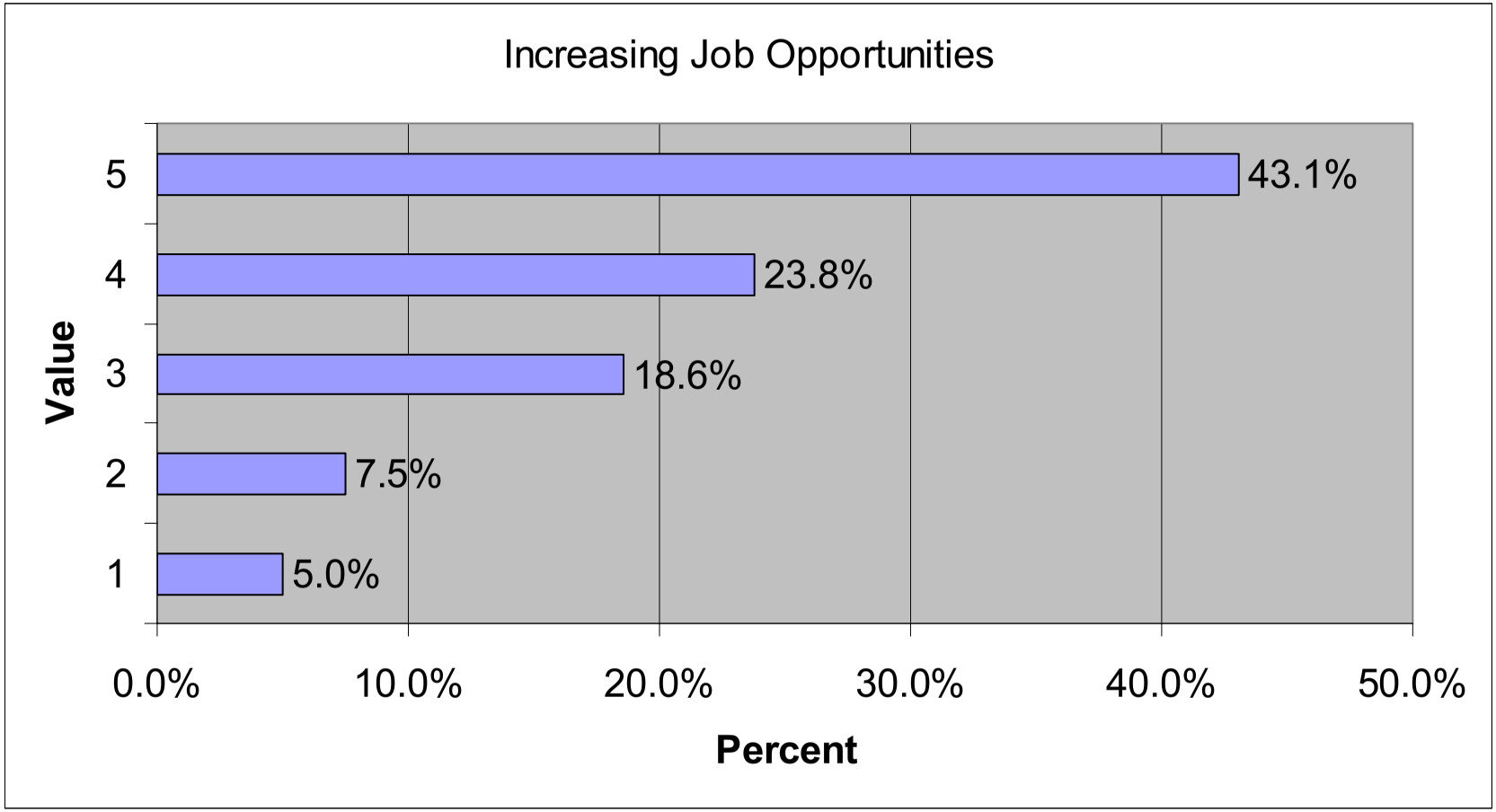
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Providing Affordable Housing



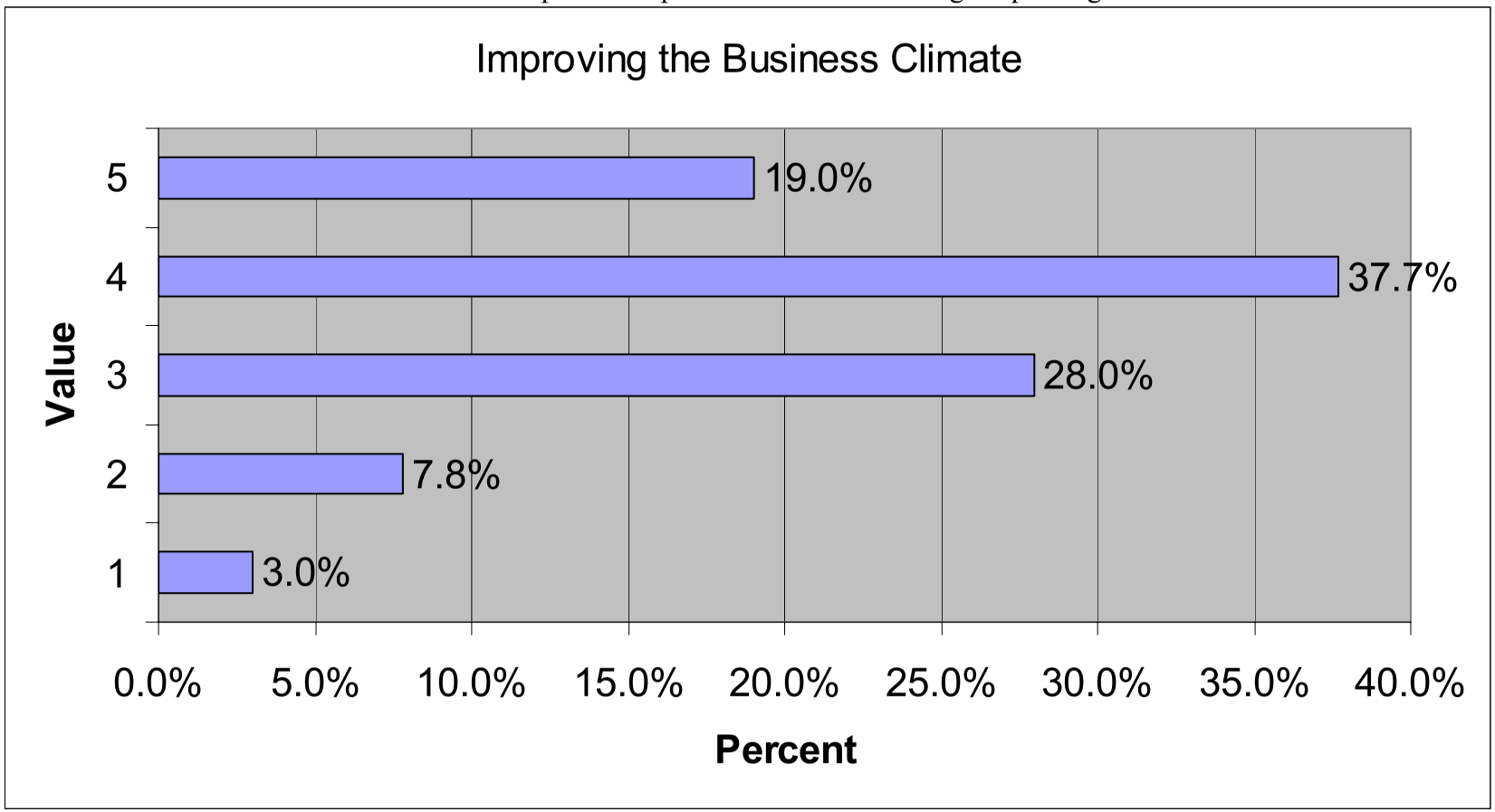
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Managing Growth



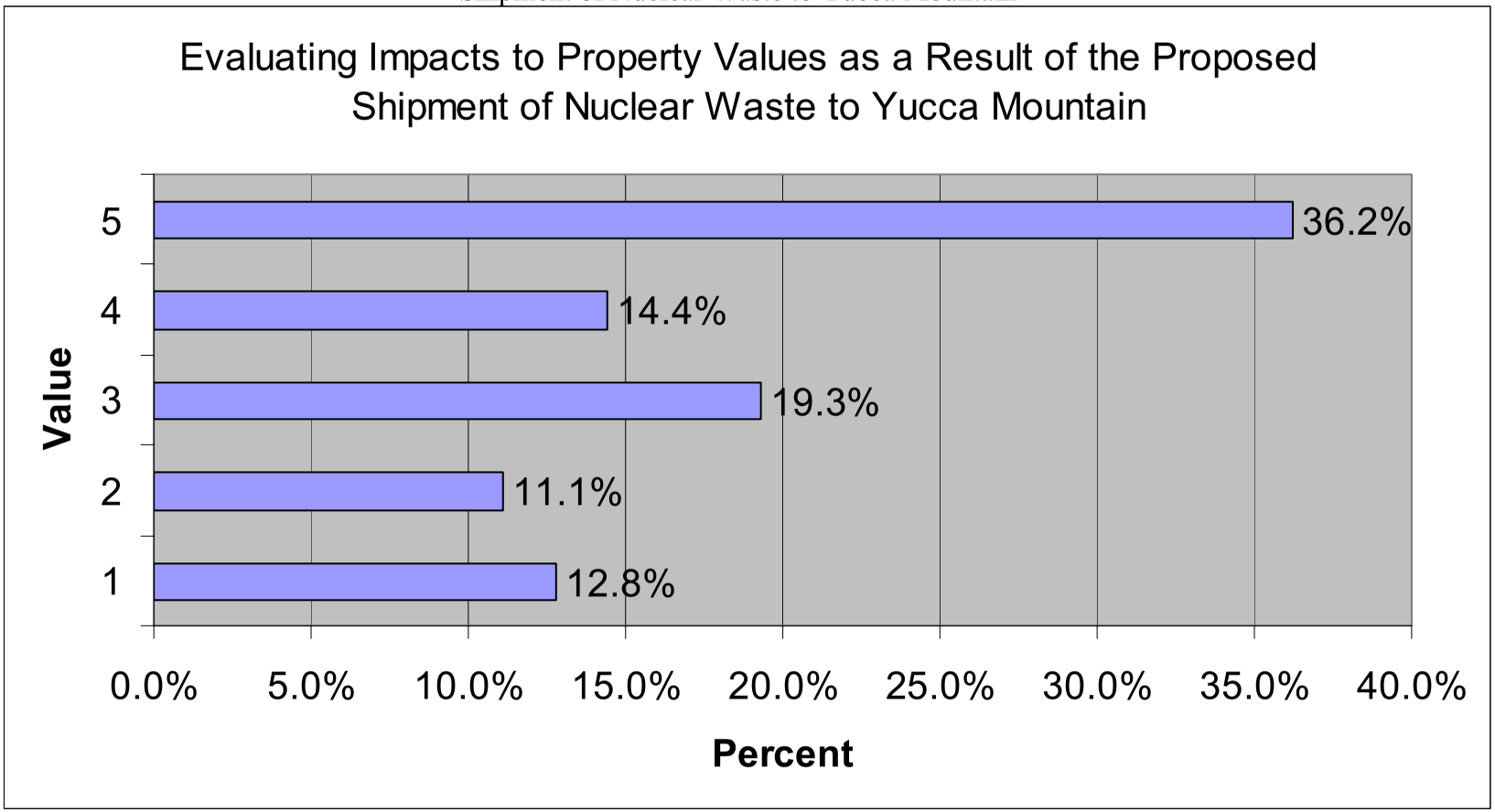
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Increasing Job Opportunities



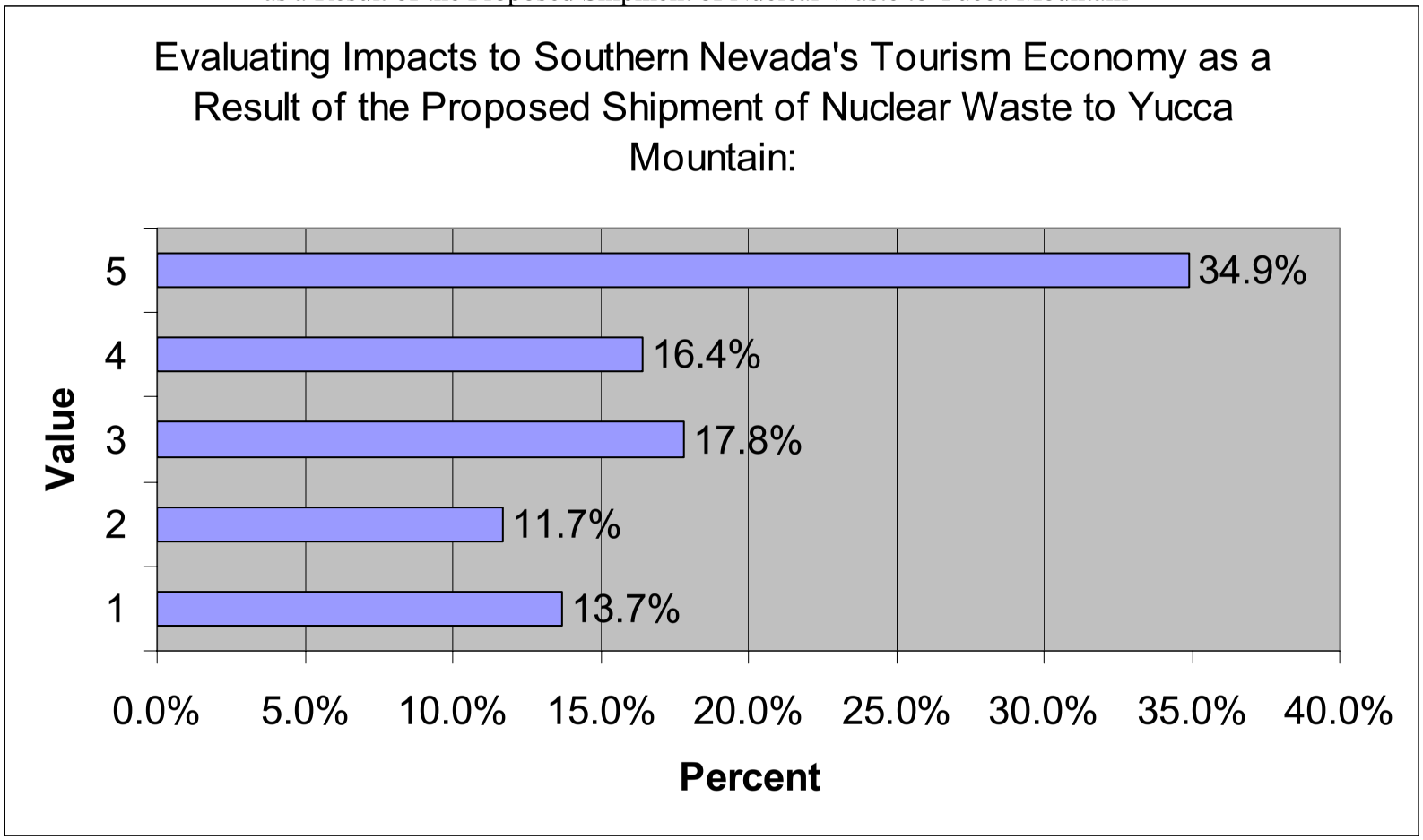
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Improving the Business Climate



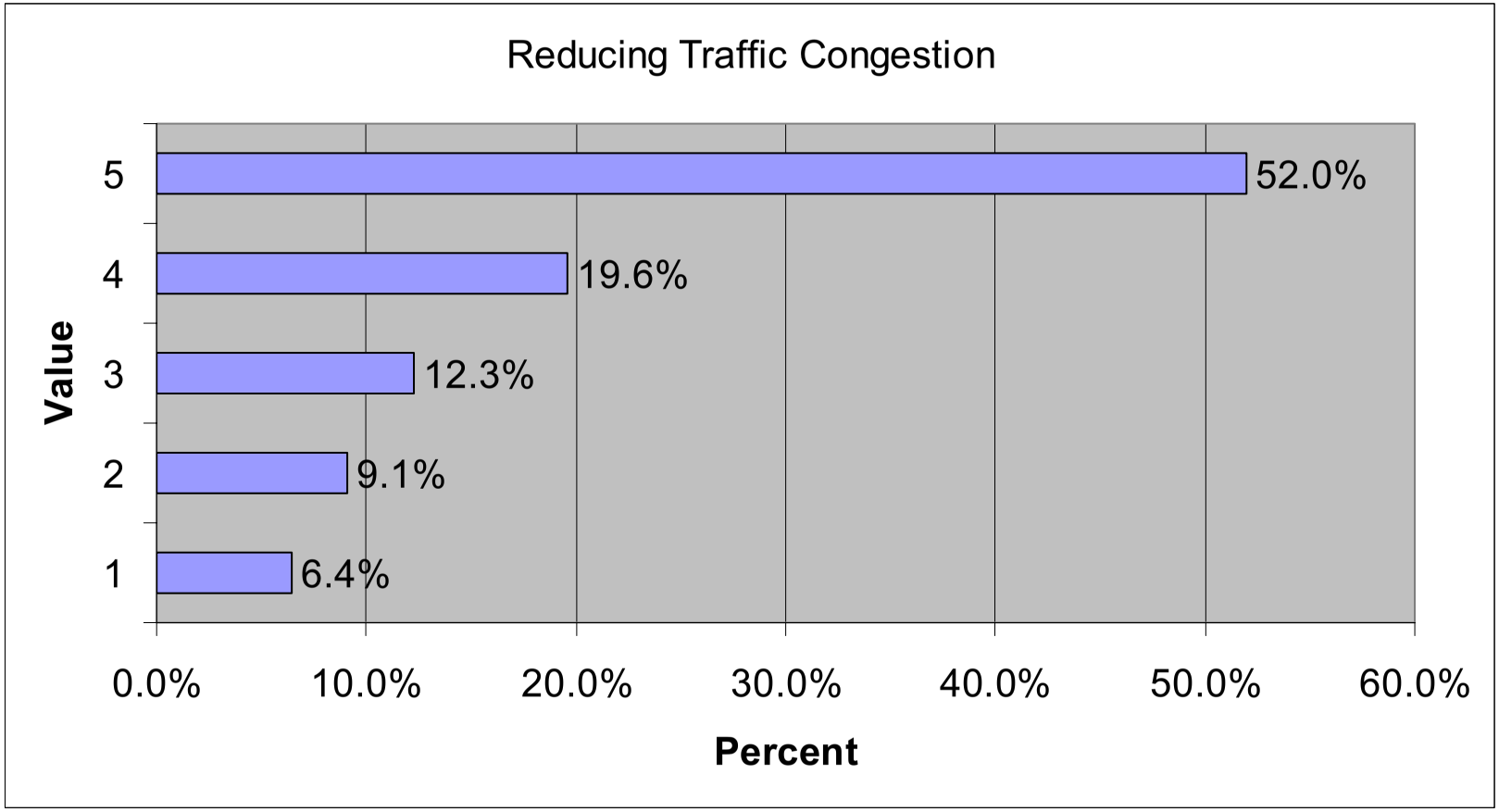
Appendix I
Importance scores for selected variables
On a scale where 1 means "low importance" please Rank the following: Evaluating Impacts to Property Values as a Result of Shipment of Nuclear Waste to Yucca Mountain



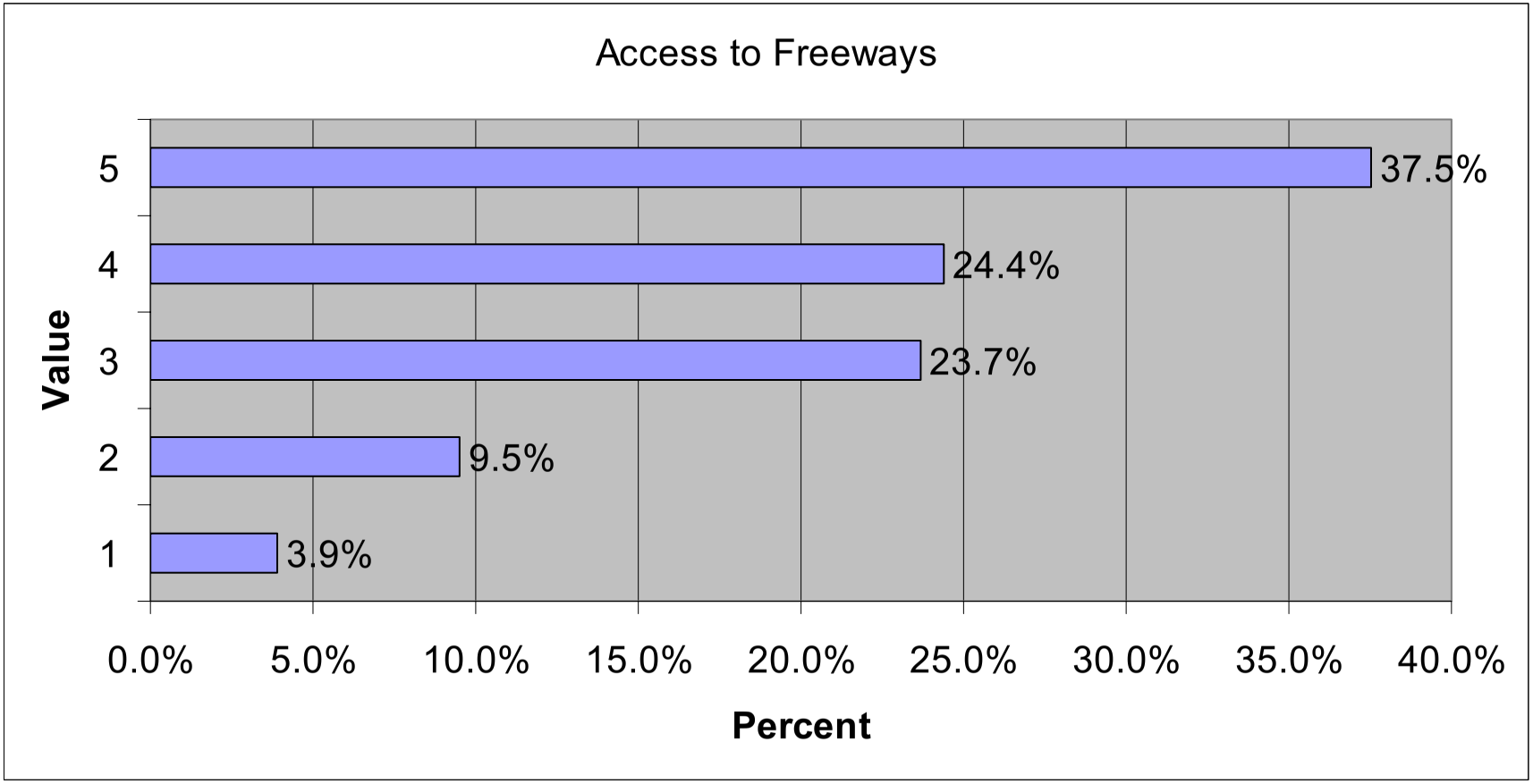
Appendix I
Importance scores for selected variables
On a scale where 1 means "low importance" please Rank the following: Evaluating Impacts to Southern Nevada's Tourism Economy as a Result of the Proposed Shipment of Nuclear Waste to Yucca Mountain



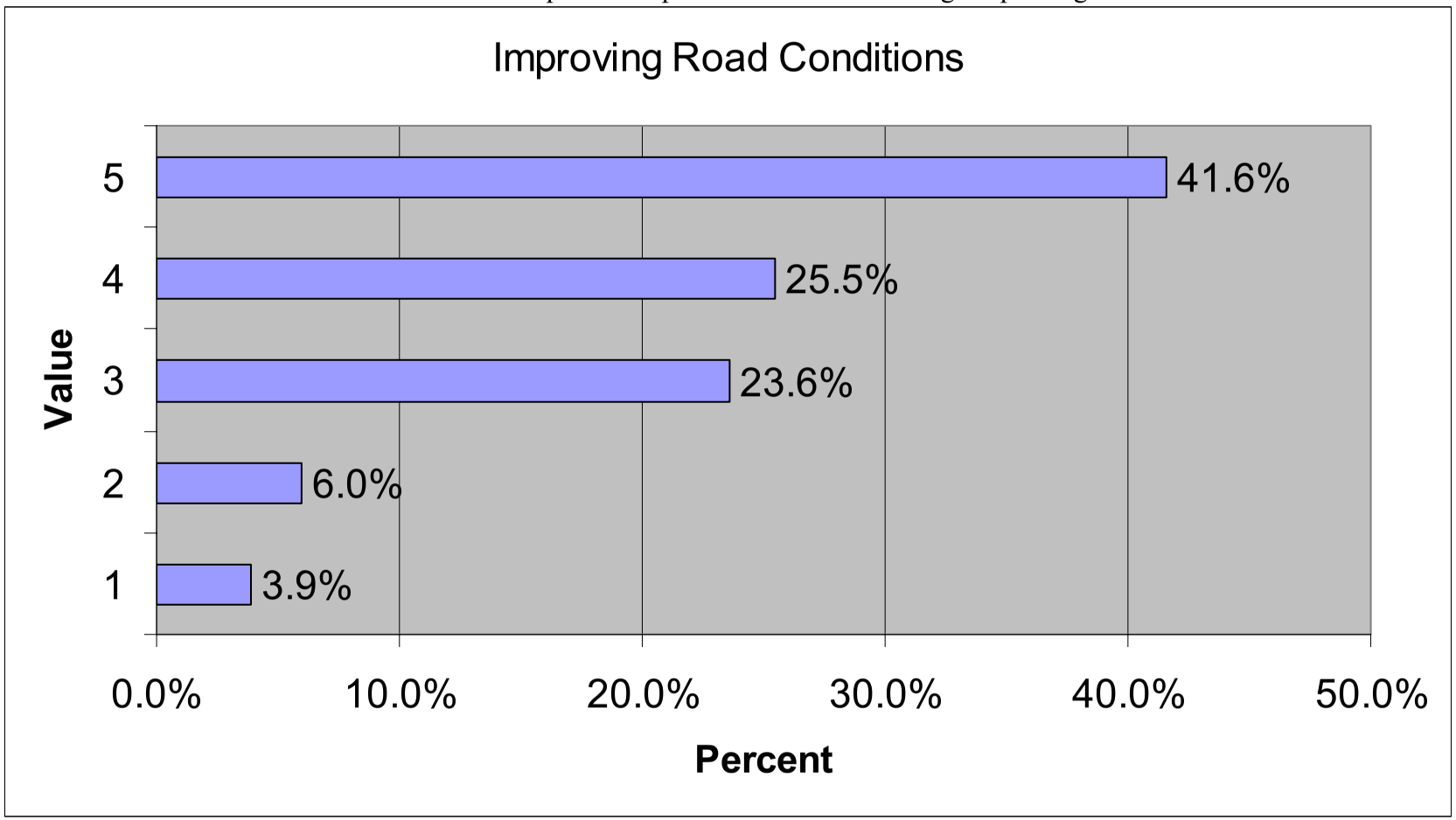
Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Reducing Traffic Congestion



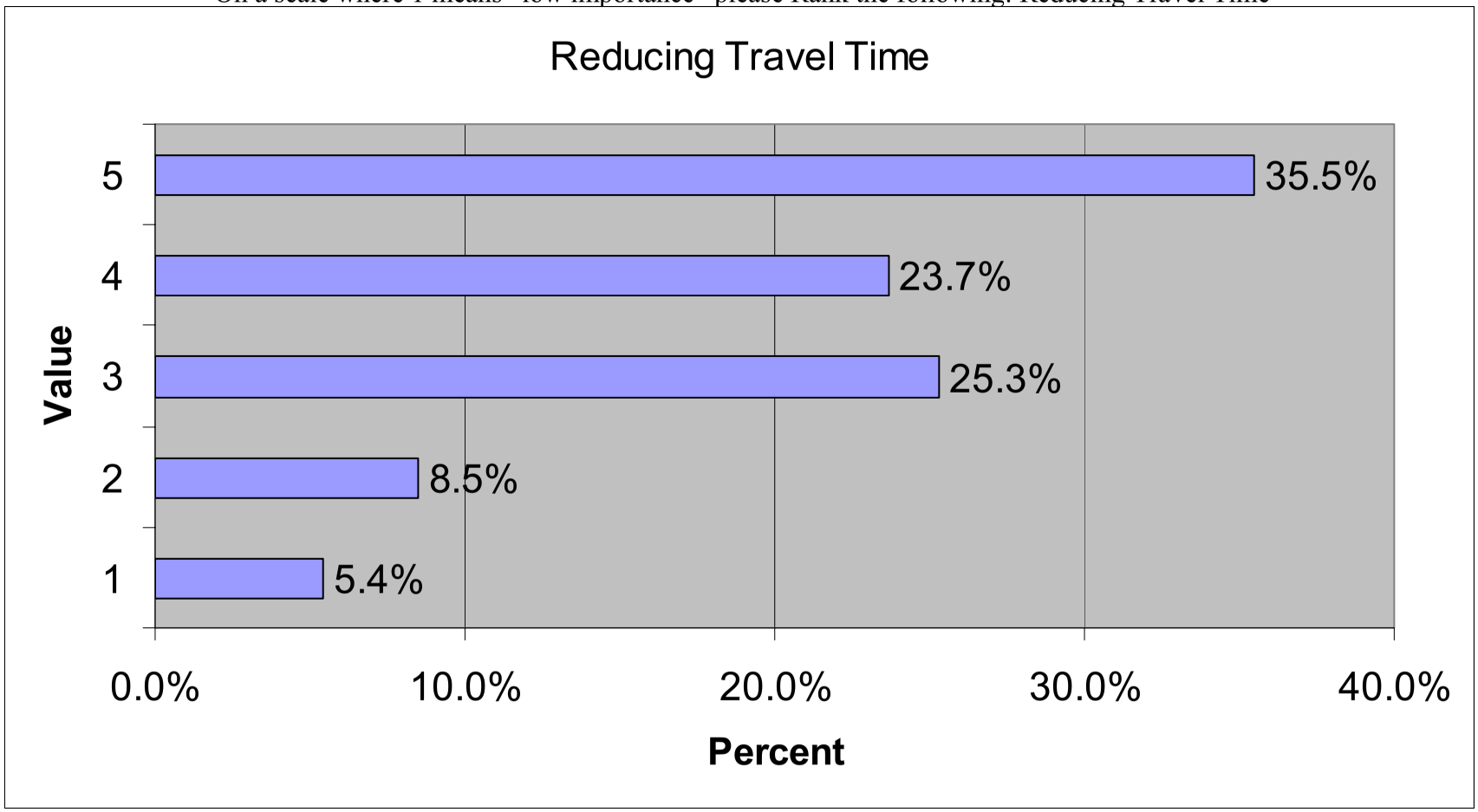
Appendix I
Importance scores for selected variables
On a scale where 1 means "low importance" please Rank the following: Access to Freeways

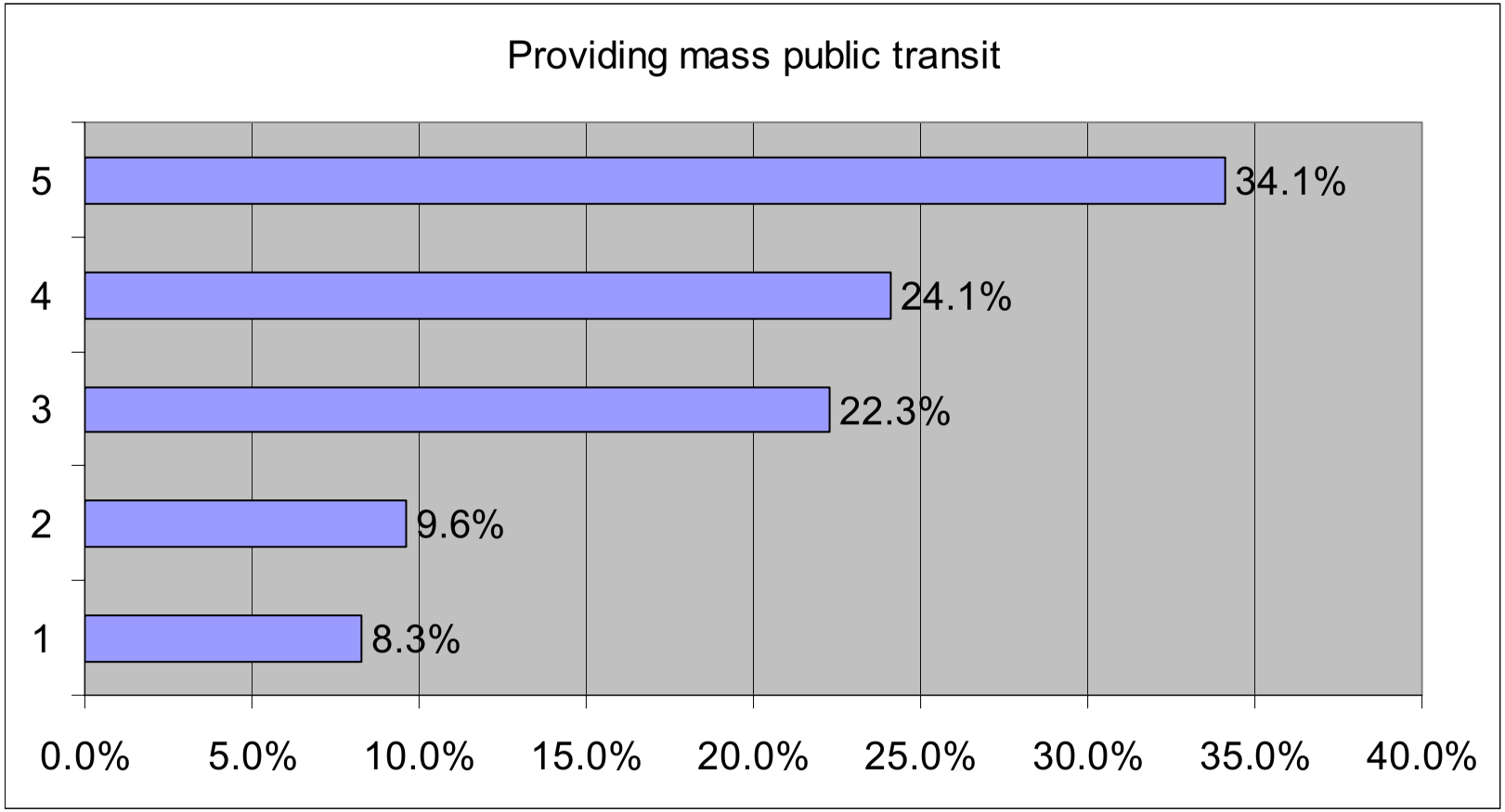


Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Improving Road Conditions



Appendix I
Importance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Reducing Travel Time




Providing mass public transit
5
4
3
2
1
34.1%
24.1%
22.3%
9.6%
8.3%
0.0%
5.0%
10.0%
15.0%
20.0%
25.0%
30.0%
35.0%
40.0%

Appendix I
Importance scores for selected variables
Summary Statistics by Jurisdiction

General Government Importance Measure		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Road maintenance:	Unincorporated Clark County	242	1	4.00	0.072	4	5	1.119	1.252	-1.076	0.157	0.572	0	4	1	5
	City of Las Vegas	196	1	4.04	0.076	4	5	1.058	1.120	-0.904	0.174	0.184	0	4	1	5
	North Las Vegas	70	2	3.98	0.122	4	5	1.019	1.038	-0.700	0.286	0.170	1	4	1	5
	Henderson	84	0	4.26	0.090	4	5	0.824	0.679	-0.839	0.263	0.325	1	4	1	5
	Boulder City	8	0	3.93	0.498	4	5	1.382	1.911	-1.500	0.764	2.371	2	4	1	5
	Mesquite	6	0	4.35	0.396	5	5	0.965	0.930	-1.013	0.849	-1.297	2	2	3	5
Revitalizing older neighborhoods:	Unincorporated Clark County	236	7	3.29	0.085	3	3	1.300	1.691	-0.275	0.159	-0.944	0	4	1	5
	City of Las Vegas	190	7	3.49	0.090	4	5	1.237	1.531	-0.312	0.176	-0.922	0	4	1	5
	North Las Vegas	70	2	3.43	0.144	3	3	1.205	1.451	-0.307	0.287	-0.706	1	4	1	5
	Henderson	80	4	3.60	0.134	4	5	1.198	1.434	-0.456	0.269	-0.758	1	4	1	5
	Boulder City	7	1	3.56	0.393	3	3	1.046	1.094	0.511	0.790	-0.836	2	3	2	5
	Mesquite	6	0	2.97	0.672	3	1	1.636	2.676	-0.093	0.849	-1.572	2	4	1	5
Flood control:	Unincorporated Clark County	241	1	3.90	0.078	4	5	1.216	1.478	-0.880	0.157	-0.231	0	4	1	5
	City of Las Vegas	197	0	3.86	0.087	4	5	1.216	1.479	-0.902	0.173	-0.054	0	4	1	5
	North Las Vegas	71	1	3.88	0.158	4	5	1.331	1.771	-0.903	0.286	-0.394	1	4	1	5
	Henderson	84	0	3.84	0.136	4	5	1.249	1.559	-0.972	0.263	0.138	1	4	1	5
	Boulder City	8	0	4.32	0.537	5	5	1.490	2.219	-2.193	0.764	4.384	2	4	1	5
	Mesquite	6	0	4.08	0.468	4	5	1.140	1.300	-1.457	0.849	2.419	2	3	2	5
Budget management:	Unincorporated Clark County	238	5	3.97	0.079	4	5	1.212	1.468	-1.026	0.158	0.156	0	4	1	5
	City of Las Vegas	194	3	3.82	0.089	4	5	1.240	1.537	-0.722	0.174	-0.466	0	4	1	5
	North Las Vegas	68	4	4.07	0.136	4	5	1.123	1.260	-1.106	0.291	0.571	1	4	1	5
	Henderson	81	3	4.33	0.100	5	5	0.900	0.809	-1.445	0.268	2.056	1	4	1	5
	Boulder City	8	0	4.53	0.310	5	5	0.860	0.740	-1.551	0.764	0.813	2	2	3	5
	Mesquite	6	0	4.12	0.687	5	5	1.672	2.797	-1.849	0.849	2.752	2	4	1	5

Appendix I
Importance scores for selected variables
Summary Statistics by Jurisdiction

General Government Importance Measure		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers:	Unincorporated Clark County	234	8	3.58	0.096	4	5	1.464	2.142	-0.641	0.159	-0.967	0	4	1	5
	City of Las Vegas	190	7	3.46	0.108	4	5	1.489	2.218	-0.447	0.176	-1.198	0	4	1	5
	North Las Vegas	66	6	3.86	0.167	4	5	1.350	1.822	-0.962	0.296	-0.247	1	4	1	5
	Henderson	81	3	3.84	0.149	4	5	1.339	1.793	-0.853	0.267	-0.424	1	4	1	5
	Boulder City	7	1	3.15	0.633	3	5	1.686	2.843	-0.222	0.790	-1.677	2	4	1	5
	Mesquite	6	0	2.87	0.623	3	3	1.516	2.299	0.118	0.849	-0.130	2	4	1	5
Monitor and report to the public on how well government services are being performed:	Unincorporated Clark County	238	5	3.63	0.083	4	5	1.274	1.624	-0.638	0.158	-0.587	0	4	1	5
	City of Las Vegas	195	2	3.72	0.082	4	5	1.152	1.326	-0.442	0.174	-0.726	0	4	1	5
	North Las Vegas	71	1	3.84	0.139	4	5	1.167	1.362	-0.797	0.285	-0.123	1	4	1	5
	Henderson	81	3	3.92	0.120	4	5	1.088	1.183	-0.663	0.267	-0.270	1	4	1	5
	Boulder City	7	1	3.01	0.530	3	3	1.380	1.905	0.139	0.804	-0.480	2	4	1	5
	Mesquite	6	0	3.99	0.584	5	5	1.421	2.019	-1.570	0.849	3.306	2	4	1	5

Appendix I
Importance scores for selected variables
Summary Statistics by Jurisdiction

Social and Judicial Services Importance Measure		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Providing child protection services:	Unincorporated Clark County	211	31	2.84	0.071	3	3	1.036	1.074	-0.018	0.167	0.450	0	4	1	5
	City of Las Vegas	190	7	3.95	0.092	5	5	1.276	1.672	-0.887	0.176	-0.456	0	4	1	5
	North Las Vegas	69	3	4.18	0.129	5	5	1.075	1.156	-1.355	0.288	1.017	1	4	3	5
	Henderson	81	3	4.32	0.109	5	5	0.980	0.960	-1.435	0.267	1.569	1	4	3	5
	Boulder City	8	0	4.41	0.308	5	5	0.855	0.731	-1.089	0.764	-0.428	2	2	1	5
	Mesquite	6	0	4.30	0.293	4	4	0.713	0.509	-0.548	0.849	0.398	2	2	1	5
Providing child welfare services:	Unincorporated Clark County	229	13	3.95	0.080	4	5	1.212	1.468	-0.867	0.161	-0.328	0	4	1	5
	City of Las Vegas	191	6	3.91	0.089	4	5	1.231	1.516	-0.735	0.176	-0.699	0	4	1	5
	North Las Vegas	71	1	4.02	0.145	4	5	1.215	1.477	-1.097	0.286	0.165	1	4	3	5
	Henderson	79	5	4.19	0.111	5	5	0.986	0.972	-1.056	0.270	0.399	1	4	1	5
	Boulder City	7	1	4.44	0.333	5	5	0.887	0.786	-1.260	0.790	-0.167	2	2	1	5
	Mesquite	6	0	3.95	0.575	4	5	1.401	1.963	-1.541	0.849	3.400	2	4	1	5
Providing juvenile justice services:	Unincorporated Clark County	228	15	3.96	0.076	4	5	1.153	1.330	-0.877	0.161	-0.252	0	4	1	5
	City of Las Vegas	186	11	3.80	0.093	4	5	1.264	1.597	-0.751	0.178	-0.524	0	4	1	5
	North Las Vegas	68	4	3.98	0.150	4	5	1.233	1.520	-1.174	0.291	0.533	1	4	3	5
	Henderson	82	2	4.07	0.108	4	5	0.975	0.950	-0.965	0.266	0.723	1	4	3	5
	Boulder City	7	1	4.31	0.325	5	5	0.866	0.750	-0.812	0.790	-1.014	2	2	1	5
	Mesquite	6	0	3.82	0.392	4	3	0.955	0.911	0.478	0.849	-2.153	2	2	1	5

Appendix I
Importance scores for selected variables
Summary Statistics by Jurisdiction

Social and Judicial Services Importance Measure (Continued)		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Provide attainable housing for working class families:	Unincorporated Clark County	238	4	3.71	0.086	4	5	1.334	1.779	-0.735	0.158	-0.660	0	4	1	5
	City of Las Vegas	195	3	3.59	0.100	4	5	1.394	1.944	-0.519	0.174	-1.052	0	4	1	5
	North Las Vegas	71	1	4.02	0.149	5	5	1.259	1.586	-1.198	0.284	0.379	1	4	1	5
	Henderson	83	1	3.83	0.137	4	5	1.252	1.566	-0.802	0.264	-0.482	1	4	2	5
	Boulder City	7	1	3.22	0.530	3	3	1.410	1.989	-0.078	0.790	-0.475	2	4	1	5
	Mesquite	5	1	3.82	0.625	4	5	1.438	2.069	-0.466	0.890	-2.573	2	3	1	5
Providing affordable housing for low income families:	Unincorporated Clark County	238	5	3.58	0.091	4	5	1.399	1.958	-0.571	0.158	-0.967	0	4	1	5
	City of Las Vegas	193	4	3.47	0.104	3	5	1.444	2.086	-0.352	0.175	-1.259	0	4	1	5
	North Las Vegas	71	1	3.84	0.167	4	5	1.407	1.979	-0.962	0.285	-0.412	1	4	1	5
	Henderson	81	3	3.51	0.151	4	5	1.356	1.838	-0.451	0.268	-0.966	1	4	1	5
	Boulder City	8	0	3.33	0.518	4	4	1.436	2.063	-0.397	0.764	-0.987	2	4	1	5
	Mesquite	6	0	3.36	0.618	3	5	1.505	2.266	-0.274	0.849	-1.178	2	4	1	5
Providing shelter for the homeless:	Unincorporated Clark County	238	4	3.30	0.093	3	5	1.429	2.043	-0.261	0.158	-1.251	0	4	1	5
	City of Las Vegas	192	5	3.30	0.101	3	5	1.406	1.976	-0.235	0.175	-1.200	0	4	1	5
	North Las Vegas	67	5	3.56	0.166	4	5	1.356	1.839	-0.618	0.293	-0.791	1	4	1	5
	Henderson	84	0	3.37	0.151	4	4	1.387	1.923	-0.434	0.263	-1.036	1	4	1	5
	Boulder City	8	0	3.21	0.435	3	3	1.207	1.457	-0.524	0.764	0.803	2	4	1	5
	Mesquite	6	0	2.74	0.599	3	3	1.460	2.131	-0.087	0.849	-0.667	2	4	1	5

Appendix I
Importance scores for selected variables
Summary Statistics by Jurisdiction

Social and Judicial Services Importance Measure (continued)		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Providing affordable housing for seniors:	Unincorporated Clark County	237	5	4.01	0.081	5	5	1.243	1.545	-1.068	0.158	0.023	0	4	1	5
	City of Las Vegas	194	3	3.84	0.091	4	5	1.270	1.614	-0.743	0.174	-0.609	0	4	1	5
	North Las Vegas	70	2	3.84	0.163	4	5	1.366	1.865	-1.027	0.287	-0.154	1	4	1	5
	Henderson	84	0	3.95	0.124	4	5	1.133	1.284	-0.740	0.263	-0.561	1	4	2	5
	Boulder City	8	0	3.77	0.477	4	4	1.323	1.750	-1.332	0.764	2.216	2	4	1	5
	Mesquite	6	0	4.05	0.516	5	5	1.257	1.581	-0.723	0.849	-1.638	2	3	1	5
Providing medical care for the poor:	Unincorporated Clark County	238	4	3.69	0.086	4	5	1.325	1.756	-0.654	0.158	-0.741	0	4	1	5
	City of Las Vegas	190	7	3.76	0.096	4	5	1.326	1.758	-0.729	0.176	-0.627	0	4	1	5
	North Las Vegas	72	0	3.76	0.159	4	5	1.345	1.809	-0.779	0.283	-0.561	1	4	1	5
	Henderson	81	3	3.85	0.145	4	5	1.306	1.706	-0.794	0.267	-0.549	1	4	1	5
	Boulder City	8	0	3.69	0.506	4	4	1.405	1.974	-1.108	0.764	0.706	2	4	1	5
	Mesquite	6	0	3.02	0.640	3	3	1.560	2.432	0.134	0.849	-0.709	2	4	1	5
Providing 24 hour emergency trauma care:	Unincorporated Clark County	238	4	4.43	0.063	5	5	0.970	0.940	-1.891	0.158	3.178	0	4	1	5
	City of Las Vegas	194	3	4.27	0.073	5	5	1.012	1.025	-1.210	0.175	0.443	0	4	1	5
	North Las Vegas	71	1	4.61	0.093	5	5	0.787	0.620	-2.512	0.285	7.018	1	4	1	5
	Henderson	83	1	4.32	0.118	5	5	1.073	1.150	-1.474	0.265	1.175	1	4	1	5
	Boulder City	8	0	4.29	0.516	5	5	1.431	2.047	-2.183	0.764	4.740	2	4	1	5
	Mesquite	6	0	4.06	0.721	5	5	1.755	3.079	-1.816	0.849	2.187	2	4	1	5

Appendix I
Importance scores for selected variables
Summary Statistics by Jurisdiction

Public Safety Importance Measure		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Providing crime prevention programs:	Unincorporated Clark County	237	5	4.02	0.072	4	5	1.113	1.240	-0.899	0.158	-0.066	0	4	1	5
	City of Las Vegas	190	7	2.89	0.077	3	3	1.064	1.132	-0.111	0.176	-0.419	0	4	1	5
	North Las Vegas	69	2	3.92	0.132	4	5	1.100	1.210	-0.815	0.288	-0.050	1	4	1	5
	Henderson	84	0	4.23	0.101	4	5	0.922	0.850	-1.175	0.263	1.024	1	4	2	5
	Boulder City	8	0	3.61	0.510	4	4	1.414	2.000	-1.006	0.764	0.239	2	4	1	5
	Mesquite	6	0	3.93	0.473	4	5	1.152	1.327	-0.553	0.849	-0.953	2	3	1	5
Enforcing traffic laws:	Unincorporated Clark County	241	1	3.97	0.073	4	5	1.134	1.285	-0.826	0.157	-0.227	0	4	1	5
	City of Las Vegas	196	1	3.79	0.090	4	5	1.265	1.600	-0.644	0.174	-0.727	0	4	1	5
	North Las Vegas	72	0	3.89	0.137	4	5	1.159	1.344	-0.754	0.283	-0.262	1	4	1	5
	Henderson	84	0	4.07	0.136	5	5	1.247	1.554	-1.179	0.263	0.273	1	4	2	5
	Boulder City	8	0	3.42	0.558	3	5	1.548	2.397	-0.332	0.764	-1.434	2	4	1	5
	Mesquite	6	0	3.86	0.656	5	5	1.596	2.548	-0.685	0.849	-2.629	2	3	1	5
Maintaining a low crime rate:	Unincorporated Clark County	241	1	4.23	0.072	5	5	1.117	1.247	-1.453	0.157	1.262	0	4	1	5
	City of Las Vegas	195	2	3.91	0.098	5	5	1.375	1.890	-0.910	0.174	-0.538	0	4	1	5
	North Las Vegas	72	0	4.19	0.143	5	5	1.212	1.468	-1.423	0.283	0.982	1	4	1	5
	Henderson	84	0	4.31	0.118	5	5	1.084	1.175	-1.547	0.263	1.484	1	4	3	5
	Boulder City	8	0	4.05	0.539	5	5	1.494	2.232	-1.437	0.764	1.355	2	4	1	5
	Mesquite	6	0	4.68	0.295	5	5	0.718	0.515	-2.515	0.849	7.883	2	2	1	5
Maintaining neighborhood police patrols:	Unincorporated Clark County	242	1	4.04	0.076	4	5	1.175	1.380	-1.105	0.157	0.260	0	4	1	5
	City of Las Vegas	196	1	3.87	0.091	4	5	1.271	1.615	-0.717	0.174	-0.745	0	4	1	5
	North Las Vegas	71	1	3.96	0.136	4	5	1.144	1.310	-0.791	0.286	-0.265	1	4	2	5
	Henderson	82	2	4.07	0.122	4	5	1.109	1.229	-0.942	0.266	0.021	1	4	1	5
	Boulder City	8	0	3.72	0.415	3	3	1.152	1.328	0.015	0.764	-1.598	2	3	1	5
	Mesquite	6	0	3.52	0.626	3	5	1.524	2.323	-0.384	0.849	-0.879	2	4	1	5

Appendix I
Importance scores for selected variables
Summary Statistics by Jurisdiction

Public Safety Importance Measure (Continued)		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Keeping police response times low:	Unincorporated Clark County	238	4	4.25	0.068	5	5	1.056	1.114	-1.369	0.158	1.104	0	4	1	5
	City of Las Vegas	191	7	4.17	0.085	5	5	1.173	1.375	-1.227	0.176	0.363	0	4	1	5
	North Las Vegas	70	2	4.26	0.119	5	5	0.998	0.997	-1.540	0.287	2.343	1	4	3	5
	Henderson	81	3	4.31	0.112	5	5	1.010	1.021	-1.655	0.267	2.396	1	4	3	5
	Boulder City	6	2	4.30	0.342	4	5	0.849	0.720	-0.771	0.835	-0.821	2	2	1	5
	Mesquite	5	1	4.76	0.311	5	5	0.717	0.514	-3.418	0.890	16.173	2	2	1	5
Keeping fire department response times low:	Unincorporated Clark County	239	3	4.54	0.049	5	5	0.758	0.574	-2.002	0.157	4.729	0	4	2	5
	City of Las Vegas	190	7	4.50	0.063	5	5	0.870	0.757	-1.903	0.176	3.221	0	4	1	5
	North Las Vegas	69	3	4.54	0.088	5	5	0.731	0.534	-1.492	0.289	1.481	1	3	3	5
	Henderson	82	2	4.64	0.081	5	5	0.737	0.543	-2.464	0.266	6.688	1	4	2	5
	Boulder City	6	2	4.60	0.350	5	5	0.870	0.757	-2.057	0.835	3.205	2	2	2	5
	Mesquite	6	0	4.37	0.420	5	5	1.022	1.045	-2.186	0.849	7.239	2	3	1	5
Keeping paramedic and emergency medical response times low:	Unincorporated Clark County	241	1	4.57	0.046	5	5	0.709	0.503	-1.750	0.157	2.749	0	3	2	5
	City of Las Vegas	192	5	4.50	0.063	5	5	0.877	0.769	-1.849	0.175	2.945	0	4	2	5
	North Las Vegas	70	2	4.56	0.087	5	5	0.731	0.534	-1.553	0.287	1.612	1	3	3	5
	Henderson	83	1	4.67	0.074	5	5	0.675	0.456	-2.039	0.264	3.360	1	3	4	5
	Boulder City	6	2	4.70	0.280	5	5	0.696	0.484	-2.627	0.835	8.589	2	2	2	5
	Mesquite	6	0	4.89	0.139	5	5	0.337	0.114	-3.526	0.849	16.121	2	1	1	5
Well trained paramedic and emergency medical response personnel:	Unincorporated Clark County	236	6	4.64	0.047	5	5	0.719	0.517	-2.172	0.158	4.241	0	3	3	5
	City of Las Vegas	193	4	4.56	0.055	5	5	0.767	0.588	-1.733	0.175	2.502	0	4	2	5
	North Las Vegas	68	3	4.68	0.073	5	5	0.604	0.365	-1.749	0.290	1.965	1	2	4	5
	Henderson	82	2	4.75	0.065	5	5	0.589	0.348	-2.597	0.265	6.810	1	3	5	5
	Boulder City	8	0	4.72	0.173	5	5	0.480	0.230	-1.259	0.764	-0.680	2	1	1	5
	Mesquite	6	0	5.00	0.000	5	5	0.000	0.000		0.849		2	0	1	5

Appendix I
Importance scores for selected variables
Summary Statistics by Jurisdiction

Public Safety Importance Measure (Continued)		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Facilitate neighborhood watch programs:	Unincorporated Clark County	238	5	3.77	0.072	4	4	1.111	1.234	-0.668	0.158	-0.243	0	4	1	5
	City of Las Vegas	194	3	3.72	0.086	4	5	1.194	1.426	-0.649	0.175	-0.305	0	4	1	5
	North Las Vegas	66	6	3.36	0.141	3	3	1.142	1.303	-0.118	0.296	-0.499	1	4	1	5
	Henderson	80	4	3.75	0.132	4	4	1.187	1.408	-0.777	0.268	-0.342	1	4	1	5
	Boulder City	8	0	3.57	0.475	4	3	1.318	1.737	-0.834	0.764	1.029	2	4	1	5
	Mesquite	6	0	3.24	0.700	4	5	1.705	2.907	-0.332	0.849	-1.855	2	4	1	5
Preparing for natural disasters, (i.e. floods, earthquakes, etc):	Unincorporated Clark County	238	4	3.87	0.080	4	5	1.238	1.533	-0.953	0.158	-0.026	0	4	1	5
	City of Las Vegas	193	4	3.56	0.101	4	5	1.399	1.958	-0.531	0.175	-0.948	0	4	1	5
	North Las Vegas	69	2	3.73	0.161	4	5	1.338	1.790	-0.795	0.288	-0.514	1	4	2	5
	Henderson	82	2	3.94	0.125	4	5	1.132	1.282	-0.953	0.265	0.179	1	4	1	5
	Boulder City	8	0	3.61	0.449	4	4	1.245	1.551	-0.324	0.764	-1.538	2	3	1	5
	Mesquite	6	0	3.29	0.737	3	5	1.795	3.224	-0.372	0.849	-1.756	2	4	1	5
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events:	Unincorporated Clark County	238	4	4.00	0.079	4	5	1.218	1.483	-1.017	0.158	0.038	0	4	1	5
	City of Las Vegas	191	6	3.70	0.099	4	5	1.374	1.889	-0.716	0.176	-0.697	0	4	1	5
	North Las Vegas	72	0	4.06	0.155	5	5	1.311	1.719	-1.256	0.283	0.405	1	4	1	5
	Henderson	82	2	4.14	0.127	5	5	1.147	1.315	-1.234	0.266	0.583	1	4	1	5
	Boulder City	8	0	3.57	0.499	4	4	1.385	1.919	-0.876	0.764	0.298	2	4	1	5
	Mesquite	6	0	3.52	0.554	3	3	1.349	1.821	-0.540	0.849	1.202	2	4	1	5
Investigating criminal activity:	Unincorporated Clark County	235	7	4.03	0.069	4	5	1.062	1.127	-0.908	0.159	0.067	0	4	1	5
	City of Las Vegas	192	5	4.01	0.086	4	5	1.193	1.423	-0.932	0.176	-0.320	0	4	1	5
	North Las Vegas	70	2	4.00	0.127	4	5	1.063	1.130	-0.924	0.287	0.398	1	4	1	5
	Henderson	83	1	4.16	0.112	4	5	1.017	1.035	-1.145	0.264	0.682	1	4	1	5
	Boulder City	7	1	3.70	0.509	4	4	1.356	1.839	-1.258	0.790	1.997	2	4	1	5
	Mesquite	6	0	3.96	0.576	4	5	1.402	1.964	-1.567	0.849	3.500	2	4	1	5

Appendix I
Importance scores for selected variables
Summary Statistics by Jurisdiction

Public Safety Importance Measure (Continued)		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Providing fire protection & prevention services:	Unincorporated Clark County	239	4	4.40	0.056	5	5	0.860	0.739	-1.364	0.158	1.104	0	4	2	5
	City of Las Vegas	194	3	4.23	0.071	5	5	0.989	0.978	-1.070	0.175	0.139	0	4	2	5
	North Las Vegas	72	0	4.13	0.111	4	5	0.938	0.881	-0.900	0.283	-0.037	1	3	3	5
	Henderson	82	2	4.48	0.080	5	5	0.724	0.525	-1.194	0.265	0.663	1	3	3	5
	Boulder City	8	0	4.28	0.298	4	5	0.827	0.685	-0.661	0.764	-0.989	2	2	1	5
	Mesquite	6	0	4.43	0.363	5	5	0.885	0.783	-1.264	0.849	0.062	2	2	1	5
Providing emergency medical services:	Unincorporated Clark County	240	2	4.49	0.054	5	5	0.833	0.694	-1.765	0.157	2.751	0	4	2	5
	City of Las Vegas	197	0	4.32	0.068	5	5	0.959	0.919	-1.412	0.173	1.432	0	4	2	5
	North Las Vegas	71	1	4.32	0.102	5	5	0.856	0.732	-1.209	0.285	0.843	1	3	4	5
	Henderson	84	0	4.60	0.071	5	5	0.650	0.422	-1.567	0.263	1.928	1	3	5	5
	Boulder City	8	0	4.72	0.173	5	5	0.480	0.230	-1.259	0.764	-0.680	2	1	1	5
	Mesquite	6	0	5.00	0.000	5	5	0.000	0.000		0.849		2	0	1	5
Providing for neighborhood code enforcement services:	Unincorporated Clark County	228	15	3.57	0.078	4	3	1.174	1.378	-0.322	0.161	-0.844	0	4	1	5
	City of Las Vegas	187	10	3.62	0.089	4	5	1.220	1.489	-0.377	0.178	-0.854	0	4	1	5
	North Las Vegas	66	6	3.34	0.147	3	3	1.196	1.431	-0.380	0.295	-0.489	1	4	2	5
	Henderson	77	7	3.49	0.121	3	3	1.067	1.138	-0.203	0.273	-0.570	1	4	1	5
	Boulder City	7	1	3.26	0.379	3	3	1.010	1.020	0.528	0.790	0.169	2	3	1	5
	Mesquite	6	0	3.29	0.737	3	5	1.795	3.224	-0.372	0.849	-1.756	2	4	1	5
Examining potential impacts from Yucca Mountain nuclear waste shipments:	Unincorporated Clark County	233	9	3.68	0.094	4	5	1.431	2.047	-0.710	0.159	-0.858	0	4	1	5
	City of Las Vegas	185	12	3.56	0.107	4	5	1.451	2.107	-0.559	0.178	-1.062	0	4	1	5
	North Las Vegas	70	2	3.68	0.166	4	5	1.384	1.916	-0.762	0.288	-0.530	1	4	2	5
	Henderson	79	5	4.00	0.151	5	5	1.342	1.802	-1.121	0.270	-0.040	1	4	1	5
	Boulder City	7	1	3.18	0.370	3	3	0.986	0.971	0.829	0.790	1.056	2	3	1	5
	Mesquite	6	0	3.23	0.697	3	5	1.697	2.878	-0.157	0.849	-1.619	2	4	1	5

Appendix I
Importance scores for selected variables
Summary Statistics by Jurisdiction

Community Development Importance Measure		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Providing affordable housing:	Unincorporated Clark County	239	3	3.58	0.087	4	5	1.341	1.798	-0.488	0.157	-0.923	0	4	1	5
	City of Las Vegas	196	1	3.21	0.100	3	5	1.396	1.949	-0.075	0.174	-1.237	0	4	1	5
	North Las Vegas	72	0	3.59	0.158	4	5	1.337	1.786	-0.440	0.283	-1.035	1	4	1	5
	Henderson	82	2	3.73	0.137	4	5	1.239	1.535	-0.703	0.266	-0.379	1	4	1	5
	Boulder City	8	0	3.46	0.605	4	5	1.677	2.813	-0.302	0.764	-1.947	2	4	1	5
	Mesquite	5	1	3.07	0.905	4	5	2.083	4.341	-0.096	0.890	-3.241	2	4	1	5
Managing growth:	Unincorporated Clark County	241	2	3.77	0.086	4	5	1.339	1.793	-0.782	0.157	-0.634	0	4	1	5
	City of Las Vegas	193	4	3.59	0.093	4	5	1.294	1.674	-0.543	0.175	-0.807	0	4	1	5
	North Las Vegas	71	1	4.01	0.138	4	5	1.161	1.349	-1.155	0.284	0.651	1	4	4	5
	Henderson	83	1	4.06	0.135	5	5	1.235	1.524	-1.267	0.264	0.638	1	4	2	5
	Boulder City	8	0	4.80	0.154	5	5	0.427	0.182	-1.917	0.764	2.185	2	1	1	5
	Mesquite	6	0	4.29	0.537	5	5	1.307	1.709	-1.592	0.849	1.090	2	3	1	5
Increasing job opportunities:	Unincorporated Clark County	239	3	4.02	0.075	4	5	1.166	1.360	-1.144	0.157	0.490	0	4	1	5
	City of Las Vegas	192	5	3.78	0.090	4	5	1.246	1.552	-0.609	0.175	-0.781	0	4	1	5
	North Las Vegas	70	2	4.01	0.146	4	5	1.217	1.482	-1.155	0.287	0.490	1	4	3	5
	Henderson	82	2	4.08	0.107	4	5	0.974	0.949	-0.839	0.265	0.159	1	4	1	5
	Boulder City	8	0	3.87	0.367	4	3	1.018	1.036	0.327	0.764	-2.505	2	2	1	5
	Mesquite	5	1	3.74	0.749	5	5	1.725	2.977	-0.867	0.890	-1.371	2	4	1	5
Improving the business climate:	Unincorporated Clark County	238	5	3.89	0.067	4	5	1.031	1.064	-0.618	0.158	-0.306	0	4	1	5
	City of Las Vegas	191	6	3.77	0.083	4	5	1.154	1.332	-0.540	0.176	-0.638	0	4	2	5
	North Las Vegas	71	1	3.88	0.115	4	5	0.972	0.944	-0.390	0.284	-0.506	1	4	3	5
	Henderson	81	3	3.93	0.107	4	5	0.969	0.939	-0.453	0.267	-0.844	1	3	2	5
	Boulder City	7	1	3.77	0.376	3	3	1.001	1.002	0.598	0.790	-2.215	2	2	1	5
	Mesquite	6	0	3.87	0.509	4	5	1.239	1.535	-0.594	0.849	-1.173	2	3	1	5

Appendix I
Importance scores for selected variables
Summary Statistics by Jurisdiction

Community Development Importance Measure (Continued)		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Planning for commercial development:	Unincorporated Clark County	236	6	3.63	0.072	4	4	1.101	1.212	-0.610	0.158	-0.070	0	4	1	5
	City of Las Vegas	189	8	3.66	0.083	4	3	1.146	1.313	-0.533	0.177	-0.390	0	4	1	5
	North Las Vegas	69	3	3.87	0.124	4	5	1.029	1.059	-0.646	0.289	-0.099	1	4	3	5
	Henderson	82	2	3.79	0.128	4	5	1.154	1.332	-0.715	0.266	-0.247	1	4	3	5
	Boulder City	8	0	3.91	0.288	4	4	0.798	0.637	0.185	0.764	-1.082	2	2	1	5
	Mesquite	6	0	4.68	0.295	5	5	0.718	0.515	-2.515	0.849	7.883	2	2	1	5
Evaluating impacts to property values as a result of the proposed shipment of nuclear waste to Yucca Mountain:	Unincorporated Clark County	229	13	3.52	0.097	4	5	1.476	2.178	-0.535	0.161	-1.123	0	4	1	5
	City of Las Vegas	182	15	3.43	0.110	4	5	1.483	2.199	-0.351	0.180	-1.299	0	4	1	5
	North Las Vegas	68	4	3.68	0.167	4	5	1.375	1.891	-0.645	0.291	-0.726	1	4	1	5
	Henderson	79	5	3.76	0.146	4	5	1.295	1.677	-0.558	0.271	-0.965	1	4	2	5
	Boulder City	7	1	3.06	0.601	3	1	1.598	2.555	-0.230	0.790	-1.444	2	4	1	5
	Mesquite	6	0	3.25	0.483	3	3	1.177	1.385	0.694	0.849	-0.380	2	3	1	5
Evaluating impacts to Southern Nevada's tourism economy as a result of the proposed shipment of nuclear waste to Yucca Mountain:	Unincorporated Clark County	233	10	3.46	0.097	4	5	1.482	2.196	-0.464	0.159	-1.184	0	4	1	5
	City of Las Vegas	181	16	3.47	0.113	4	5	1.524	2.323	-0.424	0.181	-1.333	0	4	1	5
	North Las Vegas	70	2	3.44	0.170	4	5	1.423	2.024	-0.424	0.287	-1.081	1	4	1	5
	Henderson	79	5	3.75	0.139	4	5	1.238	1.532	-0.491	0.270	-1.004	1	4	1	5
	Boulder City	7	1	3.39	0.514	4	4	1.368	1.872	-0.652	0.790	0.139	2	4	1	5
	Mesquite	6	0	3.27	0.580	4	4	1.414	1.998	-1.103	0.849	0.798	2	4	1	5
Reducing traffic congestion:	Unincorporated Clark County	243	0	4.02	0.084	5	5	1.306	1.706	-1.084	0.156	-0.139	0	4	1	5
	City of Las Vegas	194	3	3.89	0.094	4	5	1.308	1.710	-0.872	0.174	-0.509	0	4	1	5
	North Las Vegas	72	0	4.07	0.145	5	5	1.225	1.501	-1.260	0.283	0.601	1	4	1	5
	Henderson	83	1	4.32	0.109	5	5	0.992	0.984	-1.580	0.264	2.236	1	4	2	5
	Boulder City	8	0	3.96	0.479	4	4	1.329	1.767	-1.786	0.764	3.843	2	4	1	5
	Mesquite	6	0	3.98	0.569	5	5	1.387	1.923	-1.045	0.849	-0.880	2	3	1	5

Appendix I
Importance scores for selected variables
Summary Statistics by Jurisdiction

Community Development Importance Measure (Continued)		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Access to freeways:	Unincorporated Clark County	239	3	3.83	0.078	4	5	1.201	1.441	-0.766	0.157	-0.356	0	4	1	5
	City of Las Vegas	195	2	3.71	0.086	4	5	1.201	1.443	-0.445	0.174	-0.900	0	4	1	5
	North Las Vegas	72	0	3.91	0.122	4	5	1.035	1.071	-0.417	0.283	-0.875	1	4	1	5
	Henderson	83	1	4.01	0.106	4	4	0.962	0.926	-0.860	0.264	0.475	1	4	3	5
	Boulder City	8	0	3.95	0.528	5	5	1.463	2.141	-1.300	0.764	1.156	2	4	1	5
	Mesquite	6	0	4.17	0.392	4	5	0.956	0.914	-0.462	0.849	-2.182	2	2	1	5
Improving road conditions:	Unincorporated Clark County	242	1	4.03	0.073	4	5	1.127	1.270	-1.040	0.157	0.334	0	4	2	5
	City of Las Vegas	197	0	3.85	0.079	4	5	1.114	1.241	-0.619	0.173	-0.484	0	4	1	5
	North Las Vegas	72	0	4.00	0.109	4	5	0.925	0.857	-0.138	0.283	-1.556	1	3	2	5
	Henderson	83	1	4.01	0.108	4	5	0.982	0.964	-0.775	0.264	0.057	1	4	3	5
	Boulder City	8	0	4.12	0.396	4	5	1.099	1.209	-1.137	0.764	0.609	2	3	1	5
	Mesquite	6	0	4.41	0.303	5	5	0.738	0.545	-0.973	0.849	0.749	2	2	1	5
Reducing travel time:	Unincorporated Clark County	241	2	3.79	0.077	4	5	1.188	1.411	-0.678	0.157	-0.390	0	4	1	5
	City of Las Vegas	195	2	3.70	0.089	4	5	1.242	1.543	-0.610	0.174	-0.650	0	4	1	5
	North Las Vegas	70	2	3.78	0.134	4	5	1.123	1.261	-0.556	0.287	-0.377	1	4	2	5
	Henderson	82	2	3.87	0.122	4	5	1.101	1.212	-0.735	0.266	-0.168	1	4	1	5
	Boulder City	7	1	3.65	0.439	3	3	1.167	1.363	0.169	0.790	-1.594	2	3	1	5
	Mesquite	5	1	3.62	0.648	4	4	1.404	1.970	-1.345	0.939	4.730	2	4	1	5
Providing mass public transit:	Unincorporated Clark County	239	3	3.67	0.084	4	5	1.293	1.673	-0.744	0.157	-0.472	0	4	1	5
	City of Las Vegas	195	2	3.64	0.092	4	5	1.289	1.662	-0.529	0.174	-0.849	0	4	1	5
	North Las Vegas	69	2	3.77	0.147	4	5	1.221	1.490	-0.672	0.288	-0.408	1	4	2	5
	Henderson	82	2	3.69	0.135	4	5	1.224	1.497	-0.618	0.266	-0.558	1	4	1	5
	Boulder City	8	0	3.83	0.417	4	5	1.157	1.339	-0.285	0.764	-1.467	2	3	1	5
	Mesquite	6	0	3.26	0.683	3	5	1.662	2.764	-0.379	0.849	-1.443	2	4	1	5

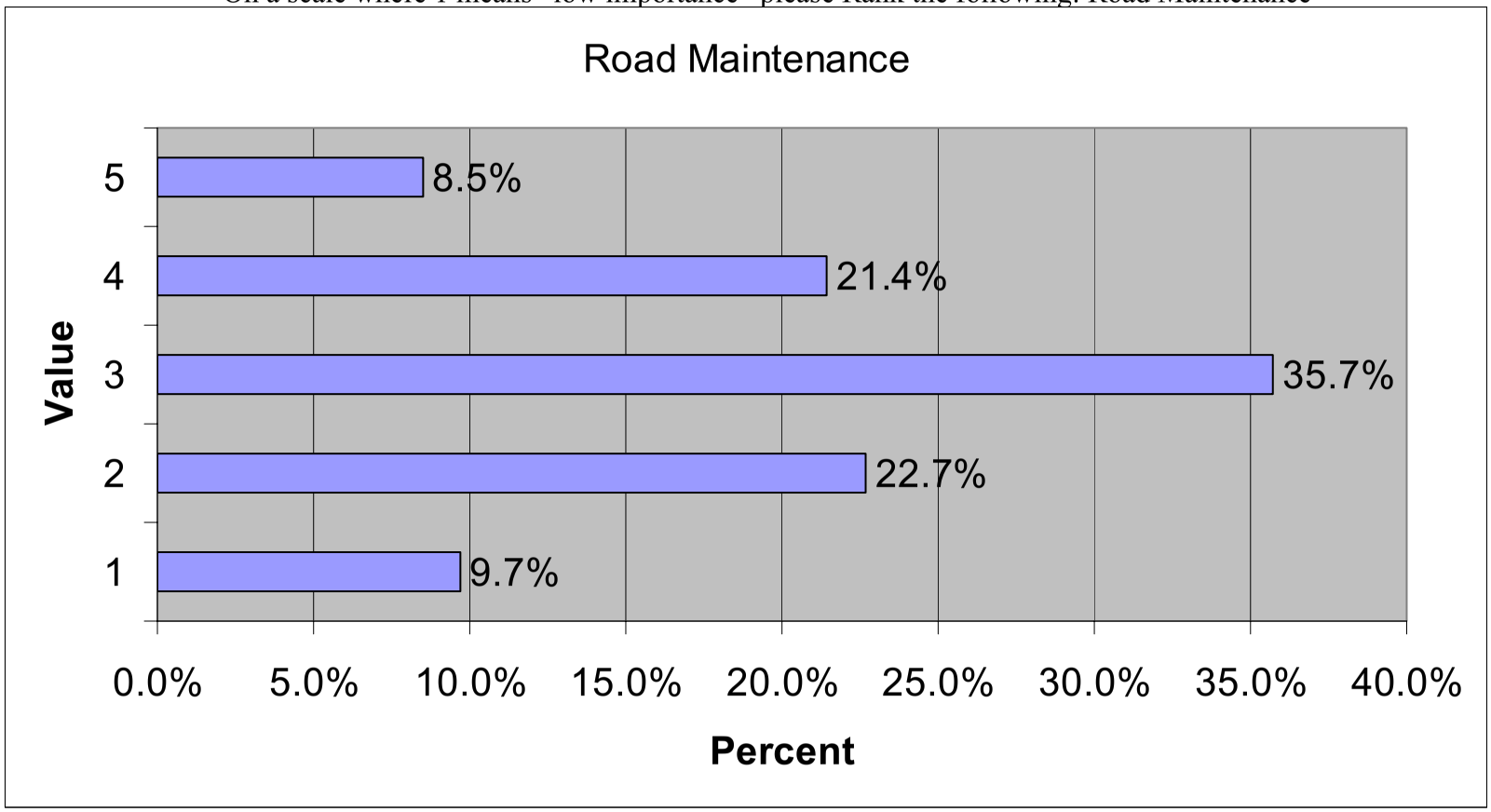
Appendix II
Performance Score for Selected Services

Appendix II
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 Being high)

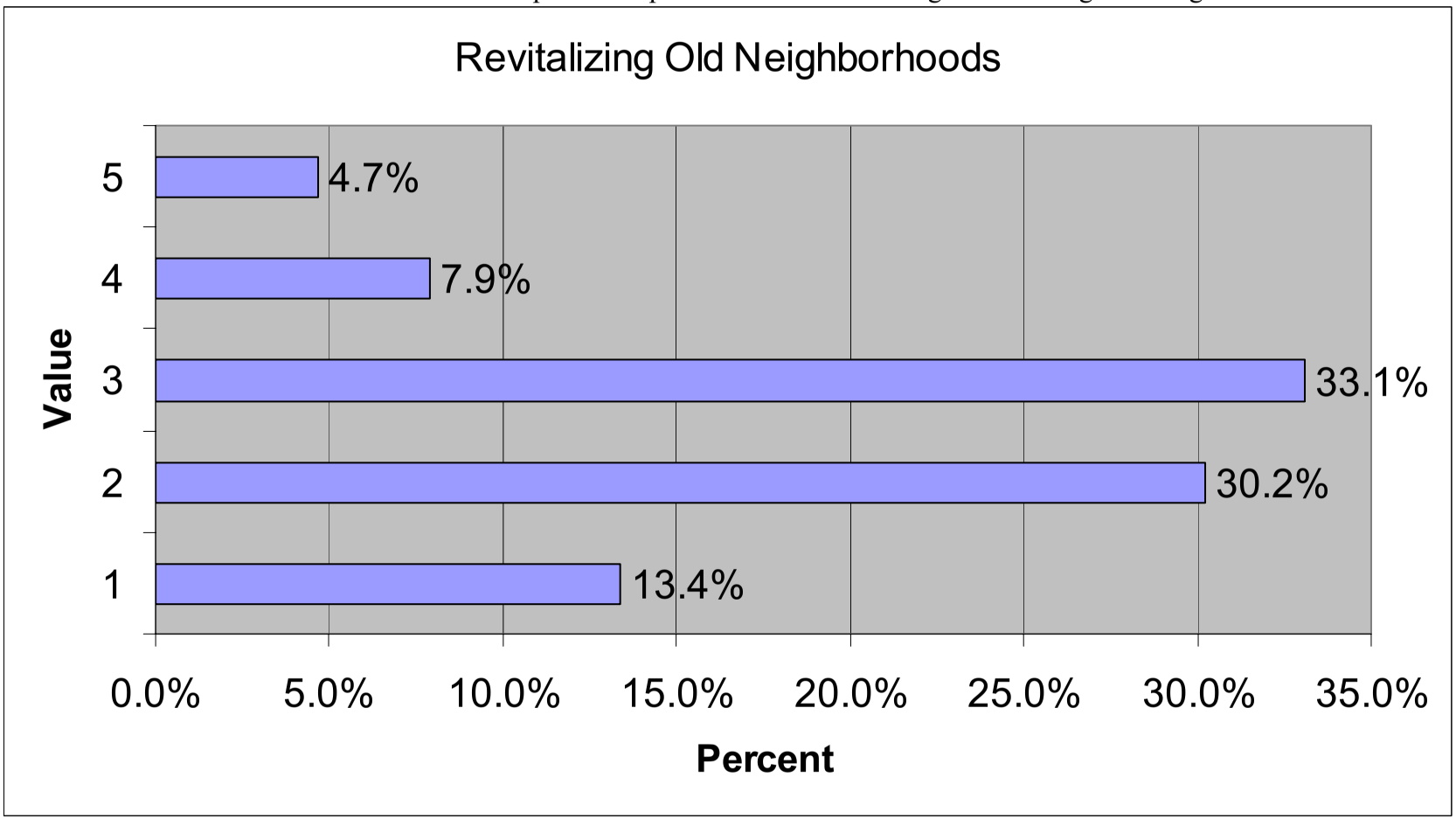
Variable	N	Mean	Median	Std. Error of Mean	Min	Max	Std. Deviation	Kurtosis	Std Error of Kurtosis	Skewness	Std Error of Skewness
General Government Services											
Road Maintenance	598	3.59	3	0.045	1	5	1.093	-0.591	0.200	0.019	0.100
Revitalizing older neighborhoods	544	3.72	3	0.044	1	5	1.020	-0.041	0.209	0.419	0.105
Flood Control	593	3.44	4	0.046	1	5	1.127	-0.472	0.200	-0.452	0.100
Budget management	558	2.71	3	0.044	1	5	1.040	-0.280	0.207	0.134	0.103
Communicate Clark County's local governments' views about Yucca Mountain to federal decision makers	564	2.83	3	0.054	1	1	1.272	-0.992	0.205	0.082	0.103
Monitor and report to the public on how well government services are being performed	579	2.57	3	0.045	1	1	1.084	-0.530	0.203	0.219	0.102
**Social and Judicial Services*											
Providing Child Protection Services	552	2.82	3	0.047	1	5	1.113	-0.545	0.208	0.094	0.104
Providing Child Welfare Services	543	2.90	3	0.048	1	5	1.121	-0.576	0.209	0.080	0.105
Providing Juvenile Justice Services	547	2.79	3	0.046	1	5	1.068	-0.493	0.208	0.048	0.104
Providing Attainable Housing for Working Class Families	562	2.48	2	0.047	1	5	1.108	-0.515	0.206	0.372	0.103
Providing Affordable housing for Low Income Families	566	2.39	2	0.047	1	5	1.150	-0.560	0.205	0.486	0.103
Providing shelter for the homeless	569	2.10	2	0.049	1	5	1.171	-0.165	0.205	0.853	0.102
Providing Affordable housing for seniors	557	2.56	3	0.049	1	5	1.151	-0.703	0.207	0.264	0.104
Providing medical care for the poor	558	2.56	3	0.052	1	5	1.226	-0.946	0.206	0.249	0.103
Providing 24-hour emergency trauma care	486	2.55	3	0.049	1	5	1.086	-0.624	0.221	0.211	0.110
**Public Safety*											
Providing crime prevention programs	581	2.90	3	0.042	1	5	1.004	-0.277	0.202	1.009	-0.152
Enforcing traffic laws	599	2.90	3	0.049	1	5	1.210	-0.846	0.199	1.464	0.074
Maintaining a low crime rate	598	2.76	3	0.044	1	5	1.068	-0.531	0.200	0.003	0.100
Maintaining neighborhood police patrols	591	2.68	3	0.045	1	5	1.092	-0.508	0.201	0.325	0.101
Keeping police response times low	567	3.01	3	0.048	1	5	1.150	-0.756	0.205	-0.054	0.103
Keeping fire department response times low	546	3.73	4	0.041	1	5	0.960	0.399	0.209	-0.689	0.105

Performance Variable	N	Mean	Median	Std. Error of Mean	Min	Max	Std. Deviation	Kurtosis	Std Error of Kurtosis	Skewness	Std Error of Skewness
Keeping paramedic and emergency response times low	560	3.76	4	0.041	1	5	0.960	0.052	0.206	-0.602	0.103
Well trained paramedic and emergency response personnel	549	3.93	4	0.038	1	5	0.892	0.613	0.208	-0.769	0.104
Facilitate neighborhood watch programs	548	2.69	3	0.044	1	5	1.021	-0.232	0.208	0.246	0.104
Preparing for natural disasters	573	2.81	3	0.049	1	5	1.177	-0.808	0.204	0.023	0.102
Preparing for man-made accidents or terrorist events	575	2.76	3	0.049	1	5	1.176	-0.755	0.203	0.127	0.102
Investigating criminal activity	562	2.99	3	0.046	1	5	1.079	-0.467	0.206	-0.091	0.103
Providing fire protection and prevention services	574	3.58	4	0.039	1	5	0.940	-0.068	0.204	-0.330	0.102
Providing emergency medical services	582	3.65	4	0.041	1	5	0.991	0.011	0.202	-0.540	0.101
Providing for neighborhood code enforcement services	532	2.86	3	0.047	1	5	1.095	-0.559	0.211	0.170	0.106
Examining potential impacts from Yucca Mountain nuclear waste shipments	545	2.69	3	0.053	1	5	1.232	-0.952	0.209	0.177	0.105
Community Development											
Providing affordable housing	568	2.43	2	0.044	1	5	1.060	-0.403	0.205	0.361	0.103
Managing growth	598	2.45	2	0.047	1	5	1.145	-0.571	0.199	0.418	0.100
Increasing job opportunities	588	3.06	3	0.048	1	5	1.152	-0.653	0.201	-0.095	0.101
Improving the business climate	586	3.27	3	0.041	1	5	0.998	-0.133	0.202	-0.335	0.101
Planning for commercial development	575	3.26	3	0.044	1	5	1.059	-0.277	0.204	-0.324	0.102
Evaluating impacts to property values as a result of the proposed shipment of nuclear waste to Yucca Mountain	543	2.33	2	0.051	1	5	1.183	-0.511	0.209	0.550	0.105
Evaluating impacts to Southern Nevada's tourism economy as a result of proposed shipment of nuclear waste to Yucca Mountain	541	2.55	3	0.052	1	5	1.204	-0.736	0.210	0.323	0.104
Reducing traffic congestion	596	2.38	2	0.045	1	5	1.097	-0.410	0.200	0.503	0.100
Access to freeways	597	2.98	3	0.044	1	5	1.085	-0.553	0.200	-0.052	0.100
Improving road conditions	599	2.93	3	0.044	1	5	1.790	-0.580	0.199	-0.048	0.100
Reducing travel time	592	2.67	3	0.046	1	5	1.117	-0.602	0.201	0.225	0.100
Providing mass public transit	585	2.76	3	0.031	1	5	1.248	0.425	0.202	0.144	0.101

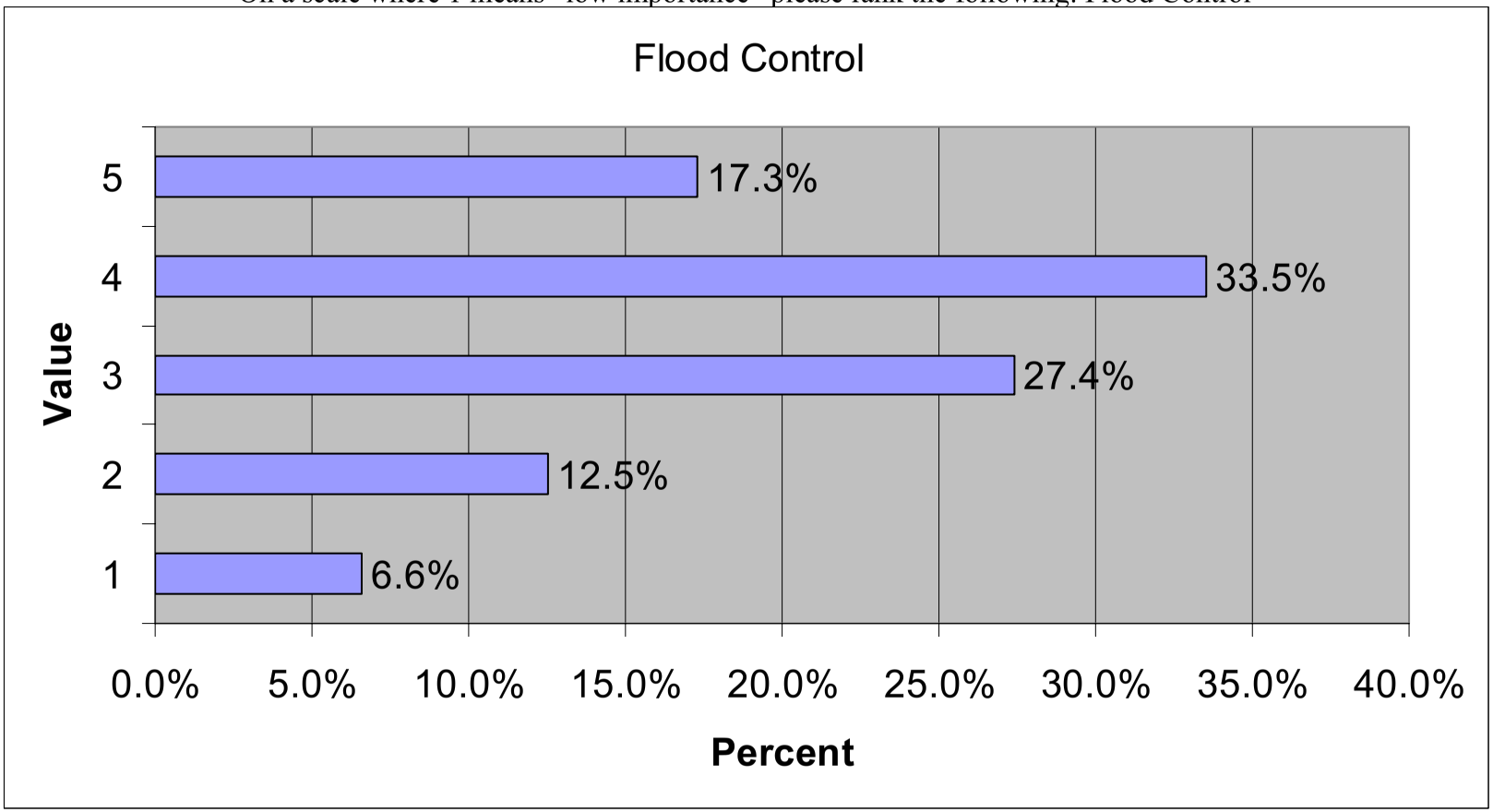
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Road Maintenance



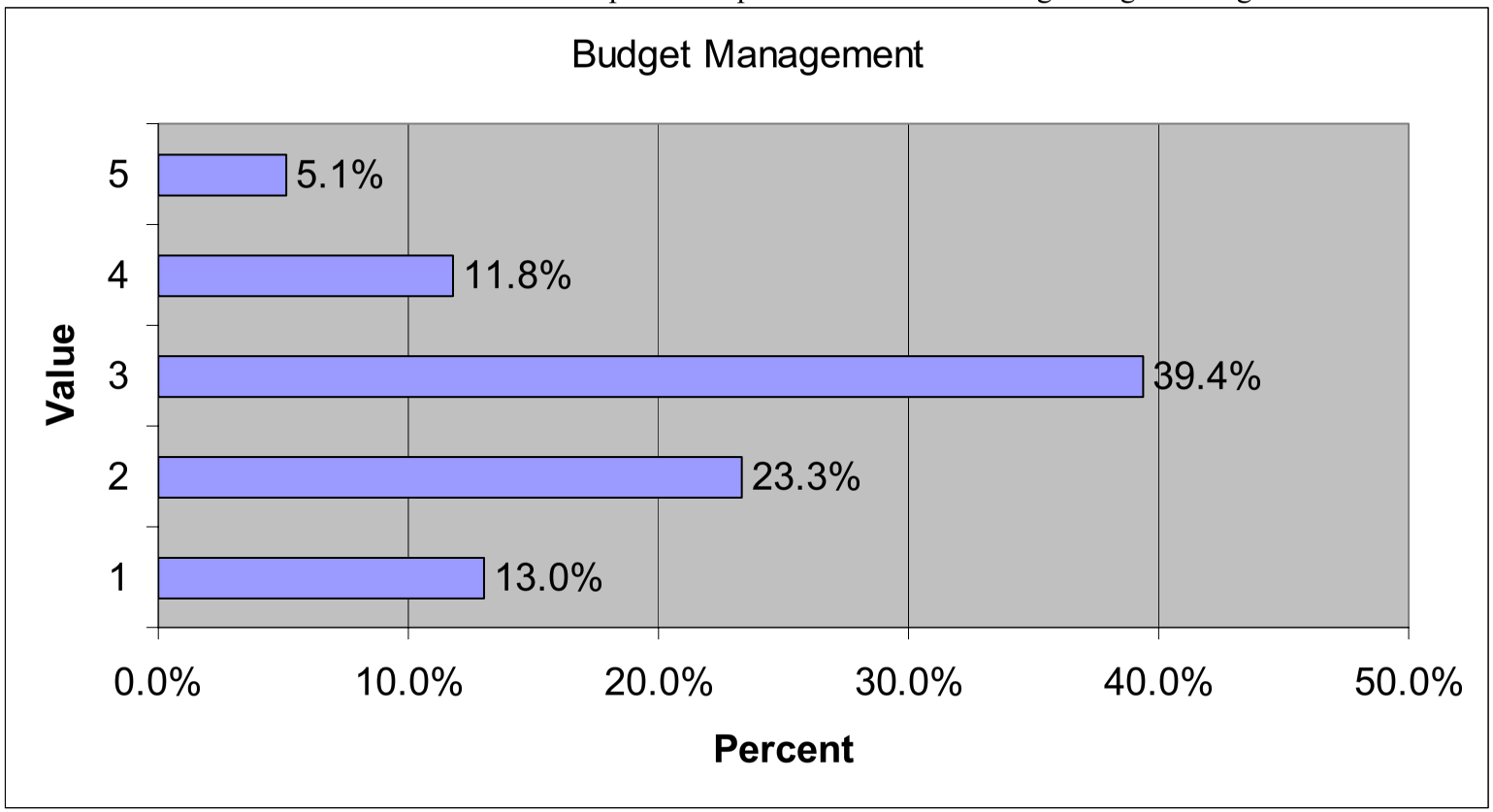
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please Rank the following: Revitalizing Old Neighborhoods



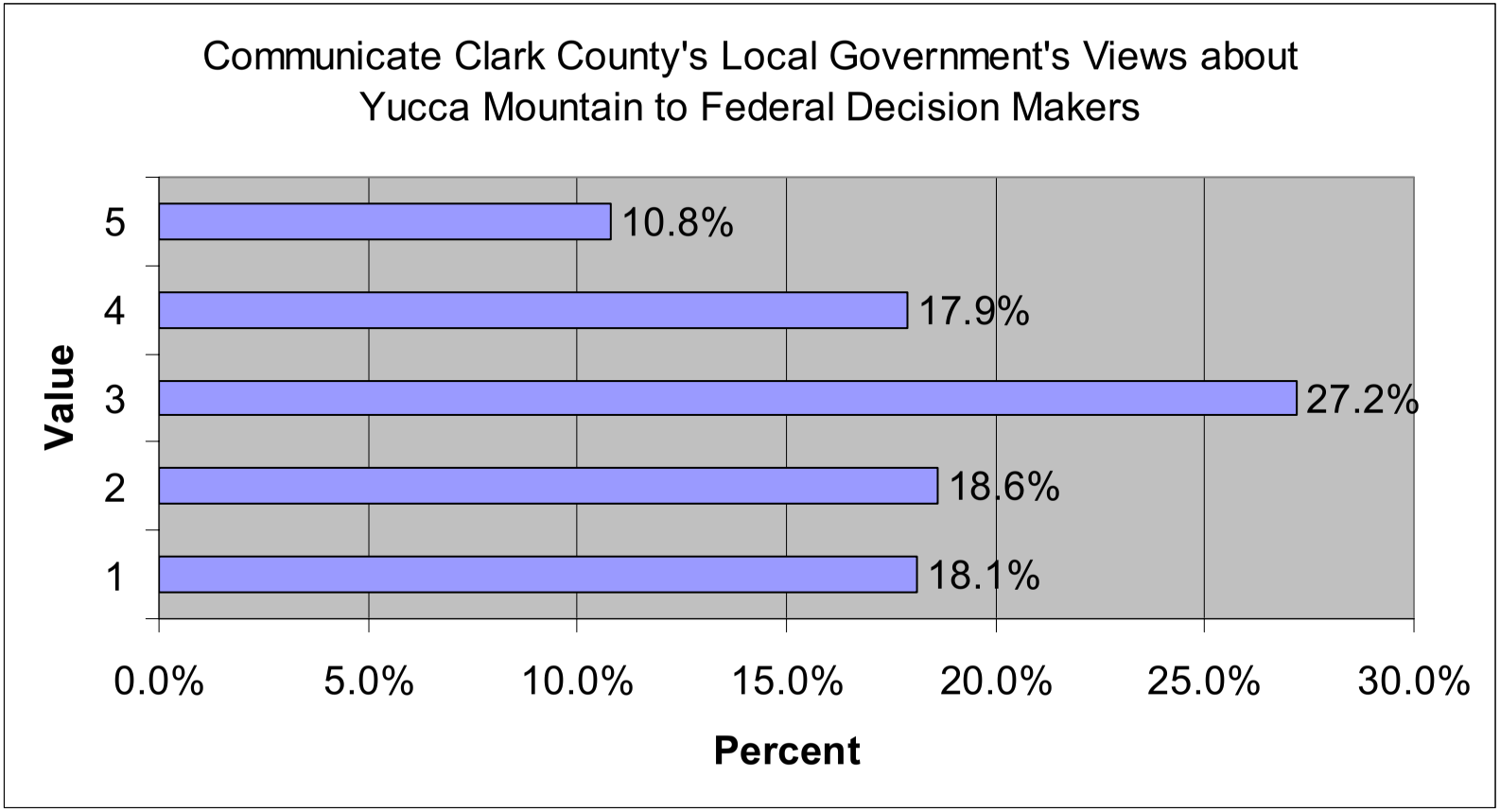
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Flood Control



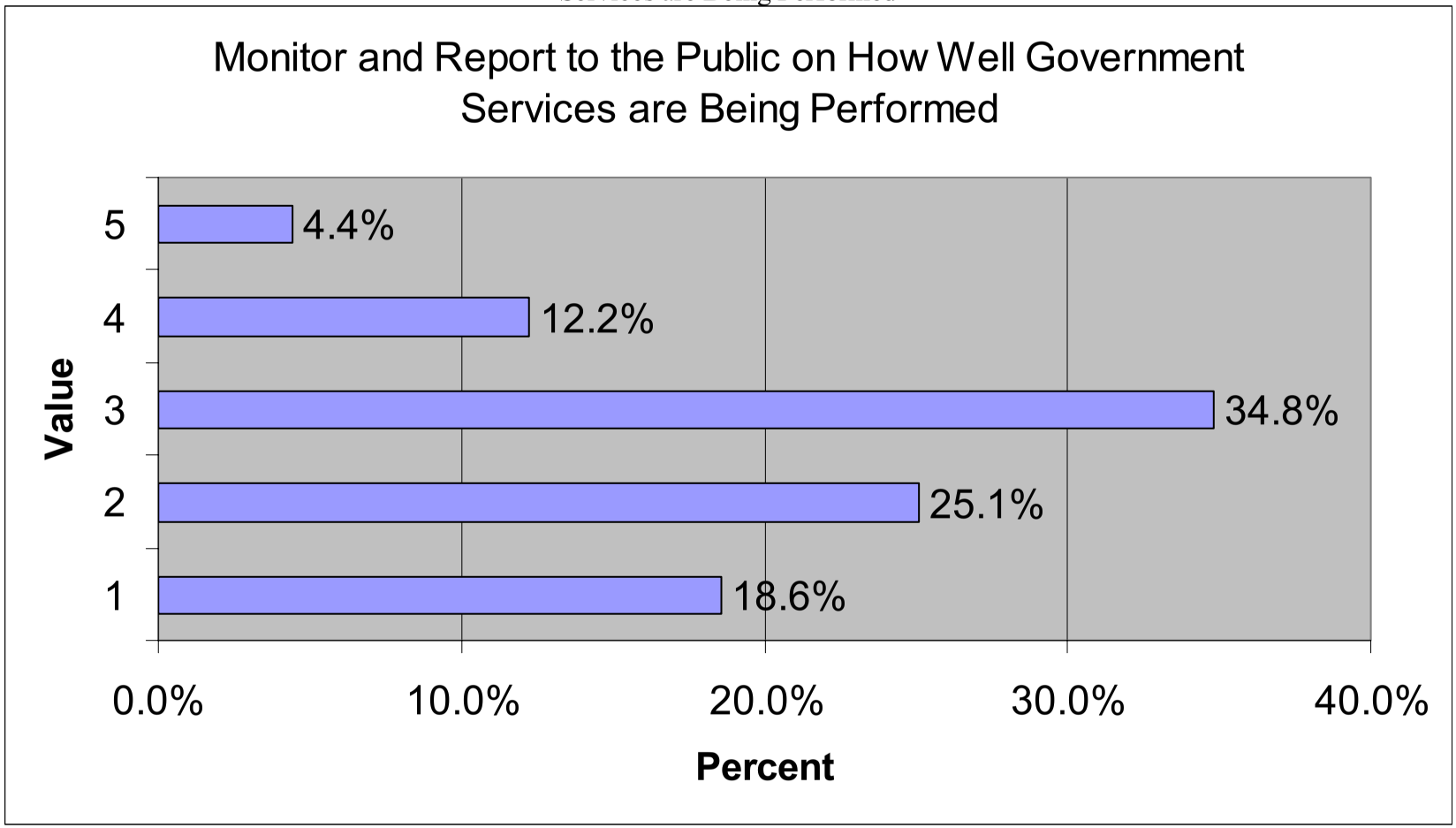
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Budget Management



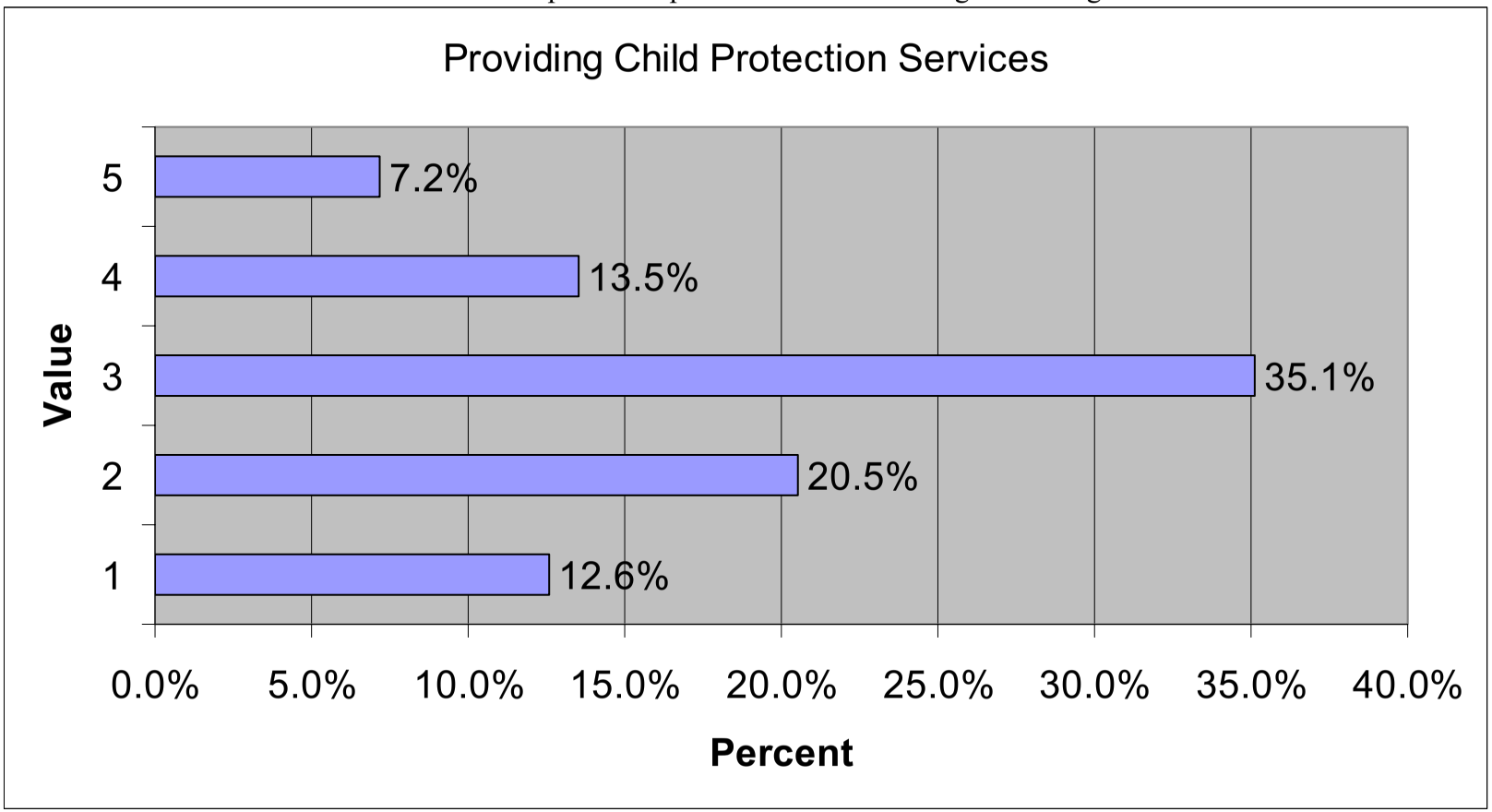
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Communicate Clark County’s Local Government Views about Yucca Mountain to Federal Decision Makers



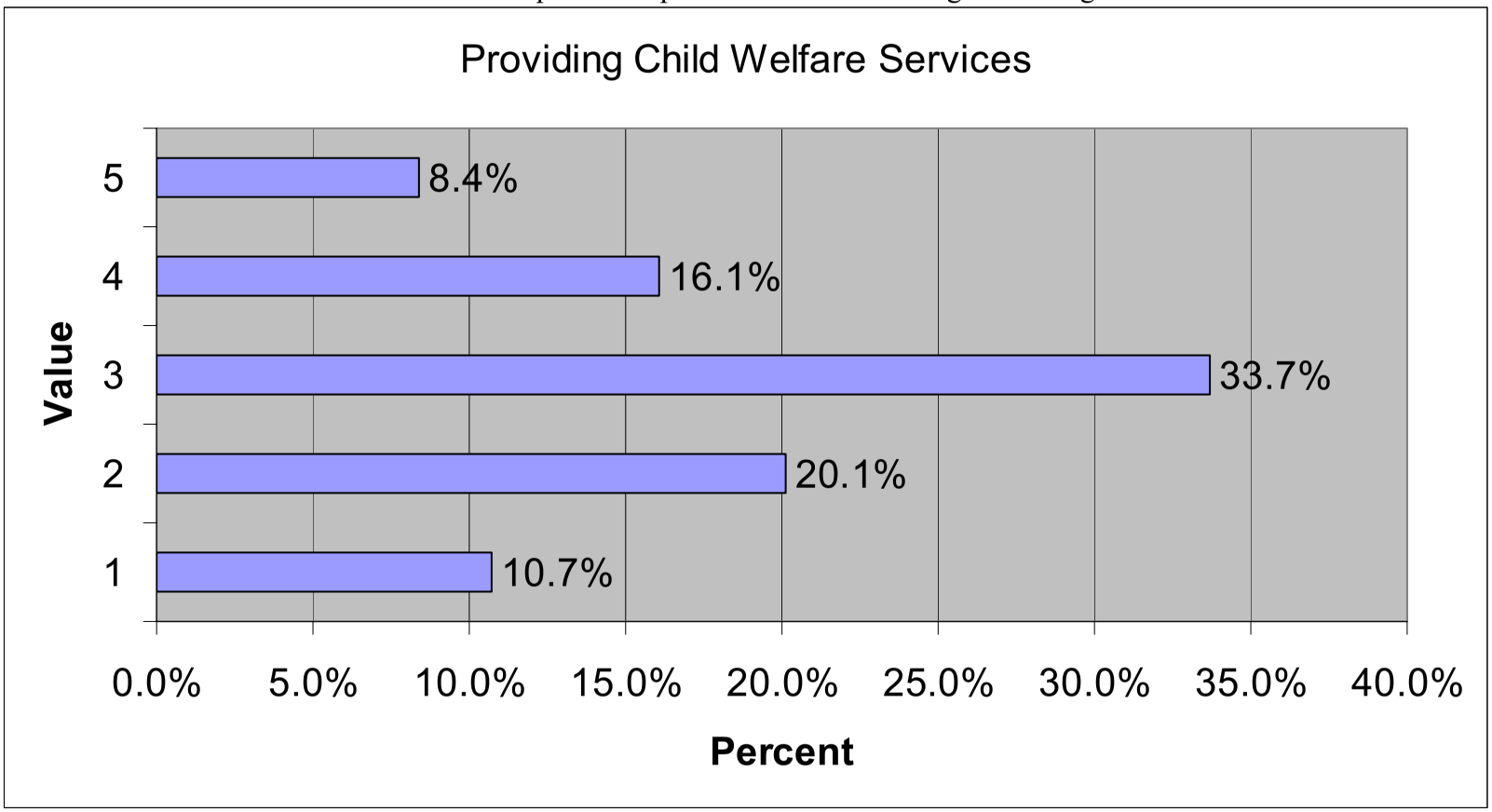
Appendix II
Performance scores for selected variables
On a scale where 1 means "low importance" please rank the following: Monitor and Report to the Public on how Well Government Services are Being Performed



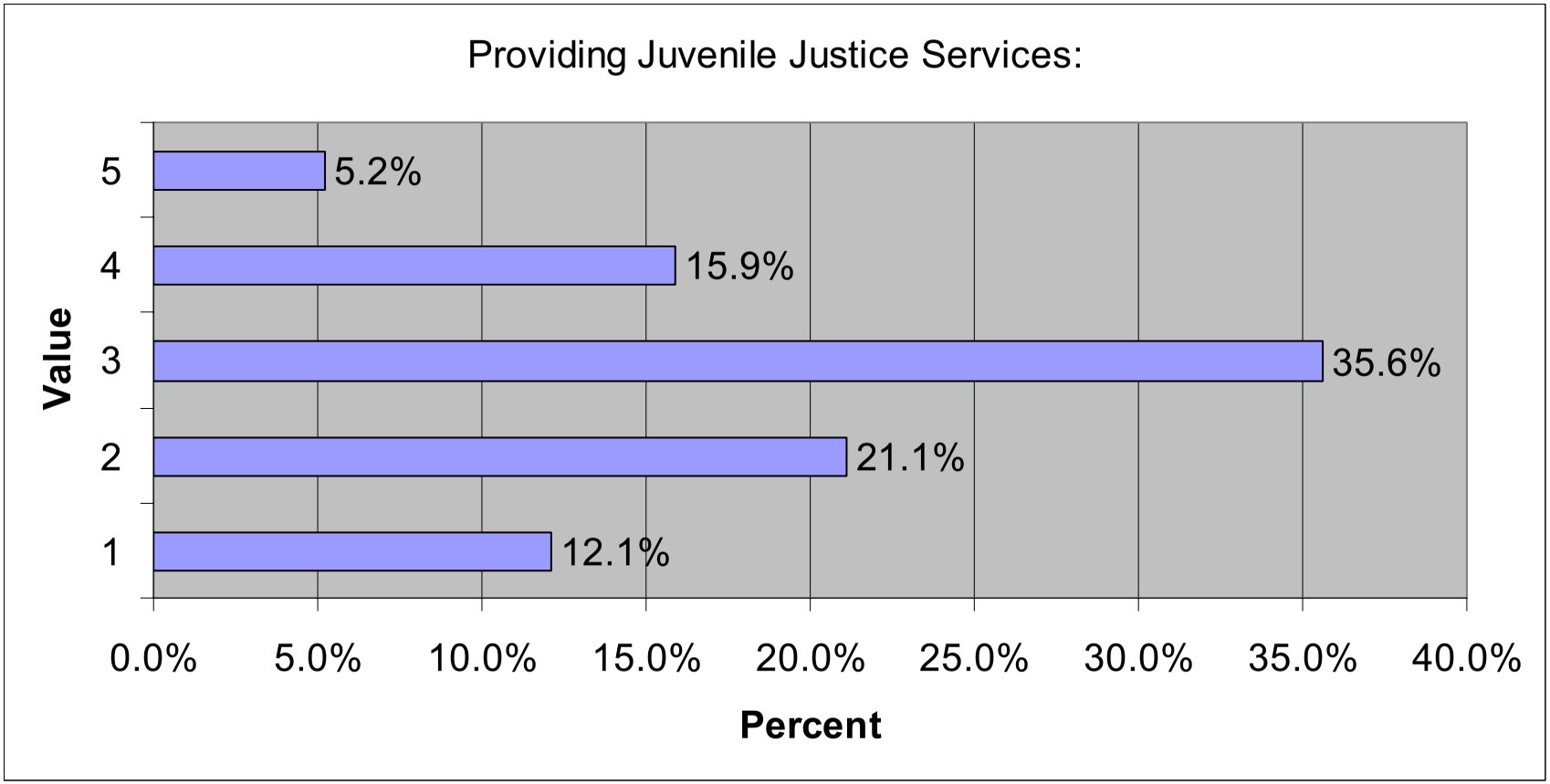
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Providing Child Protection Services



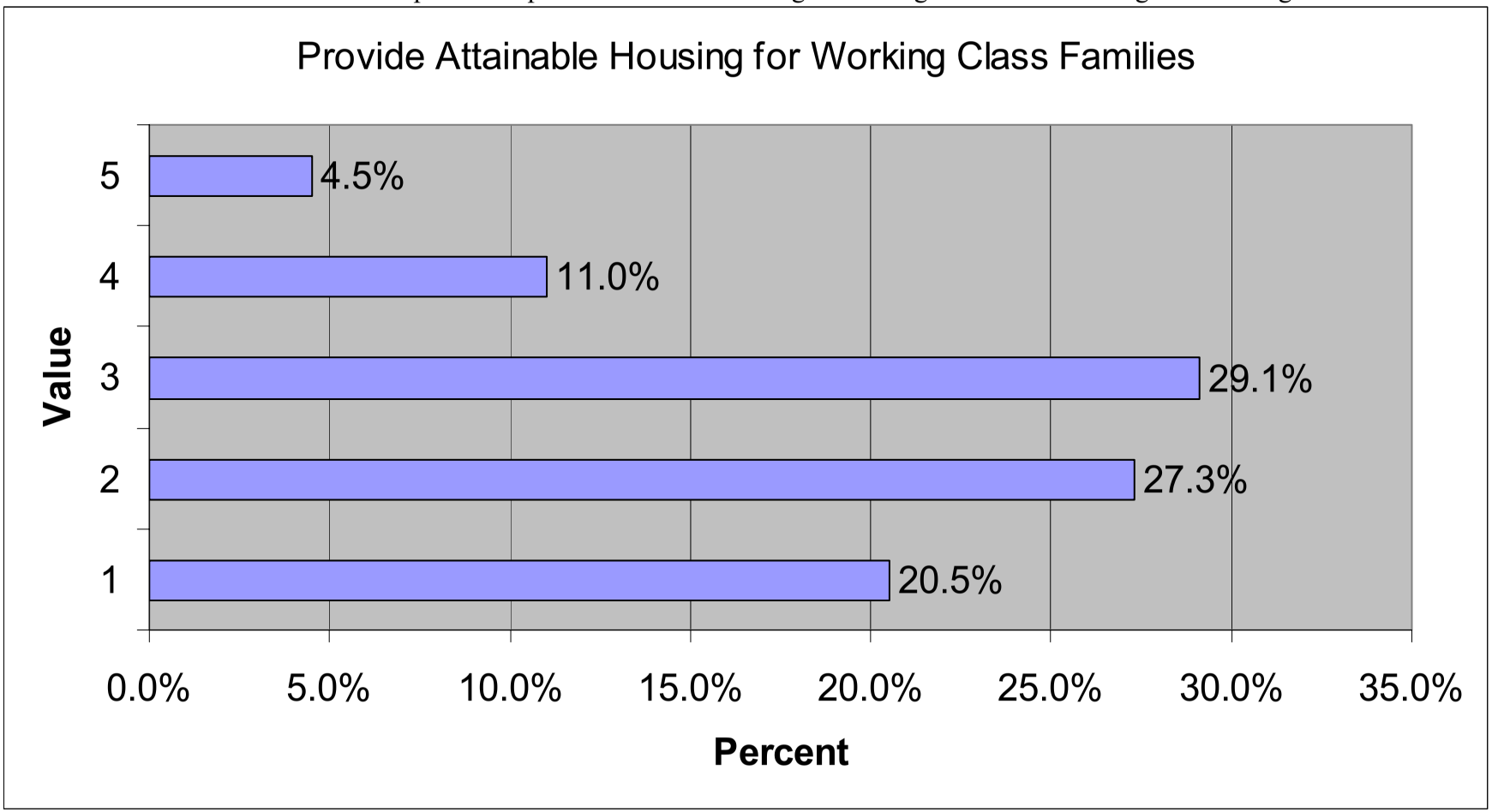
Appendix II
Performance scores for selected variables
On a scale where 1 means "low importance" please rank the following: Providing Child Welfare Services



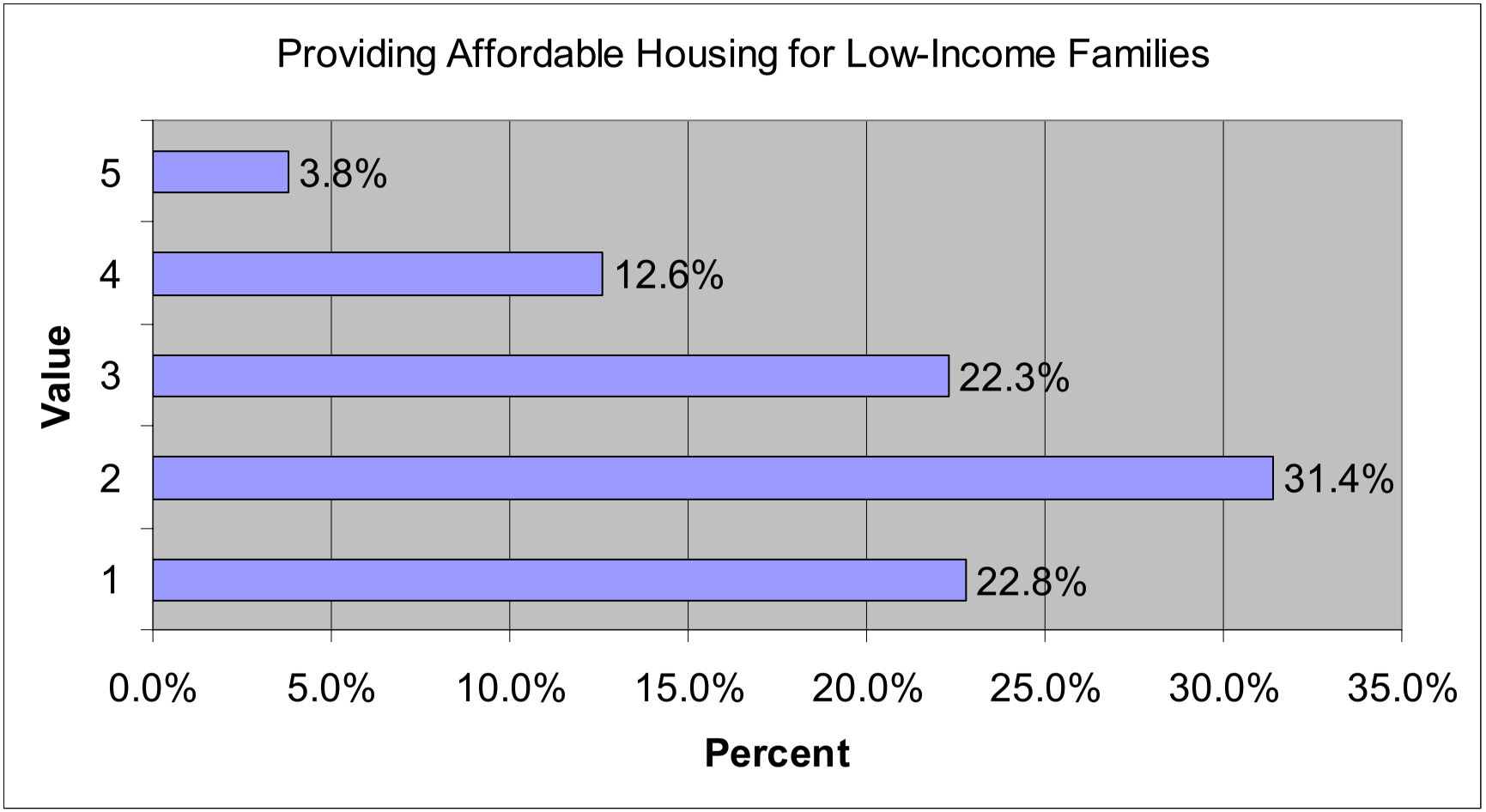
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Providing Juvenile Justice Services



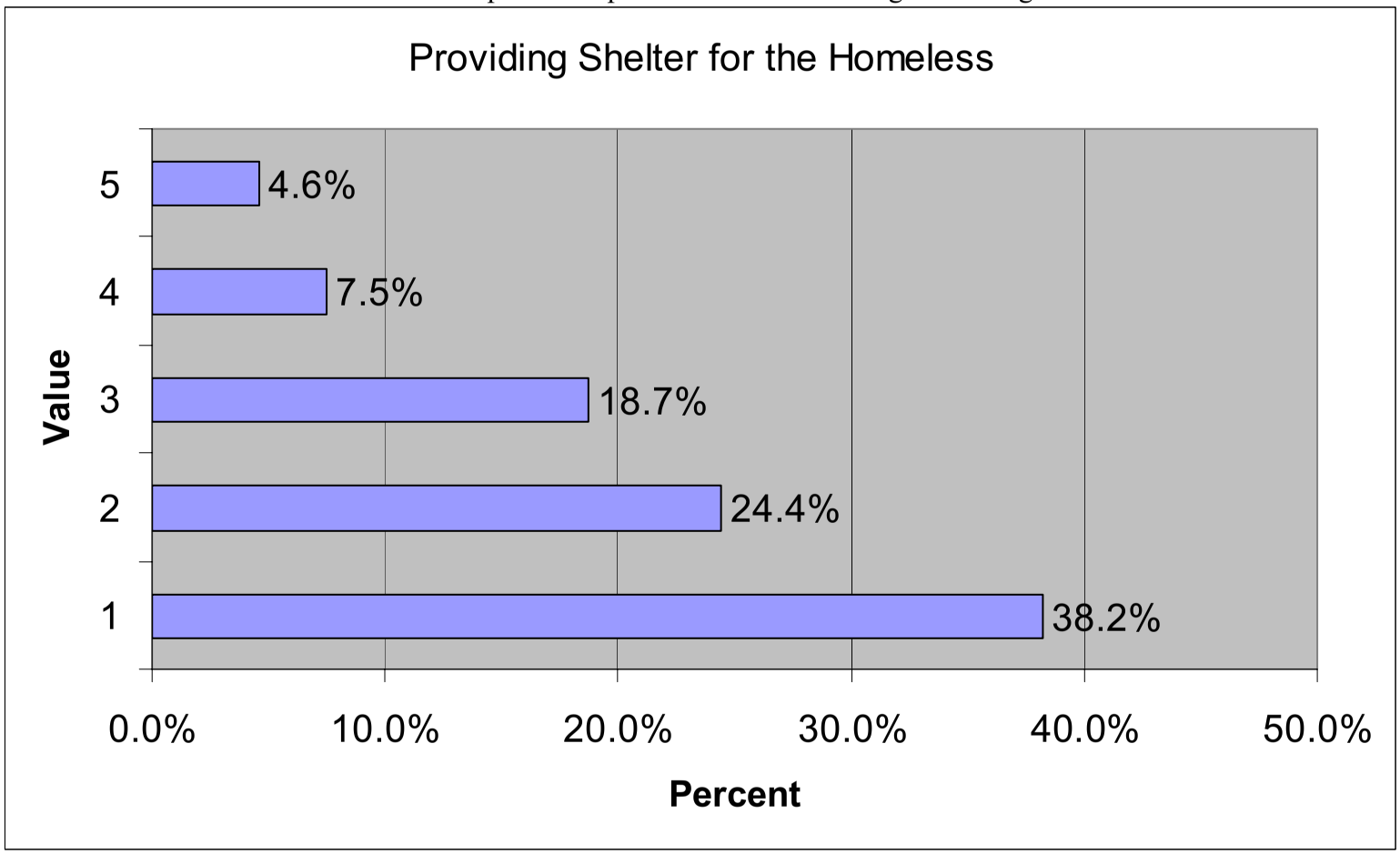
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Providing Attainable Housing for Working Class Families



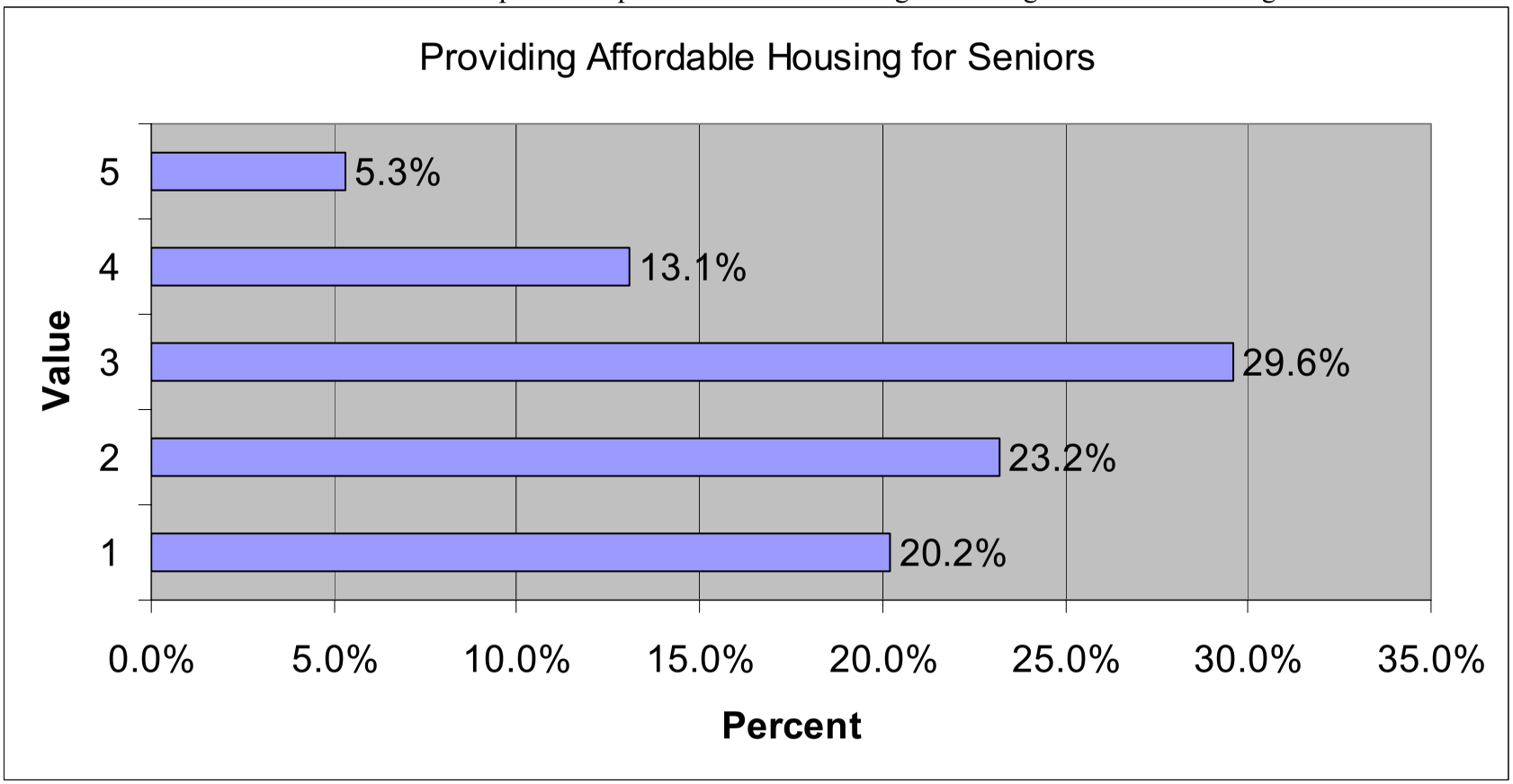
Appendix II
Performance scores for selected variables
On a scale where 1 means "low importance" please rank the following: Provide Affordable Housing for Low-Income Families



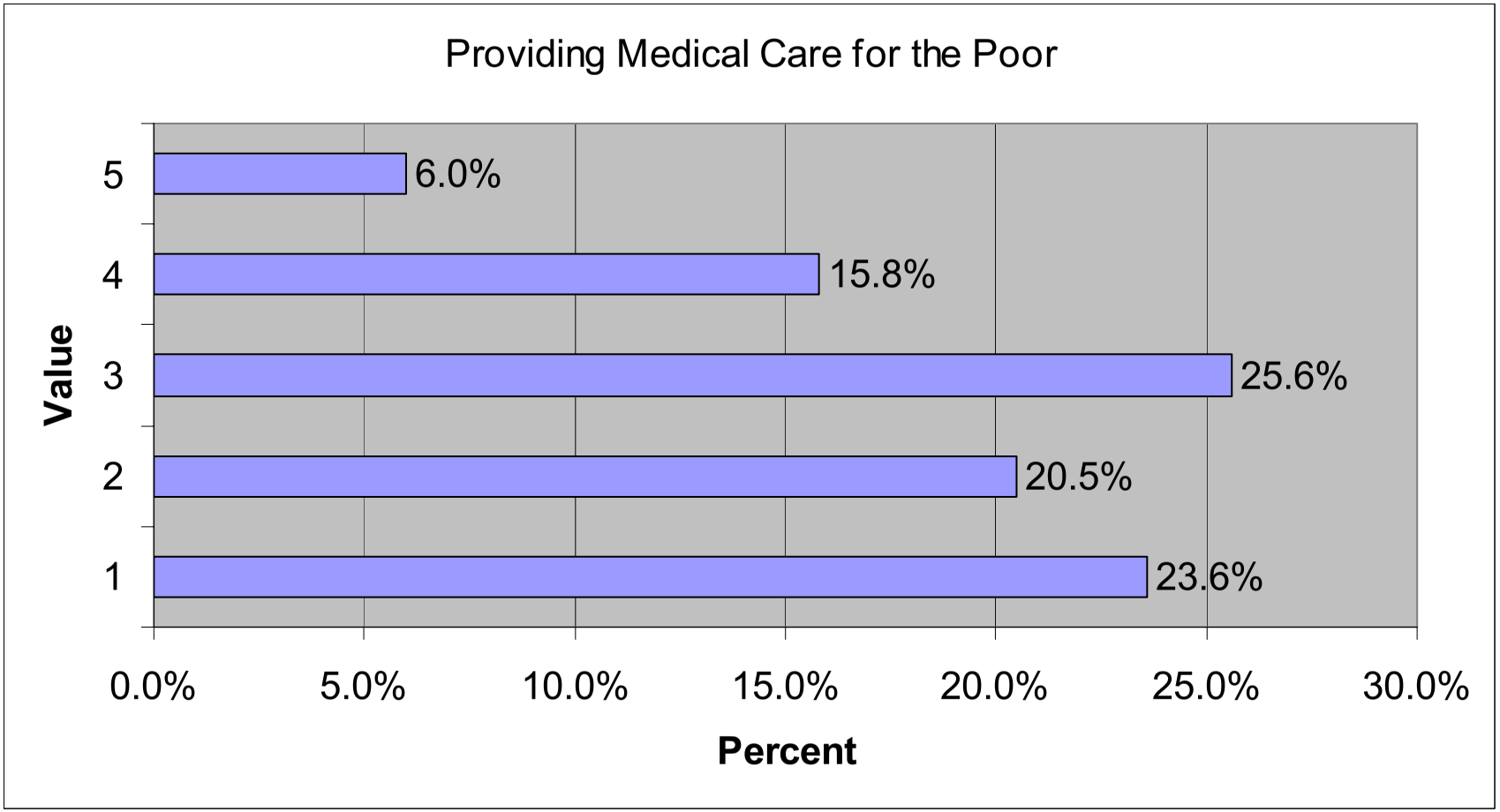
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Providing Shelter for the Homeless



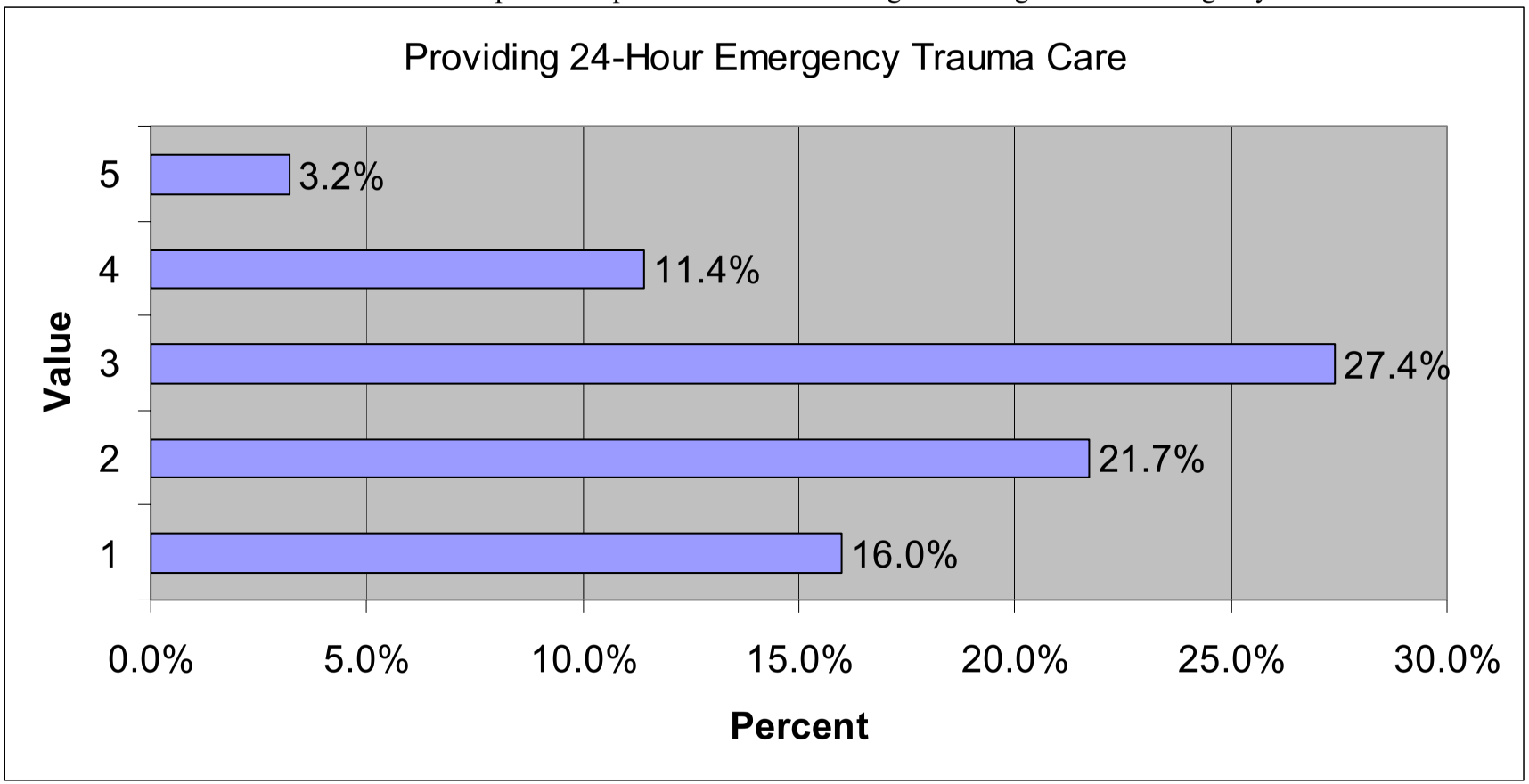
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Providing Affordable Housing for Seniors



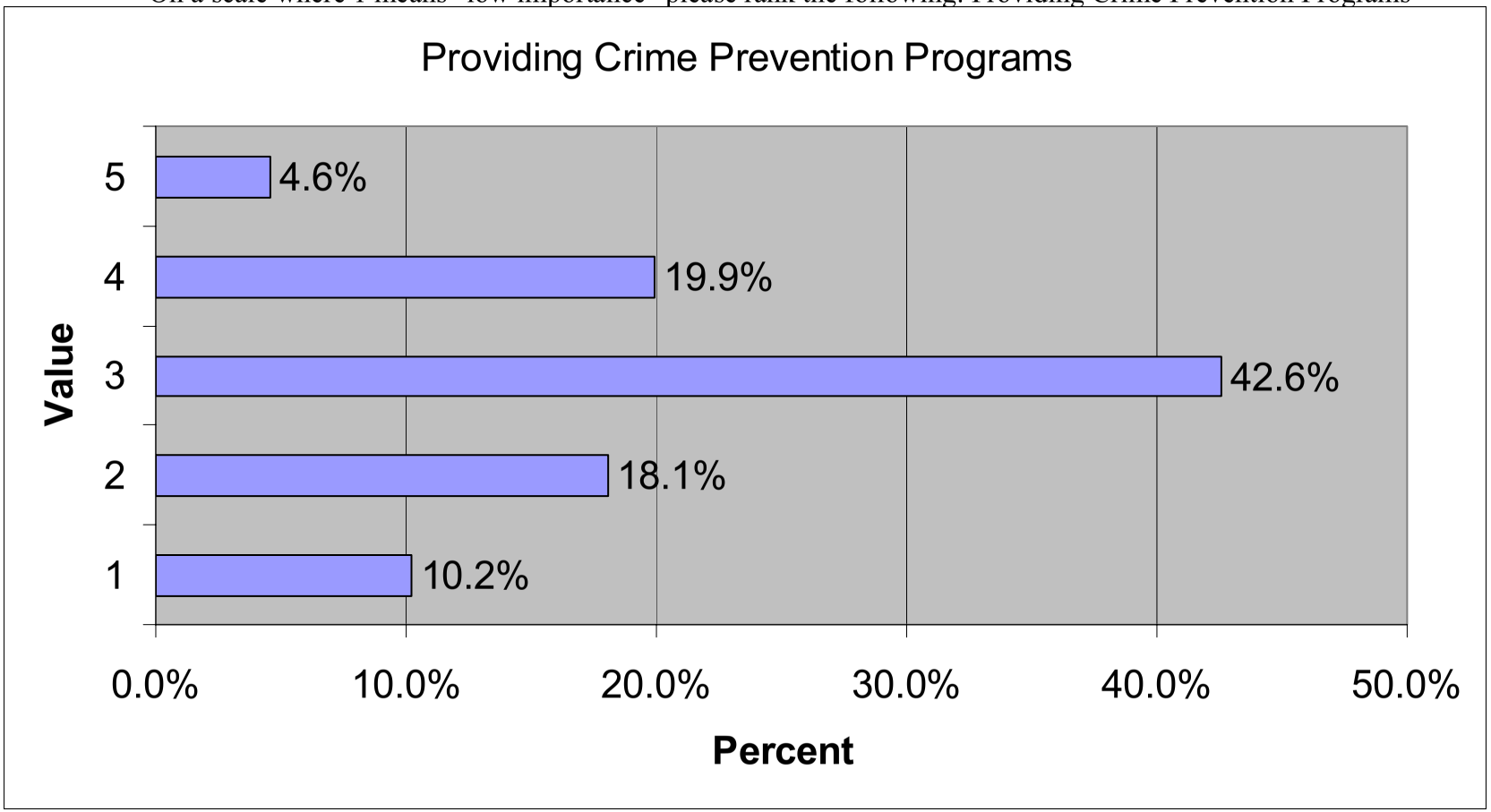
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Providing Medical Care for the Poor



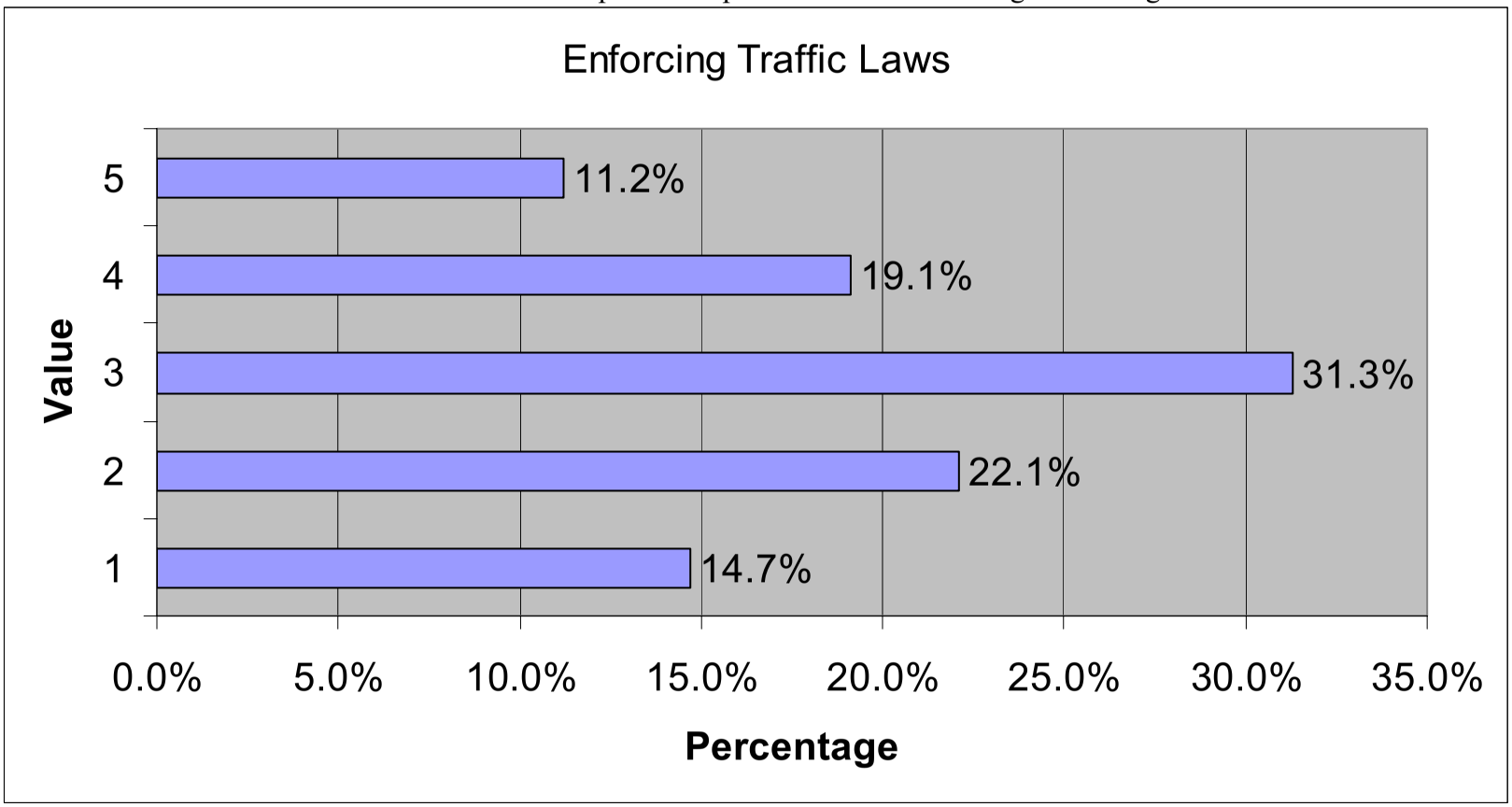
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Providing 24-Hour Emergency Trauma Care



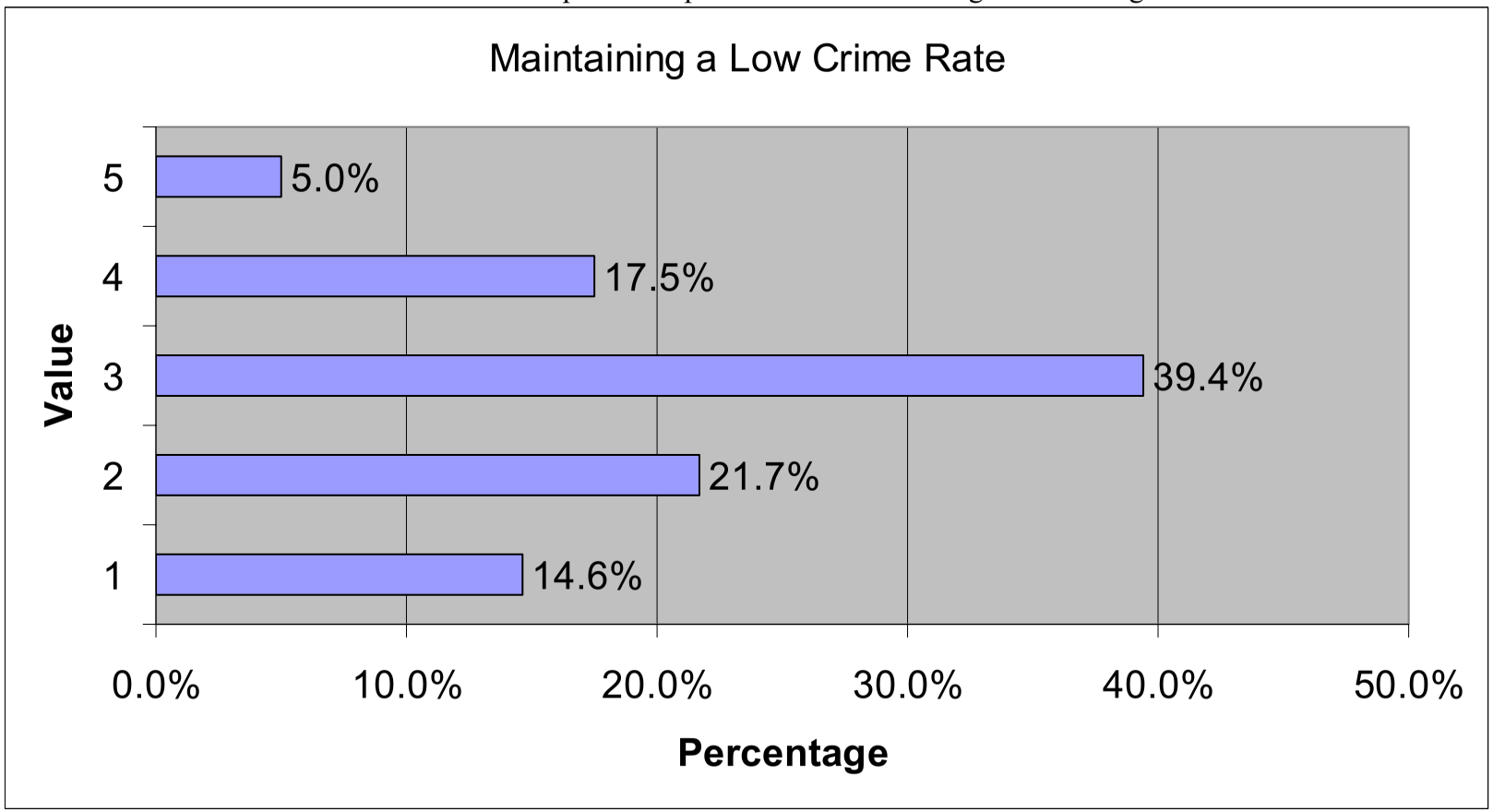
Appendix II
Performance scores for selected variables
On a scale where 1 means "low importance" please rank the following: Providing Crime Prevention Programs



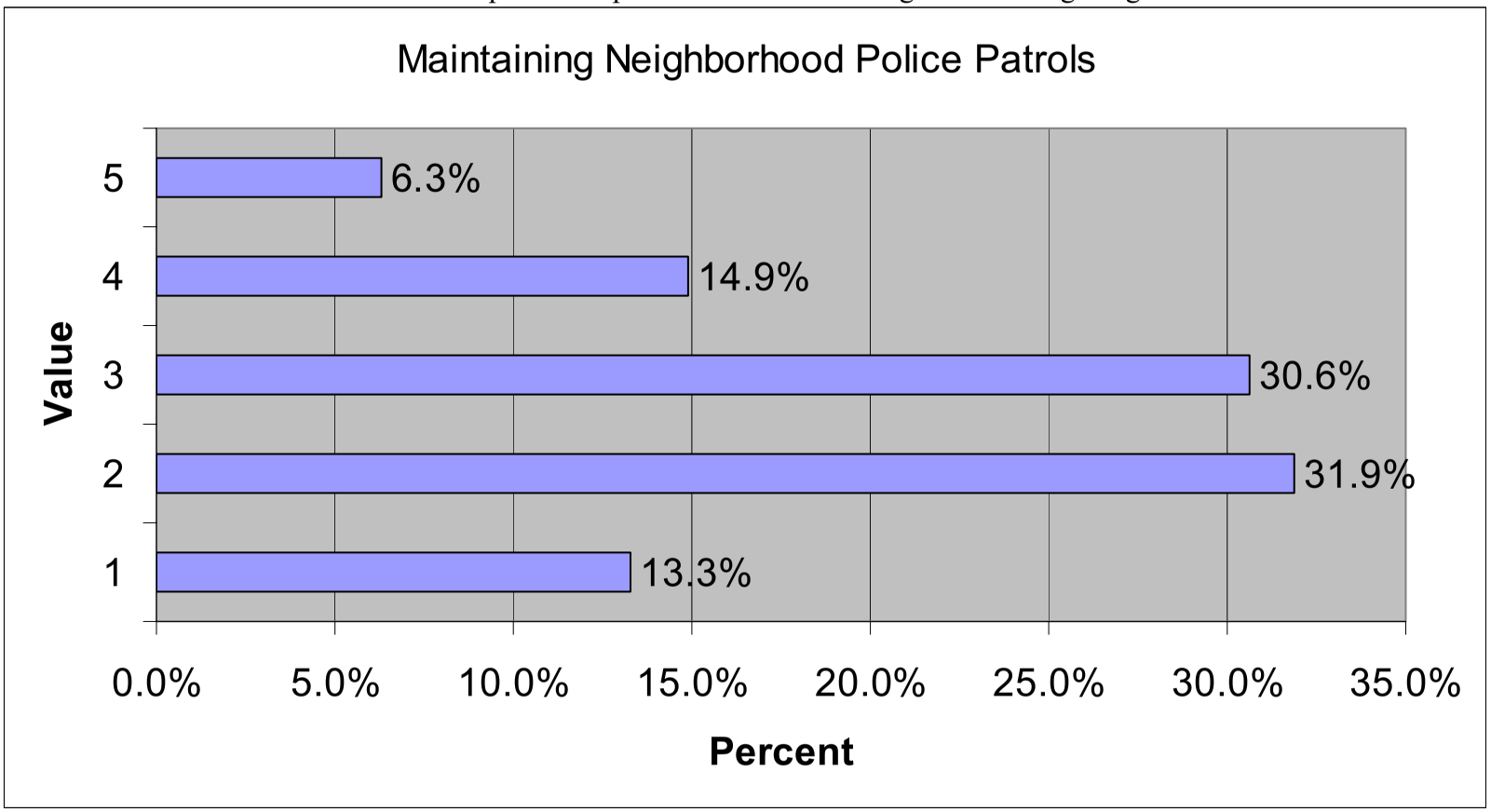
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Enforcing Traffic Laws



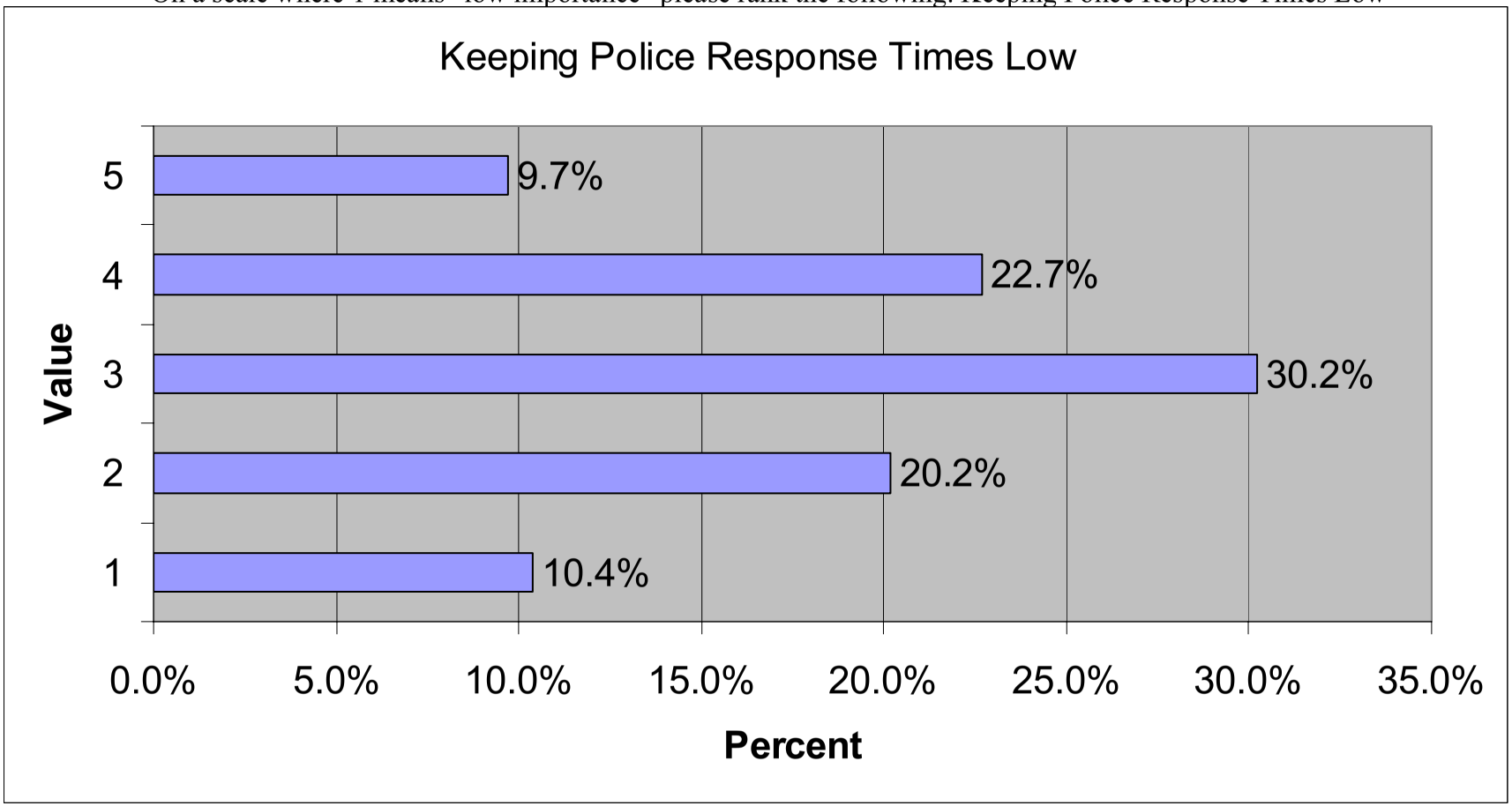
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Maintaining a Low Crime Rate



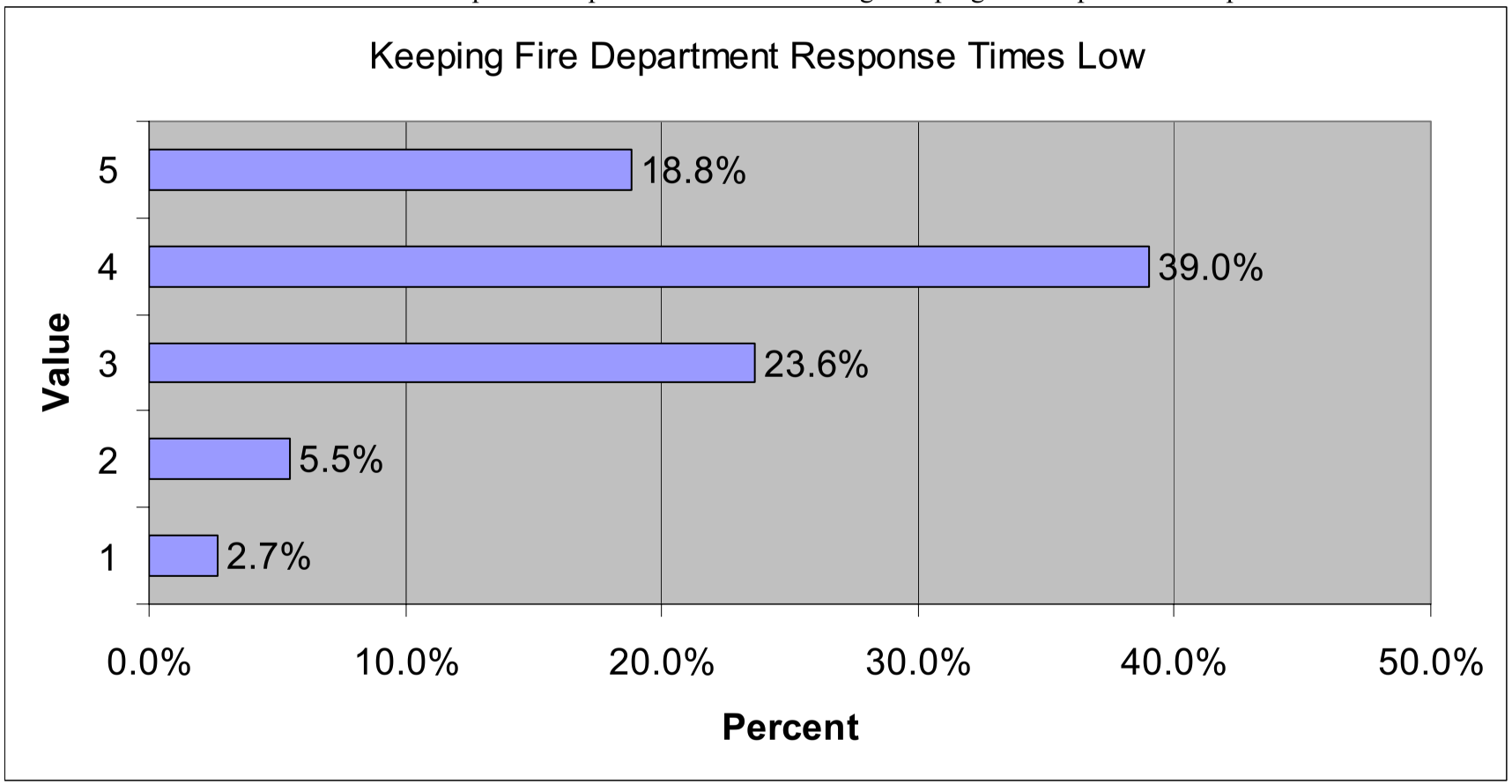
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Maintaining Neighborhood Police Patrols



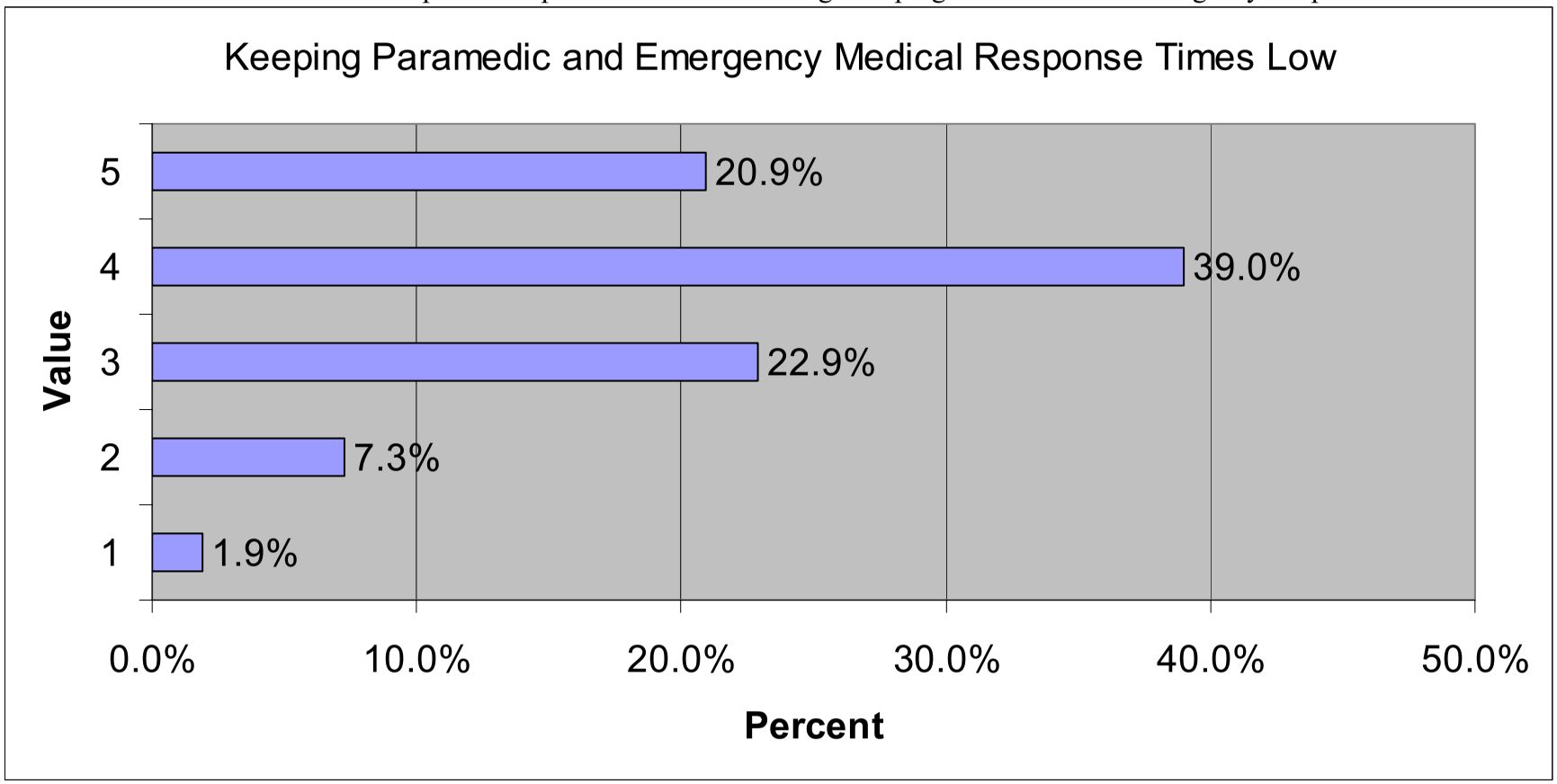
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Keeping Police Response Times Low



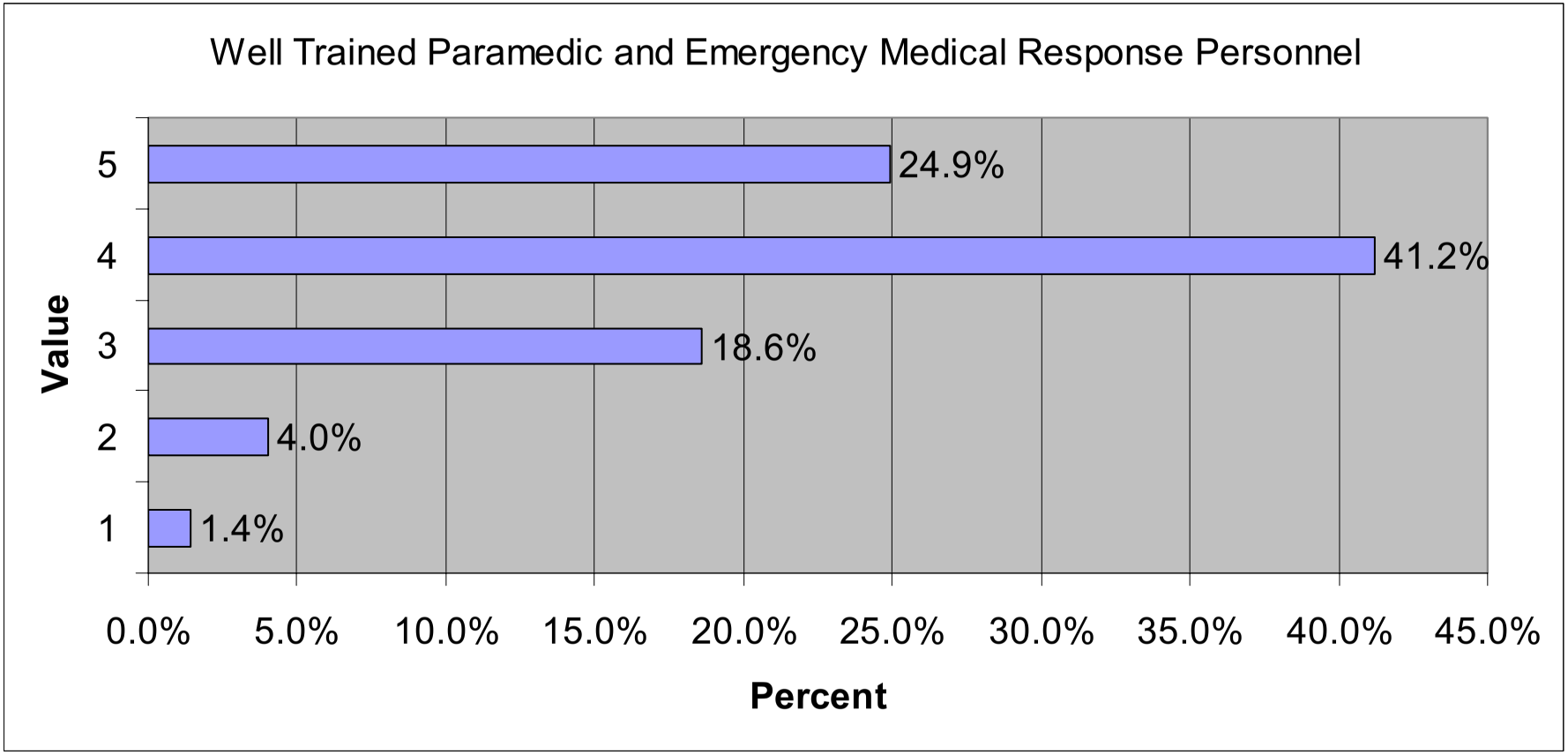
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Keeping Fire Department Response Times Low



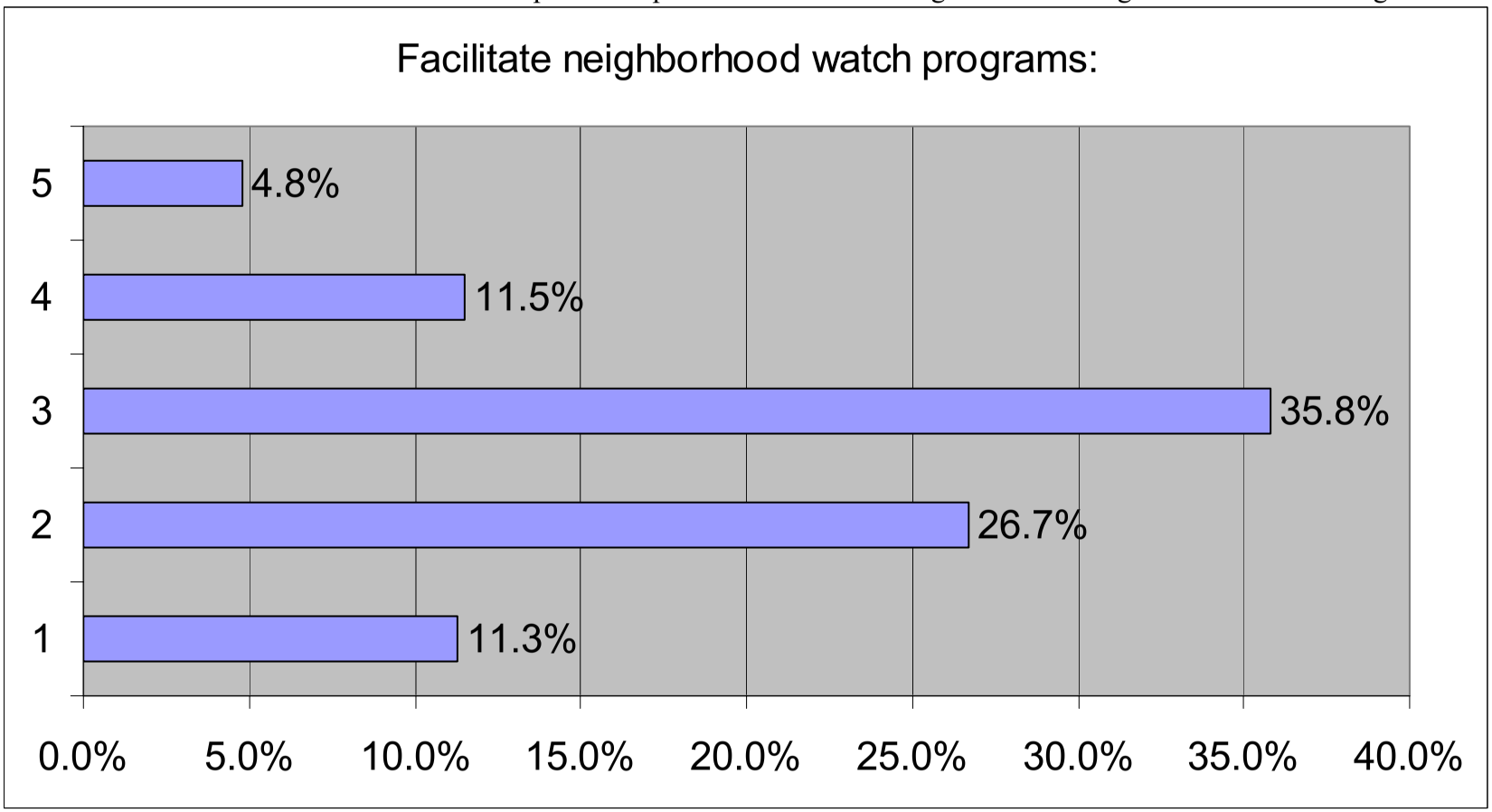
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Keeping Paramedic and Emergency Response Times Low



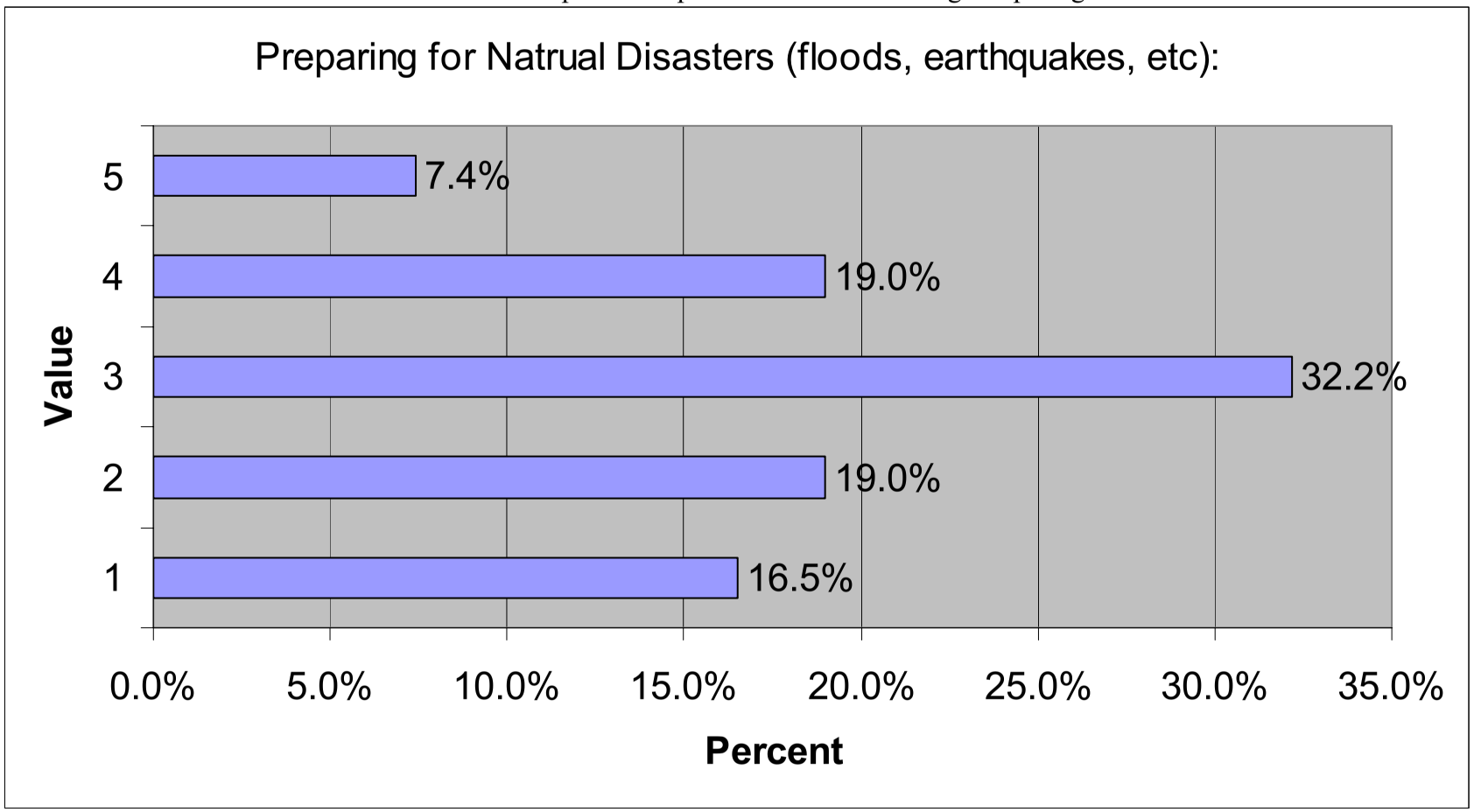
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Well Trained Paramedic and Emergency Medical Response Personnel



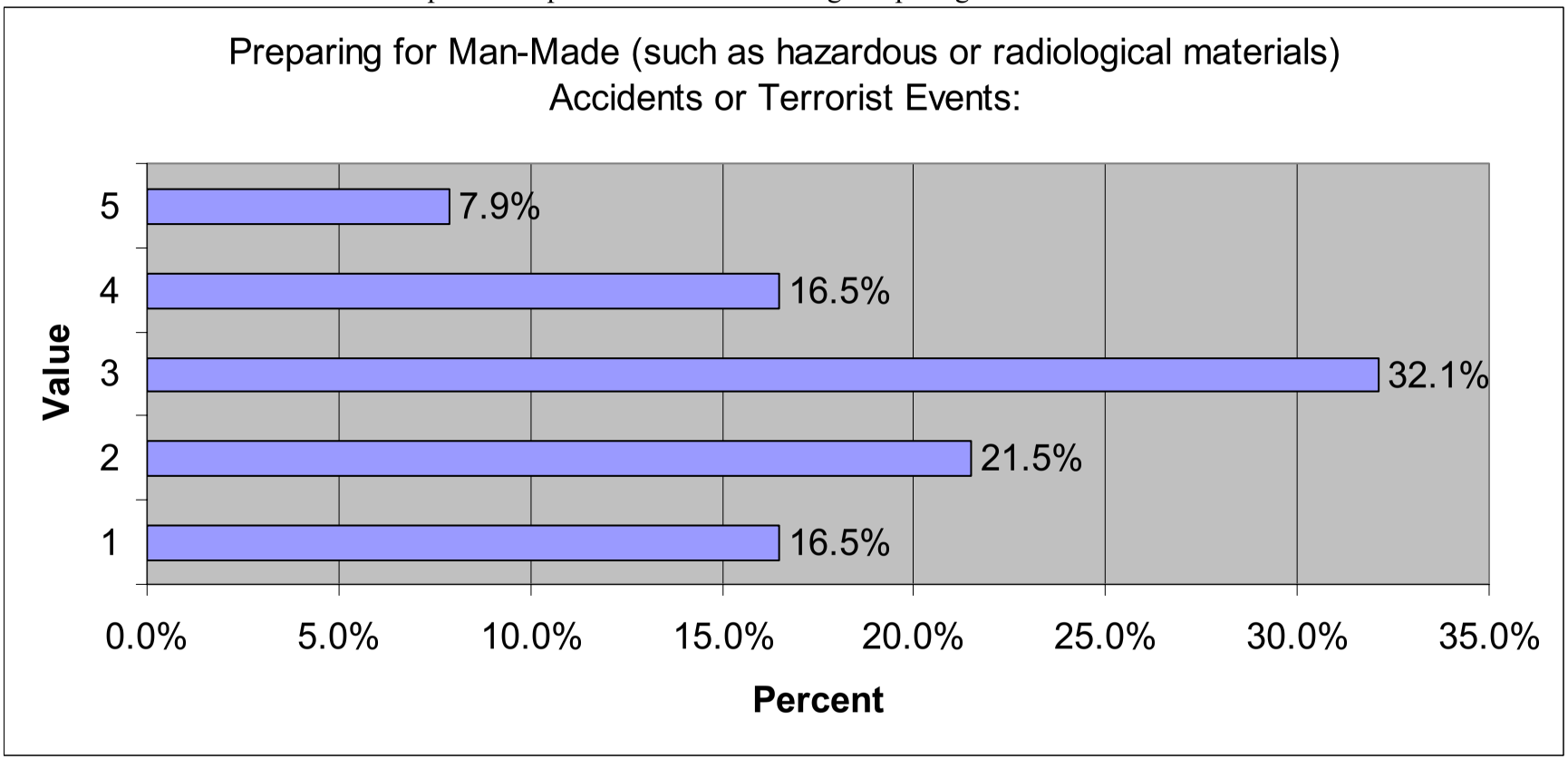
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Facilitate Neighborhood Watch Programs



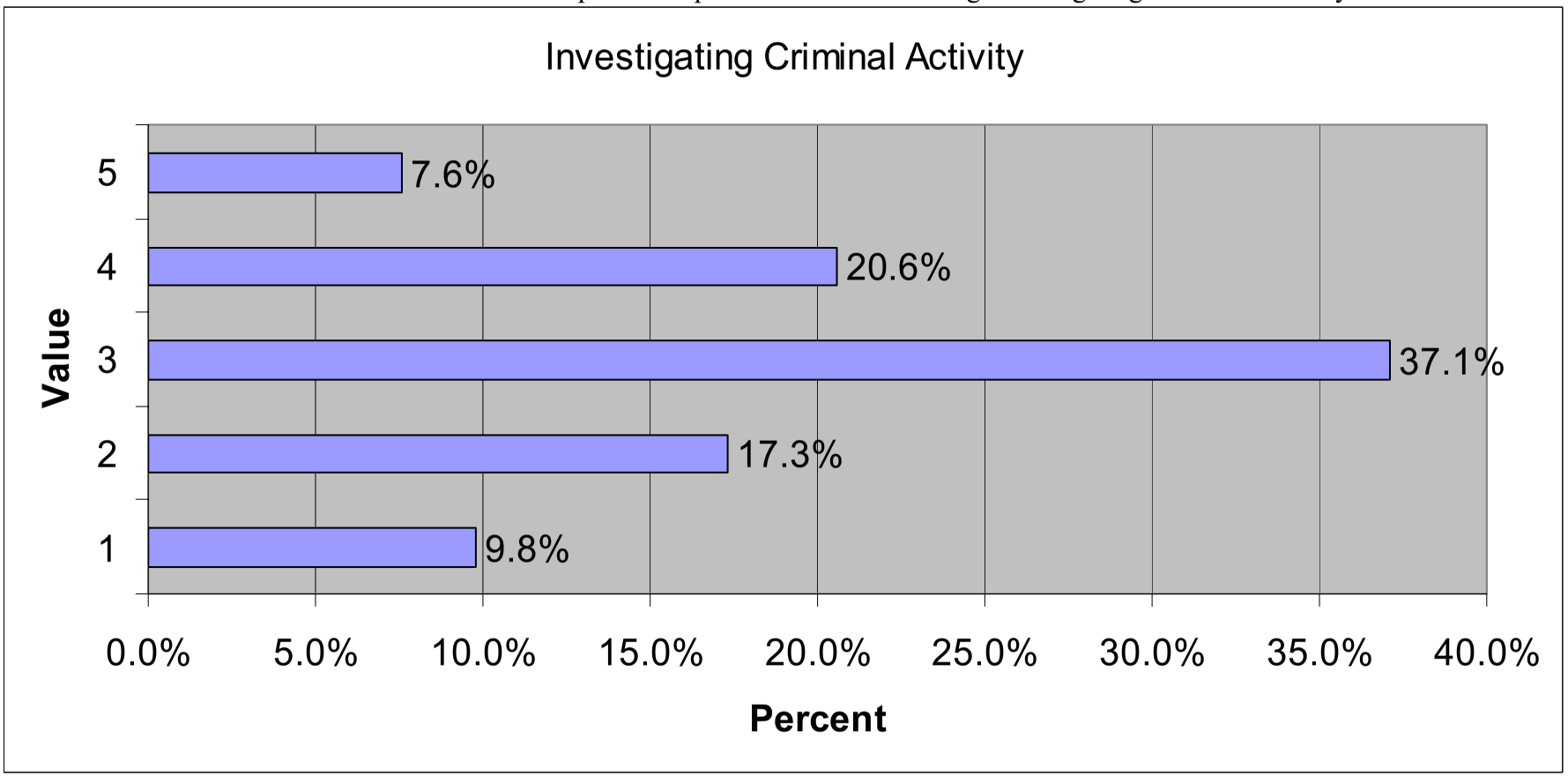
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Preparing for Natural Disasters



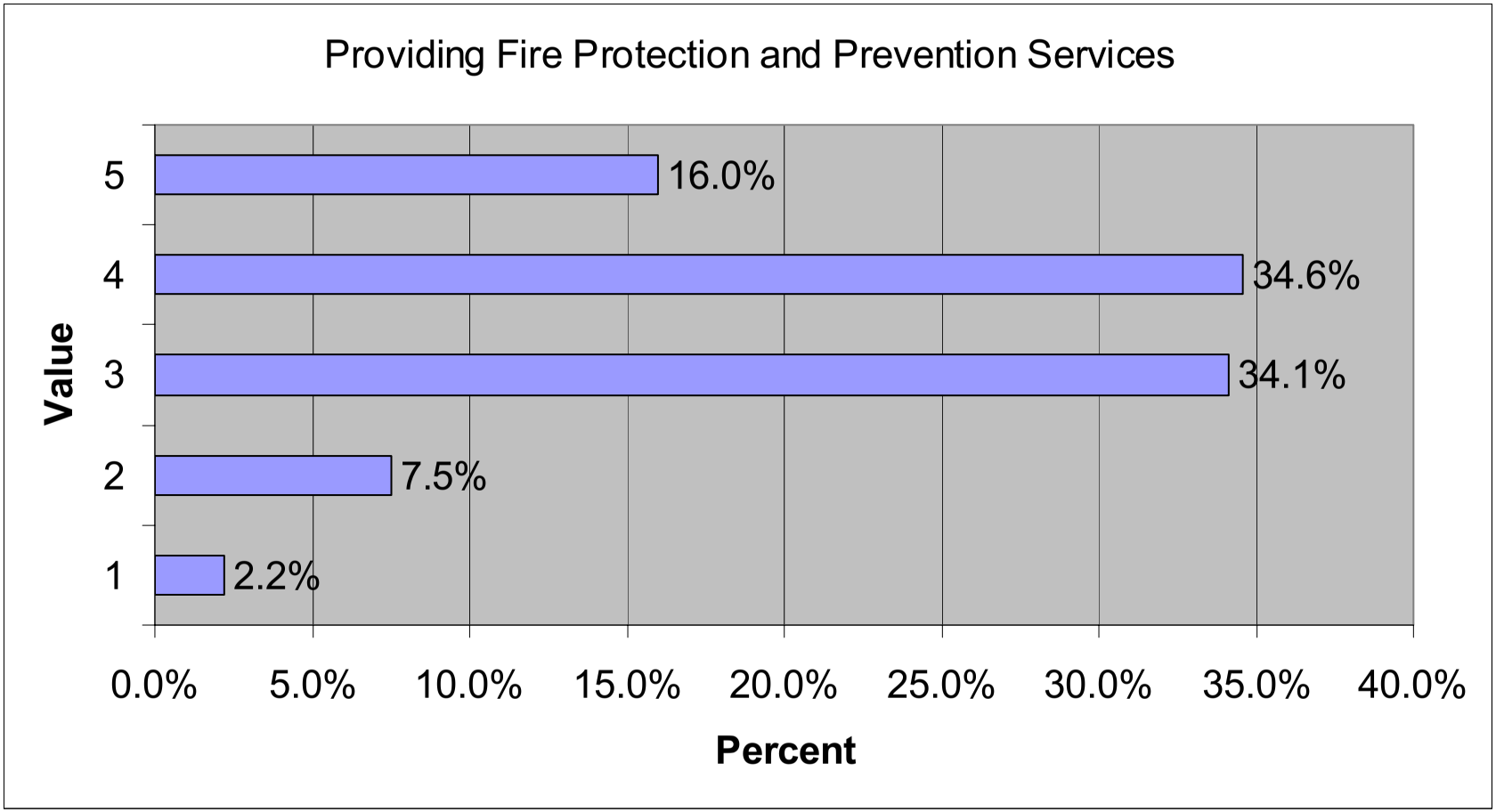
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Preparing for Man-Made Accidents or Terrorist Events



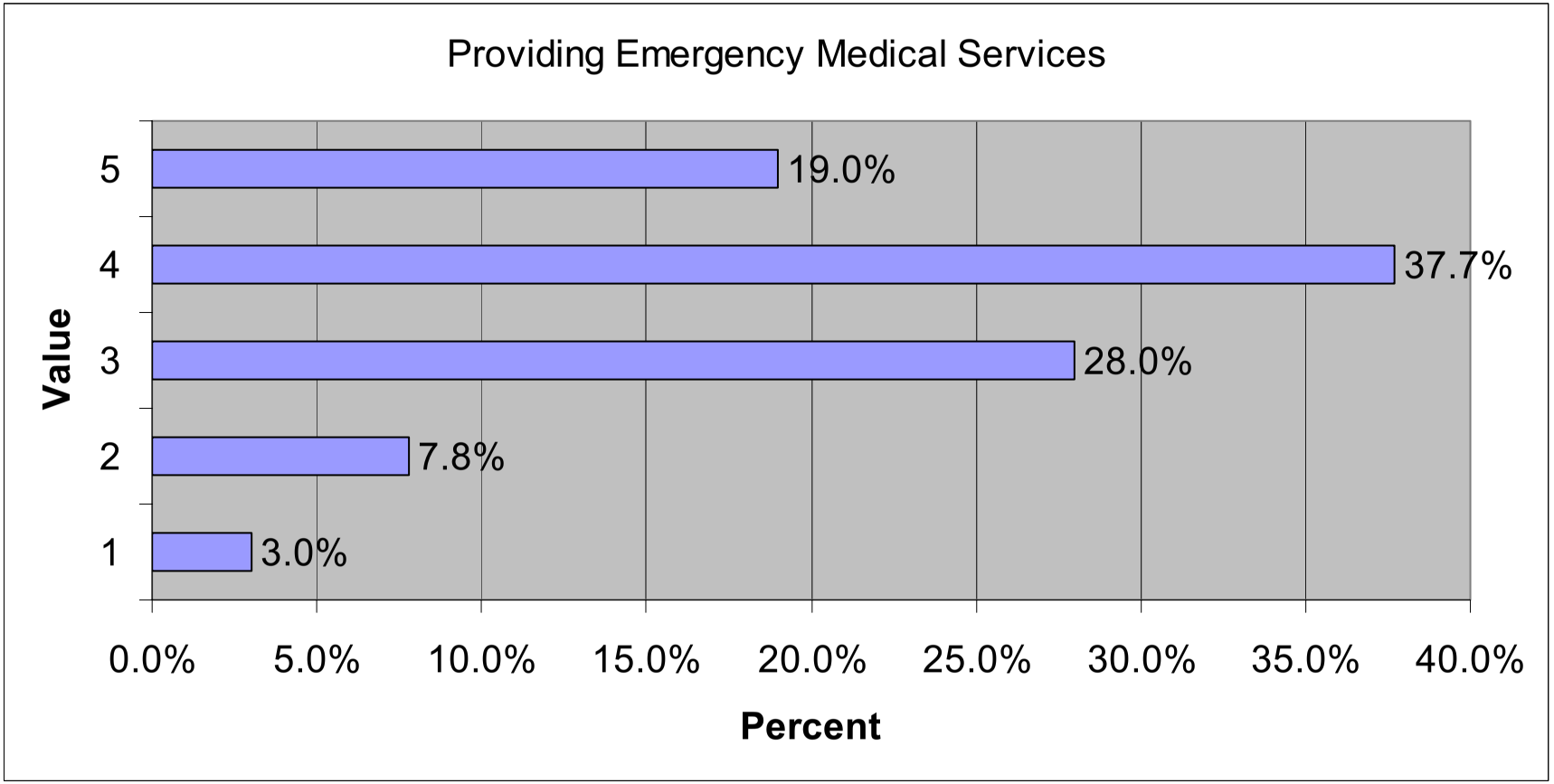
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Investigating Criminal Activity



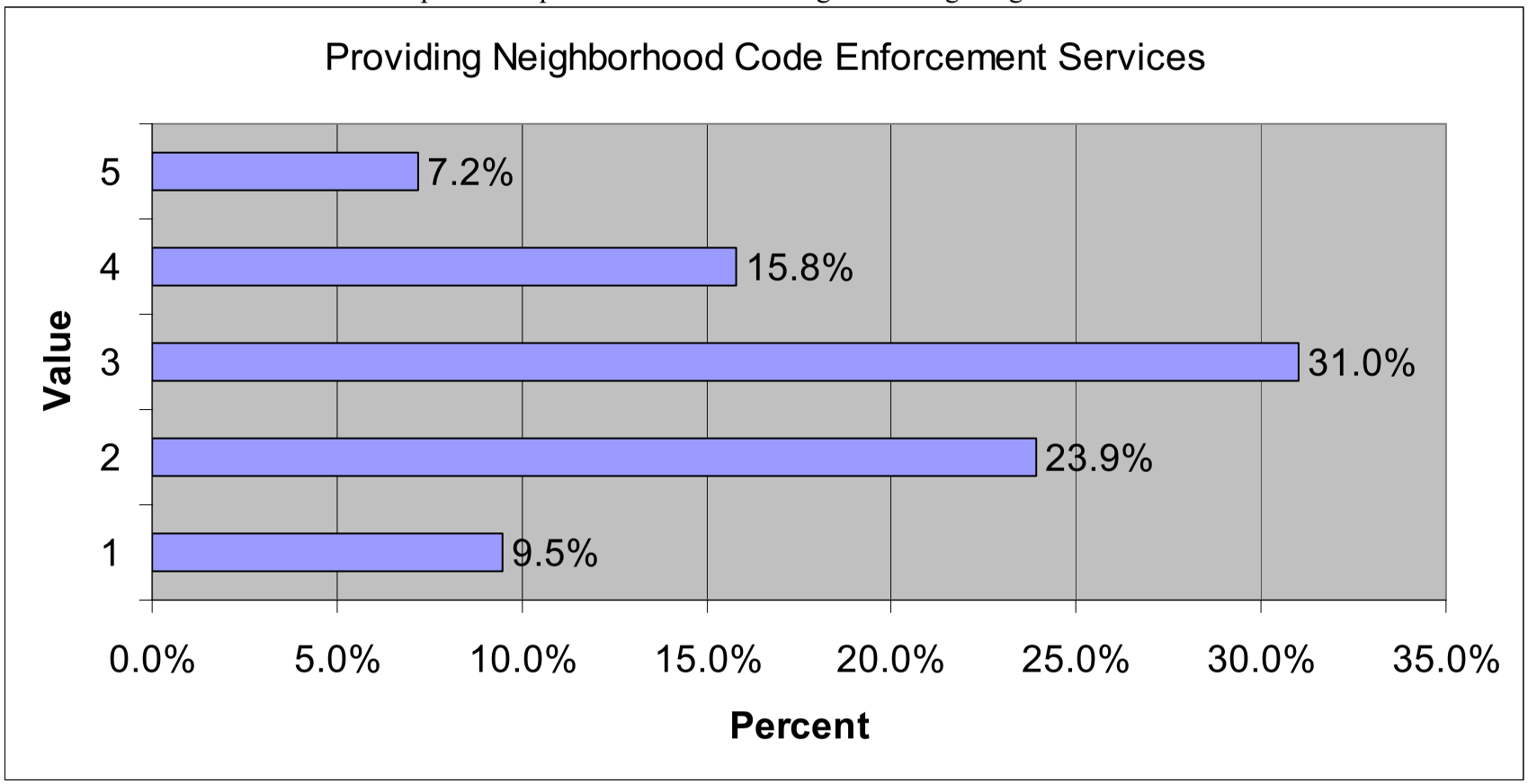
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Providing Fire Protection and Prevention Services



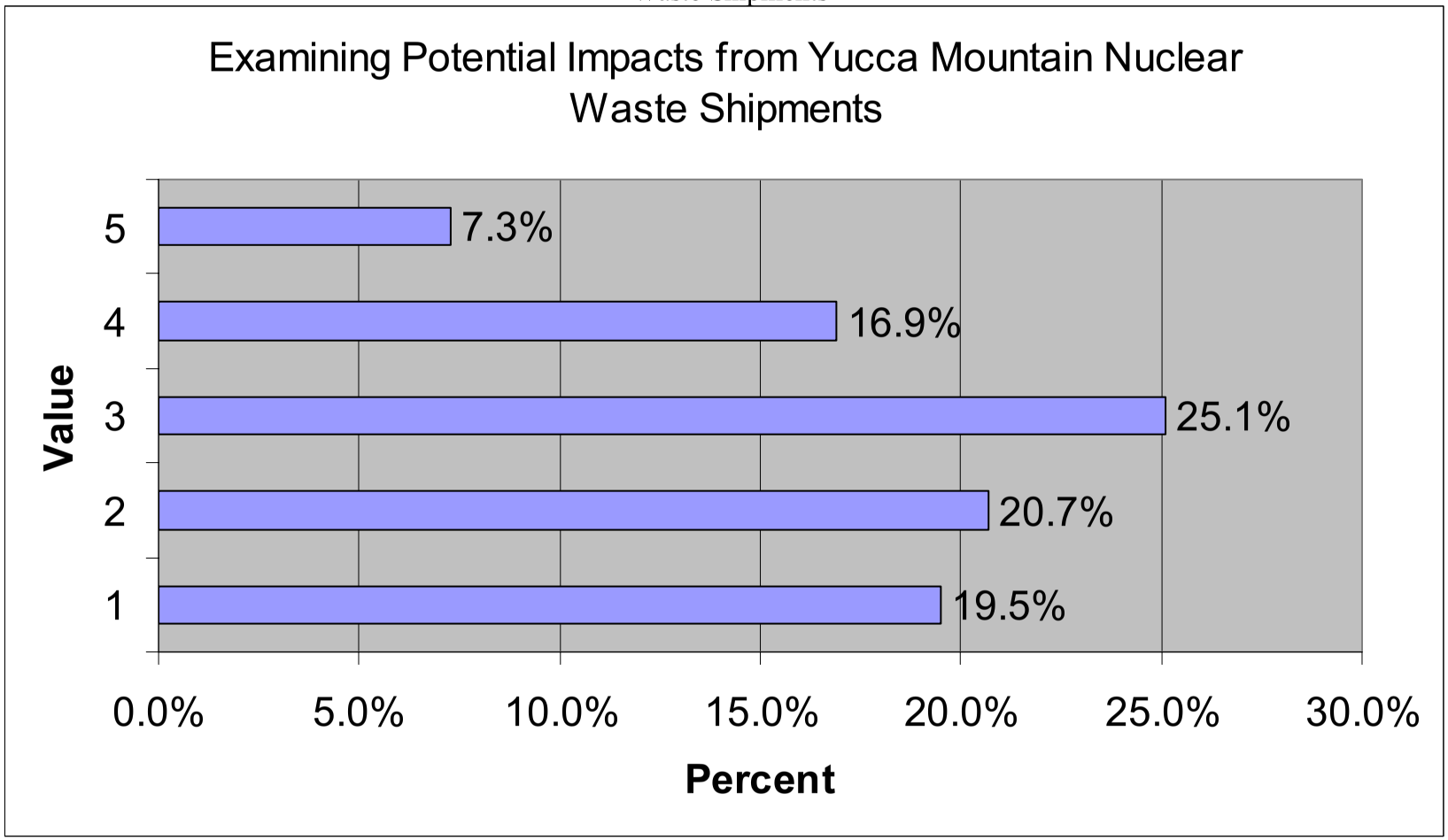
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Providing Emergency Medical Services



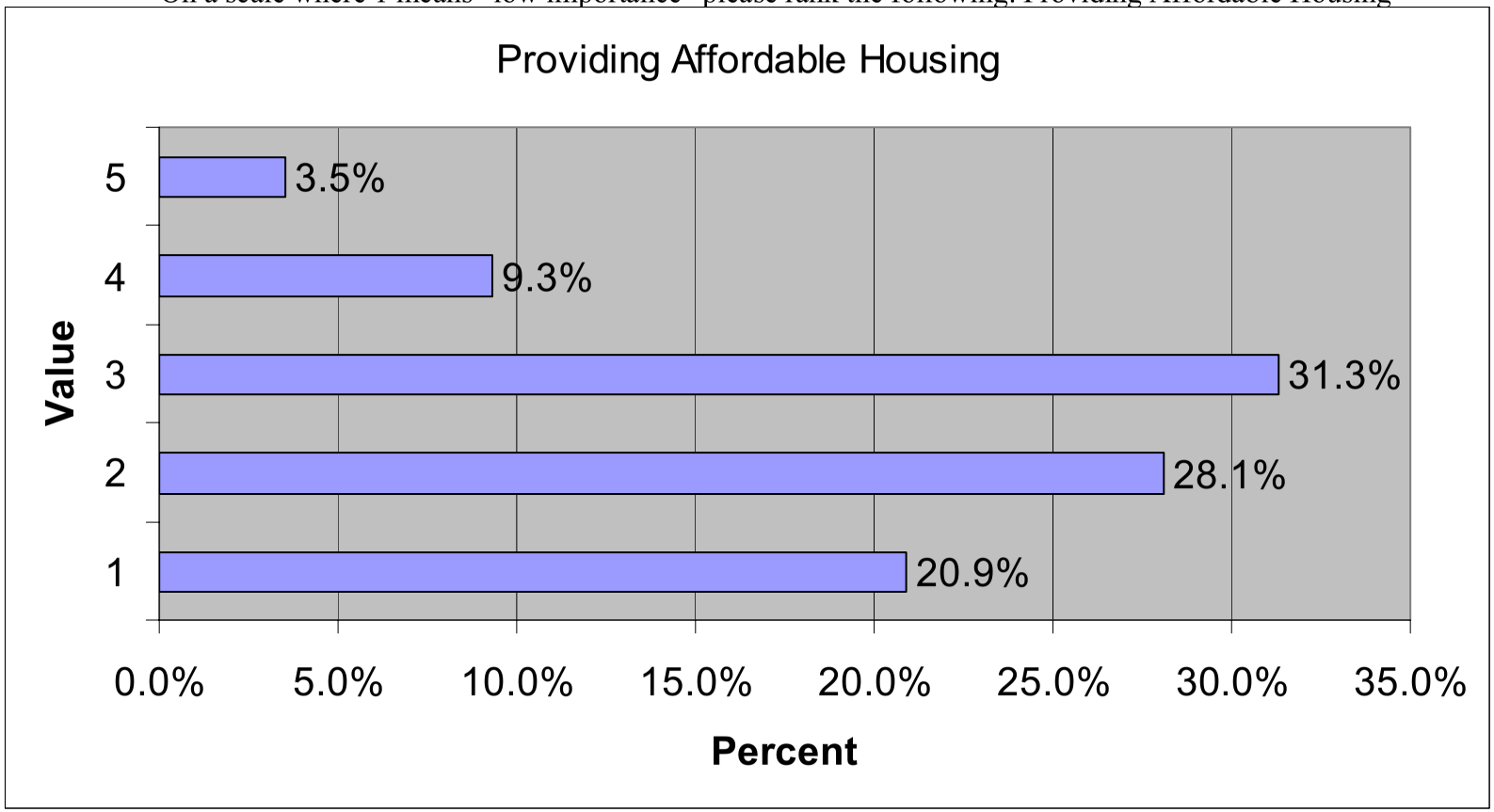
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Providing Neighborhood Code Enforcement Services



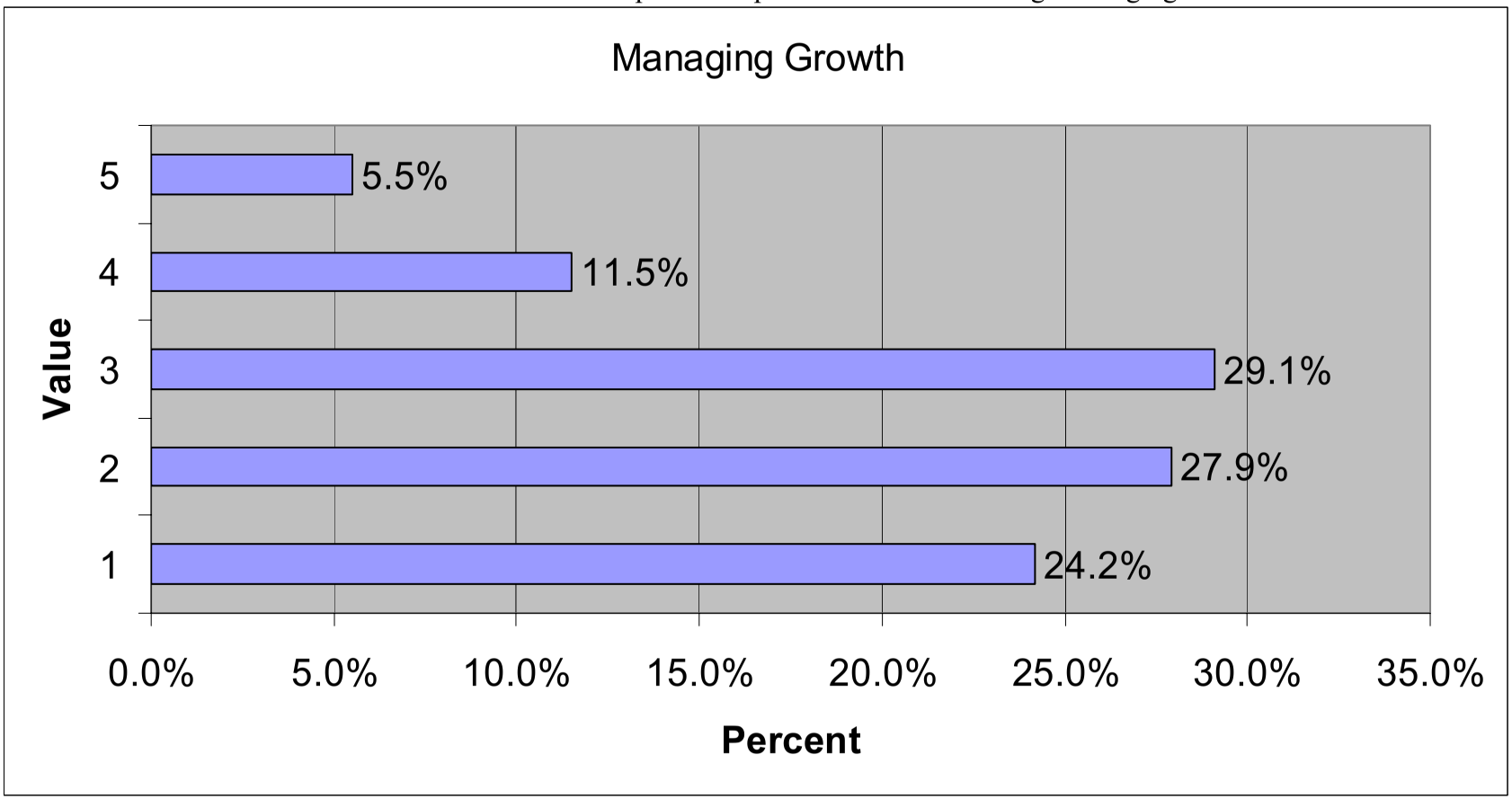
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Examining Potential Impacts from Yucca Mountain Nuclear Waste Shipments



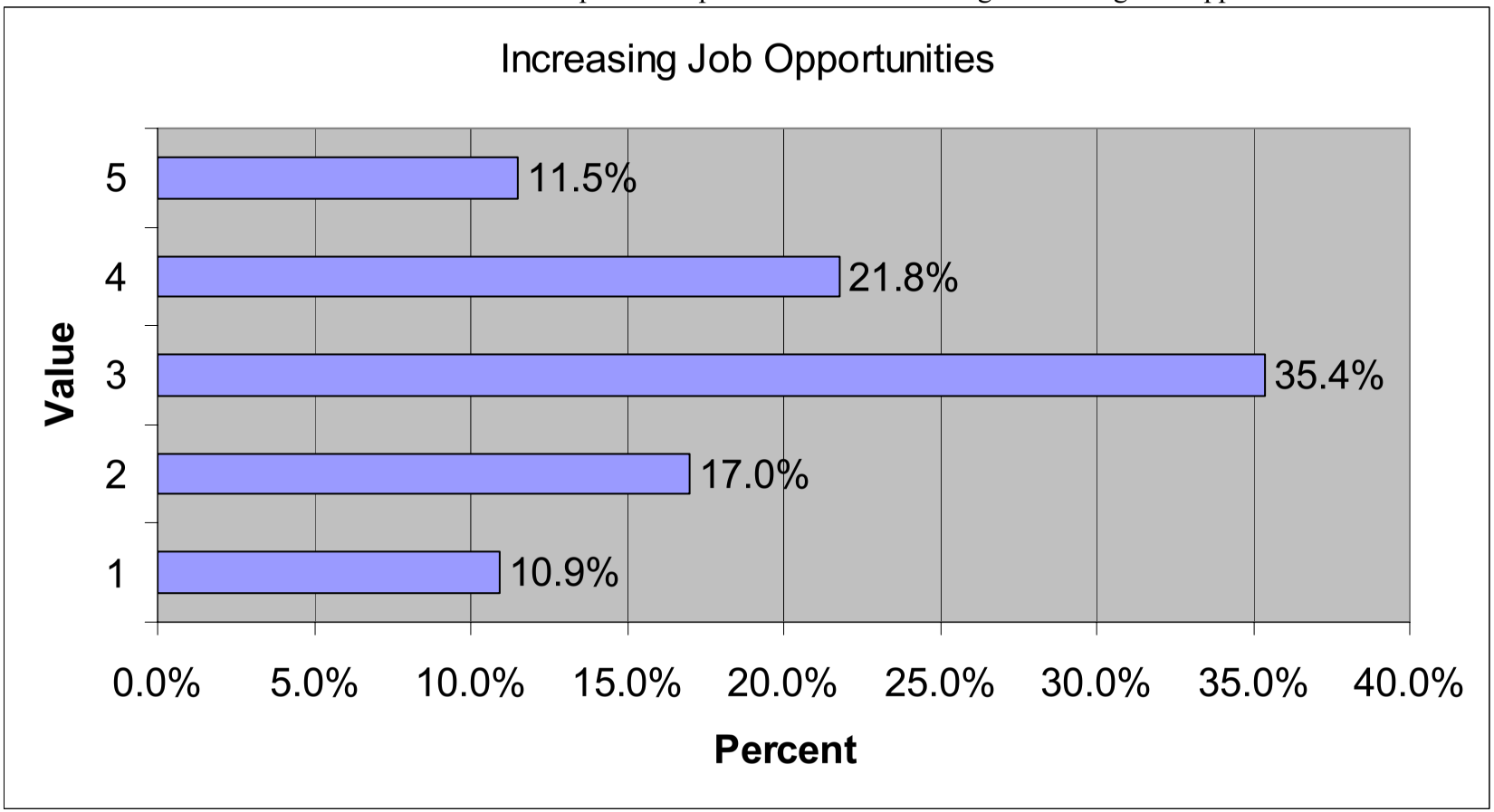
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Providing Affordable Housing



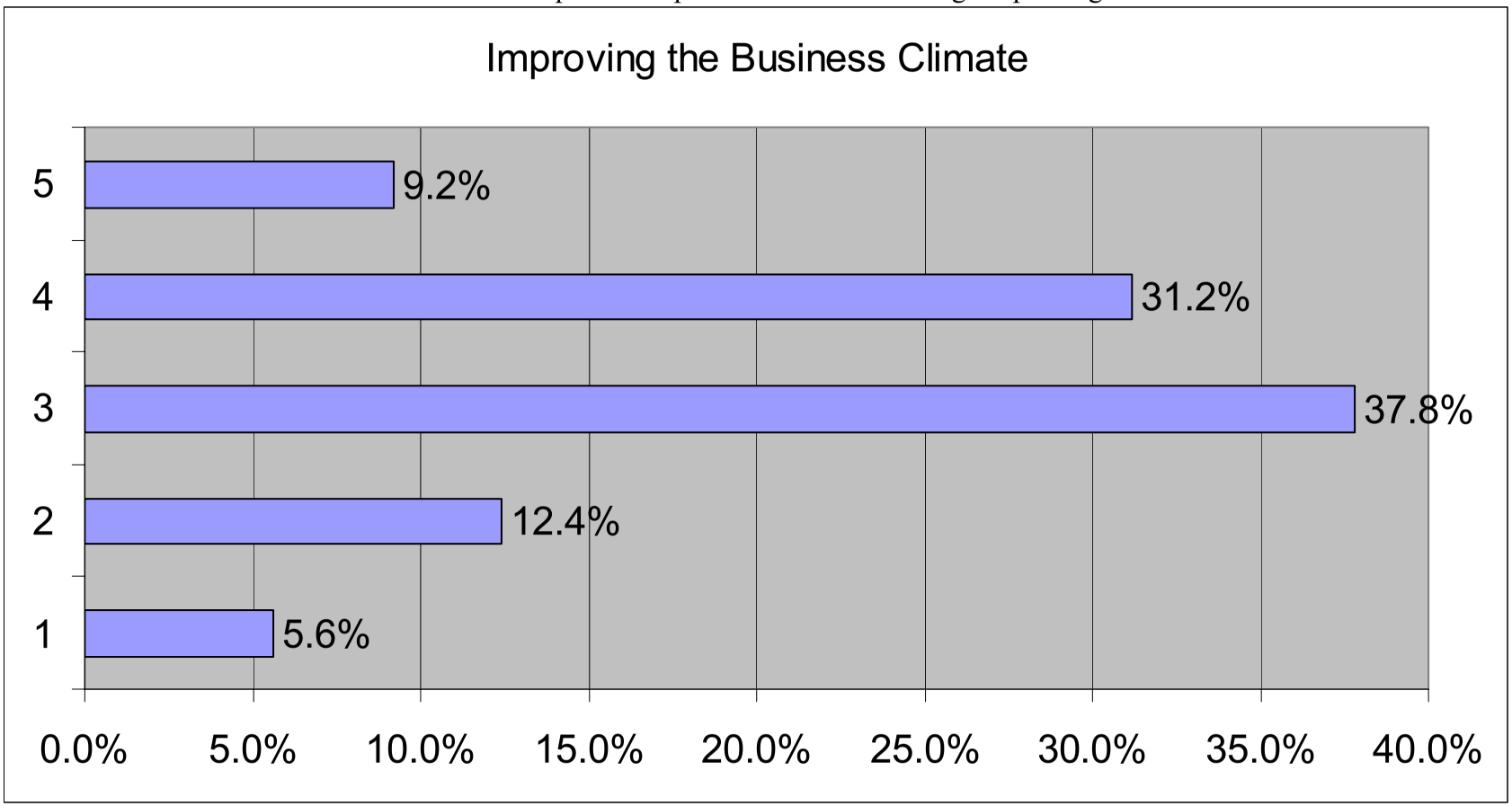
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Managing Growth



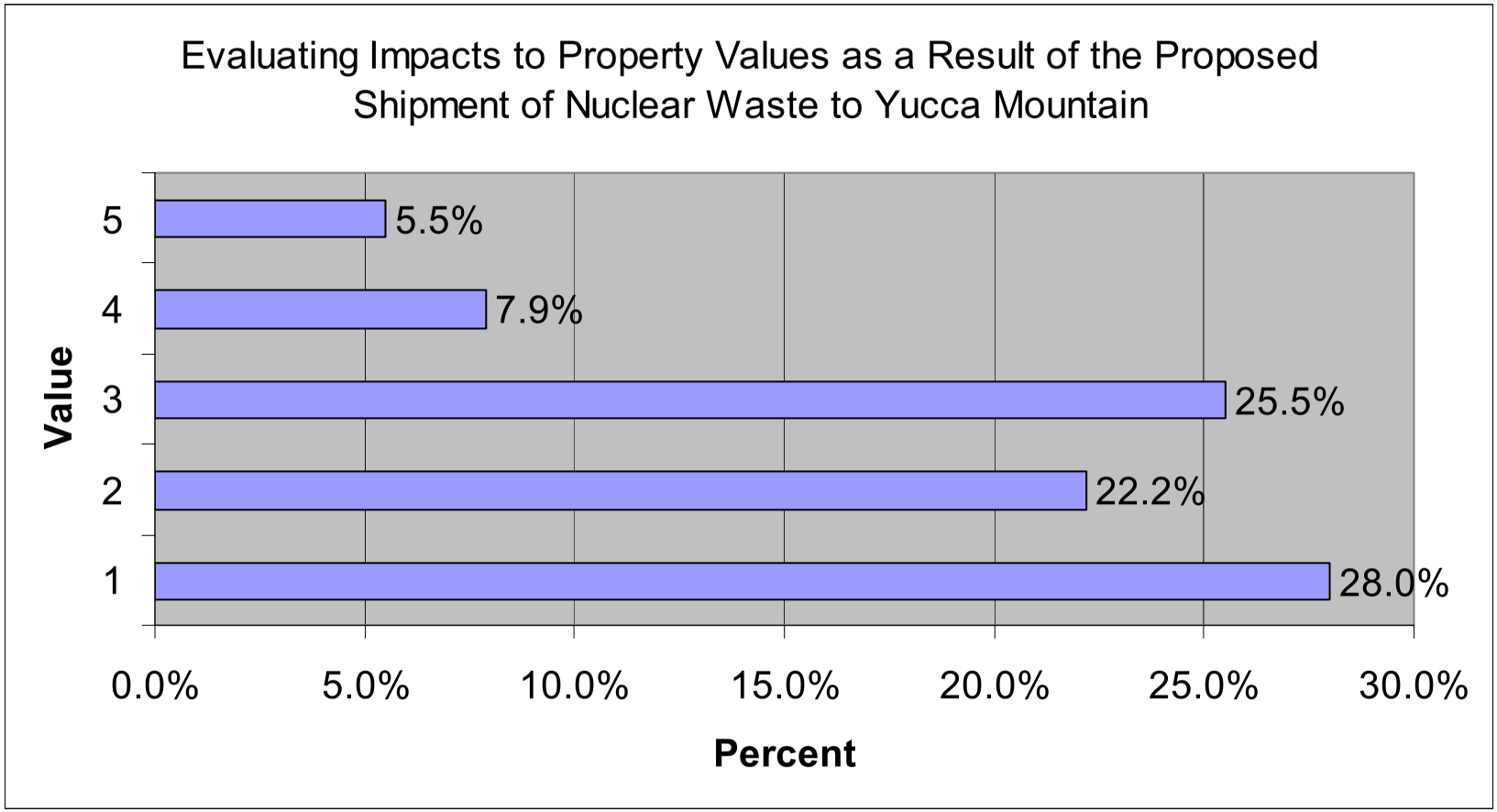
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Increasing Job Opportunities



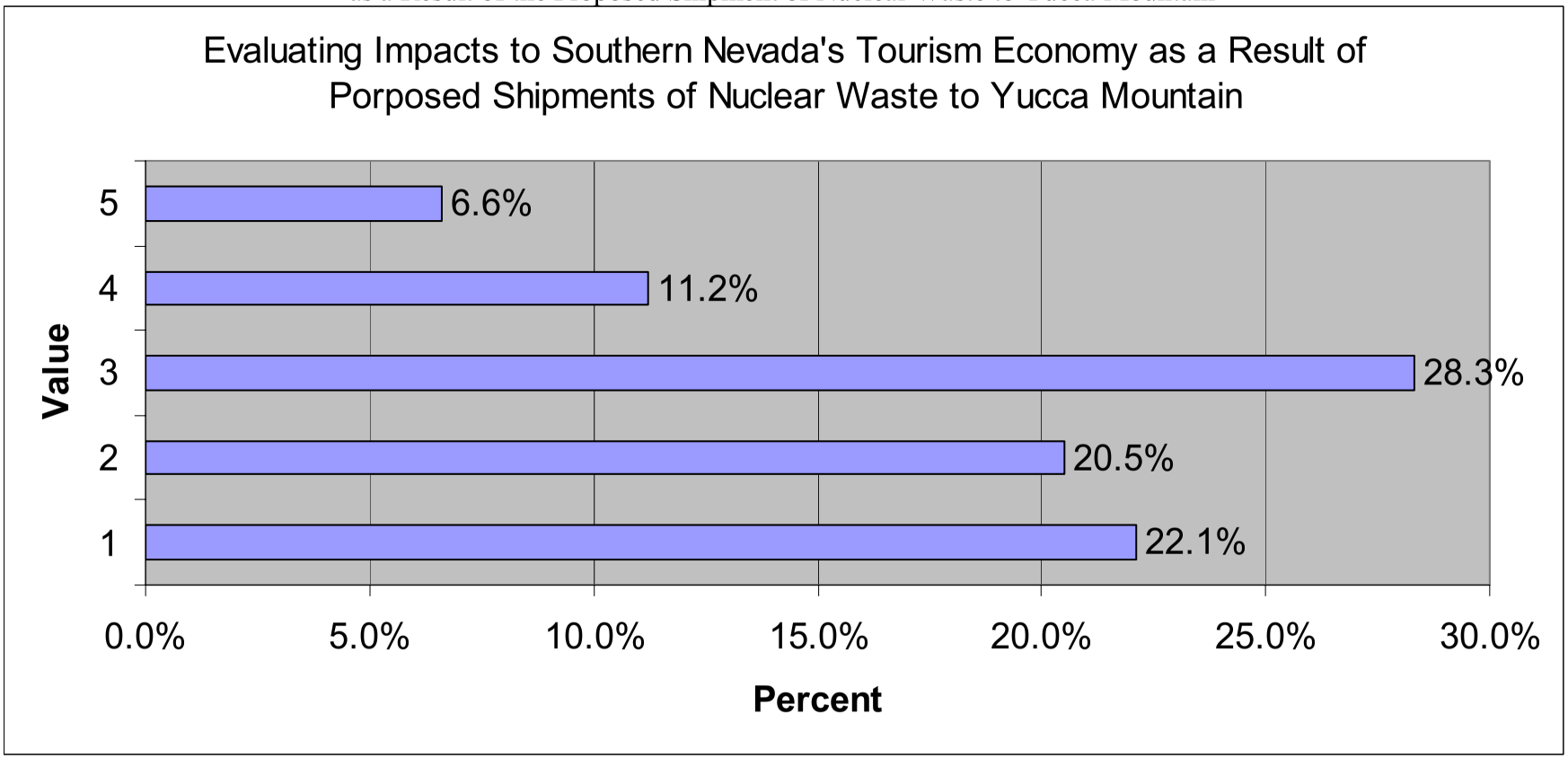
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Improving the Business Climate



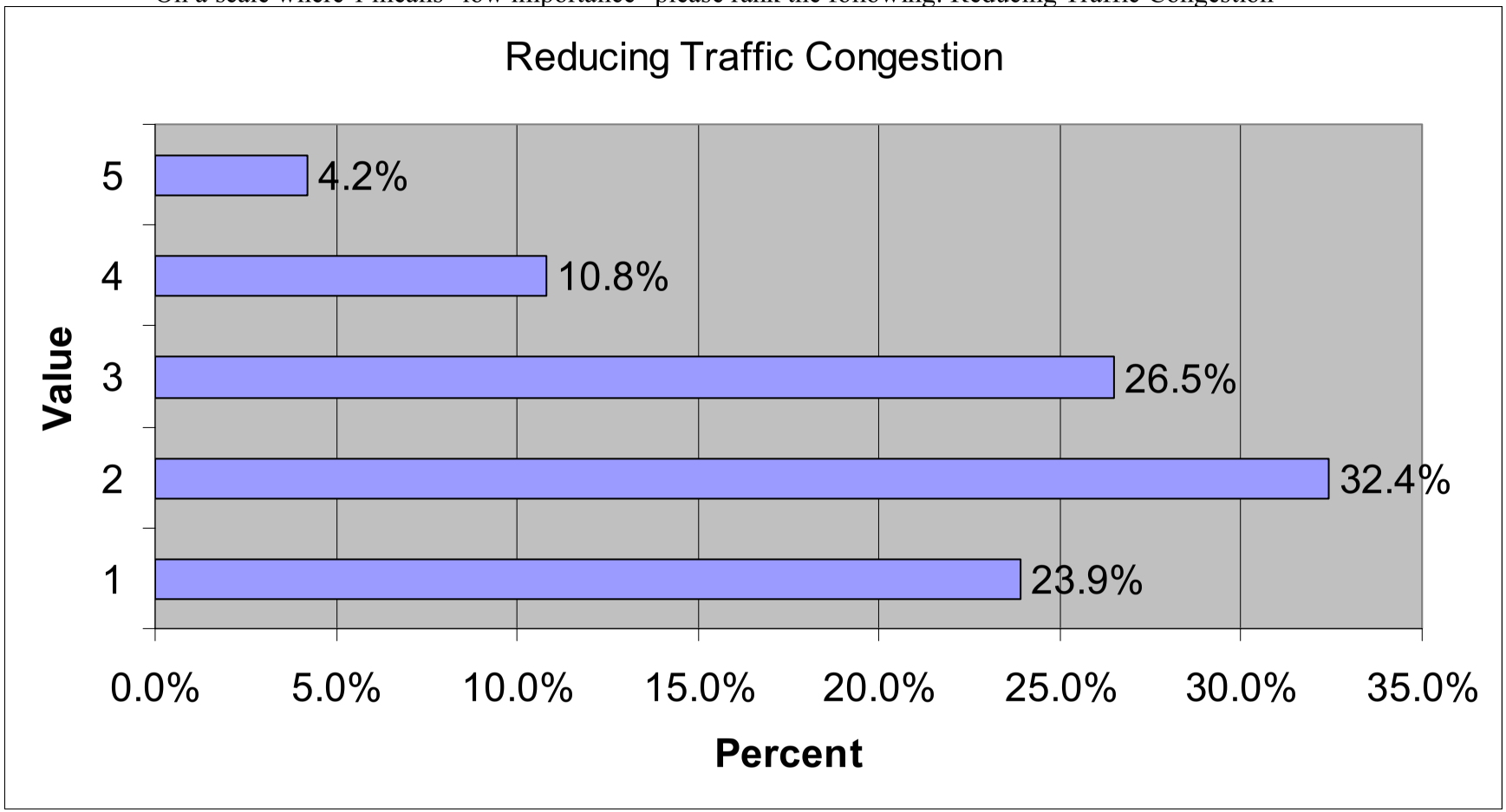
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Evaluating Impacts to Property Values as a Result of the Proposed Shipment of Nuclear Waste to Yucca Mountain:



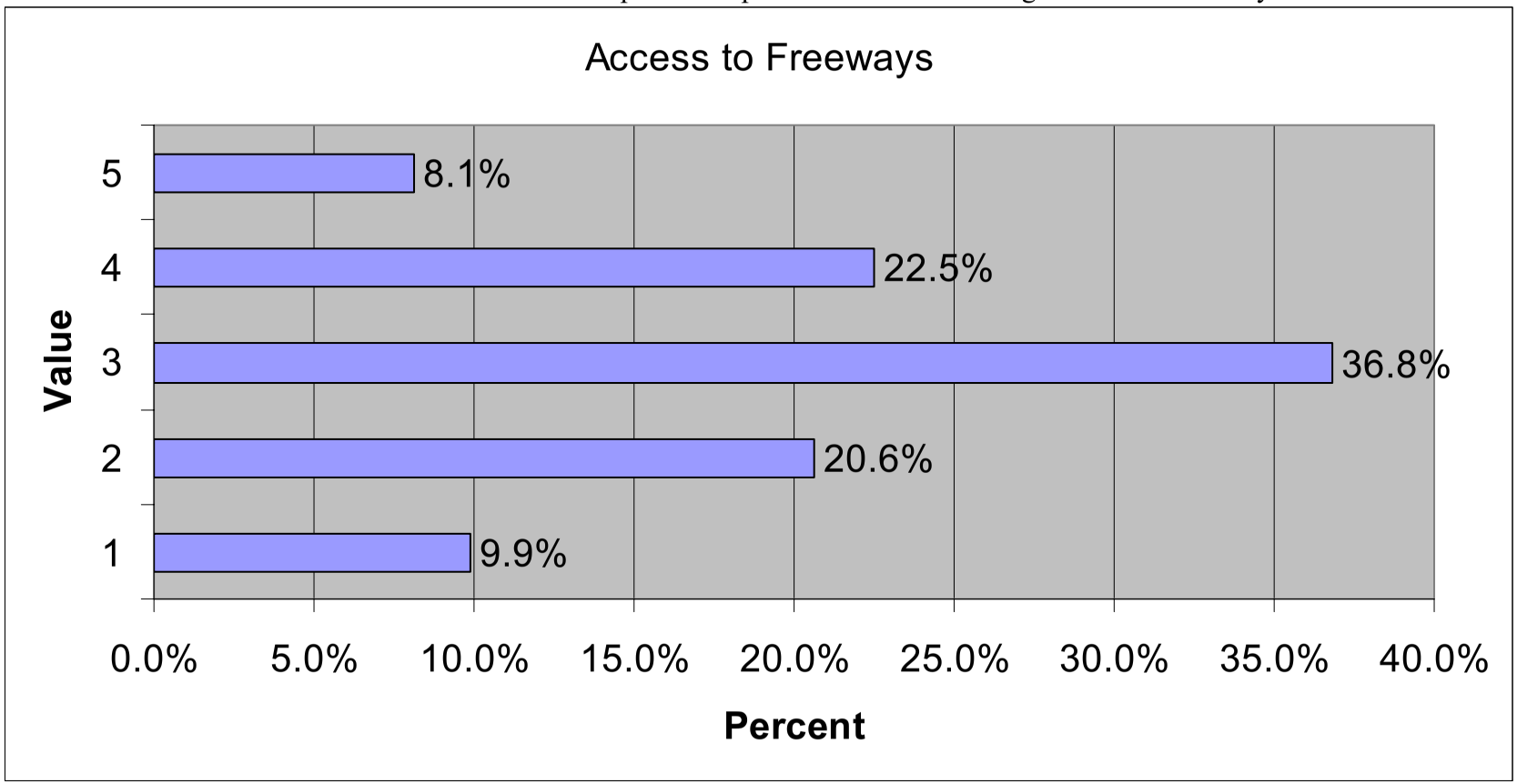
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Evaluating Impacts to Southern Nevada’s Tourism Economy as a Result of the Proposed Shipment of Nuclear Waste to Yucca Mountain



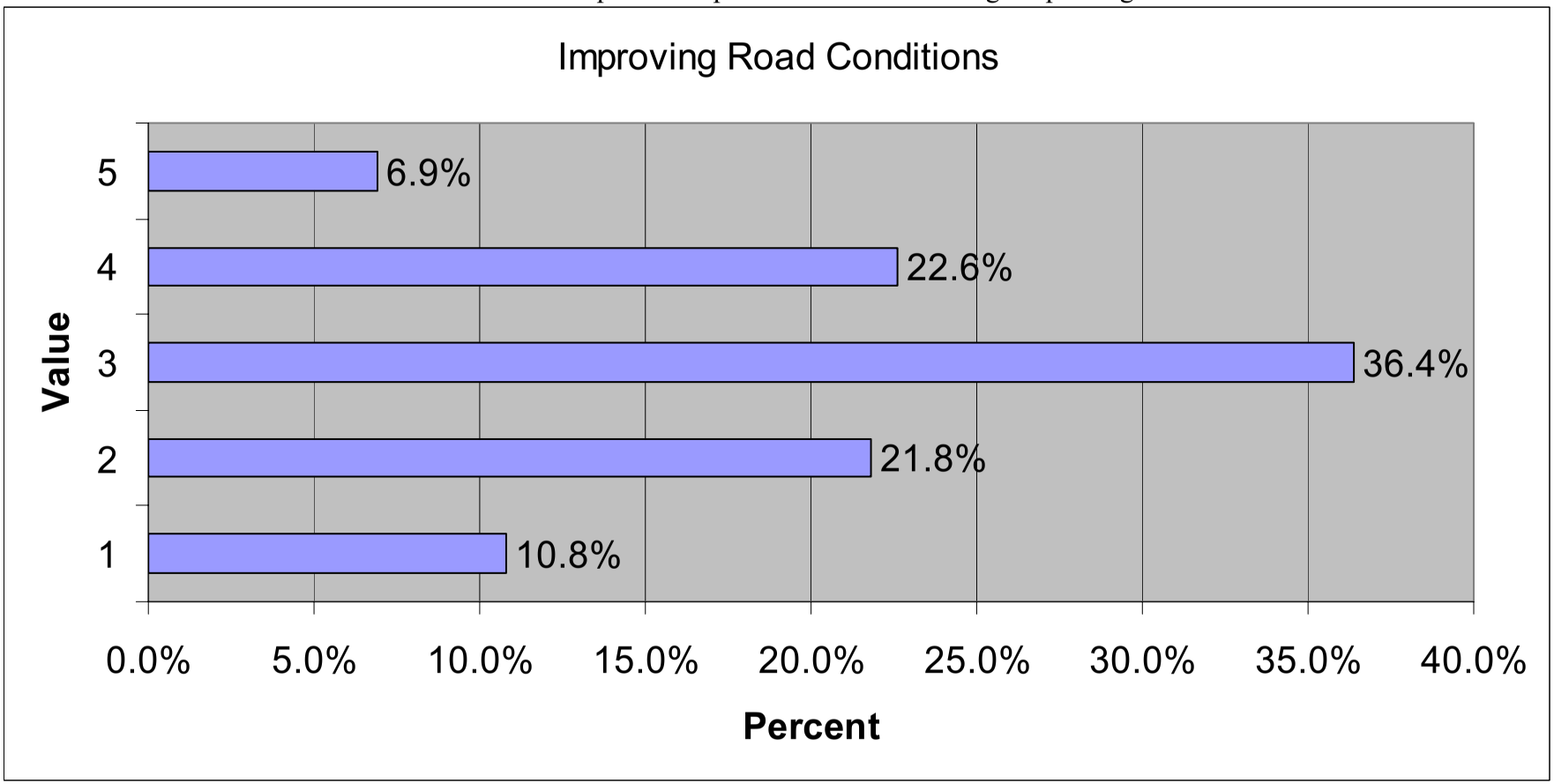
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Reducing Traffic Congestion



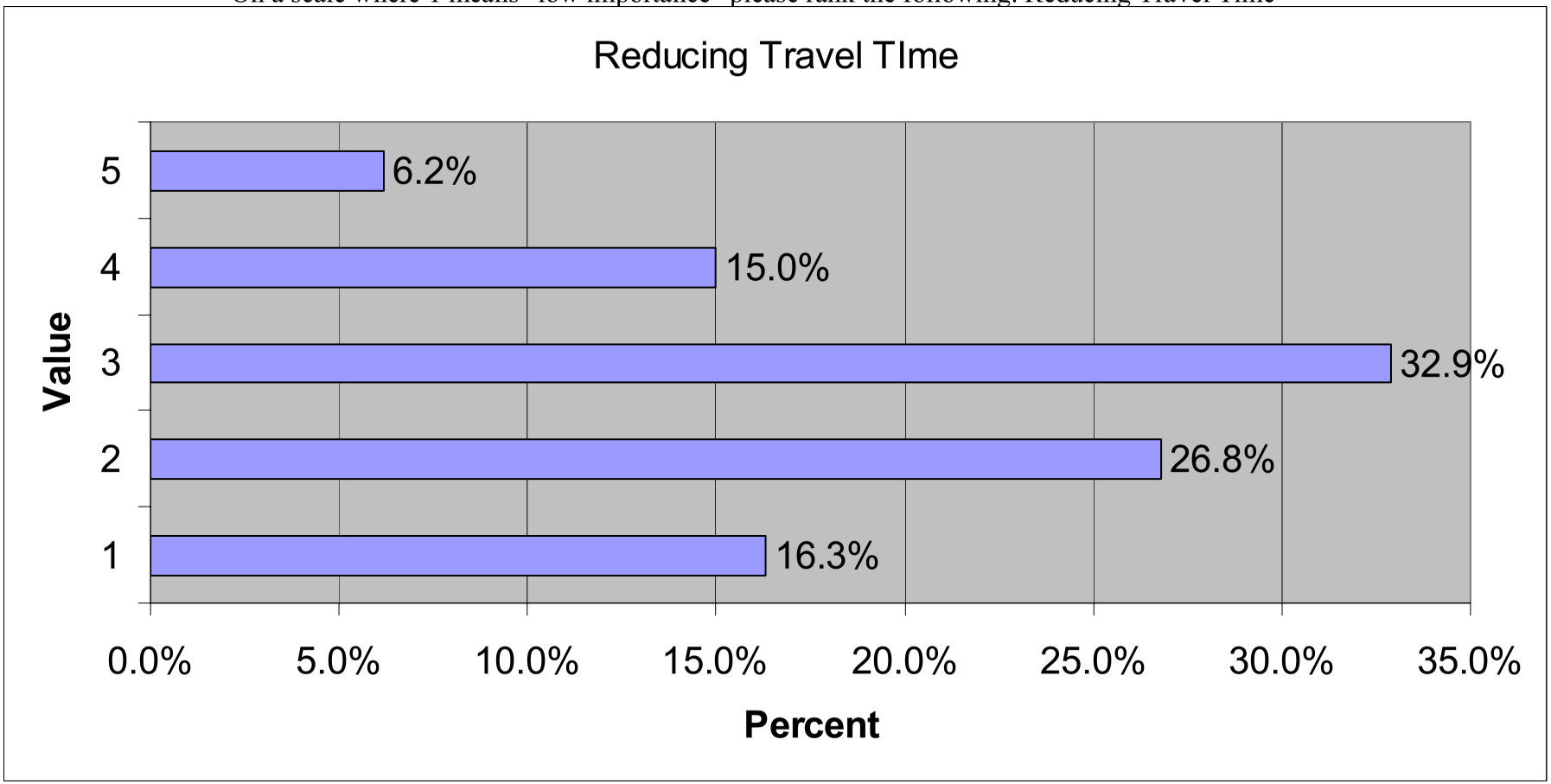
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Access to Freeways



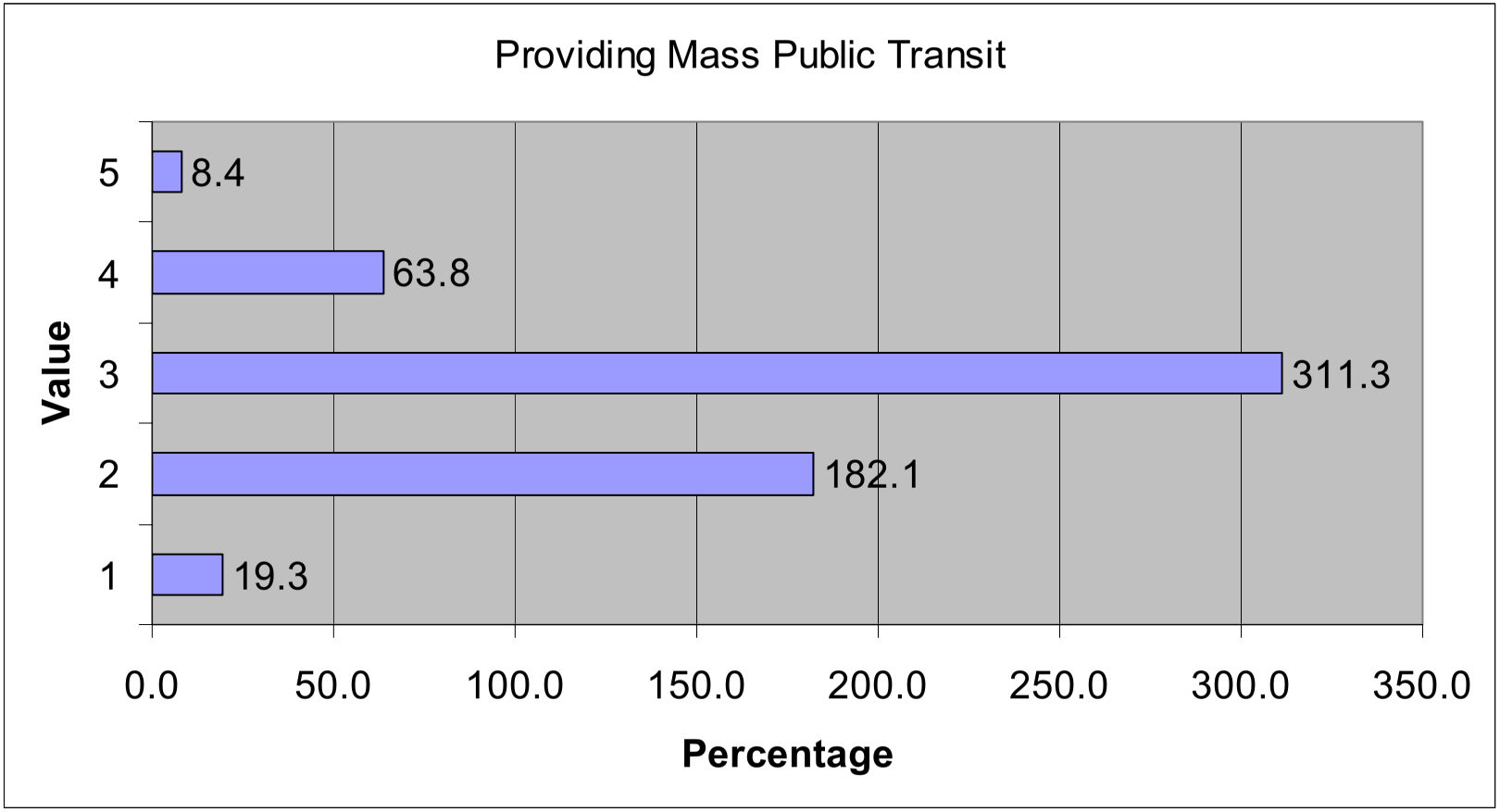
Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Improving Road Conditions



Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Reducing Travel Time



Appendix II
Performance scores for selected variables
On a scale where 1 means “low importance” please rank the following: Providing Mass Public Transit



Appendix II
Performance scores for selected variables
Summary Statistics by Jurisdiction

General Government Performance Measure		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Road maintenance:	Unincorporated Clark County	239	3	2.81	0.067	3	3	1.043	1.087	0.023	0.157	-0.515	0	4	1	5
	City of Las Vegas	193	4	3.09	0.082	3	3	1.139	1.297	0.092	0.175	-0.783	0	4	1	5
	North Las Vegas	70	2	2.90	0.130	3	3	1.094	1.197	0.075	0.286	-0.416	1	4	1	5
	Henderson	81	3	3.13	0.119	3	3	1.074	1.154	-0.347	0.267	-0.334	1	4	1	5
	Boulder City	8	0	3.37	0.419	3	3	1.163	1.352	-0.965	0.764	2.221	2	4	1	5
	Mesquite	6	0	3.01	0.503	3	3	1.226	1.503	-0.021	0.849	0.800	2	4	1	5
Revitalizing older neighborhoods:	Unincorporated Clark County	218	25	2.42	0.066	2	3	0.972	0.945	0.350	0.165	-0.057	0	4	1	5
	City of Las Vegas	175	22	2.70	0.081	3	3	1.077	1.159	0.397	0.184	-0.262	0	4	1	5
	North Las Vegas	68	4	2.66	0.116	3	3	0.955	0.912	0.303	0.291	0.241	1	4	1	5
	Henderson	72	11	2.48	0.118	2	2	1.005	1.009	0.565	0.282	0.310	1	4	2	5
	Boulder City	6	2	2.76	0.498	3	3	1.237	1.530	0.390	0.835	1.230	2	4	1	5
	Mesquite	5	1	3.06	0.642	3	2	1.390	1.932	1.133	0.939	-0.325	2	3	1	5
Flood control:	Unincorporated Clark County	234	8	3.49	0.071	4	4	1.089	1.187	-0.589	0.159	-0.172	0	4	1	5
	City of Las Vegas	193	4	3.27	0.086	3	4	1.192	1.421	-0.362	0.175	-0.708	0	4	1	5
	North Las Vegas	70	2	3.44	0.137	4	4	1.147	1.315	-0.217	0.286	-0.929	1	4	1	5
	Henderson	81	3	3.74	0.103	4	3	0.931	0.866	-0.265	0.267	-0.332	1	4	1	5
	Boulder City	8	0	3.33	0.507	3	3	1.405	1.975	-0.250	0.764	-0.584	2	4	1	5
	Mesquite	6	0	2.93	0.659	2	2	1.605	2.576	0.697	0.849	-1.473	2	4	1	5
Budget management:	Unincorporated Clark County	220	23	2.65	0.068	3	3	1.001	1.002	-0.001	0.164	-0.465	0	4	1	5
	City of Las Vegas	182	15	2.79	0.076	3	3	1.026	1.052	0.227	0.180	-0.183	0	4	1	5
	North Las Vegas	65	7	2.66	0.144	3	3	1.159	1.343	0.229	0.298	-0.508	1	4	3	5
	Henderson	79	5	2.67	0.117	3	3	1.036	1.074	0.131	0.270	0.058	1	4	1	5
	Boulder City	8	0	3.56	0.347	3	3	0.962	0.925	1.243	0.764	-0.735	2	2	1	5
	Mesquite	4	2	2.42	0.769	3	1	1.597	2.550	0.770	0.977	1.398	2	4	1	5

Appendix II
Performance scores for selected variables
Summary Statistics by Jurisdiction

General Government Performance Measure		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers:	Unincorporated Clark County	228	14	2.79	0.082	3	3	1.242	1.542	0.123	0.161	-0.952	0	4	1	5
	City of Las Vegas	183	15	2.90	0.099	3	3	1.333	1.777	0.041	0.180	-1.085	0	4	1	5
	North Las Vegas	67	5	2.88	0.150	3	3	1.224	1.497	-0.141	0.293	-0.852	1	4	1	4
	Henderson	75	9	2.76	0.144	3	3	1.245	1.549	0.204	0.277	-0.851	1	4	1	5
	Boulder City	6	2	2.62	0.529	3	4	1.316	1.731	-0.112	0.835	-2.004	2	3	1	5
	Mesquite	5	1	3.01	0.834	3	5	1.807	3.266	0.130	0.939	-2.094	2	4	1	5
Monitor and report to the public on how well government services are being performed:	Unincorporated Clark County	231	11	2.38	0.067	2	3	1.012	1.025	0.304	0.160	-0.335	0	4	1	5
	City of Las Vegas	186	11	2.72	0.081	3	3	1.105	1.221	0.154	0.178	-0.468	0	4	1	5
	North Las Vegas	70	2	2.68	0.128	3	3	1.068	1.140	0.170	0.287	-0.460	1	4	1	5
	Henderson	79	5	2.62	0.126	3	3	1.116	1.246	0.119	0.271	-0.796	1	4	1	5
	Boulder City	8	0	2.69	0.595	3	1	1.651	2.726	-0.080	0.764	-2.315	2	4	1	5
	Mesquite	6	0	2.74	0.599	3	3	1.460	2.131	-0.087	0.849	-0.667	2	4	1	5

Appendix II
Performance scores for selected variables
Summary Statistics by Jurisdiction

Social and Judicial Services Performance Measure		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Providing child protection services:	Unincorporated Clark County	219	24	2.81	0.068	3	3	1.003	1.005	-0.007	0.165	-0.248	0	4	1	5
	City of Las Vegas	179	18	2.87	0.088	3	3	1.173	1.376	0.182	0.182	-0.651	0	4	1	5
	North Las Vegas	66	6	2.86	0.148	3	3	1.196	1.431	-0.050	0.296	-0.846	1	4	1	5
	Henderson	78	6	2.79	0.132	3	3	1.162	1.350	0.137	0.273	-0.620	1	4	1	5
	Boulder City	7	1	2.65	0.485	3	3	1.292	1.669	0.304	0.790	0.068	2	4	1	5
	Mesquite	5	1	1.95	0.745	1	1	1.611	2.596	1.808	0.941	4.504	2	4	1	5
Providing child welfare services:	Unincorporated Clark County	211	31	2.84	0.071	3	3	1.036	1.074	-0.018	0.167	-0.450	0	4	1	5
	City of Las Vegas	182	15	3.02	0.089	3	3	1.194	1.425	0.069	0.180	-0.715	0	4	1	5
	North Las Vegas	66	6	2.98	0.141	3	3	1.148	1.317	-0.108	0.294	-0.742	1	4	1	4
	Henderson	73	11	2.83	0.131	3	3	1.115	1.243	0.268	0.282	-0.311	1	4	1	5
	Boulder City	6	2	2.19	0.406	2	2	1.008	1.016	0.487	0.835	0.347	2	3	1	5
	Mesquite	5	1	2.21	0.689	2	1	1.489	2.218	1.518	0.941	4.563	2	4	1	5
Providing juvenile justice services:	Unincorporated Clark County	221	21	2.74	0.069	3	3	1.027	1.054	0.128	0.164	-0.354	0	4	1	5
	City of Las Vegas	174	23	2.86	0.082	3	3	1.087	1.181	-0.035	0.184	-0.459	0	4	1	5
	North Las Vegas	65	7	2.73	0.147	3	3	1.187	1.410	-0.082	0.297	-1.056	1	4	1	4
	Henderson	75	9	2.84	0.122	3	3	1.055	1.113	0.225	0.278	-0.328	1	4	1	5
	Boulder City	7	1	2.57	0.374	3	3	0.996	0.991	-0.896	0.790	0.205	2	3	1	5
	Mesquite	5	1	2.99	0.537	3	3	1.161	1.347	-0.009	0.941	8.538	2	4	1	5
Providing attainable housing for working class families:	Unincorporated Clark County	226	17	2.48	0.071	2	2	1.066	1.136	0.428	0.162	-0.313	0	4	1	5
	City of Las Vegas	181	16	2.55	0.085	3	3	1.140	1.299	0.264	0.180	-0.646	0	4	1	5
	North Las Vegas	68	3	2.41	0.137	2	2	1.132	1.282	0.355	0.290	-0.762	1	4	1	3
	Henderson	76	8	2.46	0.133	2	3	1.163	1.353	0.445	0.275	-0.449	1	4	1	3
	Boulder City	6	2	2.05	0.324	2	2	0.805	0.648	-0.102	0.835	-0.894	2	2	1	5
	Mesquite	5	1	1.61	0.371	1	1	0.802	0.644	1.119	0.941	1.497	2	2	1	5

Appendix II
Performance scores for selected variables
Summary Statistics by Jurisdiction

Social and Judicial Services Performance Measure (Continued)		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Providing affordable housing for low income families:	Unincorporated Clark County	226	16	2.30	0.067	2	2	1.006	1.012	0.608	0.162	-0.030	0	4	1	5
	City of Las Vegas	186	11	2.53	0.087	2	2	1.185	1.405	0.371	0.178	-0.726	0	4	1	5
	North Las Vegas	66	6	2.43	0.147	2	2	1.194	1.426	0.388	0.295	-1.086	1	4	1	3
	Henderson	77	7	2.36	0.133	2	1	1.166	1.361	0.385	0.274	-0.873	1	4	1	2
	Boulder City	6	2	1.96	0.381	2	1	0.948	0.898	0.098	0.835	-2.329	2	2	1	5
	Mesquite	5	1	1.13	0.178	1	1	0.384	0.148	3.325	0.941	17.042	2	1	1	5
Providing shelter for the homeless:	Unincorporated Clark County	224	18	1.99	0.074	2	1	1.108	1.228	1.010	0.163	0.291	0	4	1	5
	City of Las Vegas	186	11	2.29	0.087	2	1	1.181	1.395	0.707	0.178	-0.236	0	4	1	5
	North Las Vegas	69	2	2.10	0.140	2	1	1.166	1.360	0.712	0.288	-0.513	1	4	1	4
	Henderson	78	6	2.05	0.146	2	1	1.290	1.664	0.944	0.272	-0.382	1	4	1	4
	Boulder City	7	1	1.74	0.398	1	1	1.060	1.123	1.396	0.790	1.606	2	3	1	5
	Mesquite	5	1	1.77	0.685	1	1	1.481	2.192	1.714	0.941	1.305	2	3	1	5
Providing affordable housing for seniors:	Unincorporated Clark County	218	24	2.48	0.074	2	3	1.090	1.188	0.294	0.165	-0.557	0	4	1	5
	City of Las Vegas	184	14	2.64	0.086	3	3	1.159	1.342	0.204	0.179	-0.673	0	4	1	5
	North Las Vegas	67	4	2.62	0.153	3	3	1.254	1.572	0.391	0.292	-0.676	1	4	1	3
	Henderson	76	8	2.69	0.137	3	4	1.197	1.433	0.064	0.275	-1.075	1	4	1	4
	Boulder City	7	1	1.92	0.395	2	1	1.030	1.060	0.204	0.804	-2.747	2	2	1	5
	Mesquite	5	1	1.66	0.529	1	1	1.144	1.310	2.304	0.941	9.130	2	3	1	5
Providing medical care for the poor:	Unincorporated Clark County	222	20	2.47	0.080	2	1	1.193	1.424	0.289	0.163	-0.977	0	4	1	5
	City of Las Vegas	181	16	2.70	0.093	3	3	1.257	1.579	0.173	0.180	-0.960	0	4	1	5
	North Las Vegas	68	3	2.70	0.152	3	3	1.258	1.583	0.030	0.290	-0.966	1	4	1	4
	Henderson	75	9	2.41	0.137	2	1	1.190	1.417	0.493	0.277	-0.585	1	4	1	5
	Boulder City	6	2	2.16	0.466	2	1	1.158	1.341	0.237	0.835	-1.563	2	3	1	5
	Mesquite	5	1	2.78	0.738	3	1	1.596	2.546	0.176	0.941	-1.513	2	4	1	5

Social and Judicial Services Performance Measure (Continued)		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Providing 24-Hour Emergency Trauma Care	Unincorporated Clark County	195	47	2.44	0.072	2	3	1.012	1.024	0.313	0.174	-0.277	0	4	1	5
	City of Las Vegas	162	36	2.56	0.089	3	3	1.125	1.265	0.121	0.191	-0.948	0	4	1	5
	North Las Vegas	58	14	2.78	0.154	3	3	1.174	1.378	0.001	0.314	-0.841	1	4	1	4
	Henderson	63	21	2.67	0.137	3	3	1.088	1.185	0.242	0.301	-0.194	1	4	1	5
	Boulder City	4	4	2.16	0.700	2	1	1.341	1.797	0.656	1.064			3	1	5
	Mesquite	4	2	2.84	0.665	3	3	1.338	1.791	0.508	1.008	7.253	3	4	1	5

Appendix II
Performance scores for selected variables
Summary Statistics by Jurisdiction

Public Safety Performance Measure		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
providing crime prevention programs:	Unincorporated Clark County	229	13	2.94	0.064	3	3	0.970	0.940	-0.079	0.161	-0.107	0	4	1	5
	City of Las Vegas	190	7	2.89	0.077	3	3	1.064	1.132	-0.111	0.176	-0.419	0	4	1	5
	North Las Vegas	69	3	2.70	0.116	3	3	0.962	0.926	-0.240	0.289	-0.574	1	4	1	4
	Henderson	80	4	3.01	0.111	3	3	0.994	0.988	-0.353	0.269	-0.119	1	4	1	4
	Boulder City	8	0	2.92	0.308	3	3	0.854	0.729	-1.030	0.764	2.837	2	3	1	5
	Mesquite	5	1	2.51	0.502	3	3	1.156	1.337	-0.759	0.890	-0.718	2	3	1	5
Enforcing traffic laws:	Unincorporated Clark County	239	3	2.86	0.077	3	3	1.197	1.433	0.015	0.157	-0.833	0	4	1	5
	City of Las Vegas	192	5	2.88	0.084	3	3	1.162	1.351	0.098	0.175	-0.804	0	4	1	5
	North Las Vegas	72	0	3.10	0.147	3	3	1.248	1.558	0.018	0.283	-0.856	1	4	2	5
	Henderson	83	1	2.82	0.142	3	3	1.296	1.680	0.211	0.264	-0.946	1	4	1	5
	Boulder City	8	0	3.37	0.375	3	3	1.041	1.085	0.642	0.764	-0.163	2	3	1	5
	Mesquite	5	1	2.89	0.897	3	1	1.939	3.759	0.166	0.941	-2.704	2	4	1	5
Maintaining a low crime rate:	Unincorporated Clark County	239	3	2.77	0.062	3	3	0.955	0.912	0.126	0.157	-0.116	0	4	1	5
	City of Las Vegas	196	1	2.78	0.080	3	3	1.124	1.263	-0.048	0.174	-0.659	0	4	1	5
	North Las Vegas	69	3	2.50	0.149	3	3	1.236	1.528	0.200	0.289	-1.011	1	4	1	4
	Henderson	81	3	2.94	0.120	3	3	1.081	1.168	-0.080	0.268	-0.600	1	4	1	4
	Boulder City	8	0	2.92	0.308	3	3	0.854	0.729	-1.030	0.764	2.837	2	3	1	5
	Mesquite	5	1	2.28	0.545	3	3	1.255	1.576	-0.096	0.890	-2.311	2	3	1	5

Appendix II
Performance scores for selected variables
Summary Statistics by Jurisdiction

Public Safety Performance Measure (Continued)		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Maintaining neighborhood police patrols:	Unincorporated Clark County	235	7	2.56	0.070	2	2	1.074	1.153	0.443	0.159	-0.384	0	4	1	5
	City of Las Vegas	194	3	2.73	0.078	3	3	1.089	1.185	0.250	0.175	-0.497	0	4	1	5
	North Las Vegas	70	2	2.63	0.129	3	2	1.078	1.163	0.305	0.288	-0.501	1	4	2	4
	Henderson	80	4	2.93	0.123	3	3	1.101	1.212	0.312	0.269	-0.542	1	4	1	5
	Boulder City	7	1	3.09	0.249	3	3	0.645	0.416	-0.040	0.808	1.384	2	2	1	5
	Mesquite	5	1	2.96	0.828	4	1	1.911	3.651	-0.243	0.889	-2.959	2	4	1	5
Keeping police response times low:	Unincorporated Clark County	228	15	2.92	0.076	3	3	1.140	1.300	-0.080	0.161	-0.724	0	4	1	5
	City of Las Vegas	185	12	3.00	0.085	3	3	1.155	1.334	0.052	0.179	-0.789	0	4	1	5
	North Las Vegas	65	7	2.89	0.146	3	3	1.175	1.382	0.096	0.297	-0.796	1	4	2	5
	Henderson	79	5	3.36	0.119	3	4	1.064	1.131	-0.305	0.270	-0.418	1	4	1	5
	Boulder City	6	2	3.56	0.426	4	3	1.060	1.123	0.002	0.835	-0.438	2	3	1	5
	Mesquite	4	2	2.80	0.953	3	1	1.918	3.677	0.321	1.008	-2.454	3	4	1	5
Keeping fire department response times low:	Unincorporated Clark County	219	24	3.70	0.066	4	4	0.981	0.962	-0.836	0.164	0.672	0	4	1	5
	City of Las Vegas	174	23	3.63	0.075	4	4	0.986	0.971	-0.411	0.184	-0.115	0	4	1	5
	North Las Vegas	64	7	3.88	0.109	4	4	0.873	0.762	-0.850	0.298	1.223	1	4	3	5
	Henderson	77	7	3.89	0.103	4	4	0.904	0.818	-0.743	0.274	0.632	1	4	3	5
	Boulder City	6	2	4.26	0.275	4	4	0.683	0.467	-0.352	0.835	0.537	2	2	1	5
	Mesquite	5	1	4.00	0.402	4	5	0.925	0.856	-0.007	0.890	-2.167	2	2	1	5
Keeping paramedic and emergency medical response times low:	Unincorporated Clark County	229	14	3.74	0.063	4	4	0.953	0.908	-0.603	0.161	0.243	0	4	2	5
	City of Las Vegas	177	20	3.71	0.075	4	4	0.998	0.996	-0.496	0.182	-0.228	0	4	1	5
	North Las Vegas	65	7	3.88	0.098	4	4	0.792	0.627	-0.631	0.297	0.372	1	3	3	5
	Henderson	77	7	3.76	0.118	4	4	1.034	1.069	-0.681	0.273	-0.121	1	4	3	5
	Boulder City	6	2	4.21	0.299	4	4	0.743	0.552	-0.399	0.835	-0.057	2	2	1	5
	Mesquite	5	1	4.42	0.334	5	5	0.769	0.591	-1.115	0.890	1.213	2	2	1	5

Appendix II
Performance scores for selected variables
Summary Statistics by Jurisdiction

Public Safety Performance Measure (Continued)		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Well trained paramedic and emergency medical response personnel:	Unincorporated Clark County	218	24	3.91	0.064	4	4	0.941	0.885	-0.966	0.165	1.016	0	4	2	5
	City of Las Vegas	176	21	3.97	0.065	4	4	0.868	0.754	-0.644	0.183	0.374	0	4	1	5
	North Las Vegas	66	6	3.91	0.091	4	4	0.736	0.542	-0.088	0.295	-0.553	1	3	3	5
	Henderson	75	9	3.95	0.107	4	4	0.931	0.867	-0.740	0.277	0.145	1	4	2	5
	Boulder City	8	0	4.13	0.316	4	5	0.876	0.767	-0.310	0.764	-1.678	2	2	1	5
	Mesquite	5	1	3.86	0.527	4	5	1.214	1.473	-0.827	0.890	-0.111	2	3	1	5
Facilitate neighborhood watch programs:	Unincorporated Clark County	222	21	2.63	0.065	3	3	0.973	0.946	0.387	0.163	0.014	0	4	1	5
	City of Las Vegas	177	20	2.72	0.082	3	3	1.094	1.197	0.073	0.182	-0.590	0	4	1	5
	North Las Vegas	66	6	2.67	0.112	3	3	0.907	0.823	-0.234	0.295	-0.288	1	4	2	5
	Henderson	72	12	2.76	0.127	3	3	1.074	1.153	0.542	0.284	0.070	1	4	1	5
	Boulder City	7	1	3.18	0.366	3	3	0.953	0.909	0.567	0.804	0.761	2	3	1	5
	Mesquite	5	1	2.57	0.629	3	3	1.359	1.848	0.908	0.941	3.916	2	4	1	5
Preparing for natural disasters, (i.e. floods, earthquakes, etc):	Unincorporated Clark County	233	10	2.70	0.073	3	3	1.120	1.254	0.048	0.159	-0.780	0	4	1	5
	City of Las Vegas	186	11	2.93	0.093	3	3	1.270	1.614	-0.042	0.178	-0.929	0	4	1	5
	North Las Vegas	67	5	2.82	0.129	3	3	1.055	1.113	-0.098	0.292	-0.865	1	4	1	5
	Henderson	75	9	2.85	0.135	3	3	1.165	1.357	0.038	0.278	-0.542	1	4	1	5
	Boulder City	7	1	2.83	0.517	3	4	1.376	1.892	-0.087	0.790	-0.927	2	4	1	5
	Mesquite	5	1	2.43	0.783	2	1	1.692	2.863	0.626	0.941	-1.209	2	4	1	5
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events:	Unincorporated Clark County	231	12	2.77	0.075	3	3	1.137	1.293	0.158	0.160	-0.645	0	4	1	5
	City of Las Vegas	188	9	2.78	0.090	3	3	1.226	1.503	0.155	0.177	-0.822	0	4	1	5
	North Las Vegas	67	4	2.68	0.140	3	3	1.147	1.315	-0.019	0.292	-0.940	1	4	1	5
	Henderson	78	6	2.81	0.134	3	3	1.181	1.394	0.098	0.273	-0.687	1	4	1	5
	Boulder City	7	1	2.92	0.506	3	3	1.348	1.816	-0.327	0.790	-0.494	2	4	1	5
	Mesquite	5	1	2.30	0.729	2	1	1.577	2.486	0.936	0.941	1.202	2	4	1	5

Appendix II
Performance scores for selected variables
Summary Statistics by Jurisdiction

Public Safety Performance Measure (Continued)		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Investigating criminal activity:	Unincorporated Clark County	223	20	2.98	0.069	3	3	1.030	1.060	-0.073	0.163	-0.295	0	4	1	5
	City of Las Vegas	185	12	3.00	0.088	3	3	1.192	1.421	-0.064	0.178	-0.670	0	4	1	5
	North Las Vegas	67	5	2.98	0.111	3	3	0.911	0.830	-0.524	0.292	-0.206	1	4	2	5
	Henderson	75	9	2.92	0.125	3	3	1.078	1.162	-0.006	0.278	-0.675	1	4	1	5
	Boulder City	7	1	3.28	0.335	3	3	0.873	0.762	0.621	0.804	1.579	2	3	1	5
	Mesquite	5	1	3.38	0.643	4	4	1.482	2.195	-0.635	0.890	-0.420	2	4	1	5
Providing fire protection & prevention services:	Unincorporated Clark County	232	10	3.61	0.061	4	4	0.932	0.869	-0.393	0.160	0.105	0	4	1	5
	City of Las Vegas	183	14	3.56	0.072	3	3	0.977	0.954	-0.222	0.180	-0.210	0	4	1	5
	North Las Vegas	69	3	3.57	0.111	4	4	0.922	0.851	-0.756	0.289	0.614	1	4	3	5
	Henderson	77	7	3.51	0.106	4	4	0.932	0.869	-0.126	0.273	-0.540	1	4	3	5
	Boulder City	8	0	3.68	0.237	4	4	0.657	0.431	0.395	0.764	0.077	2	2	1	5
	Mesquite	5	1	3.82	0.444	4	3	1.022	1.044	0.540	0.890	-2.724	2	2	1	5
Providing emergency medical services:	Unincorporated Clark County	230	13	3.69	0.066	4	4	1.003	1.006	-0.703	0.160	0.205	0	4	1	5
	City of Las Vegas	189	8	3.58	0.073	4	4	1.006	1.013	-0.407	0.177	-0.127	0	4	1	5
	North Las Vegas	69	3	3.75	0.105	4	4	0.871	0.759	-0.367	0.289	-0.014	1	4	3	5
	Henderson	81	3	3.54	0.116	4	4	1.043	1.087	-0.433	0.267	-0.175	1	4	3	5
	Boulder City	8	0	4.08	0.242	4	4	0.671	0.451	-0.076	0.764	0.466	2	2	1	5
	Mesquite	5	1	3.70	0.396	3	3	0.912	0.832	0.861	0.890	-1.118	2	2	1	5
Providing for neighborhood code enforcement services:	Unincorporated Clark County	220	23	2.81	0.075	3	3	1.111	1.234	0.249	0.164	-0.586	0	4	1	5
	City of Las Vegas	169	28	2.83	0.087	3	3	1.126	1.268	0.154	0.187	-0.697	0	4	1	5
	North Las Vegas	64	8	2.92	0.114	3	3	0.916	0.839	0.228	0.299	0.511	1	4	3	5
	Henderson	69	15	2.96	0.134	3	3	1.112	1.236	0.098	0.289	-0.540	1	4	1	5
	Boulder City	6	2	3.47	0.310	3	3	0.746	0.556	1.545	0.857	2.574	2	2	1	5
	Mesquite	4	2	2.80	0.894	3	1	1.803	3.252	-0.093	1.006	-3.049	3	4	1	5

Appendix II
Performance scores for selected variables
Summary Statistics by Jurisdiction

Public Safety Performance Measure (Continued)		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Examining potential impacts from Yucca Mountain nuclear waste shipments:	Unincorporated Clark County	224	19	2.66	0.081	3	2	1.214	1.475	0.271	0.163	-0.885	0	4	1	5
	City of Las Vegas	176	21	2.77	0.096	3	3	1.269	1.610	0.050	0.183	-1.016	0	4	1	5
	North Las Vegas	62	10	2.67	0.161	3	3	1.262	1.592	0.081	0.305	-1.030	1	4	1	4
	Henderson	73	11	2.64	0.134	3	3	1.146	1.314	0.242	0.281	-0.639	1	4	1	5
	Boulder City	6	2	1.78	0.469	1	1	1.165	1.357	1.684	0.835	2.848	2	3	1	5
	Mesquite	5	1	2.56	0.825	3	1	1.783	3.179	0.326	0.941	-2.671	2	4	1	5

Appendix II
Performance scores for selected variables
Summary Statistics by Jurisdiction

Community Development Performance Measure		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Providing affordable housing:	Unincorporated Clark County	229	13	2.33	0.069	2	2	1.042	1.085	0.443	0.161	-0.344	0	4	1	5
	City of Las Vegas	179	18	2.51	0.078	3	3	1.040	1.083	0.305	0.181	-0.347	0	4	1	5
	North Las Vegas	71	1	2.62	0.136	3	3	1.143	1.306	0.312	0.286	-0.384	1	4	1	3
	Henderson	76	8	2.44	0.122	3	3	1.067	1.139	0.212	0.275	-0.594	1	4	1	2
	Boulder City	7	1	2.08	0.331	2	2	0.862	0.743	-0.187	0.804	-1.586	2	2	1	5
	Mesquite	5	1	1.26	0.230	1	1	0.498	0.248	1.653	0.941	0.907	2	1	1	5
Managing growth:	Unincorporated Clark County	242	1	2.39	0.071	2	3	1.106	1.224	0.463	0.157	-0.379	0	4	1	5
	City of Las Vegas	190	8	2.51	0.083	2	3	1.148	1.318	0.273	0.177	-0.819	0	4	1	5
	North Las Vegas	72	0	2.53	0.143	2	3	1.213	1.472	0.486	0.283	-0.488	1	4	1	5
	Henderson	82	2	2.41	0.129	2	2	1.163	1.353	0.538	0.266	-0.416	1	4	1	4
	Boulder City	8	0	2.67	0.561	2	2	1.555	2.418	0.680	0.764	-0.932	2	4	1	5
	Mesquite	6	0	2.46	0.537	3	3	1.309	1.713	-0.267	0.849	-2.040	2	3	1	5
Increasing job opportunities:	Unincorporated Clark County	237	6	2.98	0.070	3	3	1.075	1.156	0.016	0.158	-0.534	0	4	1	5
	City of Las Vegas	187	10	3.10	0.091	3	3	1.245	1.549	-0.254	0.178	-0.809	0	4	1	5
	North Las Vegas	70	2	3.34	0.146	3	3	1.225	1.501	-0.074	0.287	-0.924	1	4	2	4
	Henderson	81	3	3.00	0.116	3	3	1.040	1.081	-0.165	0.268	-0.175	1	4	1	5
	Boulder City	8	0	3.04	0.276	3	3	0.766	0.587	-0.075	0.764	-0.768	2	2	1	5
	Mesquite	6	0	2.67	0.758	3	1	1.846	3.407	0.256	0.849	-2.472	2	4	1	5
Improving the business climate:	Unincorporated Clark County	237	6	3.19	0.064	3	3	0.992	0.984	-0.367	0.158	-0.136	0	4	1	5
	City of Las Vegas	190	7	3.24	0.076	3	3	1.043	1.087	-0.266	0.176	-0.353	0	4	1	5
	North Las Vegas	64	8	3.49	0.120	4	4	0.963	0.927	-0.538	0.299	0.441	1	4	2	4
	Henderson	81	3	3.38	0.097	3	3	0.879	0.773	-0.153	0.267	0.360	1	4	1	5
	Boulder City	8	0	3.13	0.296	3	3	0.822	0.675	-0.291	0.764	-1.259	2	2	1	5
	Mesquite	6	0	3.55	0.670	4	5	1.632	2.664	-0.944	0.849	-0.106	2	4	1	5

Appendix II
Performance scores for selected variables
Summary Statistics by Jurisdiction

Community Development Performance Measure (Continued)		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Planning for commercial development:	Unincorporated Clark County	229	14	3.20	0.070	3	3	1.058	1.119	-0.197	0.161	-0.326	0	4	1	5
	City of Las Vegas	185	12	3.31	0.080	3	3	1.087	1.183	-0.438	0.179	-0.184	0	4	1	5
	North Las Vegas	69	3	3.50	0.118	4	4	0.978	0.956	-0.445	0.289	0.130	1	4	2	4
	Henderson	79	5	3.10	0.116	3	3	1.033	1.067	-0.277	0.270	-0.365	1	4	1	5
	Boulder City	7	1	3.37	0.295	4	4	0.767	0.589	-0.891	0.804	0.010	2	2	1	5
	Mesquite	6	0	3.35	0.635	3	3	1.546	2.391	-0.665	0.849	-0.153	2	4	1	5
Evaluating impacts to property values as a result of the proposed shipment of nuclear waste to Yucca Mountain:	Unincorporated Clark County	226	16	2.26	0.076	2	1	1.150	1.322	0.624	0.162	-0.393	0	4	1	5
	City of Las Vegas	172	26	2.31	0.090	2	1	1.181	1.394	0.564	0.185	-0.453	0	4	1	5
	North Las Vegas	62	10	2.35	0.157	2	1	1.234	1.522	0.475	0.304	-0.663	1	4	1	4
	Henderson	72	12	2.59	0.149	2	3	1.260	1.589	0.437	0.283	-0.695	1	4	1	4
	Boulder City	6	2	2.41	0.446	3	3	1.107	1.226	-0.425	0.835	-1.136	2	3	1	5
	Mesquite	5	1	2.46	0.470	3	3	1.083	1.173	-0.392	0.890	-0.311	2	3	1	5
Evaluating impacts to Southern Nevada's tourism economy as a result of the proposed shipment of nuclear waste to Yucca M	Unincorporated Clark County	223	19	2.48	0.081	2	3	1.204	1.450	0.442	0.163	-0.606	0	4	1	5
	City of Las Vegas	172	25	2.47	0.092	3	3	1.206	1.456	0.322	0.185	-0.755	0	4	1	5
	North Las Vegas	62	10	2.80	0.154	3	3	1.214	1.474	0.249	0.304	-0.661	1	4	1	4
	Henderson	71	13	2.74	0.136	3	2	1.146	1.314	0.154	0.285	-0.801	1	4	1	4
	Boulder City	7	1	2.54	0.520	3	1	1.383	1.912	-0.257	0.790	-2.185	2	3	1	5
	Mesquite	5	1	2.05	0.561	2	1	1.291	1.667	0.521	0.890	-2.137	2	3	1	5
Reducing traffic congestion:	Unincorporated Clark County	239	3	2.21	0.064	2	2	0.997	0.994	0.515	0.157	-0.271	0	4	1	5
	City of Las Vegas	190	7	2.41	0.084	2	2	1.156	1.336	0.526	0.176	-0.473	0	4	1	5
	North Las Vegas	71	1	2.55	0.138	3	3	1.161	1.348	0.403	0.286	-0.428	1	4	1	4
	Henderson	82	2	2.60	0.126	2	2	1.135	1.288	0.359	0.266	-0.698	1	4	1	4
	Boulder City	8	0	2.49	0.408	3	3	1.133	1.283	-0.075	0.764	-1.146	2	3	1	5
	Mesquite	6	0	2.64	0.466	2	2	1.135	1.289	0.288	0.849	-1.389	2	3	1	5

Appendix II
Performance scores for selected variables
Summary Statistics by Jurisdiction

Community Development Performance Measure (Continued)		N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Range	Minimum	Maximum
Access to freeways:	Unincorporated Clark County	238	4	2.88	0.068	3	3	1.044	1.089	-0.055	0.158	-0.387	0	4	1	5
	City of Las Vegas	195	3	2.96	0.080	3	3	1.122	1.258	0.030	0.174	-0.633	0	4	1	5
	North Las Vegas	70	2	2.98	0.136	3	3	1.142	1.303	-0.091	0.287	-0.591	1	4	2	5
	Henderson	81	3	3.28	0.112	3	4	1.005	1.011	-0.217	0.268	-0.571	1	4	1	5
	Boulder City	8	0	3.12	0.366	3	3	1.014	1.028	0.405	0.764	-0.534	2	3	1	5
	Mesquite	6	0	3.86	0.549	4	5	1.337	1.789	-1.515	0.849	3.949	2	4	1	5
Improving road conditions:	Unincorporated Clark County	239	3	2.77	0.063	3	3	0.974	0.950	-0.073	0.157	-0.424	0	4	1	5
	City of Las Vegas	194	3	3.08	0.085	3	3	1.184	1.401	-0.116	0.174	-0.748	0	4	1	5
	North Las Vegas	71	1	2.83	0.121	3	3	1.014	1.029	-0.170	0.286	-0.716	1	4	3	4
	Henderson	82	2	3.05	0.123	3	3	1.113	1.238	-0.107	0.266	-0.695	1	4	1	5
	Boulder City	8	0	3.28	0.173	3	3	0.480	0.230	1.259	0.764	-0.680	2	1	1	5
	Mesquite	6	0	3.50	0.656	4	5	1.597	2.549	-0.943	0.849	0.040	2	4	1	5
Reducing travel time:	Unincorporated Clark County	236	7	2.59	0.067	3	3	1.027	1.054	0.149	0.159	-0.419	0	4	1	5
	City of Las Vegas	192	5	2.73	0.088	3	2	1.225	1.502	0.276	0.175	-0.839	0	4	1	5
	North Las Vegas	71	1	2.53	0.132	3	3	1.107	1.225	0.306	0.286	-0.497	1	4	2	4
	Henderson	81	3	2.84	0.124	3	3	1.119	1.252	0.075	0.267	-0.683	1	4	1	5
	Boulder City	8	0	3.08	0.265	3	3	0.735	0.541	-0.125	0.764	-0.409	2	2	1	5
	Mesquite	5	1	2.93	0.615	3	3	1.332	1.773	0.232	0.939	1.904	2	4	1	5
Providing mass public transit:	Unincorporated Clark County	236	7	2.65	0.046	3	3	0.702	0.492	-0.043	0.158	0.046	0	4	1	5
	City of Las Vegas	187	10	2.81	0.057	3	3	0.774	0.599	0.218	0.178	0.294	0	4	1	5
	North Las Vegas	69	2	2.91	0.090	3	3	0.752	0.566	0.289	0.288	1.179	1	4	2	4
	Henderson	81	3	2.83	0.083	3	3	0.749	0.561	0.126	0.268	1.111	1	4	2	4
	Boulder City	7	1	2.79	0.290	3	3	0.772	0.596	0.435	0.790	-0.635	2	2	1	5
	Mesquite	5	1	3.13	0.361	3	3	0.834	0.695	-0.307	0.889	-0.911	2	2	1	6

Appendix III
Quality of Life Considerations

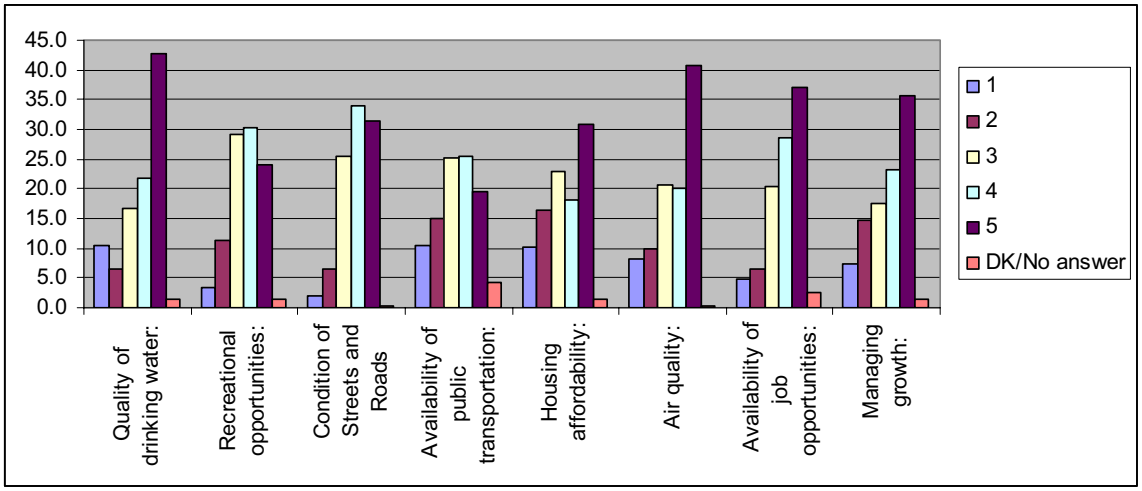
Appendix III
Quality of Life Considerations
Summary Statistics

	Overall sense of preparedness in the event of a large scale natural or man-made emergency:	Quality of drinking water:	Recreational opportunities:	Condition of streets & roads:	Availability of public transportation:	Housing affordability:	Air quality:	Availability of job opportunities:	Managing growth:
N	593	600	600	607	583	600	608	594	600
Missing	16	9	9	2	26	9	1	15	9
Mean	3.55	3.81	3.61	3.87	3.29	3.43	3.76	3.89	3.66
Std. Error of Mean	0.06	0.05	0.04	0.04	0.05	0.06	0.05	0.05	0.05
Median	4	4	4	4	3	3	4	4	4
Std. Deviation	1.35	1.34	1.08	1.00	1.26	1.35	1.30	1.13	1.31
Variance	1.84	1.80	1.17	1.00	1.60	1.83	1.69	1.28	1.70
Skewness	-0.47	-0.88	-0.40	-0.61	-0.29	-0.32	-0.70	-0.86	-0.57
Std. Error of Skewness	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Kurtosis	-0.97	-0.42	-0.52	-0.17	-0.91	-1.13	-0.65	0.01	-0.89
Std. Error of Kurtosis	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Range	4	4	4	4	4	4	4	4	4
Minimum	1	1	1	1	1	1	1	1	1
Maximum	5	5	5	5	5	5	5	5	5

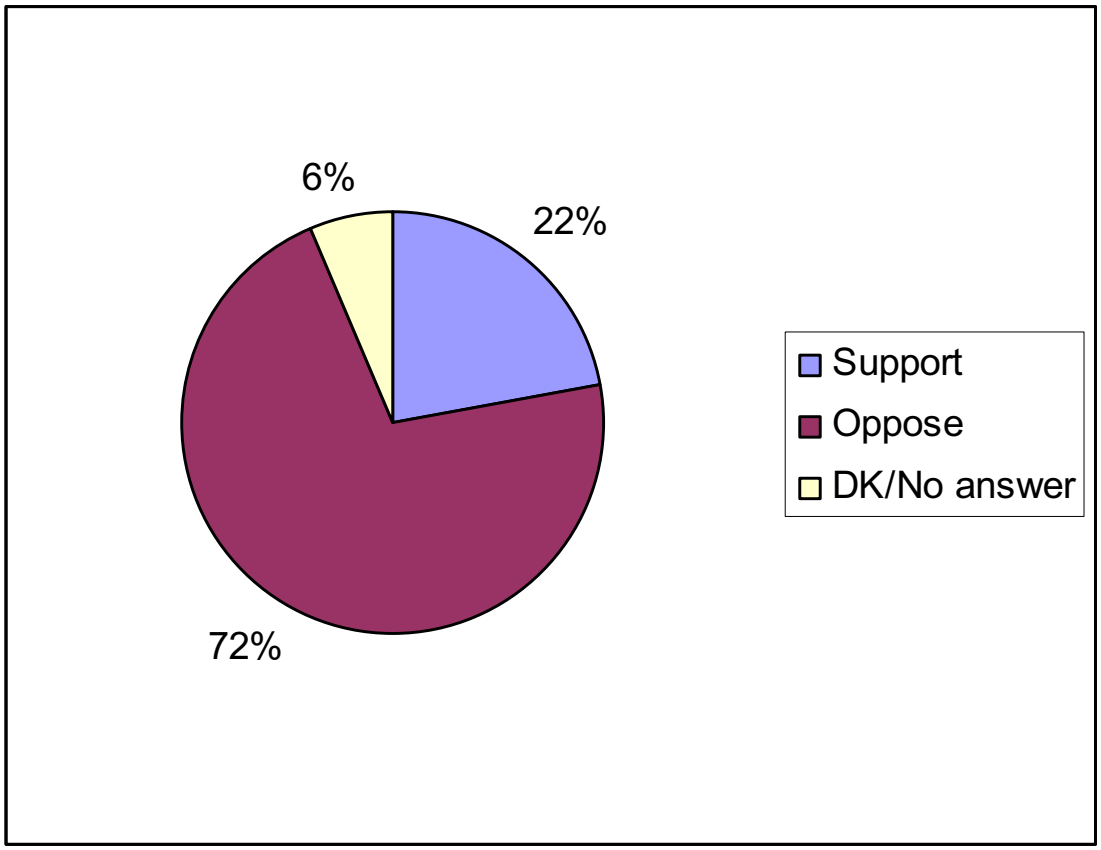
Appendix III
Quality of Life Considerations

Now I'd like to ask you about different factors that may contribute to your quality of life. On a scale of one to five, where one means "low importance" and five means "high importance," please rate the level of importance for the following services:

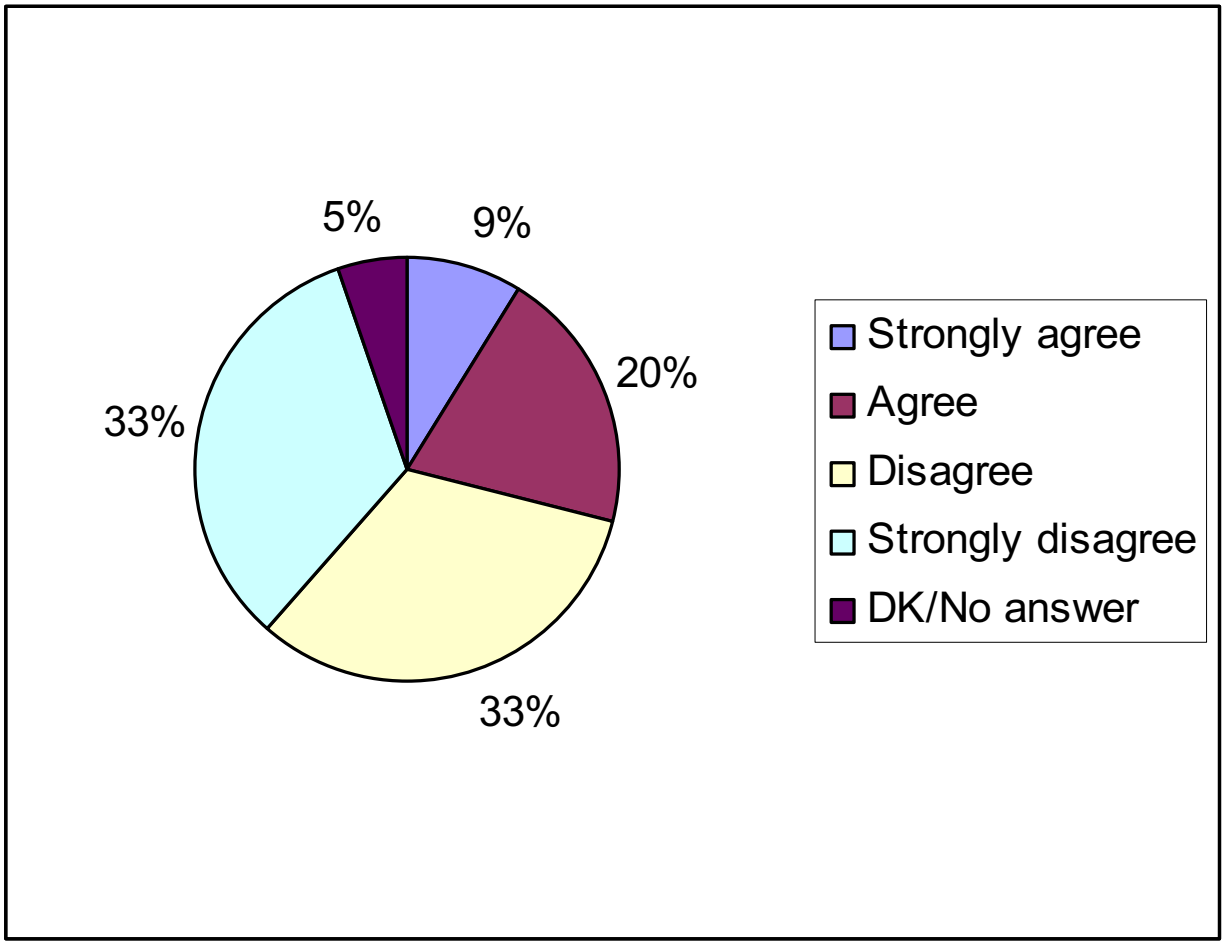
	1	2	3	4	5	DK/ No answer	Total
Quality of drinking water:	10.6	6.5	16.8	21.9	42.7	1.5	100.0
Recreational opportunities:	3.4	11.3	29.3	30.3	24.1	1.6	100.0
Condition of Streets and Roads	2.0	6.6	25.5	34.0	31.5	0.3	100.0
Availability of public transportation:	10.6	15.1	25.2	25.4	19.5	4.2	100.0
Housing affordability:	10.3	16.4	23.0	18.1	30.7	1.5	100.0
Air quality:	8.1	10.0	20.8	20.1	40.8	0.2	100.0
Availability of job opportunities:	4.7	6.6	20.5	28.7	37.1	2.5	100.0
Managing growth:	7.4	14.8	17.5	23.1	35.8	1.4	100.0



The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain in Southern Nevada. If given the opportunity to vote on this matter, would your vote support or oppose locating a nuclear waste repository at Yucca Mountain?	Frequency	Percent
Support	135	22.2
Oppose	435	71.4
DK/No answer	39	6.4
Total	609	100.0

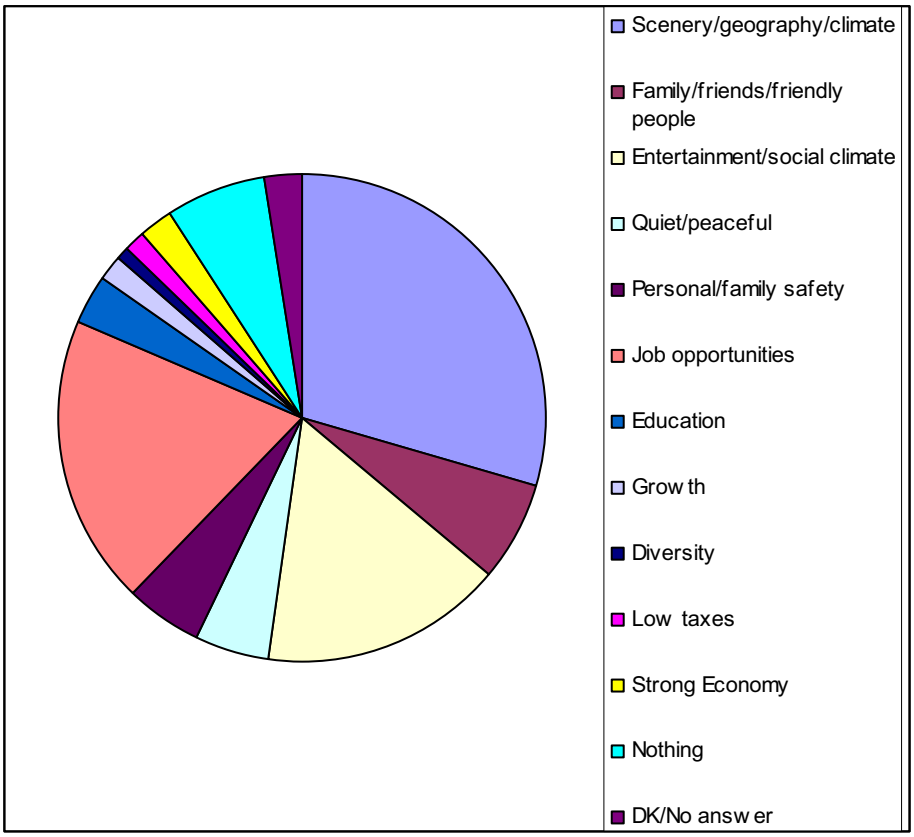


The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you strongly agree, agree, disagree, or strongly disagree with this claim?	Frequency	Percent
Strongly agree	55	9.0
Agree	121	19.8
Disagree	198	32.5
Strongly disagree	203	33.4
DK/No answer	32	5.2
Total	609	100.0



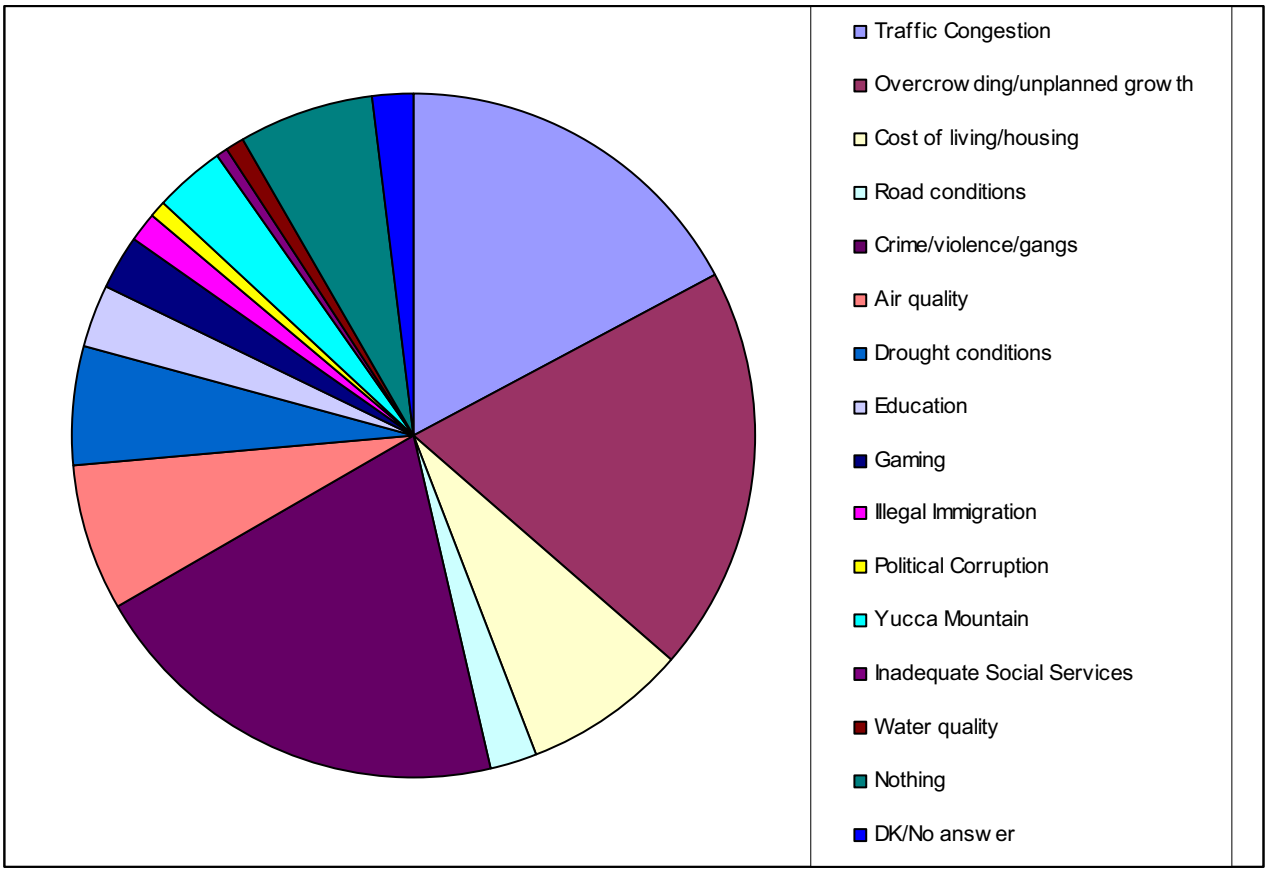
Appendix III
Quality of Life Considerations

Generally speaking, what aspect of living in Clark County, if any, has the greatest positive impact on your quality of life in Clark County, what would it be?	Frequency	Percent
Scenery/geography/climate	179	29.5
Family/friends/friendly people	40	6.6
Entertainment/social climate	99	16.3
Quiet/peaceful	30	5.0
Personal/family safety	29	4.8
Job opportunities	117	19.3
Education	20	3.3
Growth	10	1.6
Diversity	4	0.7
Low taxes	9	1.4
Strong Economy	14	2.2
Nothing	41	6.7
DK/No answer	16	2.5
Total	609	100.0



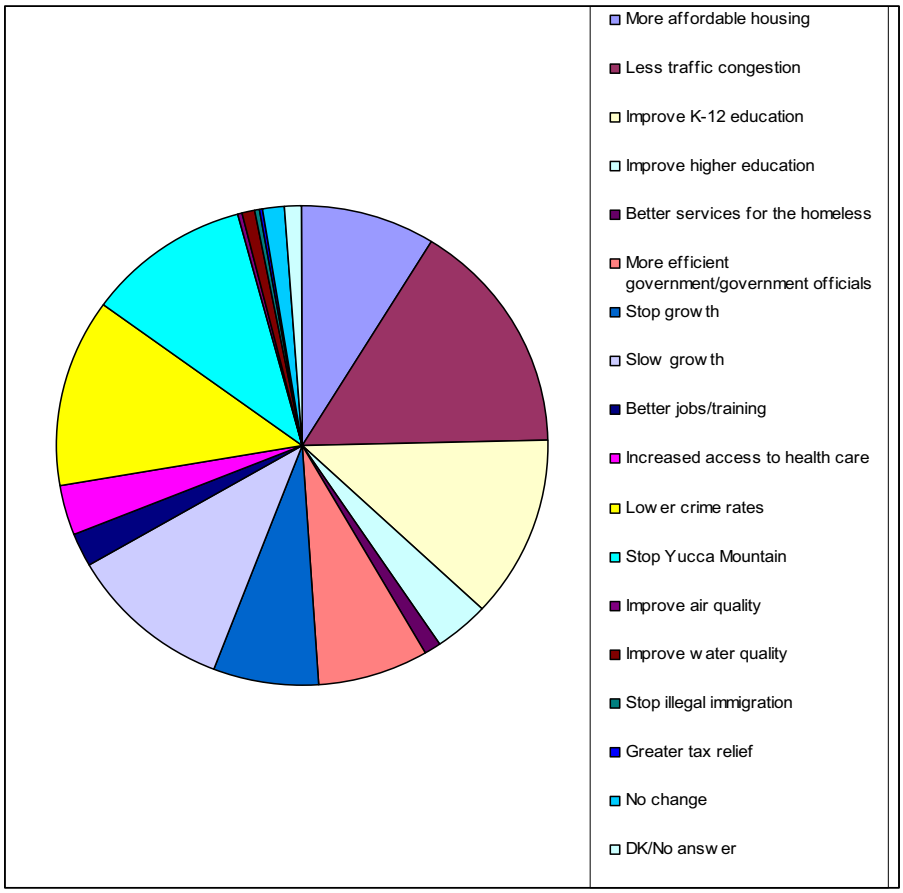
Appendix III
Quality of Life Considerations

Generally speaking, what aspect of living in Clark County, if any, has the greatest negative impact on your quality of life in Clark County, what would it be?	Frequency	Percent
Traffic Congestion	104	17.1
Overcrowding/unplanned growth	116	19.1
Cost of living/housing	48	7.9
Road conditions	14	2.3
Crime/violence/gangs	123	20.2
Air quality	43	7.0
Drought conditions	33	5.5
Education	19	3.1
Gaming	15	2.5
Illegal Immigration	8	1.3
Political Corruption	6	0.9
Yucca Mountain	20	3.2
Inadequate Social Services	3	0.6
Water quality	5	0.8
Nothing	39	6.4
DK/No answer	12	2.0
Total	609	100.0



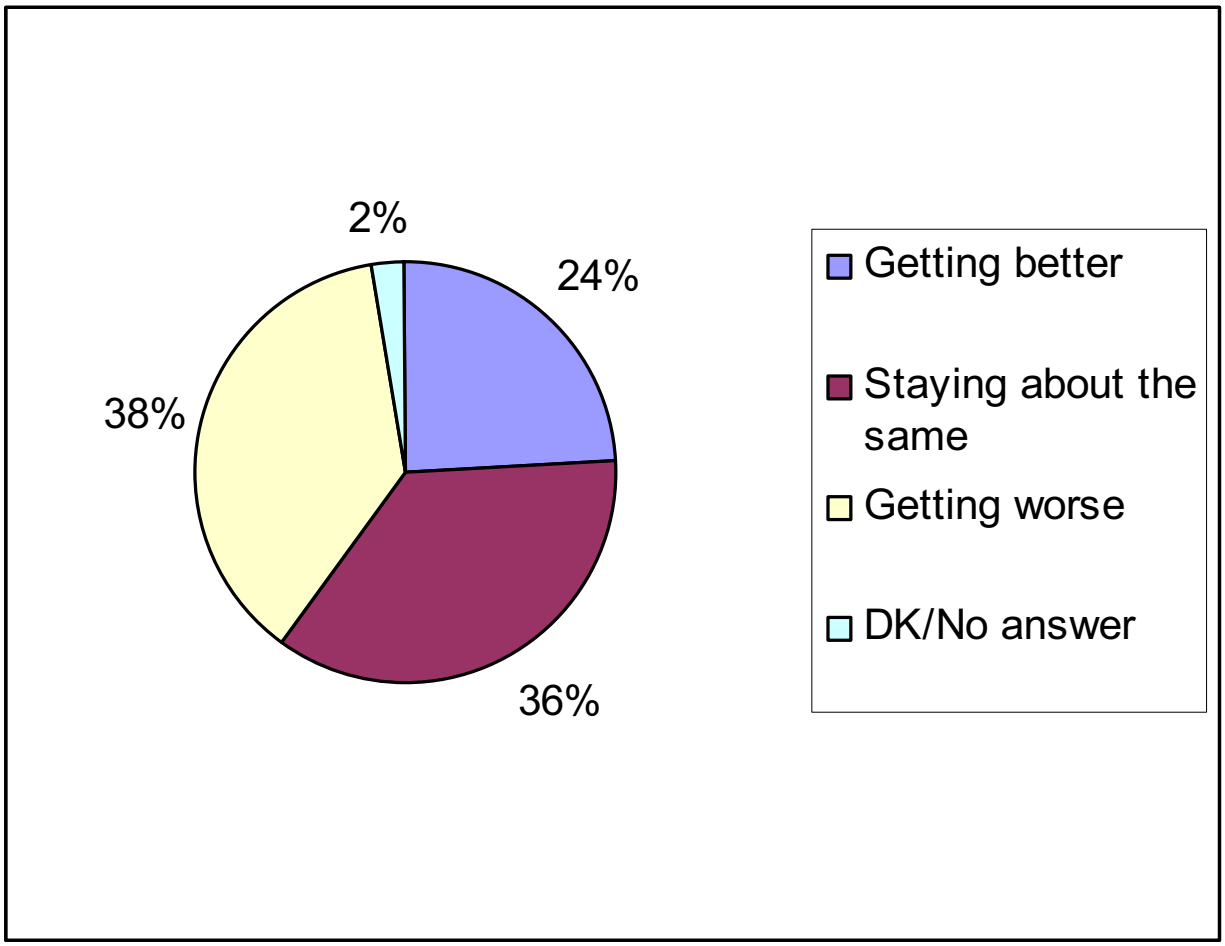
Appendix III
Quality of Life Considerations

In thinking about all of the issues we have talked about today, if you could make one major change locally to improve the quality of life in Clark County, what would it be?	Frequency	Percent
More affordable housing	54	8.8
Less traffic congestion	96	15.8
Improve K-12 education	76	12.4
Improve higher education	21	3.5
Better services for the homeless	7	1.2
More efficient government/government officials	44	7.2
Stop growth	42	6.9
Slow growth	66	10.9
Better jobs/training	13	2.1
Increased access to health care	20	3.3
Lower crime rates	78	12.8
Stop Yucca Mountain	66	10.8
Improve air quality	3	0.5
Improve water quality	4	0.7
Stop illegal immigration	2	0.2
Greater tax relief	2	0.4
No change	9	1.4
DK/No answer	6	1.0
Total	609	100.0


More affordable housing
Less traffic congestion
Improve K-12 education
Improve higher education
Better services for the homeless
More efficient government/government officials
Stop growth
Slow growth
Better jobs/training
Increased access to health care
Lower crime rates
Stop Yucca Mountain
Improve air quality
Improve water quality
Stop illegal immigration
Greater tax relief
No change
DK/No answer

Appendix III
Quality of Life Considerations

Overall would you say the quality of life in Clark County is getting better, worse, or staying the same?	Frequency	Percent
Getting better	147	24.2
Staying about the same	217	35.6
Getting worse	230	37.8
DK/No answer	15	2.4
Total	609	100.0



Appendix III
Quality of Life Considerations
Summary Statistics by Jurisdiction

Unincorporated Clark County		Overall sense of preparedness in the event of a large scale natural or man-made emergency:	Quality of drinking water:	Recreational opportunities:	Condition of streets & roads:	Availability of public transportation:	Housing affordability:	Air quality:	Availability of job opportunities:	Managing growth:
N	Valid	237	238	238	241	233	238	241	235	241
	Missing	6	5	4	1	9	4	1	8	2
Mean		3.59	3.89	3.57	3.95	3.27	3.48	3.85	4.04	3.70
Std. Error of Mean		0.087	0.083	0.068	0.064	0.089	0.090	0.081	0.072	0.085
Median		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Std. Deviation		1.342	1.276	1.054	0.989	1.354	1.382	1.263	1.103	1.312
Variance		1.800	1.629	1.112	0.978	1.833	1.910	1.595	1.218	1.721
Skewness		-0.459	-0.960	-0.408	-0.658	-0.291	-0.375	-0.794	-1.093	-0.628
Std. Error of Skewness		0.158	0.158	0.158	0.157	0.159	0.158	0.157	0.159	0.157
Kurtosis		-0.996	-0.178	-0.336	-0.143	-1.174	-1.124	-0.494	0.510	-0.848
Std. Error of Kurtosis		0.315	0.314	0.314	0.312	0.317	0.314	0.312	0.317	0.313
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations
Summary Statistics by Jurisdiction

City of Las Vegas		Overall sense of preparedness in the event of a large scale natural or man-made emergency:	Quality of drinking water:	Recreational opportunities:	Condition of streets & roads:	Availability of public transportation:	Housing affordability:	Air quality:	Availability of job opportunities:	Managing growth:
N	Valid	192	197	195	196	190	193	197	192	193
	Missing	5	0	2	1	7	4	0	5	4
Mean		3.30	3.56	3.64	3.71	3.26	3.25	3.53	3.76	3.55
Std. Error of Mean		0.098	0.105	0.080	0.072	0.093	0.095	0.097	0.083	0.093
Median		3.00	4.00	4.00	4.00	3.00	3.00	4.00	4.00	4.00
Std. Deviation		1.359	1.468	1.118	1.013	1.279	1.320	1.359	1.155	1.297
Variance		1.847	2.155	1.249	1.026	1.635	1.744	1.847	1.335	1.682
Skewness		-0.284	-0.650	-0.435	-0.284	-0.226	-0.148	-0.421	-0.642	-0.389
Std. Error of Skewness		0.176	0.173	0.174	0.174	0.177	0.175	0.173	0.175	0.175
Kurtosis		-1.022	-0.952	-0.619	-0.667	-0.909	-1.086	-1.017	-0.377	-1.043
Std. Error of Kurtosis		0.349	0.345	0.346	0.345	0.351	0.348	0.345	0.349	0.348
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations
Summary Statistics by Jurisdiction

City of North Las Vegas		Overall sense of preparedness in the event of a large scale natural or man-made emergency:	Quality of drinking water:	Recreational opportunities:	Condition of streets & roads:	Availability of public transportation:	Housing affordability:	Air quality:	Availability of job opportunities:	Managing growth:
N	Valid	72	71	72	72	66	72	72	71	69
	Missing	0	1	0	0	5	0	0	1	3
Mean		3.63	4.00	3.51	3.80	3.56	3.58	3.76	3.95	3.66
Std. Error of Mean		0.176	0.154	0.133	0.125	0.126	0.149	0.155	0.132	0.155
Median		4.00	5.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00
Std. Deviation		1.495	1.293	1.131	1.057	1.029	1.265	1.313	1.108	1.283
Variance		2.236	1.672	1.279	1.117	1.059	1.600	1.724	1.227	1.646
Skewness		-0.577	-1.127	-0.340	-0.862	-0.268	-0.237	-0.650	-0.950	-0.473
Std. Error of Skewness		0.283	0.285	0.283	0.283	0.294	0.283	0.283	0.286	0.289
Kurtosis		-1.147	0.122	-0.801	0.458	-0.156	-1.307	-0.827	0.373	-1.036
Std. Error of Kurtosis		0.560	0.563	0.560	0.560	0.580	0.560	0.560	0.564	0.571
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations
Summary Statistics by Jurisdiction

City of Henderson		Overall sense of preparedness in the event of a large scale natural or man-made emergency:	Quality of drinking water:	Recreational opportunities:	Condition of streets & roads:	Availability of public transportation:	Housing affordability:	Air quality:	Availability of job opportunities:	Managing growth:
N	Valid	80	81	81	84	81	83	84	83	84
	Missing	4	3	3	0	3	1	0	1	0
Mean		3.95	3.92	3.72	4.00	3.20	3.52	3.93	3.70	3.73
Std. Error of Mean		0.133	0.138	0.113	0.099	0.124	0.151	0.134	0.126	0.148
Median		4.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00
Std. Deviation		1.193	1.237	1.013	0.912	1.115	1.377	1.230	1.151	1.353
Variance		1.424	1.529	1.026	0.831	1.243	1.897	1.514	1.324	1.830
Skewness		-0.953	-0.943	-0.269	-0.917	-0.236	-0.498	-1.159	-0.753	-0.841
Std. Error of Skewness		0.269	0.268	0.268	0.263	0.268	0.264	0.263	0.264	0.263
Kurtosis		-0.087	0.001	-0.545	0.849	-0.536	-1.024	0.521	-0.053	-0.491
Std. Error of Kurtosis		0.532	0.529	0.529	0.520	0.530	0.522	0.520	0.521	0.520
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations
Summary Statistics by Jurisdiction

City of Boulder City		Overall sense of preparedness in the event of a large scale natural or man-made emergency:	Quality of drinking water:	Recreational opportunities:	Condition of streets & roads:	Availability of public transportation:	Housing affordability:	Air quality:	Availability of job opportunities:	Managing growth:
N	Valid	8	8	8	8	8	8	8	8	8
	Missing	0	0	0	0	0	0	0	0	0
Mean		3.33	4.44	4.12	3.80	3.20	3.87	4.12	3.72	4.01
Std. Error of Mean		0.432	0.246	0.313	0.447	0.434	0.514	0.477	0.454	0.487
Median		4.00	4.68	4.00	4.00	3.00	4.32	4.32	4.00	4.07
Std. Deviation		1.197	0.683	0.869	1.241	1.204	1.426	1.323	1.260	1.350
Variance		1.433	0.466	0.756	1.539	1.450	2.035	1.751	1.587	1.823
Skewness		-1.063	-0.898	-0.275	-1.814	-0.496	-1.226	-2.192	-1.510	-1.814
Std. Error of Skewness		0.764	0.764	0.764	0.764	0.764	0.764	0.764	0.764	0.764
Kurtosis		1.200	0.407	-1.648	4.447	0.823	1.204	5.752	3.157	3.808
Std. Error of Kurtosis		1.510	1.510	1.510	1.510	1.510	1.510	1.510	1.510	1.510
Range		4	2	2	4	4	4	4	4	4
Minimum		1	3	3	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix III
Quality of Life Considerations
Summary Statistics by Jurisdiction

City of Mesquite		Overall sense of preparedness in the event of a large scale natural or man-made emergency:	Quality of drinking water:	Recreational opportunities:	Condition of streets & roads:	Availability of public transportation:	Housing affordability:	Air quality:	Availability of job opportunities:	Managing growth:
N	Valid	5	6	6	6	5	6	6	5	6
	Missing	1	0	0	0	1	0	0	1	0
Mean		3.77	3.97	3.62	4.63	3.87	3.84	4.38	4.41	4.06
Std. Error of Mean		0.386	0.571	0.622	0.299	0.635	0.721	0.361	0.406	0.425
Median		3.71	5.00	3.99	5.00	4.28	4.95	5.00	5.00	4.00
Std. Deviation		0.890	1.391	1.514	0.727	1.464	1.755	0.880	0.938	1.034
Variance		0.792	1.936	2.293	0.529	2.143	3.080	0.774	0.879	1.070
Skewness		0.626	-0.736	-0.688	-2.105	-1.434	-1.336	-1.105	-1.286	-1.190
Std. Error of Skewness		0.890	0.849	0.849	0.849	0.889	0.849	0.849	0.889	0.849
Kurtosis		-1.301	-1.870	-0.412	5.336	3.132	0.366	-0.340	-0.210	2.270
Std. Error of Kurtosis		1.903	1.754	1.754	1.754	1.898	1.754	1.754	1.898	1.754
Range		2	3	4	2	4	4	2	2	3
Minimum		3	2	1	3	1	1	3	3	2
Maximum		5	5	5	5	5	5	5	5	5

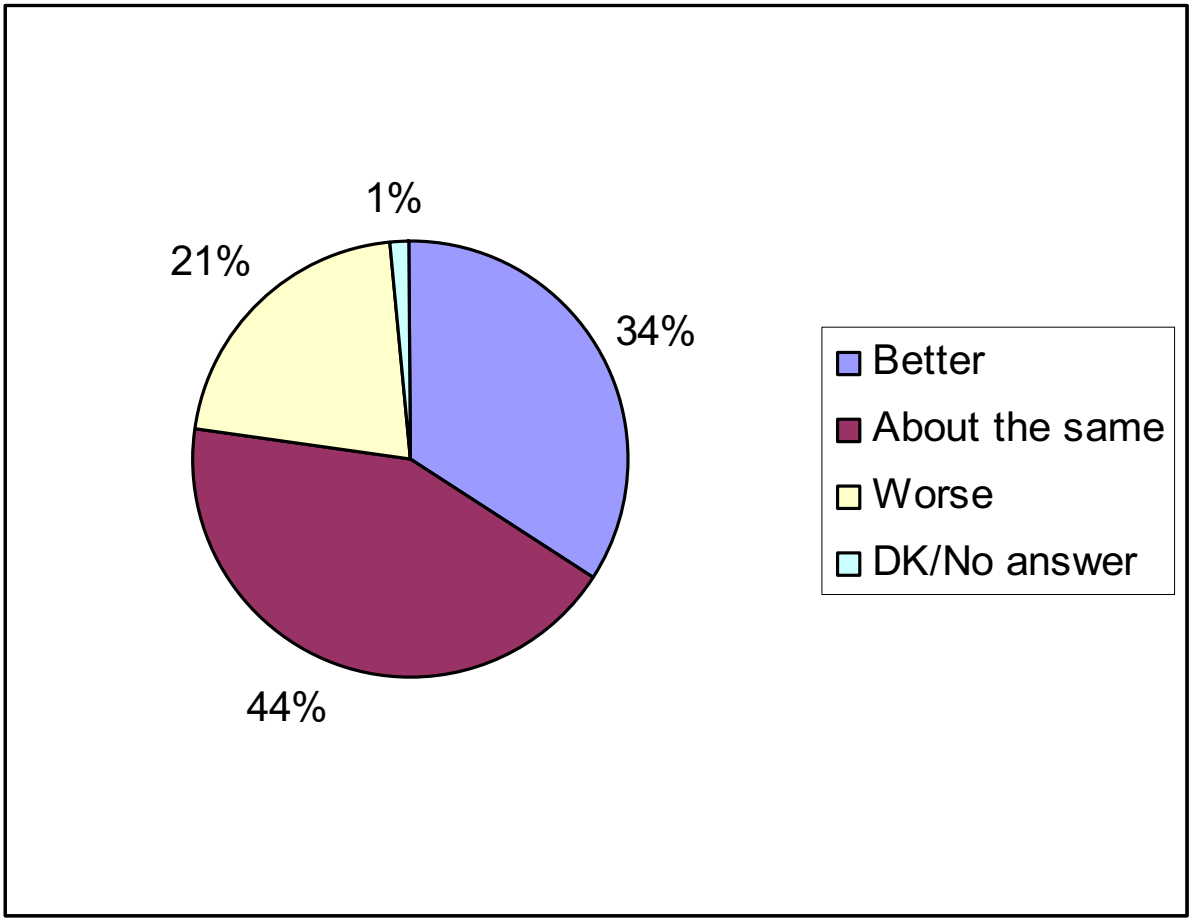
Appendix IV
General Economic Conditions

Appendix IV
General Economic Conditions
(Summary Statistics)

		We are interested in how people are getting along financially these days. Would you say that you and any family members living with you are better or worse off than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	600	599	595	588	590
	Missing	9	10	14	21	19
Mean		1.87	1.76	2.17	1.74	1.47
Std. Error of Mean		.030	.031	.031	.026	.021
Median		2.00	2.00	2.00	2.00	1.00
Std. Deviation		.740	.749	.766	.620	.500
Variance		.548	.560	.586	.385	.250
Skewness		.214	.421	.337	.242	.105
Std. Error of Skewness		.100	.100	.100	.101	.101
Kurtosis		-1.153	-1.116	-.136	-.619	-1.996
Std. Error of Kurtosis		.199	.199	.200	.201	.201
Range		2	2	3	2	1
Minimum		1	1	1	1	1
Maximum		3	3	4	3	2

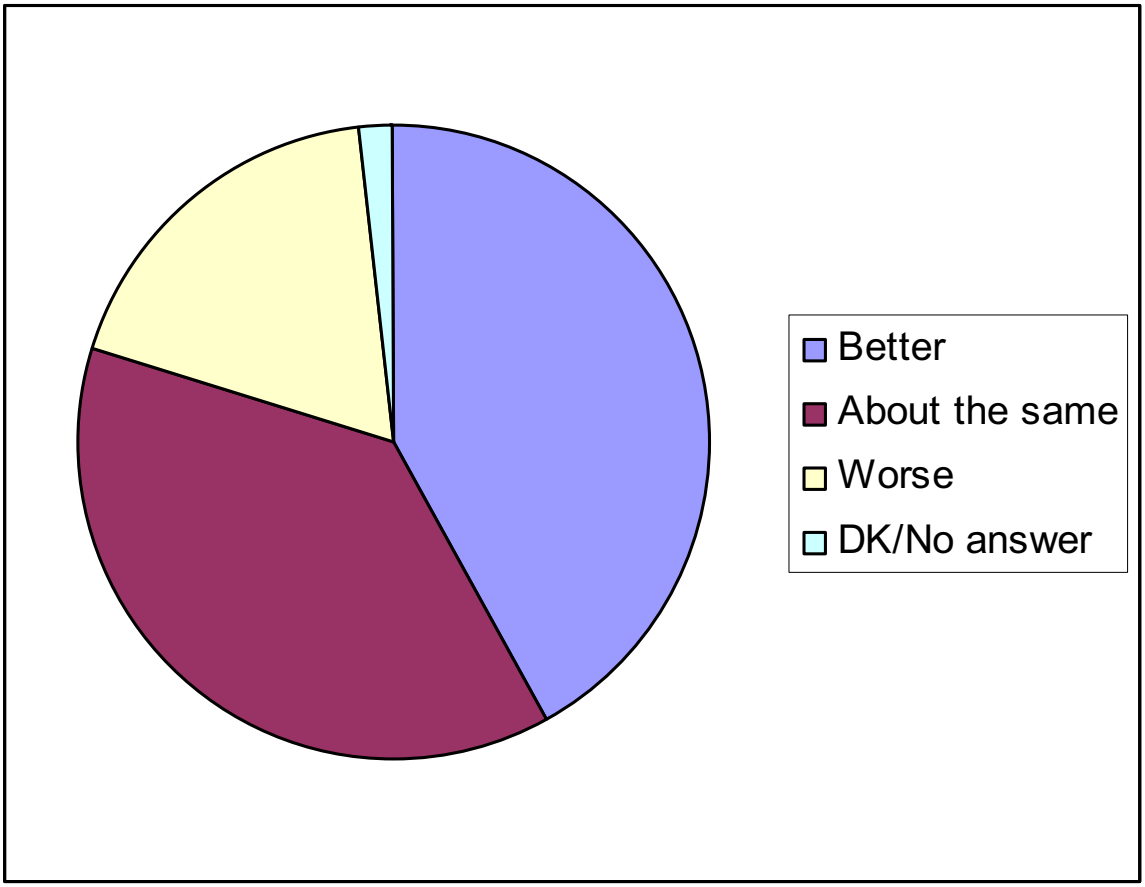
Appendix IV
General Economic Conditions

We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you are better or worse off than you were a year ago, or about the same?	Frequency	Percent
Better	209	34.3
About the same	262	43.0
Worse	130	21.4
DK/No answer	9	1.4
Total	609	100.0



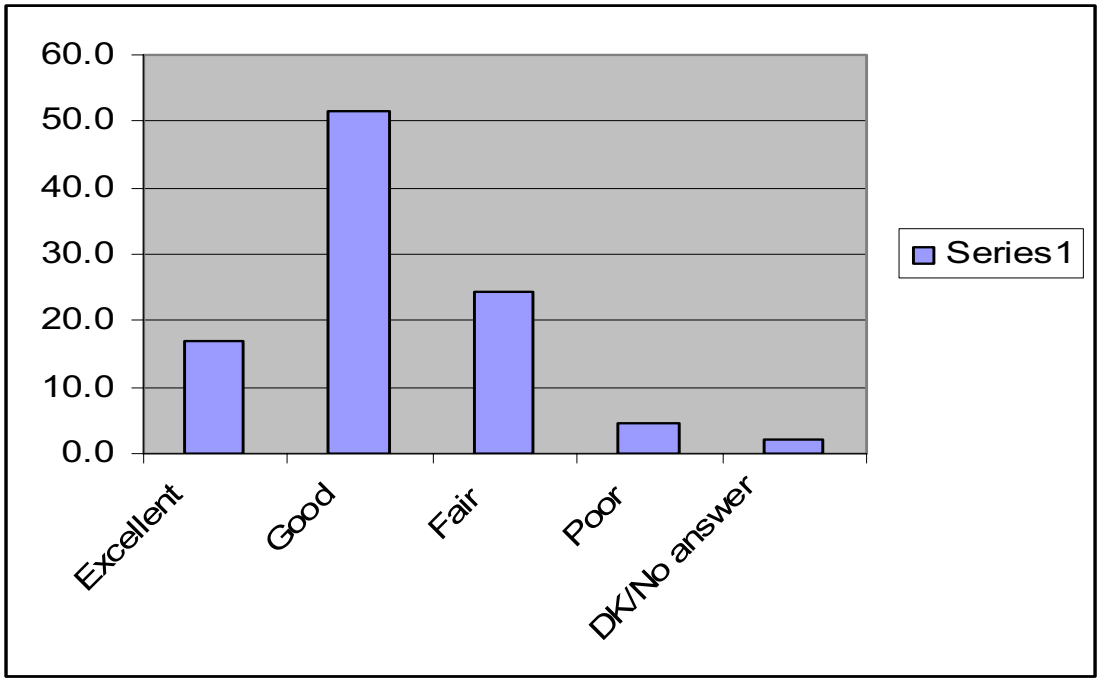
Appendix IV
General Economic Conditions

Now looking ahead - do you think that a year from now your financial situation and the financial situation of any family members will be better, worse or about the same?	Frequency	Percent
Better	256	42.0
About the same	230	37.7
Worse	113	18.6
DK/No answer	10	1.7
Total	609	100.0



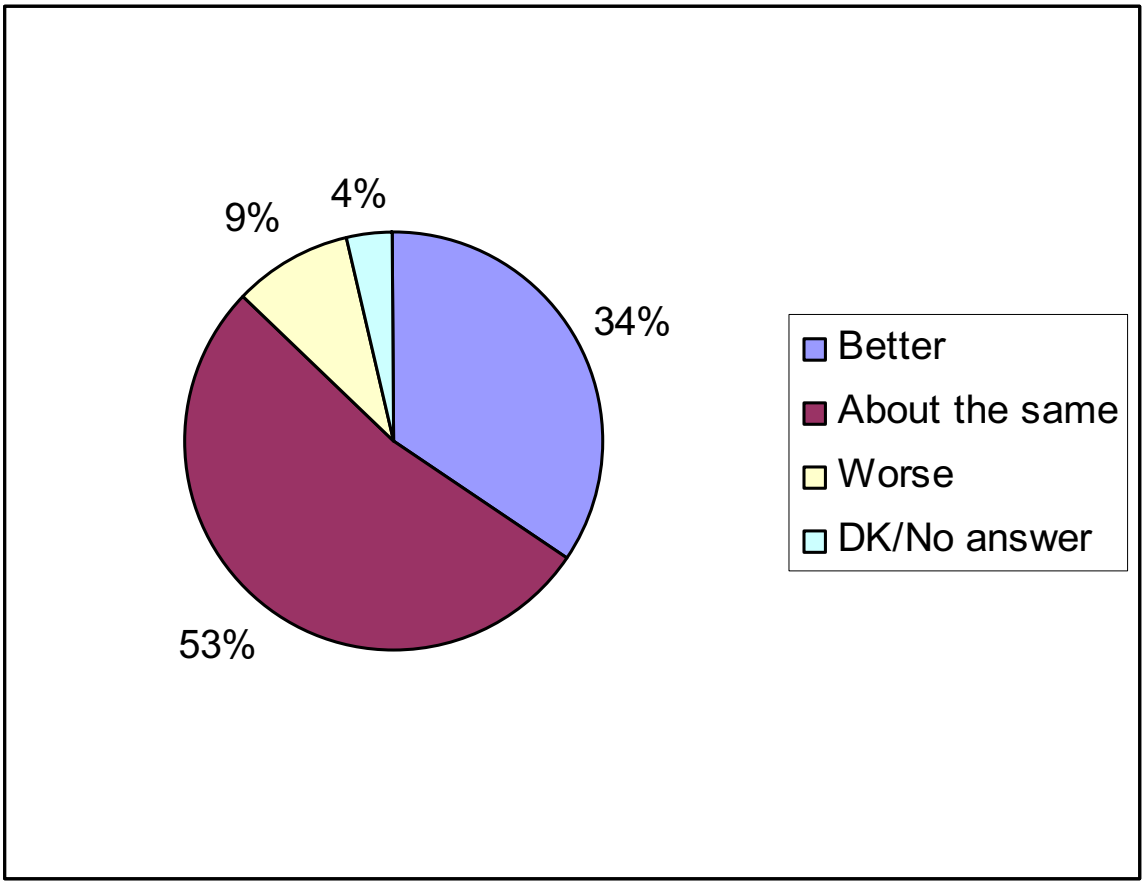
Appendix IV
General Economic Conditions

Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	Frequency	Percent
Excellent	103	17.0
Good	314	51.6
Fair	149	24.5
Poor	28	4.7
DK/No answer	14	2.3
Total	609	100.0



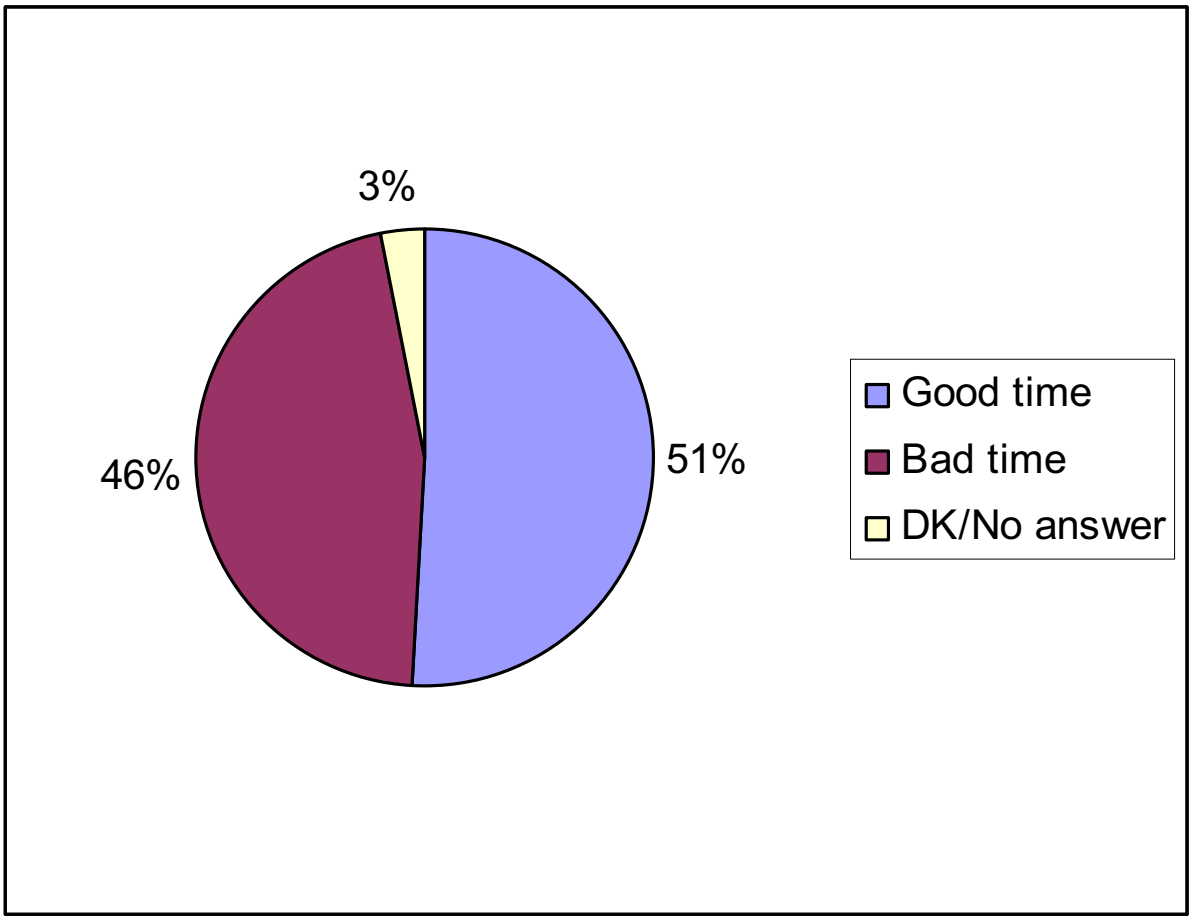
Appendix IV
General Economic Conditions

And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same?	Frequency	Percent
Better	209	34.4
About the same	322	52.8
Worse	56	9.2
DK/No answer	21	3.5
Total	609	100.0



Appendix IV
General Economic Conditions

Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?	Frequency	Percent
Good time	310	51.0
Bad time	280	45.9
DK/No answer	19	3.1
Total	609	100.0



Appendix IV
General Economic Conditions
Summary Statistics by Jurisdiction

Unincorporated Clark County		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you are better or worse off than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	238	238	238	232	234
	Missing	4	4	5	11	8
Mean		1.88	1.76	2.21	1.78	1.48
Std. Error of Mean		.048	.047	.052	.040	.033
Median		2.00	2.00	2.00	2.00	1.00
Std. Deviation		.737	.732	.809	.615	.501
Variance		.543	.536	.654	.378	.251
Skewness		.191	.411	.372	.167	.072
Std. Error of Skewness		.158	.158	.158	.160	.159
Kurtosis		-1.135	-1.046	-.234	-.529	-2.012
Std. Error of Kurtosis		.314	.314	.314	.319	.317
Range		2	2	3	2	1
Minimum		1	1	1	1	1
Maximum		3	3	4	3	2

Appendix IV
General Economic Conditions
Summary Statistics by Jurisdiction

City of Las Vegas		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you are better or worse off than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	196	196	191	193	190
	Missing	1	1	6	4	7
Mean		1.83	1.69	2.17	1.65	1.46
Std. Error of Mean		.053	.055	.052	.045	.036
Median		2.00	2.00	2.00	2.00	1.00
Std. Deviation		.746	.770	.712	.623	.500
Variance		.557	.592	.507	.388	.250
Skewness		.284	.589	.237	.417	.164
Std. Error of Skewness		.174	.174	.176	.175	.177
Kurtosis		-1.157	-1.078	-.059	-.655	-1.994
Std. Error of Kurtosis		.346	.346	.350	.348	.351
Range		2	2	3	2	1
Minimum		1	1	1	1	1
Maximum		3	3	4	3	2

Appendix IV
General Economic Conditions
Summary Statistics by Jurisdiction

City of North Las Vegas		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you are better or worse off than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation and the financial situation of any family members will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	70	69	70	69	70
	Missing	2	3	2	3	2
Mean		1.76	1.77	2.14	1.66	1.51
Std. Error of Mean		.087	.087	.078	.072	.060
Median		2.00	2.00	2.00	2.00	2.00
Std. Deviation		.729	.727	.647	.597	.504
Variance		.531	.528	.418	.357	.254
Skewness		.407	.392	.060	.289	-.036
Std. Error of Skewness		.286	.289	.288	.290	.288
Kurtosis		-1.011	-1.006	-.112	-.625	-2.059
Std. Error of Kurtosis		.566	.570	.568	.572	.568
Range		2	2	3	2	1
Minimum		1	1	1	1	1
Maximum		3	3	4	3	2

Appendix IV
General Economic Conditions
Summary Statistics by Jurisdiction

City of Henderson		We are interested in how people are getting along financially these days. Would you say that you and any family members living with you are better or worse off than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation and the financial situation of any family members will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	83	82	84	81	83
	Missing	1	2	0	3	1
Mean		1.97	1.88	2.11	1.84	1.43
Std. Error of Mean		.081	.084	.092	.071	.055
Median		2.00	2.00	2.00	2.00	1.00
Std. Deviation		.740	.761	.840	.637	.498
Variance		.547	.580	.705	.406	.248
Skewness		.048	.202	.421	.142	.278
Std. Error of Skewness		.264	.266	.263	.267	.264
Kurtosis		-1.145	-1.235	-.317	-.545	-1.970
Std. Error of Kurtosis		.523	.526	.520	.527	.521
Range		2	2	3	2	1
Minimum		1	1	1	1	1
Maximum		3	3	4	3	2

Appendix IV
General Economic Conditions
Summary Statistics by Jurisdiction

City of Boulder City		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you are better or worse off than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	7	8	8	8	7
	Missing	1	0	0	0	1
Mean		2.01	1.92	1.92	2.08	1.39
Std. Error of Mean		.294	.241	.242	.104	.197
Median		2.00	2.00	2.00	2.00	1.00
Std. Deviation		.782	.668	.671	.290	.525
Variance		.611	.447	.450	.084	.276
Skewness		-.023	.069	.070	3.925	.602
Std. Error of Skewness		.790	.764	.764	.764	.790
Kurtosis		-.834	.516	.484	18.266	-2.465
Std. Error of Kurtosis		1.577	1.510	1.510	1.510	1.577
Range		2	2	2	1	1
Minimum		1	1	1	2	1
Maximum		3	3	3	3	2

Appendix IV
General Economic Conditions
Summary Statistics by Jurisdiction

City of Mesquite		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you are better or worse off than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation and the financial situation of any family members will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	6	6	5	5	6
	Missing	0	0	1	1	0
Mean		2.31	2.17	2.39	2.11	1.89
Std. Error of Mean		.292	.334	.498	.277	.139
Median		2.00	2.00	2.00	2.00	2.00
Std. Deviation		.710	.813	1.147	.638	.337
Variance		.504	.661	1.315	.407	.114
Skewness		-.554	-.396	.602	-.002	-3.526
Std. Error of Skewness		.849	.849	.890	.890	.849
Kurtosis		.425	-.822	-.213	3.099	16.121
Std. Error of Kurtosis		1.754	1.754	1.903	1.903	1.754
Range		2	2	3	2	1
Minimum		1	1	1	1	1
Maximum		3	3	4	3	2

Appendix IV
General Economic Conditions
Jurisdiction Cross-Tabulations

Jurisdiction * We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you are better or worse off than you were a year ago, or about the same?

			We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you are better or worse off than you were a year ago, or about the same?			
			Better	About the same	Worse	Total
Jurisdiction	Unincorporated Clark County	Count	80	106	52	238
		% within Jurisdiction	33.6%	44.5%	21.8%	100.0%
	City of Las Vegas	Count	74	82	41	197
		% within Jurisdiction	37.6%	41.6%	20.8%	100.0%
	City of North Las Vegas	Count	29	29	12	70
		% within Jurisdiction	41.4%	41.4%	17.1%	100.0%
	City of Henderson	Count	24	38	21	83
		% within Jurisdiction	28.9%	45.8%	25.3%	100.0%
	Boulder City	Count	2	3	2	7
		% within Jurisdiction	28.6%	42.9%	28.6%	100.0%
	Mesquite	Count	1	3	2	6
		% within Jurisdiction	16.7%	50.0%	33.3%	100.0%
Total		Count	210	261	130	601
		% within Jurisdiction	34.9%	43.4%	21.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.085(a)	10	.885
Likelihood Ratio	5.181	10	.879
Linear-by-Linear Association	.496	1	.481
N of Valid Cases	601		

a 6 cells (33.3%) have expected count less than 5. The minimum expected count is 1.30.

Appendix IV
General Economic Conditions
Jurisdiction Cross-Tabulations

Jurisdiction * Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members will be better, worse or about the same?

			Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members will be better, worse or about the same?			
			Better	About the same	Worse	Total
Jurisdiction	Unincorporated Clark County	Count	99	97	42	238
		% within Jurisdiction	41.6%	40.8%	17.6%	100.0%
	City of Las Vegas	Count	97	62	37	196
		% within Jurisdiction	49.5%	31.6%	18.9%	100.0%
	City of North Las Vegas	Count	28	29	12	69
		% within Jurisdiction	40.6%	42.0%	17.4%	100.0%
	City of Henderson	Count	29	34	19	82
		% within Jurisdiction	35.4%	41.5%	23.2%	100.0%
	Boulder City	Count	2	5	1	8
		% within Jurisdiction	25.0%	62.5%	12.5%	100.0%
	Mesquite	Count	1	2	2	5
		% within Jurisdiction	20.0%	40.0%	40.0%	100.0%
Total		Count	256	229	113	598
		% within Jurisdiction	42.8%	38.3%	18.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.233(a)	10	.340
Likelihood Ratio	11.073	10	.352
Linear-by-Linear Association	2.231	1	.135
N of Valid Cases	598		

a 6 cells (33.3%) have expected count less than 5. The minimum expected count is .94.

Appendix IV
General Economic Conditions
Jurisdiction Cross-Tabulations

Jurisdiction * Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?

			Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?				
			Excellent	Good	Fair	Poor	Total
Jurisdiction	Unincorporated Clark County	Count	42	120	59	16	237
		% within Jurisdiction	17.7%	50.6%	24.9%	6.8%	100.0%
	City of Las Vegas	Count	29	106	50	6	191
		% within Jurisdiction	15.2%	55.5%	26.2%	3.1%	100.0%
	City of North Las Vegas	Count	9	41	18	1	69
		% within Jurisdiction	13.0%	59.4%	26.1%	1.4%	100.0%
	City of Henderson	Count	20	40	19	5	84
		% within Jurisdiction	23.8%	47.6%	22.6%	6.0%	100.0%
	Boulder City	Count	2	5	1	0	8
		% within Jurisdiction	25.0%	62.5%	12.5%	.0%	100.0%
	Mesquite	Count	1	2	1	1	5
		% within Jurisdiction	20.0%	40.0%	20.0%	20.0%	100.0%
Total		Count	103	314	148	29	594
		% within Jurisdiction	17.3%	52.9%	24.9%	4.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.711(a)	15	.548
Likelihood Ratio	13.652	15	.552
Linear-by-Linear Association	1.100	1	.294
N of Valid Cases	594		

a 10 cells (41.7%) have expected count less than 5. The minimum expected count is .24.

Appendix IV
General Economic Conditions
Jurisdiction Cross-Tabulations

Jurisdiction * And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same?

			And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same?			
			Better	About the same	Worse	Total
Jurisdiction	Unincorporated Clark County	Count	74	133	24	231
		% within Jurisdiction	32.0%	57.6%	10.4%	100.0%
	City of Las Vegas	Count	83	95	15	193
		% within Jurisdiction	43.0%	49.2%	7.8%	100.0%
	City of North Las Vegas	Count	28	36	4	68
		% within Jurisdiction	41.2%	52.9%	5.9%	100.0%
	City of Henderson	Count	24	47	11	82
		% within Jurisdiction	29.3%	57.3%	13.4%	100.0%
	Boulder City	Count	0	7	1	8
		% within Jurisdiction	.0%	87.5%	12.5%	100.0%
	Mesquite	Count	1	3	1	5
		% within Jurisdiction	20.0%	60.0%	20.0%	100.0%
Total		Count	210	321	56	587
		% within Jurisdiction	35.8%	54.7%	9.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.305(a)	10	.121
Likelihood Ratio	17.816	10	.058
Linear-by-Linear Association	.734	1	.392
N of Valid Cases	587		

a 6 cells (33.3%) have expected count less than 5. The minimum expected count is .48.

Appendix IV
General Economic Conditions
Jurisdiction Cross-Tabulations

Jurisdiction * Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?

			Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?		
			Good time	Bad time	Total
Jurisdiction	Unincorporated Clark County	Count	121	113	234
		% within Jurisdiction	51.7%	48.3%	100.0%
	City of Las Vegas	Count	103	87	190
		% within Jurisdiction	54.2%	45.8%	100.0%
	City of North Las Vegas	Count	34	35	69
		% within Jurisdiction	49.3%	50.7%	100.0%
	City of Henderson	Count	47	36	83
		% within Jurisdiction	56.6%	43.4%	100.0%
	Boulder City	Count	4	3	7
		% within Jurisdiction	57.1%	42.9%	100.0%
	Mesquite	Count	1	5	6
		% within Jurisdiction	16.7%	83.3%	100.0%
Total		Count	310	279	589
		% within Jurisdiction	52.6%	47.4%	100.0%

Chi-Square Tests

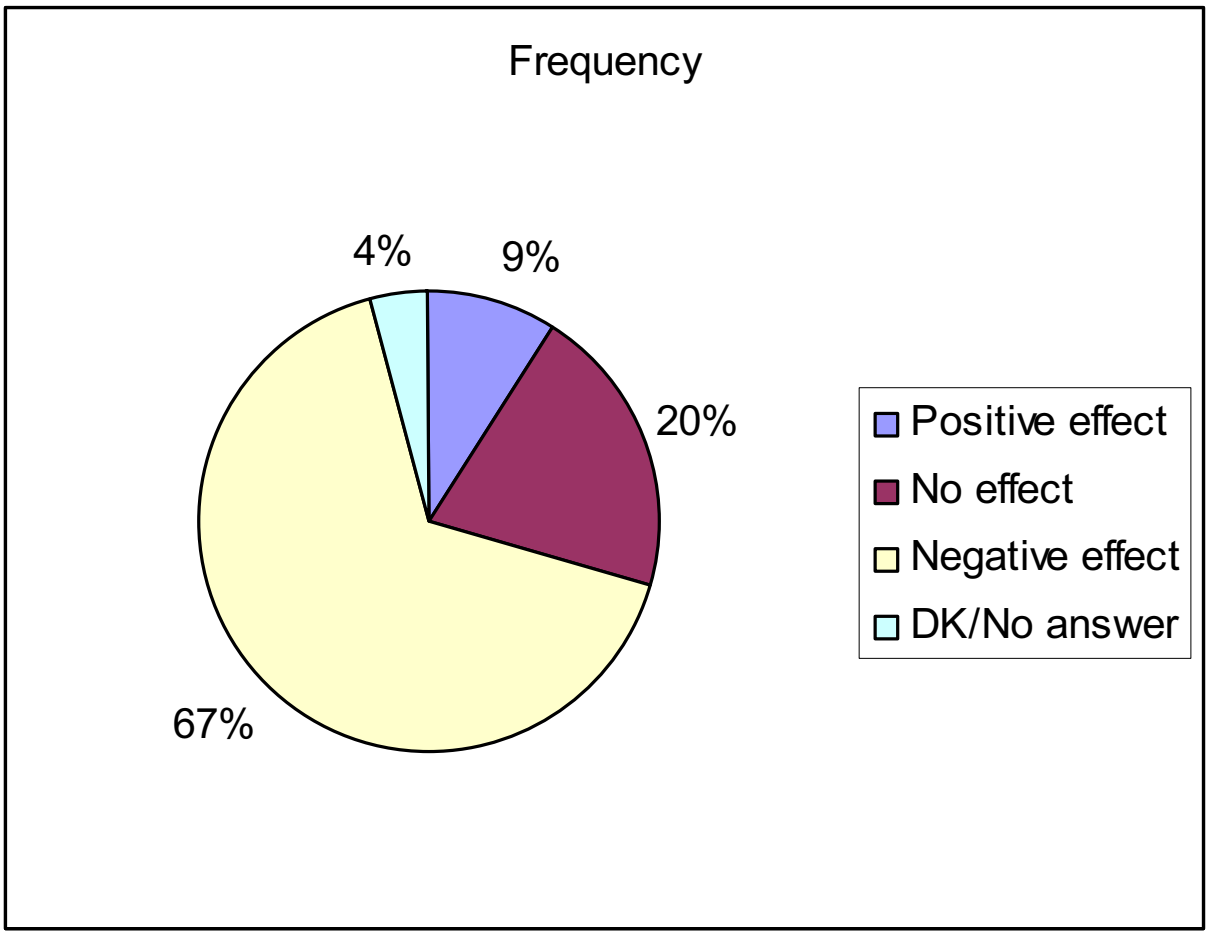
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.283(a)	5	.509
Likelihood Ratio	4.521	5	.477
Linear-by-Linear Association	.007	1	.931
N of Valid Cases	589		

a 4 cells (33.3%) have expected count less than 5. The minimum expected count is 2.84.

Appendix V
Property Value Considerations

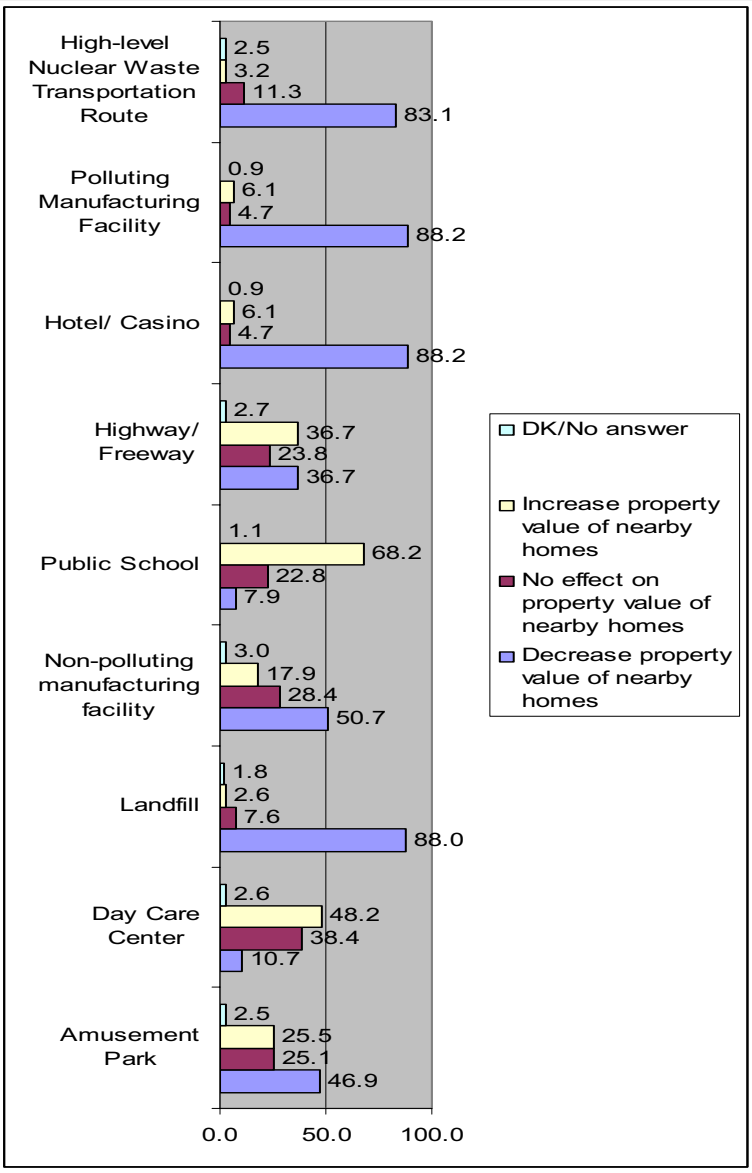
		Amusement Park:	Day care center:	Landfill:	Non-polluting manufacturing facility:	Public school:	Highway/Freeway:	Hotel-casino:	Polluting manufacturing facility:	transportation route:
N	Valid	594	593	598	591	603	593	589	603	594
	Missing	15	16	11	18	6	16	20	6	15
Mean		1.78	2.39	1.13	1.66	2.61	2.00	1.88	1.17	1.18
Std. Error of Mean		0.03	0.03	0.02	0.03	0.03	0.04	0.03	0.02	0.02
Median		2	2	1	1	3	2	2	1	1
Std. Deviation		0.83	0.68	0.41	0.77	0.63	0.87	0.84	0.52	0.46
Variance		0.70	0.46	0.17	0.59	0.40	0.76	0.71	0.27	0.21
Skewness		0.43	-0.65	3.28	0.66	-1.38	0.00	0.24	2.93	2.59
Std. Error of Skewness		0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Kurtosis		-1.43	-0.67	10.39	-1.02	0.71	-1.68	-1.56	7.19	6.08
Std. Error of Kurtosis		0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Range		2	2	2	2	2	2	2	2	2
Minimum		1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	3	3

Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative effect on the quality of life of Southern Nevada Residents?	Frequency	Percent
Positive effect	56	9.3
No effect	123	20.1
Negative effect	405	66.5
DK/No answer	25	4.1
Total	609	100.0



Now I'm going to read you a list of things that may or may not affect the value of residential (homes) property in Clark County. For each item please tell me whether you believe it would decrease, have no affect or increase the property value of nearby, privately owned homes.

	Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	DK/No answer	Total
Amusement Park	46.9	25.1	25.5	2.5	100.0
Day Care Center	10.7	38.4	48.2	2.6	100.0
Landfill	88.0	7.6	2.6	1.8	100.0
Non-polluting manufacturing facility	50.7	28.4	17.9	3.0	100.0
Public School	7.9	22.8	68.2	1.1	100.0
Highway/ Freeway	36.7	23.8	36.7	2.7	100.0
Hotel/ Casino	88.2	4.7	6.1	0.9	100.0
Polluting Manufacturing Facility	88.2	4.7	6.1	0.9	100.0
High-level Nuclear Waste Transportation Route	83.1	11.3	3.2	2.5	100.0



Jurisdiction * Amusement Park:

			Amusement Park:			Total
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Jurisdiction	Unincorporated Clark County	Count	121	61	57	239
		% within Jurisdiction	50.6%	25.5%	23.8%	100.0%
	City of Las Vegas	Count	98	41	53	192
		% within Jurisdiction	51.0%	21.4%	27.6%	100.0%
	City of North Las Vegas	Count	30	12	26	68
		% within Jurisdiction	44.1%	17.6%	38.2%	100.0%
	City of Henderson	Count	32	32	18	82
		% within Jurisdiction	39.0%	39.0%	22.0%	100.0%
	Boulder City	Count	2	3	2	7
		% within Jurisdiction	28.6%	42.9%	28.6%	100.0%
	Mesquite	Count	2	3	1	6
		% within Jurisdiction	33.3%	50.0%	16.7%	100.0%
Total		Count	285	152	157	594
		% within Jurisdiction	48.0%	25.6%	26.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.282(a)	10	.037
Likelihood Ratio	18.179	10	.052
Linear-by-Linear Association	2.367	1	.124
N of Valid Cases	594		

a 6 cells (33.3%) have expected count less than 5. The minimum expected count is 1.54.

Jurisdiction * Day care center:

			Day care center:			Total
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Jurisdiction	Unincorporated Clark County	Count	16	103	118	237
		% within Jurisdiction	6.8%	43.5%	49.8%	100.0%
	City of Las Vegas	Count	26	69	93	188
		% within Jurisdiction	13.8%	36.7%	49.5%	100.0%
	City of North Las Vegas	Count	9	25	38	72
		% within Jurisdiction	12.5%	34.7%	52.8%	100.0%
	City of Henderson	Count	12	31	39	82
		% within Jurisdiction	14.6%	37.8%	47.6%	100.0%
	Boulder City	Count	0	4	4	8
		% within Jurisdiction	.0%	50.0%	50.0%	100.0%
	Mesquite	Count	2	2	2	6
		% within Jurisdiction	33.3%	33.3%	33.3%	100.0%
Total		Count	65	234	294	593
		% within Jurisdiction	11.0%	39.5%	49.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.636(a)	10	.245
Likelihood Ratio	12.960	10	.226
Linear-by-Linear Association	1.727	1	.189
N of Valid Cases	593		

a 6 cells (33.3%) have expected count less than 5. The minimum expected count is .66.

Jurisdiction * Landfill:

			Landfill:			Total
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Jurisdiction	Unincorporated Clark County	Count	216	20	3	239
		% within Jurisdiction	90.4%	8.4%	1.3%	100.0%
	City of Las Vegas	Count	172	16	4	192
		% within Jurisdiction	89.6%	8.3%	2.1%	100.0%
	City of North Las Vegas	Count	65	5	2	72
		% within Jurisdiction	90.3%	6.9%	2.8%	100.0%
	City of Henderson	Count	71	4	7	82
		% within Jurisdiction	86.6%	4.9%	8.5%	100.0%
	Boulder City	Count	8	0	0	8
		% within Jurisdiction	100.0%	.0%	.0%	100.0%
	Mesquite	Count	5	1	0	6
		% within Jurisdiction	83.3%	16.7%	.0%	100.0%
Total		Count	537	46	16	599
		% within Jurisdiction	89.6%	7.7%	2.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.595(a)	10	.112
Likelihood Ratio	13.091	10	.219
Linear-by-Linear Association	2.190	1	.139
N of Valid Cases	599		

a 6 cells (33.3%) have expected count less than 5. The minimum expected count is .16.

Jurisdiction * Non-polluting manufacturing facility:

			Non-polluting manufacturing facility:			Total
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Jurisdiction	Unincorporated Clark County	Count	119	70	47	236
		% within Jurisdiction	50.4%	29.7%	19.9%	100.0%
	City of Las Vegas	Count	113	49	31	193
		% within Jurisdiction	58.5%	25.4%	16.1%	100.0%
	City of North Las Vegas	Count	37	14	16	67
		% within Jurisdiction	55.2%	20.9%	23.9%	100.0%
	City of Henderson	Count	37	33	12	82
		% within Jurisdiction	45.1%	40.2%	14.6%	100.0%
	Boulder City	Count	1	3	2	6
		% within Jurisdiction	16.7%	50.0%	33.3%	100.0%
	Mesquite	Count	2	4	0	6
		% within Jurisdiction	33.3%	66.7%	.0%	100.0%
Total		Count	309	173	108	590
		% within Jurisdiction	52.4%	29.3%	18.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.539(a)	10	.047
Likelihood Ratio	18.997	10	.040
Linear-by-Linear Association	.161	1	.689
N of Valid Cases	590		

a 6 cells (33.3%) have expected count less than 5. The minimum expected count is 1.10.

Jurisdiction * Public school:

			Public school:			Total
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Jurisdiction	Unincorporated Clark County	Count	14	59	167	240
		% within Jurisdiction	5.8%	24.6%	69.6%	100.0%
	City of Las Vegas	Count	21	44	130	195
		% within Jurisdiction	10.8%	22.6%	66.7%	100.0%
	City of North Las Vegas	Count	5	15	51	71
		% within Jurisdiction	7.0%	21.1%	71.8%	100.0%
	City of Henderson	Count	7	21	54	82
		% within Jurisdiction	8.5%	25.6%	65.9%	100.0%
	Boulder City	Count	0	0	8	8
		% within Jurisdiction	.0%	.0%	100.0%	100.0%
	Mesquite	Count	1	1	5	7
		% within Jurisdiction	14.3%	14.3%	71.4%	100.0%
Total		Count	48	140	415	603
		% within Jurisdiction	8.0%	23.2%	68.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.544(a)	10	.576
Likelihood Ratio	10.814	10	.372
Linear-by-Linear Association	.008	1	.929
N of Valid Cases	603		

a 5 cells (27.8%) have expected count less than 5. The minimum expected count is .56.

Jurisdiction * Highway/Freeway:

			Highway/Freeway:			Total
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Jurisdiction	Unincorporated Clark County	Count	89	64	83	236
		% within Jurisdiction	37.7%	27.1%	35.2%	100.0%
	City of Las Vegas	Count	76	45	73	194
		% within Jurisdiction	39.2%	23.2%	37.6%	100.0%
	City of North Las Vegas	Count	22	14	32	68
		% within Jurisdiction	32.4%	20.6%	47.1%	100.0%
	City of Henderson	Count	33	20	29	82
		% within Jurisdiction	40.2%	24.4%	35.4%	100.0%
	Boulder City	Count	2	1	4	7
		% within Jurisdiction	28.6%	14.3%	57.1%	100.0%
	Mesquite	Count	1	2	3	6
		% within Jurisdiction	16.7%	33.3%	50.0%	100.0%
Total		Count	223	146	224	593
		% within Jurisdiction	37.6%	24.6%	37.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.363(a)	10	.784
Likelihood Ratio	6.411	10	.780
Linear-by-Linear Association	.808	1	.369
N of Valid Cases	593		

a 6 cells (33.3%) have expected count less than 5. The minimum expected count is 1.48.

Jurisdiction * Hotel-casino:

			Hotel-casino:			Total
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Jurisdiction	Unincorporated Clark County	Count	105	55	75	235
		% within Jurisdiction	44.7%	23.4%	31.9%	100.0%
	City of Las Vegas	Count	73	58	59	190
		% within Jurisdiction	38.4%	30.5%	31.1%	100.0%
	City of North Las Vegas	Count	25	20	24	69
		% within Jurisdiction	36.2%	29.0%	34.8%	100.0%
	City of Henderson	Count	41	23	18	82
		% within Jurisdiction	50.0%	28.0%	22.0%	100.0%
	Boulder City	Count	5	2	0	7
		% within Jurisdiction	71.4%	28.6%	.0%	100.0%
	Mesquite	Count	2	2	1	5
		% within Jurisdiction	40.0%	40.0%	20.0%	100.0%
Total		Count	251	160	177	588
		% within Jurisdiction	42.7%	27.2%	30.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.420(a)	10	.326
Likelihood Ratio	13.481	10	.198
Linear-by-Linear Association	1.755	1	.185
N of Valid Cases	588		

a 6 cells (33.3%) have expected count less than 5. The minimum expected count is 1.36.

Jurisdiction * Polluting manufacturing facility:

			Polluting manufacturing facility:			Total
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Jurisdiction	Unincorporated Clark County	Count	221	8	13	242
		% within Jurisdiction	91.3%	3.3%	5.4%	100.0%
	City of Las Vegas	Count	162	14	19	195
		% within Jurisdiction	83.1%	7.2%	9.7%	100.0%
	City of North Las Vegas	Count	63	5	2	70
		% within Jurisdiction	90.0%	7.1%	2.9%	100.0%
	City of Henderson	Count	78	1	4	83
		% within Jurisdiction	94.0%	1.2%	4.8%	100.0%
	Boulder City	Count	8	0	0	8
		% within Jurisdiction	100.0%	.0%	.0%	100.0%
	Mesquite	Count	5	1	0	6
		% within Jurisdiction	83.3%	16.7%	.0%	100.0%
Total		Count	537	29	38	604
		% within Jurisdiction	88.9%	4.8%	6.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	16.386(a)	10	.089
Likelihood Ratio	17.507	10	.064
Linear-by-Linear Association	.486	1	.486
N of Valid Cases	604		

a 7 cells (38.9%) have expected count less than 5. The minimum expected count is .29.

Jurisdiction * High-level nuclear waste transportation route:

			High-level nuclear waste transportation route:			Total
			Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	
Jurisdiction	Unincorporated Clark County	Count	209	24	3	236
		% within Jurisdiction	88.6%	10.2%	1.3%	100.0%
	City of Las Vegas	Count	156	23	10	189
		% within Jurisdiction	82.5%	12.2%	5.3%	100.0%
	City of North Las Vegas	Count	60	10	2	72
		% within Jurisdiction	83.3%	13.9%	2.8%	100.0%
	City of Henderson	Count	71	9	4	84
		% within Jurisdiction	84.5%	10.7%	4.8%	100.0%
	Boulder City	Count	6	2	0	8
		% within Jurisdiction	75.0%	25.0%	.0%	100.0%
	Mesquite	Count	5	1	0	6
		% within Jurisdiction	83.3%	16.7%	.0%	100.0%
Total		Count	507	69	19	595
		% within Jurisdiction	85.2%	11.6%	3.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.295(a)	10	.504
Likelihood Ratio	9.712	10	.466
Linear-by-Linear Association	2.034	1	.154
N of Valid Cases	595		

a 6 cells (33.3%) have expected count less than 5. The minimum expected count is .19.

Unincorporated Clark County		Amusement Park:	Day care center:	Landfill:	Non-polluting manufacturing facility:	Public school:	Highway/Freeway:	Hotel-casino:	Polluting manufacturing facility:	High-level nuclear waste transportation route:
N	Valid	238	238	238	236	240	236	235	242	236
	Missing	5	5	4	7	3	6	7	1	6
Mean		1.73	2.43	1.11	1.69	2.64	1.97	1.87	1.14	1.13
Std. Error of Mean		.053	.040	.023	.051	.038	.056	.057	.030	.025
Median		1.00	2.11	1.00	1.00	3.00	2.00	2.00	1.00	1.00
Std. Deviation		.822	.620	.352	.783	.590	.855	.867	.472	.377
Variance		.675	.384	.124	.612	.349	.731	.752	.223	.142
Skewness		.536	-.608	3.413	.601	-1.412	.052	.249	3.422	2.982
Std. Error of Skewness		.158	.158	.158	.159	.157	.158	.159	.157	.158
Kurtosis		-1.314	-.563	11.880	-1.118	.963	-1.634	-1.630	10.365	8.791
Std. Error of Kurtosis		.314	.314	.314	.316	.313	.316	.316	.312	.316
Range		2	2	2	2	2	2	2	2	2
Minimum		1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	3	3

City of Las Vegas		Amusement Park:	Day care center:	Landfill:	Non-polluting manufacturing facility:	Public school:	Highway/Freeway:	Hotel-casino:	Polluting manufacturing facility:	High-level nuclear waste transportation route:
N	Valid	192	188	192	192	195	193	189	195	188
	Missing	5	9	6	5	2	4	8	2	9
Mean		1.76	2.36	1.13	1.57	2.56	1.99	1.93	1.26	1.23
Std. Error of Mean		.062	.052	.029	.054	.049	.063	.061	.045	.039
Median		1.00	2.00	1.00	1.00	3.00	2.00	2.00	1.00	1.00
Std. Deviation		.856	.712	.397	.754	.680	.879	.833	.625	.531
Variance		.733	.507	.158	.568	.462	.772	.694	.390	.282
Skewness		.476	-.645	3.290	.885	-1.258	.029	.137	2.168	2.314
Std. Error of Skewness		.175	.177	.176	.175	.174	.175	.177	.174	.177
Kurtosis		-1.473	-.801	10.694	-.688	.256	-1.710	-1.548	3.124	4.371
Std. Error of Kurtosis		.349	.353	.350	.349	.346	.348	.351	.347	.352
Range		2	2	2	2	2	2	2	2	2
Minimum		1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	3	3

City of North Las Vegas		Amusement Park:	Day care center:	Landfill:	Non-polluting manufacturing facility:	Public school:	Highway/Freeway:	Hotel-casino:	Polluting manufacturing facility:	High-level nuclear waste transportation route:
N	Valid	69	72	72	67	71	68	69	70	72
	Missing	3	0	0	4	1	4	2	2	0
Mean		1.94	2.40	1.12	1.69	2.64	2.14	1.98	1.12	1.20
Std. Error of Mean		.110	.083	.046	.102	.074	.108	.102	.047	.056
Median		2.00	3.00	1.00	1.00	3.00	2.00	2.00	1.00	1.00
Std. Deviation		.912	.703	.392	.840	.622	.887	.847	.395	.472
Variance		.832	.494	.153	.705	.387	.787	.717	.156	.223
Skewness		.114	-.749	3.465	.634	-1.561	-.290	.041	3.438	2.443
Std. Error of Skewness		.289	.283	.283	.292	.284	.291	.288	.287	.283
Kurtosis		-1.814	-.635	12.199	-1.288	1.313	-1.686	-1.613	11.987	5.486
Std. Error of Kurtosis		.570	.560	.560	.576	.562	.574	.569	.567	.560
Range		2	2	2	2	2	2	2	2	2
Minimum		1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	3	3

City of Henderson		Amusement Park:	Day care center:	Landfill:	Non-polluting manufacturing facility:	Public school:	Highway/Freeway:	Hotel-casino:	Polluting manufacturing facility:	High-level nuclear waste transportation route:
N	Valid	82	82	82	83	82	82	82	83	84
	Missing	2	2	2	1	2	2	2	1	0
Mean		1.83	2.32	1.22	1.70	2.57	1.95	1.72	1.12	1.20
Std. Error of Mean		.084	.080	.064	.079	.072	.097	.089	.050	.055
Median		2.00	2.00	1.00	2.00	3.00	2.00	1.27	1.00	1.00
Std. Deviation		.763	.726	.585	.719	.650	.876	.810	.460	.502
Variance		.582	.527	.342	.517	.422	.767	.656	.211	.252
Skewness		.306	-.582	2.526	.519	-1.251	.098	.558	3.786	2.548
Std. Error of Skewness		.266	.266	.265	.264	.265	.266	.265	.264	.263
Kurtosis		-1.211	-.893	4.901	-.910	.405	-1.703	-1.251	12.980	5.742
Std. Error of Kurtosis		.525	.526	.524	.523	.524	.525	.524	.522	.520
Range		2	2	2	2	2	2	2	2	2
Minimum		1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	3	3

City of Boulder City		Amusement Park:	Day care center:	Landfill:	Non-polluting manufacturing facility:	Public school:	Highway/Freeway:	Hotel-casino:	Polluting manufacturing facility:	High-level nuclear waste transportation route:
N	Valid	7	8	8	7	8	7	7	8	8
	Missing	1	0	0	1	0	1	1	0	0
Mean		1.91	2.51	1.00	2.17	3.00	2.27	1.33	1.00	1.25
Std. Error of Mean		.289	.193	.000	.283	.000	.362	.195	.000	.167
Median		2.00	2.60	1.00	2.00	3.00	3.00	1.00	1.00	1.00
Std. Deviation		.770	.536	.000	.755	.000	.964	.509	.000	.462
Variance		.593	.287	.000	.569	.000	.930	.259	.000	.214
Skewness		.169	-.064		-.314		-.720	.954		1.477
Std. Error of Skewness		.790	.764	.764	.790	.764	.790	.804	.764	.764
Kurtosis		-.692	-2.846		-.499		-1.833	-1.735		.139
Std. Error of Kurtosis		1.577	1.510	1.510	1.577	1.510	1.577	1.615	1.510	1.510
Range		2	1	0	2	0	2	1	0	1
Minimum		1	2	1	1	3	1	1	1	1
Maximum		3	3	1	3	3	3	2	1	2

City of Mesquite		Amusement Park:	Day care center:	Landfill:	Non-polluting manufacturing facility:	Public school:	Highway/Freeway:	Hotel-casino:	Polluting manufacturing facility:	High-level nuclear waste transportation route:
N	Valid	6	6	6	6	6	6	6	6	6
	Missing	0	0	0	0	0	0	0	0	0
Mean		1.69	1.99	1.20	1.69	2.69	2.28	1.84	1.11	1.21
Std. Error of Mean		.294	.356	.181	.209	.294	.353	.337	.139	.184
Median		1.97	2.00	1.00	2.00	3.00	2.41	2.00	1.00	1.00
Std. Deviation		.717	.866	.441	.509	.717	.859	.821	.337	.448
Variance		.514	.750	.195	.259	.514	.737	.675	.114	.201
Skewness		.590	.013	2.027	-1.099	-2.538	-.734	.383	3.526	1.942
Std. Error of Skewness		.849	.849	.849	.849	.849	.849	.849	.849	.849
Kurtosis		.387	-1.575	3.076	-1.471	8.044	-.929	-.928	16.121	2.549
Std. Error of Kurtosis		1.754	1.754	1.754	1.754	1.754	1.754	1.754	1.754	1.754
Range		2	2	1	1	2	2	2	1	1
Minimum		1	1	1	1	1	1	1	1	1
Maximum		3	3	2	2	3	3	3	2	2

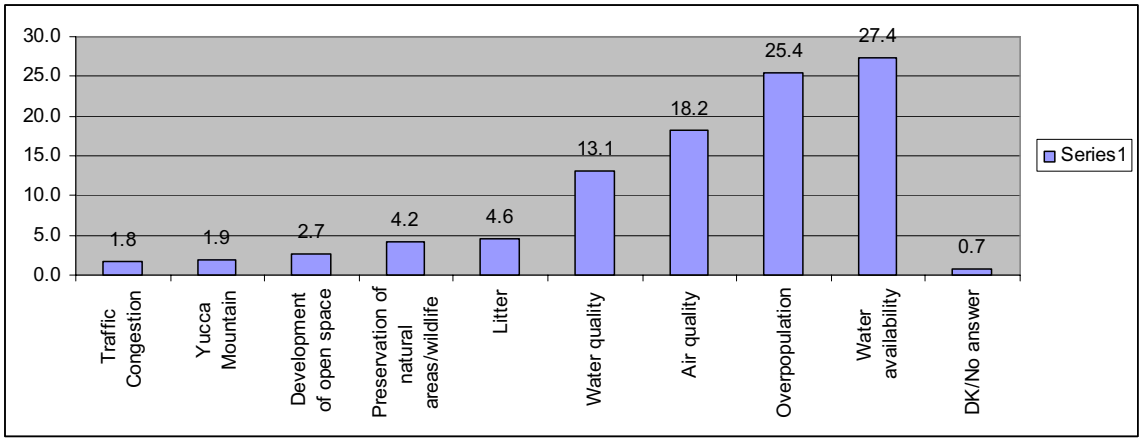
Appendix VI
Environmental Considerations

Appendix VI
Environmental Considerations
Summary Statistics

		How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	591	605	590	605
	Missing	18	4	19	4
Mean		2.74	1.65	3.14	2.99
Std. Error of Mean		.036	.033	.036	.030
Median		3.00	1.00	3.00	3.00
Std. Deviation		.873	.822	.877	.731
Variance		.762	.675	.768	.535
Skewness		-.191	1.332	-.681	-.274
Std. Error of Skewness		.100	.099	.101	.099
Kurtosis		-.685	1.380	-.460	-.344
Std. Error of Kurtosis		.201	.198	.201	.198
Range		3	3	3	3
Minimum		1	1	1	1
Maximum		4	4	4	4

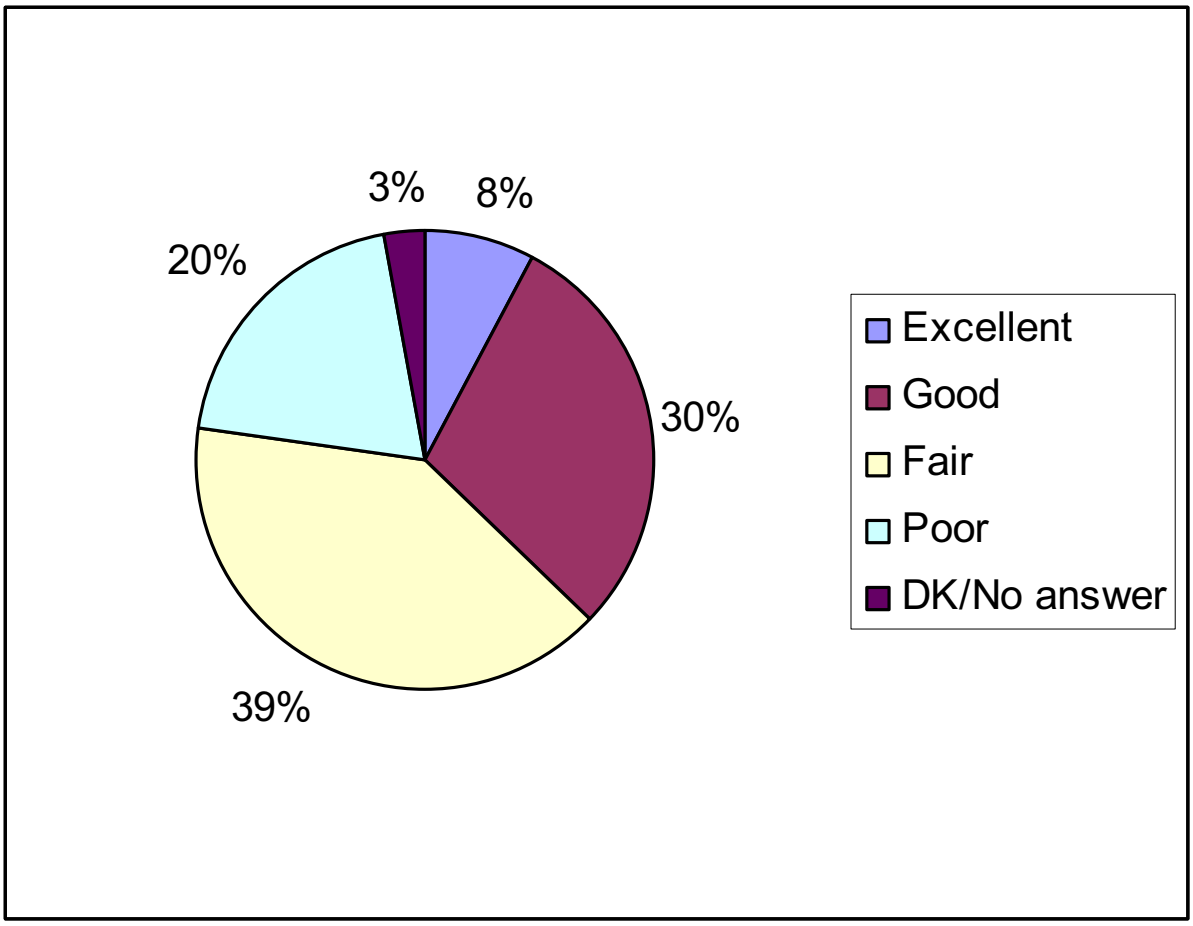
Appendix VI
Environmental Considerations

In your opinion, what is the most important Environmental issue facing Clark County today?	Frequency	Percent
Traffic Congestion	11	1.8
Yucca Mountain	12	1.9
Development of open space	17	2.7
Preservation of natural areas/wildlife	26	4.2
Litter	28	4.6
Water quality	80	13.1
Air quality	111	18.2
Overpopulation	155	25.4
Water availability	167	27.4
DK/No answer	4	0.7
Total	609	100.0



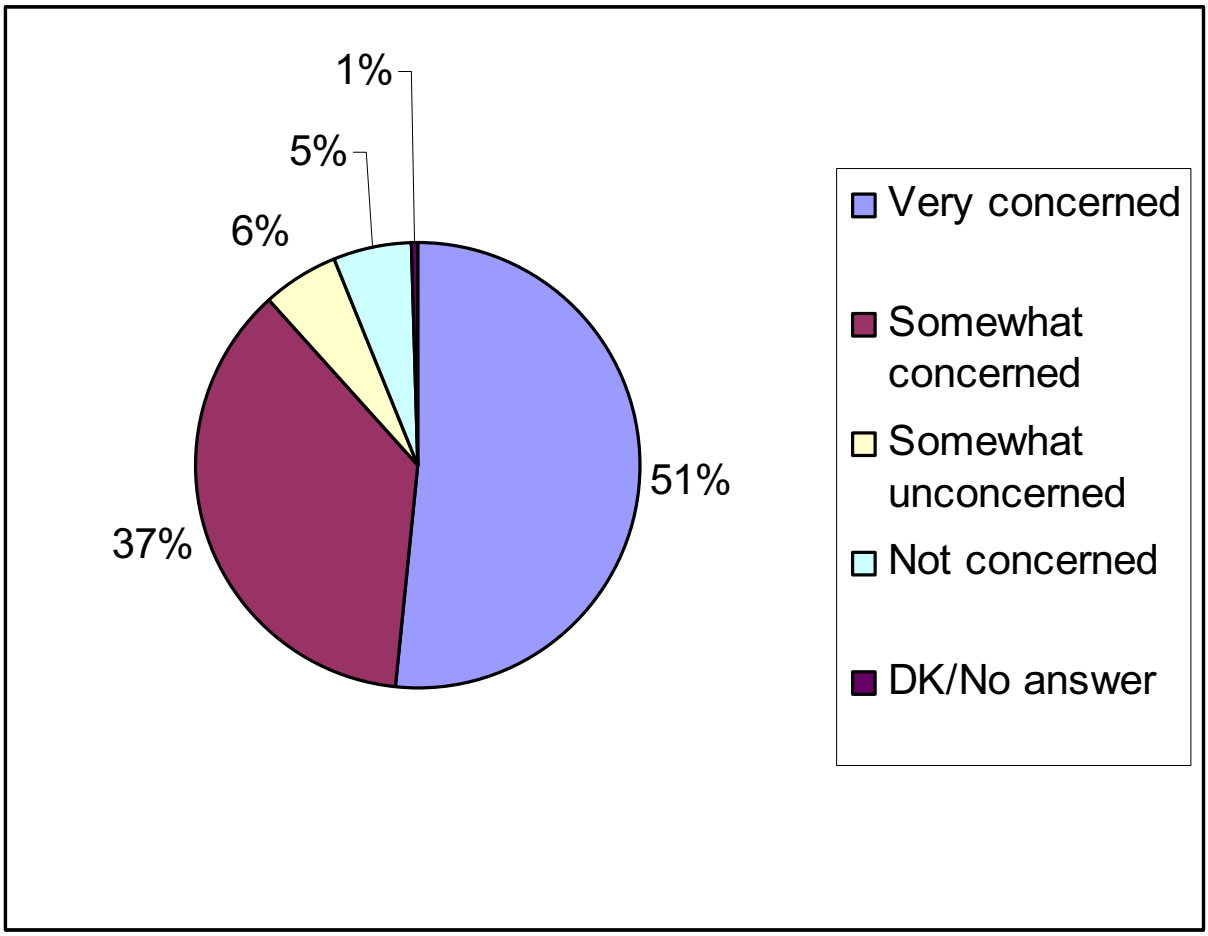
Appendix VI
Environmental Considerations

How would you rate local government's performance in preserving natural areas within Clark County?	Frequency	Percent
Excellent	47	7.7
Good	181	29.7
Fair	242	39.8
Poor	122	20.0
DK/No answer	18	2.9
Total	609	100.0



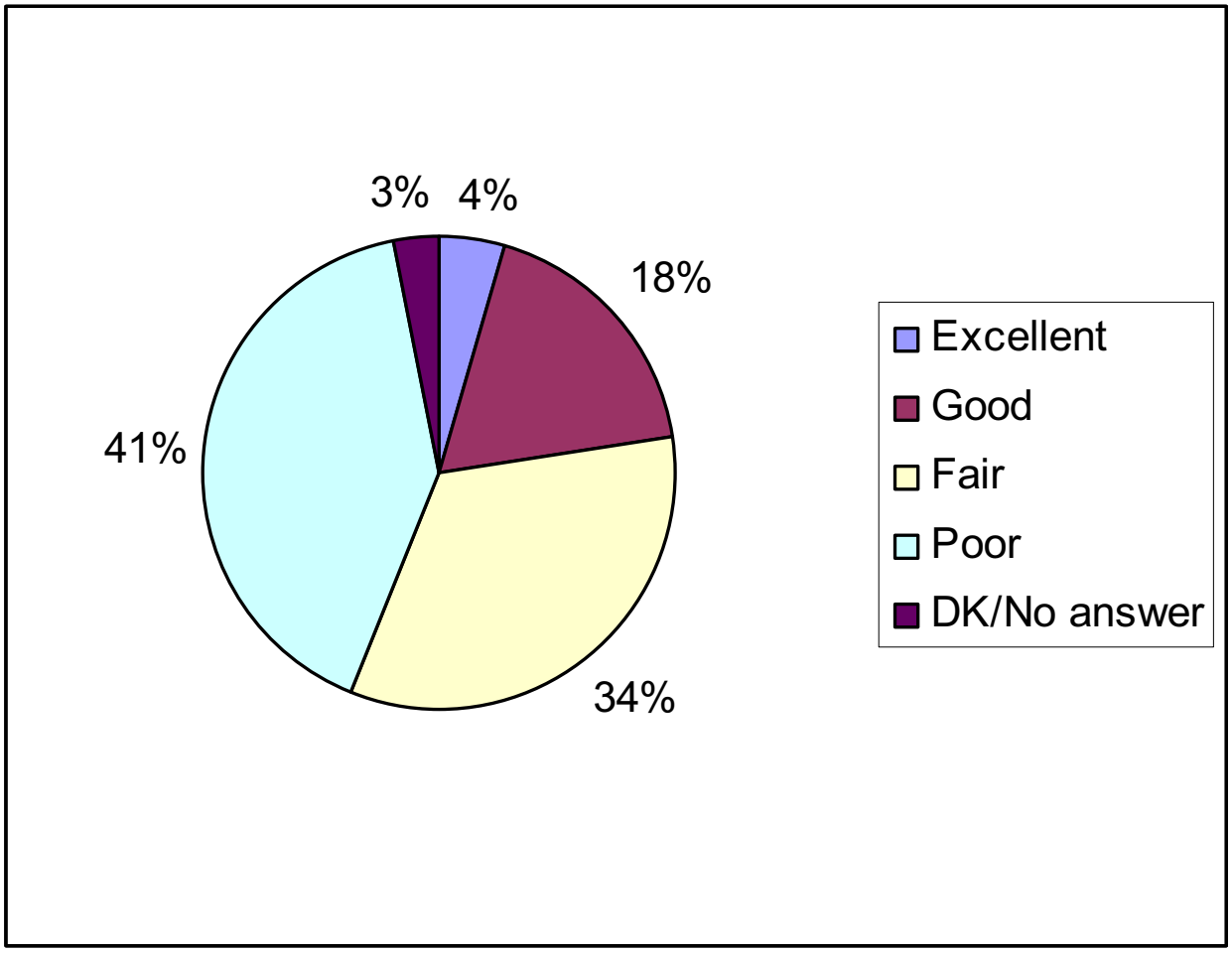
Appendix VI
Environmental Considerations

Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	Frequency	Percent
Very concerned	315	51.7
Somewhat concerned	222	36.5
Somewhat unconcerned	35	5.7
Not concerned	33	5.5
DK/No answer	4	0.6
Total	609	100.0



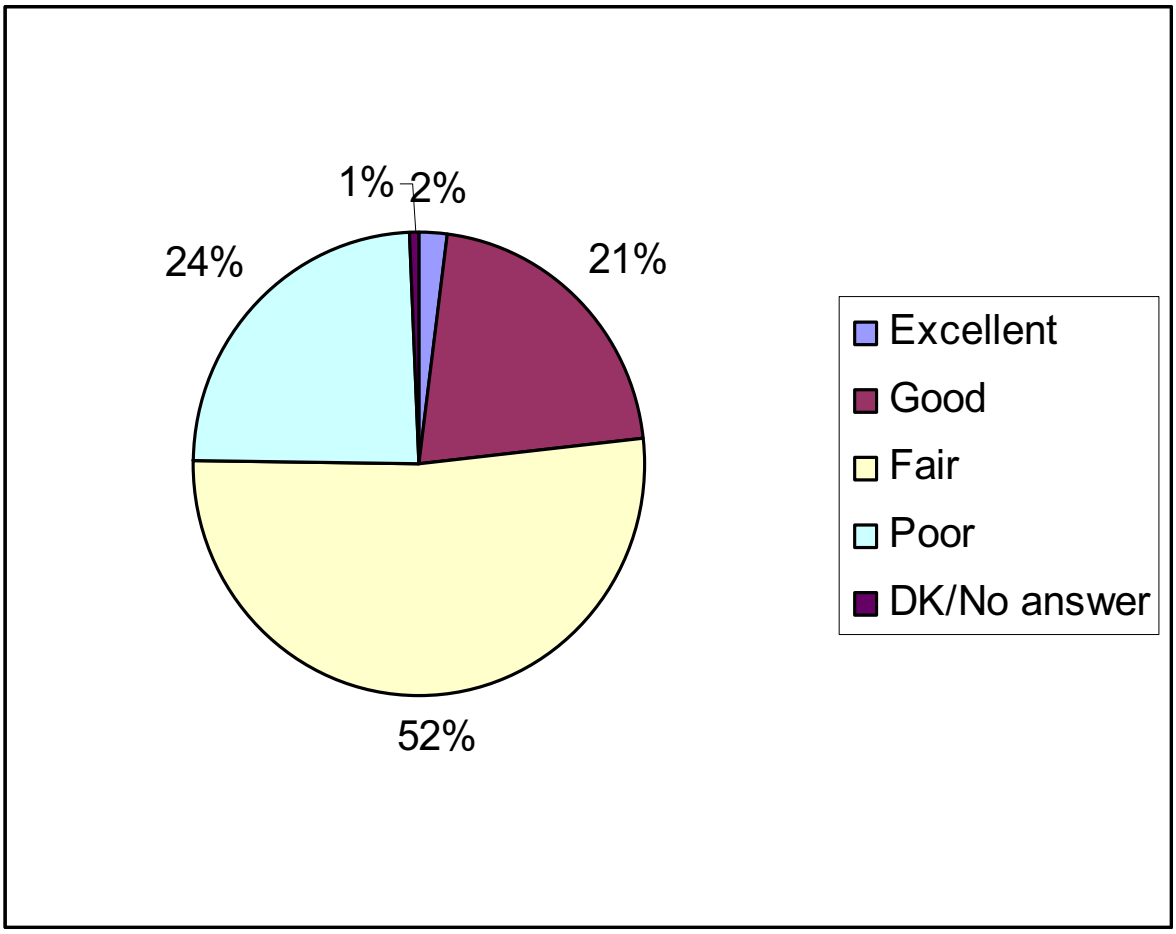
Appendix VI
Environmental Considerations

In general, how would you rate the quality of Clark County's drinking water?	Frequency	Percent
Excellent	26	4.3
Good	111	18.2
Fair	205	33.6
Poor	248	40.7
DK/No answer	19	3.1
Total	609	100.0



Appendix VI
Environmental Considerations

In general, how would you rate Clark County's air quality?	Frequency	Percent
Excellent	11	1.9
Good	130	21.4
Fair	316	51.9
Poor	147	24.2
DK/No answer	4	0.6
Total	609	100.0



Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

Unincorporated Clark County		How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	233	242	236	243
	Missing	9	1	6	0
Mean		2.77	1.63	3.14	3.02
Std. Error of Mean		.057	.050	.058	.045
Median		3.00	1.18	3.00	3.00
Std. Deviation		.864	.772	.892	.701
Variance		.746	.596	.796	.492
Skewness		-.302	1.389	-.691	-.163
Std. Error of Skewness		.159	.157	.158	.156
Kurtosis		-.533	2.012	-.485	-.537
Std. Error of Kurtosis		.317	.312	.315	.311
Range		3	3	3	3
Minimum		1	1	1	1
Maximum		4	4	4	4

Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

City of Las Vegas		How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	194	196	190	196
	Missing	3	1	7	1
Mean		2.76	1.62	3.19	2.96
Std. Error of Mean		.062	.061	.062	.052
Median		3.00	1.00	3.00	3.00
Std. Deviation		.864	.858	.850	.725
Variance		.746	.737	.723	.525
Skewness		-.105	1.409	-.678	-.242
Std. Error of Skewness		.175	.174	.176	.173
Kurtosis		-.765	1.323	-.508	-.295
Std. Error of Kurtosis		.347	.346	.351	.345
Range		3	3	3	3
Minimum		1	1	1	1
Maximum		4	4	4	4

Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

City of North Las Vegas		How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	69	71	69	71
	Missing	3	1	3	1
Mean		2.79	1.67	3.03	3.05
Std. Error of Mean		.106	.097	.112	.094
Median		3.00	1.37	3.00	3.00
Std. Deviation		.882	.818	.932	.792
Variance		.777	.670	.868	.628
Skewness		-.292	1.254	-.564	-.779
Std. Error of Skewness		.289	.284	.289	.284
Kurtosis		-.581	1.273	-.659	.627
Std. Error of Kurtosis		.571	.562	.571	.562
Range		3	3	3	3
Minimum		1	1	1	1
Maximum		4	4	4	4

Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

City of Henderson		How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	83	83	82	82
	Missing	1	1	2	2
Mean		2.55	1.67	3.20	2.97
Std. Error of Mean		.097	.092	.090	.084
Median		3.00	1.00	3.00	3.00
Std. Deviation		.884	.835	.813	.765
Variance		.782	.697	.661	.585
Skewness		-.035	1.203	-.826	-.166
Std. Error of Skewness		.264	.264	.266	.266
Kurtosis		-.677	.925	.220	-.720
Std. Error of Kurtosis		.522	.522	.526	.525
Range		3	3	3	3
Minimum		1	1	1	1
Maximum		4	4	4	4

Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

City of Boulder City		How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	7	8	8	7
	Missing	1	0	0	1
Mean		2.90	1.82	2.56	2.63
Std. Error of Mean		.412	.371	.408	.336
Median		3.00	1.98	2.70	3.00
Std. Deviation		1.097	1.029	1.131	.894
Variance		1.203	1.060	1.279	.800
Skewness		-.369	1.562	-.090	-.152
Std. Error of Skewness		.790	.764	.764	.790
Kurtosis		-1.159	2.941	-1.119	.487
Std. Error of Kurtosis		1.577	1.510	1.510	1.577
Range		3	3	3	3
Minimum		1	1	1	1
Maximum		4	4	4	4

Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

City of Mesquite		How would you rate local government's performance in preserving natural areas within Clark County?	Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	5	6	6	6
	Missing	1	0	0	0
Mean		2.96	2.47	3.07	2.80
Std. Error of Mean		.453	.419	.373	.343
Median		3.10	2.00	3.00	3.00
Std. Deviation		1.044	1.021	.908	.835
Variance		1.089	1.043	.825	.697
Skewness		.106	.624	-.174	.495
Std. Error of Skewness		.890	.849	.849	.849
Kurtosis		-3.253	.171	-1.976	-.992
Std. Error of Kurtosis		1.903	1.754	1.754	1.754
Range		2	3	2	2
Minimum		2	1	2	2
Maximum		4	4	4	4

Appendix VI
Environmental Considerations
Jurisdictional Cross-tabulations

Jurisdiction * How would you rate local government's performance in preserving natural areas within Clark County?

			How would you rate local government's performance in preserving natural areas within Clark County?				Total
			Excellent	Good	Fair	Poor	
Jurisdiction	Unincorporated Clark County	Count	19	63	104	47	233
		% within Jurisdiction	8.2%	27.0%	44.6%	20.2%	100.0%
	City of Las Vegas	Count	12	64	75	42	193
		% within Jurisdiction	6.2%	33.2%	38.9%	21.8%	100.0%
	City of North Las Vegas	Count	5	19	29	15	68
		% within Jurisdiction	7.4%	27.9%	42.6%	22.1%	100.0%
	City of Henderson	Count	10	30	31	12	83
		% within Jurisdiction	12.0%	36.1%	37.3%	14.5%	100.0%
	Boulder City	Count	1	2	2	3	8
		% within Jurisdiction	12.5%	25.0%	25.0%	37.5%	100.0%
	Mesquite	Count	0	2	1	2	5
		% within Jurisdiction	.0%	40.0%	20.0%	40.0%	100.0%
Total		Count	47	180	242	121	590
		% within Jurisdiction	8.0%	30.5%	41.0%	20.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.819(a)	15	.693
Likelihood Ratio	11.922	15	.685
Linear-by-Linear Association	1.253	1	.263
N of Valid Cases	590		

a 8 cells (33.3%) have expected count less than 5. The minimum expected count is .40.

Jurisdiction * Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?

			Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?				
			Very concerned	Somewhat concerned	Somewhat unconcerned	Not concerned	Total
Jurisdiction	Unincorporated Clark County	Count	121	100	8	12	241
		% within Jurisdiction	50.2%	41.5%	3.3%	5.0%	100.0%
	City of Las Vegas	Count	111	60	13	12	196
		% within Jurisdiction	56.6%	30.6%	6.6%	6.1%	100.0%
	City of North Las Vegas	Count	36	27	5	4	72
		% within Jurisdiction	50.0%	37.5%	6.9%	5.6%	100.0%
	City of Henderson	Count	43	29	7	4	83
		% within Jurisdiction	51.8%	34.9%	8.4%	4.8%	100.0%
	Boulder City	Count	3	3	0	1	7
		% within Jurisdiction	42.9%	42.9%	.0%	14.3%	100.0%
	Mesquite	Count	1	3	1	1	6
		% within Jurisdiction	16.7%	50.0%	16.7%	16.7%	100.0%
Total		Count	315	222	34	34	605
		% within Jurisdiction	52.1%	36.7%	5.6%	5.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.811(a)	15	.465
Likelihood Ratio	14.763	15	.469
Linear-by-Linear Association	1.632	1	.201
N of Valid Cases	605		

a 12 cells (50.0%) have expected count less than 5. The minimum expected count is .34.

Jurisdiction * In general, how would you rate the quality of Clark County's drinking water?

			In general, how would you rate the quality of Clark County's drinking water?				
			Excellent	Good	Fair	Poor	Total
Jurisdiction	Unincorporated Clark County	Count	11	45	79	101	236
		% within Jurisdiction	4.7%	19.1%	33.5%	42.8%	100.0%
	City of Las Vegas	Count	6	36	64	84	190
		% within Jurisdiction	3.2%	18.9%	33.7%	44.2%	100.0%
	City of North Las Vegas	Count	4	15	23	26	68
		% within Jurisdiction	5.9%	22.1%	33.8%	38.2%	100.0%
	City of Henderson	Count	3	11	35	33	82
		% within Jurisdiction	3.7%	13.4%	42.7%	40.2%	100.0%
	Boulder City	Count	2	2	2	2	8
		% within Jurisdiction	25.0%	25.0%	25.0%	25.0%	100.0%
	Mesquite	Count	0	2	2	2	6
		% within Jurisdiction	.0%	33.3%	33.3%	33.3%	100.0%
Total		Count	26	111	205	248	590
		% within Jurisdiction	4.4%	18.8%	34.7%	42.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.706(a)	15	.473
Likelihood Ratio	10.980	15	.754
Linear-by-Linear Association	.493	1	.483
N of Valid Cases	590		

a 10 cells (41.7%) have expected count less than 5. The minimum expected count is .26.

Jurisdiction * In general, how would you rate Clark County's air quality?

			In general, how would you rate Clark County's air quality?				Total
			Excellent	Good	Fair	Poor	
Jurisdiction	Unincorporated Clark County	Count	2	52	129	60	243
		% within Jurisdiction	.8%	21.4%	53.1%	24.7%	100.0%
	City of Las Vegas	Count	4	44	105	44	197
		% within Jurisdiction	2.0%	22.3%	53.3%	22.3%	100.0%
	City of North Las Vegas	Count	4	9	38	20	71
		% within Jurisdiction	5.6%	12.7%	53.5%	28.2%	100.0%
	City of Henderson	Count	1	21	38	21	81
		% within Jurisdiction	1.2%	25.9%	46.9%	25.9%	100.0%
	Boulder City	Count	1	2	3	1	7
		% within Jurisdiction	14.3%	28.6%	42.9%	14.3%	100.0%
	Mesquite	Count	0	2	2	1	5
		% within Jurisdiction	.0%	40.0%	40.0%	20.0%	100.0%
Total		Count	12	130	315	147	604
		% within Jurisdiction	2.0%	21.5%	52.2%	24.3%	100.0%

Chi-Square Tests

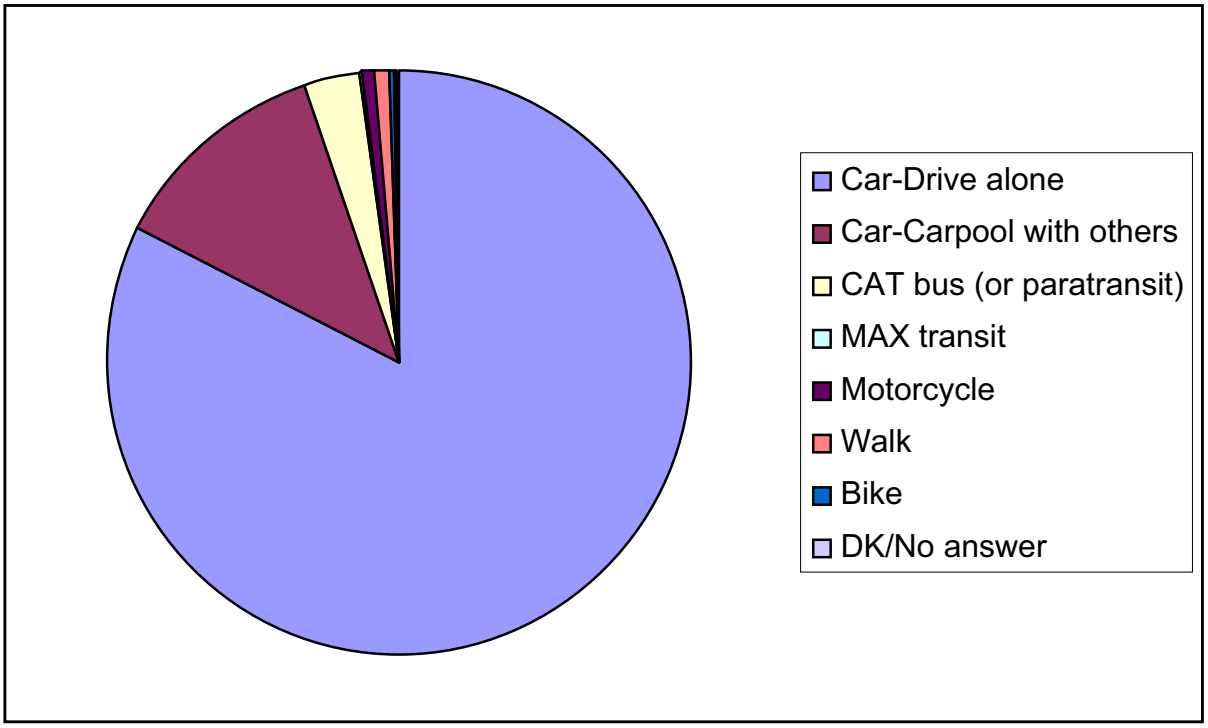
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.378(a)	15	.243
Likelihood Ratio	14.591	15	.481
Linear-by-Linear Association	.741	1	.389
N of Valid Cases	604		

a 12 cells (50.0%) have expected count less than 5. The minimum expected count is .10.

Appendix VII
Commute Profile

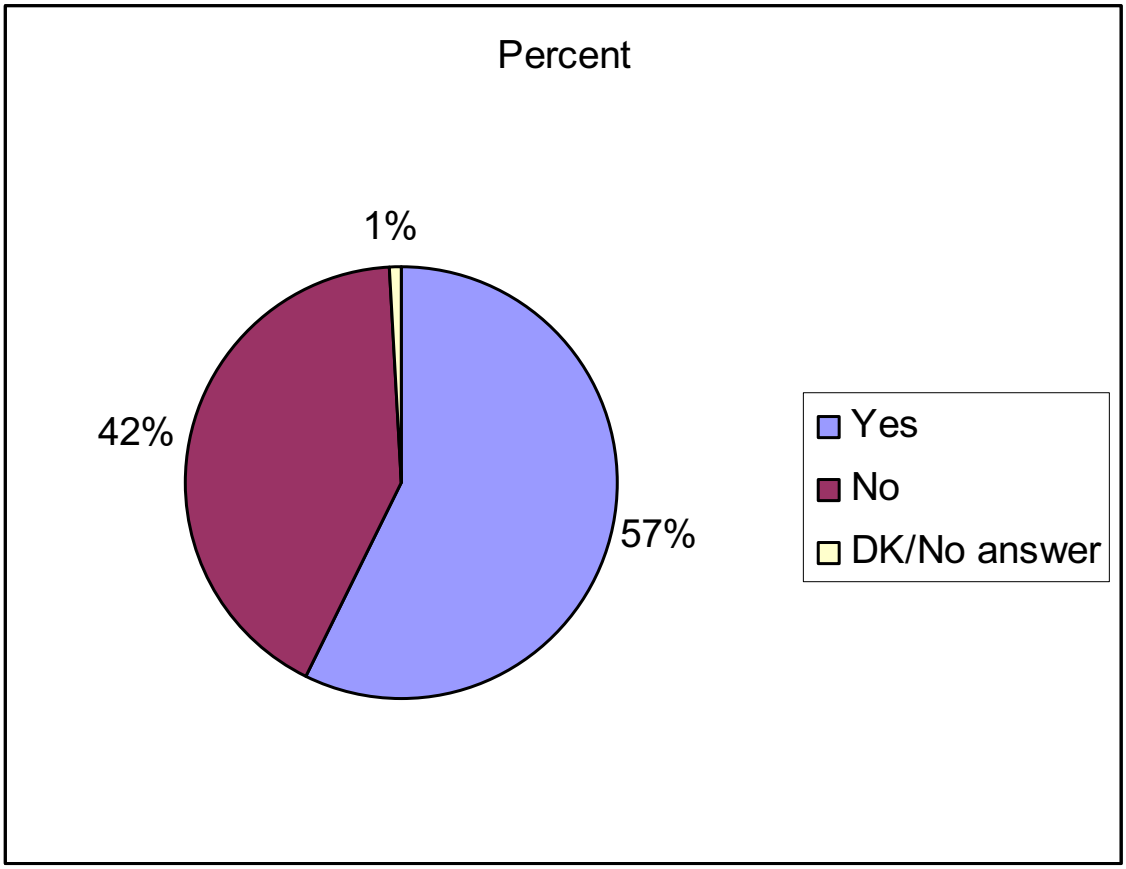
Appendix VII
Commute Profile

What is your most frequently used mode of transportation?		
	Frequency	**Percent**
Car-Drive alone	502	82.5
Car-Carpool with others	74	12.2
CAT bus (or paratransit)	19	3.2
MAX transit	1	0.1
Motorcycle	4	0.7
Walk	6	0.9
Bike	1	0.1
DK/No answer	2	0.3
Total	609	100.0



Appendix VII
Commute Profile

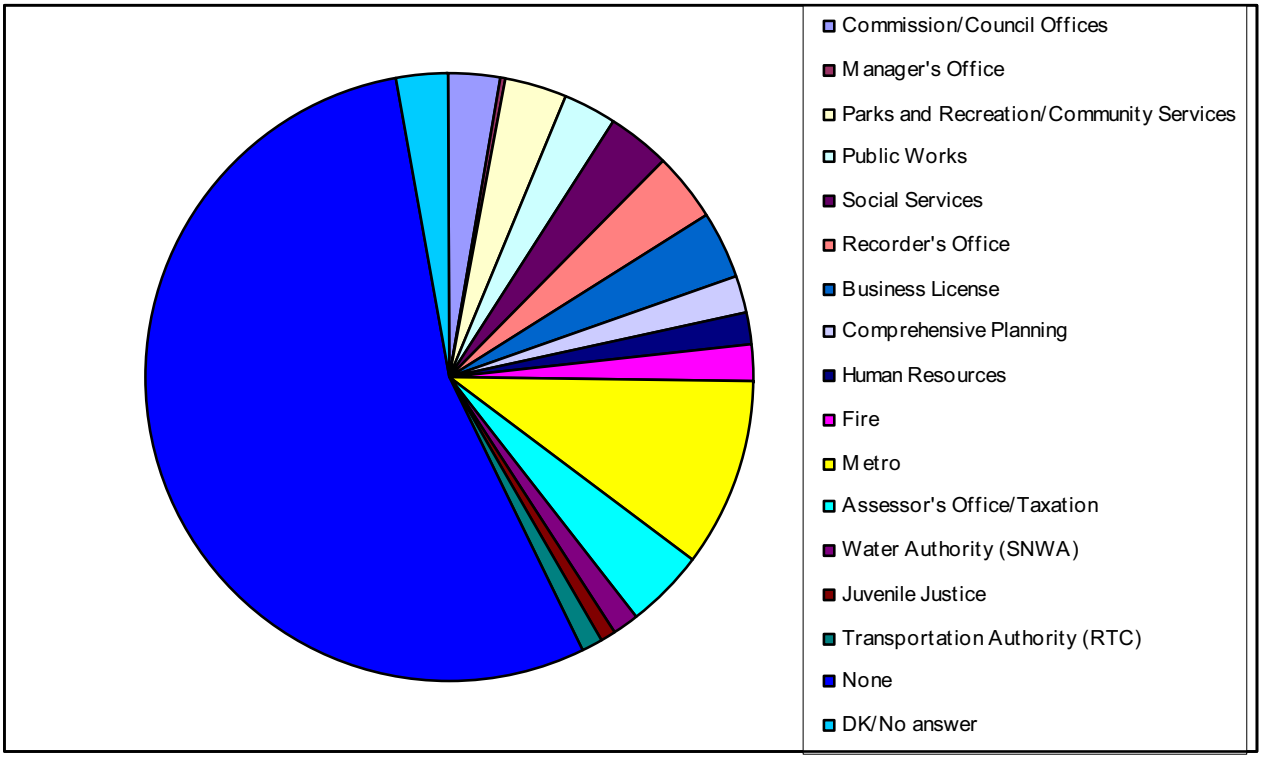
Do you currently commute on a daily basis?	Frequency	Percent
Yes	348	57.1
No	257	42.1
DK/No answer	5	0.8
Total	609	100.0



Appendix VIII
Local Government Interaction

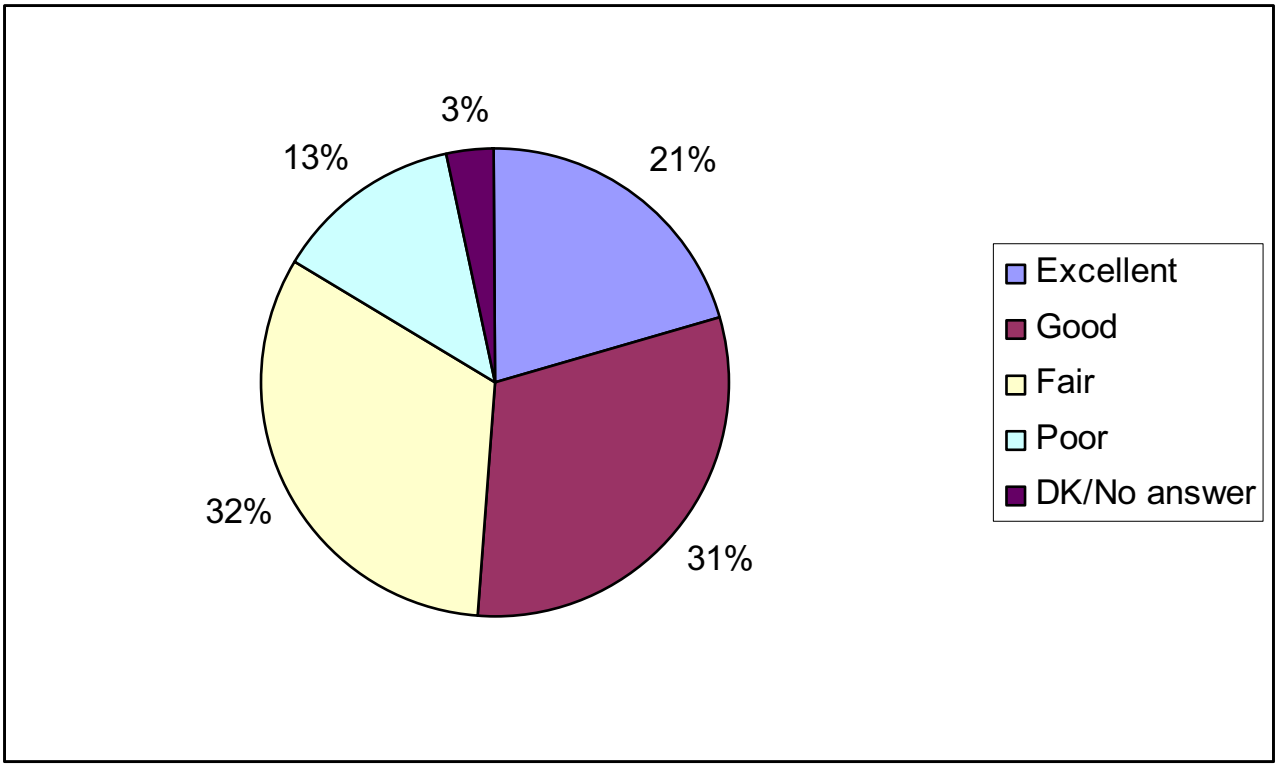
Appendix VIII
Local Government Interaction

Which local government department, if any, have you interacted with in the past year?	Frequency	Percent
Commission/Council Offices	16	2.7
Manager's Office	3	0.4
Parks and Recreation/Community Services	20	3.3
Public Works	16	2.6
Social Services	21	3.5
Recorder's Office	22	3.6
Business License	22	3.6
Comprehensive Planning	13	2.1
Human Resources	10	1.7
Fire	11	1.8
Metro	61	10.0
Assessor's Office/Taxation	25	4.2
Water Authority (SNWA)	9	1.5
Juvenile Justice	5	0.9
Transportation Authority (RTC)	7	1.1
None	332	54.5
DK/NO answer	16	2.7
Total	609	100.0



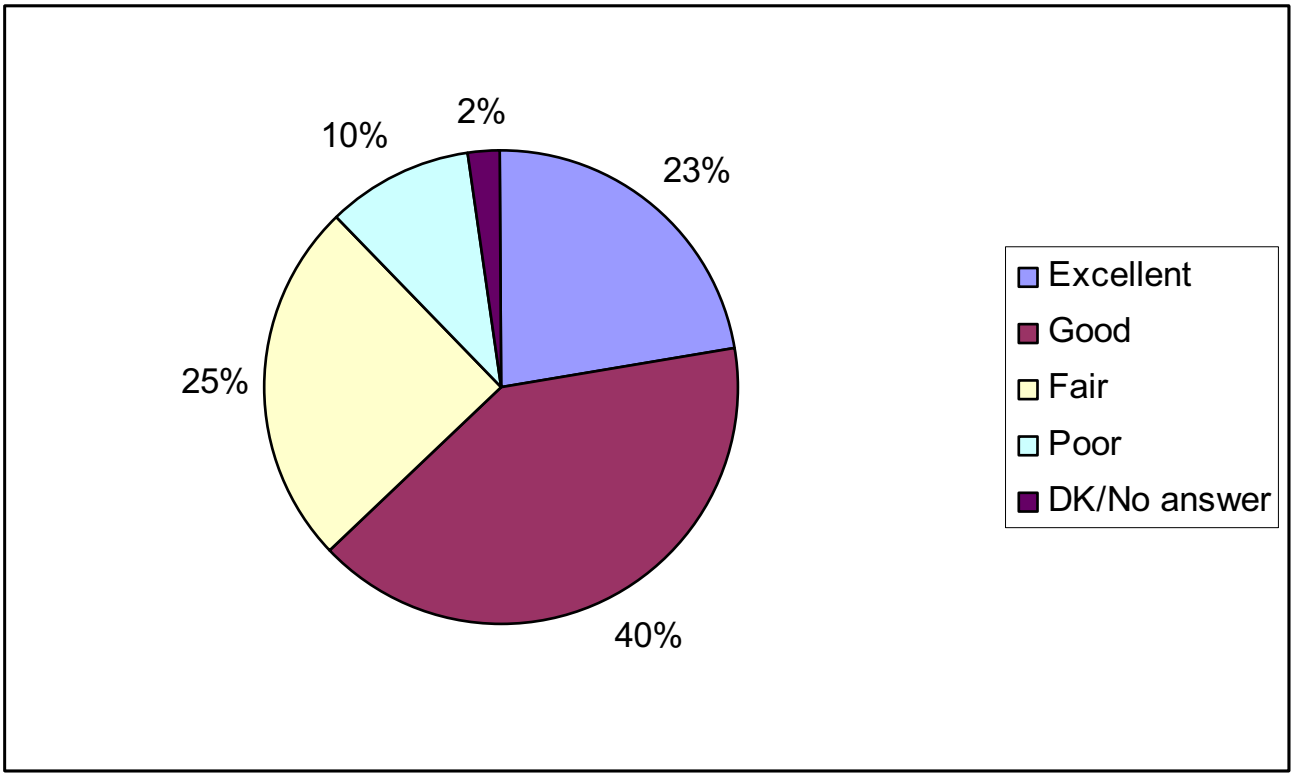
Appendix VIII
Local Government Interaction

Timeliness of response:	Frequency	Valid Percent
Excellent	54	20.5
Good	80	30.5
Fair	85	32.5
Poor	34	13.1
DK/No answer	9	3.4
Total	261	100.0



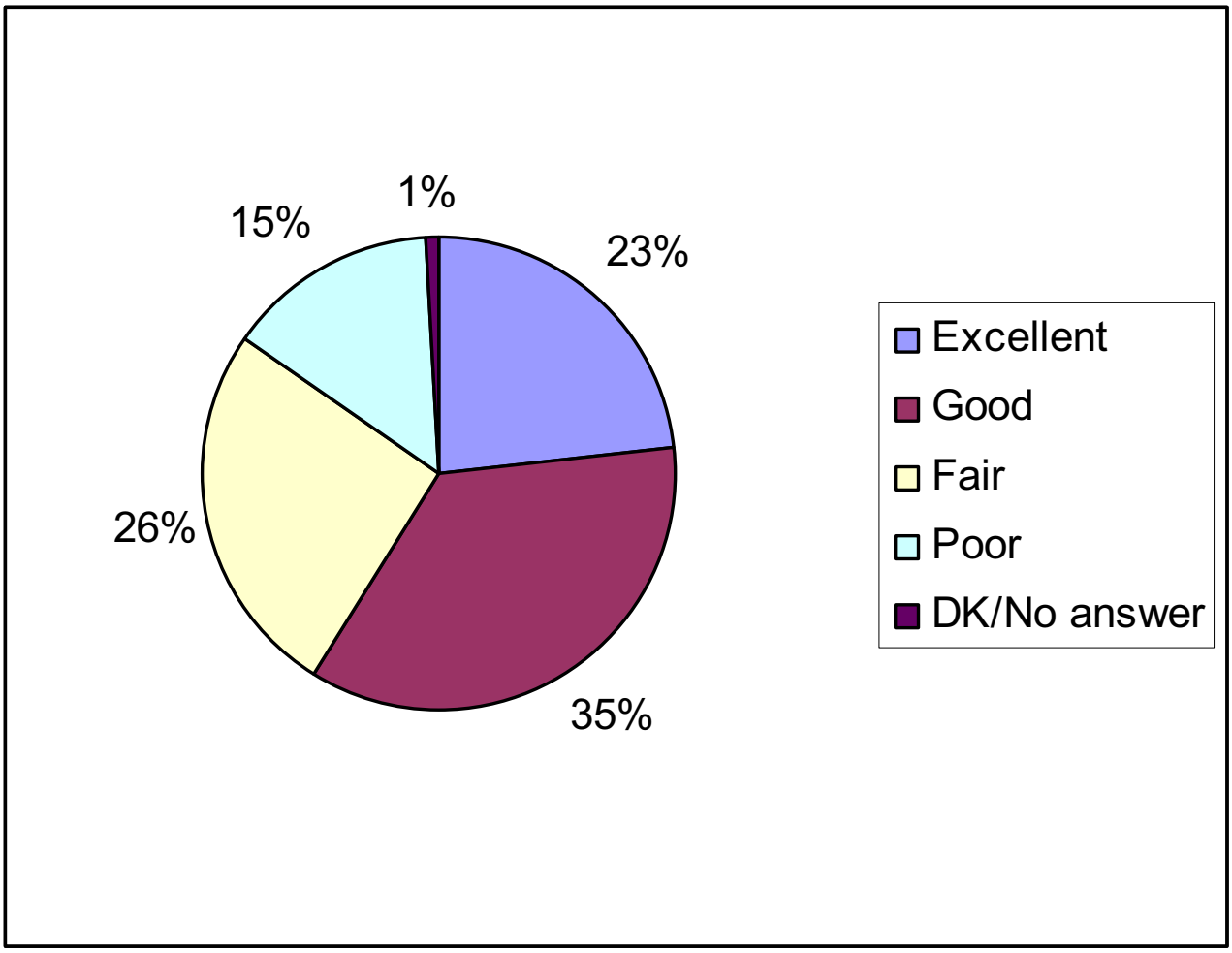
Appendix VIII
Local Government Interaction

Courtesy:	Frequency	Valid Percent
Excellent	59	22.6
Good	105	40.3
Fair	65	25.1
Poor	26	9.9
DK/No answer	6	2.2
Total	261	100.0



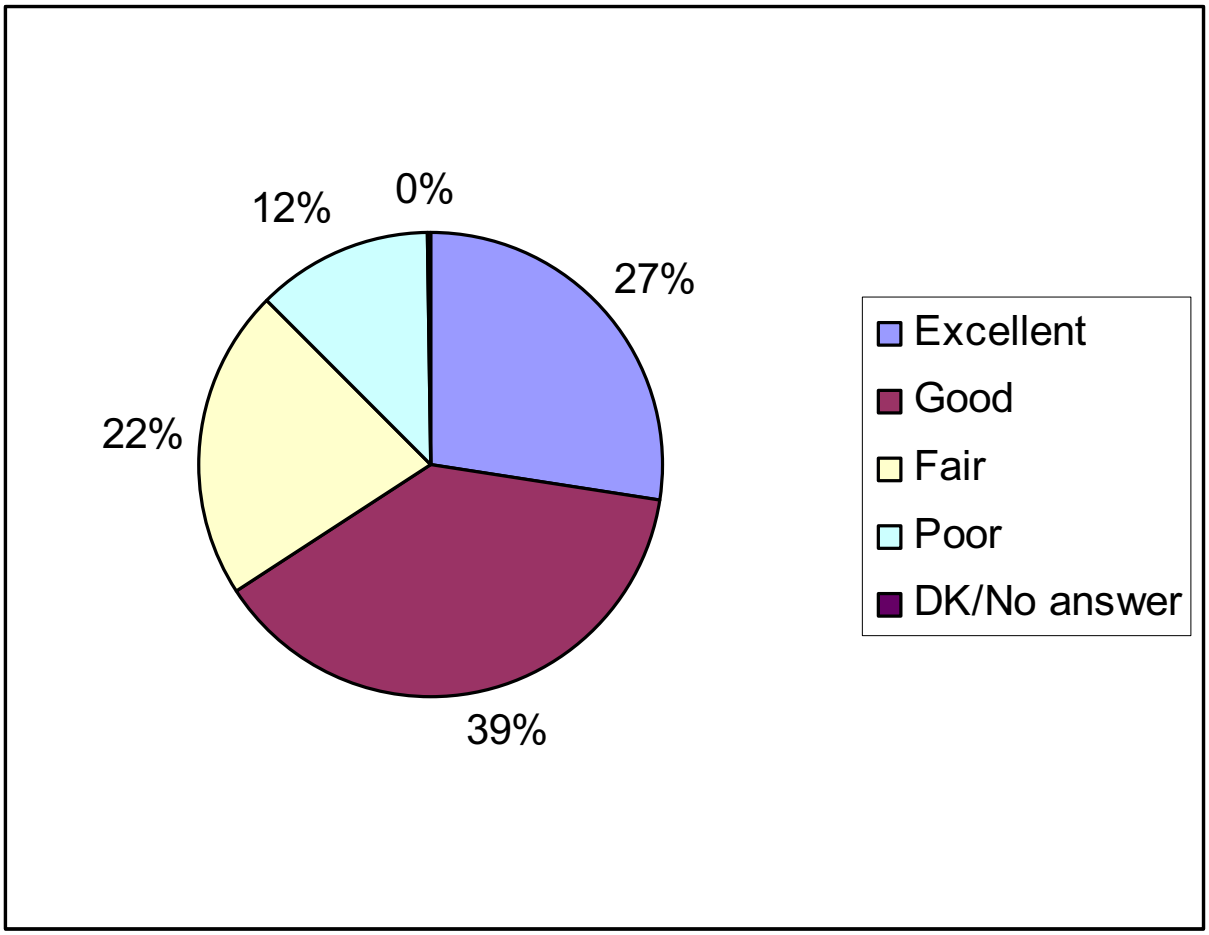
Appendix VIII
Local Government Interaction

Competency in handling your issue:	Frequency	Valid Percent
Excellent	61	23.3
Good	92	35.4
Fair	67	25.8
Poor	38	14.7
DK/No answer	2	0.7
Total	261	100.0



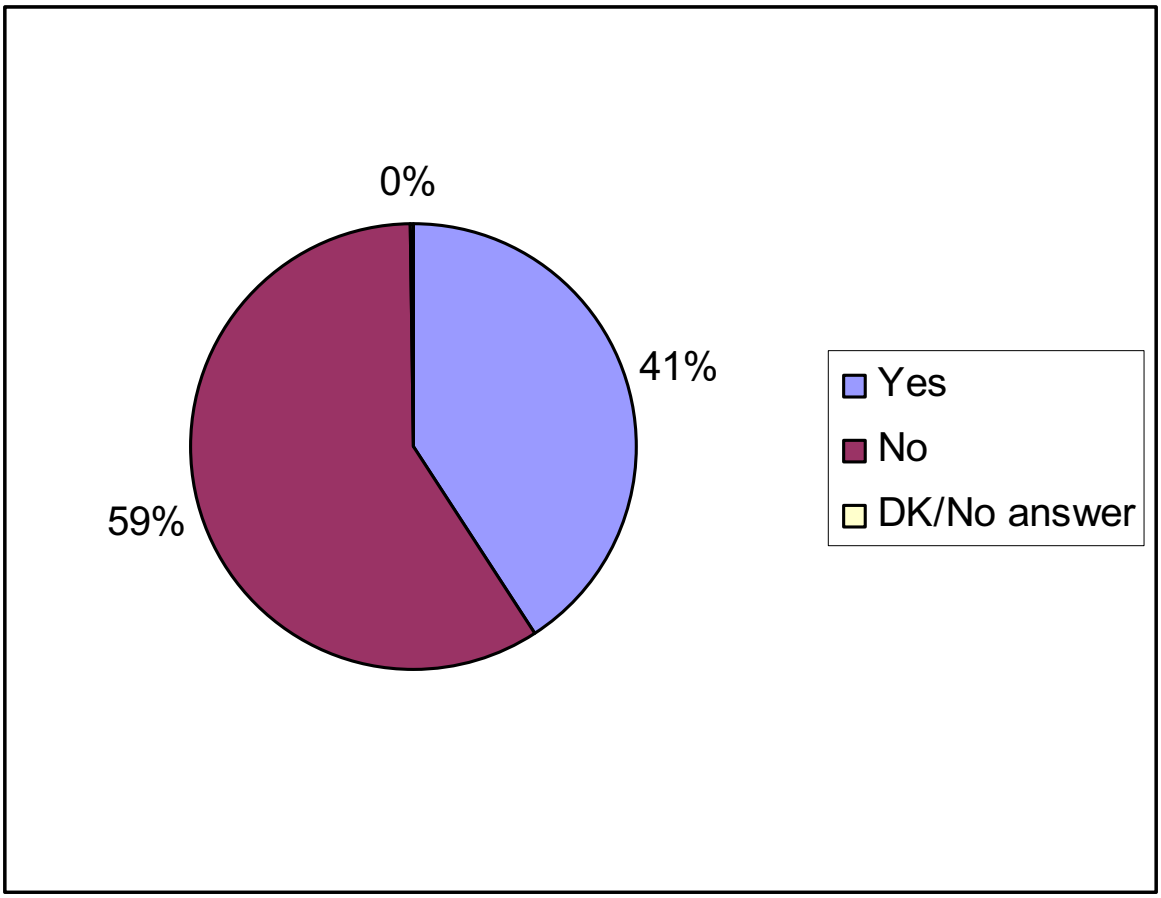
Appendix VIII
Local Government Interaction

Professionalism:	Frequency	Valid Percent
Excellent	71	27.4
Good	100	38.3
Fair	57	21.8
Poor	32	12.1
DK/No answer	1	0.3
Total	261	100.0



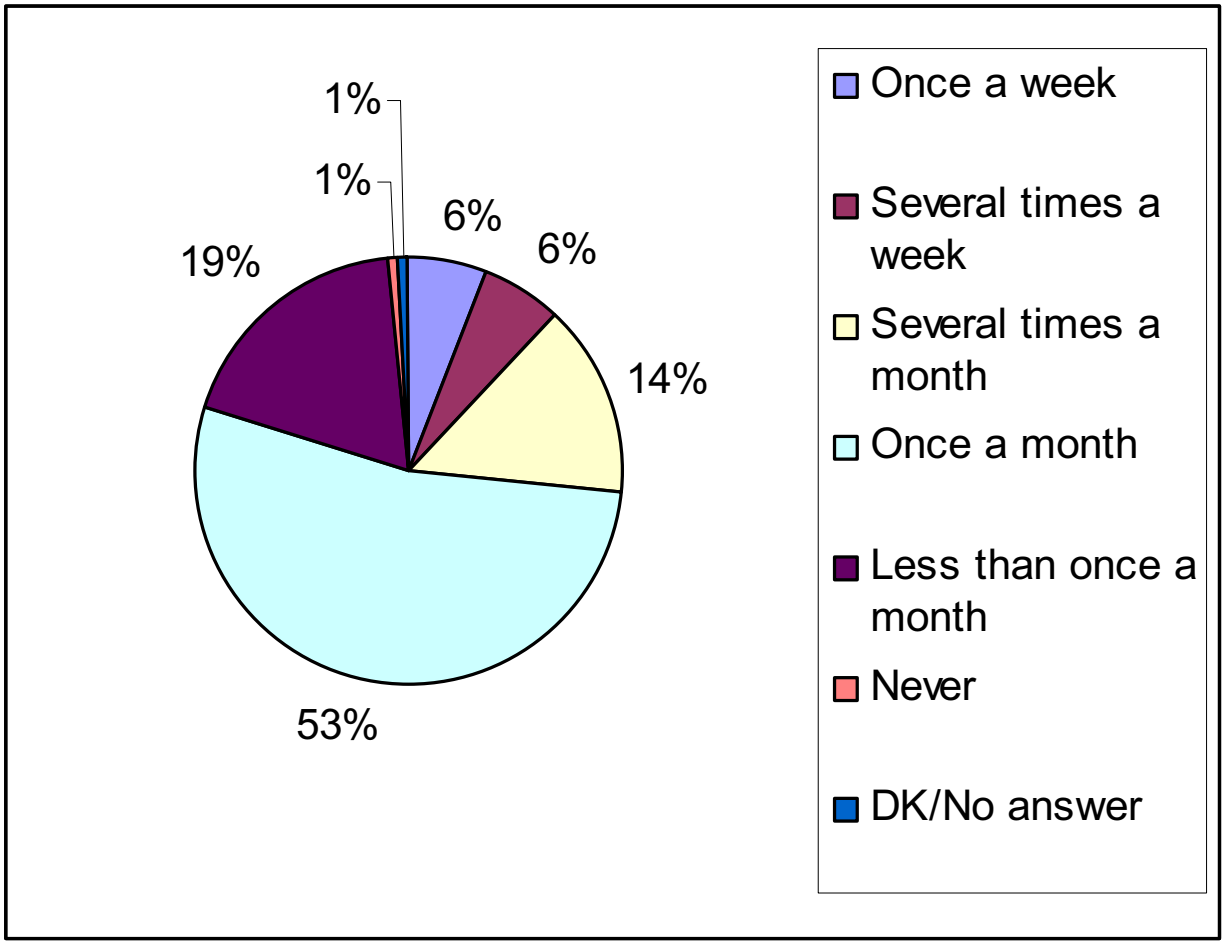
Appendix VIII
Local Government Interaction

Have you ever visited your local government's website?	Frequency	Percent
Yes	249	41.0
No	357	58.7
DK/No answer	2	0.4
Total	609	100.0



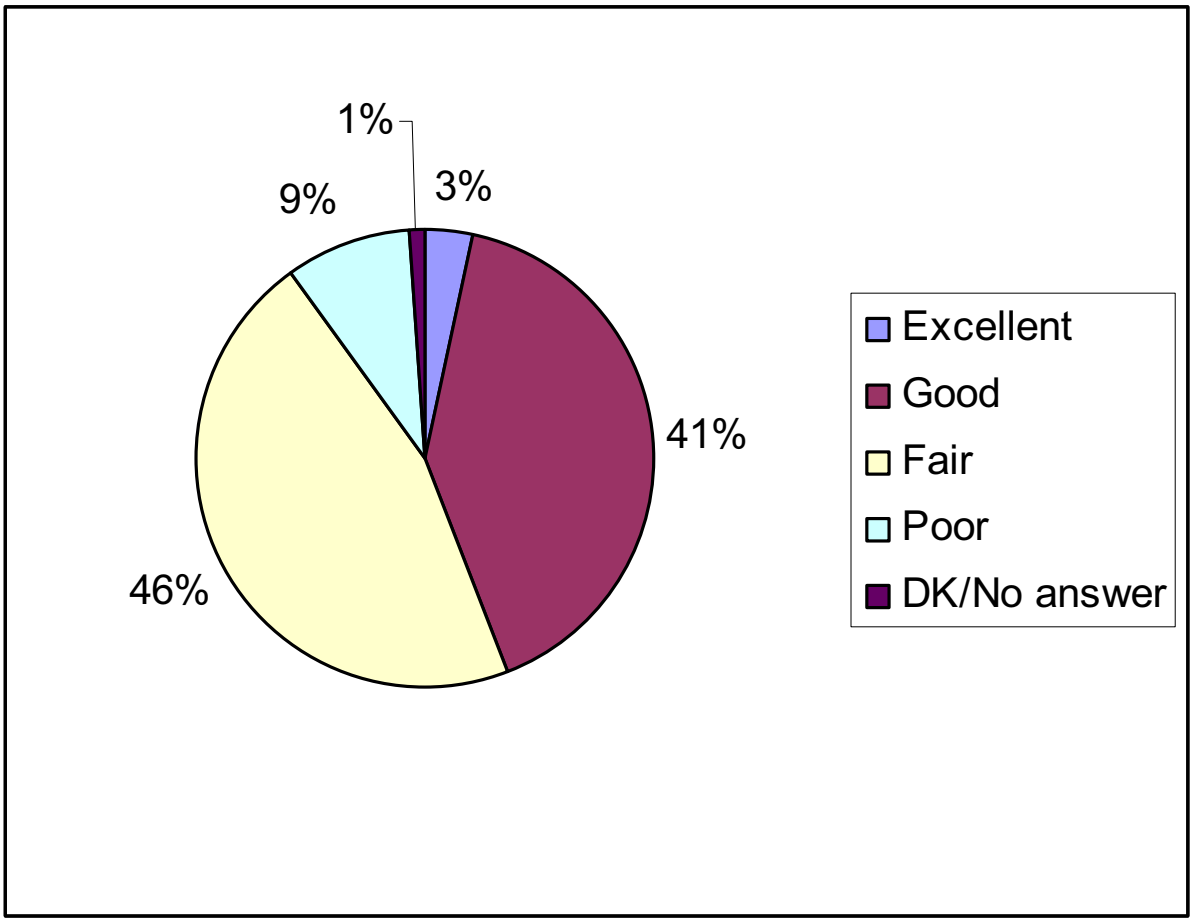
Appendix VIII
Local Government Interaction

In any given month, how often would you say you visit your local government's website?	Frequency	Valid Percent
Once a week	15	6.2
Several times a week	15	6.1
Several times a month	35	14.2
Once a month	132	52.9
Less than once a month	47	18.7
Never	2	0.7
DK/No answer	2	0.7
Total	249	100.0



Appendix VIII
Local Government Interaction

All things considered, would you rate your local government's performance in providing services as excellent, good, fair, or poor?	Frequency	Percent
Excellent	21	3.4
Good	248	40.7
Fair	279	45.8
Poor	55	9.0
DK/No answer	7	1.1
Total	609	100.0



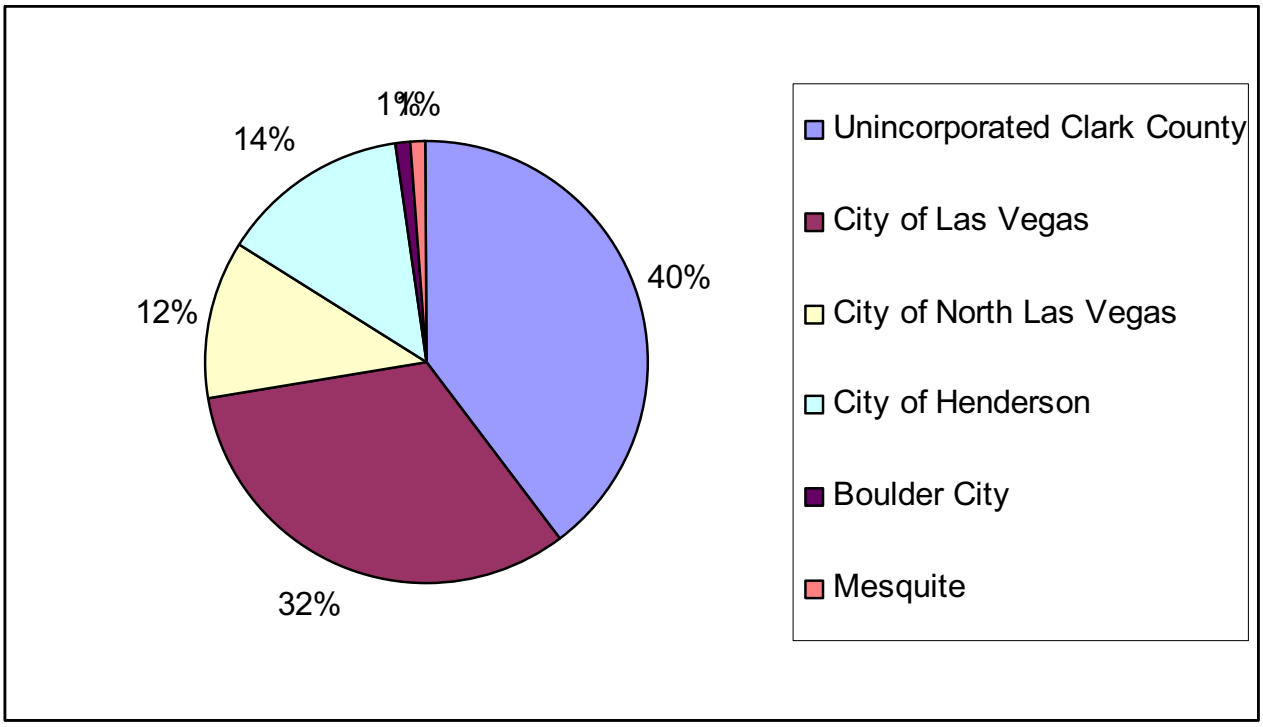
Appendix IX
Local Distribution Summary

Appendix IX
Local Distribution Summary

Zip Code	Frequency	Percent
89005	7	1.2
89012	12	2.0
89014	14	2.3
89015	24	4.0
89017	1	0.2
89021	1	0.1
89027	5	0.9
89029	2	0.4
89030	18	3.0
89031	21	3.5
89032	9	1.6
89044	3	0.6
89052	12	1.9
89074	14	2.3
89081	7	1.2
89084	10	1.6
89086	1	0.2
89100	1	0.2
89101	5	0.8
89102	9	1.4
89103	12	2.0
89104	14	2.3
89105	3	0.5
89106	6	1.0
89107	14	2.3
89108	18	2.9
89109	3	0.5
89110	14	2.4
89112	1	0.2
89113	3	0.5
89115	12	2.0
89117	30	4.9
89119	10	1.6
89120	3	0.5
89121	34	5.6
89122	13	2.1
89123	40	6.6
89128	12	1.9
89129	19	3.1
89130	12	2.0
89131	12	2.0
89132	1	0.1
89134	26	4.3
89135	12	2.0
89138	10	1.6
89139	8	1.3
89141	4	0.6
89142	8	1.3
89143	2	0.3
89144	6	1.0
89145	17	2.8
89146	10	1.6
89147	13	2.1
89148	3	0.5
89149	6	1.0
89156	11	1.8
89211	2	0.3
89221	1	0.1
89704	1	0.1
DK/No Answer	6	1.0
Total	609	100.0

Appendix IX
Local Distribution Summary

Jurisdiction	Frequency	Percent
Unincorporated Clark County	243	39.8
City of Las Vegas	197	32.4
City of North Las Vegas	72	11.8
City of Henderson	84	13.8
Boulder City	8	1.3
Mesquite	6	1.0
Total	609	100.0



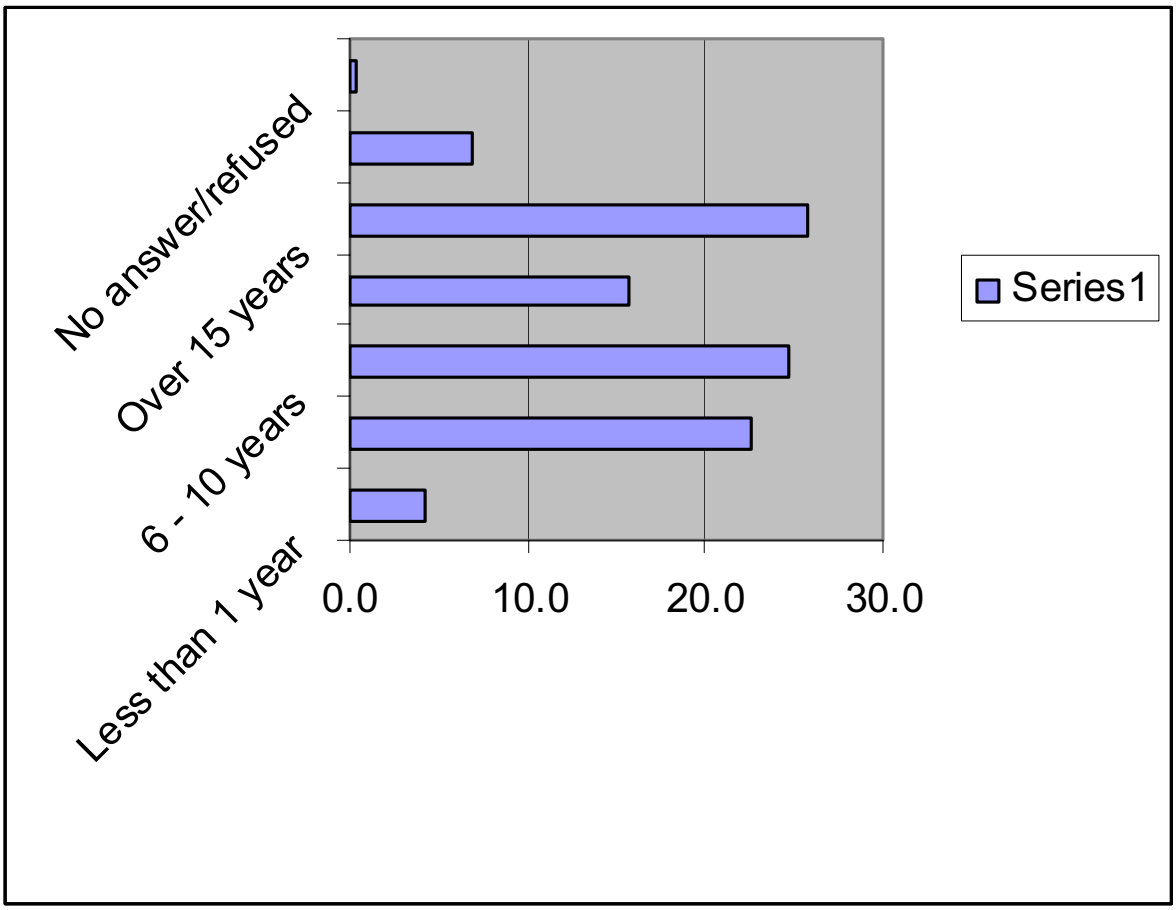
Appendix X
Respondent Demographic Profile

Appendix X
Respondent Demographic Profile
Summary Statistics

		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	544	605	607	609
	Missing	65	4	2	0
Mean		3.77	2.65	3.57	1.53
Std. Error of Mean		.081	.036	.056	.020
Median		3.00	3.00	3.00	2.00
Std. Deviation		1.897	.891	1.371	.499
Variance		3.598	.794	1.879	.249
Skewness		.596	-.048	.047	-.137
Std. Error of Skewness		.105	.099	.099	.099
Kurtosis		-.366	-.784	-1.097	-1.988
Std. Error of Kurtosis		.209	.198	.198	.198
Range		7	3	5	1
Minimum		1	1	1	1
Maximum		8	4	6	2

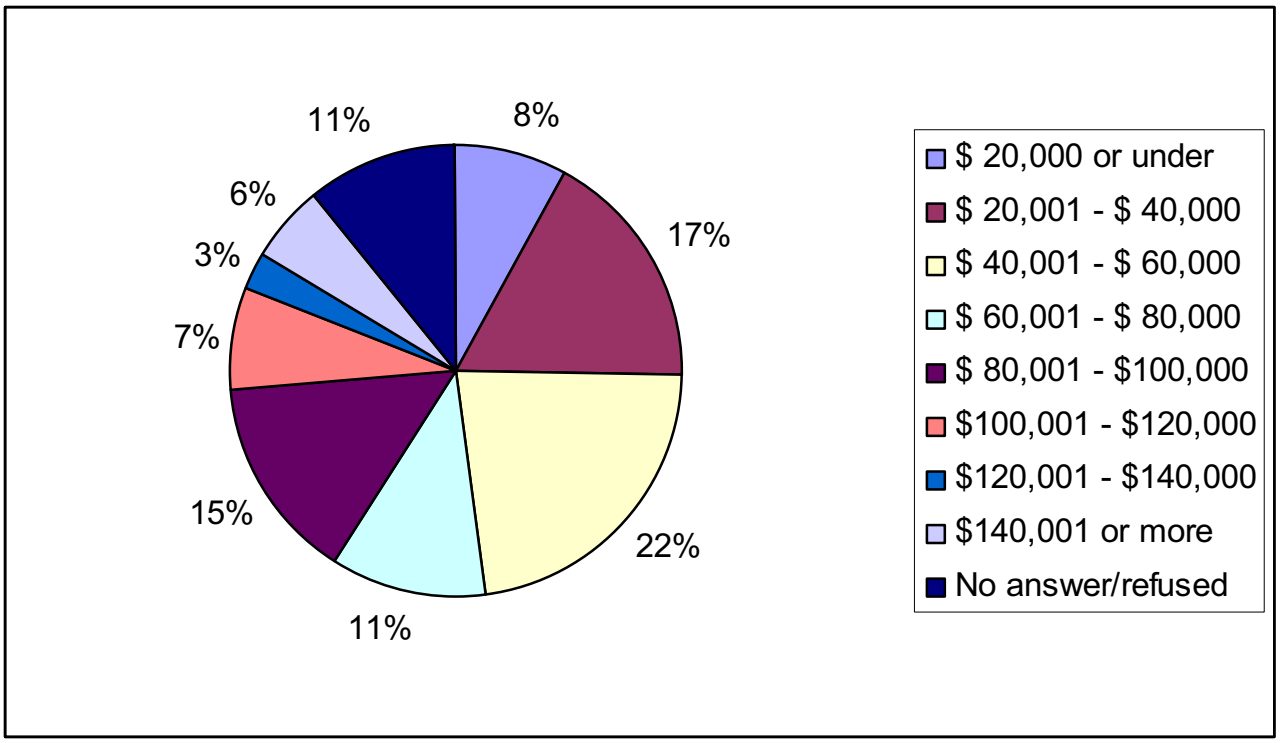
Appendix X
Respondent Demographic Profile

Clark County Tenure	Frequency	Percent
Less than 1 year	25	4.1
1- 5 years	137	22.6
6 - 10 years	151	24.7
11 - 15 years	95	15.7
Over 15 years	157	25.8
All my life	42	6.8
No answer/refused	2	0.3
Total	609	100.0



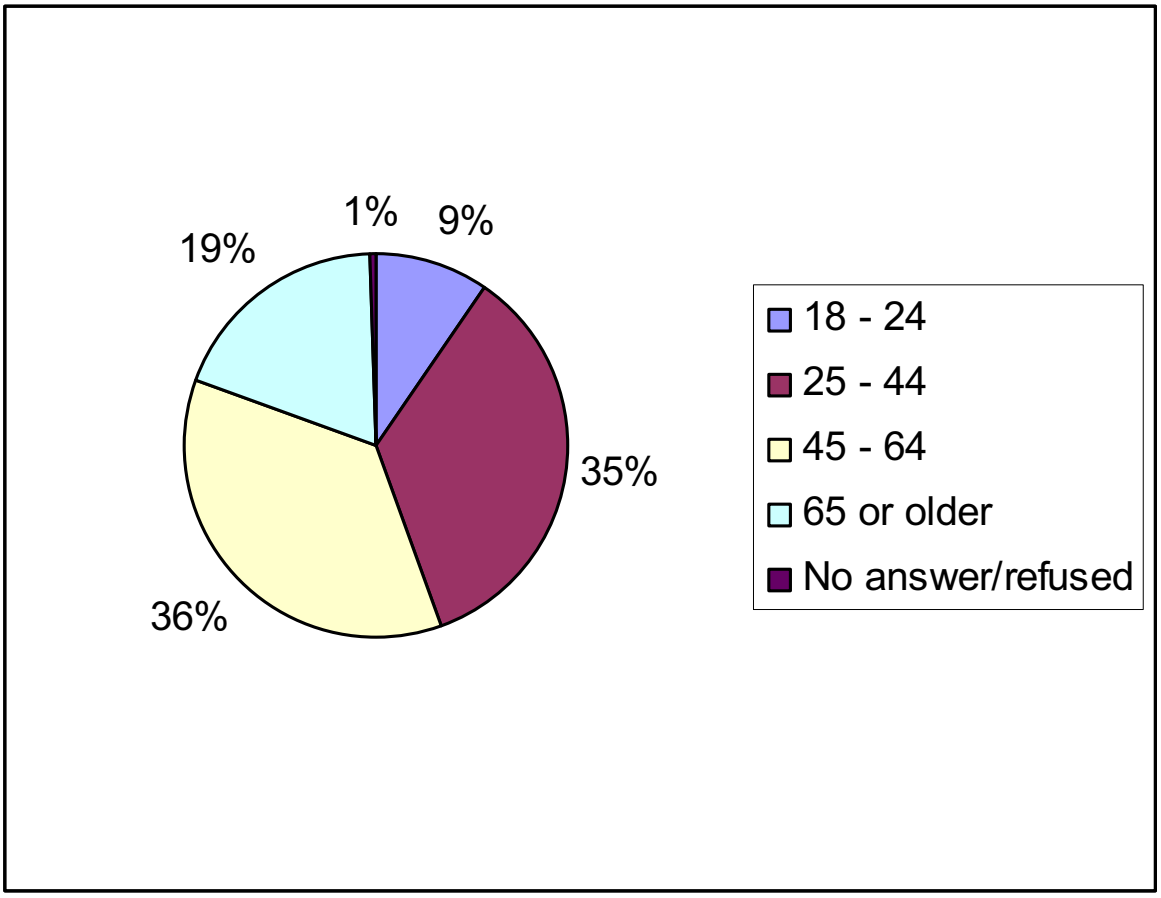
Appendix X
Respondent Demographic Profile

Annual Household Income	Frequency	Percent
$ 20,000 or under	50	8.2
$ 20,001 - $ 40,000	104	17.1
$ 40,001 - $ 60,000	136	22.4
$ 60,001 - $ 80,000	68	11.2
$ 80,001 - $100,000	89	14.7
$100,001 - $120,000	44	7.2
$120,001 - $140,000	17	2.8
$140,001 or more	35	5.8
No answer/refused	65	10.7
Total	609	100.0



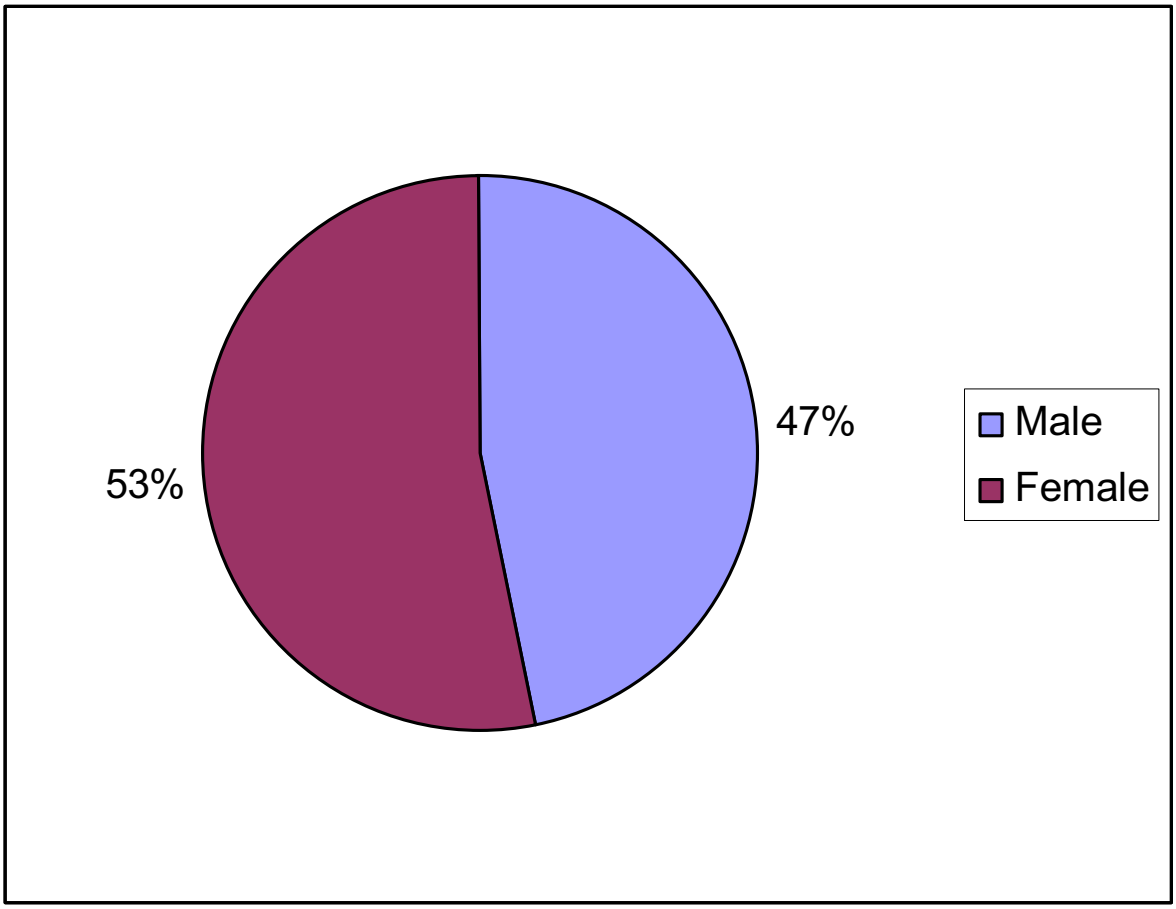
Appendix X
Respondent Demographic Profile

Age	Frequency	Percent
18 - 24	57	9.3
25 - 44	214	35.1
45 - 64	221	36.3
65 or older	114	18.7
No answer/refused	4	0.7
Total	609	100.0



Appendix X
Respondent Demographic Profile

Gender	Frequency	Percent
Male	284	46.6
Female	325	53.4
Total	609	100.0



Appendix X
Respondent Demographic Profile
Summary Statistics by Jurisdiction

Unincorporated Clark County		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	213	242	243	243
	Missing	30	1	0	0
Mean		3.98	2.70	3.54	1.50
Std. Error of Mean		.126	.056	.085	.032
Median		4.00	3.00	3.00	1.32
Std. Deviation		1.835	.874	1.330	.501
Variance		3.367	.765	1.768	.251
Skewness		.522	-.058	.062	.003
Std. Error of Skewness		.167	.157	.156	.156
Kurtosis		-.381	-.774	-1.086	-2.017
Std. Error of Kurtosis		.332	.312	.311	.311
Range		7	3	5	1
Minimum		1	1	1	1
Maximum		8	4	6	2

Appendix X
Respondent Demographic Profile
Summary Statistics by Jurisdiction

City of Las Vegas		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	178	194	197	197
	Missing	19	3	0	0
Mean		3.47	2.55	3.73	1.60
Std. Error of Mean		.143	.066	.102	.035
Median		3.00	3.00	4.00	2.00
Std. Deviation		1.908	.919	1.427	.492
Variance		3.639	.845	2.036	.242
Skewness		.673	.003	-.064	-.393
Std. Error of Skewness		.182	.174	.173	.173
Kurtosis		-.344	-.819	-1.082	-1.865
Std. Error of Kurtosis		.362	.347	.345	.345
Range		7	3	5	1
Minimum		1	1	1	1
Maximum		8	4	6	2

Appendix X
Respondent Demographic Profile
Summary Statistics by Jurisdiction

City of North Las Vegas		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	66	72	72	72
	Missing	5	0	0	0
Mean		3.69	2.32	3.25	1.54
Std. Error of Mean		.217	.098	.165	.059
Median		3.00	2.00	3.00	2.00
Std. Deviation		1.764	.828	1.397	.502
Variance		3.113	.685	1.951	.252
Skewness		.716	.377	.331	-.144
Std. Error of Skewness		.294	.283	.283	.283
Kurtosis		-.010	-.258	-.886	-2.037
Std. Error of Kurtosis		.581	.560	.560	.560
Range		7	3	5	1
Minimum		1	1	1	1
Maximum		8	4	6	2

Appendix X
Respondent Demographic Profile
Summary Statistics by Jurisdiction

City of Henderson		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	73	84	82	84
	Missing	11	0	2	0
Mean		3.95	2.88	3.48	1.49
Std. Error of Mean		.237	.089	.145	.055
Median		3.00	3.00	3.00	1.03
Std. Deviation		2.033	.818	1.313	.503
Variance		4.132	.669	1.725	.253
Skewness		.643	-.300	.030	.023
Std. Error of Skewness		.280	.263	.265	.263
Kurtosis		-.365	-.435	-1.261	-2.049
Std. Error of Kurtosis		.554	.520	.524	.520
Range		7	3	5	1
Minimum		1	1	1	1
Maximum		8	4	6	2

Appendix X
Respondent Demographic Profile
Summary Statistics by Jurisdiction

City of Boulder City		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	8	8	8	8
	Missing	0	0	0	0
Mean		3.73	3.40	4.68	1.45
Std. Error of Mean		.788	.189	.302	.192
Median		3.14	3.00	5.00	1.09
Std. Deviation		2.185	.525	.838	.533
Variance		4.775	.276	.703	.284
Skewness		.915	.522	-1.084	.273
Std. Error of Skewness		.764	.764	.764	.764
Kurtosis		1.053	-2.479	2.111	-2.750
Std. Error of Kurtosis		1.510	1.510	1.510	1.510
Range		7	1	3	1
Minimum		1	3	3	1
Maximum		8	4	6	2

Appendix X
Respondent Demographic Profile
Summary Statistics by Jurisdiction

City of Mesquite		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	6	6	6	6
	Missing	0	0	0	0
Mean		3.67	3.43	2.90	1.58
Std. Error of Mean		1.084	.363	.379	.223
Median		2.99	4.00	3.00	1.95
Std. Deviation		2.640	.885	.924	.542
Variance		6.969	.783	.854	.294
Skewness		.758	-1.264	1.691	-.427
Std. Error of Skewness		.849	.849	.849	.849
Kurtosis		-.736	.062	6.697	-3.079
Std. Error of Kurtosis		1.754	1.754	1.754	1.754
Range		7	2	3	1
Minimum		1	2	2	1
Maximum		8	4	5	2

Appendix X
Respondent Demographic Profile
Jurisdictional Cross-tabulations

Jurisdiction * Which category best describes your total household income before taxes?

			Which category best describes your total household income before taxes?								Total
			$ 20,000 or under	$ 20,001 - $ 40,000	$ 40,001 - $ 60,000	$ 60,001 - $ 80,000	$ 80,001 - $100,000	$100,001 - $120,000	$120,001 - $140,000	$140,001 or more	
Jurisdiction	Unincorporated Clark County	Count	11	38	51	32	40	21	6	15	214
		% within Jurisdiction	5.1%	17.8%	23.8%	15.0%	18.7%	9.8%	2.8%	7.0%	100.0%
	City of Las Vegas	Count	26	38	44	19	22	14	8	7	178
		% within Jurisdiction	14.6%	21.3%	24.7%	10.7%	12.4%	7.9%	4.5%	3.9%	100.0%
	City of North Las Vegas	Count	4	16	17	7	13	5	1	4	67
		% within Jurisdiction	6.0%	23.9%	25.4%	10.4%	19.4%	7.5%	1.5%	6.0%	100.0%
	City of Henderson	Count	7	10	21	10	12	4	2	8	74
		% within Jurisdiction	9.5%	13.5%	28.4%	13.5%	16.2%	5.4%	2.7%	10.8%	100.0%
	Boulder City	Count	1	2	2	1	2	0	0	1	9
		% within Jurisdiction	11.1%	22.2%	22.2%	11.1%	22.2%	.0%	.0%	11.1%	100.0%
	Mesquite	Count	1	2	1	0	1	0	1	1	7
		% within Jurisdiction	14.3%	28.6%	14.3%	.0%	14.3%	.0%	14.3%	14.3%	100.0%
Total		Count	50	106	136	69	90	44	18	36	549
		% within Jurisdiction	9.1%	19.3%	24.8%	12.6%	16.4%	8.0%	3.3%	6.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	32.408(a)	35	.594
Likelihood Ratio	33.586	35	.536
Linear-by-Linear Association	.200	1	.655
N of Valid Cases	549		

a 20 cells (41.7%) have expected count less than 5. The minimum expected count is .23.

Appendix X
Respondent Demographic Profile
Jurisdictional Cross-tabulations

Jurisdiction * In what age group do you fall?

			In what age group do you fall?				Total
			18 - 24	25 - 44	45 - 64	65 or older	
Jurisdiction	Unincorporated Clark County	Count	18	85	90	49	242
		% within Jurisdiction	7.4%	35.1%	37.2%	20.2%	100.0%
	City of Las Vegas	Count	25	70	67	32	194
		% within Jurisdiction	12.9%	36.1%	34.5%	16.5%	100.0%
	City of North Las Vegas	Count	10	36	19	7	72
		% within Jurisdiction	13.9%	50.0%	26.4%	9.7%	100.0%
	City of Henderson	Count	4	22	39	19	84
		% within Jurisdiction	4.8%	26.2%	46.4%	22.6%	100.0%
	Boulder City	Count	0	0	5	3	8
		% within Jurisdiction	.0%	.0%	62.5%	37.5%	100.0%
	Mesquite	Count	0	1	1	4	6
		% within Jurisdiction	.0%	16.7%	16.7%	66.7%	100.0%
Total		Count	57	214	221	114	606
		% within Jurisdiction	9.4%	35.3%	36.5%	18.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	38.178(a)	15	.001
Likelihood Ratio	39.541	15	.001
Linear-by-Linear Association	2.261	1	.133
N of Valid Cases	606		

a 8 cells (33.3%) have expected count less than 5. The minimum expected count is .56.

Appendix X
Respondent Demographic Profile
Jurisdictional Cross-tabulations

Jurisdiction * How long have you lived in Clark County?

			How long have you lived in Clark County?						Total
			Less than 1 year	1- 5 years	6 - 10 years	11 - 15 years	Over 15 years	All my life	
Jurisdiction	Unincorporated Clark County	Count	9	56	62	40	63	13	243
		% within Jurisdiction	3.7%	23.0%	25.5%	16.5%	25.9%	5.3%	100.0%
	City of Las Vegas	Count	9	38	45	32	51	22	197
		% within Jurisdiction	4.6%	19.3%	22.8%	16.2%	25.9%	11.2%	100.0%
	City of North Las Vegas	Count	6	19	21	7	14	4	71
		% within Jurisdiction	8.5%	26.8%	29.6%	9.9%	19.7%	5.6%	100.0%
	City of Henderson	Count	2	23	18	14	23	2	82
		% within Jurisdiction	2.4%	28.0%	22.0%	17.1%	28.0%	2.4%	100.0%
	Boulder City	Count	0	0	1	1	5	1	8
		% within Jurisdiction	.0%	.0%	12.5%	12.5%	62.5%	12.5%	100.0%
	Mesquite	Count	0	2	3	0	1	0	6
		% within Jurisdiction	.0%	33.3%	50.0%	.0%	16.7%	.0%	100.0%
Total		Count	26	138	150	94	157	42	607
		% within Jurisdiction	4.3%	22.7%	24.7%	15.5%	25.9%	6.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	29.992(a)	25	.225
Likelihood Ratio	32.027	25	.157
Linear-by-Linear Association	.204	1	.651
N of Valid Cases	607		

a 15 cells (41.7%) have expected count less than 5. The minimum expected count is .26.

Appendix X
Respondent Demographic Profile
Jurisdictional Cross-tabulations

Jurisdiction * Gender observation:

			Gender observation:		Total
			Male	Female	
Jurisdiction	Unincorporated Clark County	Count	121	121	242
		% within Jurisdiction	50.0%	50.0%	100.0%
	City of Las Vegas	Count	80	117	197
		% within Jurisdiction	40.6%	59.4%	100.0%
	City of North Las Vegas	Count	33	38	71
		% within Jurisdiction	46.5%	53.5%	100.0%
	City of Henderson	Count	42	42	84
		% within Jurisdiction	50.0%	50.0%	100.0%
	Boulder City	Count	4	3	7
		% within Jurisdiction	57.1%	42.9%	100.0%
	Mesquite	Count	3	3	6
		% within Jurisdiction	50.0%	50.0%	100.0%
Total		Count	283	324	607
		% within Jurisdiction	46.6%	53.4%	100.0%

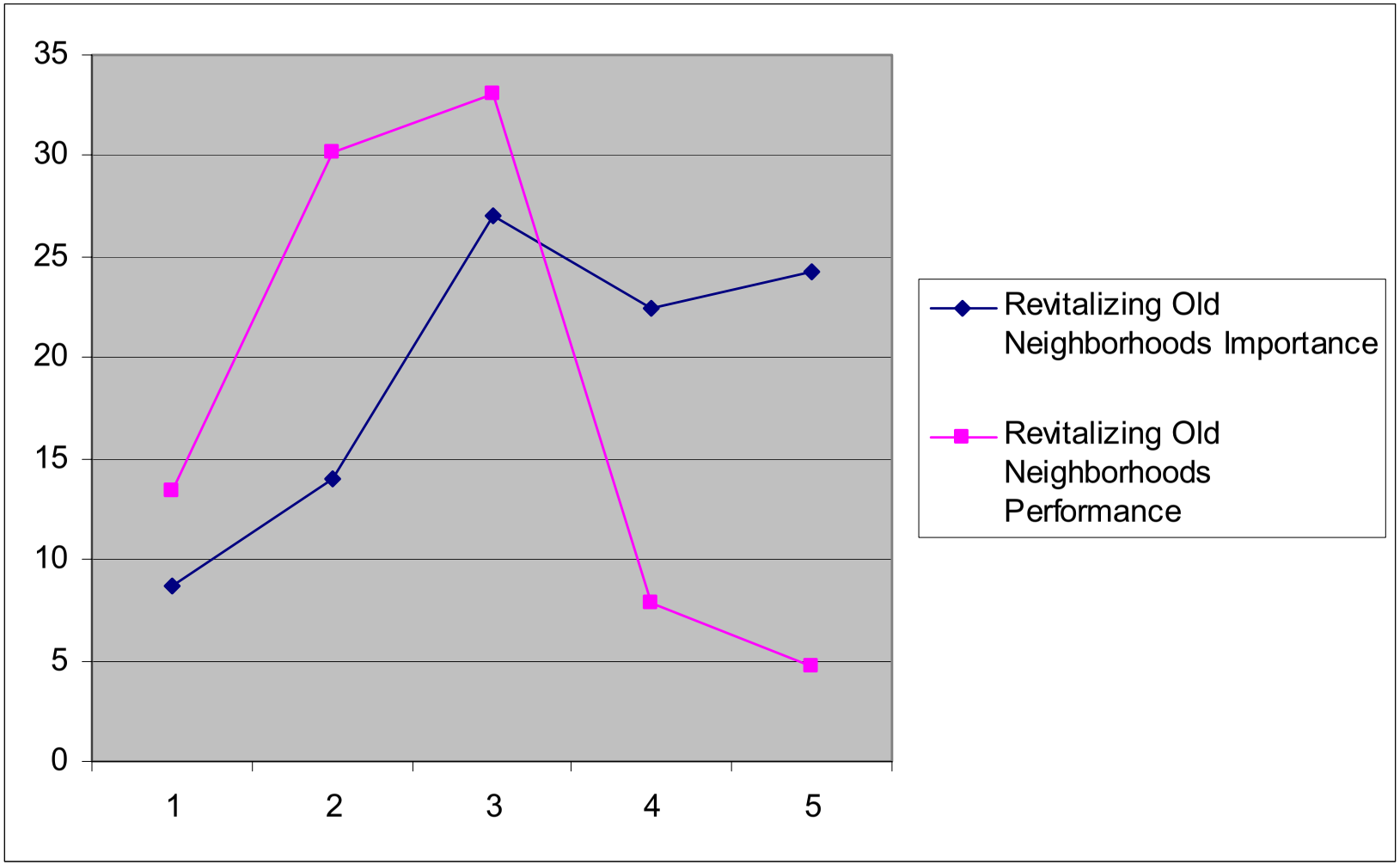
Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.696(a)	5	.454
Likelihood Ratio	4.715	5	.452
Linear-by-Linear Association	.001	1	.976
N of Valid Cases	607		

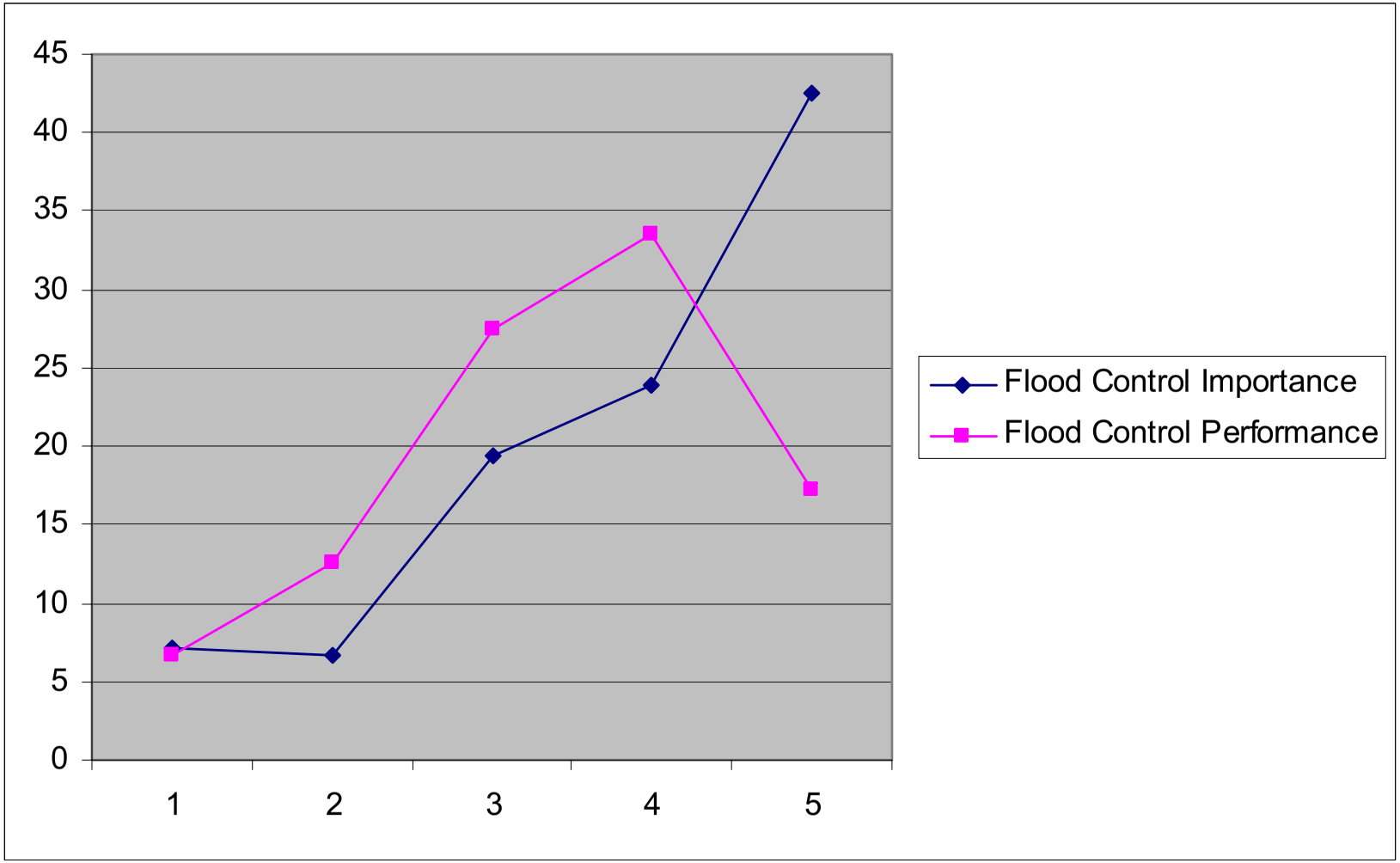
a 4 cells (33.3%) have expected count less than 5. The minimum expected count is 2.80.

Appendix XI
Importance/Performance Comparisons

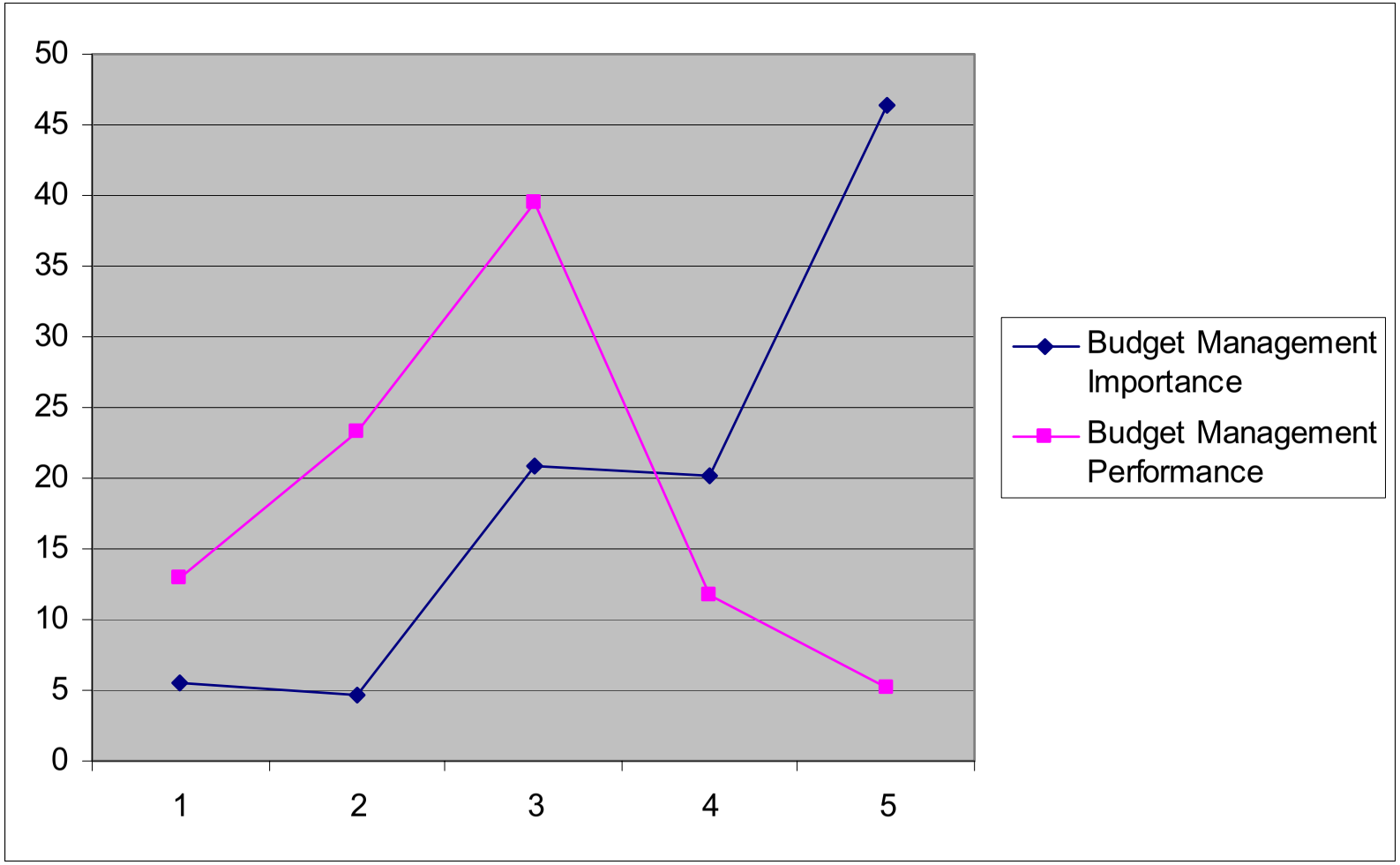
Appendix XI
Importance/Performance Comparisons



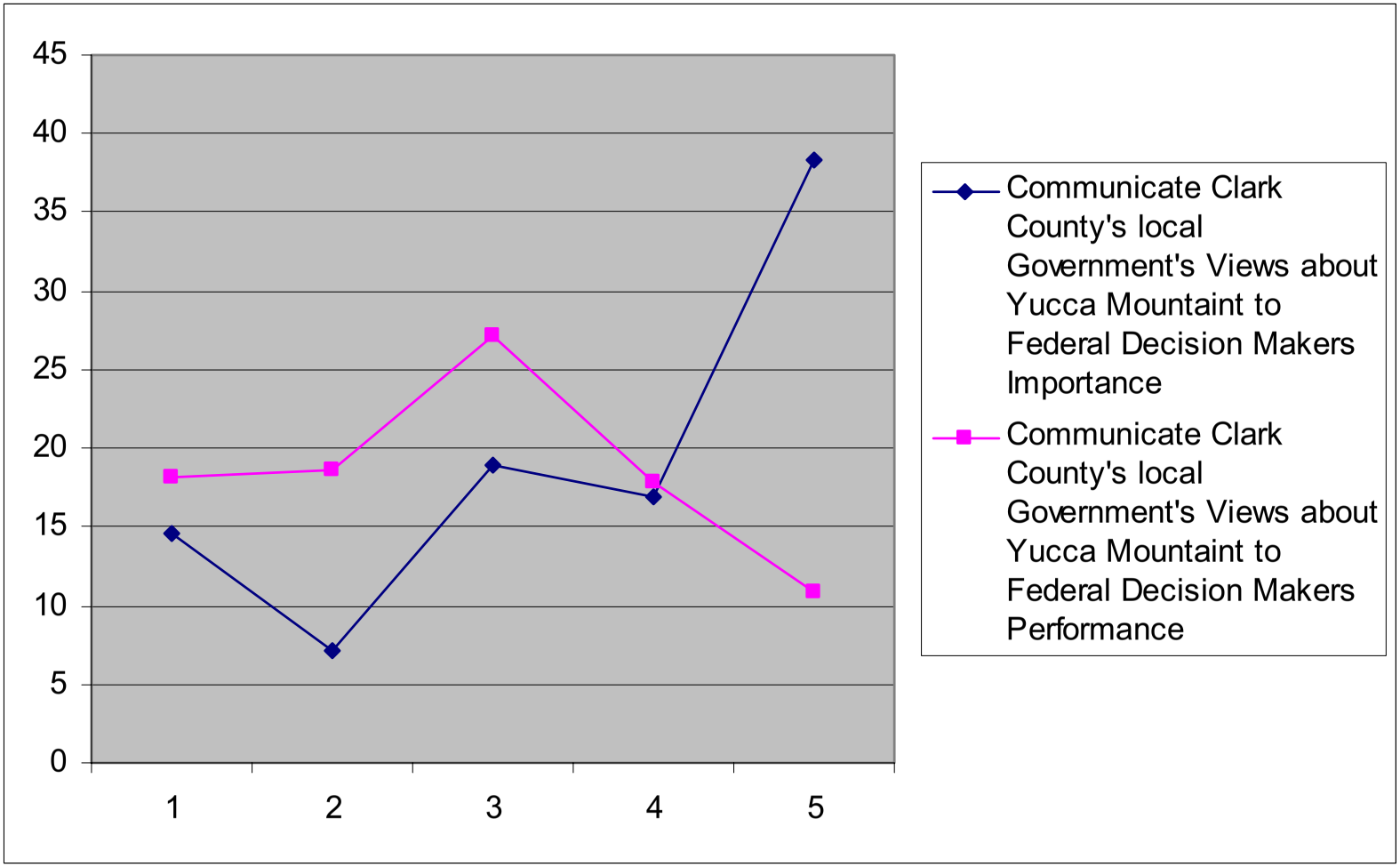
Appendix XI
Importance/Performance Comparisons



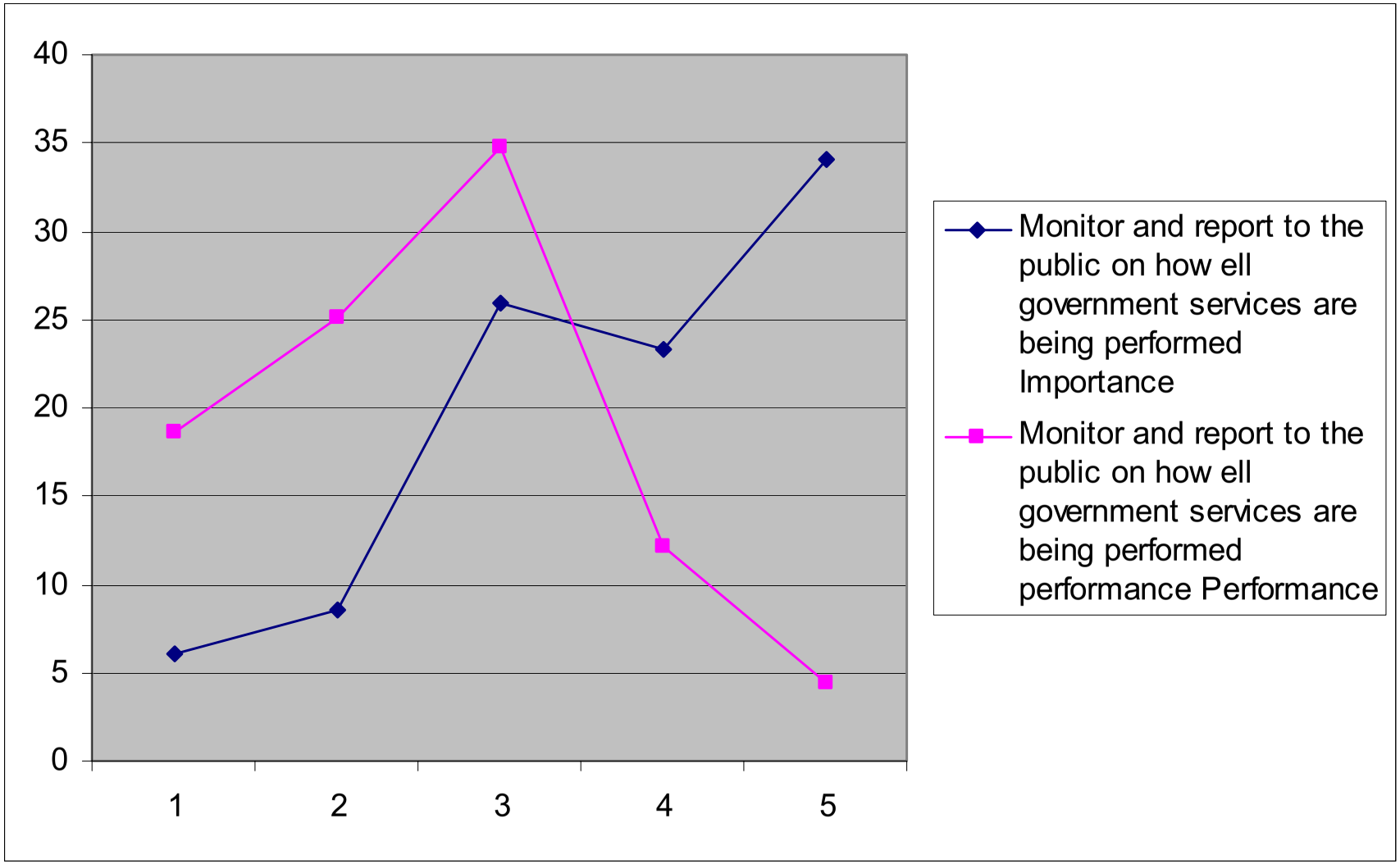
Appendix XI
Importance/Performance Comparisons

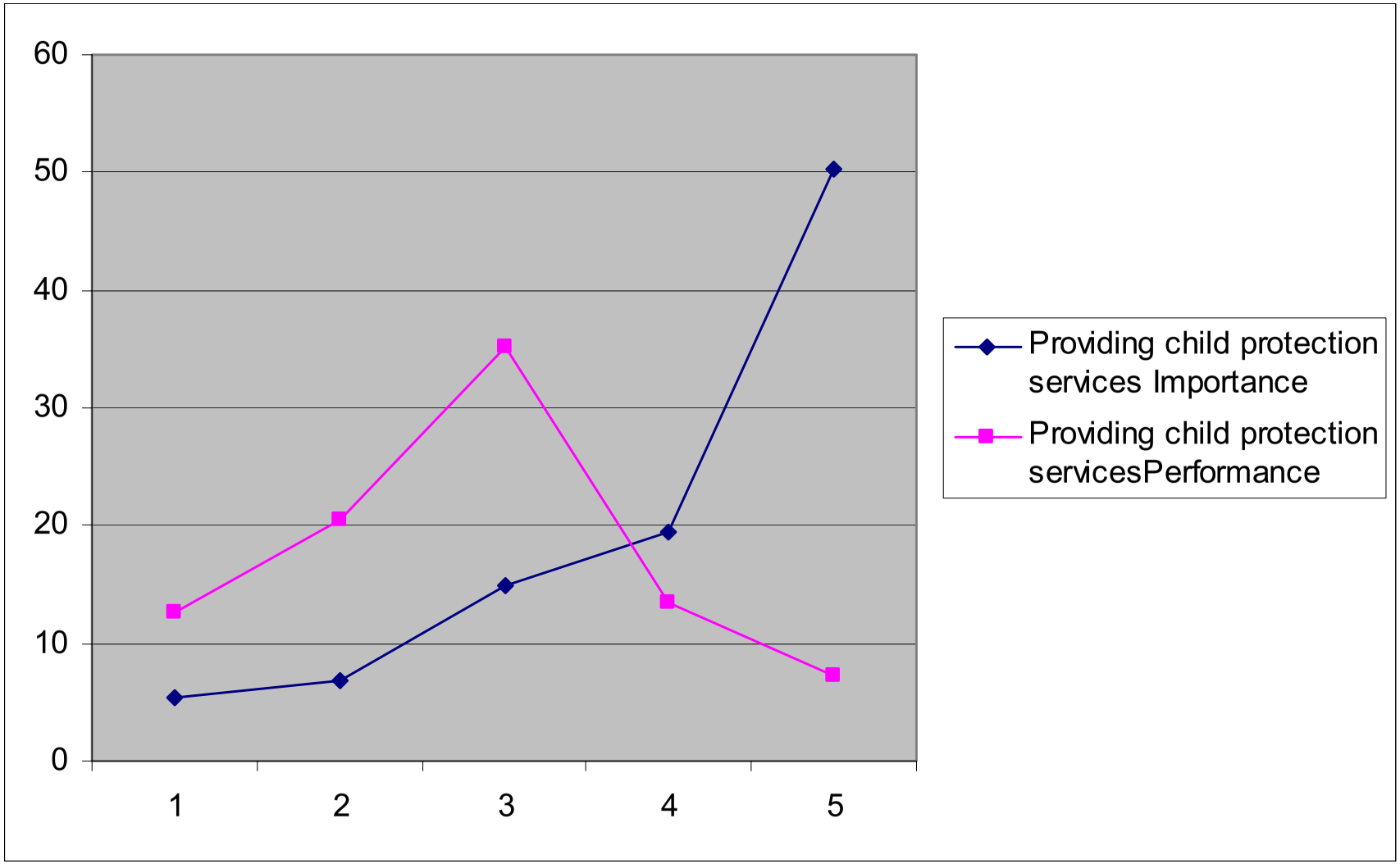


Appendix XI
Importance/Performance Comparisons



Appendix XI
Importance/Performance Comparisons

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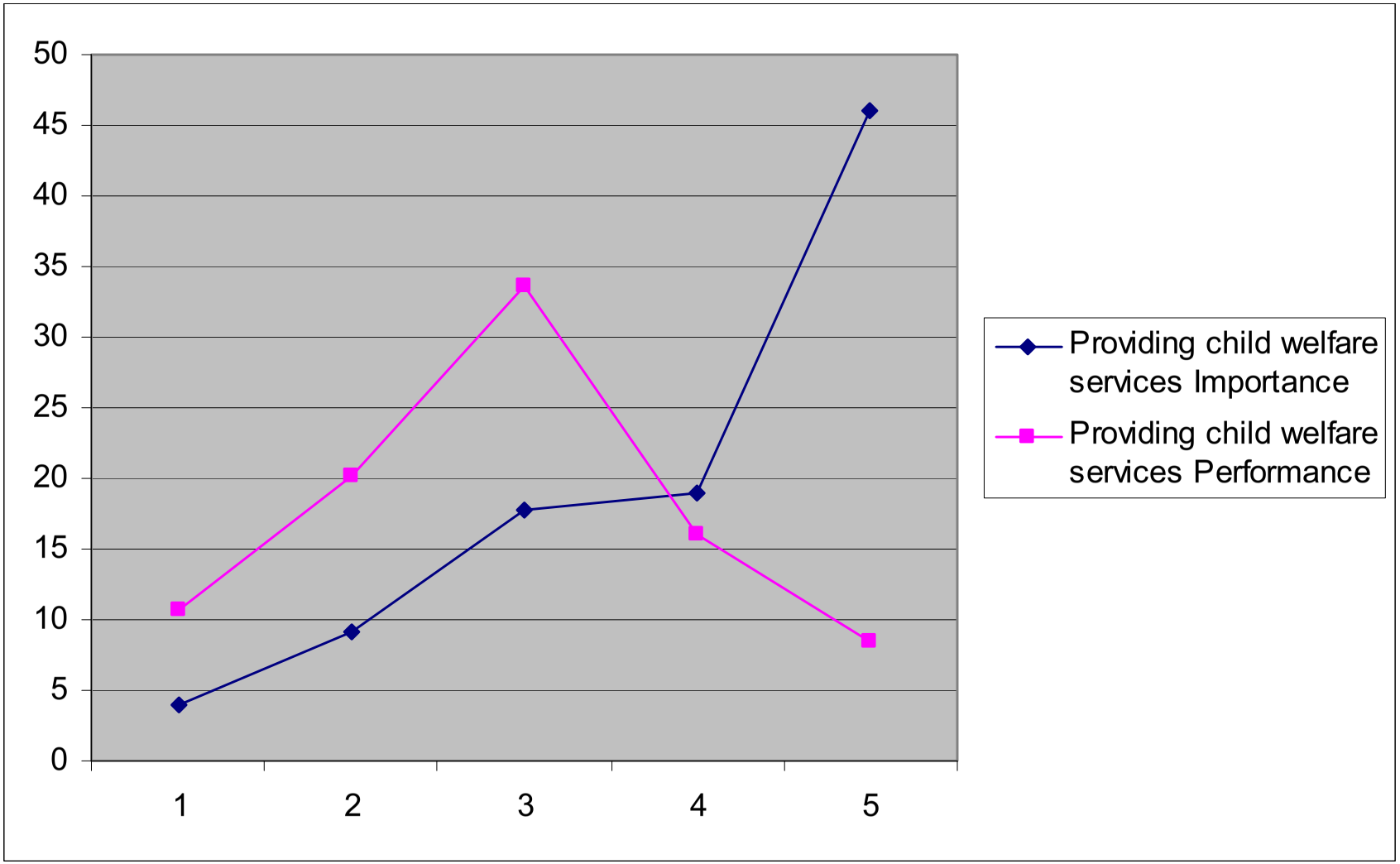
Providing child protection services Importance
Providing child protection servicesPerformance

Appendix XI
Importance/Performance Comparisons



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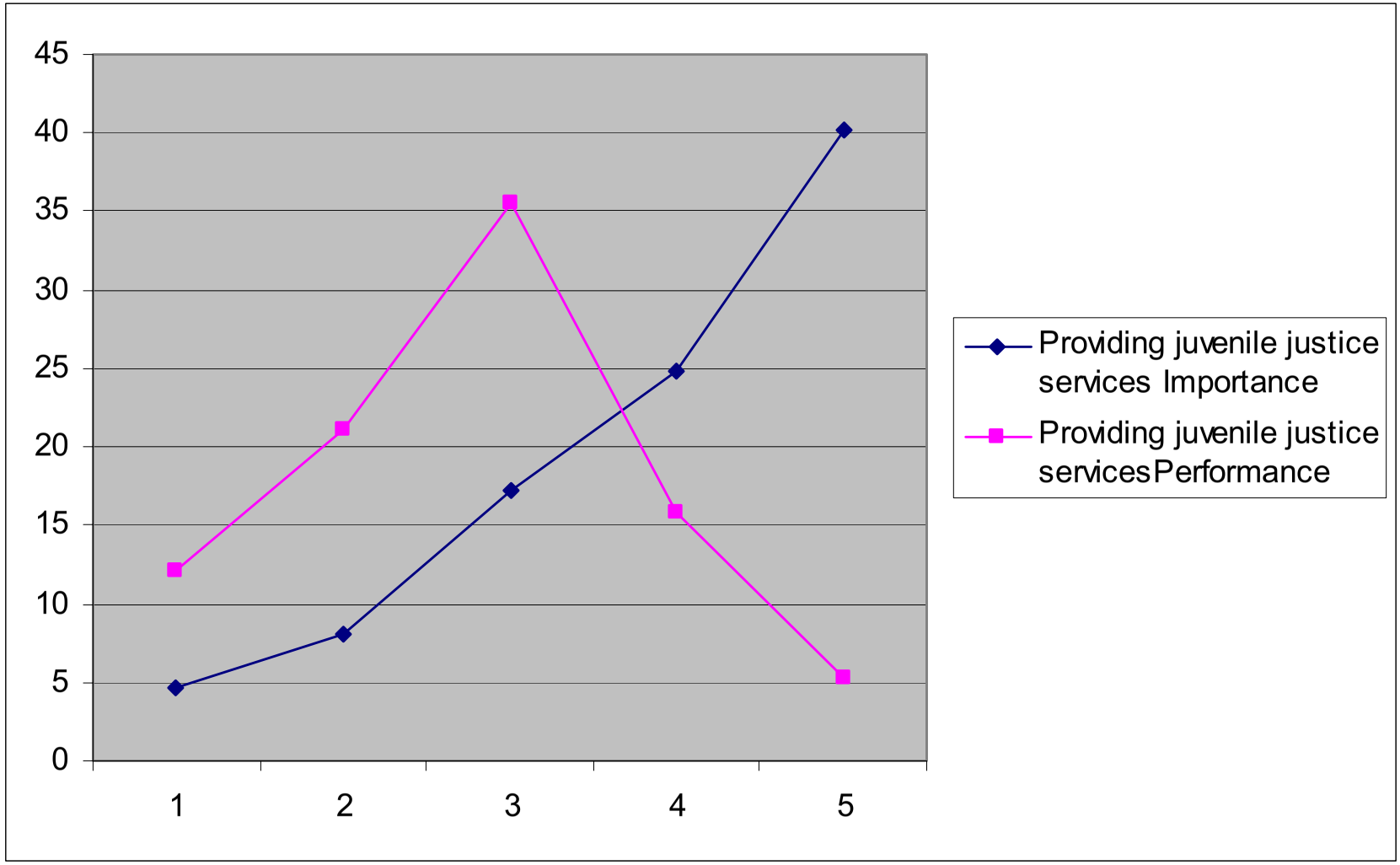
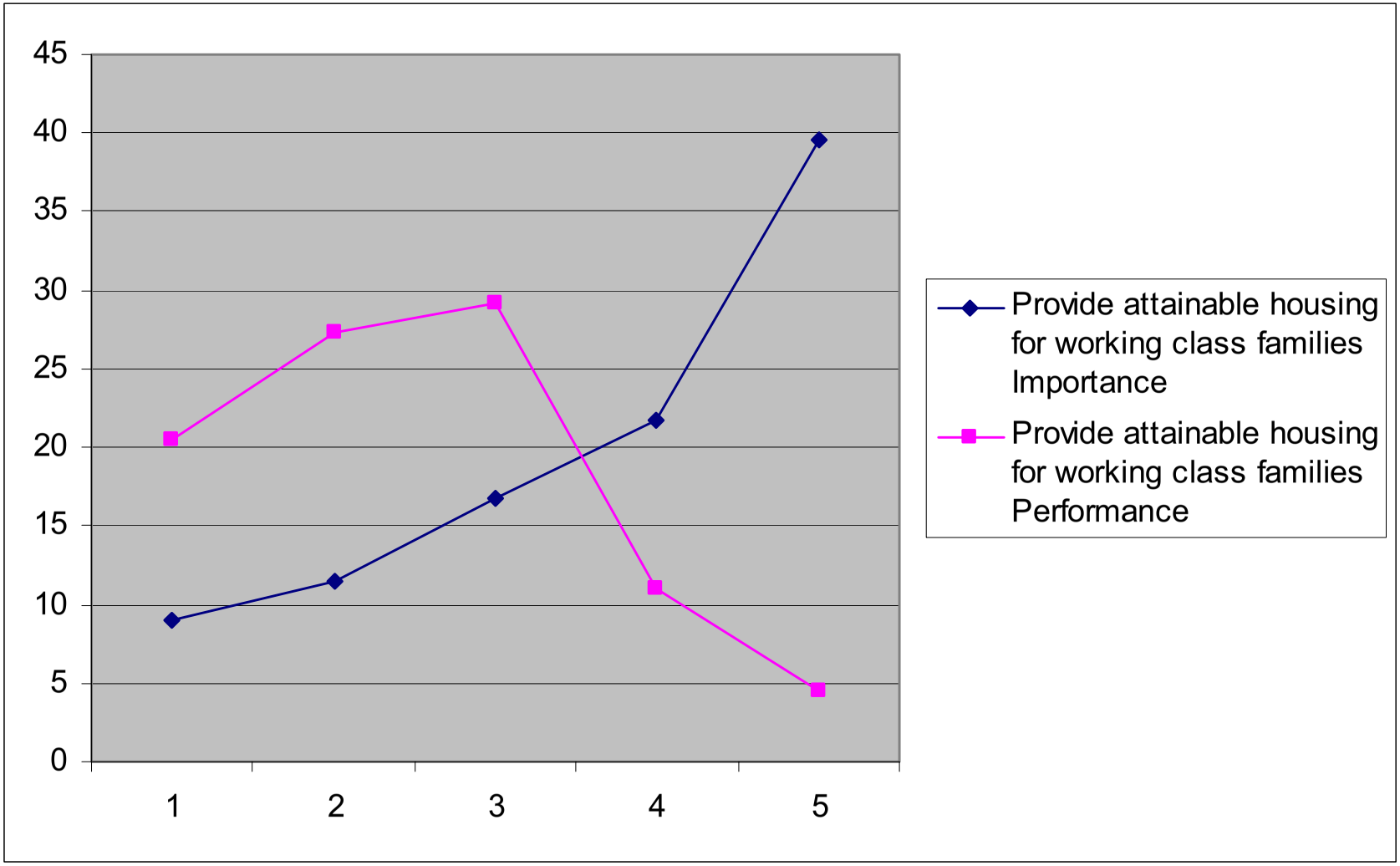
Importance/Performance Comparisons

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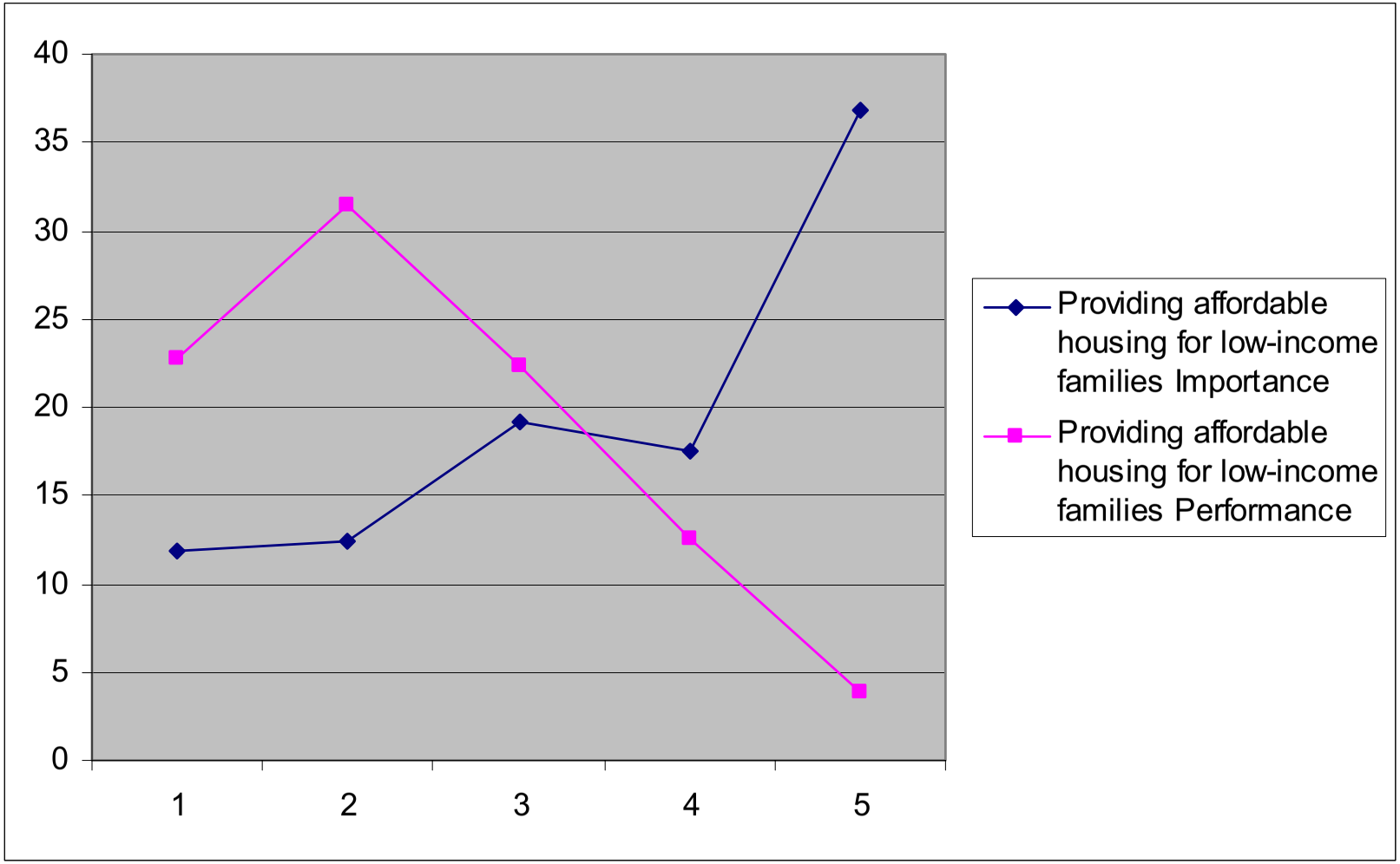
Provide attainable housing for working class families Importance
Provide attainable housing for working class families Performance

Appendix XI
Importance/Performance Comparisons



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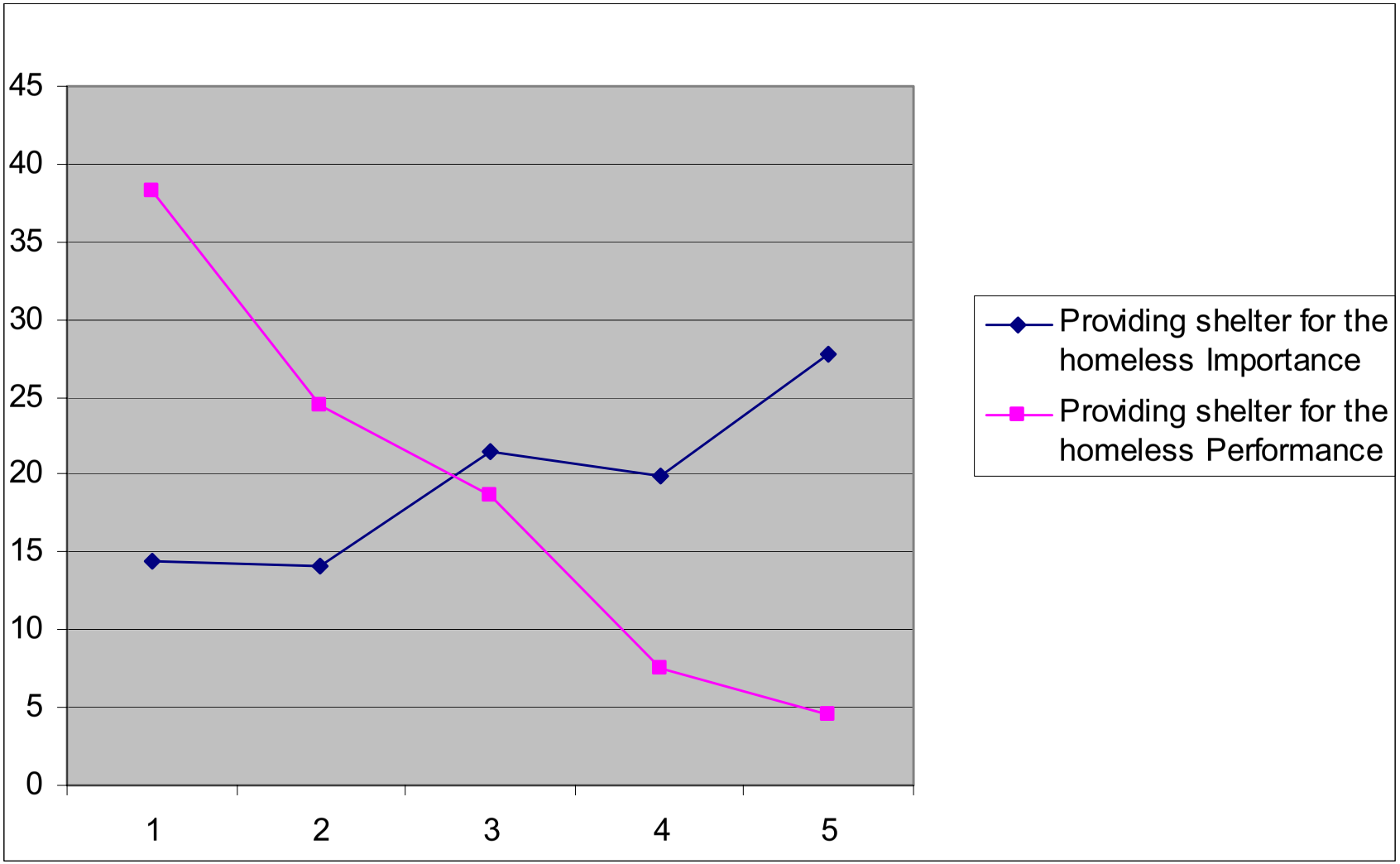
Importance/Performance Comparisons



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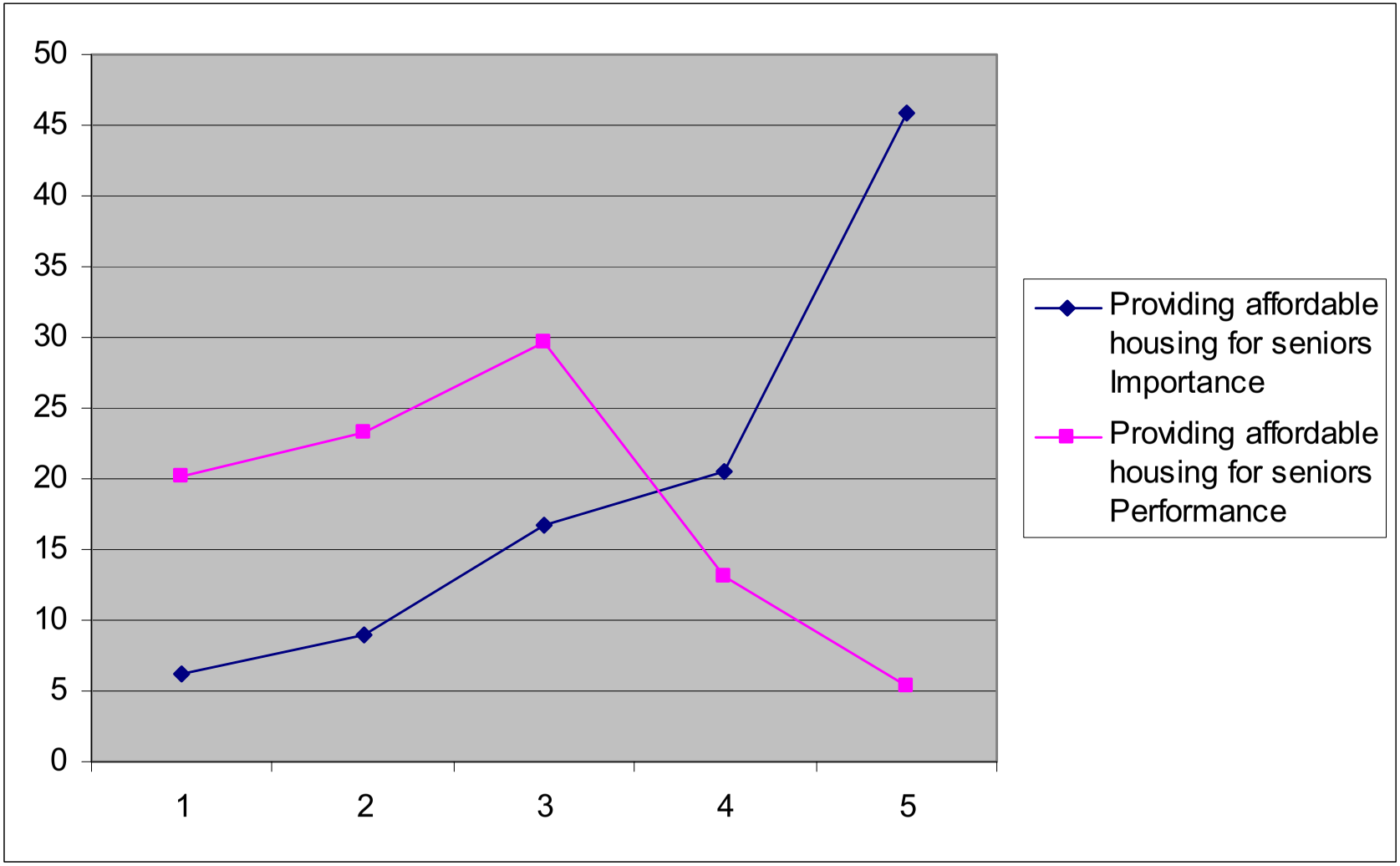

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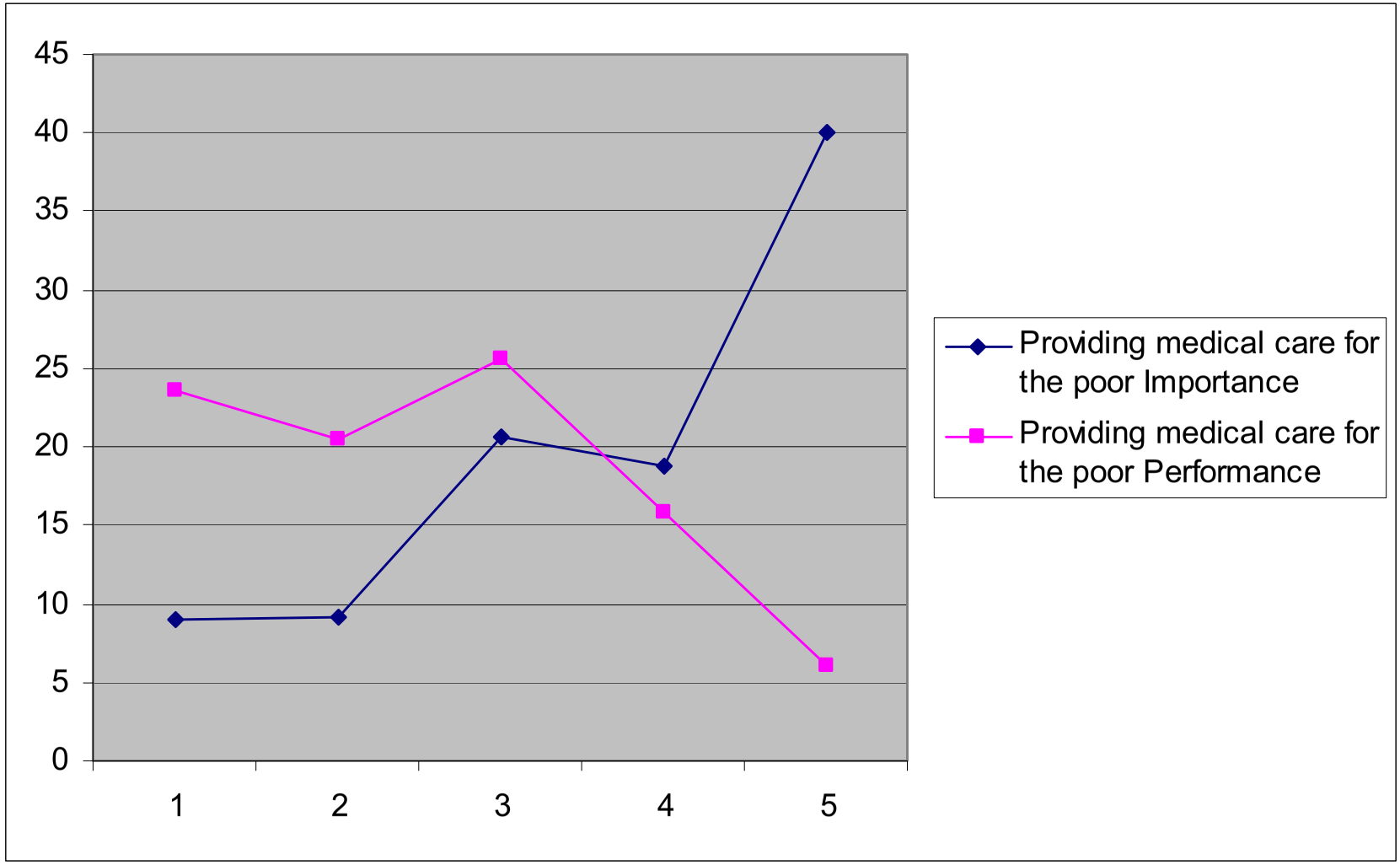
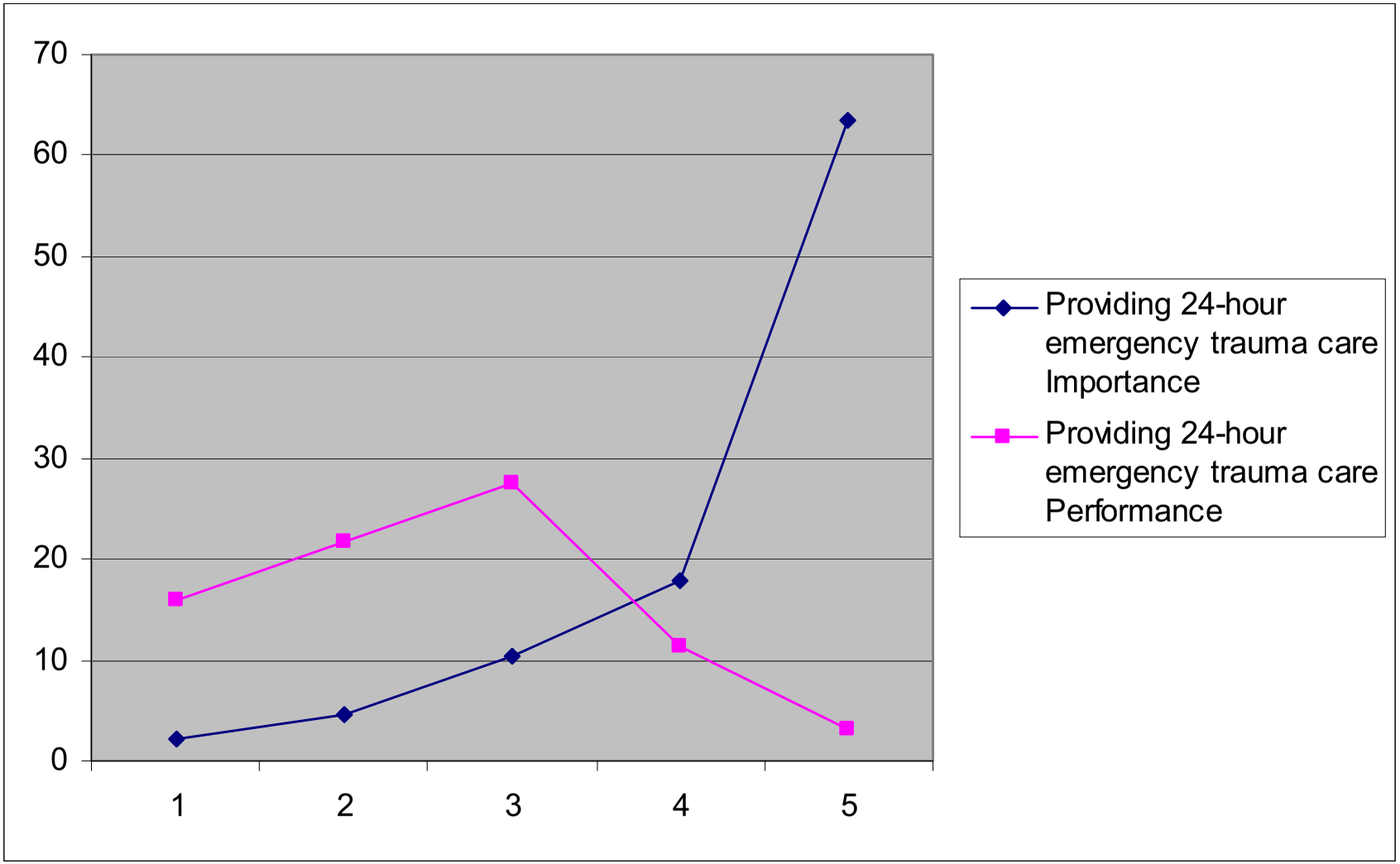
Importance/Performance Comparisons



Appendix XI
Importance/Performance Comparisons



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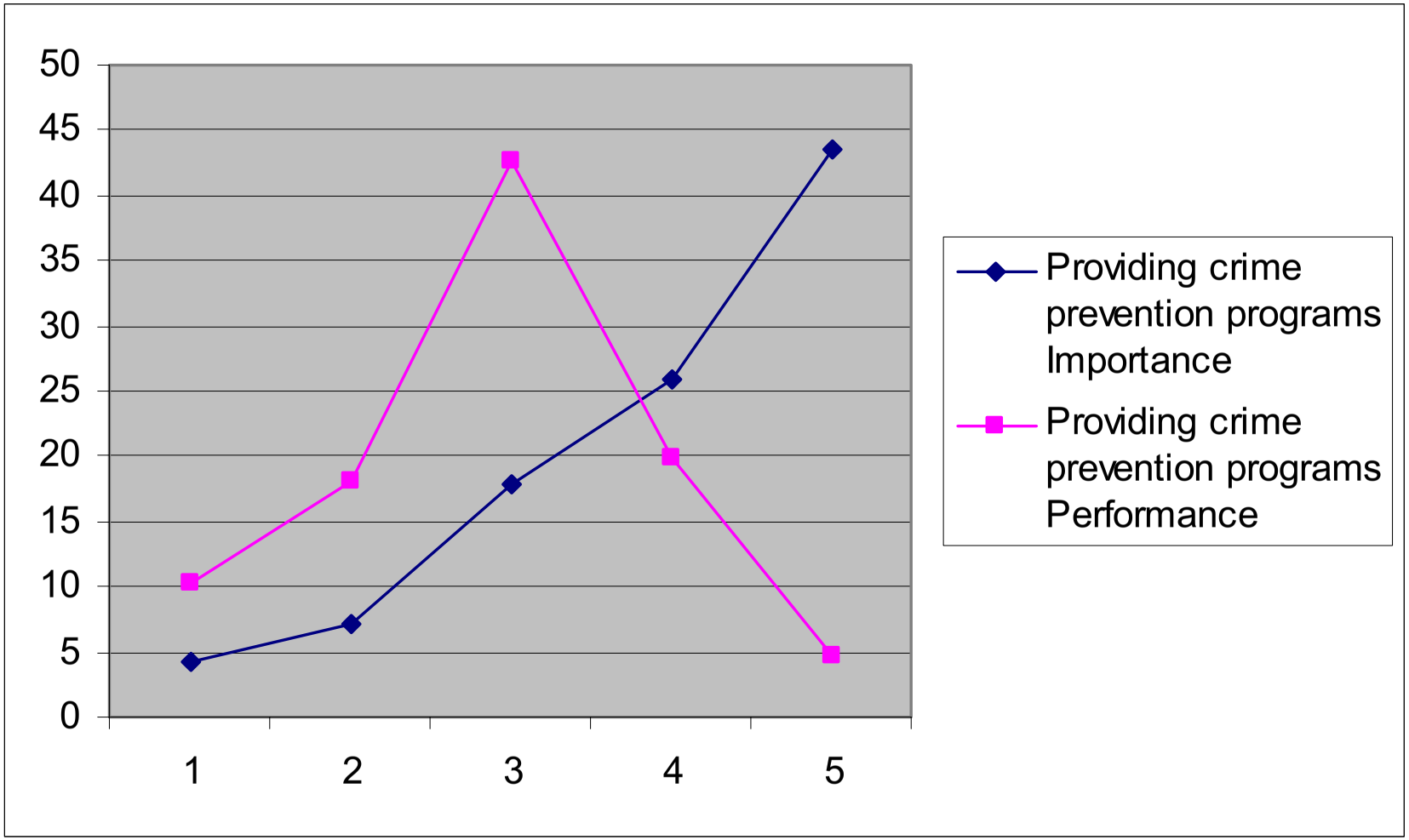

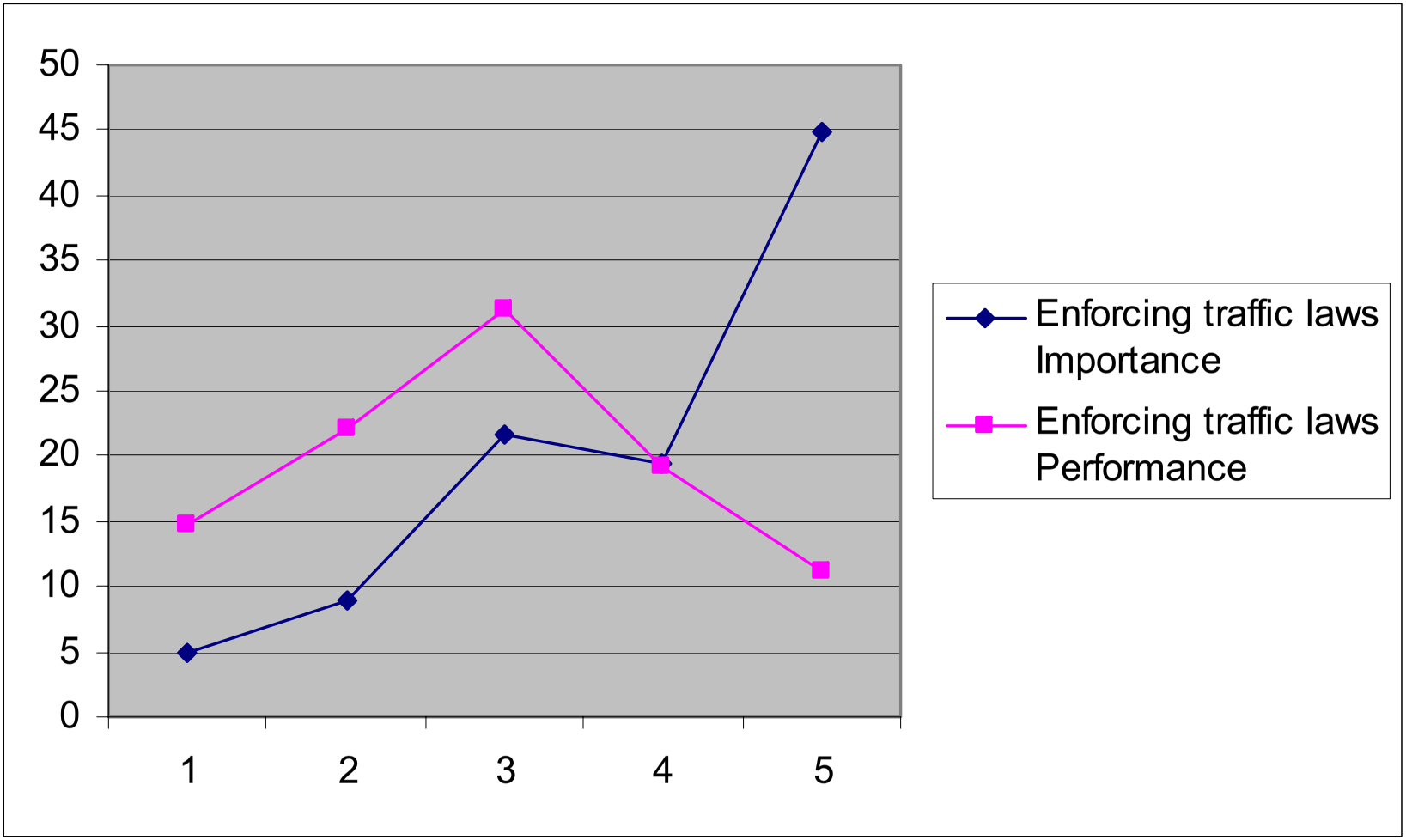

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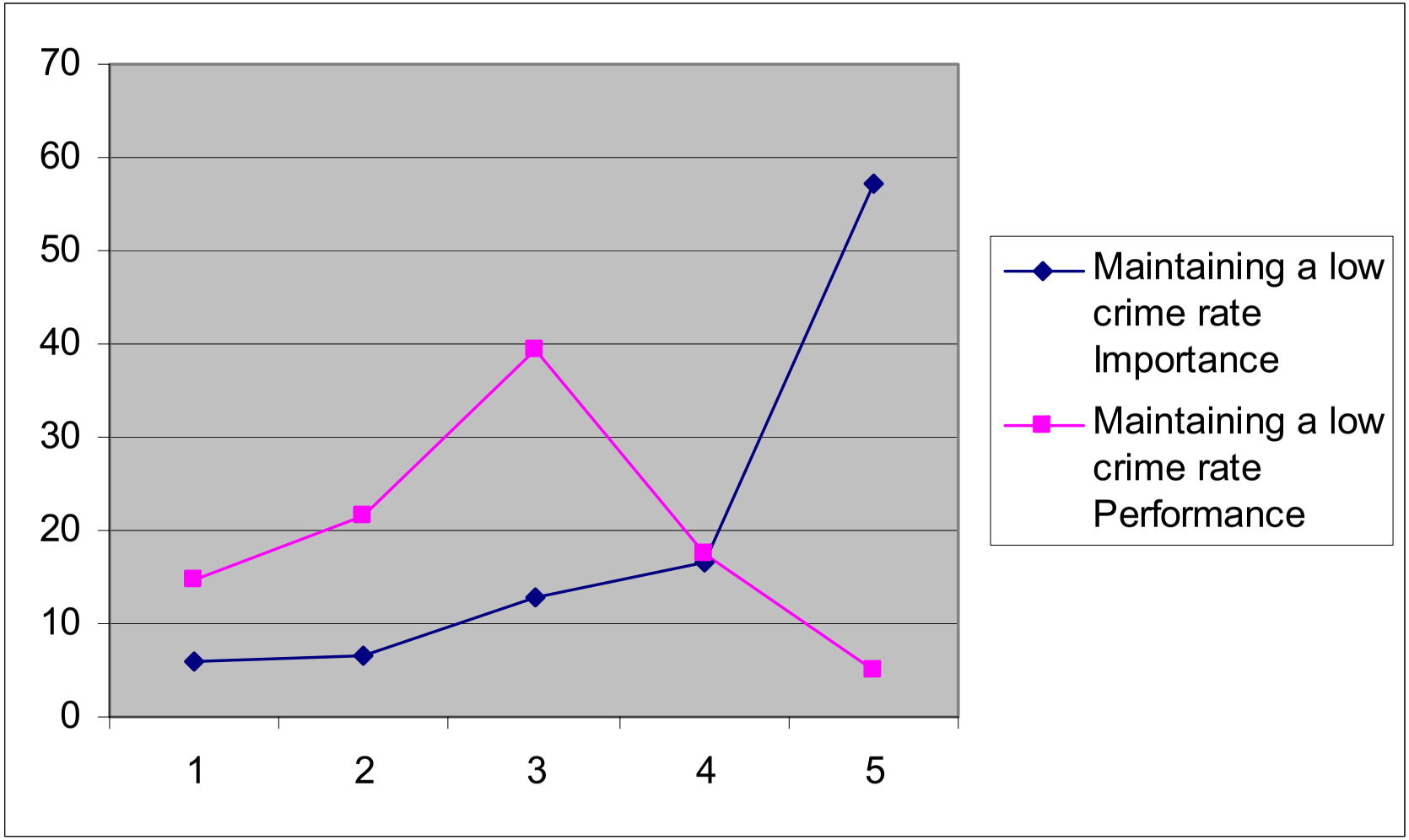
Importance/Performance Comparisons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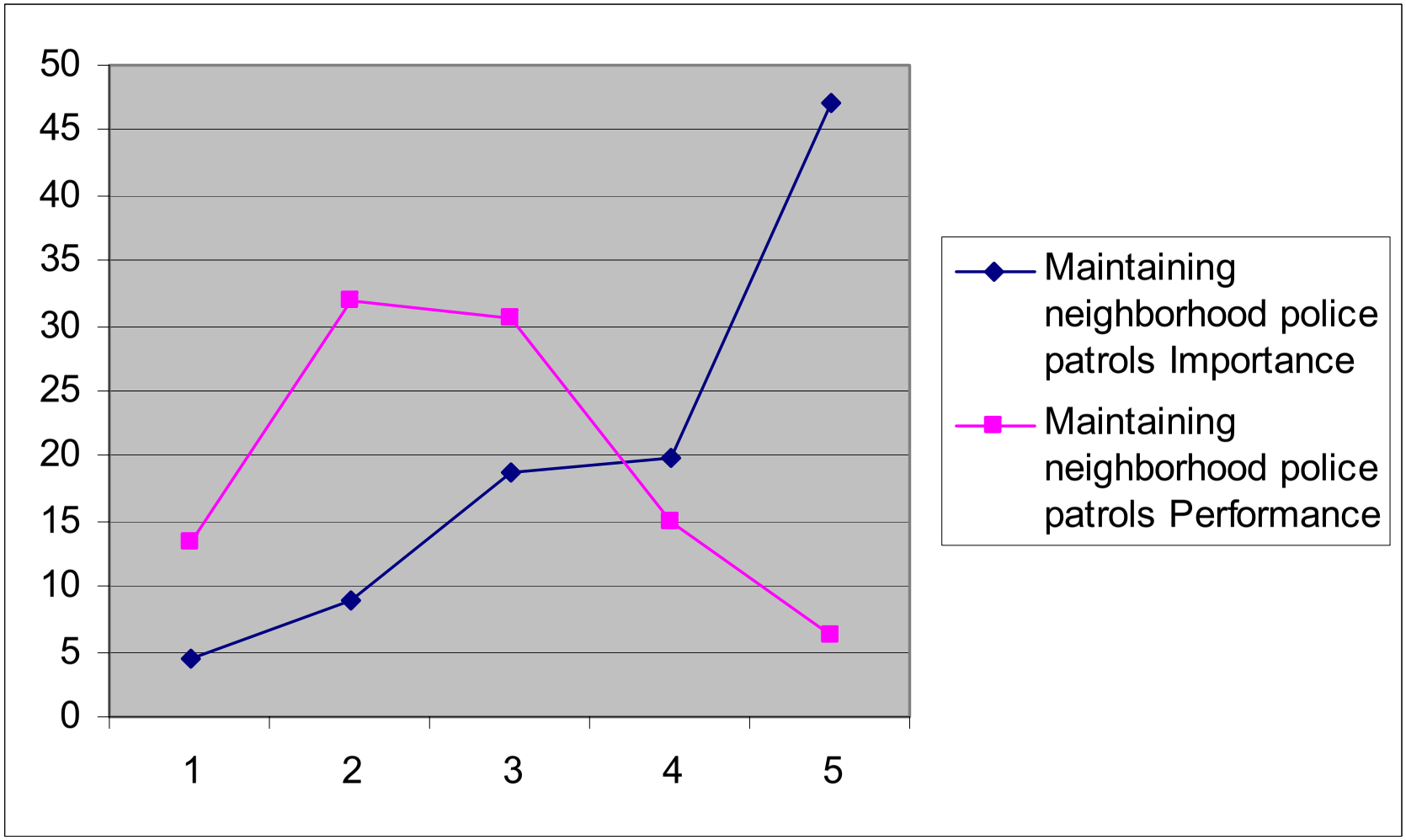
Maintaining a low crime rate Importance
Maintaining a low crime rate Performance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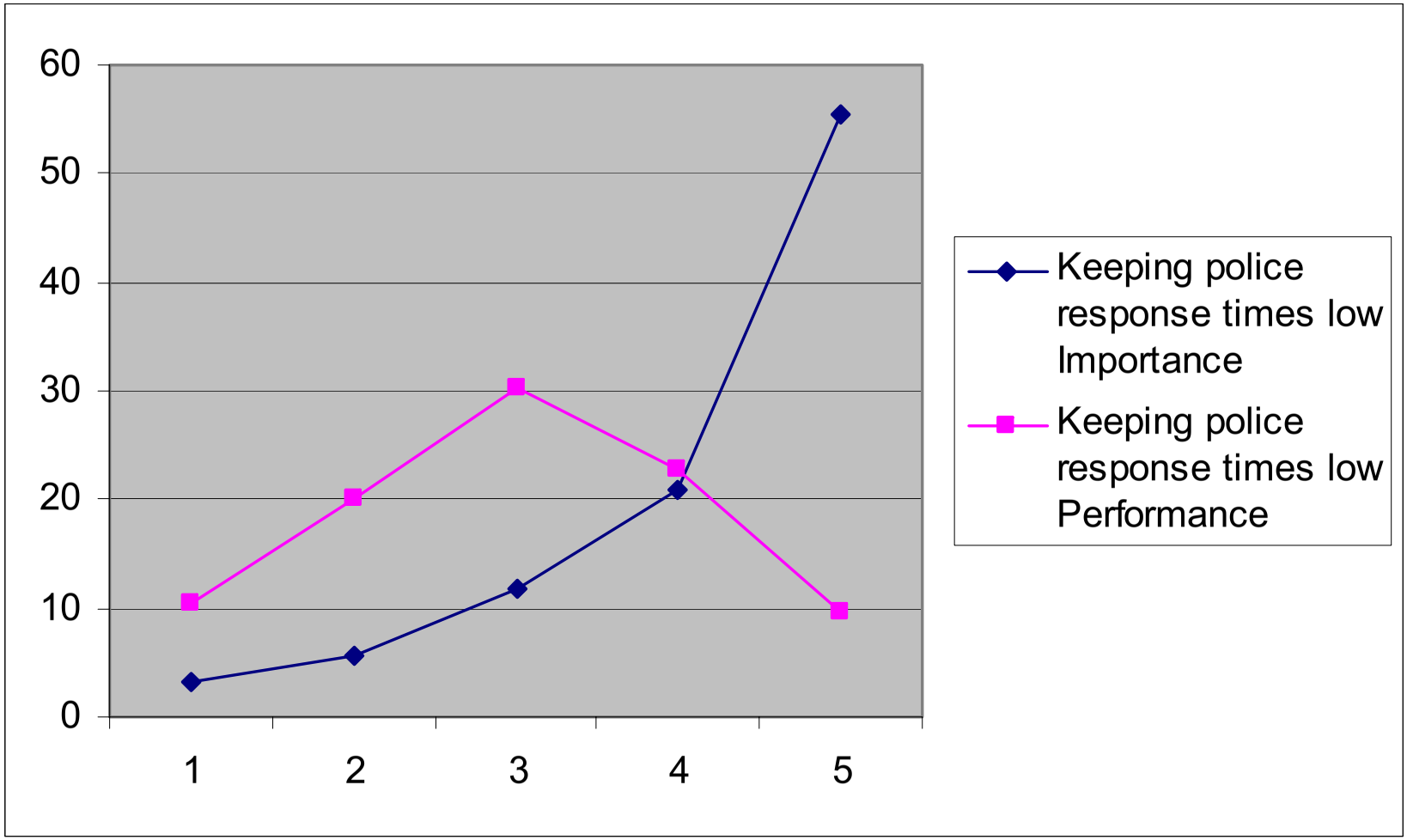
Maintaining neighborhood police patrols Importance
Maintaining neighborhood police patrols Performance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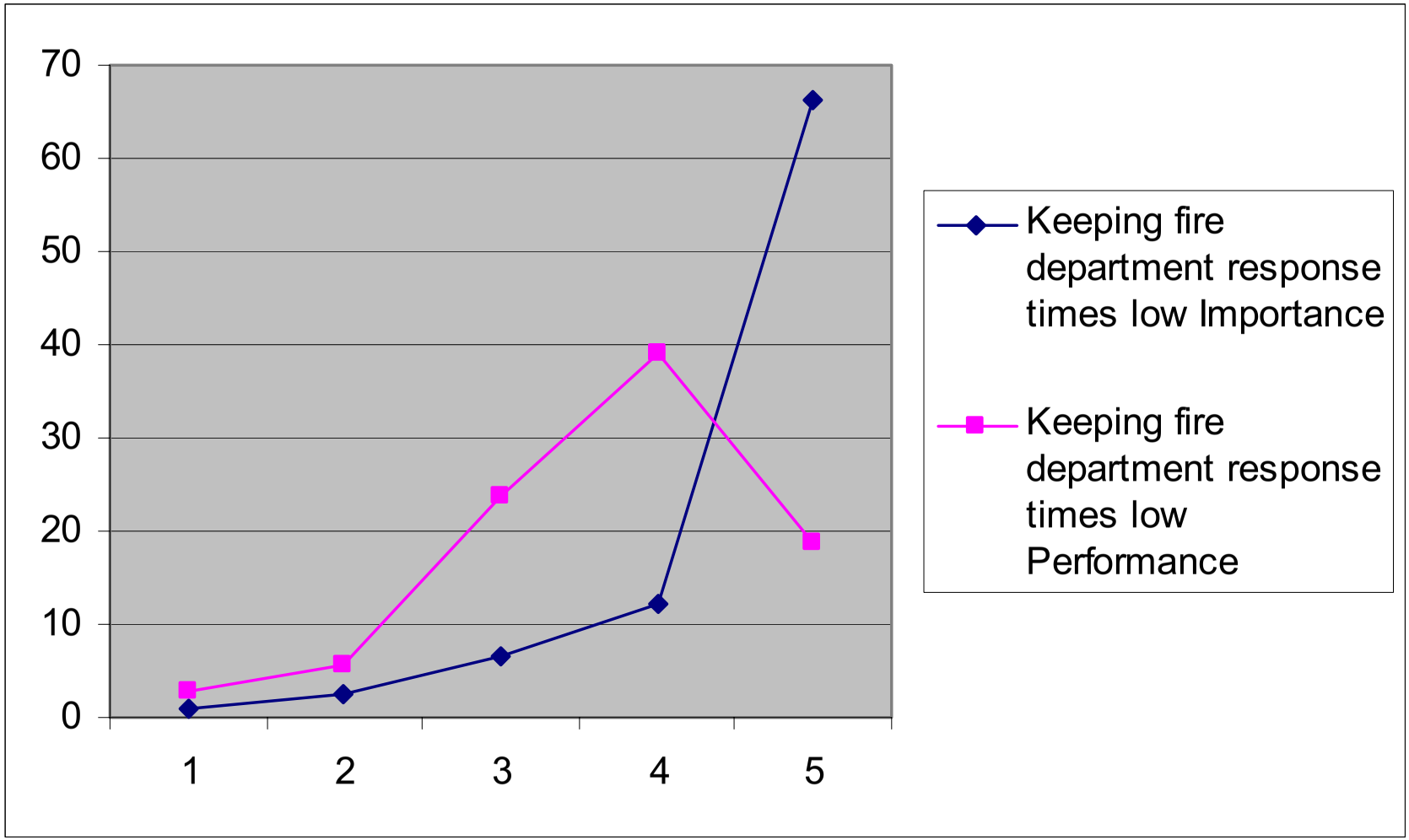
Keeping police response times low Importance
Keeping police response times low Performance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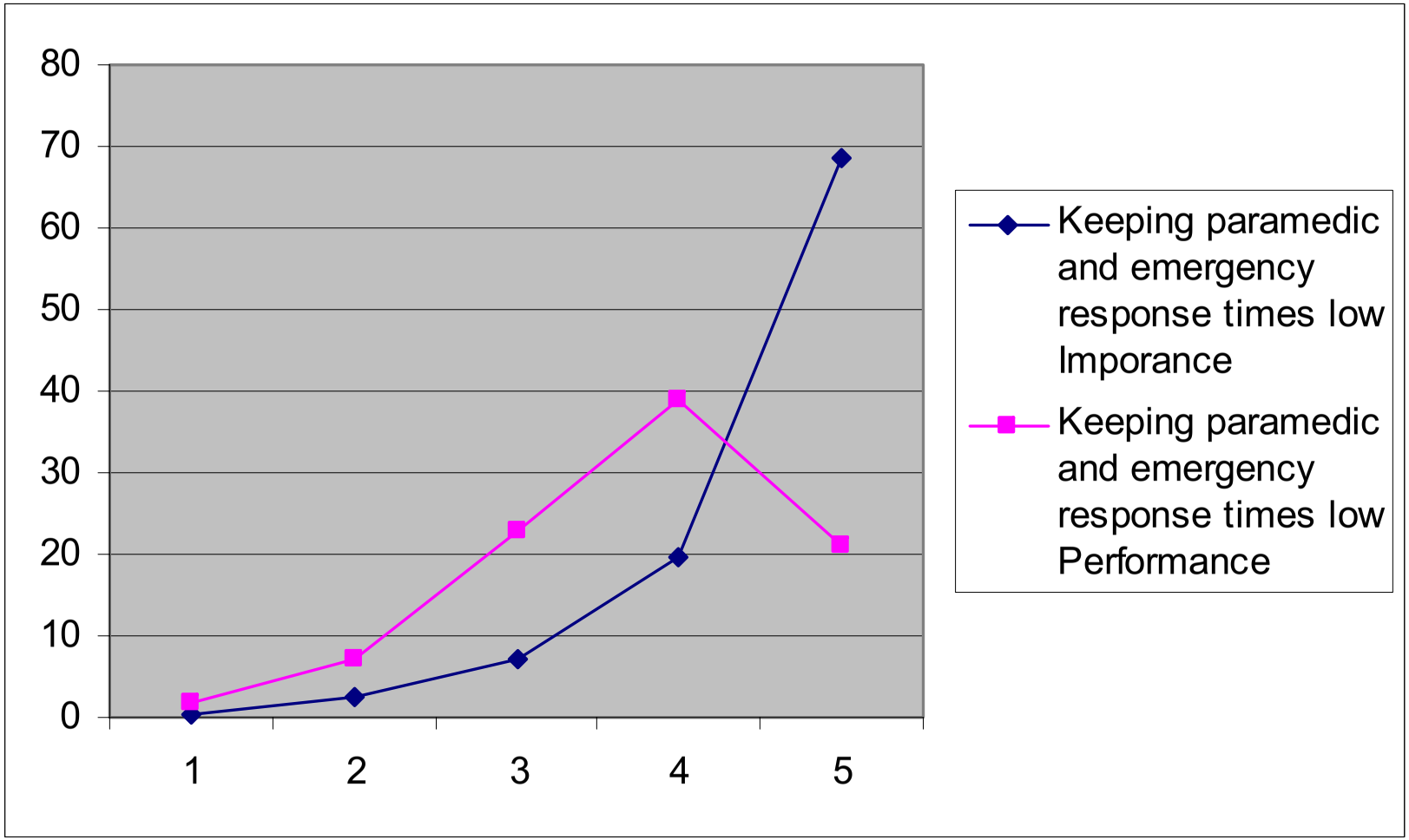
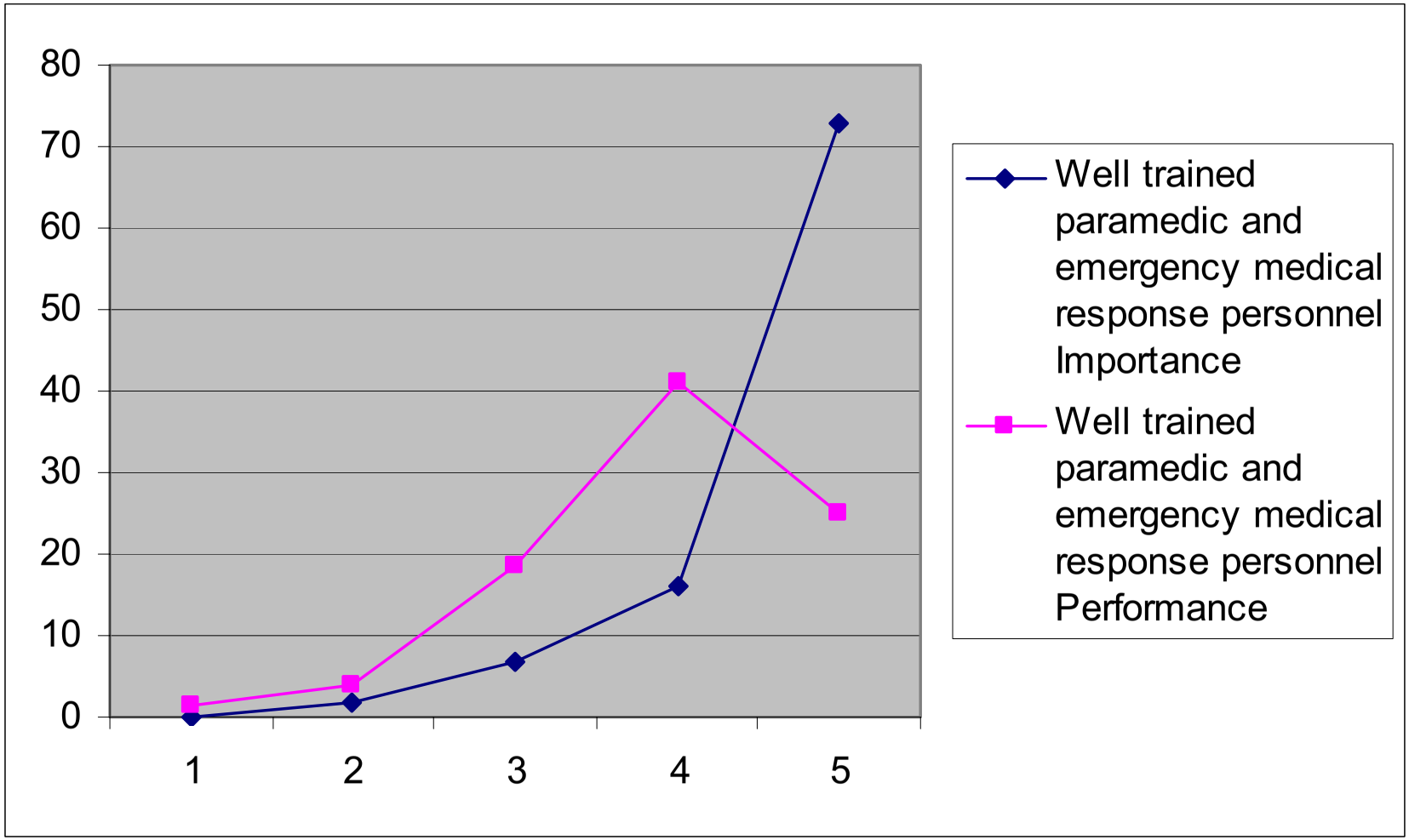
Keeping fire department response times low Importance
Keeping fire department response times low Performance

Appendix XI
Importance/Performance Comparisons

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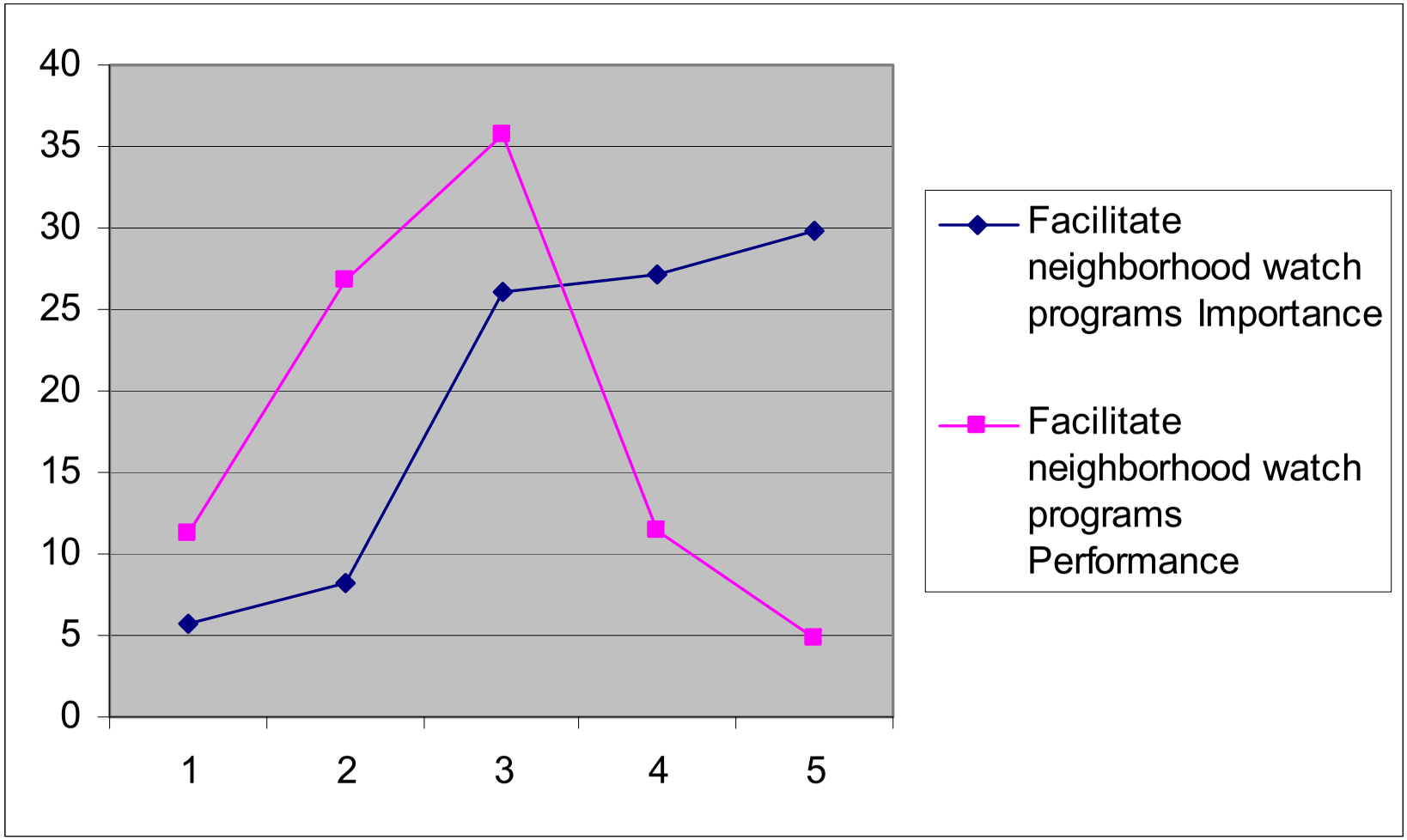
Well trained paramedic and emergency medical response personnel Importance
Well trained paramedic and emergency medical response personnel Performance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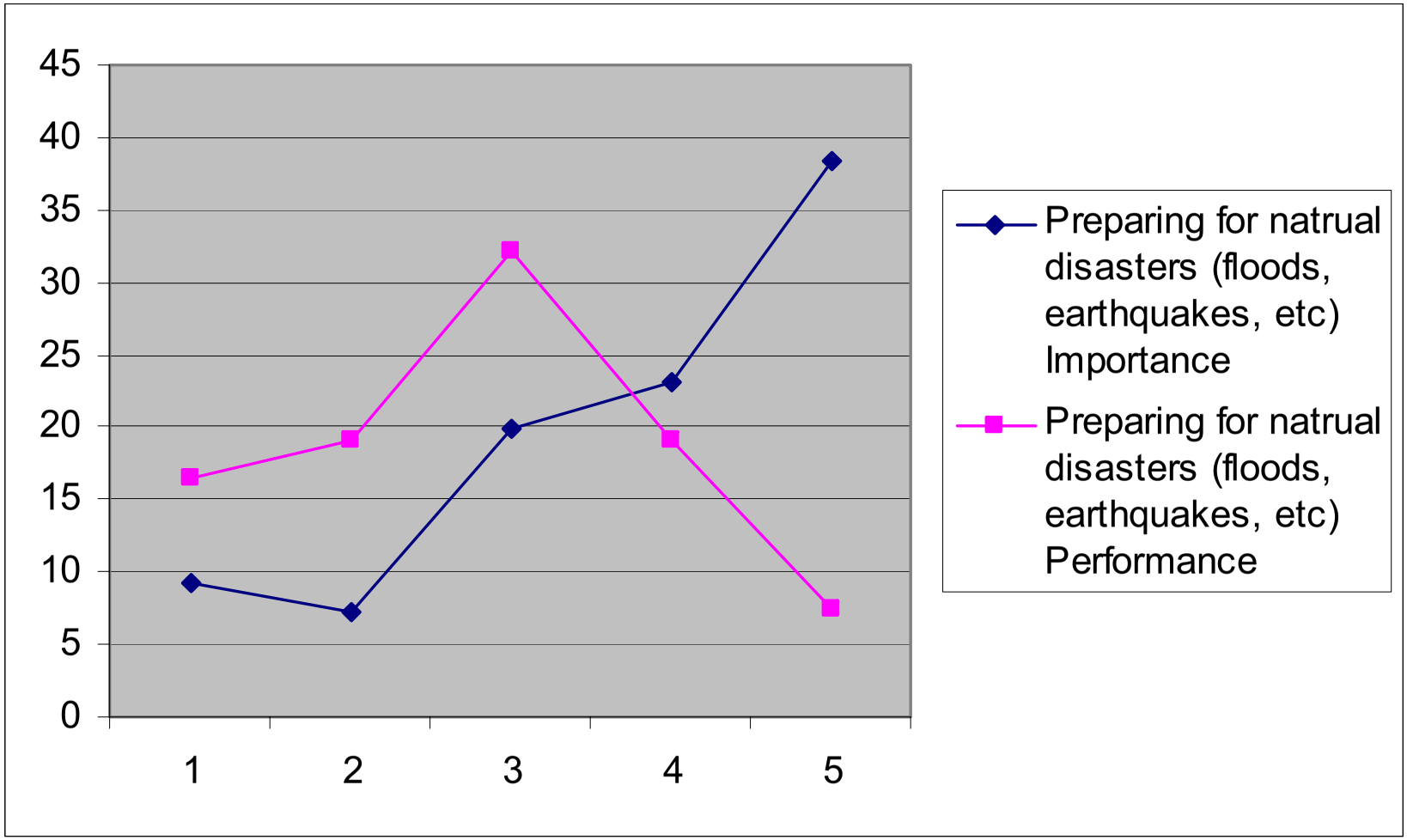
Facilitate neighborhood watch programs Importance
Facilitate neighborhood watch programs Performance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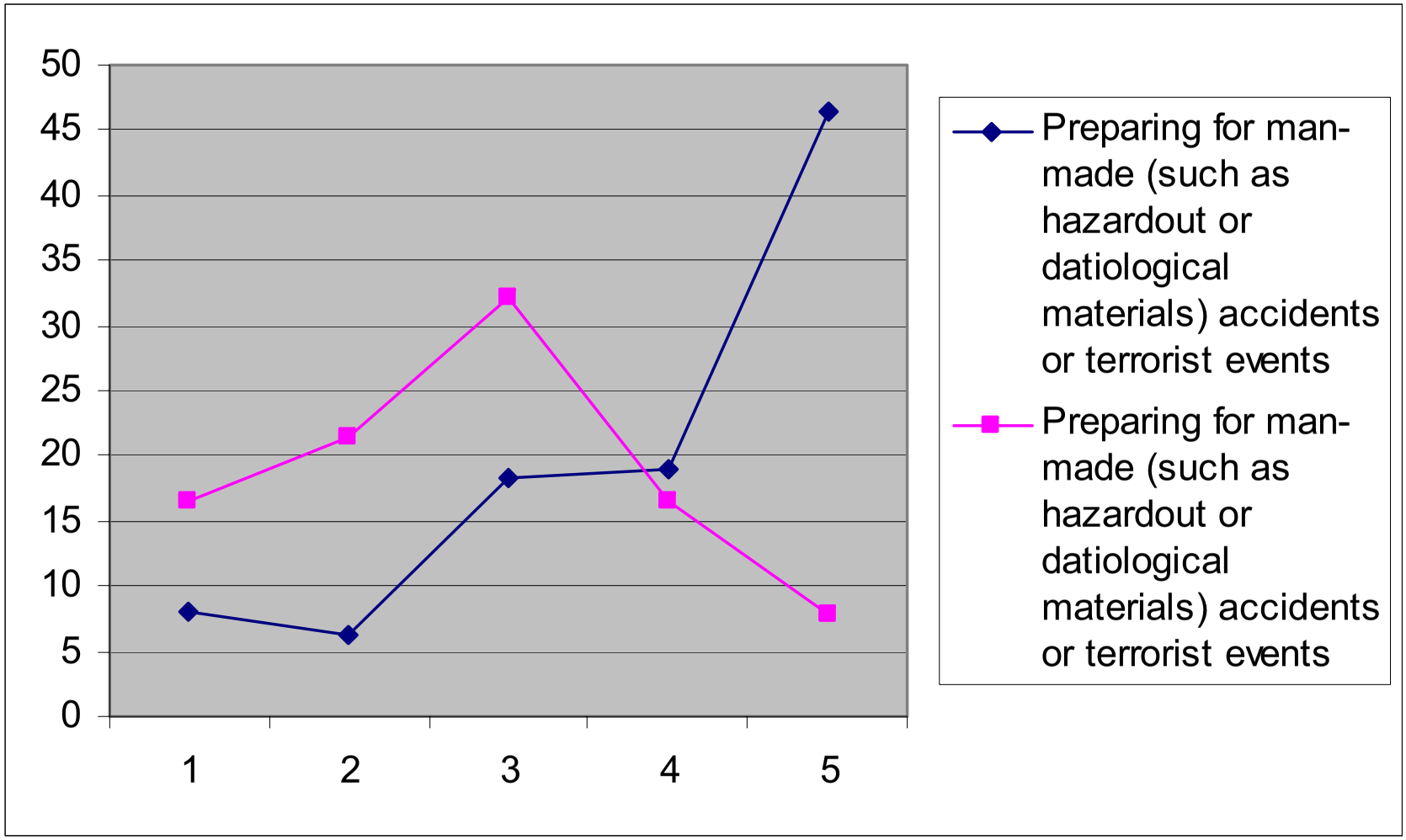
Preparing for natrual disasters (floods, earthquakes, etc) Importance
Preparing for natrual disasters (floods, earthquakes, etc) Performance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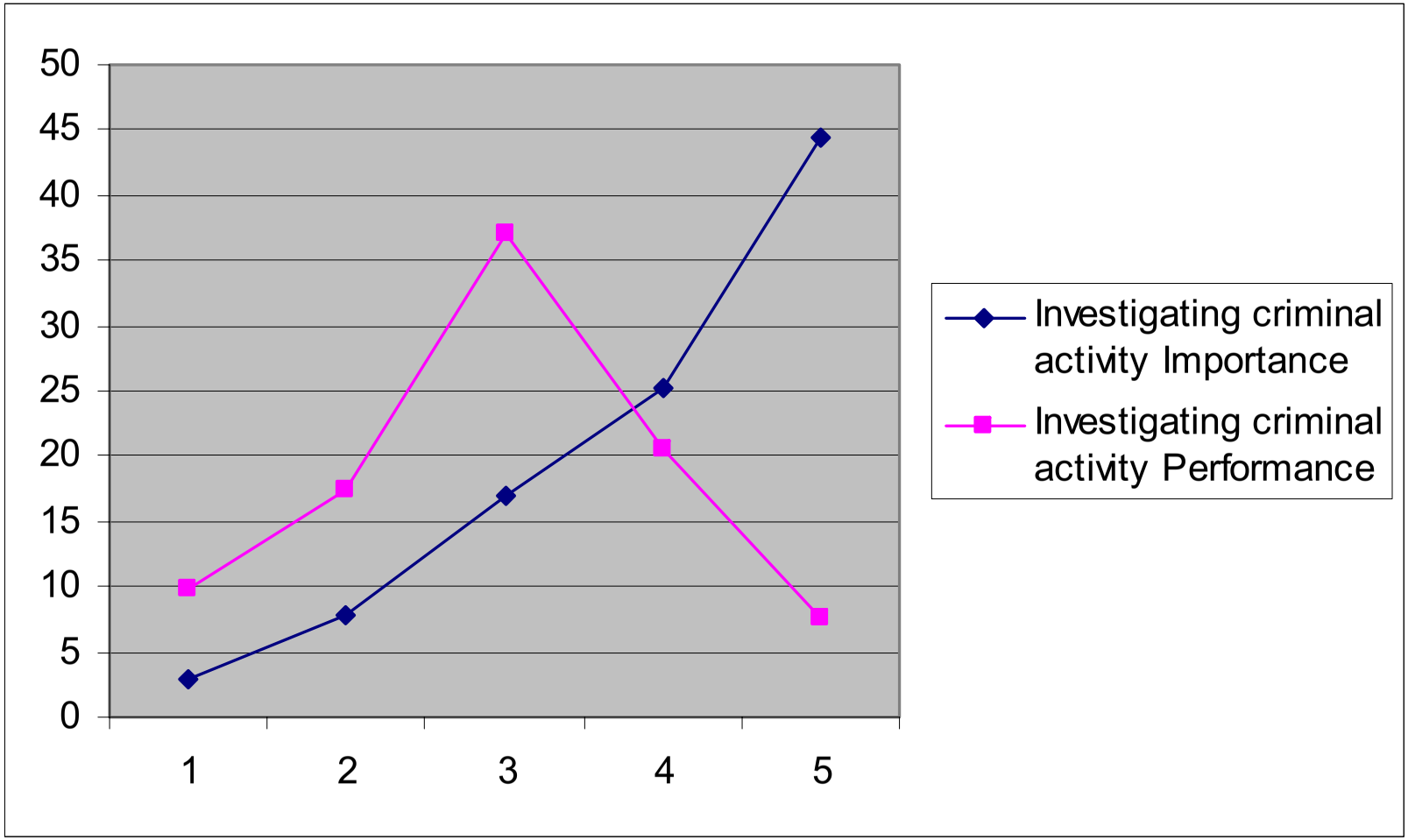
Preparing for man-made (such as hazardout or datiological materials) accidents or terrorist events
Preparing for man-made (such as hazardout or datiological materials) accidents or terrorist events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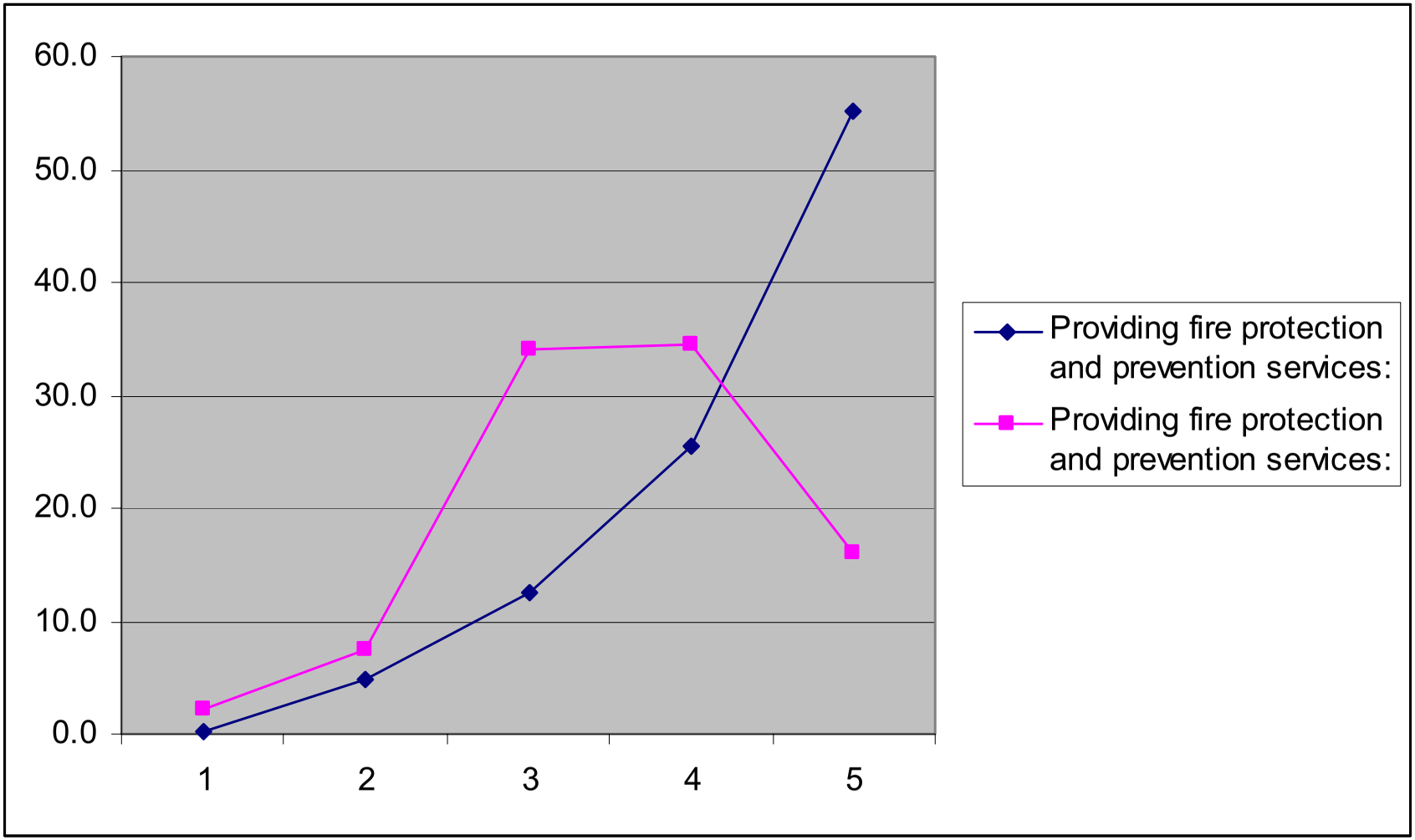
Investigating criminal activity Importance
Investigating criminal activity Performance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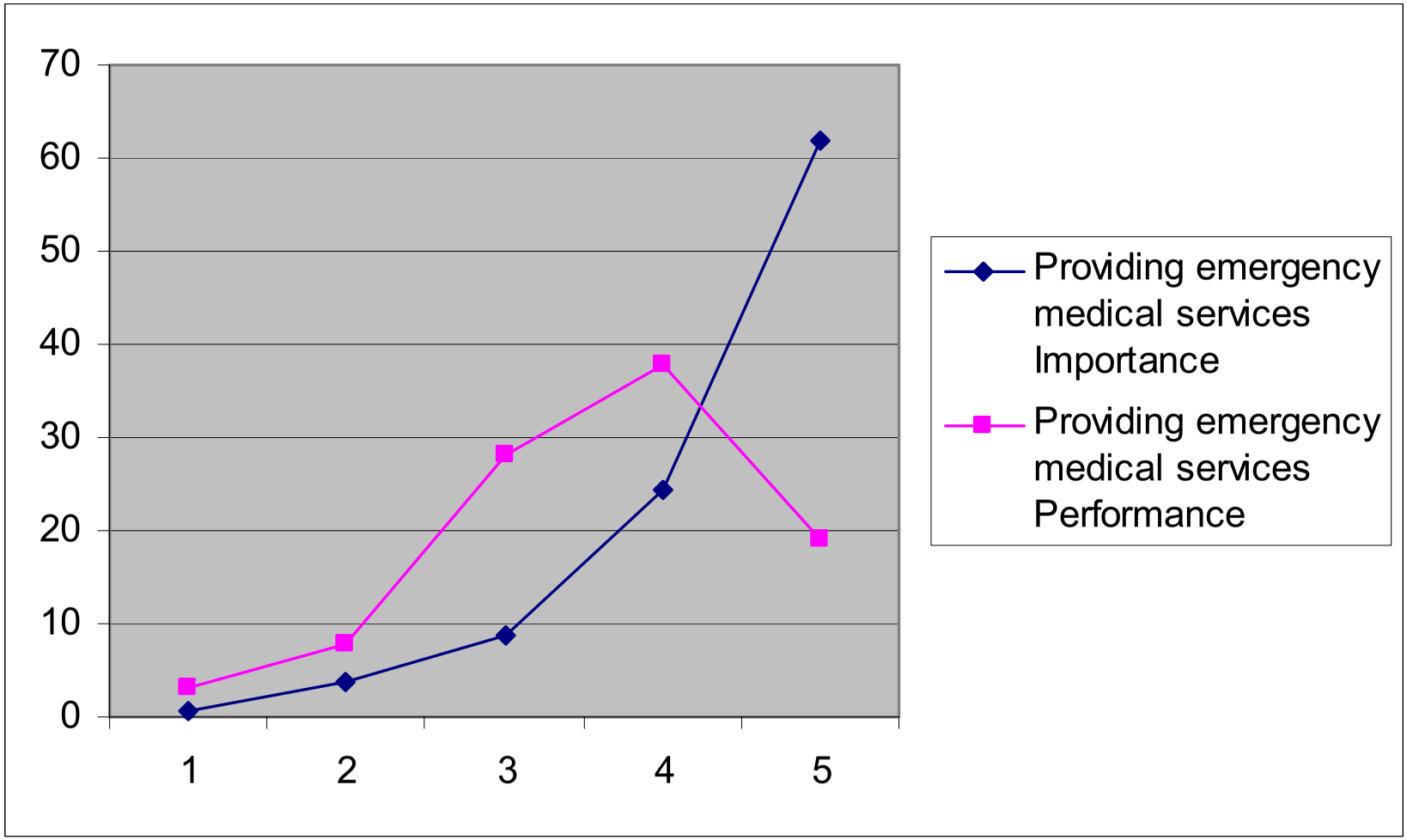
Providing fire protection and prevention services:
Providing fire protection and prevention services: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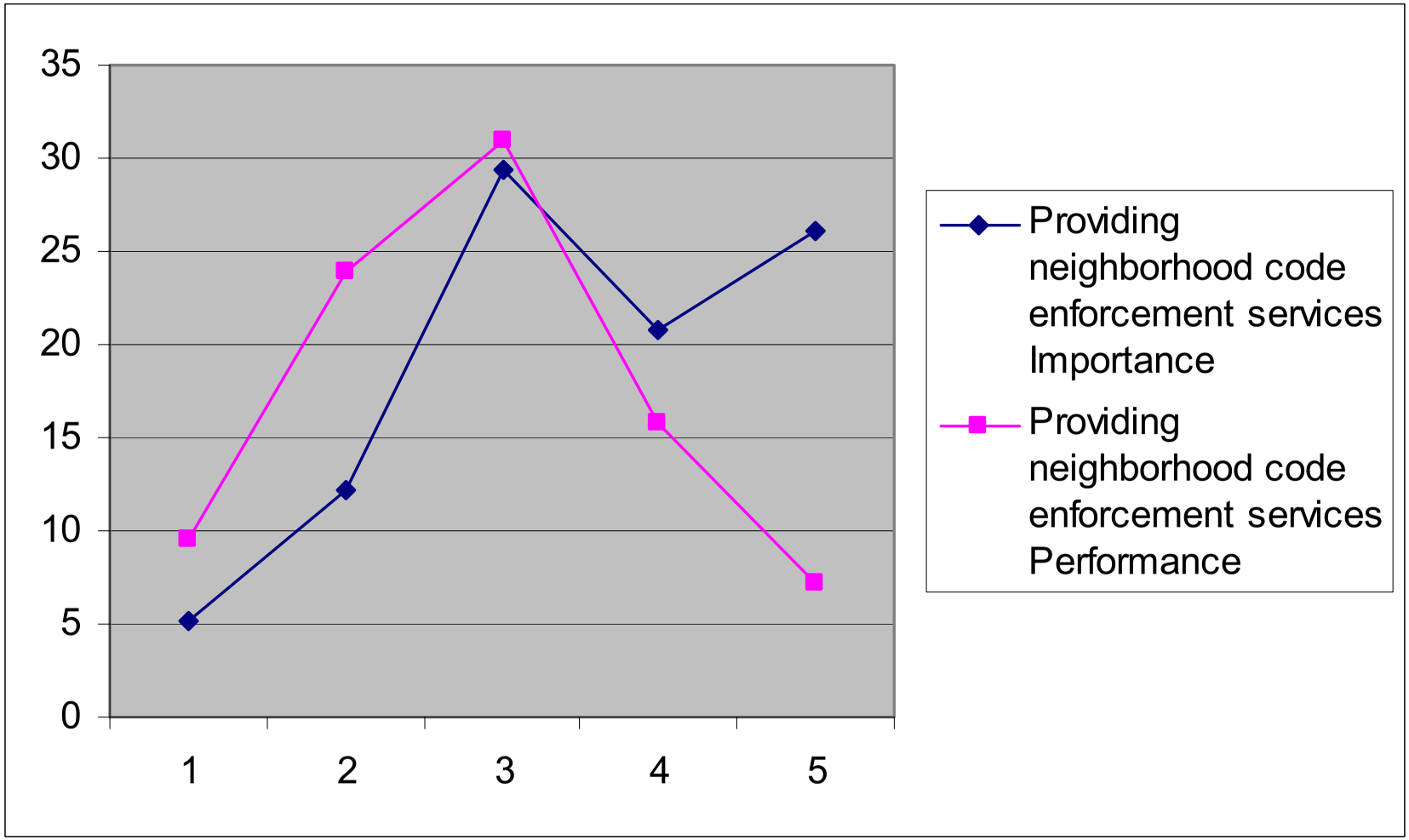
Providing emergency medical services Importance
Providing emergency medical services Performance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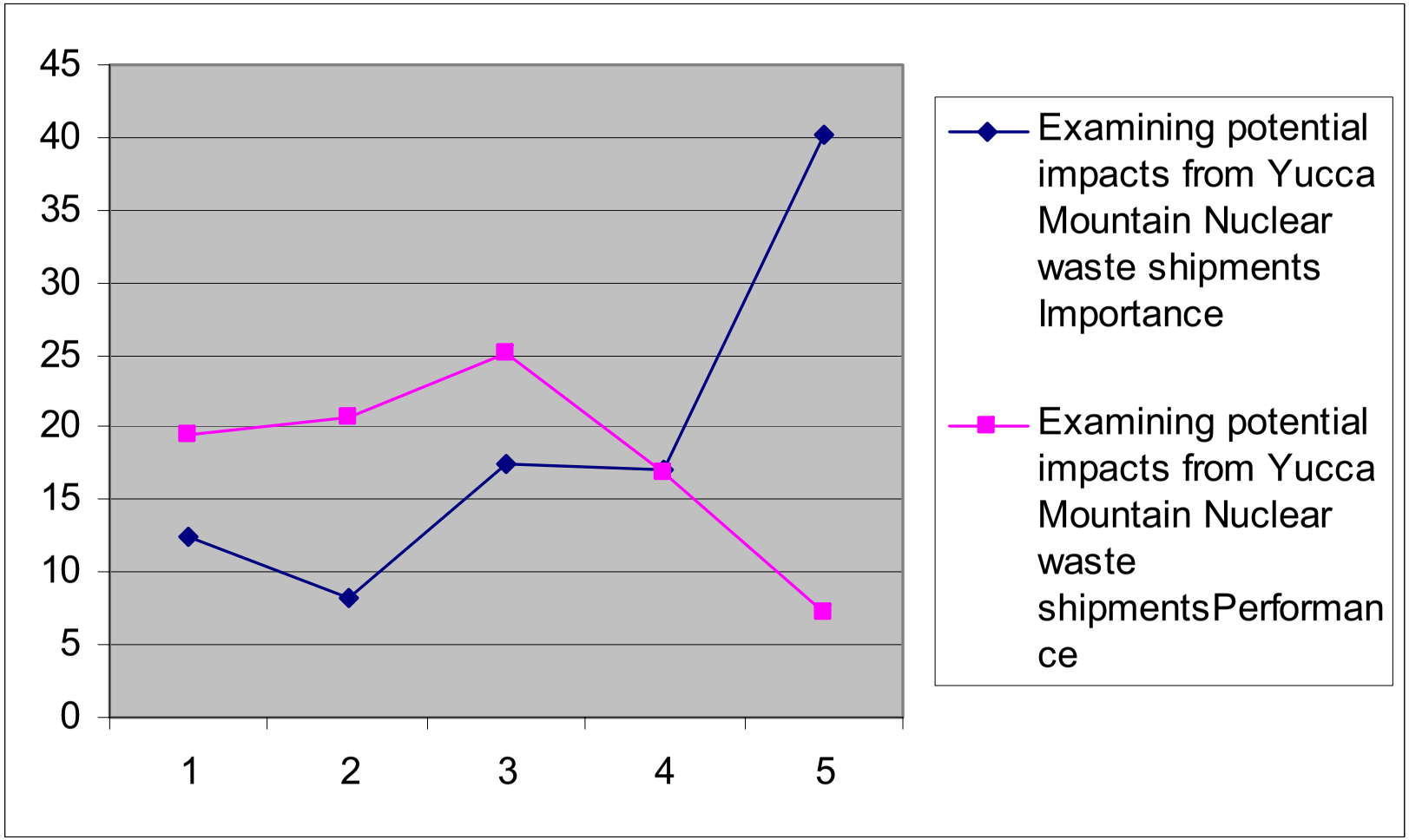
Providing neighborhood code enforcement services Importance
Providing neighborhood code enforcement services Performance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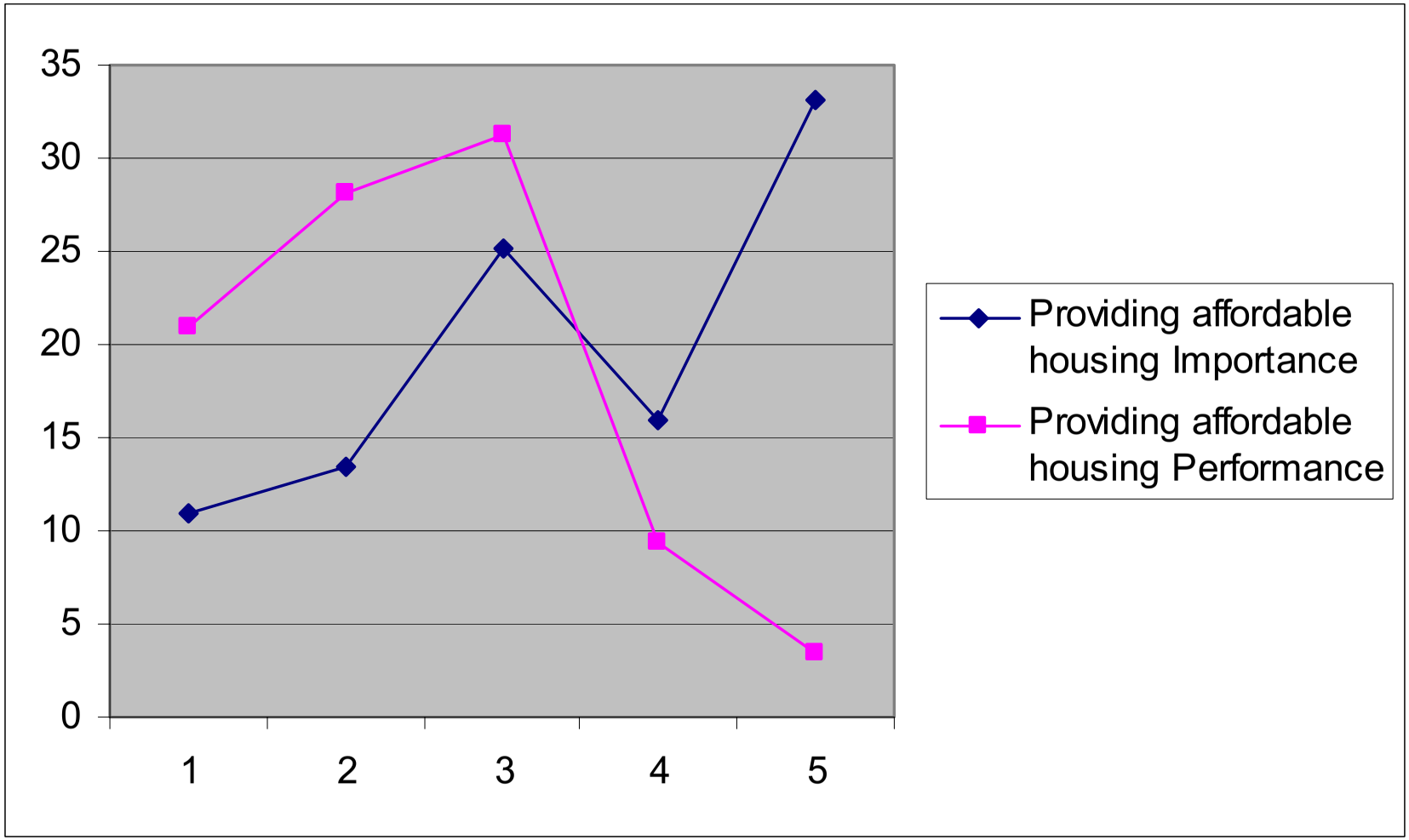
Examining potential impacts from Yucca Mountain Nuclear waste shipments Importance
Examining potential impacts from Yucca Mountain Nuclear waste shipmentsPerformance

Appendix XI
Importance/Performance Comparisons



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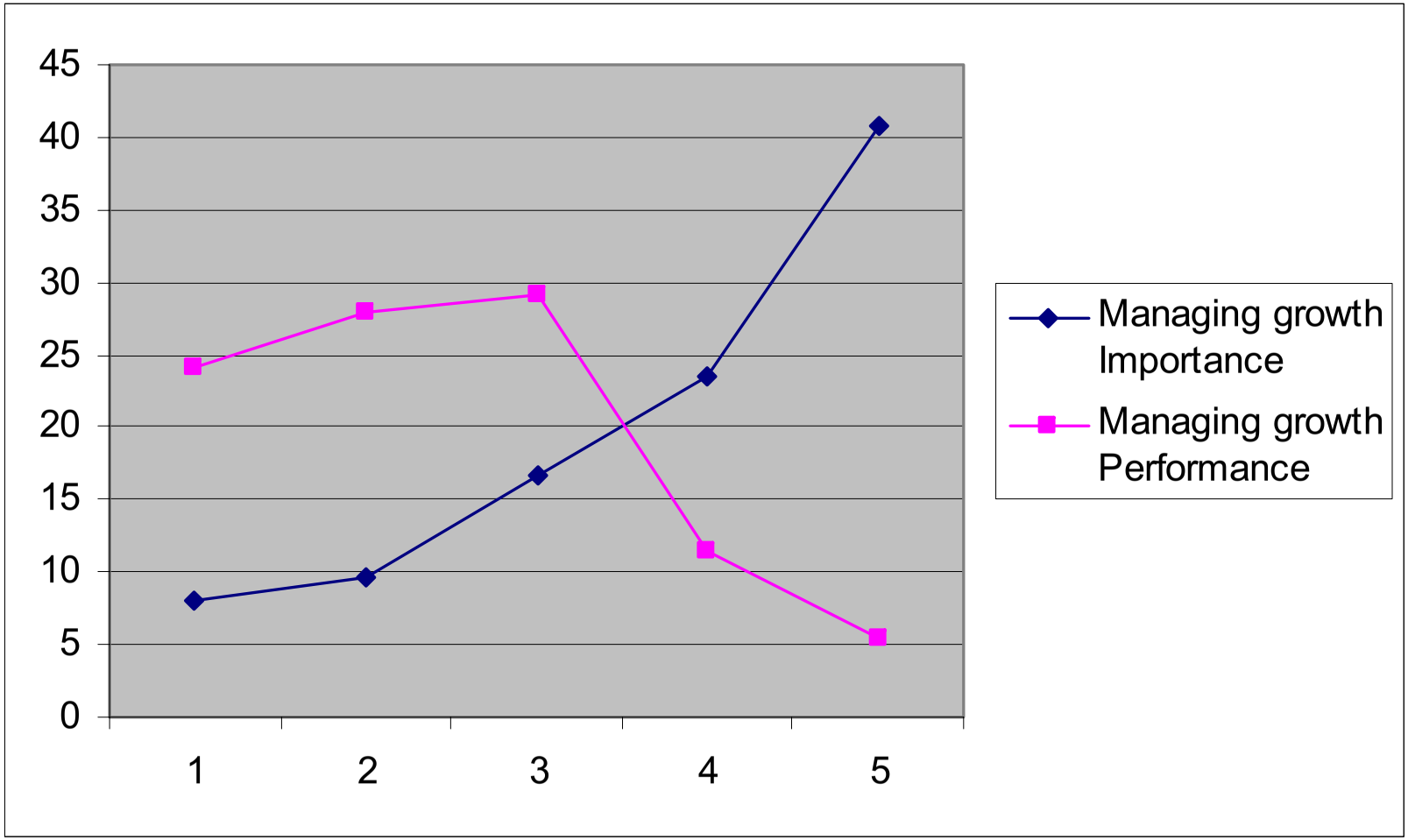
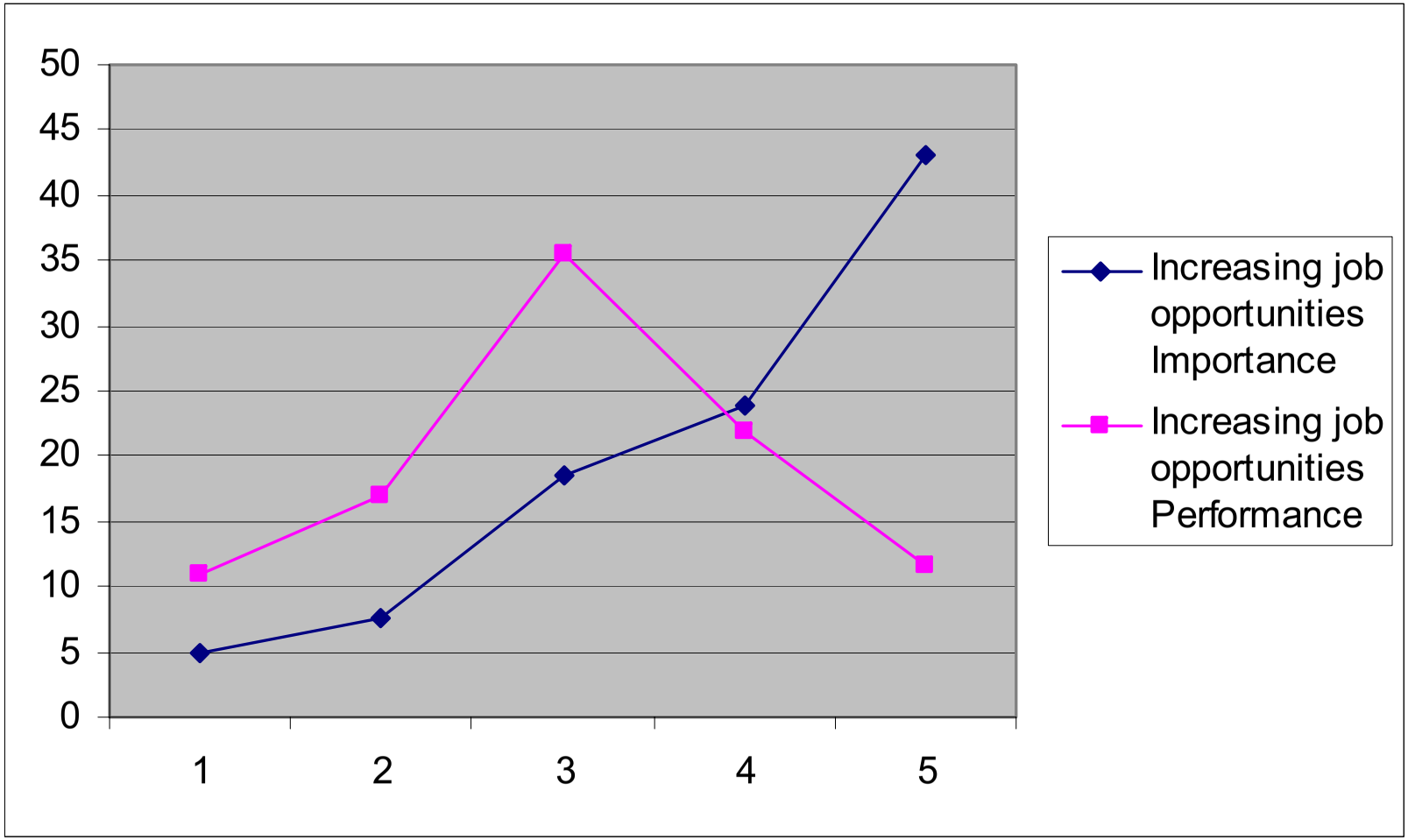
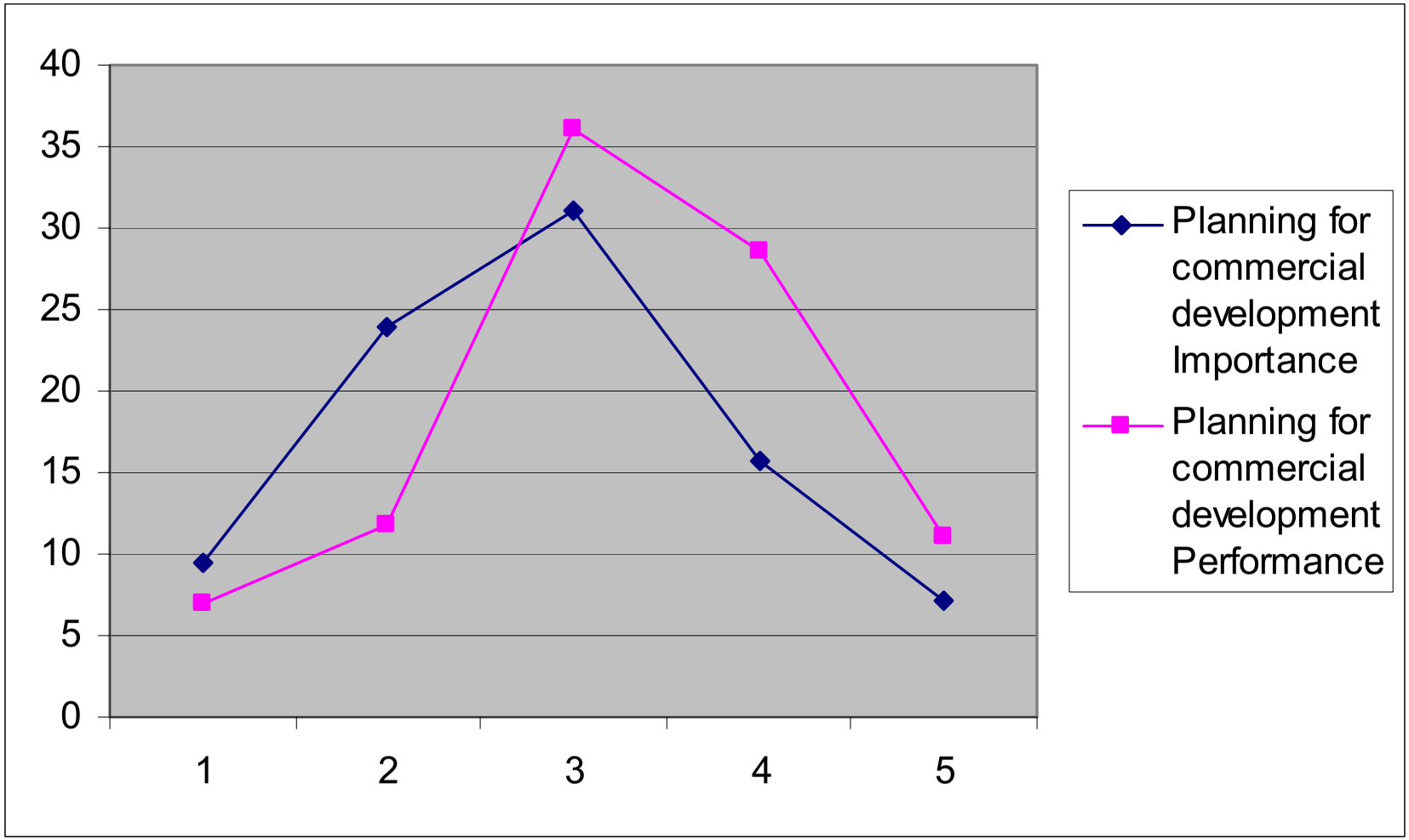
Importance/Performance Comparisons



Appendix XI
Importance/Performance Comparisons

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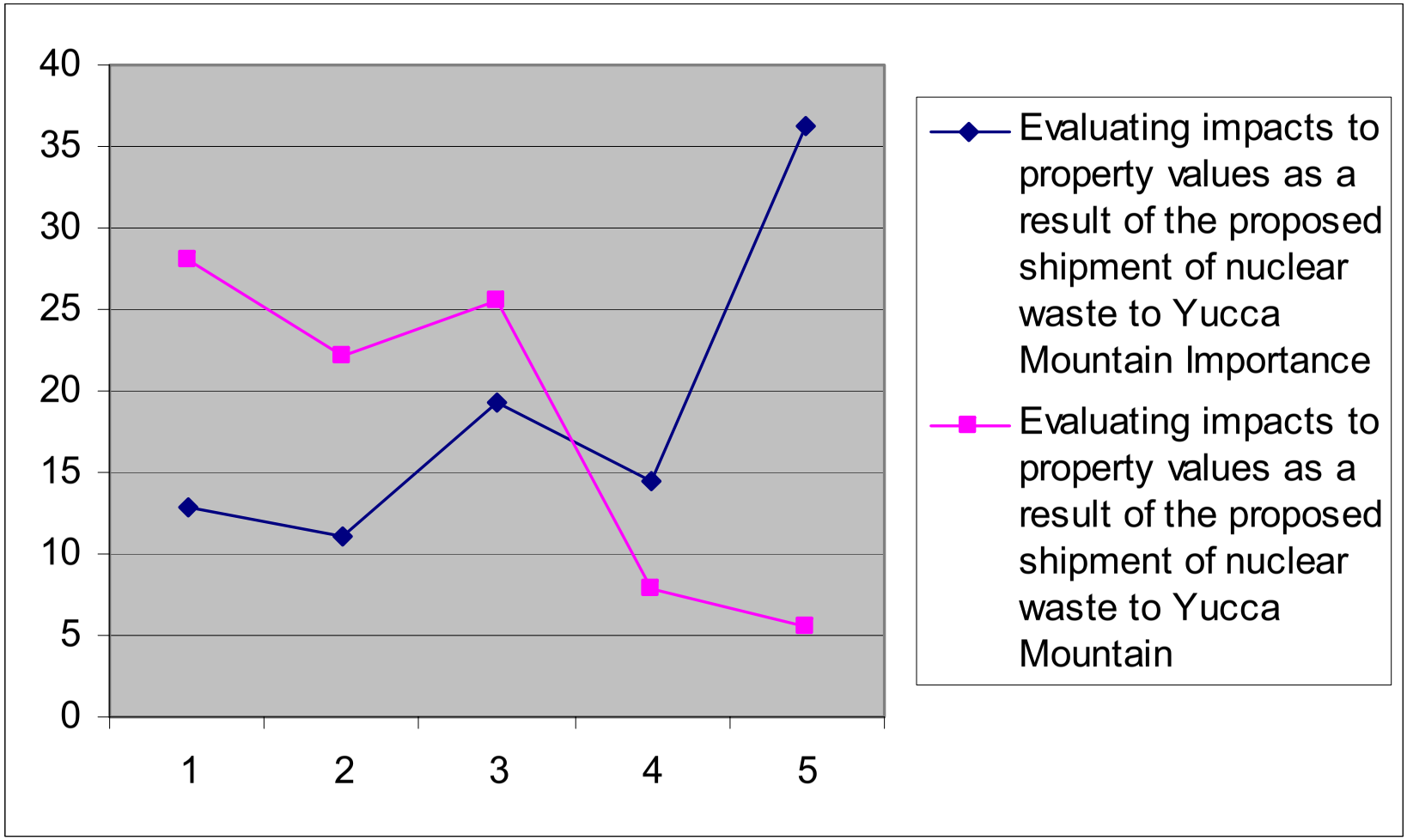
Planning for commercial development Importance
Planning for commercial development Performance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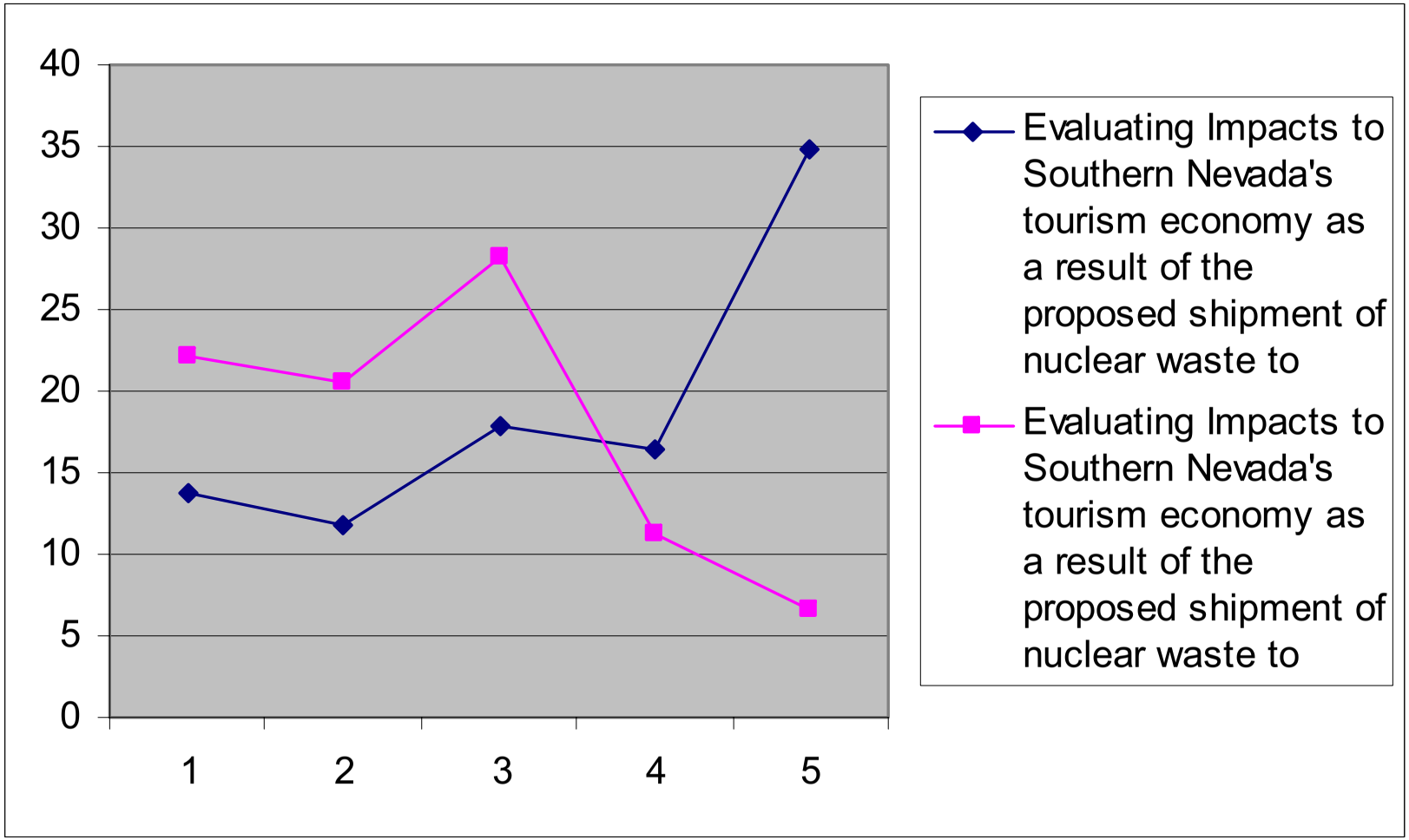
Evaluating impacts to property values as a result of the proposed shipment of nuclear waste to Yucca Mountain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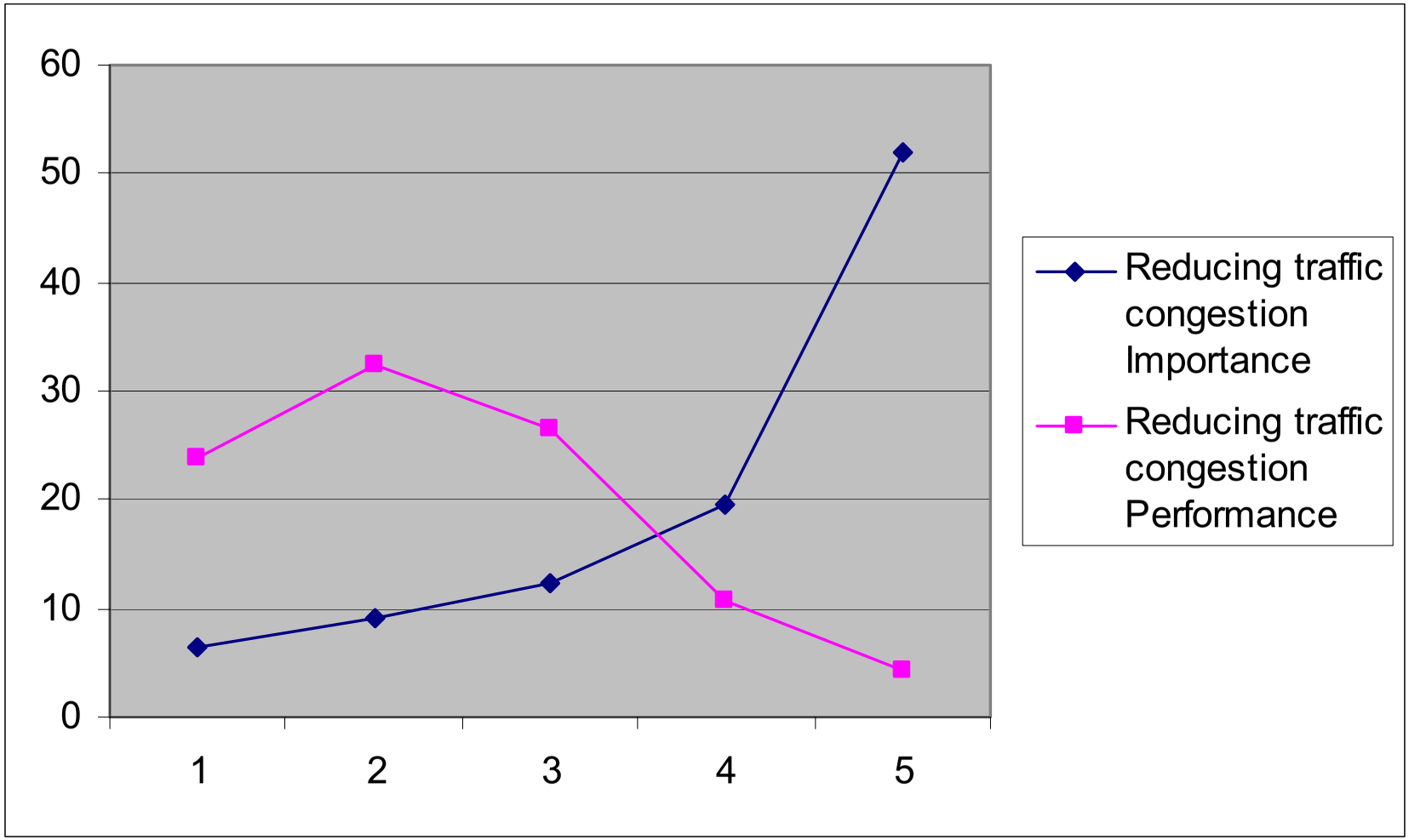
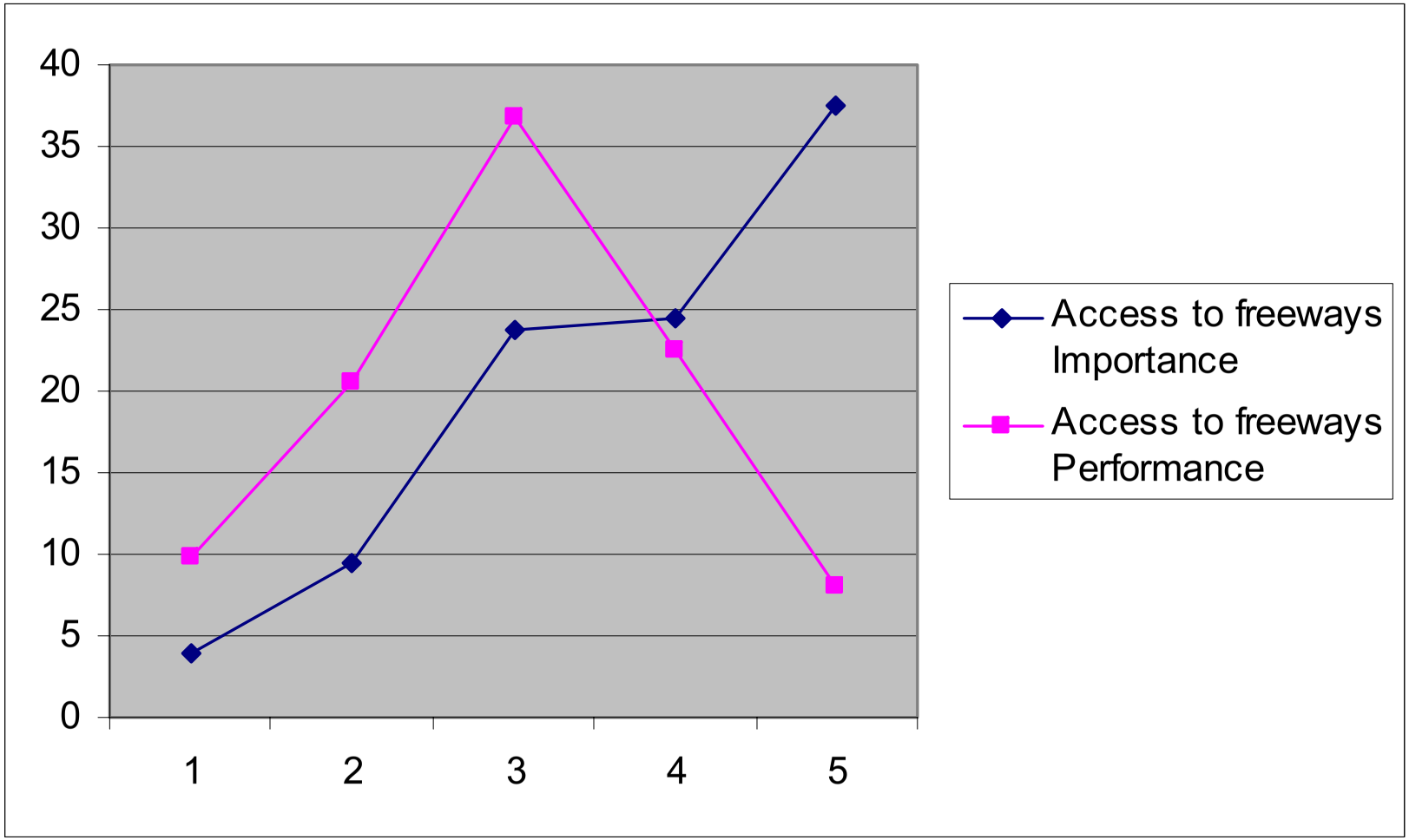
Evaluating Impacts to Southern Nevada's tourism economy as a result of the proposed shipment of nuclear waste to
Evaluating Impacts to Southern Nevada's tourism economy as a result of the proposed shipment of nuclear waste to

Appendix XI
Importance/Performance Comparisons

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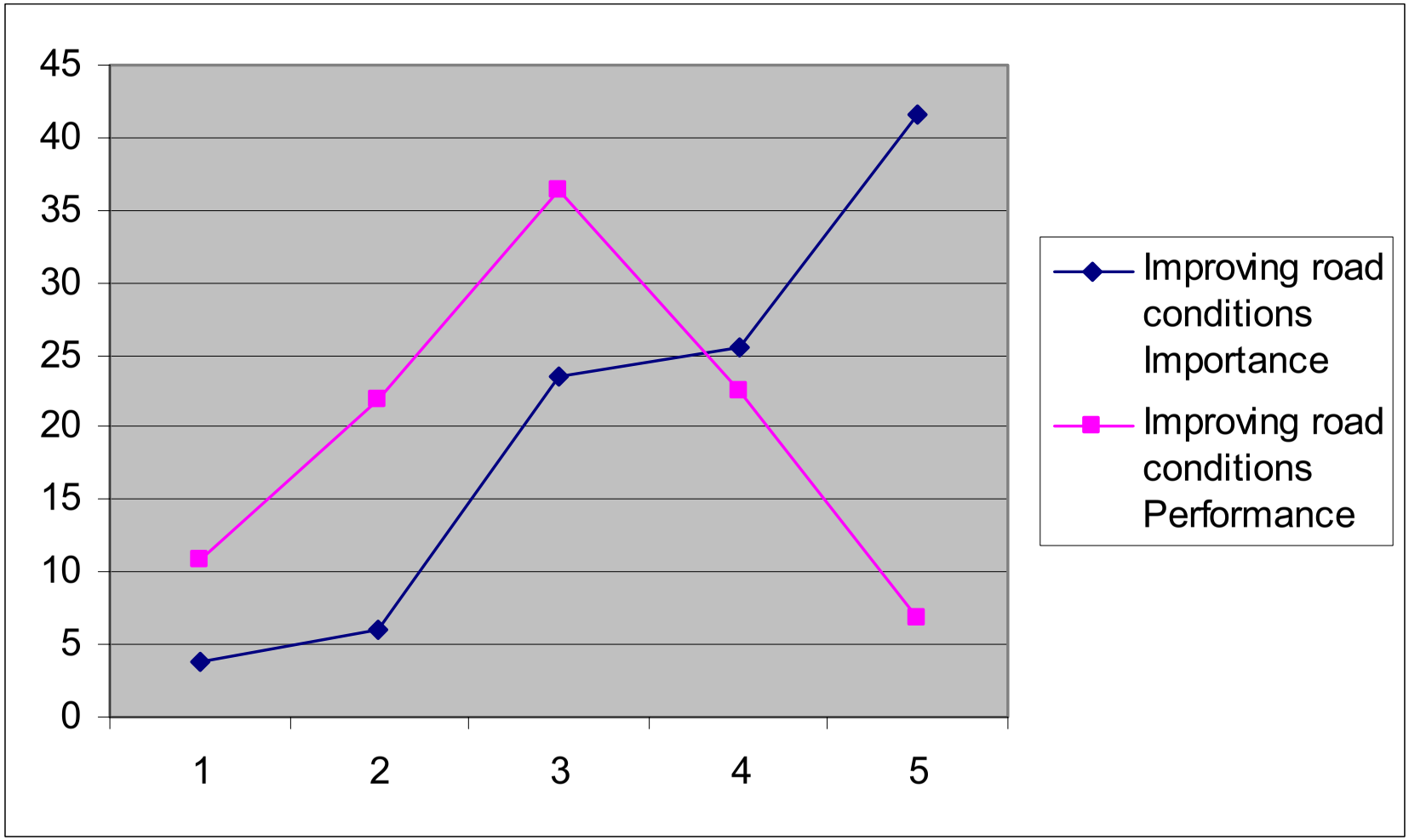
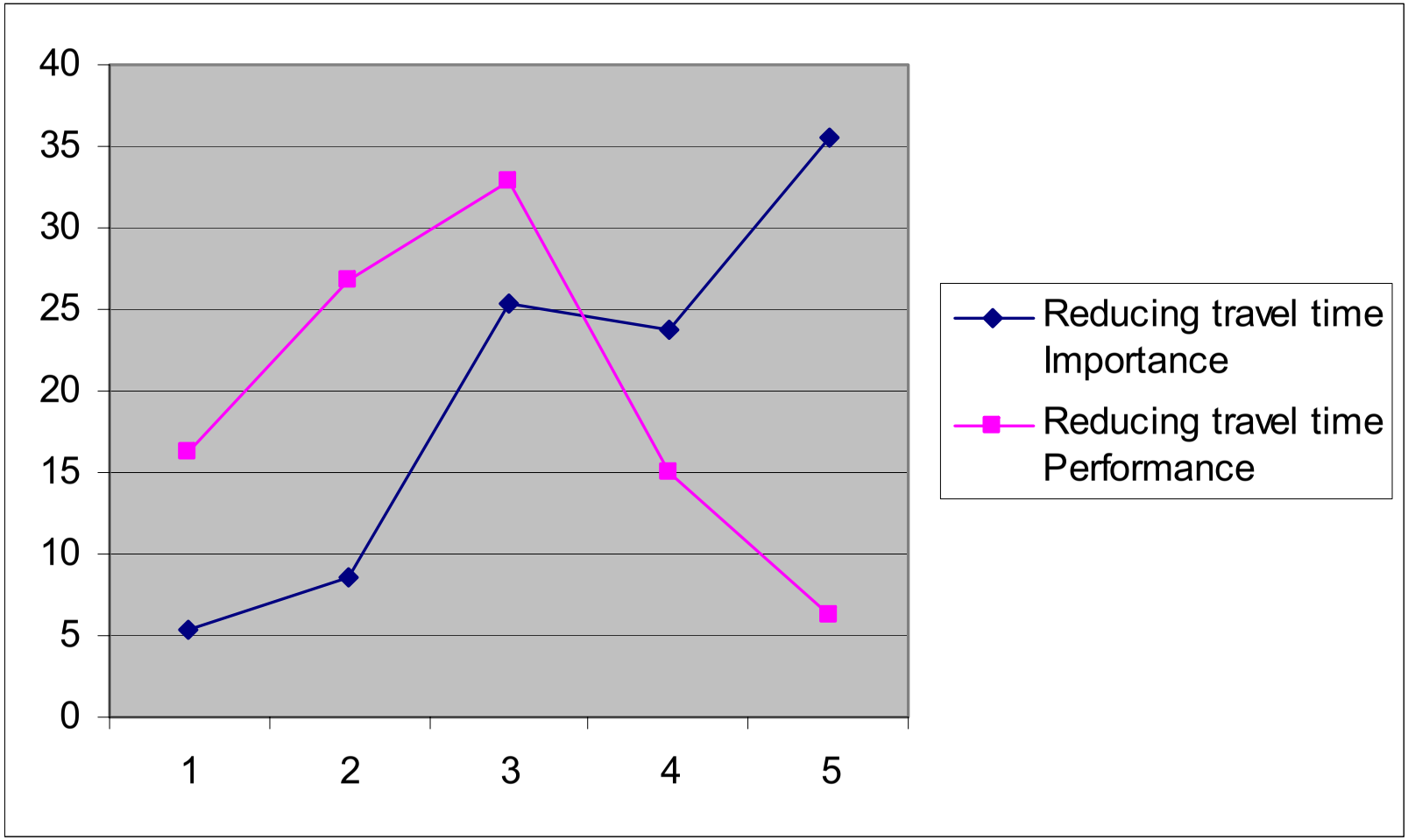
Access to freeways Importance
Access to freeways Performance

Appendix XI
Importance/Performance Comparisons

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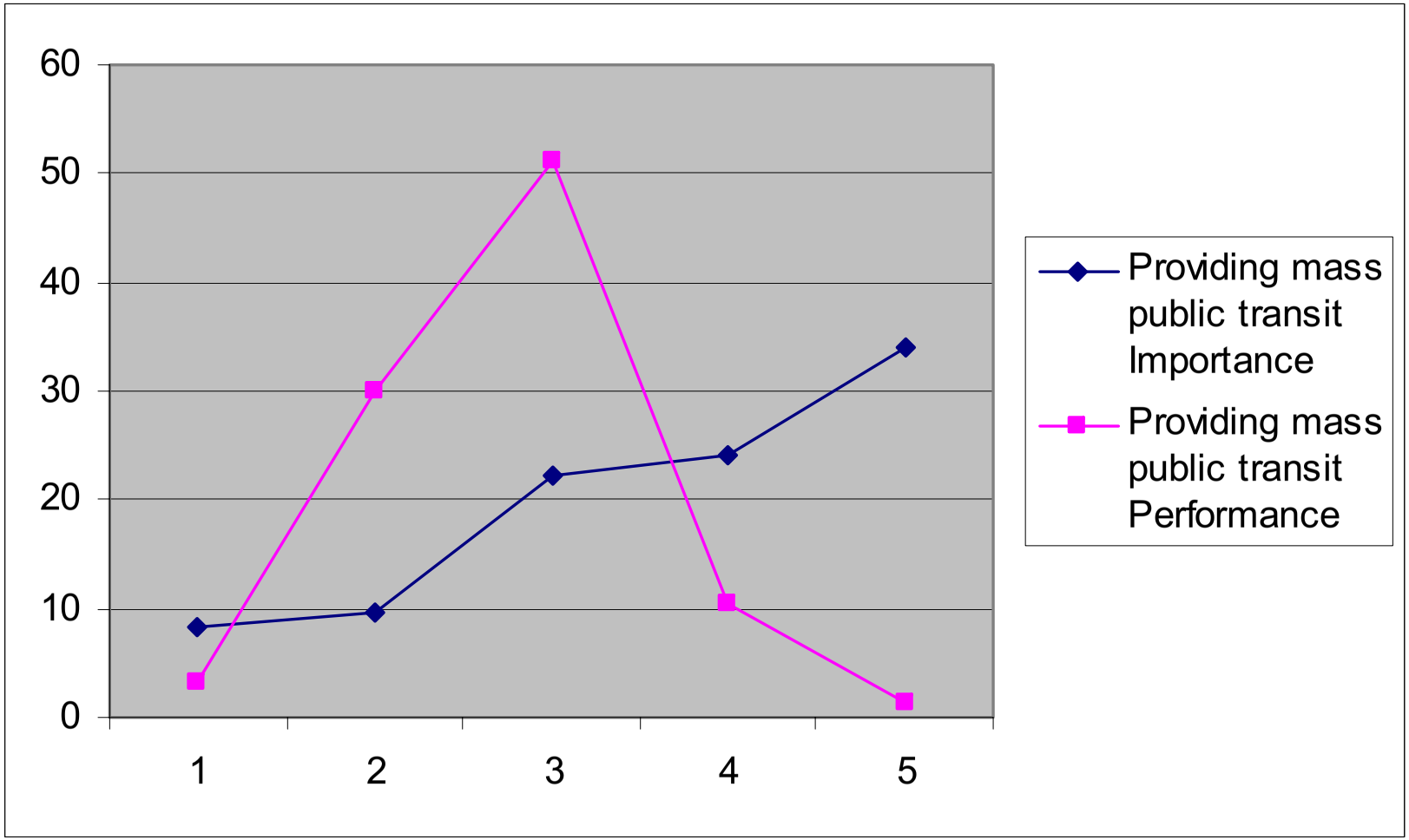
Reducing travel time Importance
Reducing travel time Performance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Providing mass public transit Importance
Providing mass public transit Performance

Appendix XII
Research Methods and Limitations

TO: DR. SHEILA CONWAY, URBAN ENVIRONMENTAL RESEARCH

FROM: JASON GRAY, STRATEGIC SOLUTIONS

SUBJECT: CLARK COUNTY MONITORING PROGRAM/COMMUNITY INDICATOR SURVEY ANALYSIS

DATE: 01/30/2008

CC: JEREMY AGUERO, APPLIED ANALYSIS

I. Introduction:

Strategic Solutions has prepared the following report as a summary of survey methods applied to the second iteration of the Clark County Monitoring Program Community Survey.

II. Purpose and Limitations:

a. Survey Development and Design:

This report has been compiled based on findings from the second in a series of point-in-time community surveys intended to support the Clark County Monitoring Program. The initial, baseline community survey was conducted in June 2005. Although the survey instrument remained relatively static, evaluative objectives became more refined subsequent to the initial phase of data collection (as is the case in many longitudinal assessments), warranting revision and amendment of measurement variables prior to the follow-up survey in February 2006. Throughout this report you will find certain variables, primarily those related to the importance and provision of selected government services, were modified or expanded while others of limited applicability or utility were deleted altogether. Additionally, response value regimes have been modified in certain instances so as to facilitate a higher order of statistical analysis and more sophisticated reporting format moving forward. A review of the relevant February 2006 modifications has been provided in Appendix XIV.

b. Analysis Limitations:

As with the baseline community survey conducted during June of 2005, this research was not developed or designed to be a comparative diagnostic or a comprehensive performance assessment. Although data collected or analyzed by the Clark County Monitoring Program and community surveys may serve secondary purposes, we neither discourage nor promote these purposes, noting only that such actions are beyond the scope of this engagement.

III. Survey Methodology

a. Logistical Details:

The community survey was conducted at Strategic Solutions' survey research facility during the afternoon and evening hours of February 1-6, 2006. Interviewers called respondents from a representative sample of unincorporated Clark County, City of Las Vegas, City of North Las Vegas, City of Boulder City, and City of Mesquite residents. A stratified random sampling method was implemented for administration of the survey and respondent records were drawn to reflect Clark County's jurisdictional and municipal composition.

Survey administrators entered data directly into In2Quest for computer assisted telephone interviewing (CATI) database software. The average duration per completed response was twenty two minutes and forty-one seconds. Surveys were conducted in English and, when necessary, in Spanish. Survey administrators attempted to reach each selected contact four times before moving on to the next corresponding record in the sample.

b. Sampling Procedure:

The resident sample for the Clark County Monitoring Program Survey (Winter/2006) was compiled using geo-coding technology which generated contact information (including name, address and telephone number) for owner and renter-occupied residential units in Clark County. Data sources included telephone directories, real estate filings, census data, voter registration files, utility, warranty, and other transactional information.

A total of 607 Clark County resident surveys were drawn from a frame of 8,000 records for this study. The sample was carefully drawn to reflect general population trends within Clark County, Nevada. Respondents were randomly selected according to the following screening criteria:

- Alternate male/female eighteen years of age or older with next birthday in contacted household.

- In an effort to mitigate bias, respondents were subsequently asked whether they were currently running for political office or employed by a political party, candidate for office, television station, radio station, newspaper or local government agency. Respondents answering in the affirmative to the screening variable were disqualified from participation.

c. Survey Instrument:

The survey instrument was constructed in consultation with representatives from Applied Analysis and Urban Environmental Research. The instrument consisted of 137 measurement variables in addition to two screening questions. The instrument is composed primarily

of scale variables. Respondents were first asked the level of importance for selected local government services and community issues. These questions were followed by queries regarding the performance of government entities in addressing the same local government services and community issues. Additional questions were asked to gauge behavioral dispositions, such as mode of transit and commute patterns Furthermore, a series of questions were asked to ascertain the opinions and perceptions of Clark County residents as they relate to certain quality of life issues/concerns and community (household/business) economic performance.

d. Error Measurement:
Surveys take into account the opinions of a sample frame of the universe, or study population and are generalized to reflect the same trends in the study population as a whole. For the purpose of this study, the universe consists of all residents in Clark County. There is always a possibility that the sample frame will not reflect the actual opinions of the study population as a whole. A scientifically sound sample size relative to the study population is one of the most common ways to mitigate this type of error. If the entire study population consisted of 1000 units, researchers express confidence that greater accuracy is observed by studying 100 units than by studying 10 units. Error is applied in terms of levels of confidence. The 95% level of confidence is standard in social research. A 95% level of indicates that if we were to draw the same number of units from the same sample frame 100 times, 95 samples would yield a result within a given range or margin of error. A sample size of 607 is associated with a 95% level of confidence that the opinions of our sample will fall within 4% above or below the actual population value.

Table 1. Final Call Dispositions

Disposition	Count
Complete	609
Initial Refusal	1415
Mid-Terminate	14
Busy	53
Answering Machine/VM	434
Continuous Ring	235
Not In Service	625
Business	223
Fax Machine	252
Not Qualified	22
Requested Call Back	173
Total Calls	**4055**

e. Interpreting the Data:

The reader will find that data in this report are presented, for the greater portion of analysis, using four measurement tools:

- Frequency (top-line) tables
- Measure of Central Tendency (Mean, Median, and Mode)
- Cross Tabulations
- Independent Sample T-Test

Frequencies offer a count and corresponding valid percentage of response values for a particular variable. Frequencies can be presented in tables, charts, or graphs. The frequency tables are labeled with the variable name, count, and valid percentage for responses in each category. The data represent the number of respondents out of the total sample who answered affirmatively to a particular response value for a given variable. The reader will find that the total count will not add up to 607 for all variables. Such instances denote additional probing questions that follow a strict logic sequence, or the re-routing of respondents for whom the question does not logically apply. The valid percentage, however, will always total 100% (when rounded).

Three measures of central tendency allow readers to examine general trends in the data. The mode demonstrates the response value reported most frequently. This can be applied to any level of analysis from categorical variables to variables of scale measurement. Medians can be used to determine where the 50th percentile score falls within a response value regime. Fifty percent of responses fall above the median, and fifty percent will fall below the median. The mean represents the numerical average of all responses values to a particular variable.

Cross tabulations allow the reader to interpret one variable in the context of another. The variable on the vertical axis is considered to be the independent variable. In other words, the vertical variable influences the variable assigned to the horizontal axis, or the dependent variable. The independent variable is typically descriptive or demographic nature.

Cross-tabulation tables are presented with percentages across rows to allow the reader a better understanding of how each category of the independent (demographic) variable influences the dependent variable. Percentages across rows should always add to 100% (rounded). There is limited utility in summing column percentages vertically.

Independent sample T-tests are used to compare mean values in different variables or distributions. For purposes of this assessment, tests were implemented to compare results from selected variables between the first

iteration of the study in June of 2005 and the second iteration of they survey in February 2006.

f. Rounding Procedures & Weighting:
Statistical Package for the Social Sciences (SPSS) software can calculate to any number of decimal places. For purposes of this report, presentation values have been rounded to the first decimal place using standard rounding conventions. Any value that is less than .05 is rounded down, and any value greater than .05 is rounded up. For example, 0.14 is rounded down to 0.1, while 0.15 is rounded up to 0.2. The Clark County Monitoring Program Survey results have been post weighted to reflect general Clark County population trends. The final weighting procedure qualified for the observed age and gender delineations.

Appendix XIII
Longitudinal Significance Tests

***Note:**

Independent Samples T-Tests

Since this study has been completed at multiple points in time, the data permit the employment of longitudinal analysis. The first iteration of the Clark County Monitoring Program occurred during June of 2005. The survey was repeated in February 0f 2006. Though numerous changes were made between iterations of the survey, seventy variables were comparable between the two surveys. Notably, many of the importance variables were asked in both versions of the survey, however, since the reporting scheme for the performance measures changed between both surveys. In order to be eligible for mean testing, data must be collected at the interval , scale, or ordinal level, nominal data such as "religion" or "political party" yield meaningless results.

After identifying comparable variables, independent samples t-tests were preformed to measure statistically significant differences in mean values in June of 2005 and February of 2006. Differences were divided into the 95% level of confidence ($\alpha \leq .05$), the 99% level of confidence ($\alpha \leq .01$), and the 99.9% level of confidence ($\alpha \leq .001$). All independent samples t-tests included two-tailed analyses based on the null hypothesis that mean values are equal at time one and time two (H_O: $\overline{X}_{June05} = \overline{X}_{Feb06}$). Therefore the research hypotheses in these t-test are that mean values are not equal at time one and time two (H_A: $\overline{X}_{June05} = \overline{X}_{Feb06}$).

T-tests are presented in the body of the report in two tables. The first table presents importance variables from questions that were asked at time one and time two. The second table includes all other comparable measures.

Appendix XIII
Longitudinal Significance Tests

	June 2005			February 2006				
Measurement	N	Mean	Std Dev	N	Mean	Std Dev	T-value	P-Value
Road maintenance:	600	4.21	0.975	606	4.05	1.053	2.716	.007**
Revitalizing older neighborhoods:	592	3.59	0.975	606	1.05	1.053	2.460	.014*
Flood control:	594	4.09	1.152	607	3.88	1.233	3.063	.002**
Budget management:	585	4.29	1.060	594	3.99	1.183	4.551	.000***
Communicate Clark County's local governments' views about Yucca Mountain to Federal decision makers:	581	3.77	1.396	584	3.59	1.452	2.136	.033*
Monitor and report to the public on how well government services are being performed:	594	3.90	1.168	598	3.72	1.202	2.634	.009**
Providing child protection services:	576	4.27	1.020	589	4.06	1.205	3.283	.001***
Providing child welfare services:	567	4.15	1.038	583	3.98	1.189	2.581	.010**
Providing juvenile justice services:	571	4.08	1.077	577	3.93	1.172	2.316	.021**
Providing affordable housing for low income families:	586	3.70	1.270	596	3.56	1.409	1.754	0.08
Providing affordable housing for seniors:	585	4.12	1.108	599	3.92	1.251	2.859	.004**
Providing medical care for the poor:	591	3.94	1.251	595	3.74	1.326	2.783	0.005
Providing 24 hour emergency trauma care:	595	4.60	0.828	600	4.38	0.997	4.120	.000***
Providing crime prevention programs:	593	4.27	0.983	599	3.99	1.141	4.616	.000***
Enforcing traffic laws:	598	4.25	1.026	607	3.91	1.206	5.231	.000***
Maintaining a low crime rate:	598	4.49	0.970	606	4.14	1.221	5.543	.000***
Maintaining neighborhood police patrols:	598	4.30	1.024	604	3.97	1.197	5.144	.000***
Facilitate neighborhood watch programs:	591	4.05	1.083	591	3.69	1.164	5.390	.000***
Preparing for natural disasters, (i.e. floods, earthquakes, etc):	589	4.05	1.113	597	3.75	1.301	4.117	.000***
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events:	590	4.18	1.100	597	3.92	1.282	3.842	.000***
Investigating criminal activity:	594	4.47	0.882	592	4.03	1.108	7.446	.000***
Providing fire protection & prevention services:	599	4.59	0.750	600	4.32	0.900	5.594	.000***
Providing emergency medical services:	598	4.66	0.721	606	4.44	0.856	4.849	.000***
Providing for neighborhood code enforcement services:	566	3.81	1.090	571	3.54	1.182	3.991	.000***
Examining potential impacts from Yucca Mountain nuclear waste shipments:	581	3.88	1.365	581	3.68	1.421	2.547	.011*
Providing affordable housing:	586	3.73	1.317	601	3.47	1.365	3.291	.001***
Managing growth:	596	602.00	1.293	602	3.80	1.295	3.541	.000***
Increasing job opportunities:	592	4.07	1.176	597	3.95	1.179	1.786	0.074
Improving the business climate:	590	4.08	1.036	594	3.86	1.057	3.623	.000***
Planning for commercial development:	587	3.82	1.173	590	3.70	1.113	1.743	0.082
Evaluating impacts to property values as a result of the proposed shipment of nuclear waste to Yucca Mountain:	561	3.78	1.378	571	3.54	1.441	2.254	.004**
Evaluating impacts to Southern Nevada's tourism economy as a result of the proposed shipment of nuclear waste to Yucca Mountain:	562	3.74	1.392	576	3.50	1.453	2.848	.004*
Reducing traffic congestion:	600	4.37	1.036	605	4.02	1.261	5.116	.000***
Access to freeways:	596	4.12	1.067	603	3.83	1.153	4.493	.000***
Improving road conditions:	600	4.29	0.920	607	3.97	1.078	5.492	.000***
Reducing travel time:	598	4.01	1.139	600	3.77	1.185	3.675	.000***
Providing mass public transit:	596	3.86	1.237	599	3.67	1.272	2.642	.008**

* Statistical Significance at p≤ .05

** Statistical Significance at p≤ .01

*** Statistical Significance at p≤ .001

Appendix XIII
Longitudinal Significance Tests

	June 2005			February 2006				
Measurement	N	Mean	Std Deviation	N	Mean	Std Deviation	T-value	P-Value
How would you rate local government's performance in preserving natural areas within Clark County?	575	2.64	0.898	591	2.74	0.873	-2.034	.042*
Which of the following best describes your level of concern, if any, about the current drought and its impact on Clark County?	598	1.67	0.760	605	1.65	0.822	0.473	0.637
In general, how would you rate the quality of Clark County's drinking water?	591	2.99	0.948	590	3.14	0.877	-2.797	.005*
In general, how would you rate Clark County's air quality?	600	2.82	0.777	605	2.99	0.731	-3.837	.000***
Timeliness of response:	244	2.32	1.040	252	2.39	0.969	-0.833	0.405
Courtesy:	247	2.04	0.955	255	2.23	0.918	-2.194	.029*
Competency in handling your issue:	247	2.26	0.987	259	2.32	0.993	-0.696	0.487
Professionalism:	249	2.04	0.939	260	2.19	0.974	-1.783	0.075
Quality of drinking water:	598	3.74	1.351	600	3.81	1.343	-0.926	0.355
Recreational opportunities:	594	3.74	1.100	600	3.61	1.081	1.947	0.052
Condition of streets & roads:	600	3.92	1.031	607	3.87	1.002	0.968	0.333
Availability of public transportation:	584	3.32	1.318	583	3.29	1.264	0.377	0.706
Housing affordability:	593	3.58	1.281	600	3.43	1.354	1.979	.048*
Air quality:	600	3.99	1.072	608	3.76	1.301	3.404	.001***
Availability of job opportunities:	589	3.84	1.176	594	3.89	1.253	-0.722	0.44
Managing growth:	595	3.97	1.253	600	3.66	1.306	4.171	.000***
Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative effect on the quality of life of Southern Nevada Residents? If you feel it will have no impact, you can tell me that too.	566	2.54	0.647	584	2.60	0.659	-0.150	0.133
Amusement Park:	584	2.09	0.843	594	1.78	0.834	6.414	.000***
Day care center:	592	1.61	0.677	593	2.39	0.677	-19.677	.000***
Landfill:	579	2.80	0.529	598	1.13	0.409	60.538	.000***
Non-polluting manufacturing facility:	581	2.19	0.843	591	1.66	0.770	11.275	.000***
Public school:	596	1.36	0.623	603	2.61	0.631	-34.533	.000***
Highway/Freeway:	585	1.87	0.884	593	2.00	870.000	-2.543	.011*
Hotel-casino:	589	2.15	0.843	589	1.88	0.845	5.614	.000***
Polluting manufacturing facility:	597	2.87	0.464	603	1.17	0.516	60.018	.000***
High-level nuclear waste transportation route:	589	2.81	0.476	594	1.18	0.462	59.834	.000***
Overall would you say the quality of life in Clark County is getting better, worse, or staying the same?	585	2.10	0.801	594	2.14	0.785	-0.944	0.345
We are interested in how people are getting along financially these days. Would you say that you and any family members living with you are better or worse off than you were a year ago, or about the same?	594	1.86	0.696	600	1.87	0.740	-0.212	0.832
Now looking ahead - do you think that a year from now your financial situation and the financial situation of any family members will be better, worse or about the same?	586	1.66	0.666	599	1.76	0.749	-2.448	.015*
Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair, or poor?	575	1.66	0.660	599	1.76	0.749	-2.115	.035*
And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same?	576	1.72	0.597	288	1.74	0.620	-0.428	0.669
All things considered, would you rate your local government's performance in providing services as excellent, good, fair, or poor?	598	2.39	0.712	602	2.61	0.699	-5.354	.000***

* Statistical Significance at p≤ .05

** Statistical Significance at p≤ .01

*** Statistical Significance at p≤ .001

Appendix XIV
Instrument Modifications

TO: DR. SHEILA CONWAY, URBAN ENVIRONMENTAL RESEARCH

FROM: JASON GRAY, STRATEGIC SOLUTIONS

AMANDA DEAN, STRATEGIC SOLUTIONS

SUBJECT: CLARK COUNTY MONITORING PROGRAM/DELINEATION OF INSTRUMENT AND SCALE PARAMETER MODIFICATIONS (APPENDIX XIV)

DATE: 01/30/2008

CC: JEREMY AGUERO, APPLIED ANALYSIS

I. Introduction:

Strategic Solutions has prepared the following technical memorandum as a summary of instrument modifications applied to the Clark County Monitoring Program community survey instrument subsequent to the inaugural survey conducted during June 2005. As mentioned in previous sections of this study report, although the survey instrument designed for the February 2006 study remained relatively similar to the inaugural instrument, evaluative objectives became more refined (as is the case in many longitudinal assessments), warranting revision and amendment of measurement variables and response values. More specifically, you will find certain variables, primarily those related to the importance and provision of selected government services, were adapted or expanded while others of limited applicability or utility were omitted altogether. Additionally, response value regimes have been modified in certain instances so as to facilitate a higher order of statistical analysis and more sophisticated reporting format moving forward.

II. Instrument Modifications:

The following description of instrument modifications is based on the structure of the June 2005 instrument. All series and variable identifiers will tie back to the June 2005 instrument and all omissions, changes, and additions applied to the February 2006 instrument are noted in the order of occurrence. The question labels (Q#/**Q#**) are formatted so that the non-bold label (Q#) corresponds to placement in the June 2005 survey instrument whereas the bold label (**Q#**) corresponds to placement in the February 2006 instrument, where applicable.

Importance/Performance of Select Government Services:

General Government Services Importance Series (Q2-Q10/**Q2-Q7**): “I am going to ask you about a number of local government services. On a scale of one to five, where one means “low importance” and five means “high importance,” please rate the level of importance for the following services.”

Series Status (Q2-Q10/**Q2-Q7**): No change to series language or variable response values. Three variables were omitted from this series for the February 2006 survey:

Variable (Q5/**N/A**): "Provide and maintain street lighting"
Variable Status: Omitted from February 2006 instrument

Variable (Q8/**N/A**): "Inform the community about local government services"
Variable Status: Omitted from February 2006 instrument

Variable (Q9/**N/A**): "Inform the community about local government events"
Variable Status: Omitted from February 2006 instrument

General Government Services Performance Series (Q11-Q19/**Q8-Q13**): "In your opinion, based on what you know or what you have heard, would you say local government is doing an excellent, good, fair or poor job performing the following services:"

*Series Status (Q11-Q19/**Q8-Q13**): Series verbiage modified for February 2006 instrument: "In your opinion, based on what you know or what you have heard, please rate the following services on a scale of one to five, where one is "poor" and five is "excellent." Series response values were also modified. Three variables were omitted from the series for the February 2006 survey:

Variable (Q14/**N/A**): "Provide and maintain street lighting"
Variable Status: Omitted from February 2006 instrument:

Variable (Q17/**N/A**): "Inform the community about local government services"
Variable Status: Omitted from February 2006 instrument:

Variable (Q18/**N/A**): "Inform the community about local government events"
Variable Status: Omitted from February 2006 instrument:

Social and Judicial Services Importance Series (Q19-Q28/**Q14-Q22**): "I am going to ask you about a number of local government services. On a scale of one to five, where one means "low importance" and five means "high importance," please rate the level of importance for the following services."

Series Status (Q19-Q28/**Q14-Q22**): No change to series language or variable response values. Two variables were omitted from the series for the February

2006 survey. Additionally, two variables were modified and one variable was added to this series for the February 2006 survey:

Variable (Q22/**N/A**): "Providing parenting skills classes"
Variable Status: Omitted from February 2006 instrument

Variable (Q24/**Q19**): "Providing affordable housing for the homeless"
Variable Status: Modified for February 2006 survey to read: "Providing shelter for the homeless"

Variable (Q25/**Q20**): "Providing housing for seniors"
Variable Status: Modified for February 2006 survey to read: "Providing affordable housing for seniors"

Variable (Q27/**N/A**): "Providing services for mediating neighborhood disputes"
Variable Status: Omitted from February 2006 instrument

Variable (N/A/**Q17)**: "Providing attainable housing for working class families"
Variable Status: Added to series for February 2006 survey

Social and Judicial Services Performance Series (Q29-Q37/**Q23-Q31**): "In your opinion, based on what you know or what you have heard, would you say local government is doing an excellent, good, fair or poor job performing the following services:"

*Series Status (Q29-Q37/**Q23-Q31**): Series verbiage modified for February 2006 instrument: "In your opinion, based on what you know or what you have heard, please rate the following services on a scale of one to five, where one is "poor" and five is "excellent." Series response values were also modified. Two variables were omitted from the series for the February 2006 survey. Additionally, two variables were modified and one variable was added to this series for the February 2006 survey:

Variable (Q32/**N/A**): "Providing parenting skills classes"
Variable Status: Omitted from February 2006 instrument

Variable (Q34/**Q28**): "Providing affordable housing for the homeless"
Variable Status: Modified for February 2006 survey to read: "Providing shelter for the homeless"

Variable (Q35/**Q29**): "Providing housing for seniors"

Variable Status: Modified for February 2006 survey to read:
"Providing affordable housing for seniors"

Variable (Q37/**N/A**): "Providing services for mediating neighborhood disputes"
Variable Status: Omitted from February 2006 instrument

Variable (N/A/**Q26**): "Providing attainable housing for working class families"
Variable Status: Added to series for February 2006 survey

Public Safety Issues Importance Series (Q38-Q51/**Q32-Q47**): "I am going to ask you about a number of local government services. On a scale of one to five, where one means "low importance" and five means "high importance," please rate the level of importance for the following services."

Series Status (Q38-Q51/**Q32-Q47**): No change to series language or variable response values. Two variables were omitted from the series for the February 2006 survey. Additionally, four variables were added to this series for the February 2006 survey:

Variable (Q40/**N/A**): "Enforcing animal control laws"
Variable Status: Omitted from February 2006 instrument

Variable (Q43/**N/A**): "Keeping public safety response times low"
Variable Status: Omitted from February 2006 instrument

Variable (N/A/**Q36**): "Keeping police response times low"
Variable Status: Added to series for February 2006 survey

Variable (N/A/**Q37**): "Keeping fire department response times low"
Variable Status: Added to series for February 2006 survey

Variable (N/A/**Q38**): "Keeping paramedic and emergency medical response times low"
Variable Status: Added to series for February 2006 survey

Variable (N/A/**Q39**): "Well trained paramedic and emergency medical response personnel"
Variable Status: Added to series for February 2006 survey

Public Safety Issues Performance Series (Q52-Q65/**Q48-Q63**): "In your opinion, based on what you know or what you have heard, would you say local government is doing an excellent, good, fair or poor job performing the following services:"

*Series Status (Q52-Q65/**Q48-Q63**): Series verbiage modified for February 2006 instrument: "In your opinion, based on what you know or what you have heard, please rate the following services on a scale of one to five, where one is "poor" and five is excellent." Series response values were also modified. Two variables were omitted from the series for the February 2006 survey. Additionally, four variables were added to this series for the February 2006 survey:

Variable (Q54/**N/A**): "Enforcing animal control laws"
Variable Status: Omitted from February 2006 instrument

Variable (Q57/**N/A**): "Keeping public safety response times low"
Variable Status: Omitted from February 2006 instrument

Variable (N/A/**Q52**): "Keeping police response times low"
Variable Status: Added to series for February 2006 survey

Variable (N/A/**Q53**): "Keeping fire department response times low"
Variable Status: Added to series for February 2006 survey

Variable (N/A/**Q54**): "Keeping paramedic and emergency medical response times low"
Variable Status: Added to series for February 2006 survey

Variable (N/A/**Q55**): "Well trained paramedic and emergency medical response personnel"
Variable Status: Added to series for February 2006 survey

Community Development Issues Importance Series (Q66-Q83/**Q64-Q75**): "I am going to ask you about a number of local government services. On a scale of one to five, where one means "low importance" and five means "high importance," please rate the level of importance for the following services."

Series Status (Q66-Q83/**Q64-Q75**): No change to series language or variable response values. One variable was omitted from the series for the February 2006 survey.

Variable (Q83/**N/A**): "Quality of signs on area roadways"
Variable Status: Omitted from February 2006 instrument

Community Development Issues Performance Series (Q84-Q101/**Q76-Q87**): "In your opinion, based on what you know or what you have heard, would you say local government is doing an excellent, good, fair or poor job performing the following services:"

*Series Status (Q84-Q101/**Q76-Q87**): Series verbiage modified for February 2006 instrument: "In your opinion, based on what you know or what you have heard, please rate the following services on a scale of one to five, where one is

"poor" and five is excellent." Series response values were also modified. One variable was omitted from the series for the February 2006 survey.

Variable (Q101/**N/A**): "Quality of signs on area roadways"
Variable Status: Omitted from February 2006 instrument

**Series label was modified to bring the response value scale for all performance variables in line with importance response value scale. More specifically, performance was tested conceptually on a scale of 1-4, (excellent, good, fair, or poor respectively) during the June 2005 survey. All performance series were changed to a scale of 1-5 (where one means "poor" and five means "excellent") during the February 2006 survey. Importance variables were tested using the 1-5 (where one means "poor" and five means "excellent") scale during both the June 2005 and February 2006 surveys.*

Quality of Life:

Quality of Life Series (Q116-Q124/**Q102-Q110**): "Now I am going to ask you about different factors that may contribute to your quality of life. On a scale of one to five, where one means "low importance" and five means "high importance," please rate the level of importance for the following factors."

Series Status (Q116-Q124/**Q102-Q110**): No change to series language or variable response values. One variable was omitted from this series while one variable was added for the February 2006 survey:

Variable (Q116/**N/A**): "Overall feeling of safety"
Variable Status: Omitted from February 2006 instrument

Variable (N/A/**Q102**): "Overall sense of preparedness in the event of a large scale natural or man-made emergency"
Variable Status: Added to series for February 2006 survey

Yucca Mountain:

Two variables pertinent to the proposed repository at Yucca Mountain were added to the February 2006 instrument:

Variable (N/A/**Q111**): "The Federal government wants to build the nation's first high-level nuclear waste repository at Yucca Mountain in Southern Nevada. If given the opportunity to vote on this matter, would you vote to support or oppose locating a nuclear waste repository at Yucca Mountain?"
Variable Status: Added to series for February 2006 survey

Variable (N/A/**Q112**): "The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository

and the transportation of radioactive waste to the repository so that the public' safety is assured. Do you strongly agree, agree, disagree, or strongly disagree with this claim?"
Variable Status: Added to series for February 2006 survey

Property Value Impacts:

Property Value Impacts Series (Q126-Q134/**Q114-Q122**): "Now I am going to read you a list of things that may or may not affect the value of residential property in Clark County. For each item please tell me whether you believe it would increase, decrease, or have no affect at all on the property value of nearby, privately owned homes."

Series Status (Q126-Q134/**Q114-Q122**):

Series language was modified for the February 2006 instrument to reflect the following:

"Now I am going to read you a list of things that may or may not affect the value of residential property in Clark County. For each item please tell me whether you believe it would decrease, have no affect, or increase the property value of nearby, privately owned homes."

*Series response value regime was amended as follows for the February 2006 survey:

June 2005	February 2006
1=Increase value	1=Decrease value
2=Decrease value	2=No affect on value
3=No affect on value	3=Increase value

General Economic Conditions:

Variable (Q138/**Q126**): Variable language was not modified for the February 2006 instrument: "Overall, would you say that the quality of life in Clark County is getting better, worse or staying about the same?

*Variable response value regime was amended as follows for the February 2006 survey:

June 2005	February 2006
1=Getting Better	1=Getting Better
2=Getting Worse	2=Staying about the same
3=Staying about the same	3=Getting worse

Variable (Q139/**Q127**): Variable language was not modified for the February 2006 instrument: "We are interested in how people are

getting along financially these days. Would you say that you, and any members of your family living with you, are better or worse of financially than they were a year ago, or about the same?

*Variable response value regime was amended as follows for the February 2006 survey:

June 2005	February 2006
1=Better	1=Better
2=Worse	2=About the same
3=About the same	3=Worse

Variable (Q140/**Q128**): Variable language was not modified for the February 2006 instrument: "Now looking ahead-do you think that a year from now your financial situation, and the financial situation of any family members living with you will be better, worse or about the same?"

*Variable response value regime was amended as follows for the February 2006 survey:

June 2005	February 2006
1=Better	1=Better
2=Worse	2=About the same
3=About the same	3=Worse

Variable (Q142/**Q130**): Variable language was not modified for the February 2006 instrument: "And how about a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?"

*Variable response value regime was amended as follows for the February 2006 survey:

June 2005	February 2006
1=Better	1=Better
2=Worse	2=About the same
3=About the same	3=Worse

**June 2005 survey response values for this variable were re-coded to bring the central value in position, facilitating measures of central tendency.*

###

Attachment 16

UER, “Clark County Monitoring Program: Community Survey”

(Jul 2006)

Clark County Monitoring Program

Summer 2006

APPLIED ANALYSIS

strategic solutions

UER
Urban Environmental Research, LLC

Clark County Monitoring Program: Community Survey
Summer 2006

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TO: MS. IRENE NAVIS, AICP
FROM: DR. SHEILA CONWAY; JEREMY AGUERO
SUBJECT: CLARK COUNTY MONITORING PROGRAM | Summer 2006
DATE: October 18, 2006
CC: BRIAN GORDON/APPLIED ANALYSIS
DR. ALVIN MUSKATEL/UER;
JASON GRAY/STRATEGIC SOLUTIONS

This memorandum summarizes the key findings of the bi-annual Summer 2006 Clark County Monitoring Program Survey conducted by Urban Environmental Research, Applied Analysis and Strategic Solutions on behalf of the Nuclear Waste Division. A more detailed statistical assessment of our methodology and findings is available in the accompanying comprehensive assessment binder and will be posted to the Clark County Monitoring Program's website (www.monitoringprogram.com) upon your approval of this deliverable. The intent of this memorandum is to provide an executive level overview of our salient findings.

A. GENERAL OVERVIEW

During the month of September 2006, Strategic Solutions, in coordination with Urban Environmental Research and Applied Analysis, administered a 143-question telephone survey to 600 Southern Nevada households. The survey, which touches on a broad number of topics, has a margin of error of ±4 percent at the 95 percent confidence level. The principal purpose of the Clark County Monitoring Program, including this survey series, is to establish an analysis baseline from which the impacts of transporting high-level nuclear waste through the Las Vegas Valley, and ultimately storing the radioactive material at the proposed Yucca Mountain Nuclear Waste Repository, can be monitored, measured and assessed.

Generally speaking, the survey is segmented into seven areas of inquiry: 1) public service importance; 2) public service performance; 3) quality-of-life considerations; 4) general economic considerations; 5) property value impact considerations; 6) environmental considerations; and 7) local government interaction. In addition to these general areas of inquiry, information on the demographic and socio-economic profile of respondents is also routinely gathered.

It is easy to conceptualize how the transportation of high-level nuclear waste through a community might negatively impact property values. It is a bit more

difficult to identify the nexus to child welfare programs, homelessness, flood protection or crime enforcement. In absence of mitigating funds, it is likely that Nevada's state and local governments will be required to shift resources away from existing programs and into efforts aimed at ensuring threats, patent and latent, sourced to storage and transportation of high-level nuclear waste are addressed. Shifts away from existing public services would be expected to reduce the quality of life with the community and may also have far-reaching economic, fiscal and social implications. Analyzing these questions requires not only an understanding of resource allocations to specific programs but also the relative importance and effectiveness of those programs. The Clark County Monitoring Program survey series is designed to provide analysts this more comprehensive framework from which impact assessments can be appropriately derived.

B. KEY FINDINGS

- Strong public service importance and performance scores for fire and emergency medical services.
- Economic conditions showing signs of weakening.
- Notable increases in the importance assigned to child-related public service categories.
- Crime appears to be an increasing concern among respondents.
- Drought remains the most pressing environmental issue.
- Housing market weakening; housing affordability /attainability not cited as a primary area of concern.

C. YUCCA MOUNTAIN QUESTIONS

- Respondents overwhelmingly oppose the Yucca Mountain project, with 71.4 percent indicating that given the opportunity to vote on the matter, they would vote against it. More than two-thirds of respondents indicated a belief that the facility will have a negative impact on their quality of life. When asked the same question in the Summer 2005 survey, 59 percent of respondents expected a negative impact.

- Trust regarding the Yucca Mountain project remains a key concern. Roughly 66 percent of all respondents indicate that they "disagree" or "strongly disagree" that the U.S. Department of Energy can be trusted to ensure the public's safety as it relates to transportation and storage of high-level nuclear waste.

- When asked what one change would most improve the quality of life in Southern Nevada, one out every nine respondents indicated "stop Yucca Mountain." While some technical changes were made to this question, the number responding similarly in the Summer 2005 survey was one out of every 11 respondents.

- Approximately 83 percent of respondents indicated an expectation that having a high-level nuclear waste transportation route near residential housing would have

a negative impact on property values. This figure is consistent with those reported previously. Nuclear waste transportation remains in the same general perception category as a landfill or polluting manufacturing facility.

- In terms of public service importance measures, Yucca Mountain-related considerations, including those related to preparing for man-made accidents or terrorist events; those examining potential impacts from Yucca Mountain nuclear waste shipments; and those relating to the communication of Clark County's views about Yucca Mountain to Federal decision makers all remained fairly consistent. On a one-to-five rating scale, these considerations tend to receive above-average scores, but are valued significantly lower than more immediate public safety, transportation and economic concerns.

- As an urgent environmental concern, the Yucca Mountain facility's placement among major issues was materially unchanged. Approximately 1.9 percent of respondents identified the Yucca Mountain project as Southern Nevada's most pressing environmental concern; this was 0.1 percent higher than reported in the Summer 2005 series.

D. PUBLIC SERVICE IMPORTANCE CONSIDERATIONS (FIGURES 1 & 2)

- Public service importance continued to be dominated by public safety considerations, which accounted for four of the top five and seven out of the top ten most highly-rated services. Traffic and transportation-related services also remained high on the list.

- On a relative scale, only modest movement was noted in the majority of services. We did note, however, that "increasing job opportunities" tracked up six places overall. This, combined with reduced optimism regarding economic conditions and significant movement in job availability as a quality-of-life factor (both discussed later), may be an early indication of softening in the economy.

- Also increasing on an ordinal basis was "providing child protective services" and "providing child welfare services." This may be partially the result of increased media coverage in these areas, although the direction of this relationship is unclear. A closer examination of this service area is warranted.

SCALE

Importance Scale	Performance Scale
Very Important (4.0 -5.0)	Excellent (4.0 – 4.99)
Important (3.0 – 3.99)	Good (3.0 – 3.99)
Neither Important or Not Important (2.0 – 2.99)	Average (2.0 – 2.99)
Not Very Important (1.0 – 1.99)	Fair (1.0 – 1.99)
Not Important At All (< 1.0)	Poor (<1.0)

FIGURE 1 PUBLIC SERVICE IMPORTANCE SCORE SUMMARY

Public Service Importance Score Summary

Service Category	Descriptive Statistics	Mean Summer '05	Mean Winter '06	Change	Mean Summer '06	Change from Winter '06	Change from Summer '05
General Government	Road Maintenance	4.21	4.05	-0.16	4.04	-0.01	-0.17
	Revitalizing older neighborhoods	3.59	3.41	-0.18	3.52	0.11	-0.07
	Flood control	4.09	3.88	-0.21	3.86	-0.02	-0.23
	Budget management	4.29	3.99	-0.3	4.23	0.24	-0.06
	Communicate Clark County's local government views about Yucca Mountain to federal decision makers	3.86	3.67	-0.19	3.58	-0.09	-0.28
	Monitor and report to the public on how well government services are being performed	3.90	3.72	-0.18	3.75	0.03	-0.15
	Water conservation programs	n/a	n/a		4.12		
Social and Judicial Services	Providing child protection services	4.27	4.06	-0.21	4.11	0.05	-0.16
	Providing child welfare services	4.15	3.98	-0.17	3.98	0	-0.17
	Providing juvenile justice services	4.08	3.93	-0.15	3.87	-0.06	-0.21
	Providing attainable housing for working class families	n/a	3.72		3.77	0.05	
	Providing affordable housing for low income families	3.70	3.56	-0.14	3.64	0.08	-0.06
	Providing shelter for the homeless	3.38	3.33	-0.05	3.54	0.21	0.16
	Providing affordable housing for seniors	4.12	3.92	-0.2	3.91	-0.01	-0.21
	Providing medical care for the poor	3.94	3.74	-0.2	3.74	0	-0.2
	Providing 24 hour emergency trauma care	4.60	4.38	-0.22	4.29	-0.09	-0.31
Public Safety	Providing crime prevention programs	4.27	3.99	-0.28	4.09	0.1	-0.18
	Enforcing traffic laws	4.25	3.91	-0.34	4.07	0.16	-0.18
	Maintaining a low crime rate	4.49	4.14	-0.35	4.28	0.14	-0.21
	Maintaining neighborhood police patrols	4.30	3.97	-0.33	4.08	0.11	-0.22
	Keeping police response times low	4.45	4.24	-0.21	4.60	0.36	0.15
	Keeping fire department response times low	4.45	4.54	0.09	4.47	-0.07	0.02
	Keeping paramedic and emergency medical response times low	4.45	4.56	0.11	4.54	-0.02	0.09
	Well trained paramedic and emergency medical response personnel	n/a	4.64		4.57	-0.07	
	Facilitate neighborhood watch programs	4.05	3.69	-0.36	3.79	0.1	-0.26
	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	4.04	3.75	-0.29	3.87	0.12	-0.17
	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	4.18	3.92	-0.26	4.01	0.09	-0.17
	Investigating criminal activity	4.47	4.03	-0.44	4.24	0.21	-0.23
	Providing fire protection & prevention services	4.59	4.32	-0.27	4.26	-0.06	-0.33
	Providing emergency medical services	4.66	4.44	-0.22	4.43	-0.01	-0.23
	Providing for neighborhood code enforcement services	3.81	3.54	-0.27	3.58	0.04	-0.23
	Examining potential impacts from Yucca	3.88	3.68	-0.2	3.65	-0.03	-0.23

	Mountain nuclear waste shipments						
	Regional justice services and facilities	n/a	n/a		3.60		
Community Development	Providing affordable housing	n/a	n/a		3.68		
	Managing growth	4.07	3.83	-0.24	3.87	0.04	-0.2
	Increasing job opportunities	4.07	3.95	-0.12	3.82	-0.13	-0.25
	Improving the business climate	4.08	3.86	-0.22	3.75	-0.11	-0.33
	Planning for commercial development	3.82	3.70	-0.12	3.56	-0.14	-0.26
	Reducing traffic congestion	4.37	4.02	-0.35	4.06	0.04	-0.31
	Access to freeways	4.12	3.83	-0.29	3.92	0.09	-0.2
	Improving road conditions	4.29	3.97	-0.32	4.04	0.07	-0.25
	Reducing travel time	4.01	3.77	-0.24	3.83	0.06	-0.18
	Providing mass public transit	3.86	3.67	-0.19	3.64	-0.03	-0.22
	Adequate airport facilities	n/a	n/a		3.91		
	Parks and recreation programs	n/a	n/a		4.02		

FIGURE 2 PUBLIC SERVICE IMPORTANCE SCORE RANKING

	Ranking		
Descriptive Statistics	**Winter (Feb) '06**	**Summer (Sept) '06**	**Change**
Keeping police response times low	7	1	6
Well trained paramedic and emergency medical response personnel	1	2	-1
Keeping paramedic and emergency medical response times low	2	3	-1
Keeping fire department response times low	3	4	-1
Providing emergency medical services	4	5	-1
Providing 24 hour emergency trauma care	5	6	-1
Maintaining a low crime rate	8	7	1
Providing fire protection & prevention services	6	8	-2
Investigating criminal activity	11	9	2
Budget management	13	10	3
Water conservation programs	n/a	11	n/a
Providing child protection services	9	12	-3
Providing crime prevention programs	14	13	1
Maintaining neighborhood police patrols	17	14	3
Enforcing traffic laws	22	15	7
Reducing traffic congestion	12	16	-4
Road Maintenance	10	17	-7
Improving road conditions	16	18	-2
Parks and recreation programs	n/a	19	n/a
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	21	20	1
Providing child welfare services	15	21	-6
Access to freeways	25	22	3
Providing affordable housing for seniors	20	23	-3
Adequate airport facilities	n/a	24	n/a
Providing juvenile justice services	19	25	-6
Preparing for natural disasters (i.e. floods, earthquakes, etc.)	28	26	2
Managing growth	26	27	-1
Flood control	23	28	-5
Reducing travel time	27	29	-2
Increasing job opportunities	18	30	-12
Facilitate neighborhood watch programs	33	31	2
Providing attainable housing for working class families	30	32	-2
Monitor and report to the public on how well government services are being performed	31	33	-2

Improving the business climate	24	34	-10
Providing medical care for the poor	29	35	-6
Providing affordable housing	n/a	36	n/a
Examining potential impacts from Yucca Mountain nuclear waste shipments	34	37	-3
Providing affordable housing for low income families	37	38	-1
Providing mass public transit	35	39	-4
Regional justice services and facilities	n/a	40	n/a
Communicate Clark County's local government views about Yucca Mountain to federal decision makers	36	41	-5
Providing for neighborhood code enforcement services	38	42	-4
Planning for commercial development	32	43	-11
Providing shelter for the homeless	42	44	-2
Revitalizing older neighborhoods	41	45	-4

FIGURE 3 GOVERNMENT SERVICE PERFORMANCE SCORE

Government Service Performance Rating

		Mean		
Service Category	**Descriptive Statistics**	**Importance**	**Performance**	**Disparity**
General Government	Road maintenance	4.04	3.21	-0.83
	Revitalizing older neighborhoods	3.52	2.67	-0.85
	Flood control	3.86	3.54	-0.32
	Budget management	4.23	2.70	-1.53
	Communicate Clark County's local government views about Yucca Mountain to federal decision makers	3.58	2.82	-0.76
	Monitor and report to the public on how well government services are being performed	3.75	2.59	-1.16
	Water conservation programs	4.12	3.31	-0.81
Social and Judicial Services	Providing child protection services	4.11	2.76	-1.35
	Providing welfare services	3.98	2.80	-1.18
	Providing juvenile justice services	3.87	2.88	-0.99
	Provide attainable housing for working class families	3.77	2.53	-1.24
	Providing affordable housing for low income families	3.64	2.47	-1.17
	Providing shelter for the homeless	3.54	2.23	-1.31
	Providing affordable housing for seniors	3.91	2.70	-1.21
	Providing medical care for the poor	3.74	2.68	-1.06
	Providing 24 hour emergency trauma care	4.29	3.24	-1.05
Public Safety	Providing crime prevention programs	4.09	2.99	-1.1
	Enforcing traffic laws	4.07	2.99	-1.08
	Maintaining a low crime rate	4.28	2.82	-1.46
	Maintaining neighborhood police patrols	4.08	2.75	-1.33
	Keeping police response times low	4.60	3.02	-1.58
	Keeping fire department response times low	4.47	3.75	-0.72
	Keeping paramedic and emergency medical response times low	4.54	3.72	-0.82
	Well trained paramedic and emergency medical response personnel	4.57	3.85	-0.72
	Facilitate neighborhood watch programs	3.79	2.87	-0.92
	Preparing for natural disasters (i.e. floods, earthquakes, etc.)	3.87	2.87	-1
	Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	4.01	2.90	-1.11
	Investigating criminal activity	4.24	3.08	-1.16
	Providing fire protection & prevention services	4.26	3.52	-0.74

	Providing emergency medical services	4.43	3.59	-0.84
	Providing for neighborhood code enforcement services	3.58	3.01	-0.57
	Examining potential impacts from Yucca Mountain nuclear waste shipments	3.65	2.75	-0.9
	Regional justice services and facilities	3.60	3.10	-0.5
Community Development	Providing affordable housing	3.68	2.56	-1.12
	Managing growth	3.87	2.62	-1.25
	Increasing job opportunities	3.82	2.96	-0.86
	Improving the business climate	3.75	3.12	-0.63
	Planning for commercial development	3.56	3.14	-0.42
	Reducing traffic congestion	4.06	2.60	-1.46
	Access to freeways	3.92	3.21	-0.71
	Improving road conditions	4.04	3.11	-0.93
	Reducing travel time	3.83	2.79	-1.04
	Providing mass public transit	3.64	2.68	-0.96
	Adequate airport facilities	3.91	3.59	-0.32
	Parks and recreation programs	4.02	3.54	-0.48

FIGURE 4 YUCCA MOUNTAIN SERVICE IMPORTANCE SCORE SUMMARY

Yucca Mountain Service Importance Score Summary	
Descriptive Statistics	**Public Service Importance**
Keeping local decision makers up to date on Yucca Mountain	3.89
Keeping the public up to date about Yucca Mountain	3.93
Reviewing technical, scientific studies about seismic, vulcanology, geology and hydrology	3.84
Identify public safety needs and impacts	3.96
Assess other government impacts	3.66
Assess impacts on the tourist sector	3.61
Assess impacts on the building, construction, and development sectors	3.57
Identify transportation impacts	3.68
Provide information to the public on all facts of Yucca Mountain	3.91

Appendix I

Performance Score for Selected Services

Appendix I
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)

Importance Variable	N	Mean	Std. Error of Mean	Median	Min	Max	Std. Deviation	Kurtosis	Std Error of Kurtosis	Skewness	Std. Error of Skewness
** General Government*											
Road Maintenance	596	4.04	.045	4	1	5	1.10	.23	.200	-.987	.10
Revitalizing older neighborhoods	586	3.52	.051	4	1	5	1.233	-.848	.202	-.358	.101
Flood control	596	3.86	.048	4	1	5	1.172	-.437	.200	-.729	.100
Budget management	576	4.23	.044	5	1	5	1.053	1.24	.206	-1.370	.102
Communicate Clark County's local government views about Yucca Mountain to federal decision makers	574	3.58	.061	4	1	5	1.452	.102	-1.087	-.567	.102
Monitor and report to the public on how well government services are being performed	584	3.75	.052	4	1	5	1.263	-.688	.202	-.647	.101
Water conservation programs	591	4.12	.046	5	1	5	1.108	.531	.201	-1.154	.201
** Social and Judicial Services*											
Providing child protection services	588	4.11	.052	5	1	5	1.250	.422	.201	-1.259	.101
Providing child welfare services	584	3.98	.50	4	1	5	1.205	-.149	.202	-.957	.101
Providing juvenile justice services	582	3.87	.048	4	1	5	1.156	-.217	.202	-.795	.101
Providing attainable housing for working class families	592	3.77	.056	4	1	5	1.350	-.723	.201	-.747	.100
Providing affordable housing for low income families	589	3.64	.056	4	1	5	1.367	-.866	.201	-.620	.101
Providing shelter for the homeless	591	3.54	.058	4	1	5	1.411	-1.089	.201	-.472	.100
Providing affordable housing for seniors	587	3.91	.051	4	1	5	1.231	-.255	.201	-.891	.101
Providing medical care for the poor	590	3.74	.054	4	1	5	1.313	-.642	.201	-.722	.100
Providing 24 hour emergency trauma care	591	4.29	.043	5	1	5	1.038	1.090	.201	-1.40	.101
** Public Safety*											
Providing crime prevention programs	592	4.09	.045	4	1	5	1.094	.514	.201	-1.115	.100
Enforcing traffic laws	598	4.07	.045	4	1	5	1.110	.457	.199	-1.104	.100

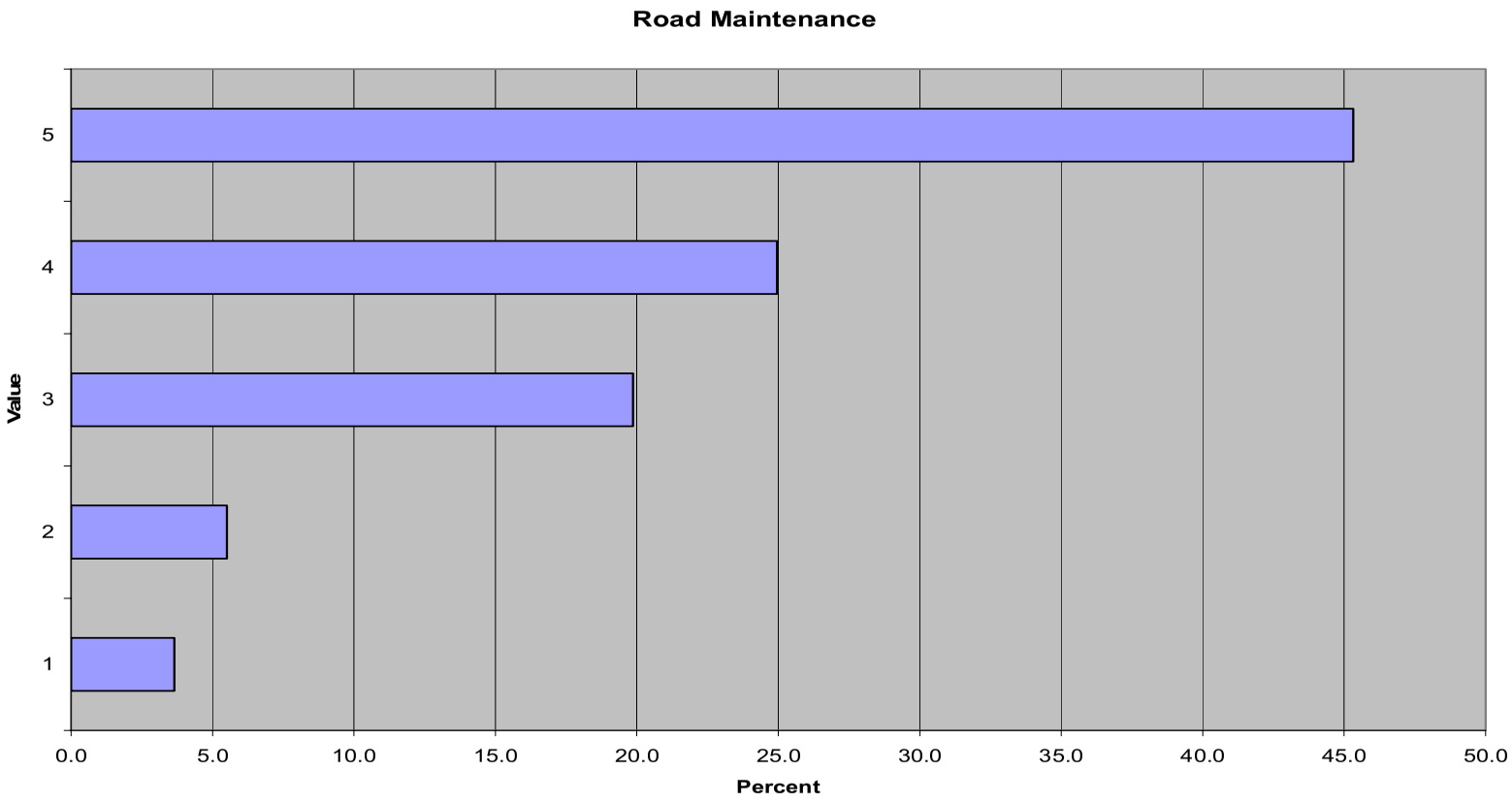
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)

Importance Variable	N	Mean	Std. Error of Mean	Median	Min	Max	Std. Deviation	Kurtosis	Std Error of Kurtosis	Skewness	Std. Error of Skewness
Maintaining a low crime rate	599	4.28	.045	5	1	5	1.106	1.246	.199	-1.491	.100
Maintaining neighborhood police patrols	598	4.08	.047	5	1	5	1.106	.304	.200	-1.111	.100
Keeping police response times low	593	4.30	.041	5	1	5	1.155	1.408	.200	-1.456	.100
Keeping fire department response times low	593	4.47	.039	5	1	5	1.009	2.798	.200	-1.830	.100
Keeping paramedic and emergency medical response times low	595	4.54	.034	5	1	5	.913	4.487	.200	-2.088	.100
Well trained paramedic and emergency medical response personnel	594	4.57	.034	5	1	5	.832	4.938	.200	-2.226	.100
Facilitate neighborhood watch programs	589	3.79	.046	4	1	5	.824	-.280	.200	-.650	.101
Preparing for natural disasters (i.e. floods, earthquakes, etc.)	593	3.89	.049	4	1	5	1.120	-.321	.200	-.793	.100
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	596	4.01	.049	4	1	5	1.189	.031	.200	-1.018	.100
Investigating criminal activity	595	4.24	.041	5	1	5	1.189	1.251	.200	-1.342	.100
Providing fire protection & prevention services	592	4.26	.040	5	1	5	1.011	1.014	.200	-1.255	.100
Providing emergency medical services	593	4.43	.037	5	1	5	.975	2.583	.200	-1.716	.100
Providing for neighborhood code enforcement services	582	3.58	.049	4	1	5	.912	-.633	.202	-.448	.101
Examining potential impacts from Yucca Mountain nuclear waste shipments	575	3.65	.60	4	1	5	1.179	-1.037	.203	-.594	.102
Regional justice services and facilities	580	3.60	.045	4	1	5	1.443	-.361	.200	-.417	.101
** Community Development*											
Providing affordable housing	593	3.68	.056	4	1	5	1.357	-.788	.200	-.656	.100
Managing growth	590	3.87	.054	4	1	5	1.315	-.279	.201	-.944	.101

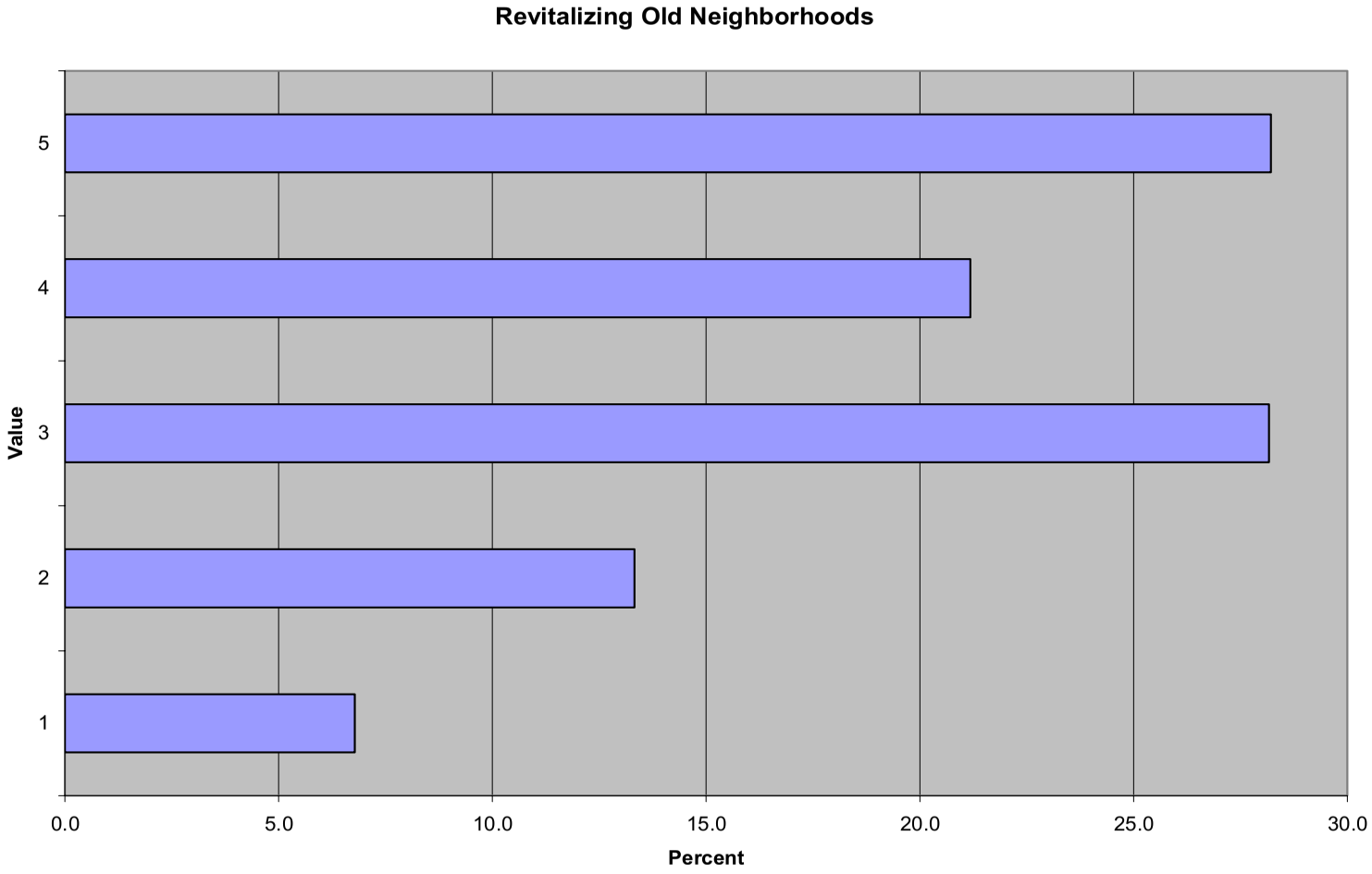
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)

Importance Variable	N	Mean	Std. Error of	Median	Min	Max	Std. Deviation	Kurtosis	Std Error of	Skewness	Std. Error of
Increasing job opportunities	591	3.82	.051	4	1	5	1.239	-.366	.201	-.799	.101
Improving the business climate	592	3.75	.048	4	1	5	1.173	-.278	.200	-.716	.100
Planning for commercial development	595	3.56	.049	4	1	5	1.193	-.591	.200	-.492	.100
Reducing traffic congestion	598	4.06	.051	5	1	5	1.242	.269	.199	-1.184	.100
Access to freeways	598	3.92	.046	4	1	5	1.125	-.018	.200	-.869	.100
Improving road conditions	599	4.04	.045	4	1	5	1.100	.324	.199	-1.017	.100
Reducing travel time	592	3.83	.049	4	1	5	1.193	-.312	.201	-.772	.100
Providing mass public transit	587	3.64	.053	4	1	5	1.289	-.722	.201	-.600	.101
Adequate airport facilities	588	3.71	.045	4	1	5	1.092	-.005	.201	-.803	.101
Parks and recreation programs	591	4.02	.044	4	1	5	1.081	.193	.201	-.933	.101

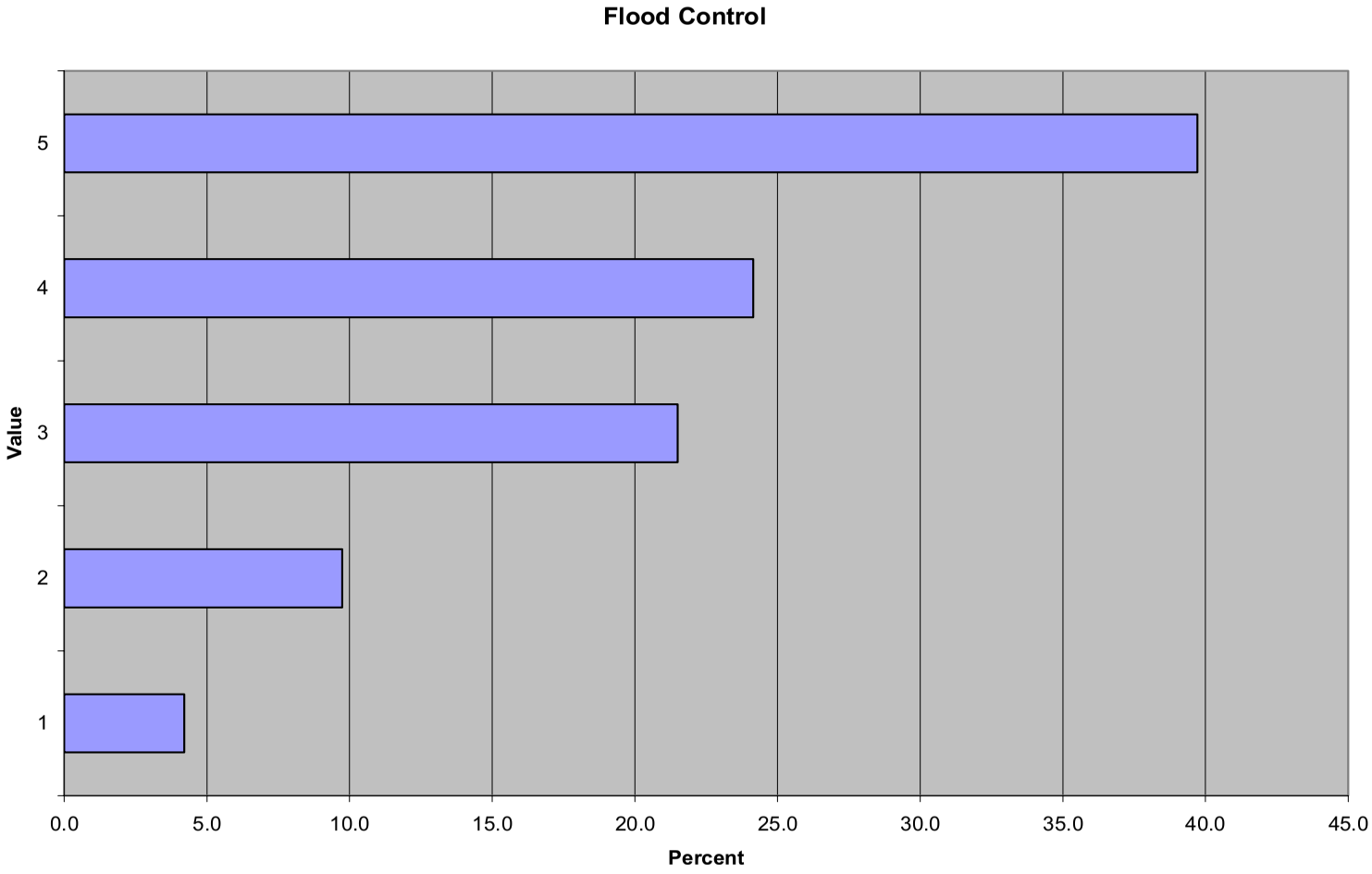
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



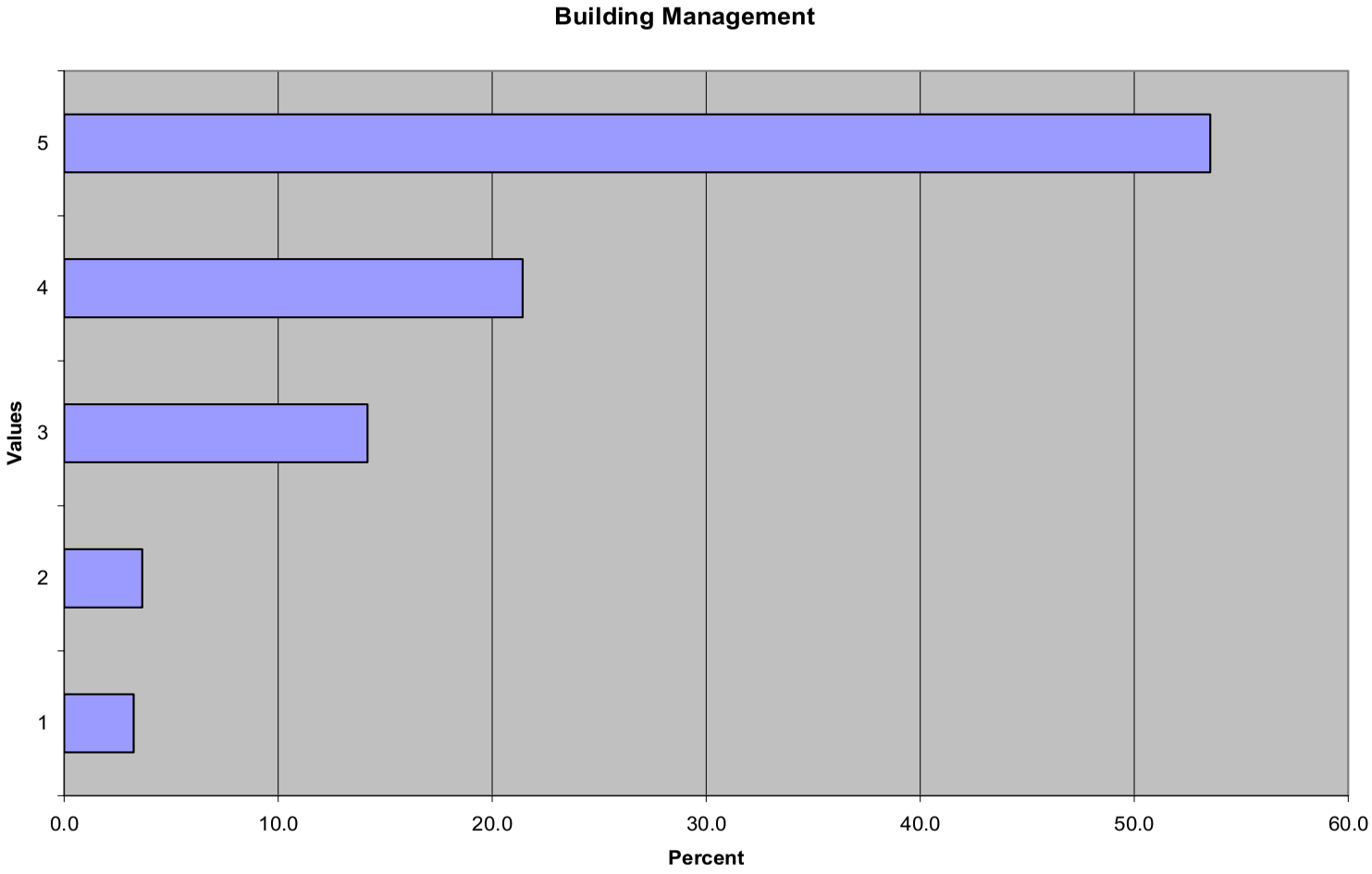
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



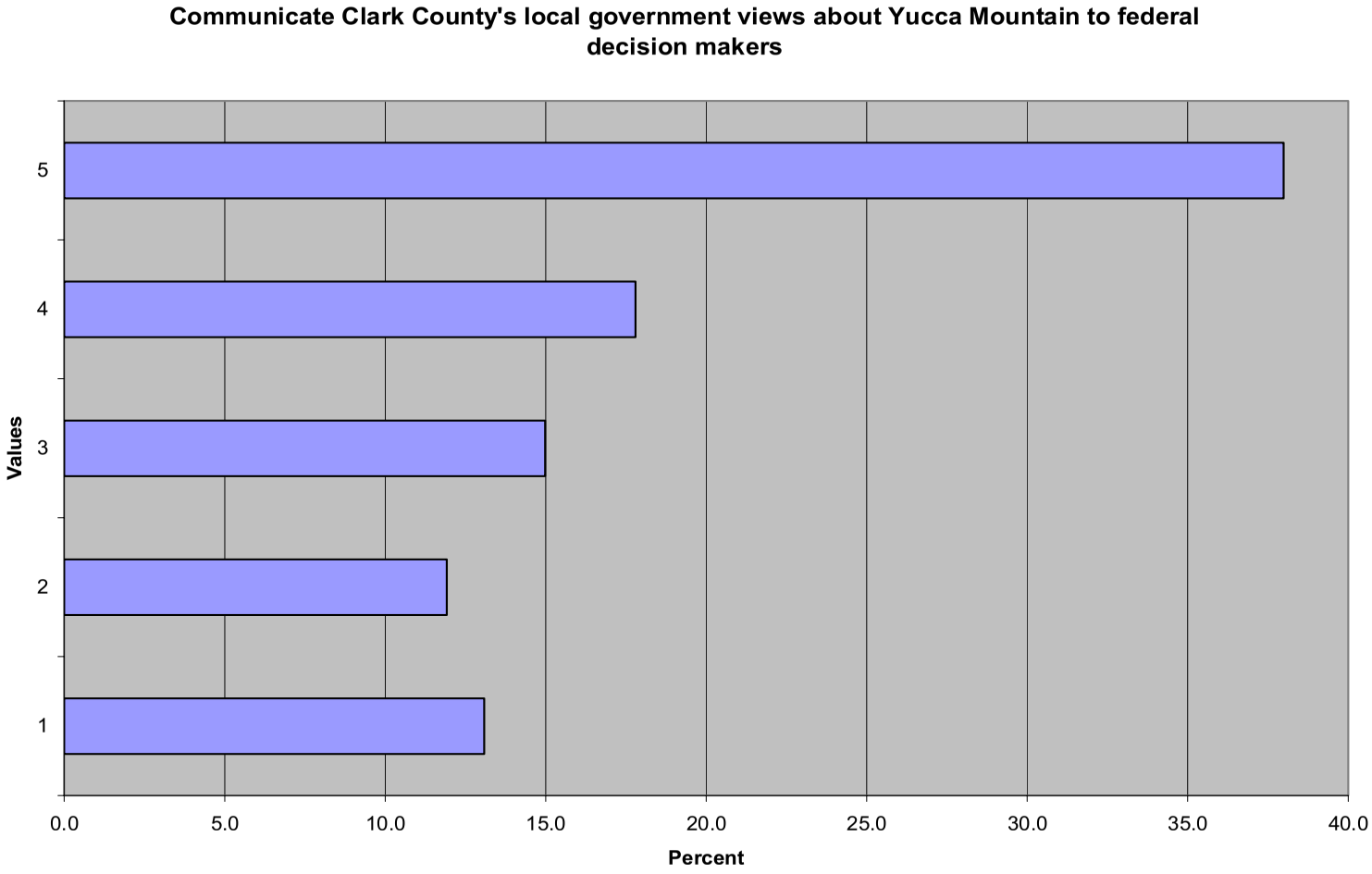
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



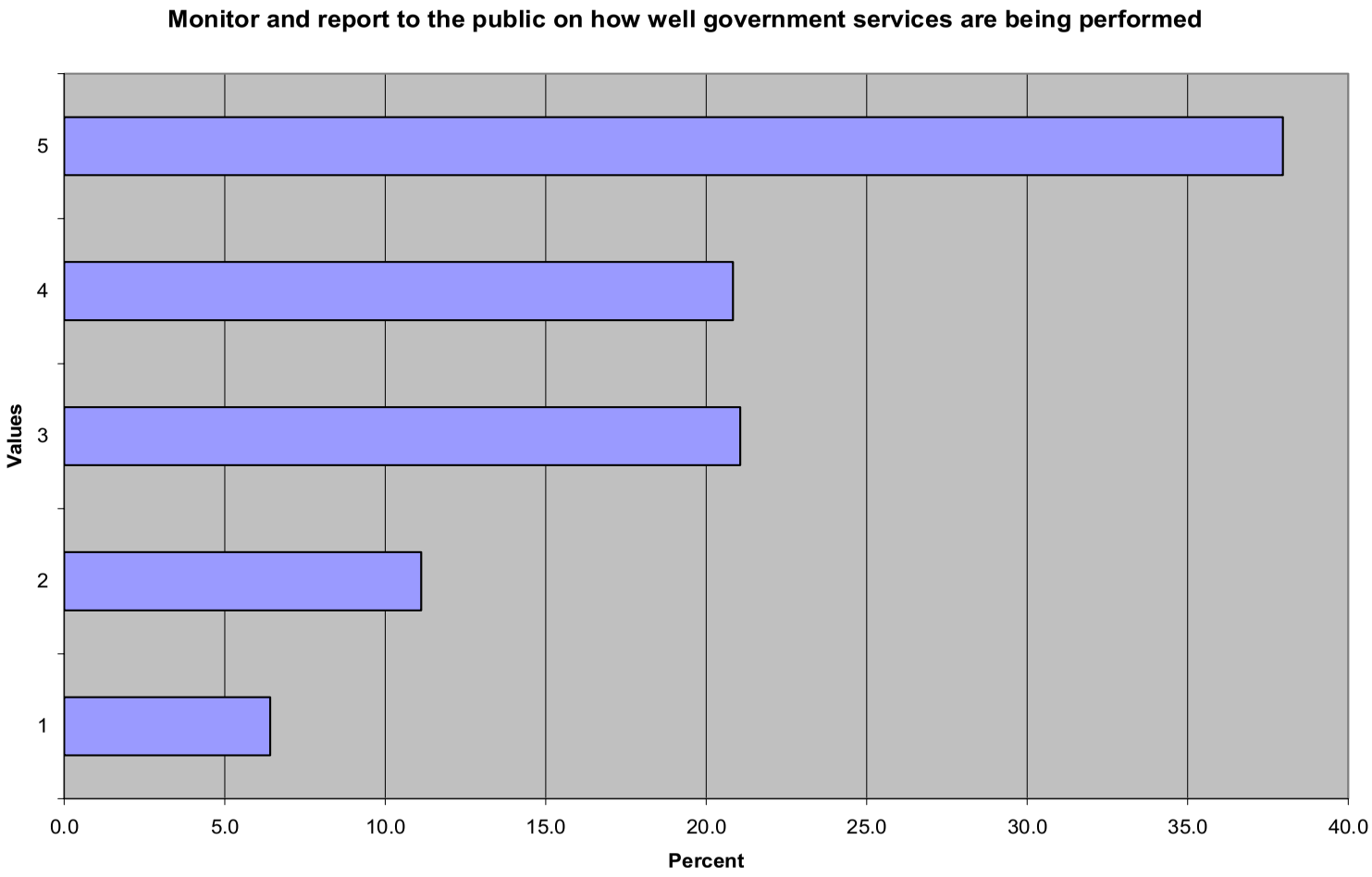
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



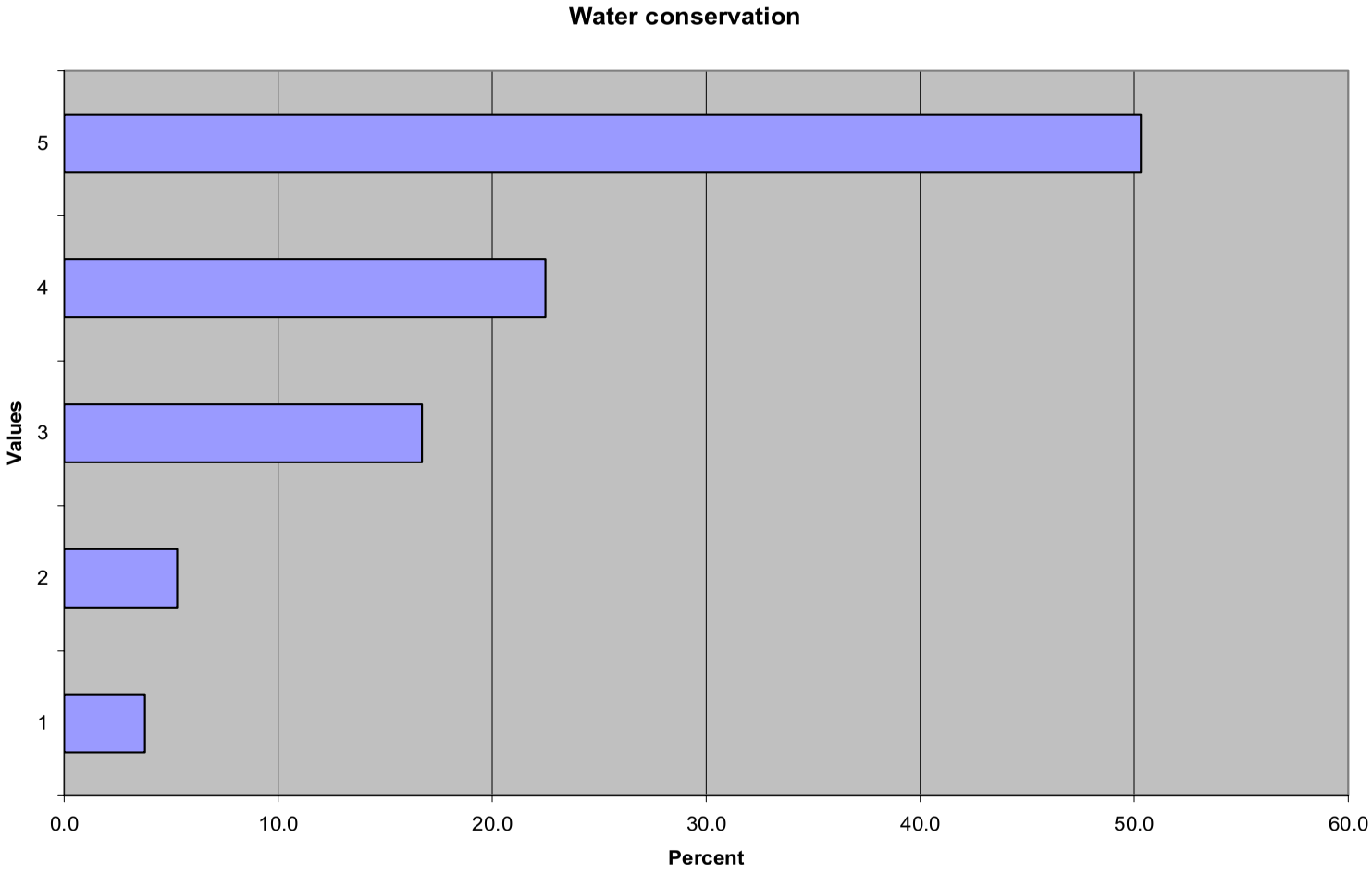
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



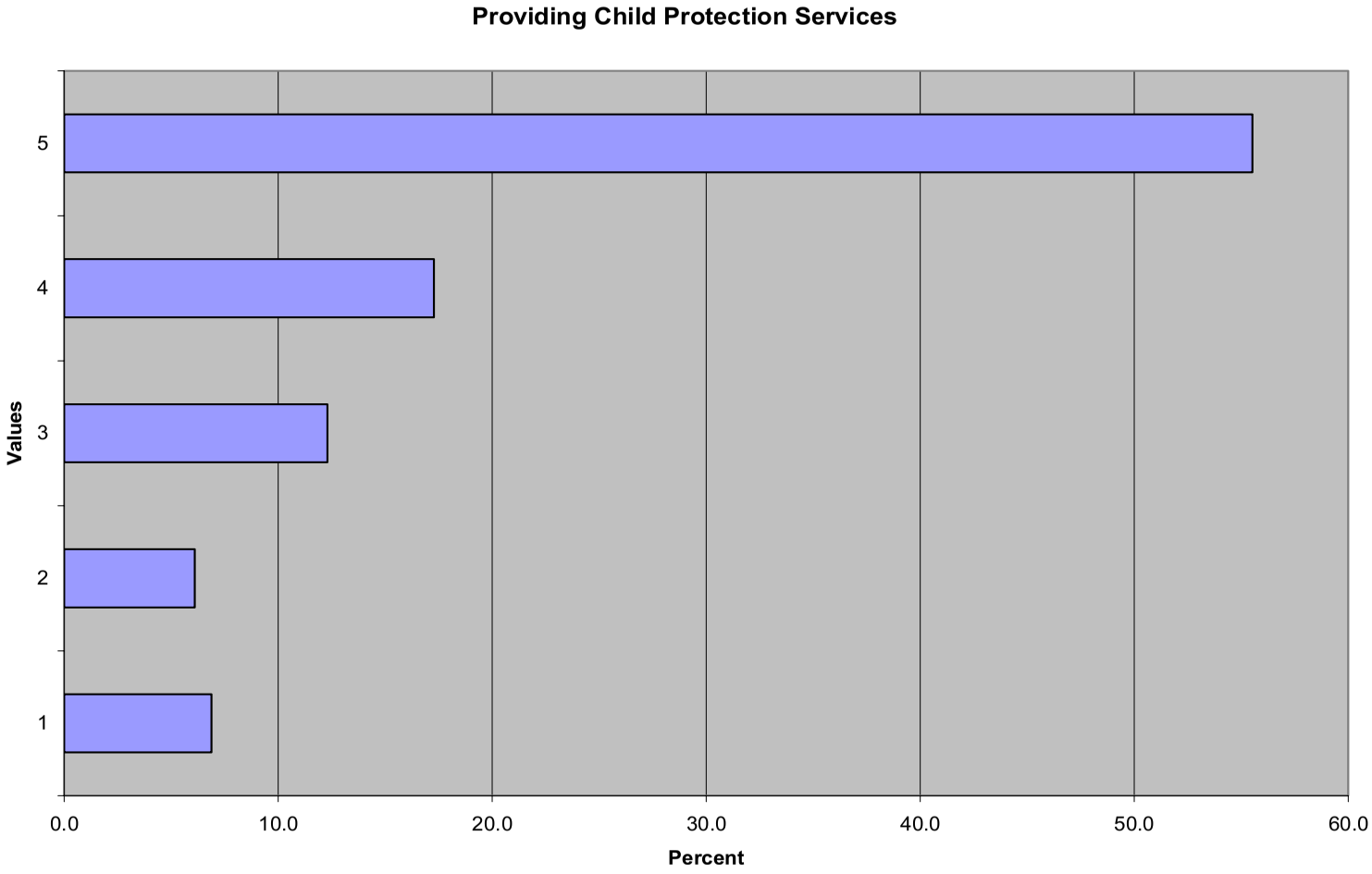
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



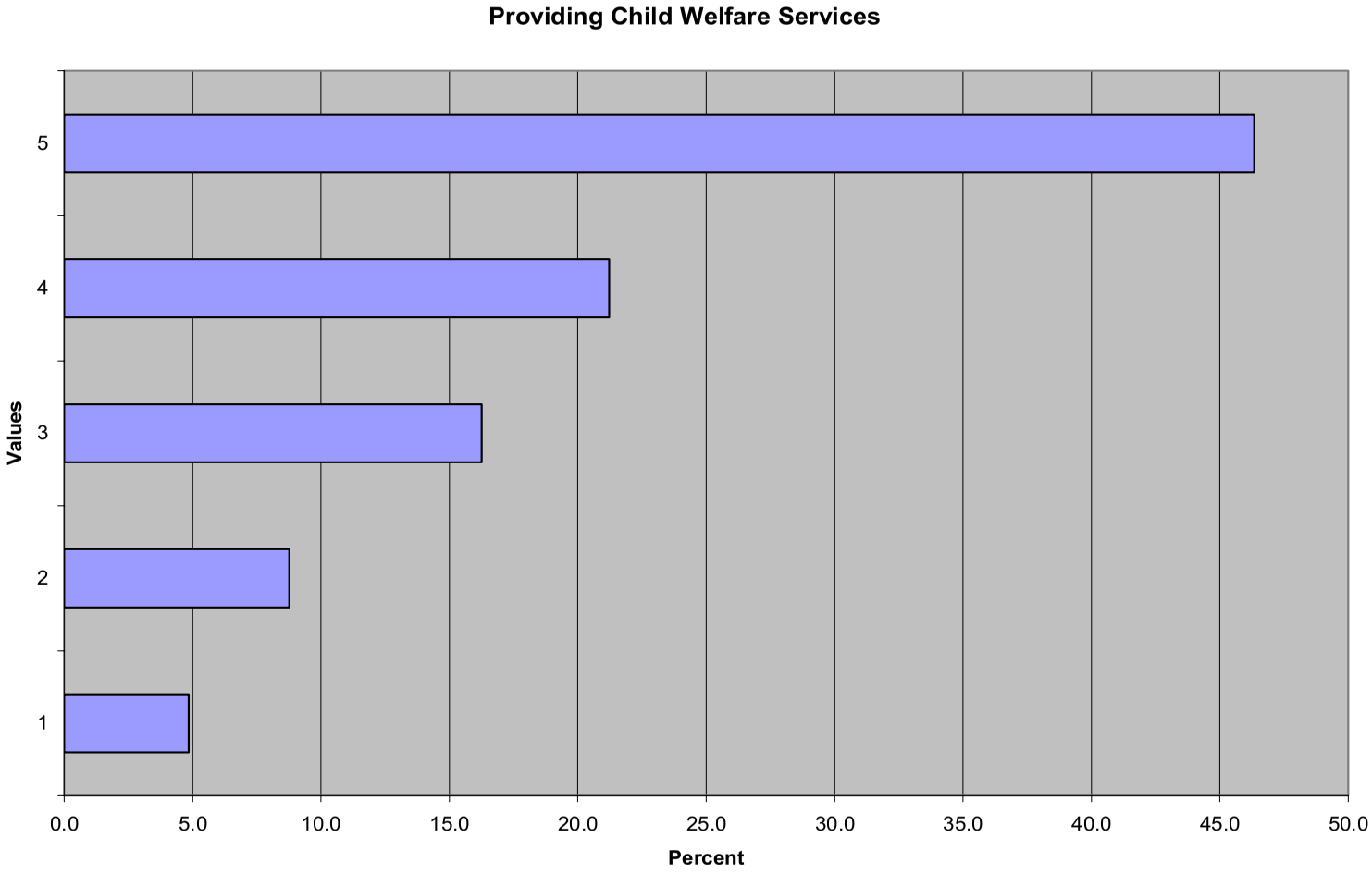
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



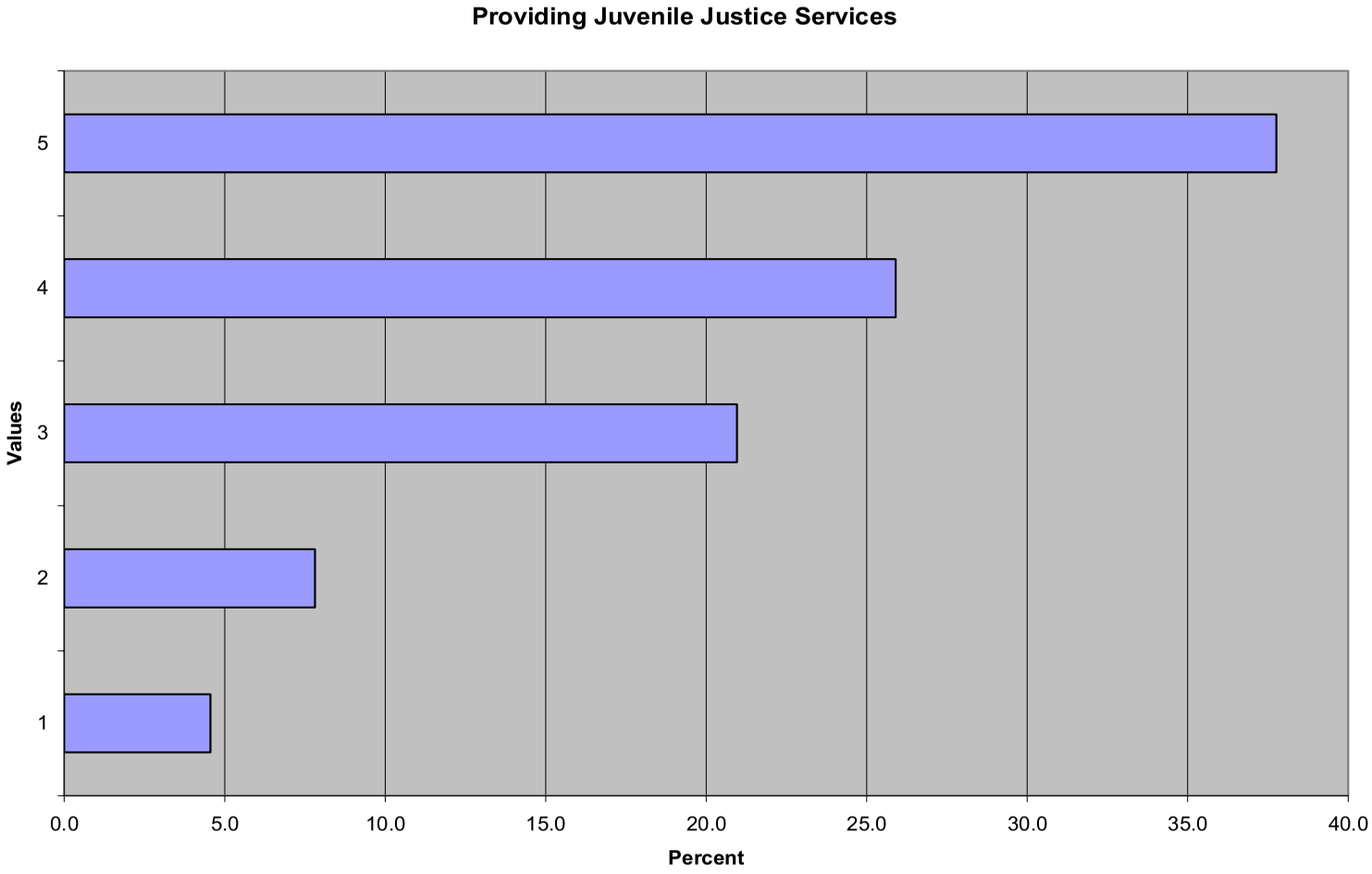
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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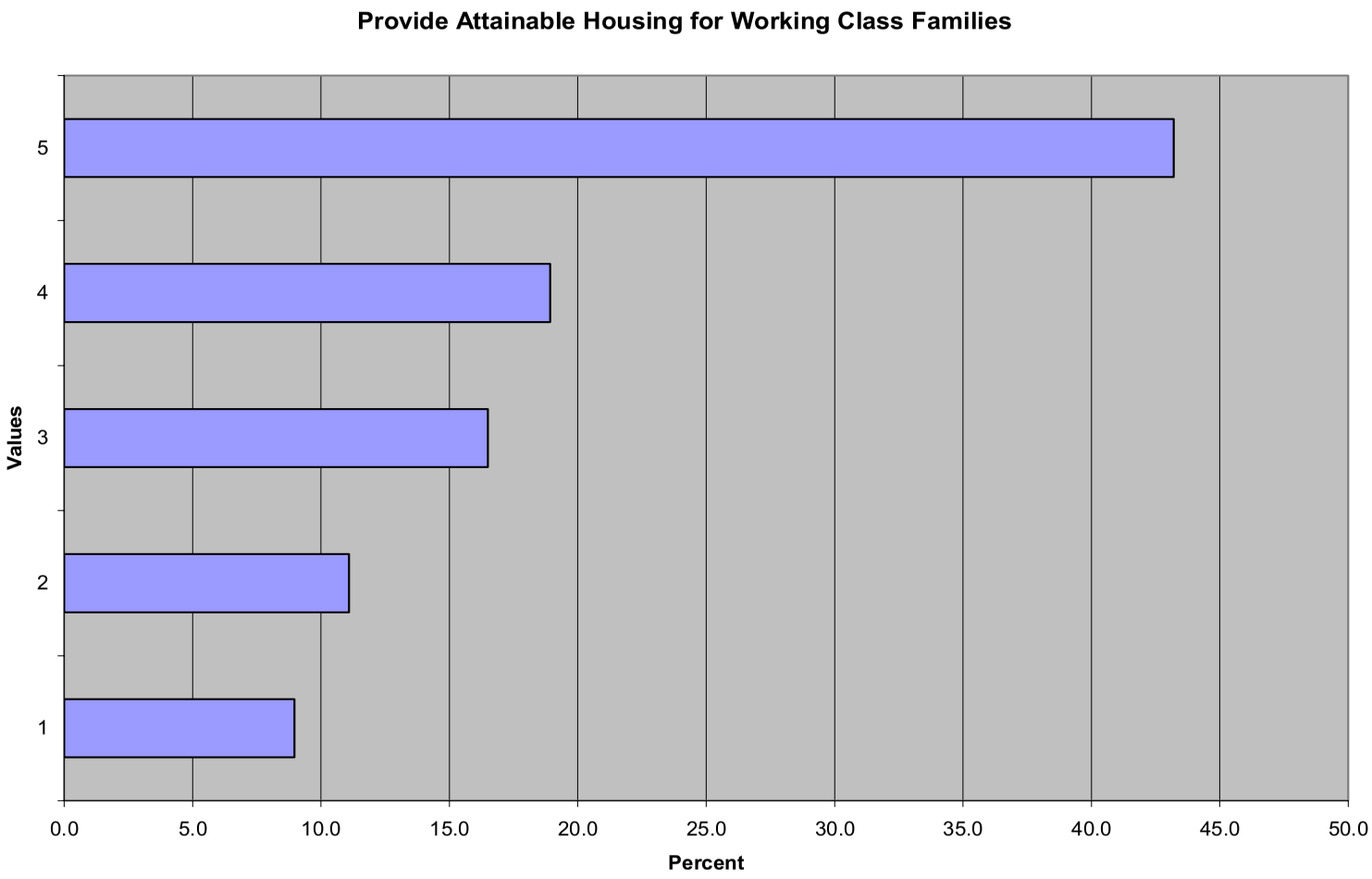
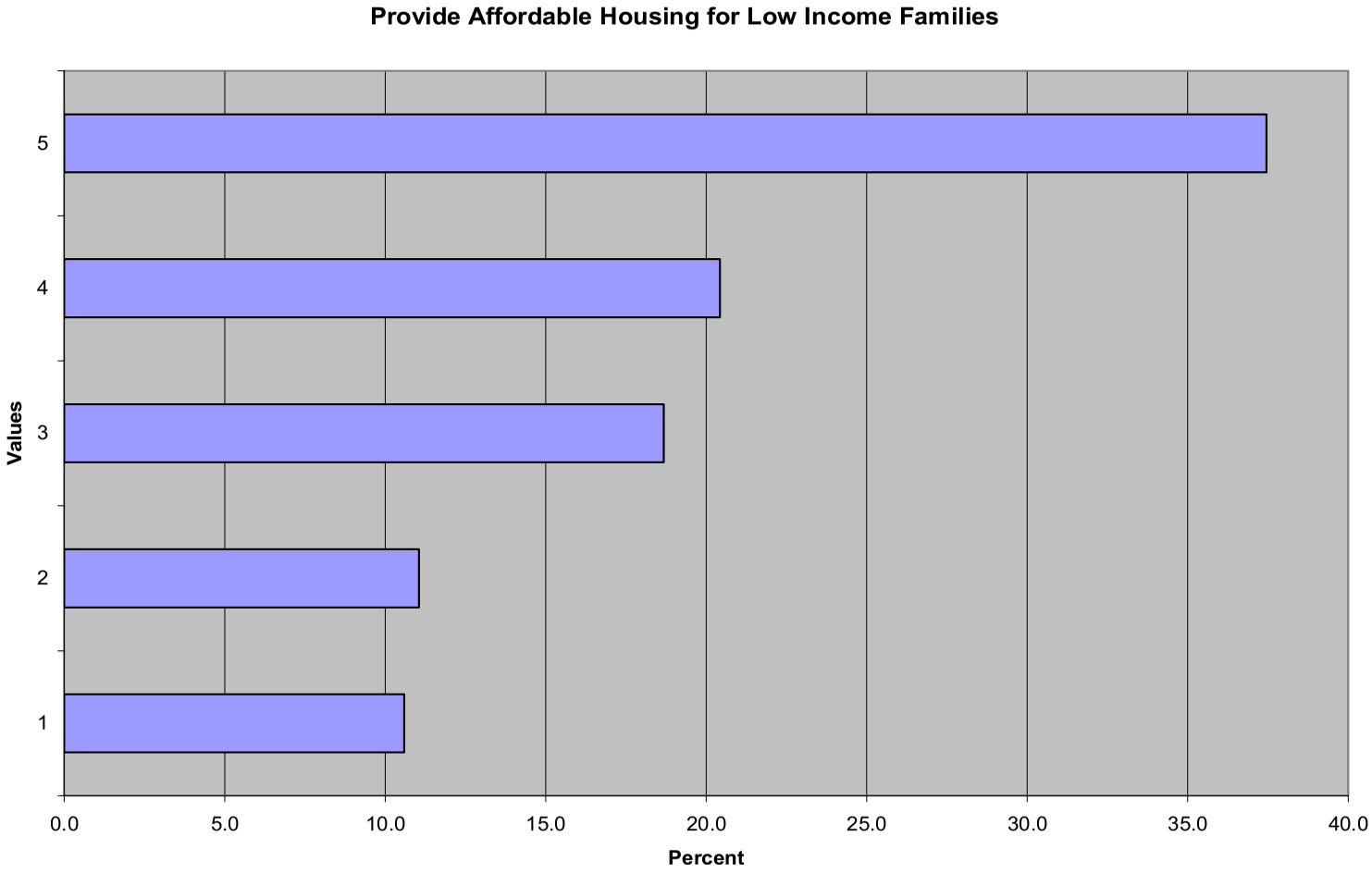
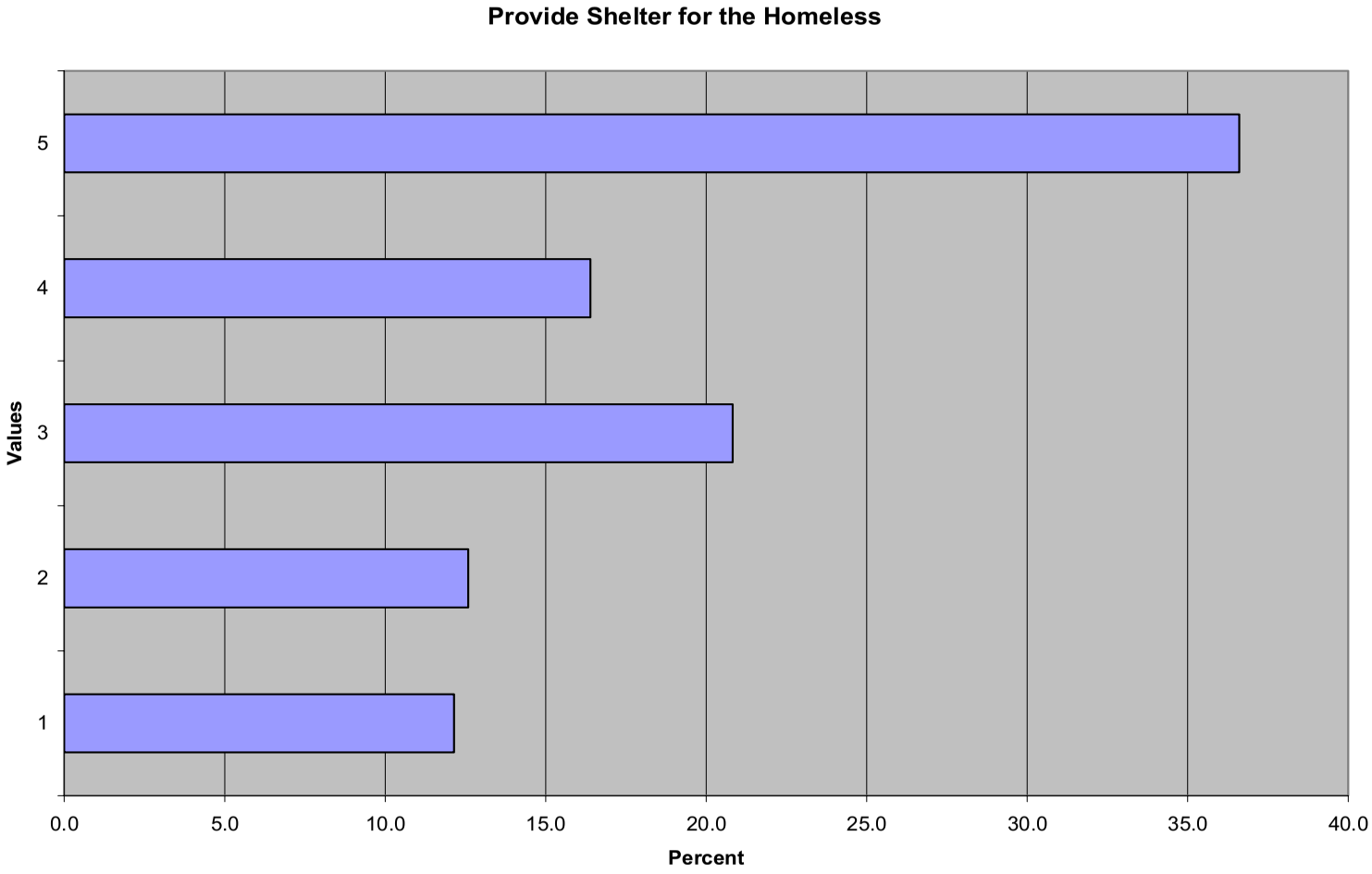
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



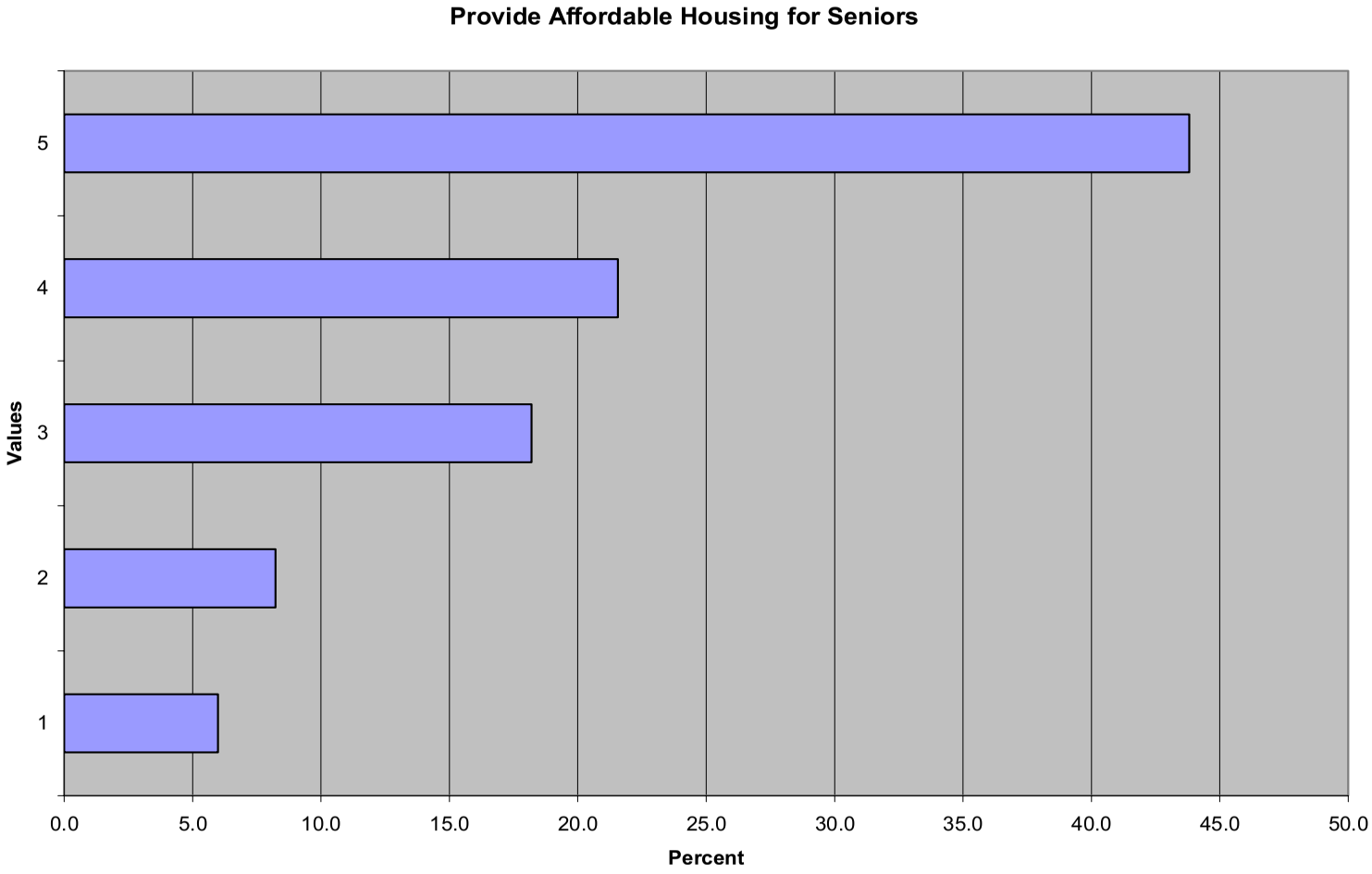
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



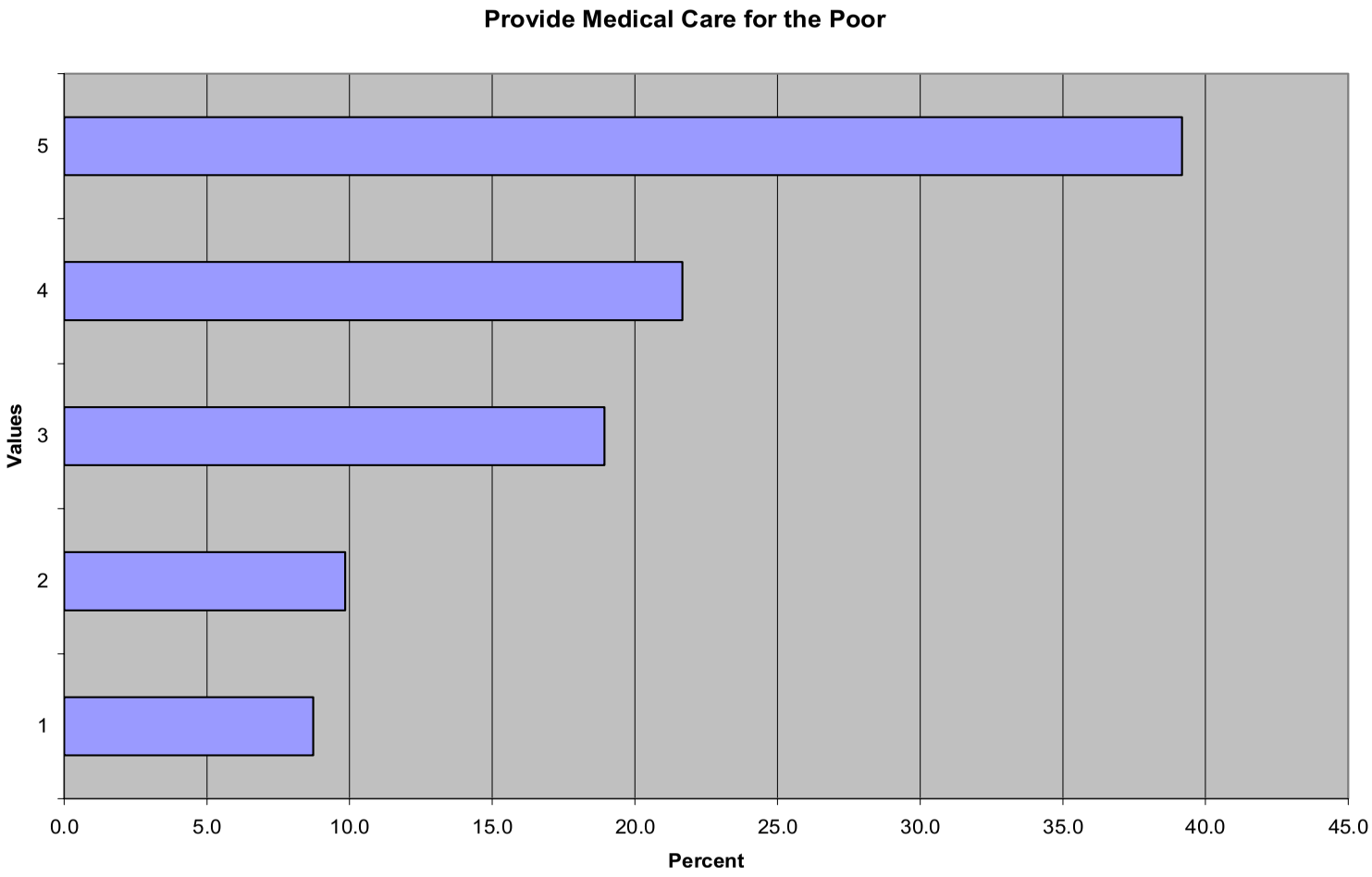
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



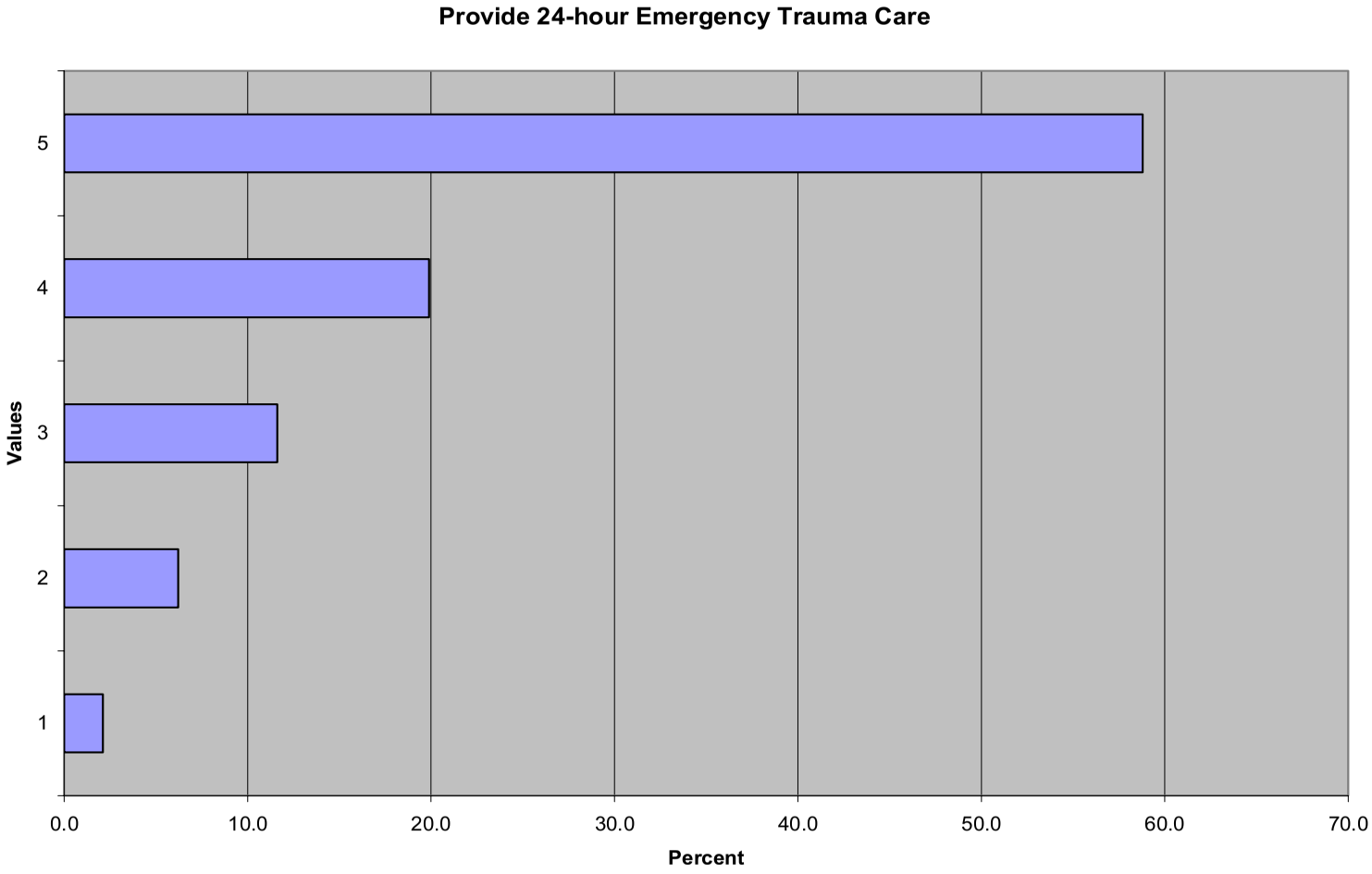
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



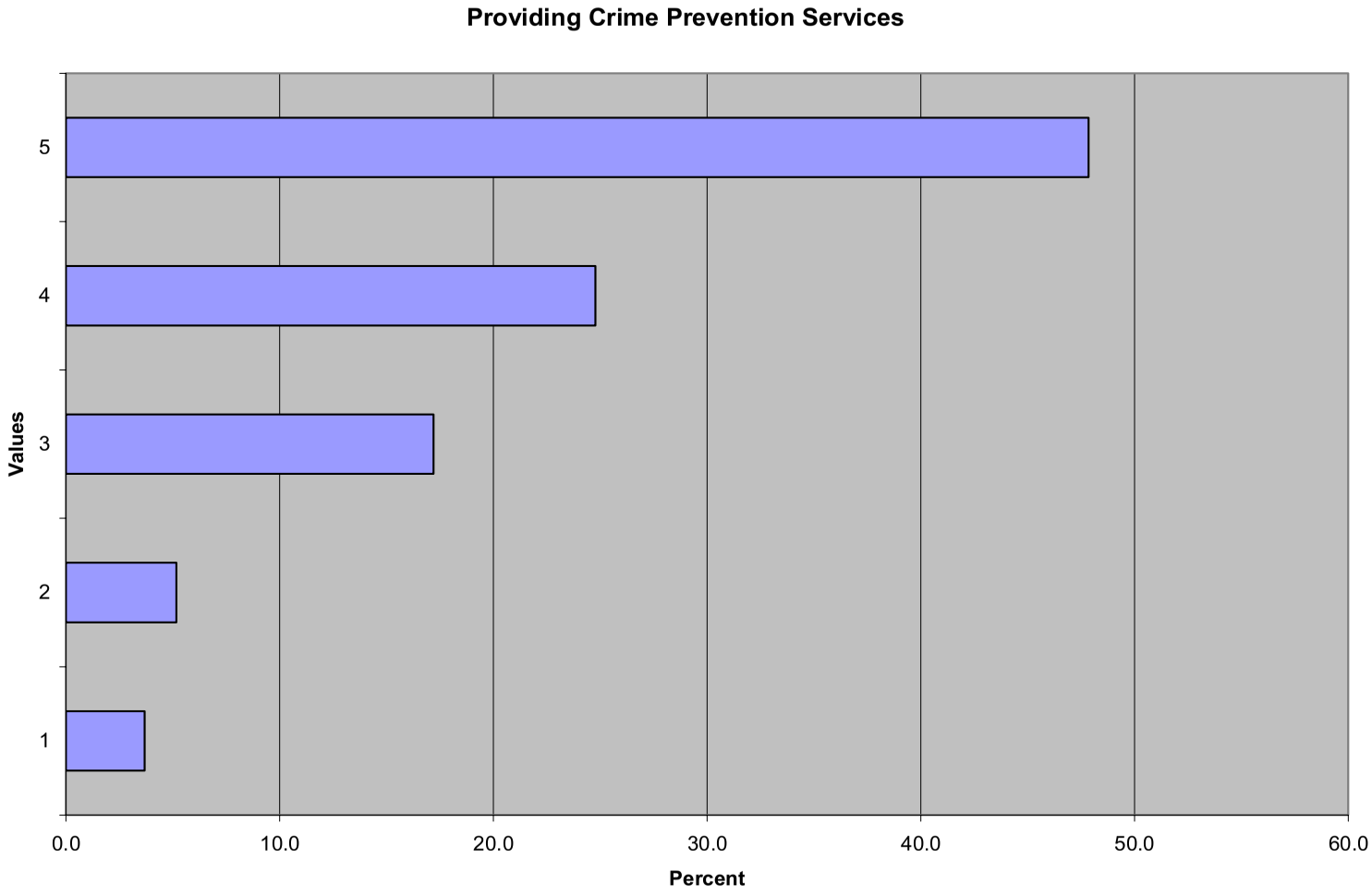
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



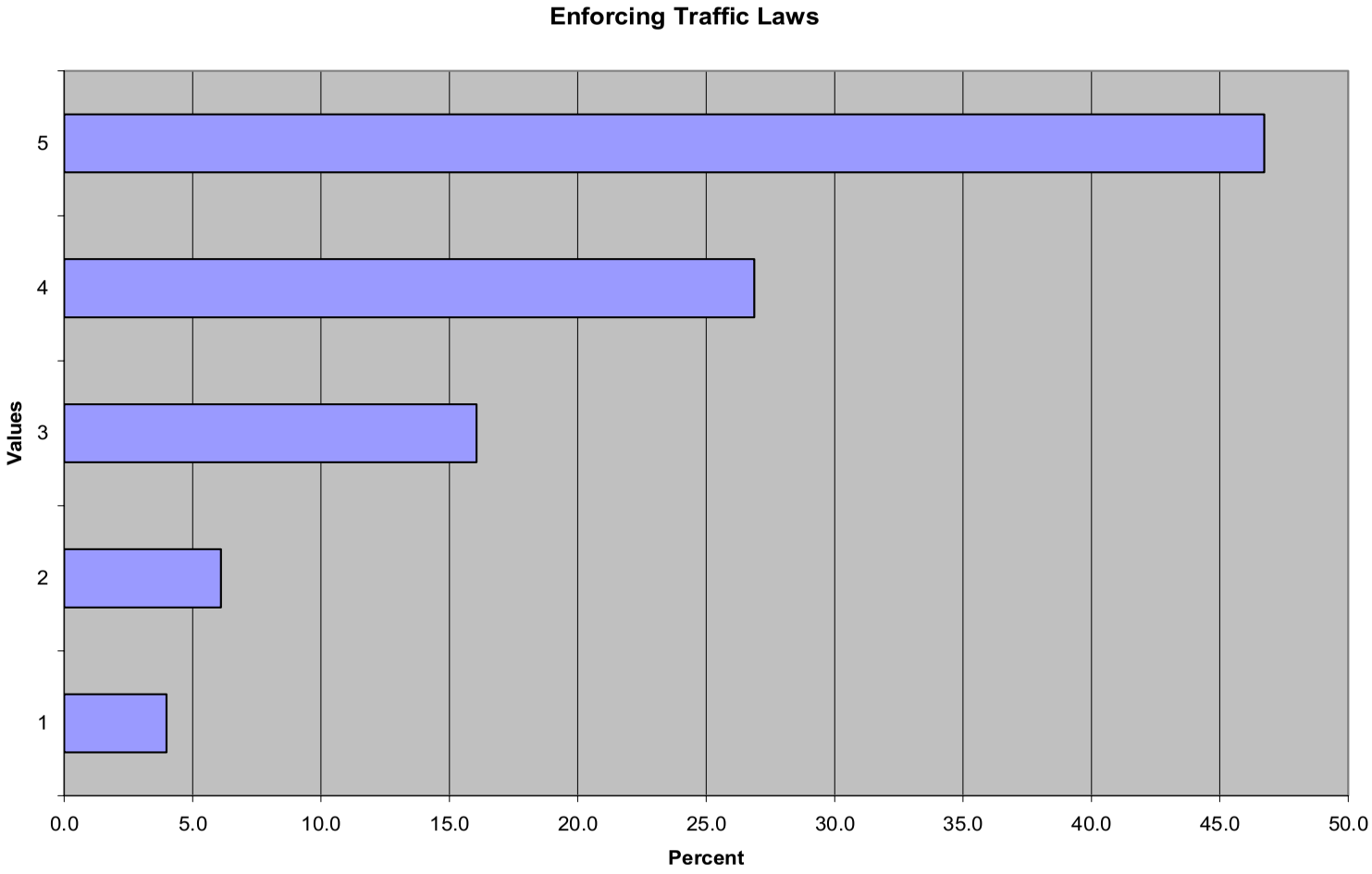
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



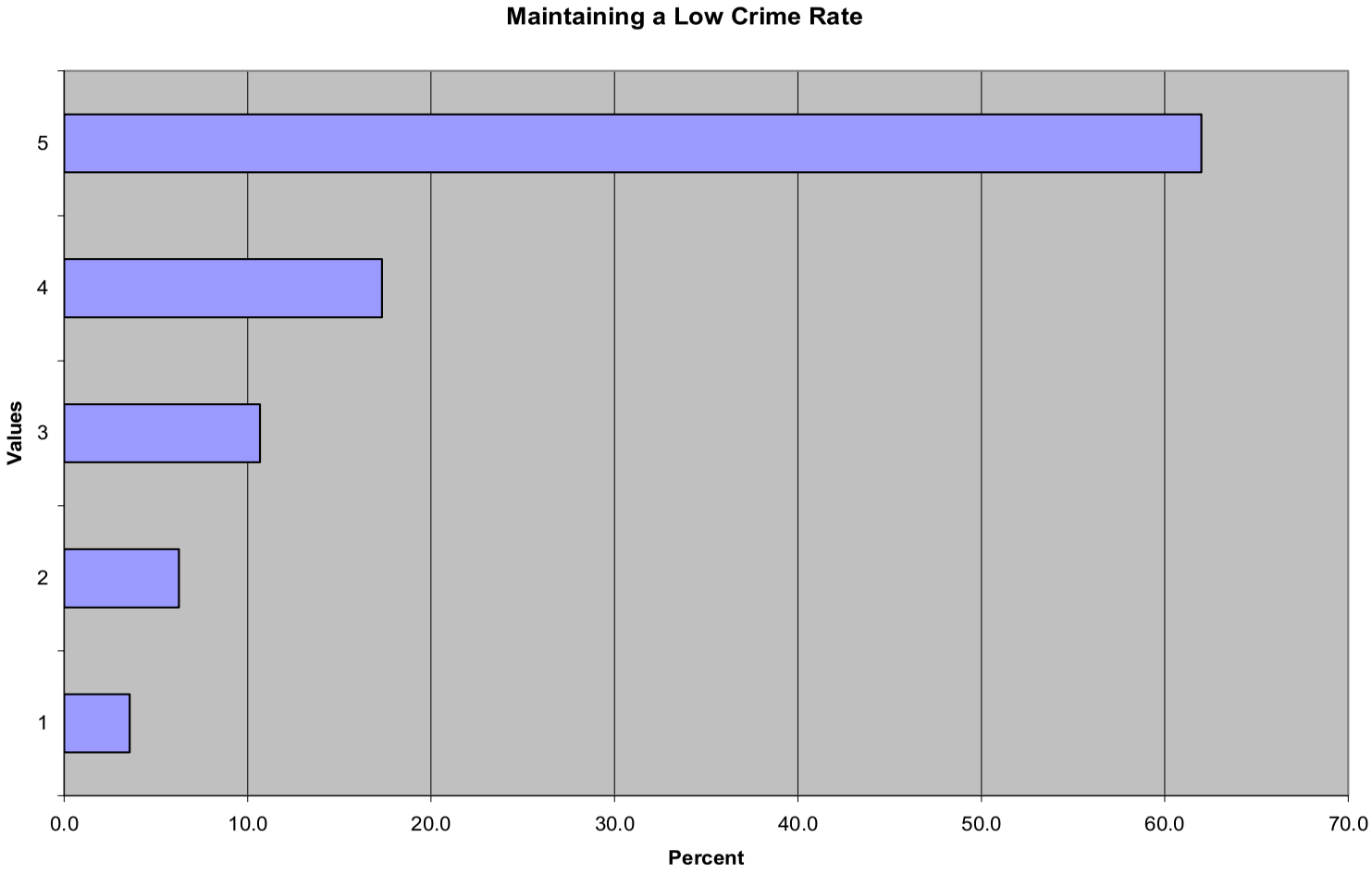
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



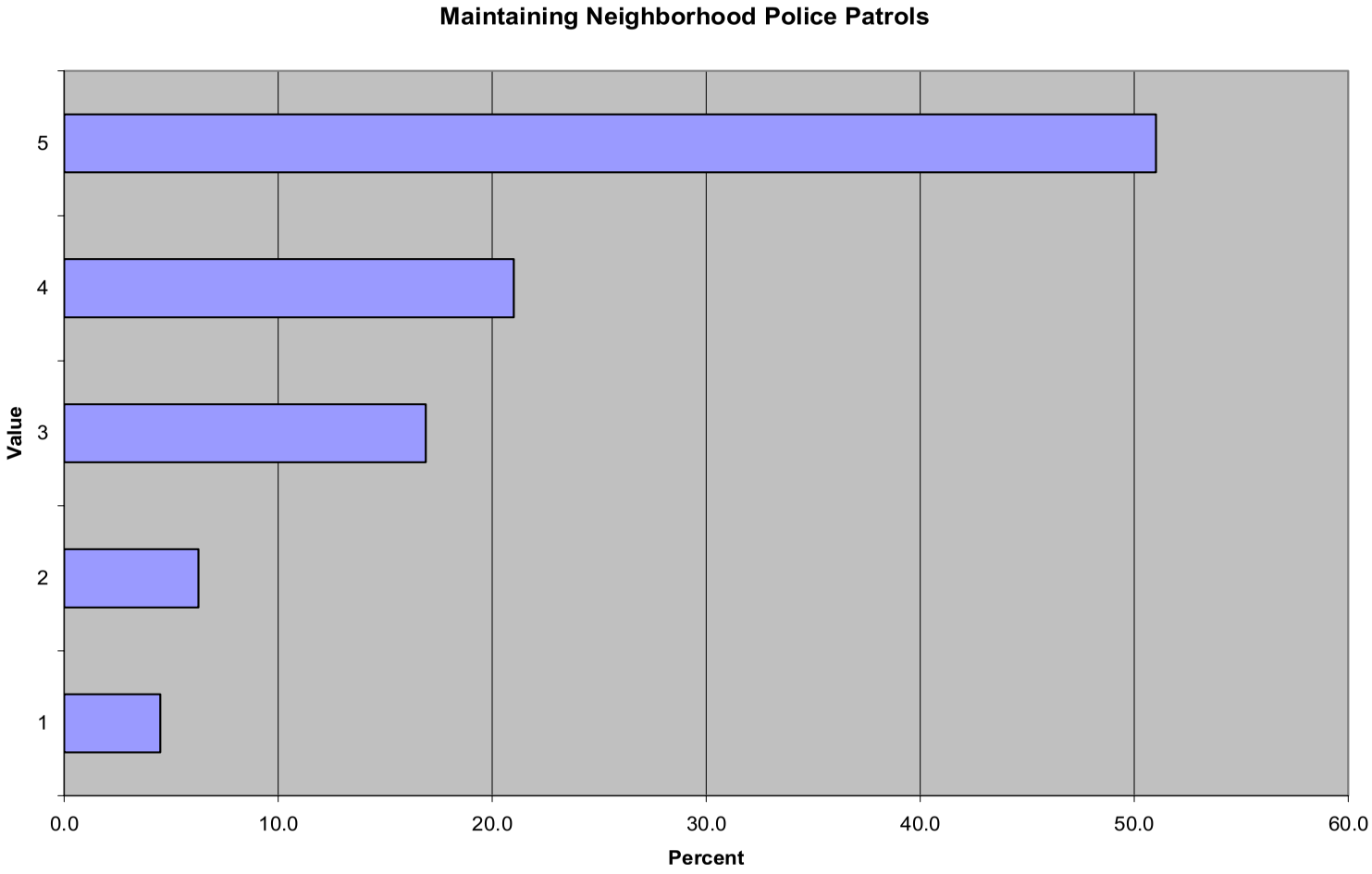
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



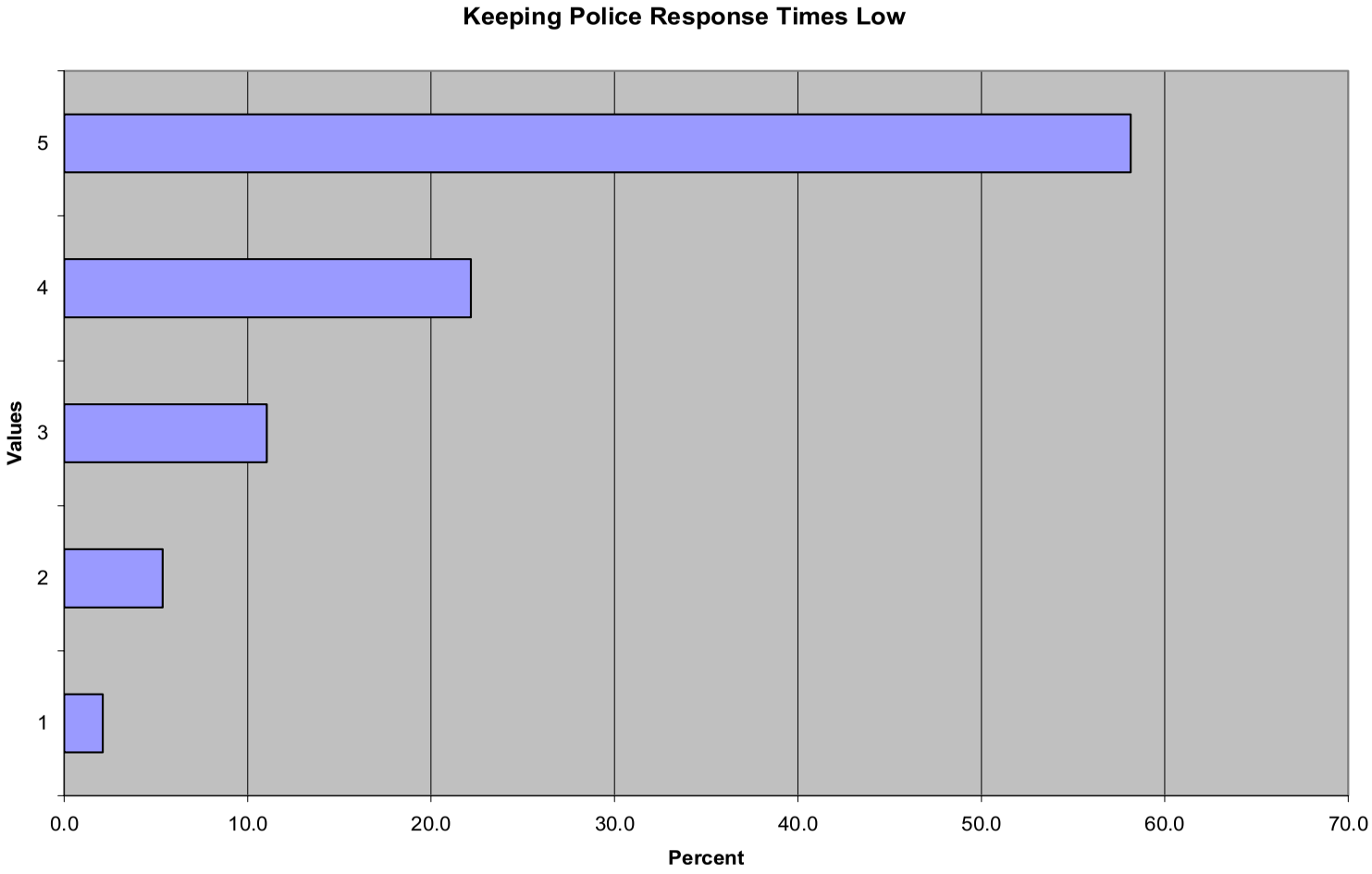
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



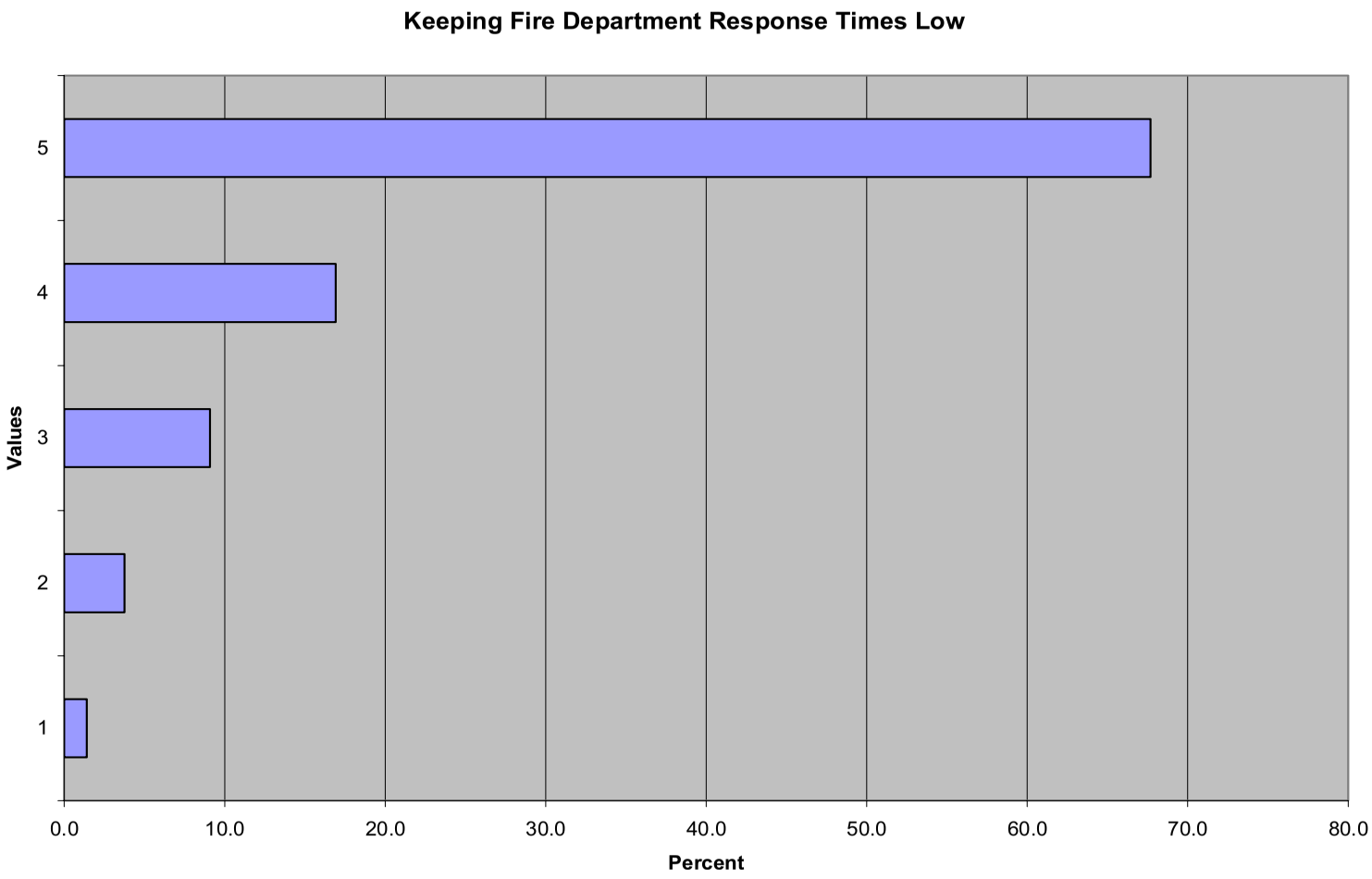
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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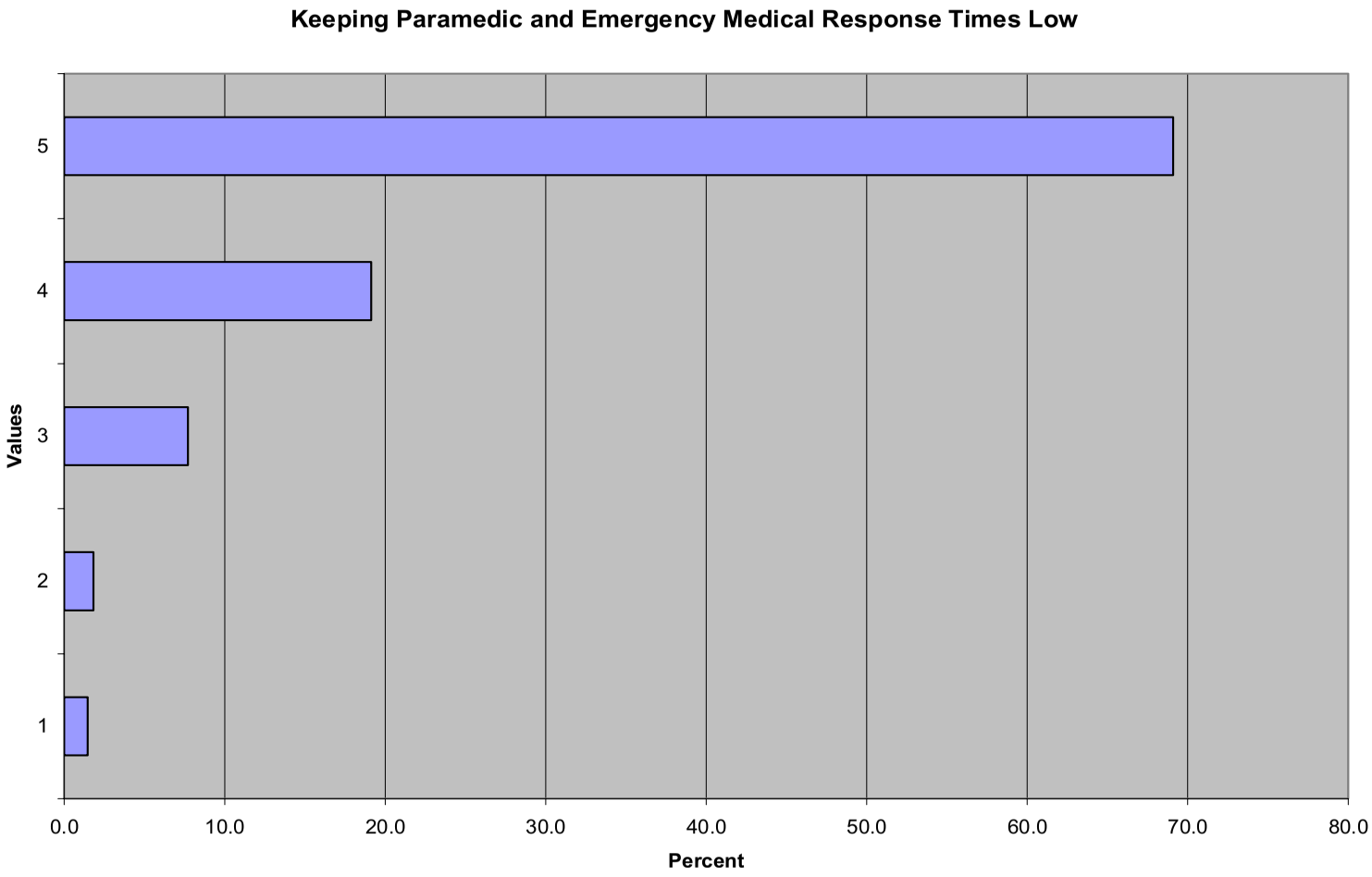
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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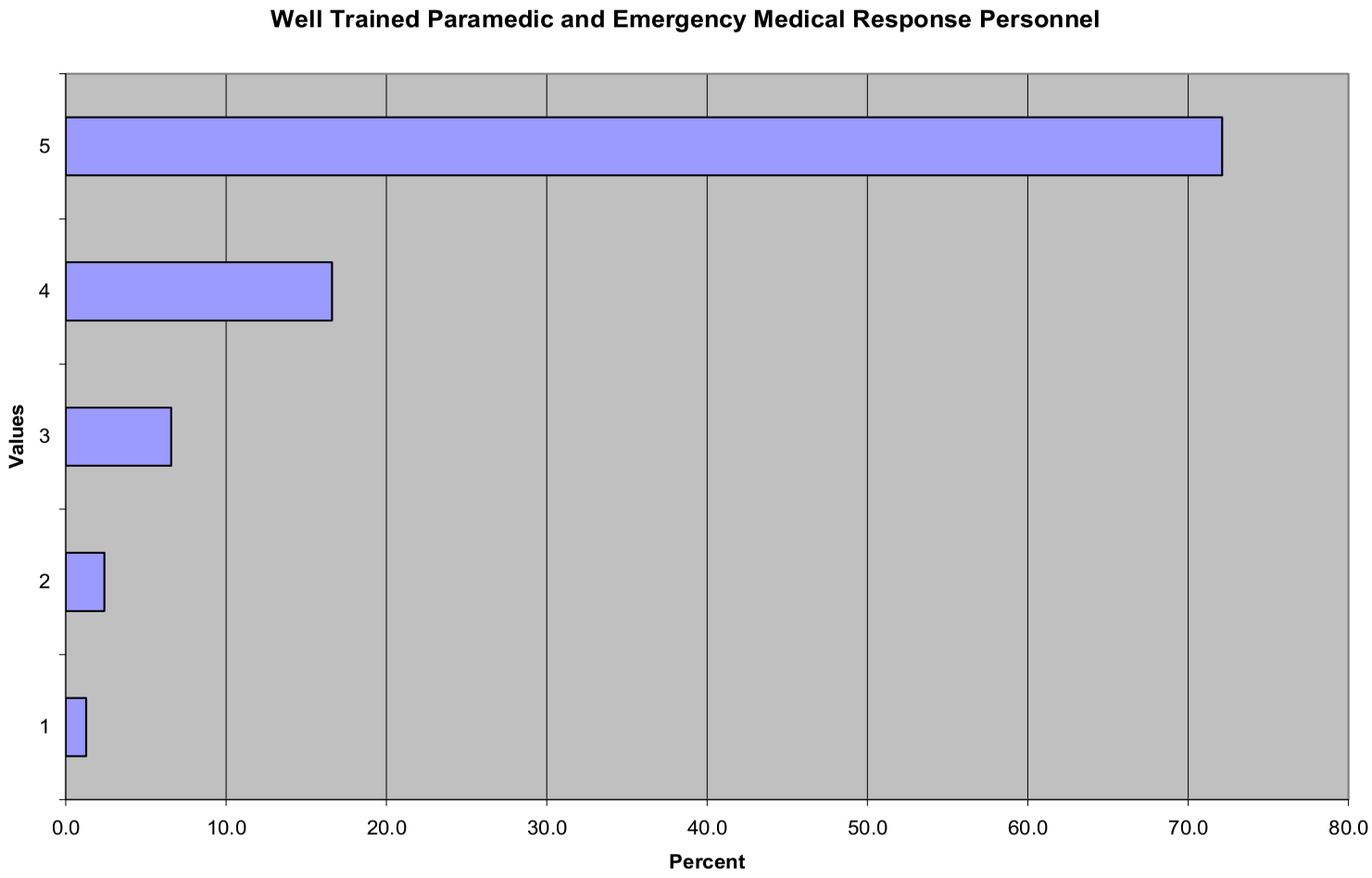
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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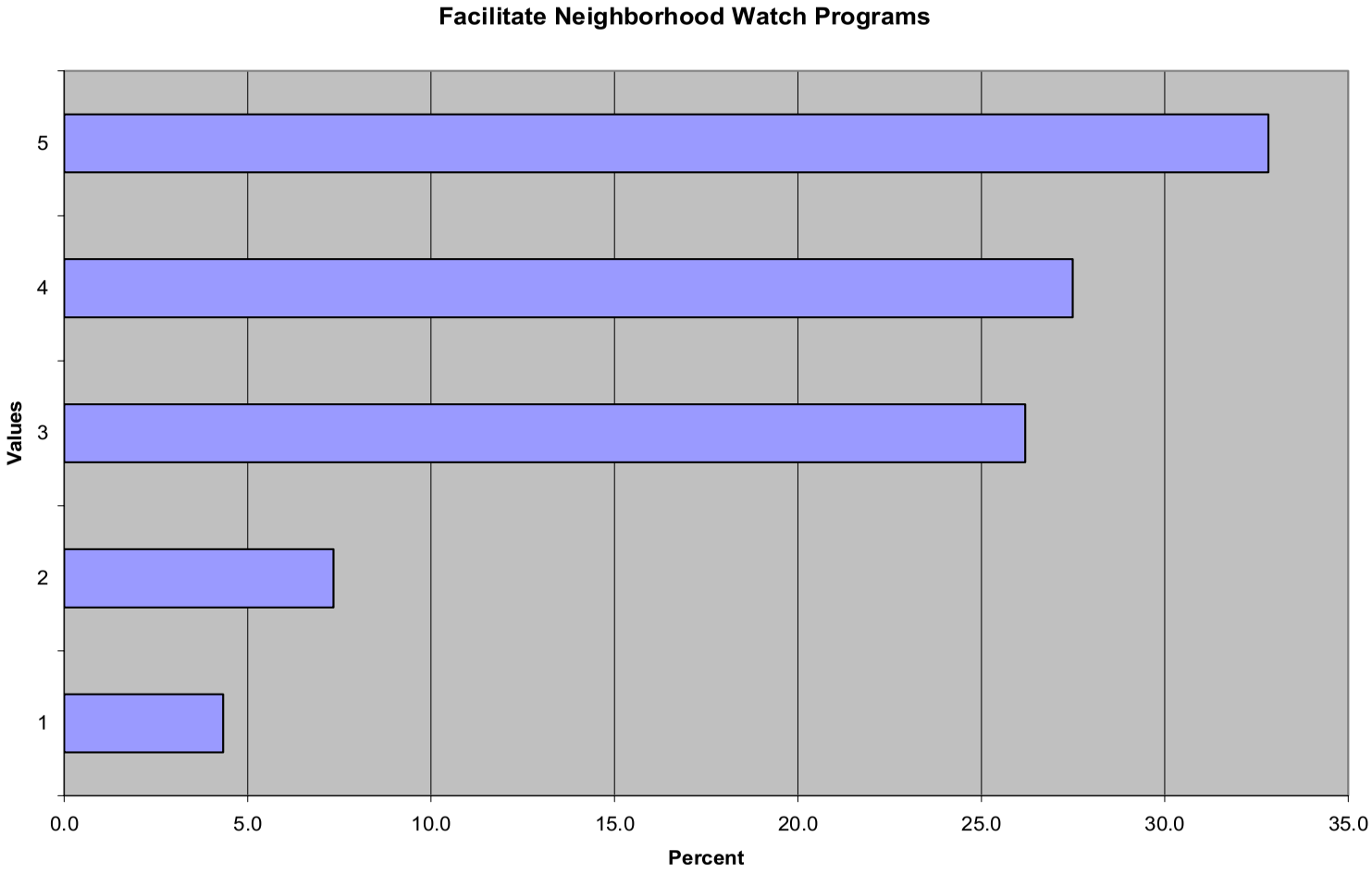
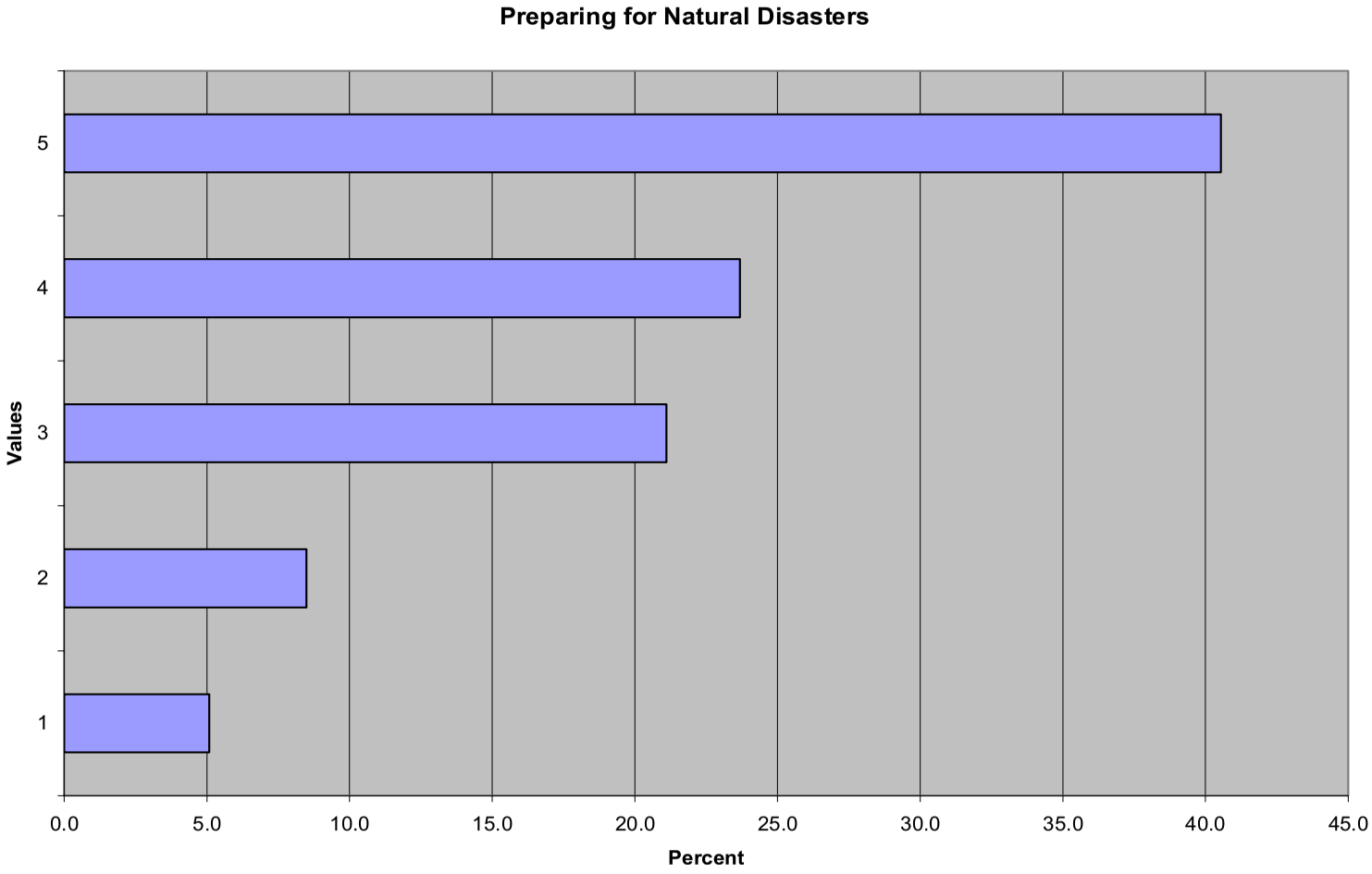
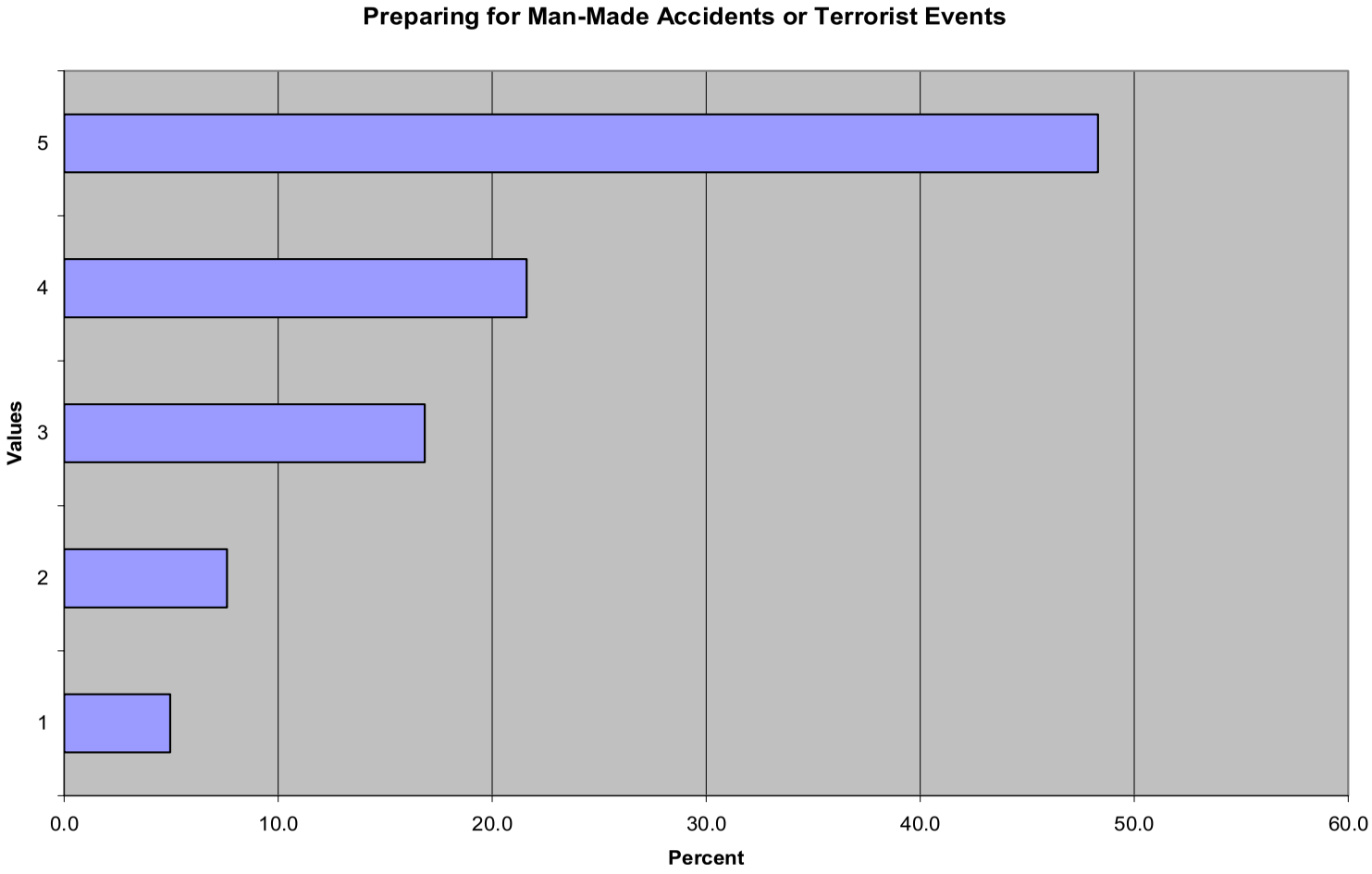
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



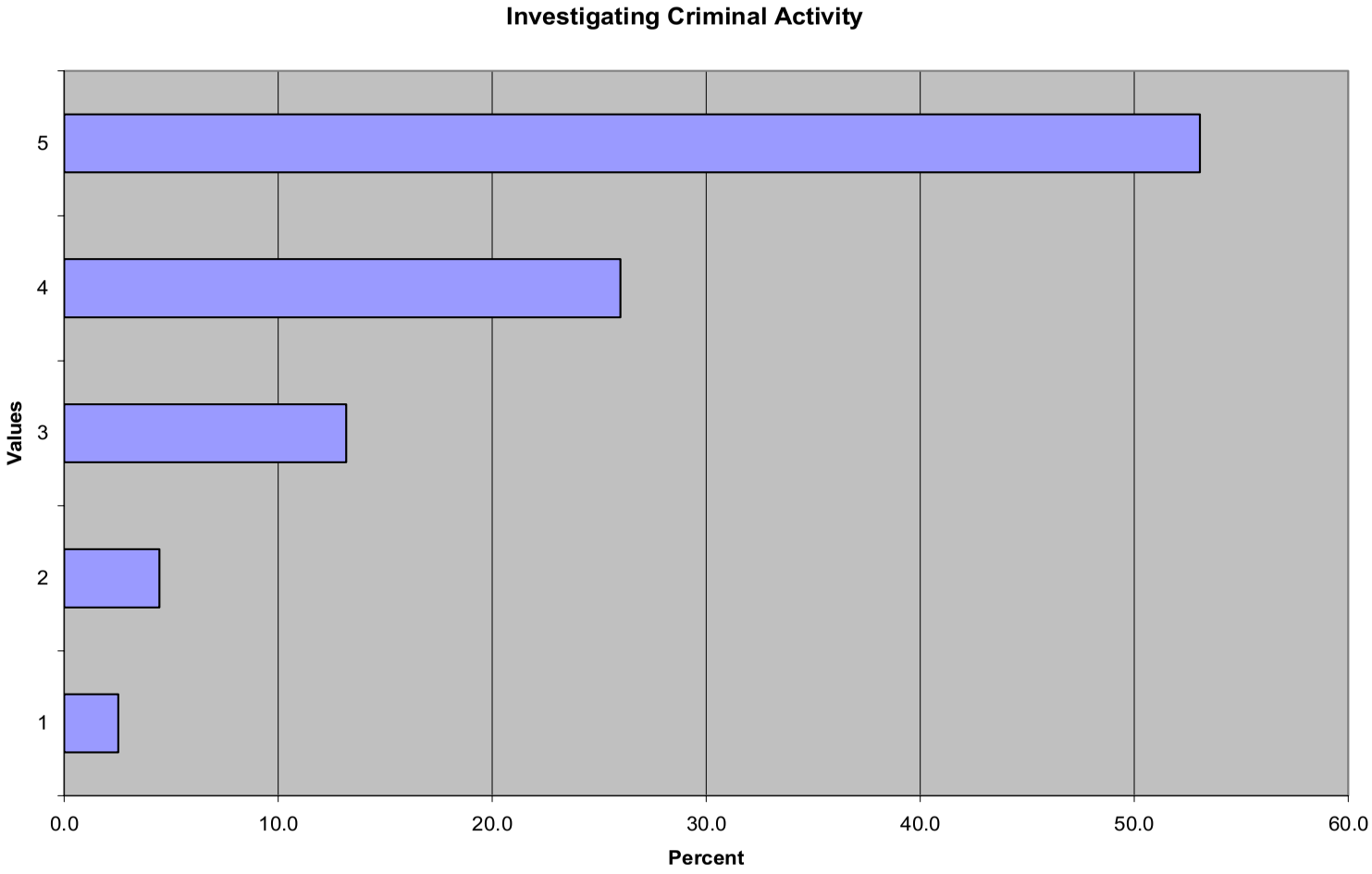
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



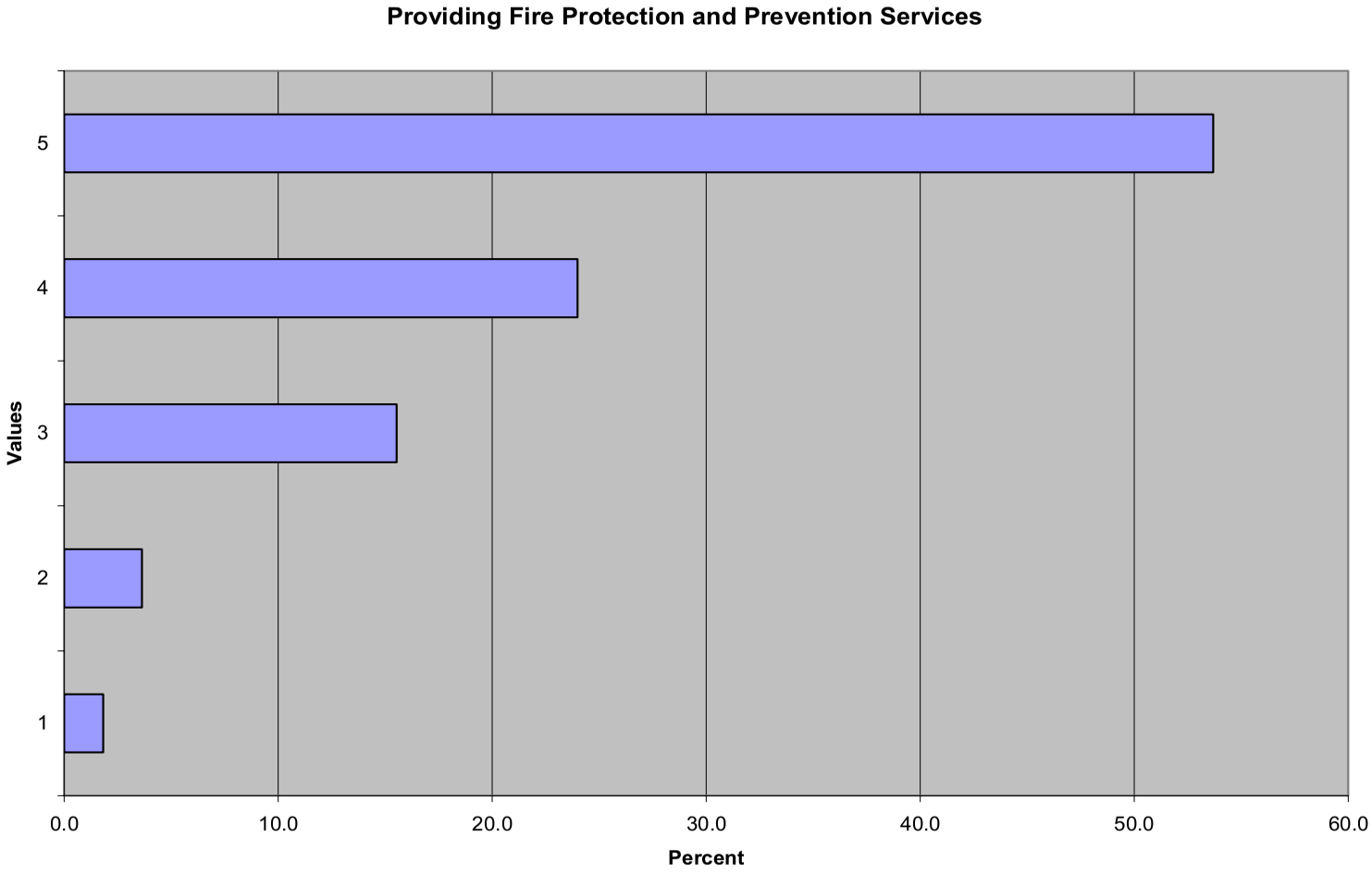
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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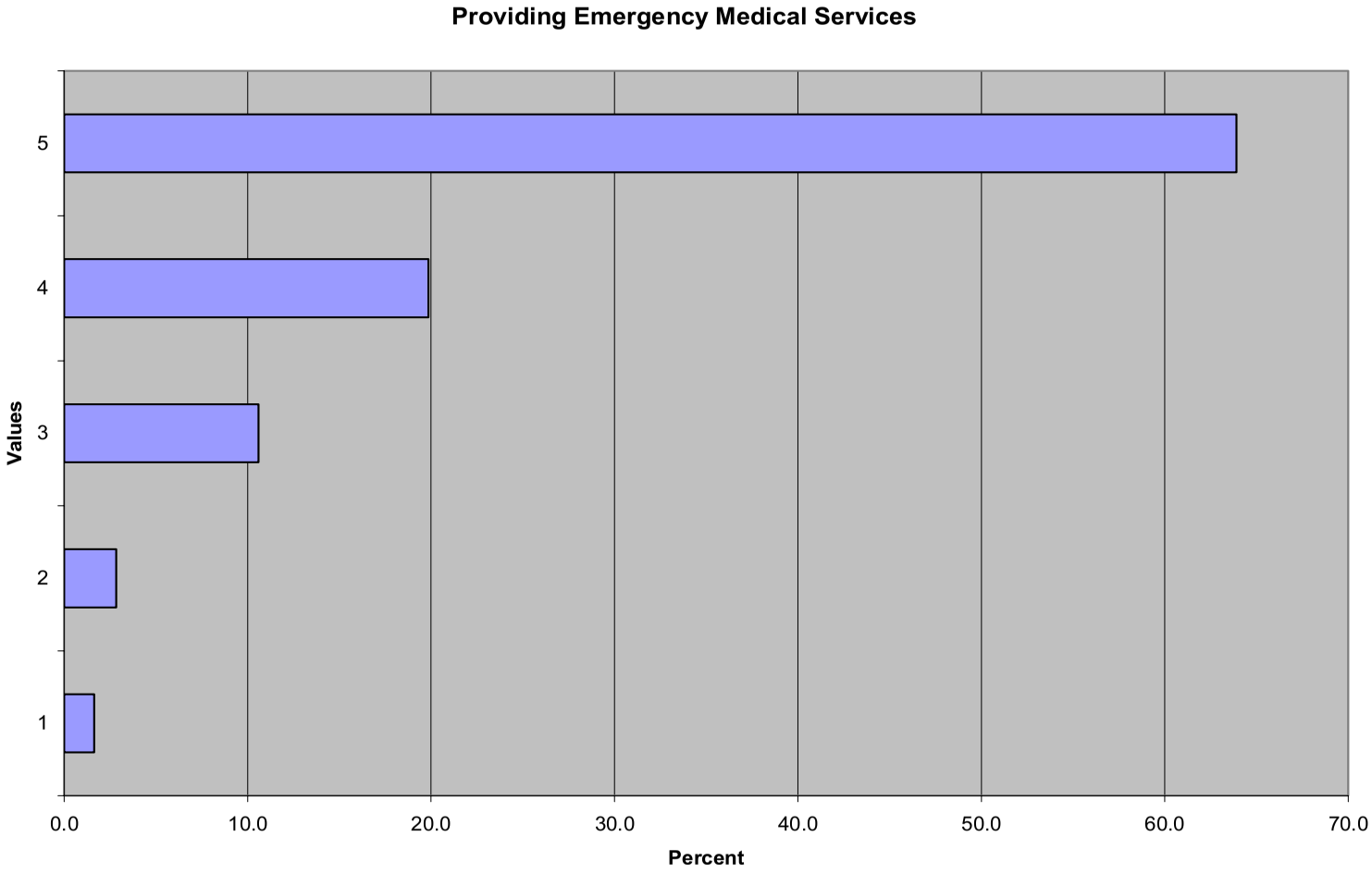
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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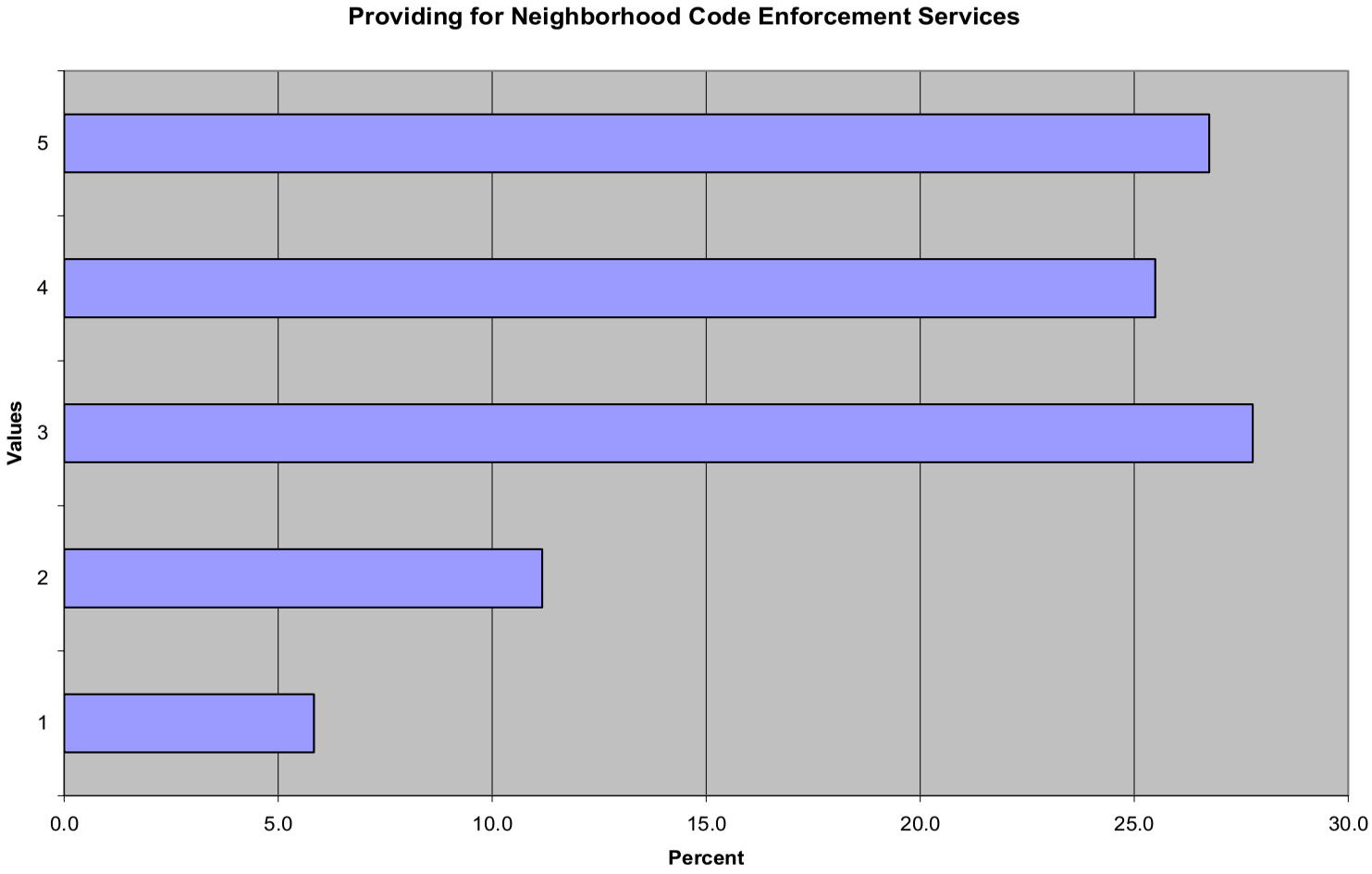
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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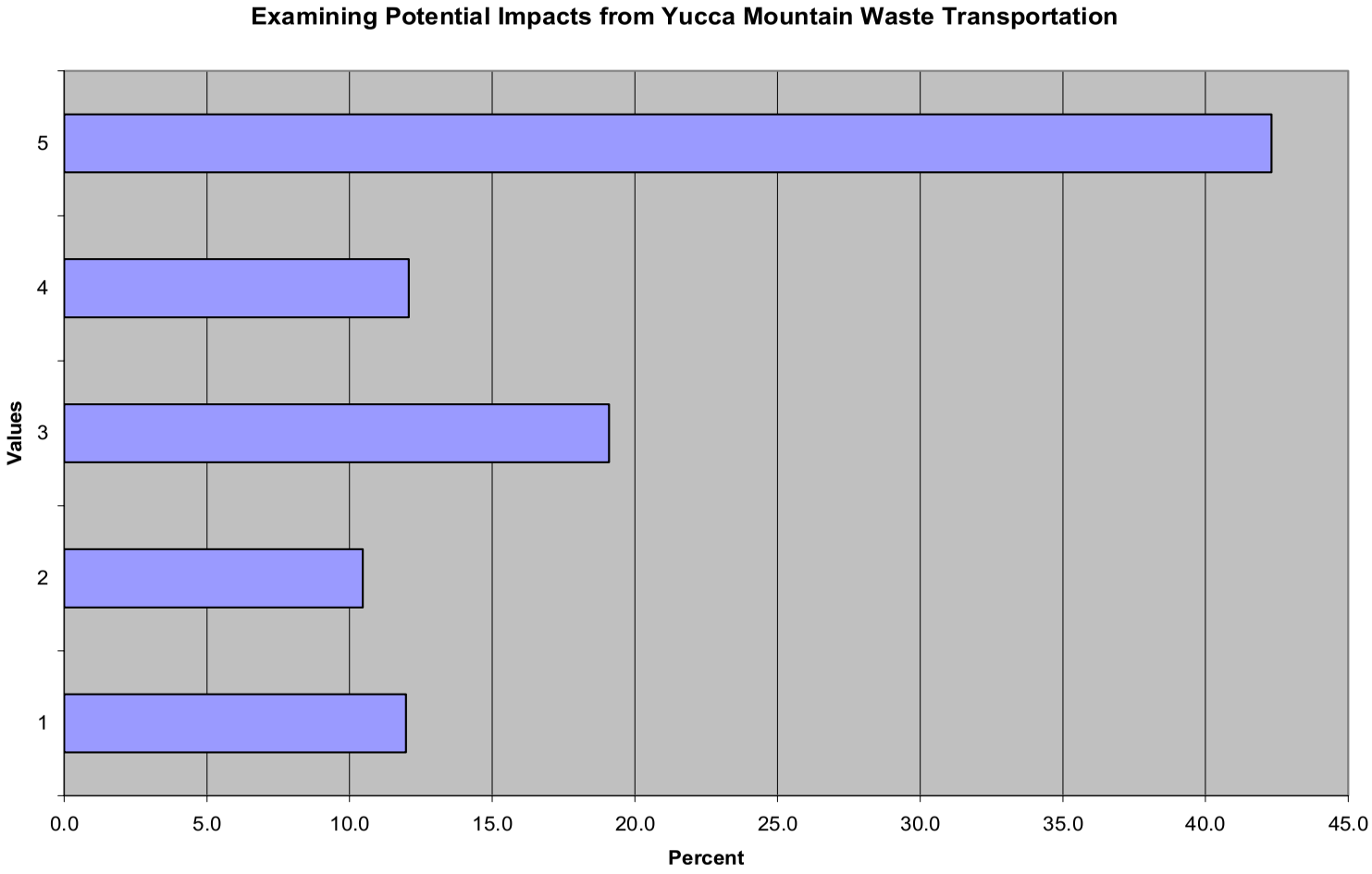

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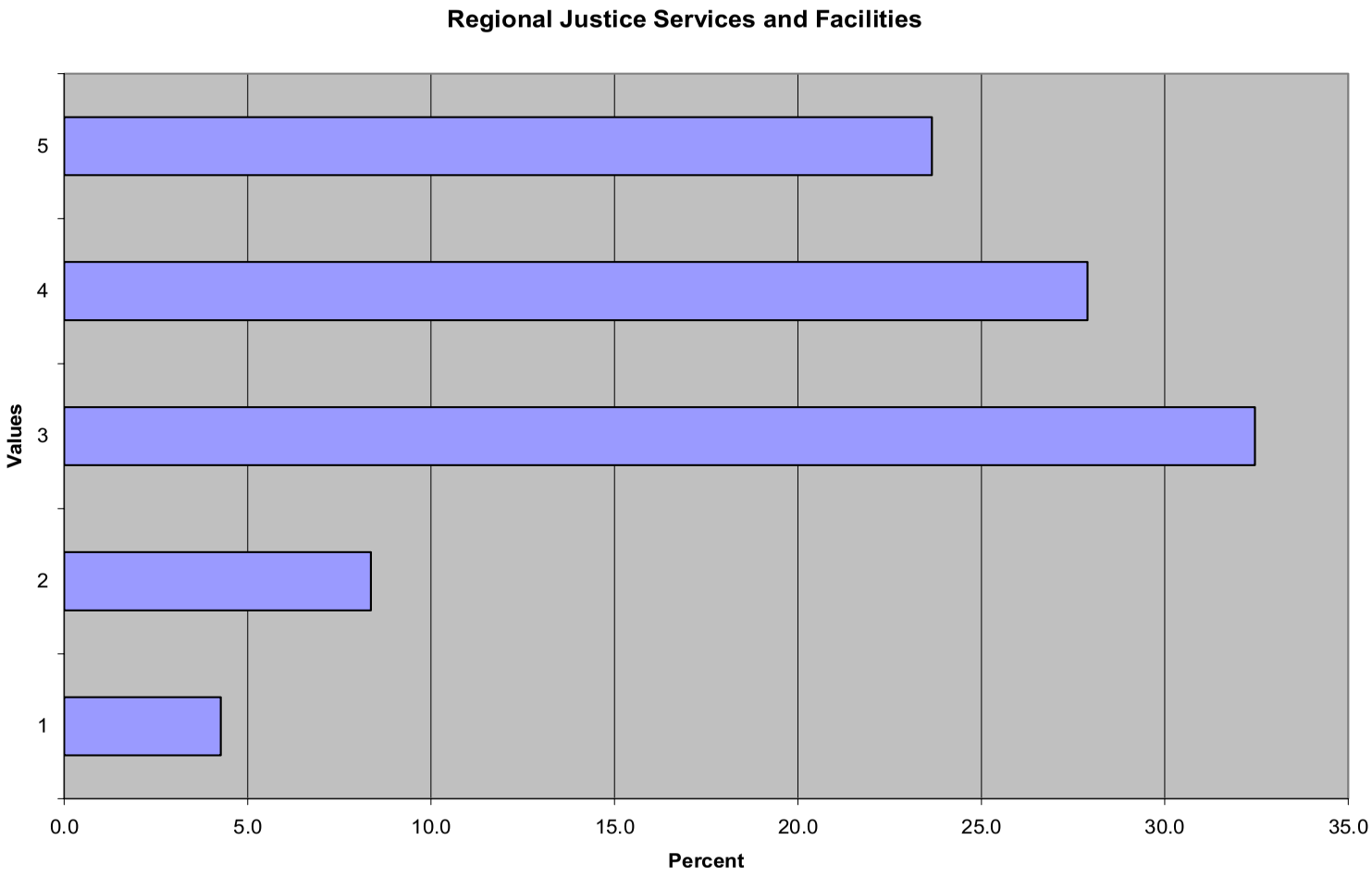
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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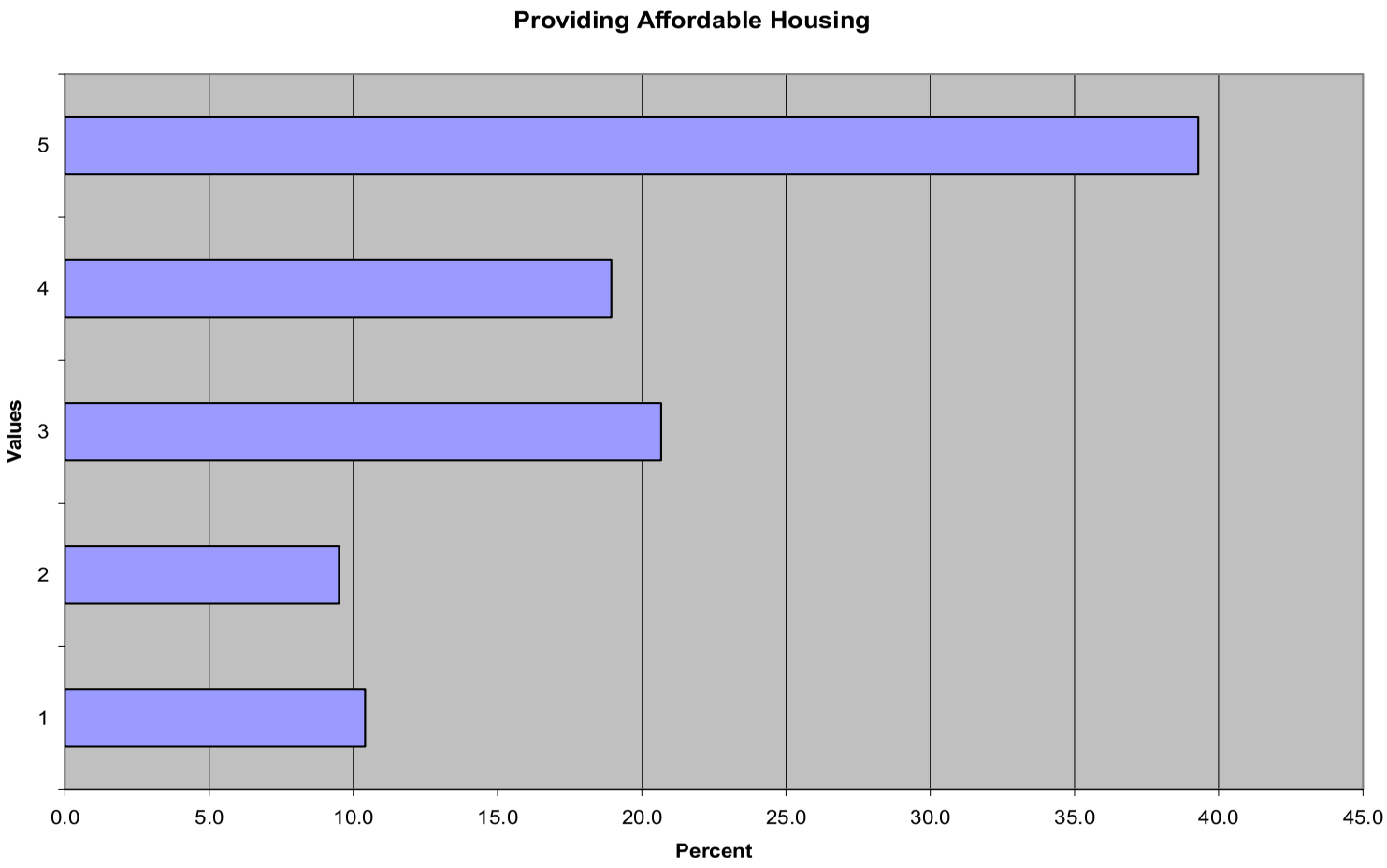
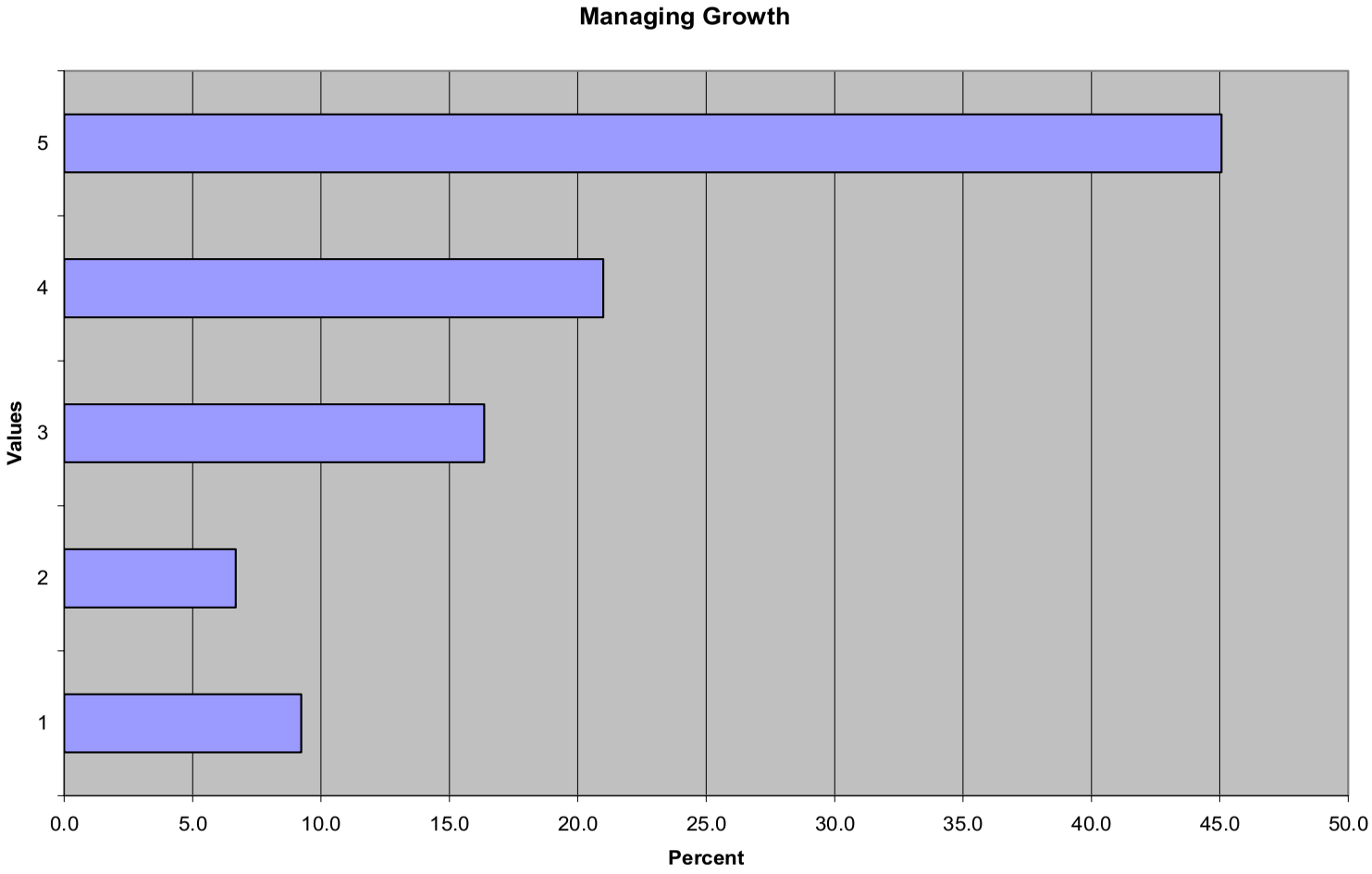
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



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Importance for Selected Services
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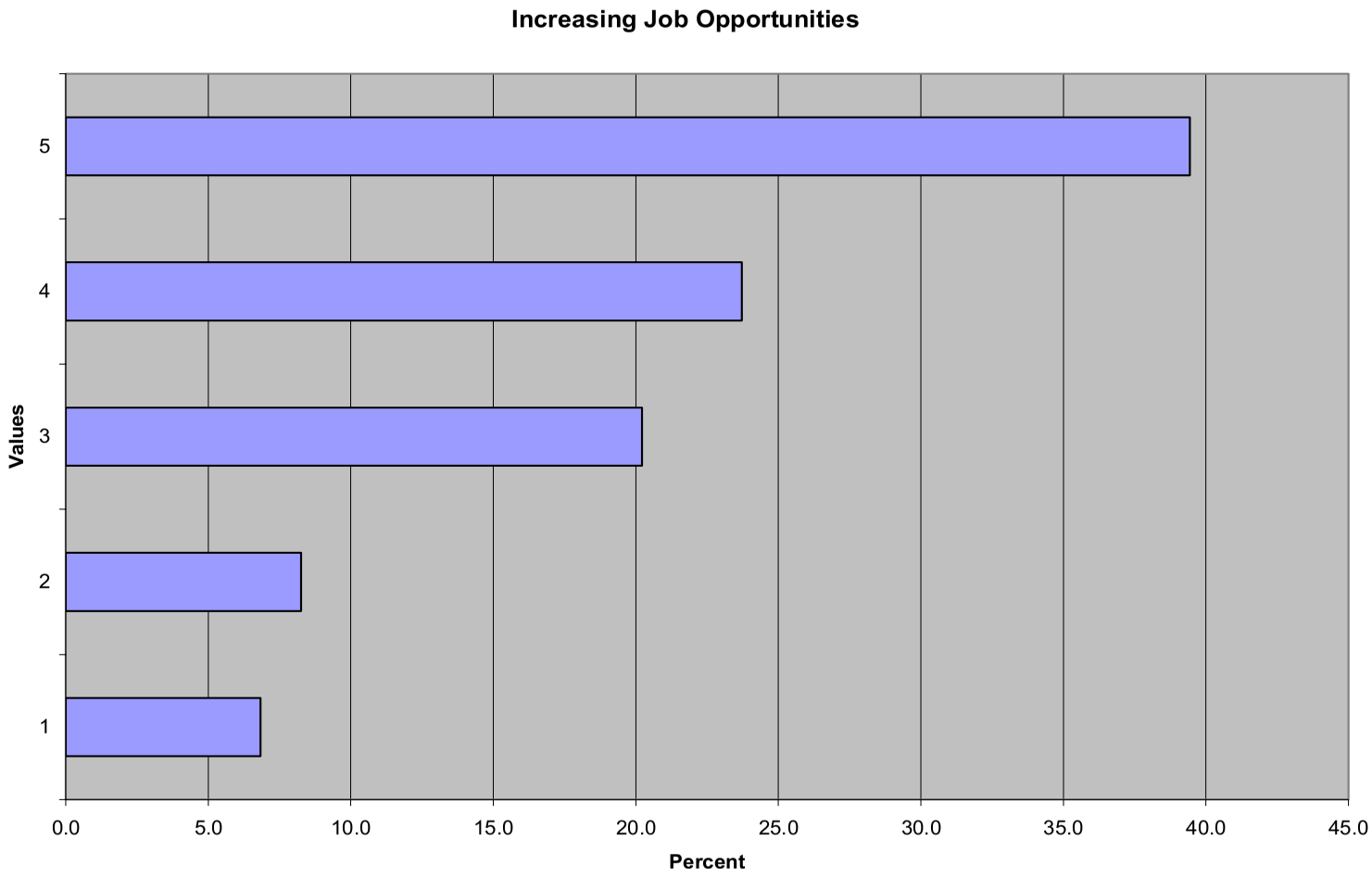

Appendix I Continued
Importance for Selected Services
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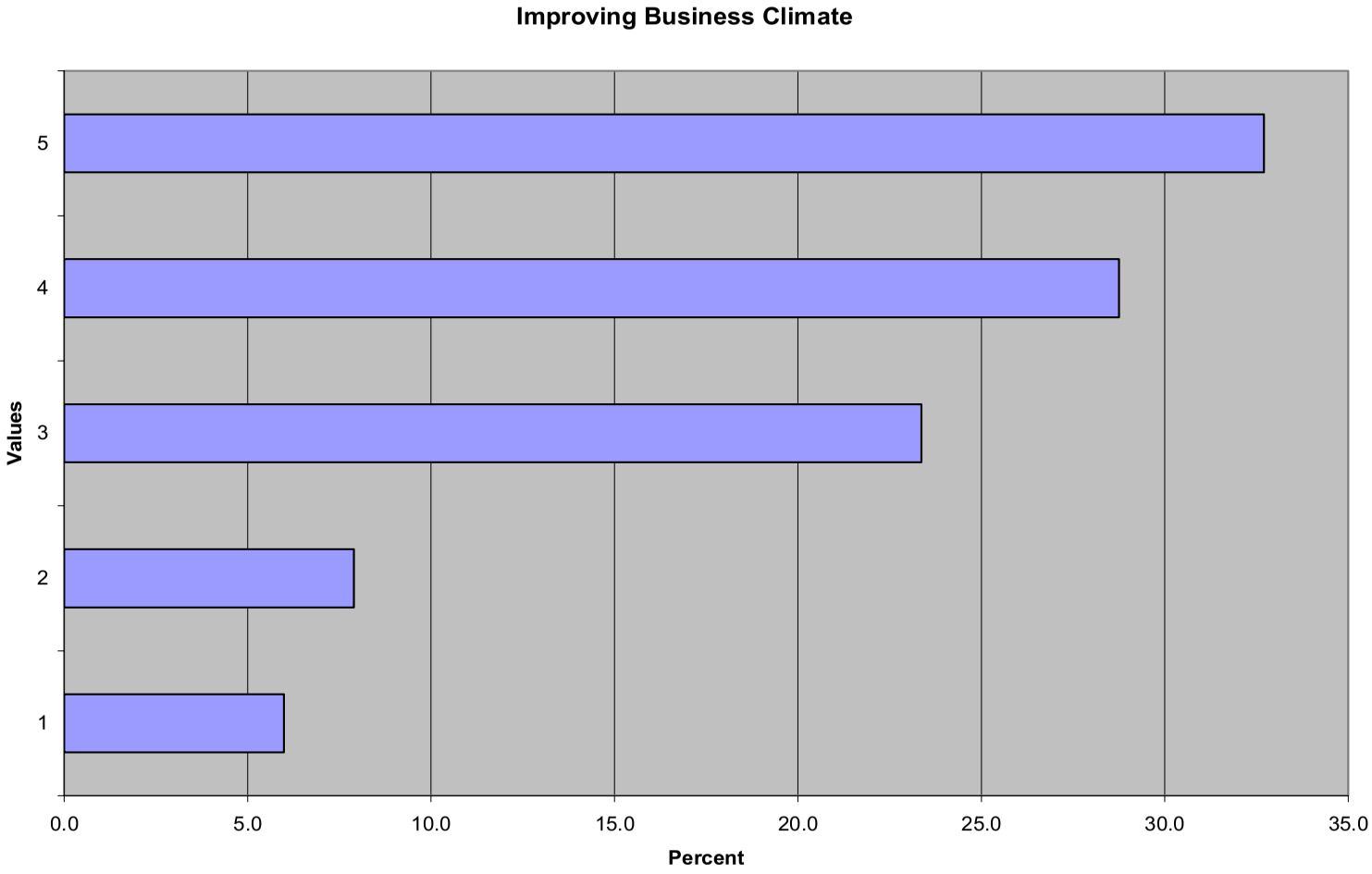
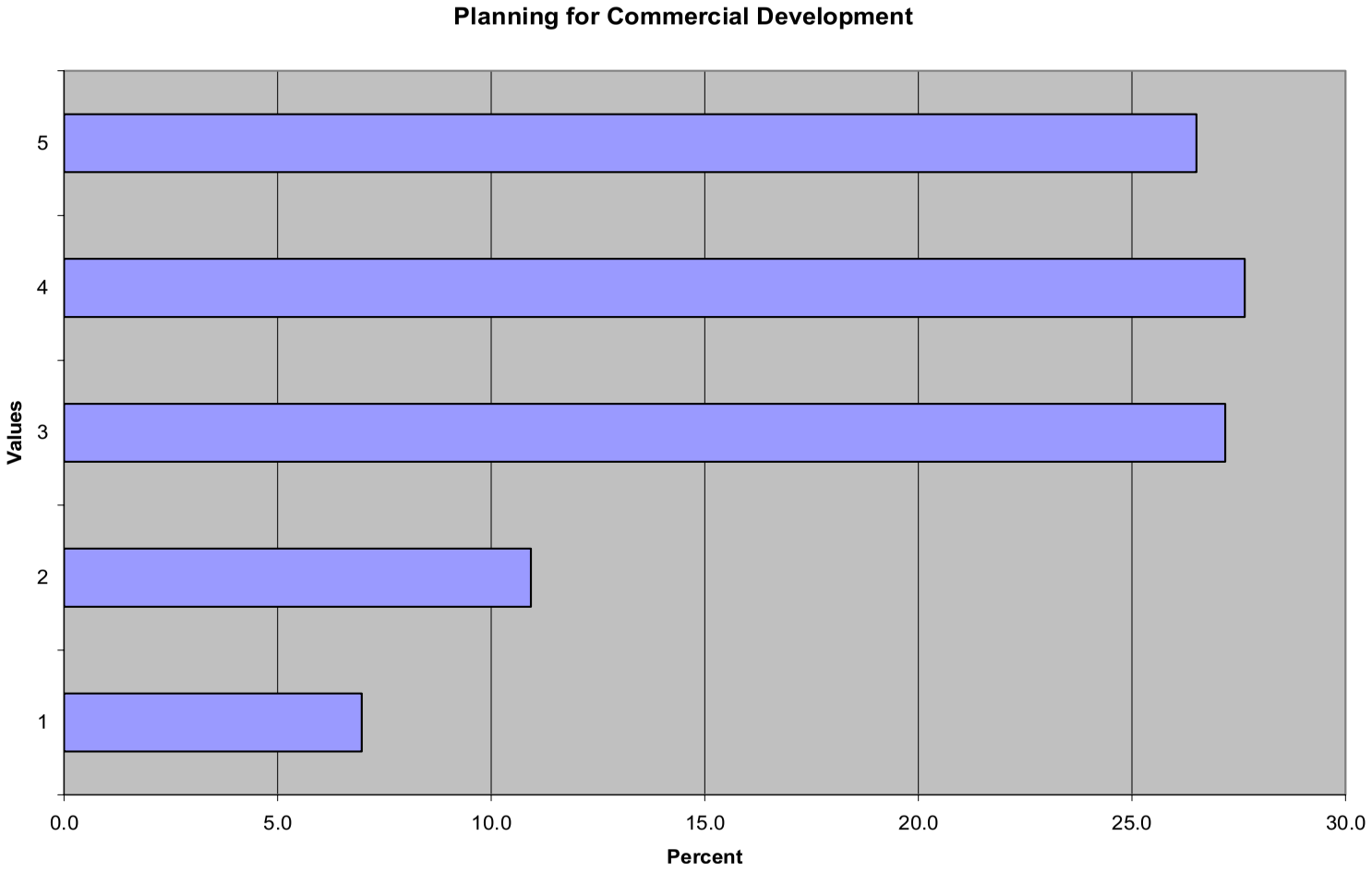
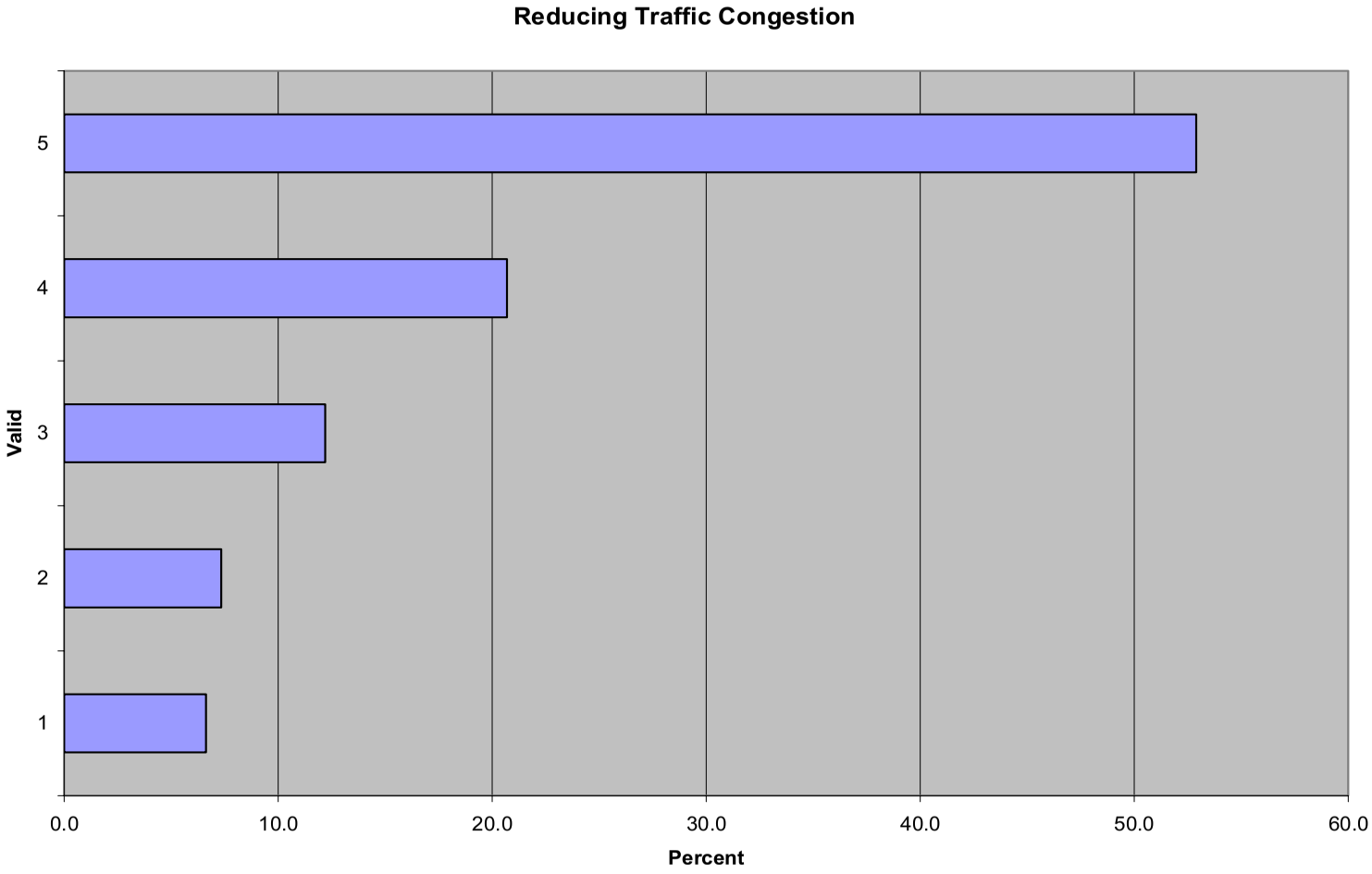


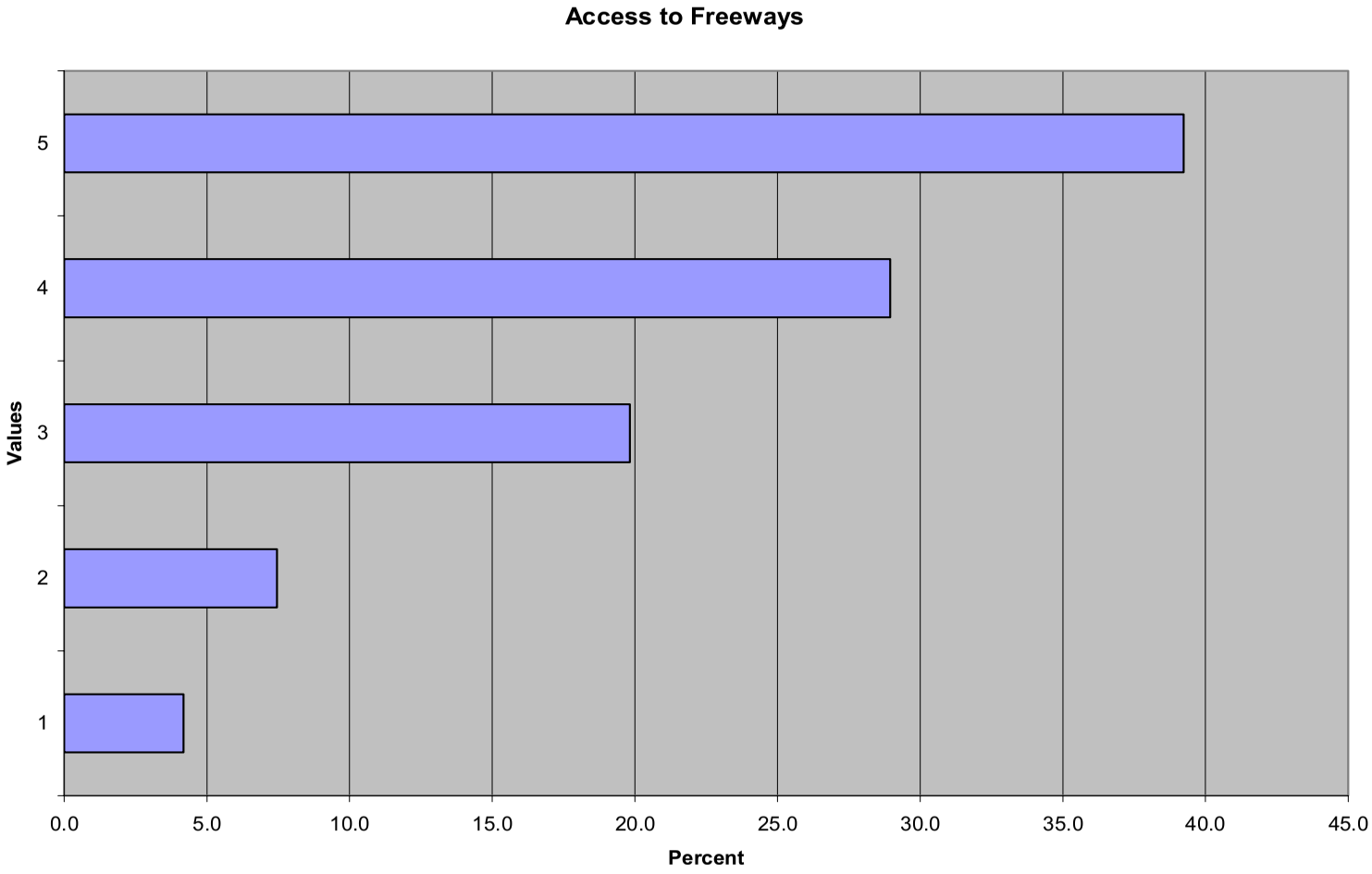
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



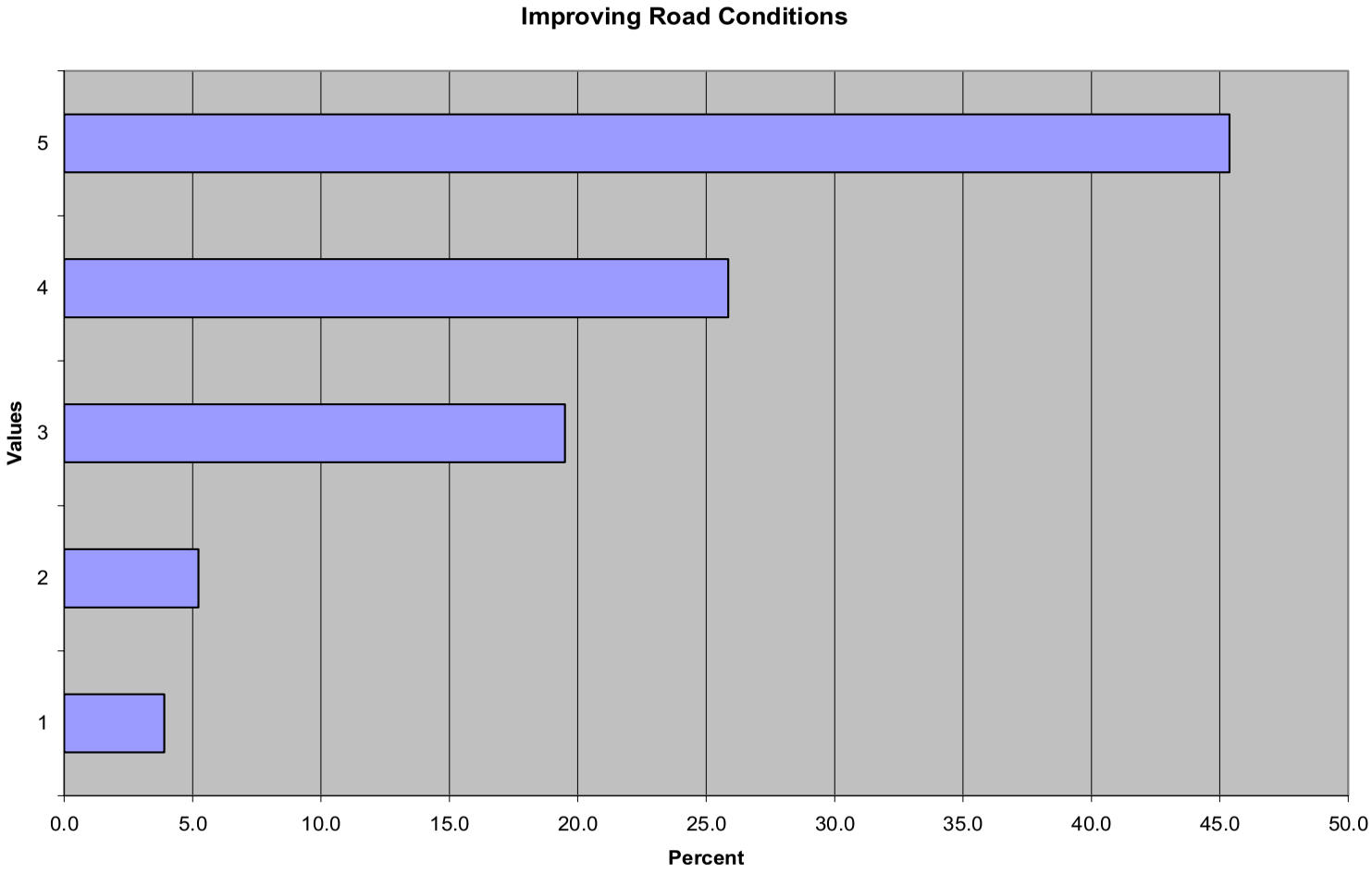
Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix I Continued
Importance for Selected Services
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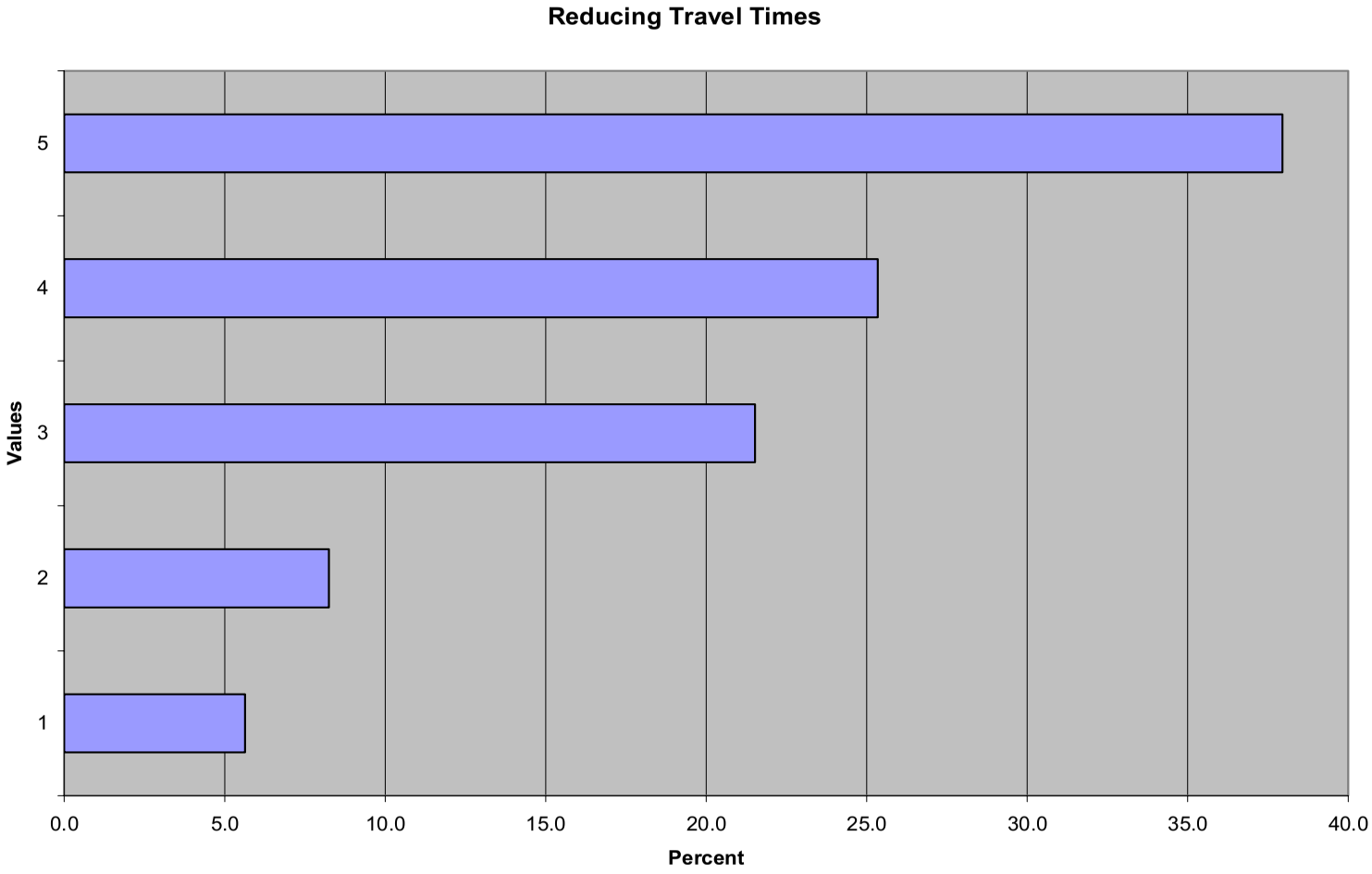
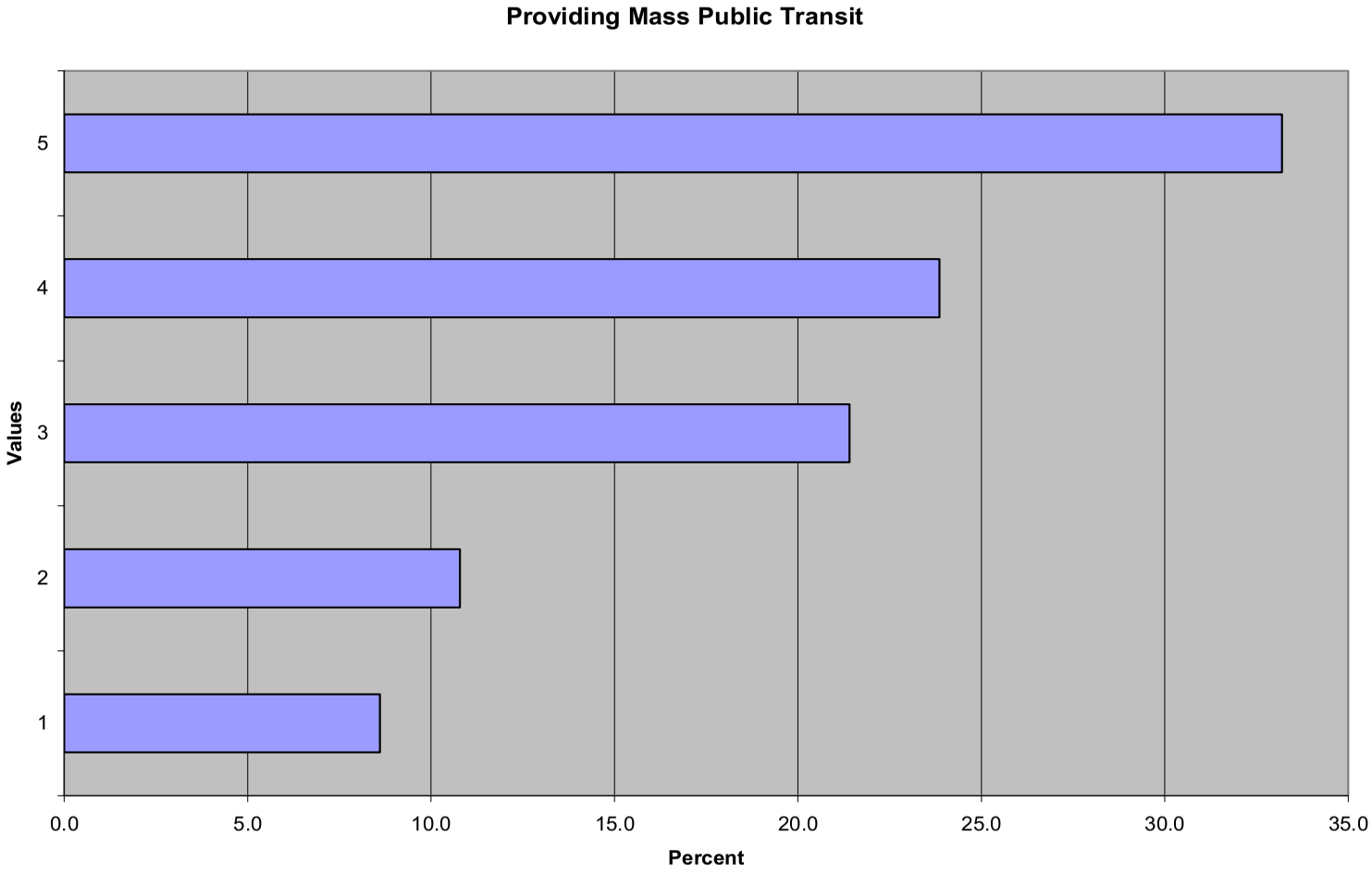


Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix I Continued
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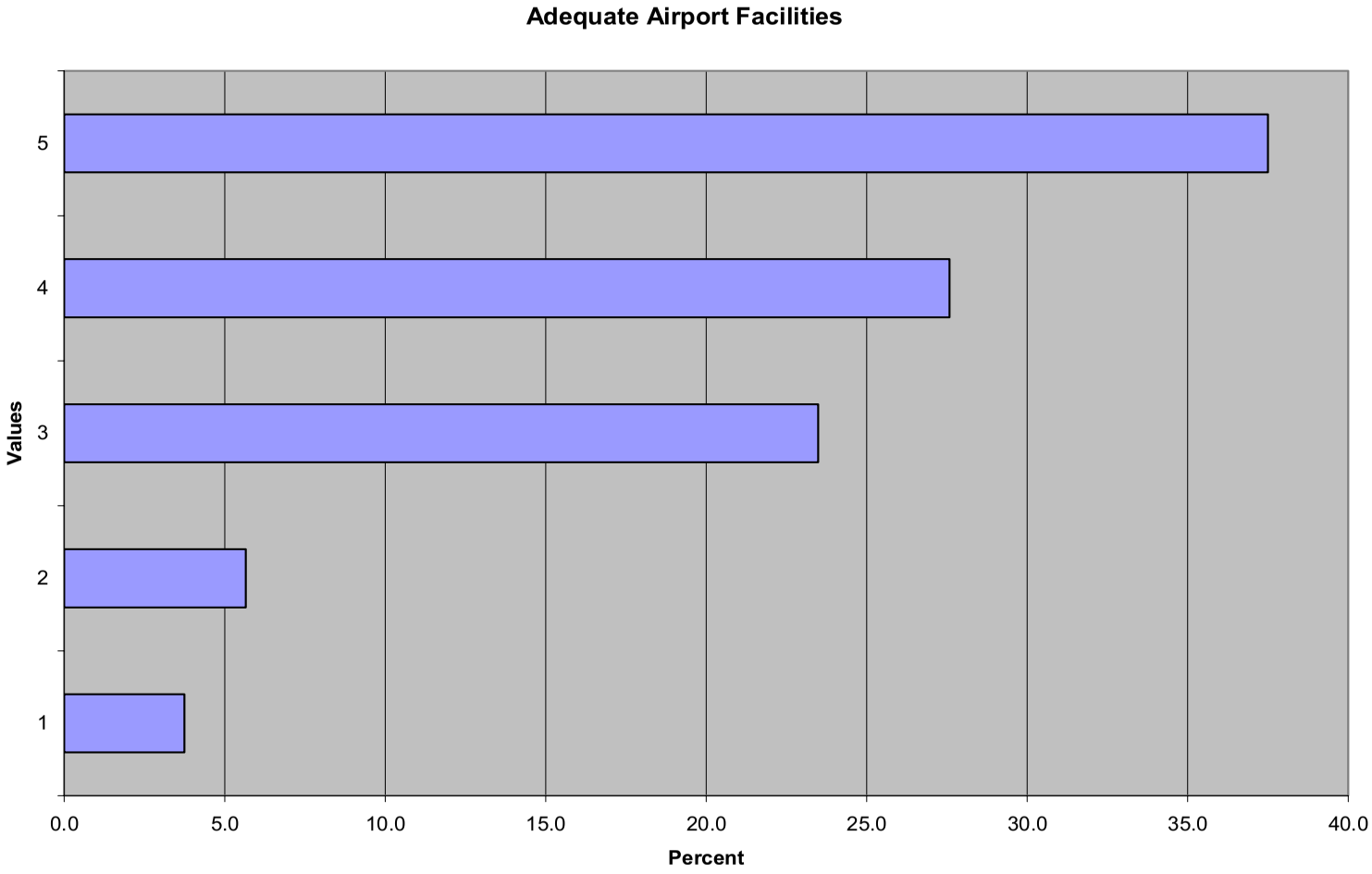
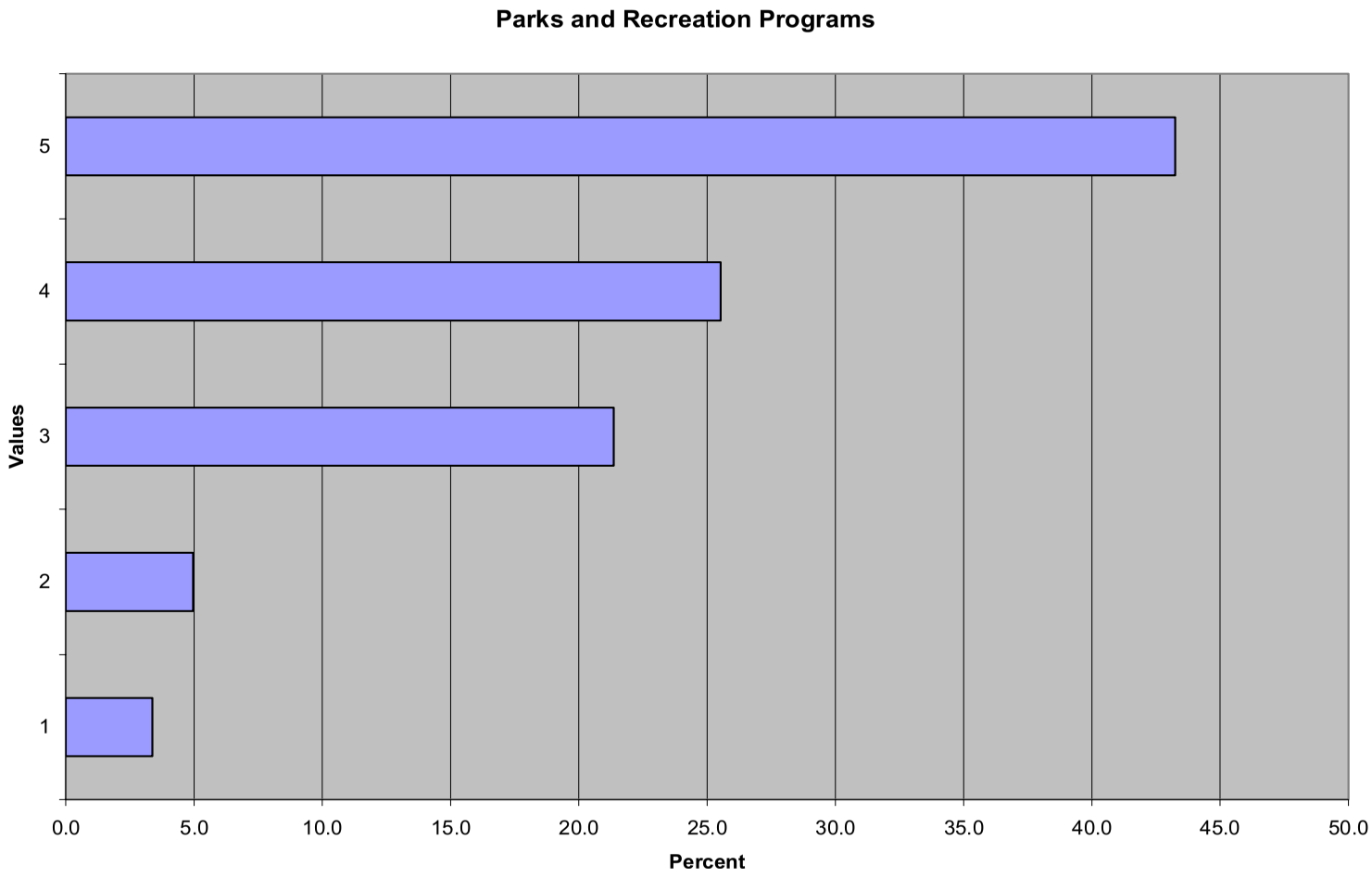


Appendix I Continued
Importance for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix I
Importance scores for selected variables
Summary Statistics by Jurisdiction

General Government Importance Measure	Region	N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
Road maintenance	Unincorporated Clark County	235	1	4.09	0.067	4.00	5	1.025	-0.886	0.159	0.027	0.316	1	5
	City of Las Vegas	187	3	3.90	0.090	4.00	5	1.226	-0.885	0.177	-0.170	0.353	1	5
	North Las Vegas	69	0	4.20	0.138	5.00	5	1.147	-1.521	0.288	1.650	0.569	1	5
	Henderson	81	0	4.03	0.113	4.00	5	1.016	-0.827	0.268	-0.131	0.530	1	5
	Boulder City	14	0	4.15	0.230	4.00	4	0.860	-0.909	0.597	0.834	1.154	2	5
	Mesquite	9	0	4.08	0.256	4.00	4	0.772	-0.153	0.715	-0.969	1.395	3	5
Revitalizing older neighborhoods	Unincorporated Clark County	233	3	3.51	0.084	4.00	5	1.283	-0.454	0.160	-0.823	0.318	1	5
	City of Las Vegas	182	9	3.51	0.088	3.00	3	1.182	-0.271	0.180	-0.770	0.359	1	5
	North Las Vegas	68	2	3.88	0.133	4.00	5	1.097	-0.428	0.292	-1.199	0.575	2	5
	Henderson	81	0	3.31	0.135	3.00	3	1.209	-0.044	0.268	-0.919	0.530	1	5
	Boulder City	14	0	3.25	0.393	3.00	5	1.472	-0.228	0.597	-1.246	1.154	1	5
	Mesquite	9	0	3.59	0.466	4.00	4	1.401	-0.938	0.715	-0.100	1.395	1	5
Flood control	Unincorporated Clark County	236	0	3.92	0.077	4.00	5	1.184	-0.784	0.158	-0.449	0.316	1	5
	City of Las Vegas	188	3	3.74	0.090	4.00	5	1.233	-0.678	0.177	-0.558	0.353	1	5
	North Las Vegas	68	1	4.04	0.123	4.00	5	1.015	-0.644	0.290	-0.807	0.573	2	5
	Henderson	81	0	3.97	0.109	4.00	5	0.979	-0.499	0.268	-0.602	0.530	1	5
	Boulder City	14	0	3.53	0.388	3.71	5	1.451	-0.448	0.597	-1.125	1.154	1	5
	Mesquite	9	0	3.07	0.468	3.00	3	1.409	-0.400	0.715	-0.564	1.395	1	5
Budget management	Unincorporated Clark County	231	5	4.25	0.067	5.00	5	1.022	-1.381	0.160	1.382	0.319	1	5
	City of Las Vegas	178	12	4.25	0.077	5.00	5	1.022	-1.331	0.182	1.136	0.362	1	5
	North Las Vegas	69	0	3.97	0.154	4.97	5	1.287	-1.076	0.288	0.122	0.569	1	5
	Henderson	77	4	4.30	0.115	5.00	5	1.006	-1.578	0.274	2.231	0.542	1	5

	Boulder City	13	1	4.38	0.279	5.00	5	0.989	-1.643	0.625	2.106	1.207	2	5
	Mesquite	8	1	4.73	0.260	5.00	5	0.729	-2.696	0.758	7.059	1.496	3	5
Communicate Clark County's local government views about Yucca Mountain to federal decision makers	Unincorporated Clark County	228	8	3.71	0.092	4.00	5	1.392	-0.668	0.161	-0.913	0.321	1	5
	City of Las Vegas	181	10	3.47	0.107	4.00	5	1.442	-0.472	0.181	-1.137	0.360	1	5
	North Las Vegas	65	5	3.75	0.179	4.00	5	1.440	-0.807	0.298	-0.716	0.588	1	5
	Henderson	78	2	3.46	0.179	4.00	5	1.584	-0.427	0.272	-1.408	0.537	1	5
	Boulder City	14	0	3.29	0.425	4.00	4	1.589	-0.507	0.597	-1.316	1.154	1	5
	Mesquite	9	0	3.06	0.584	2.79	5	1.757	0.073	0.715	-2.040	1.395	1	5
Monitor and report to the public on how well government services are being performed	Unincorporated Clark County	233	3	3.88	0.079	4.00	5	1.200	-0.840	0.160	-0.195	0.318	1	5
	City of Las Vegas	181	9	3.66	0.092	4.00	5	1.237	-0.497	0.180	-0.886	0.359	1	5
	North Las Vegas	66	3	3.79	0.161	4.00	5	1.311	-0.594	0.294	-0.933	0.581	1	5
	Henderson	81	0	3.74	0.148	4.00	5	1.332	-0.604	0.268	-0.898	0.530	1	5
	Boulder City	14	0	3.11	0.366	3.00	4	1.370	-0.390	0.597	-0.908	1.154	1	5
	Mesquite	9	0	2.90	0.577	3.32	1	1.737	-0.030	0.715	-2.115	1.395	1	5

Appendix I
Importance scores for selected variables
Summary Statistics by Jurisdiction

General Government Importance Measure	Region	N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
Water conservation programs	Unincorporated Clark County	234	3	4.26	0.066	5.00	5	1.012	-1.214	0.159	0.611	0.317	1	5
	City of Las Vegas	185	5	4.04	0.085	4.00	5	1.160	-1.134	0.178	0.469	0.355	1	5
	North Las Vegas	69	0	4.00	0.140	4.00	5	1.169	-1.024	0.288	0.298	0.569	1	5
	Henderson	80	1	4.02	0.132	4.00	5	1.176	-1.111	0.269	0.426	0.532	1	5
	Boulder City	14	0	3.94	0.323	4.00	5	1.208	-1.107	0.597	0.691	1.154	1	5
	Mesquite	9	0	4.12	0.333	4.00	5	1.004	-1.094	0.715	0.919	1.395	2	5
Providing child protection services	Unincorporated Clark County	235	2	4.20	0.079	5.00	5	1.204	-1.441	0.159	0.976	0.317	1	5
	City of Las Vegas	184	6	4.04	0.092	5.00	5	1.247	-1.177	0.179	0.326	0.356	1	5
	North Las Vegas	66	3	3.99	0.173	5.00	5	1.412	-1.052	0.294	-0.364	0.581	1	5
	Henderson	81	0	4.09	0.141	5.00	5	1.267	-1.222	0.268	0.303	0.530	1	5
	Boulder City	13	1	4.05	0.284	4.00	5	1.042	-1.233	0.608	2.377	1.174	1	5
	Mesquite	9	0	4.04	0.507	5.00	5	1.527	-1.402	0.715	0.884	1.395	1	5
Providing child welfare services	Unincorporated Clark County	233	3	4.13	0.075	5.00	5	1.140	-1.176	0.159	0.396	0.318	1	5
	City of Las Vegas	185	6	3.96	0.087	4.00	5	1.181	-0.865	0.179	-0.228	0.356	1	5
	North Las Vegas	65	5	3.87	0.177	5.00	5	1.428	-0.949	0.298	-0.555	0.587	1	5
	Henderson	80	1	3.79	0.142	4.00	5	1.270	-0.789	0.269	-0.498	0.532	1	5
	Boulder City	13	1	3.32	0.216	3.00	3	0.785	0.153	0.613	0.173	1.185	2	5
	Mesquite	9	0	3.95	0.381	4.00	5	1.147	-0.646	0.715	-0.917	1.395	2	5
Providing juvenile justice services	Unincorporated Clark County	232	4	3.97	0.072	4.00	5	1.100	-0.827	0.160	-0.079	0.318	1	5
	City of Las Vegas	184	6	3.74	0.088	4.00	5	1.199	-0.663	0.179	-0.457	0.356	1	5
	North Las Vegas	66	4	3.87	0.167	4.00	5	1.358	-0.975	0.295	-0.251	0.583	1	5
	Henderson	77	3	3.92	0.124	4.00	4	1.091	-0.847	0.273	-0.188	0.540	1	5
	Boulder City	13	1	3.66	0.265	4.00	4	0.967	-0.300	0.611	-0.533	1.180	2	5

	Mesquite	9	0	3.87	0.260	4.00	4	0.782	0.248	0.715	-1.036	1.395	3	5
Providing attainable housing for working class families	Unincorporated Clark County	235	1	3.94	0.082	4.00	5	1.254	-0.916	0.159	-0.293	0.316	1	5
	City of Las Vegas	187	4	3.66	0.105	4.00	5	1.435	-0.676	0.178	-0.948	0.354	1	5
	North Las Vegas	68	2	3.82	0.168	5.00	5	1.388	-0.694	0.291	-0.921	0.574	1	5
	Henderson	79	2	3.61	0.151	4.00	5	1.336	-0.584	0.271	-0.803	0.536	1	5
	Boulder City	14	0	3.20	0.374	3.32	2	1.401	-0.038	0.597	-1.484	1.154	1	5
	Mesquite	9	0	3.77	0.485	4.00	4	1.459	-1.261	0.715	0.571	1.395	1	5
Providing affordable housing for low income families	Unincorporated Clark County	232	4	3.76	0.086	4.00	5	1.306	-0.732	0.160	-0.659	0.318	1	5
	City of Las Vegas	188	2	3.60	0.104	4.00	5	1.430	-0.628	0.177	-0.954	0.352	1	5
	North Las Vegas	67	2	3.77	0.168	4.00	5	1.378	-0.681	0.293	-0.782	0.578	1	5
	Henderson	79	2	3.38	0.154	3.92	5	1.367	-0.394	0.271	-1.009	0.536	1	5
	Boulder City	14	0	3.08	0.331	3.00	2	1.239	0.020	0.597	-0.843	1.154	1	5
	Mesquite	9	0	3.52	0.470	4.00	4	1.416	-0.875	0.715	-0.234	1.395	1	5
Providing shelter for the homeless	Unincorporated Clark County	235	1	3.65	0.087	4.00	5	1.340	-0.544	0.159	-0.923	0.316	1	5
	City of Las Vegas	185	6	3.50	0.105	4.00	5	1.430	-0.505	0.179	-1.059	0.356	1	5
	North Las Vegas	67	2	3.56	0.188	4.00	5	1.543	-0.497	0.292	-1.323	0.577	1	5
	Henderson	81	0	3.35	0.159	3.00	5	1.426	-0.227	0.268	-1.265	0.530	1	5
	Boulder City	14	0	3.02	0.411	3.00	1	1.538	-0.115	0.597	-1.479	1.154	1	5
	Mesquite	9	0	3.51	0.483	3.87	5	1.453	-0.555	0.715	-0.826	1.395	1	5
	Unincorporated Clark County	235	1	4.11	0.070	4.00	5	1.066	-1.056	0.159	0.305	0.316	1	5
Providing affordable housing for seniors	City of Las Vegas	184	7	3.76	0.100	4.00	5	1.354	-0.702	0.179	-0.793	0.357	1	5
	North Las Vegas	66	4	3.82	0.164	4.00	5	1.332	-0.972	0.296	-0.173	0.584	1	5
	Henderson	79	2	3.84	0.141	4.00	5	1.253	-0.908	0.270	-0.070	0.535	1	5
	Boulder City	14	0	3.28	0.347	3.00	2	1.298	0.191	0.597	-1.269	1.154	1	5
	Mesquite	9	0	3.84	0.326	3.31	3	0.983	0.384	0.715	-2.207	1.395	3	5
Providing medical care for the poor	Unincorporated Clark County	235	1	3.95	0.080	4.00	5	1.235	-0.918	0.159	-0.224	0.316	1	5
	City of Las Vegas	186	4	3.64	0.101	4.00	5	1.371	-0.635	0.178	-0.889	0.354	1	5
	North Las Vegas	66	3	3.80	0.157	4.00	5	1.281	-0.873	0.294	-0.129	0.581	1	5
	Henderson	79	2	3.52	0.146	4.00	4	1.294	-0.607	0.271	-0.663	0.535	1	5
	Boulder City	14	0	3.04	0.314	3.00	3	1.174	-0.083	0.597	-0.520	1.154	1	5

	Mesquite	9	0	2.79	0.559	2.00	2	1.683	0.521	0.715	-1.554	1.395	1	5
Providing 24 hour emergency trauma care	Unincorporated Clark County	236	1	4.47	0.056	5.00	5	0.867	-1.589	0.159	1.692	0.316	1	5
	City of Las Vegas	186	4	4.29	0.076	5.00	5	1.044	-1.354	0.178	0.878	0.354	1	5
	North Las Vegas	67	2	4.13	0.136	5.00	5	1.114	-1.161	0.293	0.491	0.578	1	5
	Henderson	79	1	4.10	0.140	5.00	5	1.249	-1.395	0.270	0.916	0.533	1	5
	Boulder City	14	0	3.58	0.320	3.88	5	1.196	-0.105	0.597	-1.524	1.154	2	5
	Mesquite	9	0	3.53	0.387	3.66	4	1.165	-0.060	0.715	-1.357	1.395	2	5

Appendix I
Importance scores for selected variables
Summary Statistics by Jurisdiction

Public Safety Importance Measure	Region	N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
Providing crime prevention programs	Unincorporated Clark County	232	4	4.14	0.070	5.00	5	1.068	-1.197	0.160	0.790	0.318	1	5
	City of Las Vegas	188	3	4.02	0.081	4.00	5	1.110	-1.017	0.177	0.308	0.353	1	5
	North Las Vegas	69	0	4.21	0.130	5.00	5	1.079	-1.200	0.288	0.531	0.569	1	5
	Henderson	80	1	4.11	0.129	4.41	5	1.147	-1.342	0.270	1.226	0.533	1	5
	Boulder City	14	0	3.73	0.294	4.00	4	1.102	-0.363	0.597	-1.069	1.154	2	5
	Mesquite	9	0	3.85	0.362	4.00	5	1.091	-0.543	0.715	-0.704	1.395	2	5
Enforcing traffic laws	Unincorporated Clark County	235	2	4.11	0.070	4.00	5	1.067	-1.187	0.159	0.876	0.317	1	5
	City of Las Vegas	191	0	4.00	0.083	4.00	5	1.141	-1.036	0.176	0.219	0.350	1	5
	North Las Vegas	69	0	4.20	0.137	5.00	5	1.144	-1.335	0.288	0.912	0.569	1	5
	Henderson	81	0	4.04	0.122	4.00	5	1.093	-1.043	0.268	0.415	0.530	1	5
	Boulder City	14	0	3.73	0.281	4.00	4	1.052	-0.505	0.597	-0.706	1.154	2	5
	Mesquite	9	0	3.90	0.511	5.00	5	1.537	-1.107	0.715	-0.146	1.395	1	5
Maintaining low crime rates	Unincorporated Clark County	236	0	4.34	0.067	5.00	5	1.037	-1.585	0.158	1.765	0.316	1	5
	City of Las Vegas	190	1	4.21	0.086	5.00	5	1.187	-1.448	0.177	0.992	0.351	1	5
	North Las Vegas	69	0	4.16	0.148	5.00	5	1.231	-1.263	0.288	0.322	0.569	1	5
	Henderson	81	0	4.45	0.105	5.00	5	0.939	-1.602	0.268	1.739	0.530	1	5
	Boulder City	14	0	4.10	0.254	4.00	5	0.950	-0.878	0.597	0.224	1.154	2	5
	Mesquite	9	0	3.95	0.537	5.00	5	1.618	-1.115	0.715	-0.514	1.395	1	5
Maintaining neighborhood police patrols	Unincorporated Clark County	236	1	4.14	0.073	5.00	5	1.116	-1.191	0.159	0.562	0.316	1	5
	City of Las Vegas	189	1	3.96	0.088	4.00	5	1.204	-0.890	0.177	-0.261	0.352	1	5
	North Las Vegas	69	0	4.09	0.142	5.00	5	1.184	-1.208	0.288	0.644	0.569	1	5
	Henderson	81	0	4.19	0.117	5.00	5	1.054	-1.324	0.268	1.266	0.530	1	5
	Boulder City	14	0	4.15	0.288	4.43	5	1.076	-1.086	0.597	0.106	1.154	2	5

	Mesquite	9	0	3.91	0.600	5.00	5	1.806	-1.292	0.715	-0.329	1.395	1	5
Keeping police response times low	Unincorporated Clark County	235	2	4.44	0.057	5.00	5	0.870	-1.645	0.159	2.509	0.317	1	5
	City of Las Vegas	188	2	4.16	0.080	5.00	5	1.101	-1.214	0.177	0.567	0.352	1	5
	North Las Vegas	68	2	4.18	0.146	5.00	5	1.206	-1.270	0.291	0.370	0.575	1	5
	Henderson	79	2	4.42	0.106	5.00	5	0.940	-1.862	0.271	3.226	0.535	1	5
	Boulder City	14	0	4.09	0.259	4.00	5	0.968	-0.819	0.597	-0.044	1.154	2	5
	Mesquite	9	0	4.08	0.352	4.00	5	1.059	-1.031	0.715	0.430	1.395	2	5
Keeping fire department response times low	Unincorporated Clark County	236	1	4.56	0.054	5.00	5	0.830	-2.104	0.159	4.133	0.316	1	5
	City of Las Vegas	186	4	4.42	0.071	5.00	5	0.975	-1.750	0.178	2.560	0.354	1	5
	North Las Vegas	69	0	4.43	0.116	5.00	5	0.970	-1.730	0.288	2.283	0.569	1	5
	Henderson	81	0	4.47	0.100	5.00	5	0.894	-1.773	0.268	2.708	0.530	1	5
	Boulder City	13	1	4.31	0.283	5.00	5	1.025	-1.315	0.613	0.657	1.185	2	5
	Mesquite	8	1	3.98	0.430	4.43	5	1.205	-0.662	0.758	-1.213	1.496	2	5
Keeping paramedic and emergency medical response times low	Unincorporated Clark County	236	0	4.62	0.048	5.00	5	0.730	-2.180	0.158	5.244	0.316	1	5
	City of Las Vegas	187	3	4.47	0.063	5.00	5	0.865	-1.962	0.178	4.138	0.354	1	5
	North Las Vegas	69	0	4.45	0.108	5.00	5	0.898	-1.739	0.288	2.639	0.569	1	5
	Henderson	81	0	4.57	0.095	5.00	5	0.856	-2.364	0.268	5.803	0.530	1	5
	Boulder City	14	0	4.36	0.291	5.00	5	1.089	-1.535	0.597	1.054	1.154	2	5
	Mesquite	8	1	4.46	0.521	5.00	5	1.458	-2.696	0.758	7.059	1.496	1	5
Well trained paramedic and emergency medical response personnel	Unincorporated Clark County	236	1	4.68	0.044	5.00	5	0.682	-2.532	0.159	7.531	0.316	1	5
	City of Las Vegas	186	5	4.50	0.064	5.00	5	0.867	-1.804	0.178	2.572	0.355	1	5
	North Las Vegas	69	1	4.59	0.095	5.00	5	0.787	-1.918	0.290	2.814	0.572	2	5
	Henderson	81	0	4.51	0.110	5.00	5	0.991	-2.494	0.268	5.974	0.530	1	5
	Boulder City	14	0	4.37	0.270	5.00	5	1.009	-1.457	0.597	1.050	1.154	2	5
	Mesquite	9	0	4.17	0.468	5.00	5	1.408	-1.817	0.715	2.891	1.395	1	5
Facilitate neighborhood watch programs	Unincorporated Clark County	233	3	3.82	0.072	4.00	5	1.099	-0.732	0.159	-0.015	0.317	1	5
	City of Las Vegas	185	5	3.73	0.083	4.00	5	1.127	-0.594	0.178	-0.317	0.355	1	5
	North Las Vegas	67	2	3.94	0.145	4.00	5	1.184	-0.841	0.292	-0.284	0.577	1	5
	Henderson	80	1	3.71	0.122	4.00	3	1.092	-0.463	0.269	-0.463	0.532	1	5
	Boulder City	14	0	3.74	0.276	4.00	4	1.033	-0.263	0.597	-0.934	1.154	2	5

	Mesquite	9	0	3.74	0.505	4.03	5	1.520	-0.913	0.715	-0.553	1.395	1	5
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	Unincorporated Clark County	235	1	3.93	0.079	4.00	5	1.213	-0.992	0.159	0.068	0.316	1	5
	City of Las Vegas	188	2	3.74	0.086	4.00	5	1.176	-0.558	0.177	-0.635	0.352	1	5
	North Las Vegas	69	0	3.84	0.155	4.00	5	1.290	-0.731	0.288	-0.673	0.569	1	5
	Henderson	79	2	4.01	0.126	4.00	5	1.119	-0.838	0.271	-0.211	0.535	1	5
	Boulder City	13	1	3.89	0.260	4.00	3	0.934	-0.164	0.617	-1.019	1.193	2	5
	Mesquite	9	0	4.10	0.312	4.00	4	0.940	-1.447	0.715	3.038	1.395	2	5
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	Unincorporated Clark County	235	1	4.15	0.074	5.00	5	1.137	-1.305	0.159	0.898	0.316	1	5
	City of Las Vegas	188	3	3.85	0.090	4.00	5	1.235	-0.721	0.177	-0.631	0.353	1	5
	North Las Vegas	69	0	4.03	0.148	4.91	5	1.237	-1.121	0.288	0.185	0.569	1	5
	Henderson	81	0	4.10	0.125	4.00	5	1.119	-1.211	0.268	0.835	0.530	1	5
	Boulder City	14	0	3.66	0.383	3.92	5	1.432	-0.555	0.597	-1.006	1.154	1	5
	Mesquite	9	0	3.62	0.367	3.00	3	1.105	0.238	0.715	-1.356	1.395	2	5
Investigating criminal activity	Unincorporated Clark County	235	1	4.32	0.063	5.00	5	0.962	-1.554	0.159	2.213	0.316	1	5
	City of Las Vegas	189	2	4.20	0.073	5.00	5	1.000	-1.146	0.177	0.562	0.352	1	5
	North Las Vegas	68	2	4.25	0.134	5.00	5	1.105	-1.342	0.291	0.831	0.574	1	5
	Henderson	81	0	4.21	0.113	4.41	5	1.016	-1.449	0.268	1.893	0.530	1	5
	Boulder City	14	0	3.84	0.304	4.00	4	1.139	-1.044	0.597	1.005	1.154	1	5
	Mesquite	9	0	3.73	0.465	3.87	5	1.399	-0.864	0.715	0.241	1.395	1	5
Providing fire protection & prevention services	Unincorporated Clark County	233	3	4.32	0.060	5.00	5	0.910	-1.279	0.159	1.359	0.317	1	5
	City of Las Vegas	186	5	4.19	0.074	5.00	5	1.005	-1.151	0.178	0.708	0.355	1	5
	North Las Vegas	69	0	4.27	0.140	5.00	5	1.168	-1.435	0.288	0.872	0.569	1	5
	Henderson	81	0	4.30	0.096	5.00	5	0.865	-0.961	0.268	-0.096	0.530	2	5
	Boulder City	14	0	4.15	0.274	4.00	5	1.025	-1.210	0.597	0.785	1.154	2	5
	Mesquite	9	0	3.87	0.428	4.00	4	1.287	-1.576	0.715	2.824	1.395	1	5
Providing emergency medical services	Unincorporated Clark County	235	1	4.47	0.059	5.00	5	0.901	-2.037	0.159	4.364	0.316	1	5
	City of Las Vegas	185	5	4.44	0.064	5.00	5	0.872	-1.554	0.178	2.014	0.355	1	5
	North Las Vegas	69	1	4.40	0.130	5.00	5	1.074	-1.653	0.290	1.429	0.572	1	5
	Henderson	81	0	4.46	0.099	5.00	5	0.890	-1.608	0.268	1.996	0.530	1	5

	Boulder City	14	0	3.82	0.271	4.00	3	1.015	-0.134	0.597	-1.214	1.154	2	5
	Mesquite	9	0	4.52	0.176	4.66	5	0.530	-0.086	0.715	-2.651	1.395	4	5
Providing for neighborhood code enforcement services	Unincorporated Clark County	229	7	3.61	0.080	4.00	5	1.213	-0.536	0.161	-0.560	0.320	1	5
	City of Las Vegas	186	5	3.56	0.086	4.00	4	1.178	-0.454	0.178	-0.614	0.355	1	5
	North Las Vegas	67	2	3.77	0.138	4.00	5	1.128	-0.481	0.293	-0.748	0.578	1	5
	Henderson	77	3	3.50	0.132	4.00	3	1.159	-0.358	0.273	-0.651	0.540	1	5
	Boulder City	14	0	2.90	0.219	3.00	3	0.819	-0.629	0.597	0.770	1.154	1	4
	Mesquite	8	1	3.47	0.386	3.06	3	1.106	0.178	0.744	-1.013	1.461	2	5
Examining potential impacts from Yucca Mountain nuclear waste shipments	Unincorporated Clark County	227	10	3.69	0.096	4.00	5	1.445	-0.623	0.162	-1.019	0.322	1	5
	City of Las Vegas	179	11	3.61	0.108	4.00	5	1.444	-0.563	0.181	-1.095	0.361	1	5
	North Las Vegas	66	3	3.62	0.189	4.36	5	1.543	-0.546	0.294	-1.232	0.581	1	5
	Henderson	81	0	3.66	0.156	4.00	5	1.397	-0.667	0.268	-0.824	0.530	1	5
	Boulder City	13	1	3.50	0.388	3.36	3	1.414	-0.625	0.611	-0.433	1.180	1	5
	Mesquite	9	0	3.69	0.461	3.66	5	1.388	-0.786	0.715	0.170	1.395	1	5

Appendix I
Importance scores for selected variables
Summary Statistics by Jurisdiction

Community Development Importance Measure	Region	N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
Regional justice services and facilities	Unincorporated Clark County	234	2	3.71	0.067	4.00	3	1.024	-0.466	0.159	-0.153	0.317	1	5
	City of Las Vegas	176	15	3.53	0.082	4.00	3	1.090	-0.370	0.183	-0.462	0.365	1	5
	North Las Vegas	67	2	3.59	0.148	3.00	3	1.215	-0.361	0.293	-0.663	0.578	1	5
	Henderson	81	0	3.45	0.125	4.00	4	1.124	-0.478	0.268	-0.347	0.530	1	5
	Boulder City	13	1	3.33	0.263	3.00	3	0.947	0.955	0.617	0.217	1.193	2	5
	Mesquite	9	0	4.18	0.274	4.00	5	0.824	-0.397	0.715	-1.291	1.395	3	5
Providing affordable housing	Unincorporated Clark County	235	1	3.79	0.085	4.00	5	1.306	-0.721	0.159	-0.687	0.316	1	5
	City of Las Vegas	188	3	3.57	0.100	4.00	5	1.368	-0.574	0.177	-0.814	0.353	1	5
	North Las Vegas	67	2	4.11	0.158	5.00	5	1.292	-1.236	0.292	0.288	0.577	1	5
	Henderson	80	1	3.43	0.153	4.00	5	1.366	-0.474	0.269	-0.968	0.532	1	5
	Boulder City	13	1	3.29	0.428	3.74	5	1.560	-0.458	0.611	-1.239	1.180	1	5
	Mesquite	9	0	2.79	0.516	2.66	1	1.554	0.359	0.715	-1.267	1.395	1	5
Managing Growth	Unincorporated Clark County	234	3	3.97	0.082	4.00	5	1.255	-0.995	0.159	-0.167	0.317	1	5
	City of Las Vegas	187	4	3.77	0.101	4.00	5	1.378	-0.874	0.178	-0.463	0.354	1	5
	North Las Vegas	66	4	3.70	0.181	4.00	5	1.467	-0.667	0.296	-0.925	0.583	1	5
	Henderson	81	0	4.02	0.132	4.00	5	1.184	-1.325	0.268	1.039	0.530	1	5
	Boulder City	14	0	4.09	0.296	4.57	5	1.106	-0.853	0.597	-0.622	1.154	2	5
	Mesquite	9	0	3.14	0.505	3.00	3	1.520	-0.383	0.715	-0.989	1.395	1	5
Increasing job opportunities	Unincorporated Clark County	234	2	3.96	0.076	4.00	5	1.159	-0.933	0.159	0.032	0.317	1	5
	City of Las Vegas	186	5	3.69	0.094	4.00	5	1.282	-0.714	0.178	-0.522	0.355	1	5
	North Las Vegas	67	2	4.09	0.150	5.00	5	1.228	-1.032	0.292	-0.203	0.577	1	5
	Henderson	81	0	3.72	0.140	4.00	5	1.256	-0.673	0.268	-0.615	0.530	1	5
	Boulder City	14	0	2.75	0.341	3.00	3	1.274	-0.205	0.597	-0.871	1.154	1	5

	Mesquite	9	0	3.44	0.394	3.66	3	1.186	-0.922	0.715	1.591	1.395	1	5
Improving the business climate	Unincorporated Clark County	236	0	3.84	0.078	4.00	5	1.193	-0.919	0.158	0.065	0.316	1	5
	City of Las Vegas	185	6	3.71	0.083	4.00	4	1.135	-0.618	0.179	-0.329	0.355	1	5
	North Las Vegas	69	1	4.02	0.139	4.00	5	1.154	-0.992	0.289	0.064	0.571	1	5
	Henderson	79	2	3.52	0.128	4.00	3	1.136	-0.326	0.270	-0.623	0.534	1	5
	Boulder City	14	0	3.15	0.313	3.00	3	1.170	-0.598	0.597	0.424	1.154	1	5
	Mesquite	9	0	3.42	0.454	3.66	4	1.368	-0.536	0.715	-0.442	1.395	1	5
Planning for commercial development	Unincorporated Clark County	236	0	3.63	0.074	4.00	4	1.144	-0.544	0.158	-0.379	0.316	1	5
	City of Las Vegas	187	4	3.52	0.088	4.00	4	1.200	-0.424	0.178	-0.708	0.354	1	5
	North Las Vegas	69	1	3.73	0.150	4.00	5	1.245	-0.649	0.289	-0.688	0.571	1	5
	Henderson	81	0	3.42	0.136	3.00	3	1.223	-0.438	0.268	-0.545	0.530	1	5
	Boulder City	14	0	2.60	0.274	3.00	3	1.027	-0.426	0.597	-0.759	1.154	1	4
	Mesquite	9	0	3.98	0.440	4.00	5	1.324	-1.692	0.715	3.021	1.395	1	5
Reducing traffic congestion	Unincorporated Clark County	236	0	4.20	0.074	5.00	5	1.143	-1.525	0.158	1.543	0.316	1	5
	City of Las Vegas	190	1	4.04	0.092	5.00	5	1.273	-1.106	0.176	-0.036	0.351	1	5
	North Las Vegas	69	1	3.76	0.179	5.00	5	1.485	-0.751	0.289	-0.928	0.571	1	5
	Henderson	81	0	4.02	0.134	4.00	5	1.200	-1.023	0.268	0.014	0.530	1	5
	Boulder City	14	0	4.07	0.352	4.99	5	1.317	-1.479	0.597	1.477	1.154	1	5
	Mesquite	9	0	3.66	0.373	3.03	3	1.122	0.136	0.715	-1.479	1.395	2	5
Access to freeways	Unincorporated Clark County	236	0	3.99	0.072	4.00	5	1.104	-0.943	0.158	0.092	0.316	1	5
	City of Las Vegas	189	1	3.92	0.082	4.00	5	1.127	-0.826	0.177	-0.149	0.352	1	5
	North Las Vegas	69	0	3.96	0.144	4.00	5	1.200	-0.873	0.288	-0.250	0.569	1	5
	Henderson	81	0	3.68	0.124	4.00	4	1.113	-0.841	0.268	0.378	0.530	1	5
	Boulder City	13	1	3.90	0.316	4.00	5	1.151	-1.037	0.611	1.085	1.180	1	5
	Mesquite	9	0	3.97	0.374	4.00	4	1.126	-1.426	0.715	3.498	1.395	1	5
Improving road conditions	Unincorporated Clark County	236	0	4.10	0.068	4.00	5	1.050	-0.984	0.158	0.291	0.316	1	5
	City of Las Vegas	190	1	4.10	0.078	4.00	5	1.071	-1.136	0.176	0.712	0.351	1	5
	North Las Vegas	69	0	4.11	0.148	5.00	5	1.234	-1.294	0.288	0.606	0.569	1	5
	Henderson	81	0	3.76	0.123	4.00	4	1.103	-0.807	0.268	0.166	0.530	1	5
	Boulder City	14	0	3.69	0.316	4.00	3	1.183	-0.541	0.597	-0.140	1.154	1	5

Appendix II
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)

	Mesquite	9	0	3.70	0.498	4.04	5	1.500	-0.602	0.715	-1.046	1.395	1	5
Reducing travel time	Unincorporated Clark County	235	1	4.02	0.071	4.00	5	1.087	-0.960	0.159	0.189	0.316	1	5
	City of Las Vegas	187	4	3.83	0.091	4.00	5	1.244	-0.850	0.178	-0.227	0.354	1	5
	North Las Vegas	69	0	3.79	0.160	4.00	5	1.334	-0.756	0.288	-0.681	0.569	1	5
	Henderson	79	2	3.39	0.128	3.00	3	1.141	-0.333	0.270	-0.542	0.534	1	5
	Boulder City	14	0	3.53	0.319	3.00	3	1.194	-0.493	0.597	0.362	1.154	1	5
	Mesquite	8	1	3.32	0.392	3.00	3	1.124	0.257	0.744	-1.071	1.461	2	5
Providing mass public transit	Unincorporated Clark County	235	2	3.80	0.081	4.00	5	1.245	-0.794	0.159	-0.381	0.317	1	5
	City of Las Vegas	184	7	3.65	0.092	4.00	5	1.248	-0.650	0.179	-0.518	0.357	1	5
	North Las Vegas	66	3	3.76	0.161	4.00	5	1.309	-0.649	0.295	-0.692	0.582	1	5
	Henderson	79	1	3.22	0.151	3.00	4	1.345	-0.150	0.270	-1.191	0.533	1	5
	Boulder City	14	0	2.78	0.371	3.00	3	1.388	0.098	0.597	-0.998	1.154	1	5
	Mesquite	9	0	3.37	0.475	3.00	3	1.428	-0.260	0.715	-0.914	1.395	1	5
Adequate airport facilities	Unincorporated Clark County	232	4	3.97	0.070	4.00	5	1.063	-0.867	0.160	0.161	0.318	1	5
	City of Las Vegas	184	6	3.95	0.080	4.00	5	1.087	-0.939	0.179	0.377	0.356	1	5
	North Las Vegas	69	1	4.01	0.129	4.00	5	1.068	-0.608	0.289	-0.745	0.571	1	5
	Henderson	81	0	3.82	0.121	4.00	4	1.083	-0.751	0.268	0.062	0.530	1	5
	Boulder City	14	0	3.09	0.348	3.00	3	1.303	-0.056	0.597	-0.784	1.154	1	5
	Mesquite	8	1	2.86	0.371	3.00	3	1.063	-0.086	0.744	1.843	1.461	1	5
Parks and Recreation Programs	Unincorporated Clark County	235	1	4.12	0.070	4.00	5	1.071	-1.126	0.159	0.643	0.316	1	5
	City of Las Vegas	187	4	3.90	0.080	4.00	5	1.089	-0.812	0.178	0.032	0.354	1	5
	North Las Vegas	67	2	4.18	0.124	5.00	5	1.018	-0.885	0.292	-0.274	0.577	1	5
	Henderson	79	1	3.77	0.127	4.00	5	1.130	-0.730	0.270	-0.003	0.533	1	5
	Boulder City	13	1	4.19	0.284	4.92	5	1.034	-0.994	0.611	-0.157	1.180	2	5
	Mesquite	9	0	4.52	0.244	5.00	5	0.736	-1.336	0.715	0.899	1.395	3	5

Importance Variable	N	Mean	Std. Error of Mean	Median	Min	Max	Std. Deviation	Kurtosis	Std Error of Kurtosis	Skewness	Std. Error of Skewness
** General Government*											
Road Maintenance	595	3.21	0.044	3.00	1	5	1.084	-0.199	0.100	-0.395	0.200
Revitalizing older neighborhoods	578	2.67	0.046	3.00	1	5	1.104	0.346	0.102	-0.429	0.203
Flood control	578	3.54	0.042	4.00	1	5	1.015	-0.458	0.102	-0.140	0.203
Budget management	579	2.70	0.045	3.00	1	5	1.092	0.120	0.102	-0.546	0.203
Communicate Clark County's local government views about Yucca Mountain to federal decision makers	582	2.82	0.051	3.00	1	5	1.240	0.139	0.101	-0.885	0.202
Monitor and report to the public on how well government services are being performed	578	2.59	0.044	3.00	1	5	1.066	0.348	0.102	-0.311	0.203
Water conservation programs	580	3.31	0.048	3.00	1	5	1.154	-0.358	0.101	-0.592	0.203
** Social and Judicial Services*											
Providing child protection services	580	2.76	0.051	3.00	1	5	1.218	0.211	0.101	-0.798	0.203
Providing child welfare services	585	2.80	0.046	3.00	1	5	1.124	0.155	0.101	-0.586	0.202
Providing juvenile justice services	583	2.88	0.045	3.00	1	5	1.082	0.179	0.101	-0.307	0.202
Providing attainable housing for working class families	585	2.53	0.047	2.00	1	5	1.129	0.457	0.101	-0.354	0.202
Providing affordable housing for low income families	582	2.47	0.047	2.00	1	5	1.144	0.572	0.101	-0.295	0.202
Providing shelter for the homeless	581	2.23	0.050	2.00	1	5	1.206	0.680	0.101	-0.505	0.202
Providing affordable housing for seniors	575	2.70	0.047	3.00	1	5	1.128	0.265	0.102	-0.555	0.203
Providing medical care for the poor	578	2.68	0.051	3.00	1	5	1.233	0.288	0.102	-0.836	0.203
Providing 24 hour emergency trauma care	578	3.24	0.050	3.00	1	5	1.203	-0.268	0.102	-0.779	0.203
** Public Safety*											
Providing crime prevention programs	575	2.99	0.044	3.00	1	5	1.061	0.007	0.102	-0.351	0.203
Enforcing traffic laws	590	2.99	0.050	3.00	1	5	1.210	0.074	0.101	-0.847	0.201

Appendix II

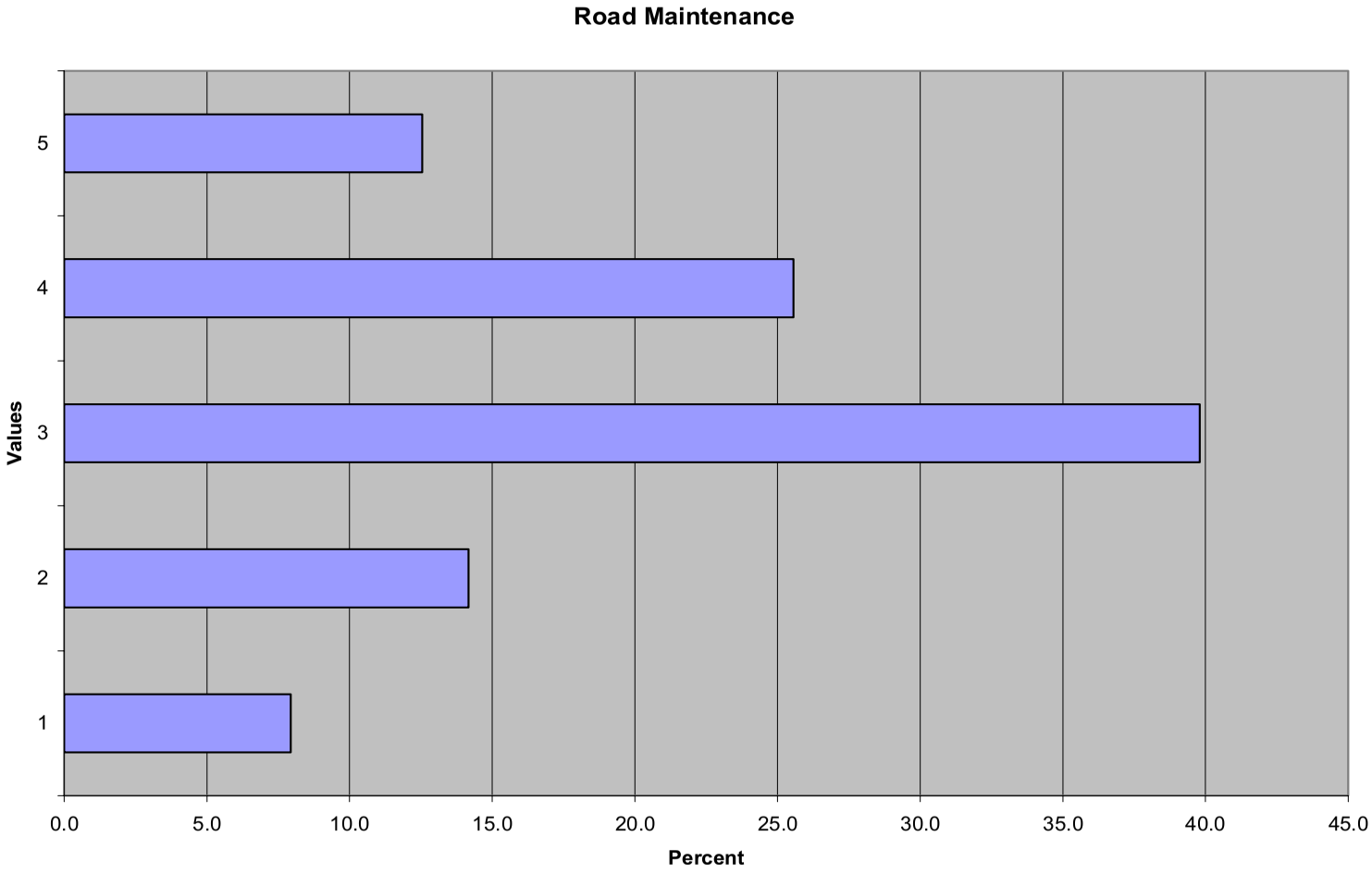
Performance Score for Selected Services

Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)

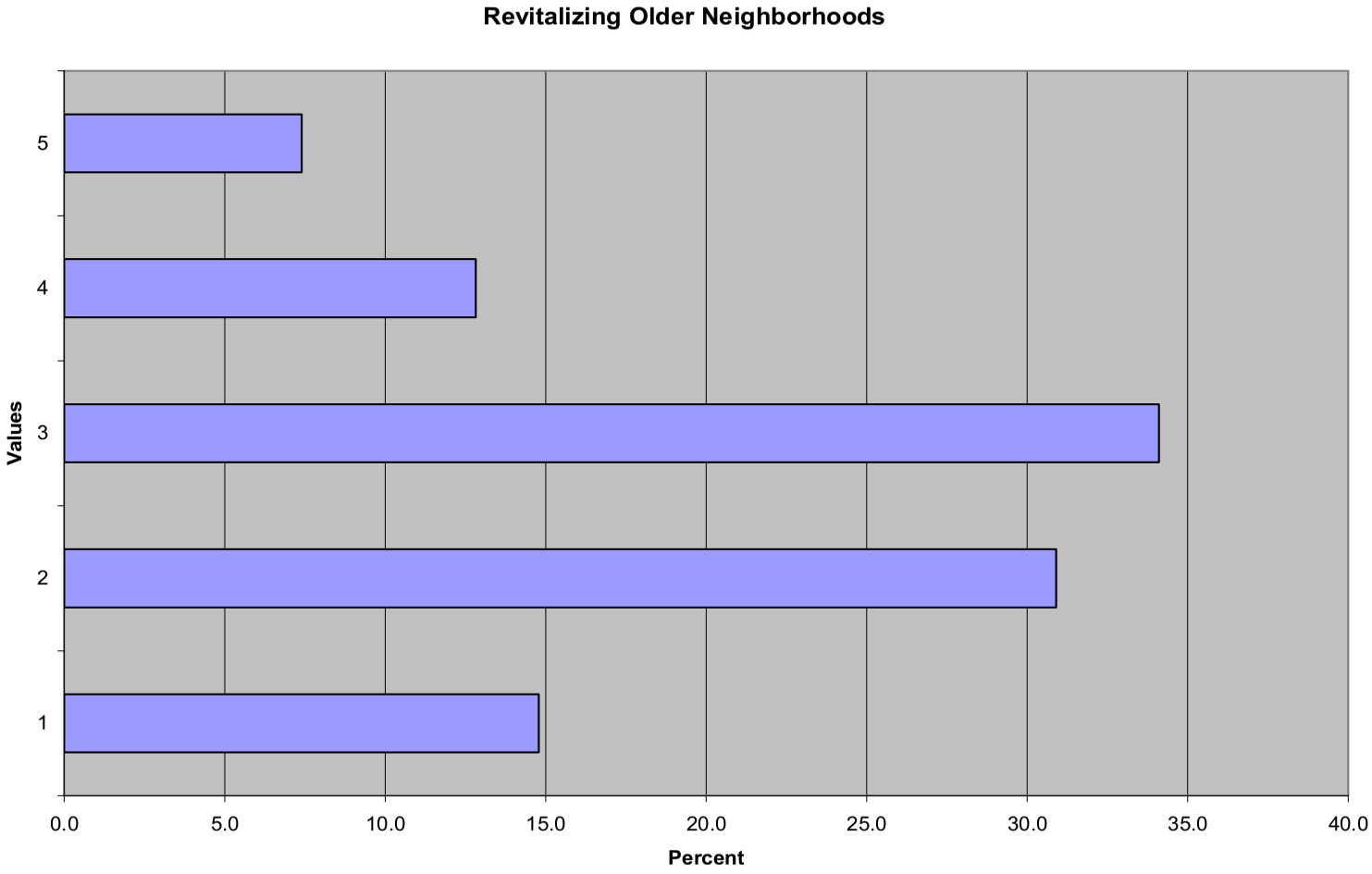
Importance Variable	N	Mean	Std. Error of Mean	Median	Min	Max	Std. Deviation	Kurtosis	Std Error of Kurtosis	Skewness	Std. Error of Skewness
Maintaining a low crime rate	592	2.82	0.047	3.00	1	5	1.154	0.235	0.100	-0.658	0.200
Maintaining neighborhood police patrols	583	2.78	0.049	3.00	1	5	1.178	0.163	0.101	-0.721	0.202
Keeping police response times low	581	3.02	0.049	3.00	1	5	1.185	-0.117	0.101	-0.740	0.202
Keeping fire department response times low	577	3.75	0.041	4.00	1	5	0.980	-0.642	0.102	0.168	0.203
Keeping paramedic and emergency medical response times low	582	3.72	0.042	4.00	1	5	1.007	-0.693	0.101	0.260	0.202
Well trained paramedic and emergency medical response personnel	574	3.85	0.042	4.00	1	5	1.008	-0.724	0.102	0.124	0.204
Facilitate neighborhood watch programs	581	2.87	0.048	3.00	1	5	1.164	0.166	0.101	-0.676	0.202
Preparing for natural disasters (i.e. floods, earthquakes, etc.)	581	2.87	0.047	3.00	1	5	1.129	0.039	0.101	-0.561	0.202
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	585	2.90	0.049	3.00	1	5	1.192	0.076	0.101	-0.766	0.202
Investigating criminal activity	589	3.08	0.045	3.00	1	5	1.101	-0.110	0.101	-0.453	0.201
Providing fire protection & prevention services	587	3.52	0.042	4.00	1	5	1.024	-0.360	0.101	-0.226	0.201
Providing emergency medical services	587	3.59	0.043	4.00	1	5	1.037	-0.503	0.101	-0.088	0.201
Providing for neighborhood code enforcement services	579	3.01	0.047	3.00	1	5	1.126	-0.019	0.101	-0.639	0.203
Examining potential impacts from Yucca Mountain nuclear waste shipments	577	2.75	0.050	3.00	1	5	1.206	0.171	0.102	-0.832	0.203
Regional justice services and facilities	577	3.10	0.044	3.00	1	5	1.056	-0.225	0.102	-0.264	0.203
** Community Development*											
Providing affordable housing	580	2.56	0.048	2.00	1	5	1.158	0.415	0.101	-0.516	0.203

Managing growth	587	2.62	0.049	3.00	1	5	1.195	0.300	0.101	-0.714	0.201
Increasing job opportunities	584	2.96	0.046	3.00	1	5	1.103	-0.025	0.101	-0.478	0.202
Improving the business climate	582	3.12	0.044	3.00	1	5	1.067	-0.140	0.101	-0.318	0.202
Planning for commercial development	579	3.14	0.048	3.00	1	5	1.148	-0.132	0.102	-0.591	0.203
Reducing traffic congestion	593	2.60	0.049	3.00	1	5	1.203	0.243	0.100	-0.836	0.200
Access to freeways	592	3.21	0.047	3.00	1	5	1.147	-0.136	0.100	-0.718	0.200
Improving road conditions	597	3.11	0.048	3.00	1	5	1.161	-0.190	0.100	-0.752	0.200
Reducing travel time	589	2.79	0.047	3.00	1	5	1.150	0.158	0.101	-0.658	0.201
Providing mass public transit	579	2.68	0.051	3.00	1	5	1.224	0.271	0.102	-0.803	0.203
Adequate airport facilities	581	3.59	0.045	4.00	1	5	1.076	-0.542	0.101	-0.179	0.202
Parks and recreation programs	581	3.54	0.046	4.00	1	5	1.097	-0.495	0.101	-0.319	0.202

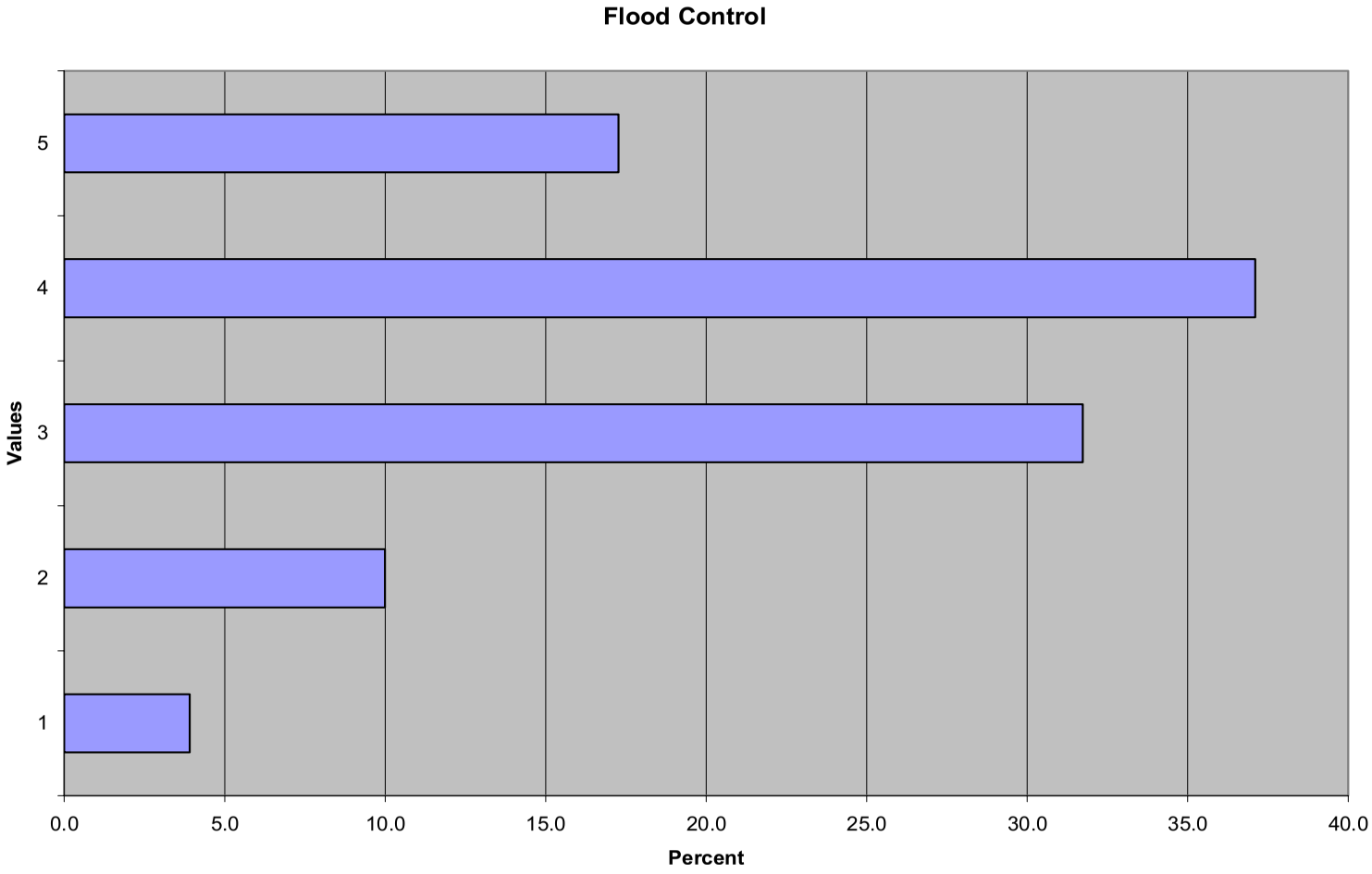
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



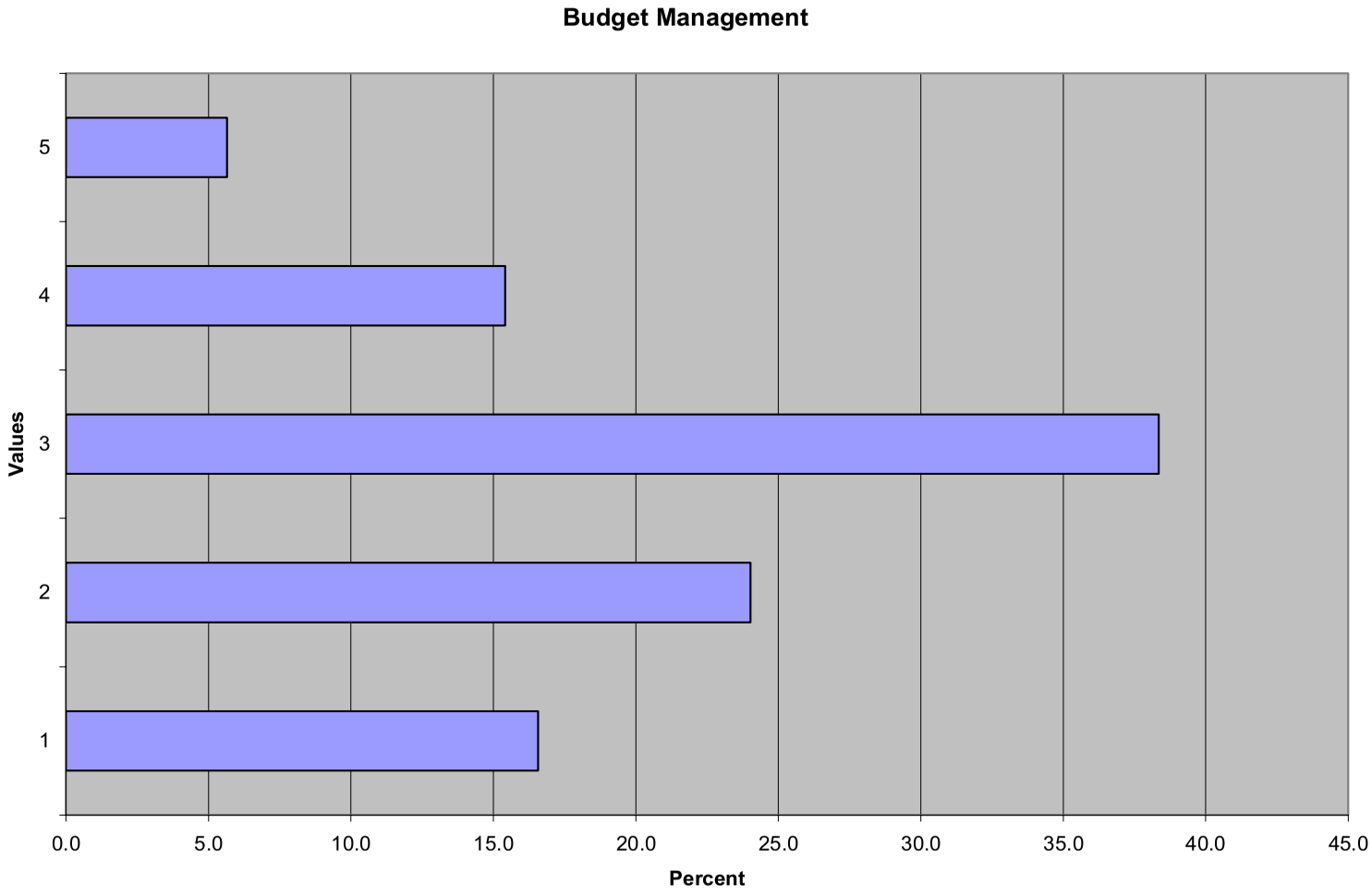
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



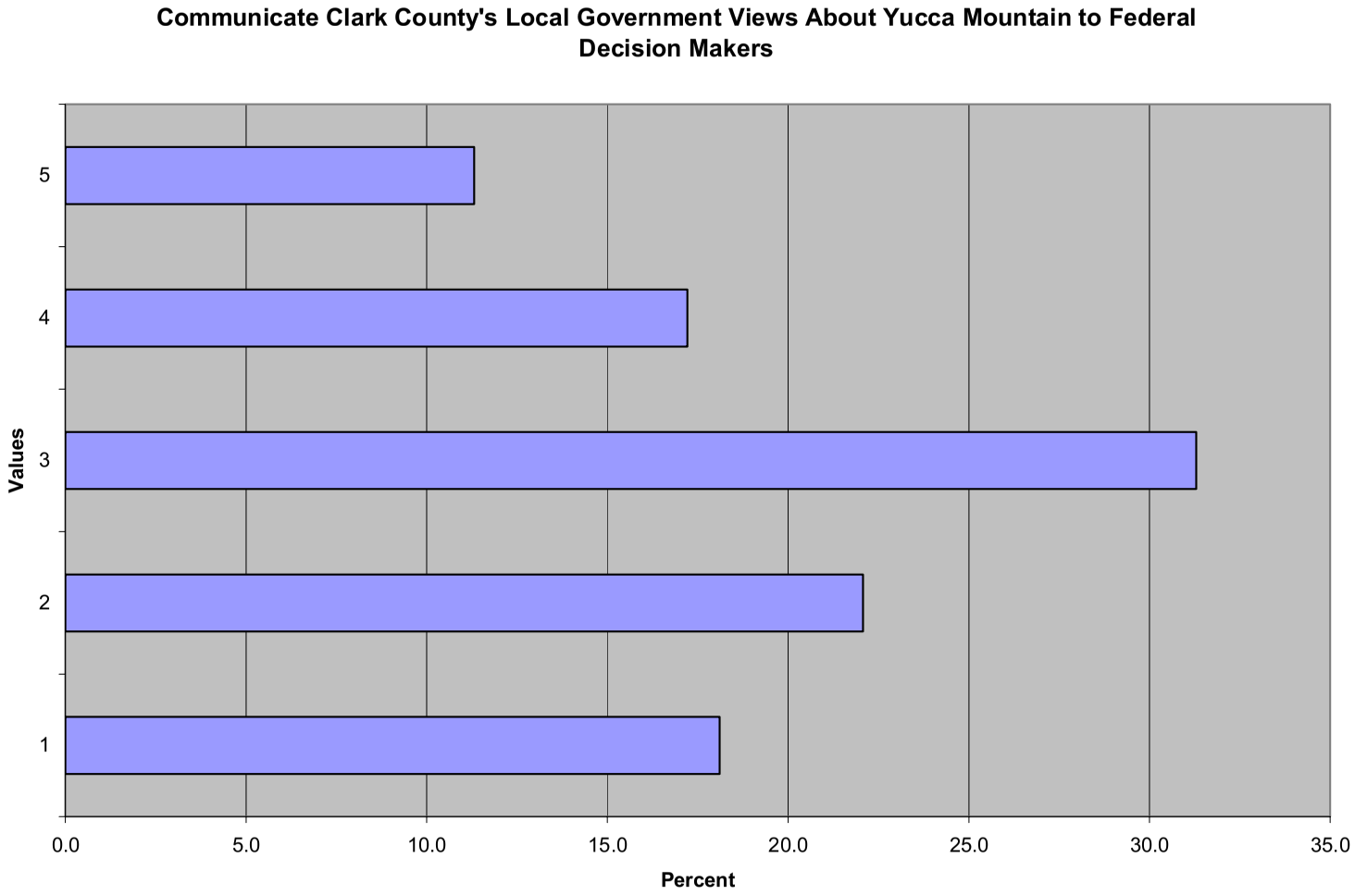
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



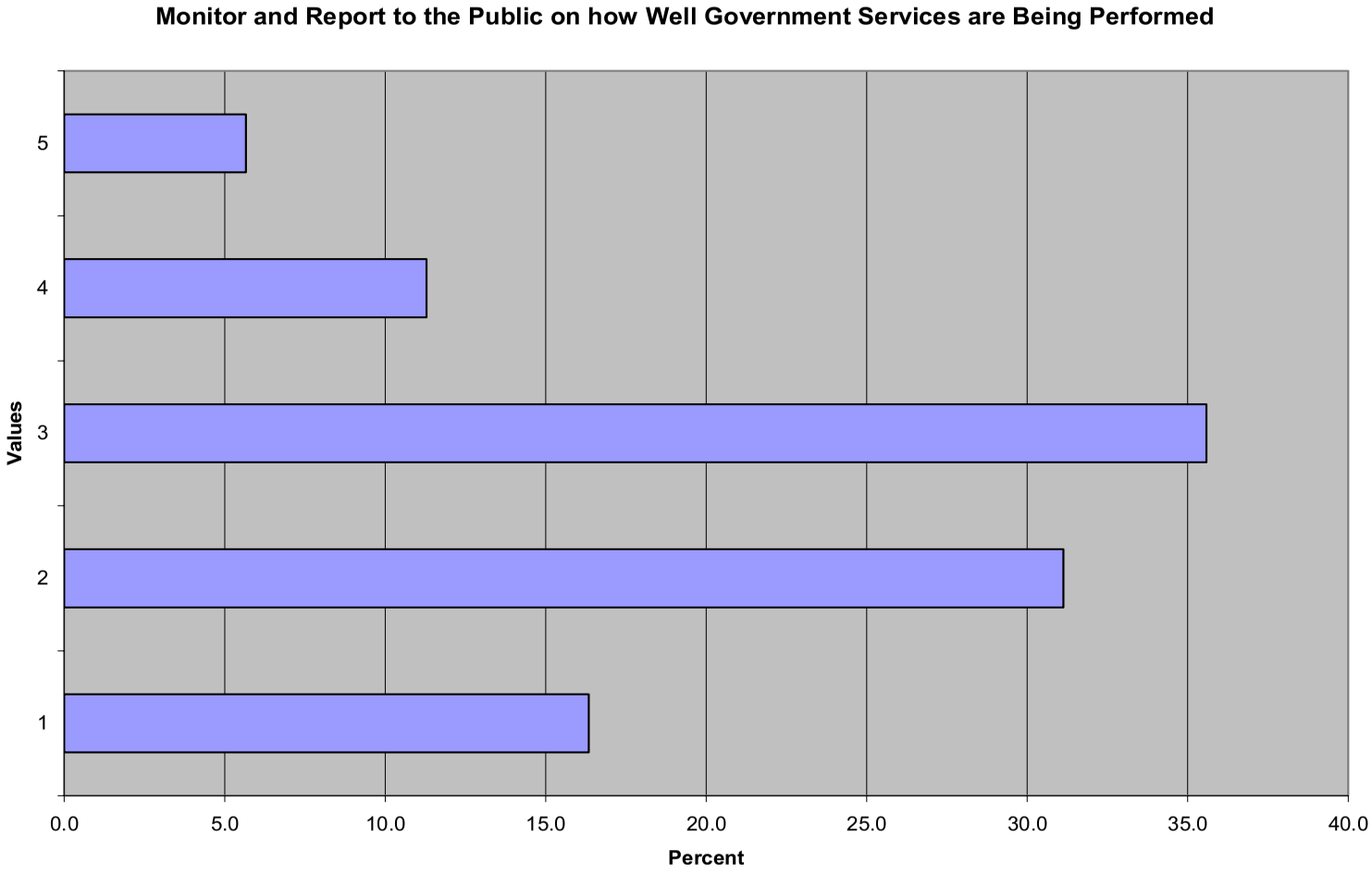
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



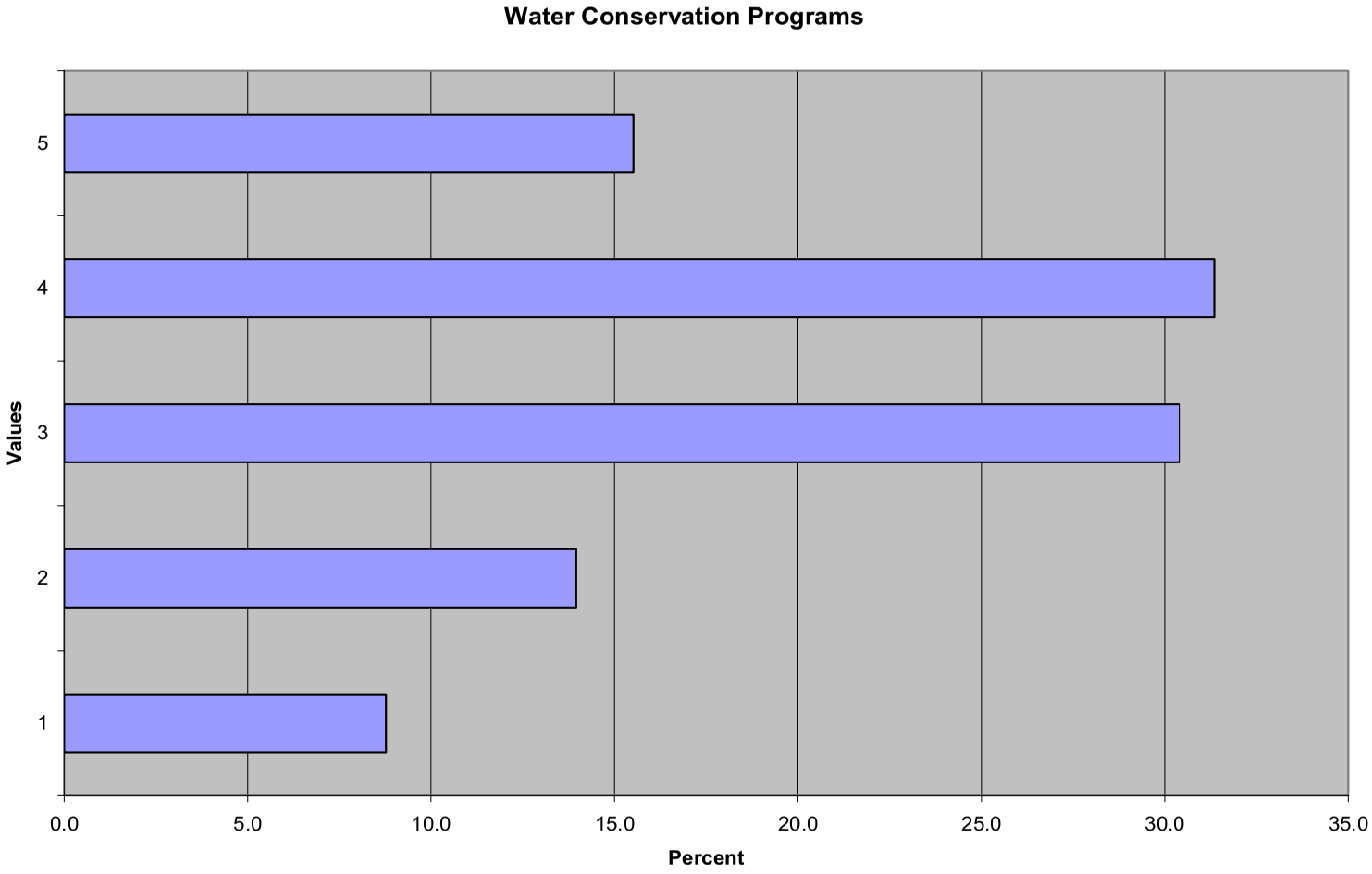
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



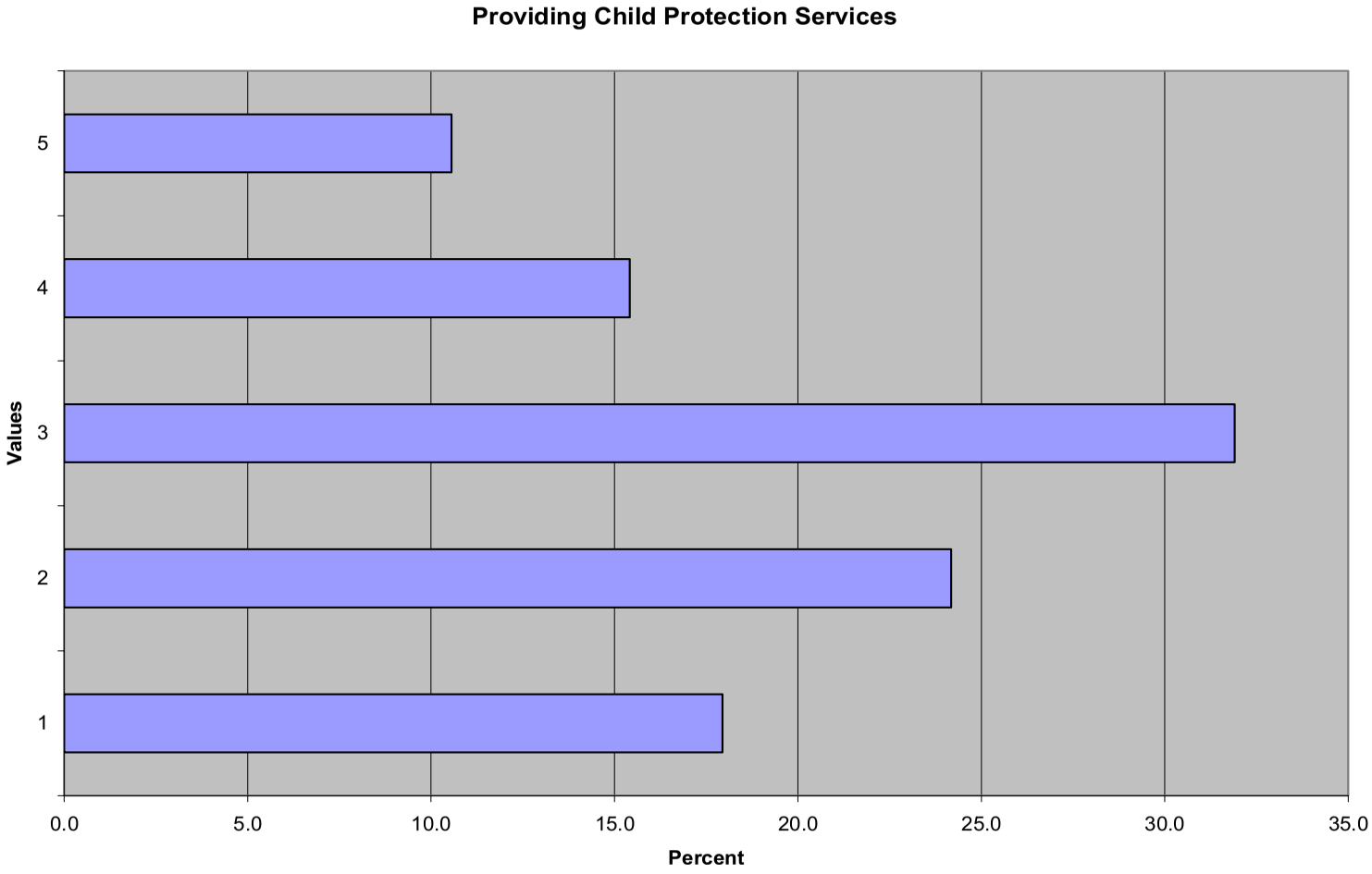
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



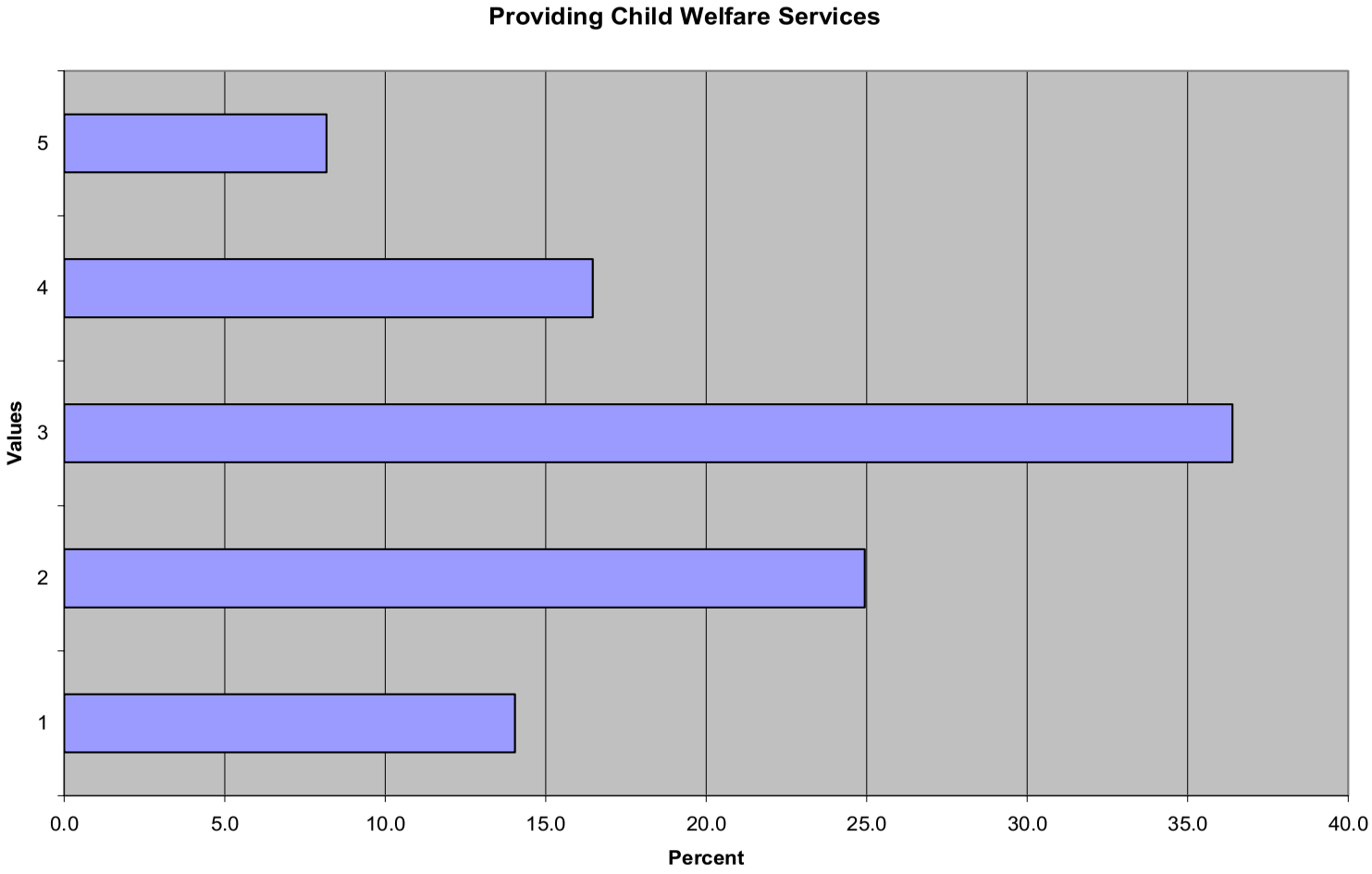
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



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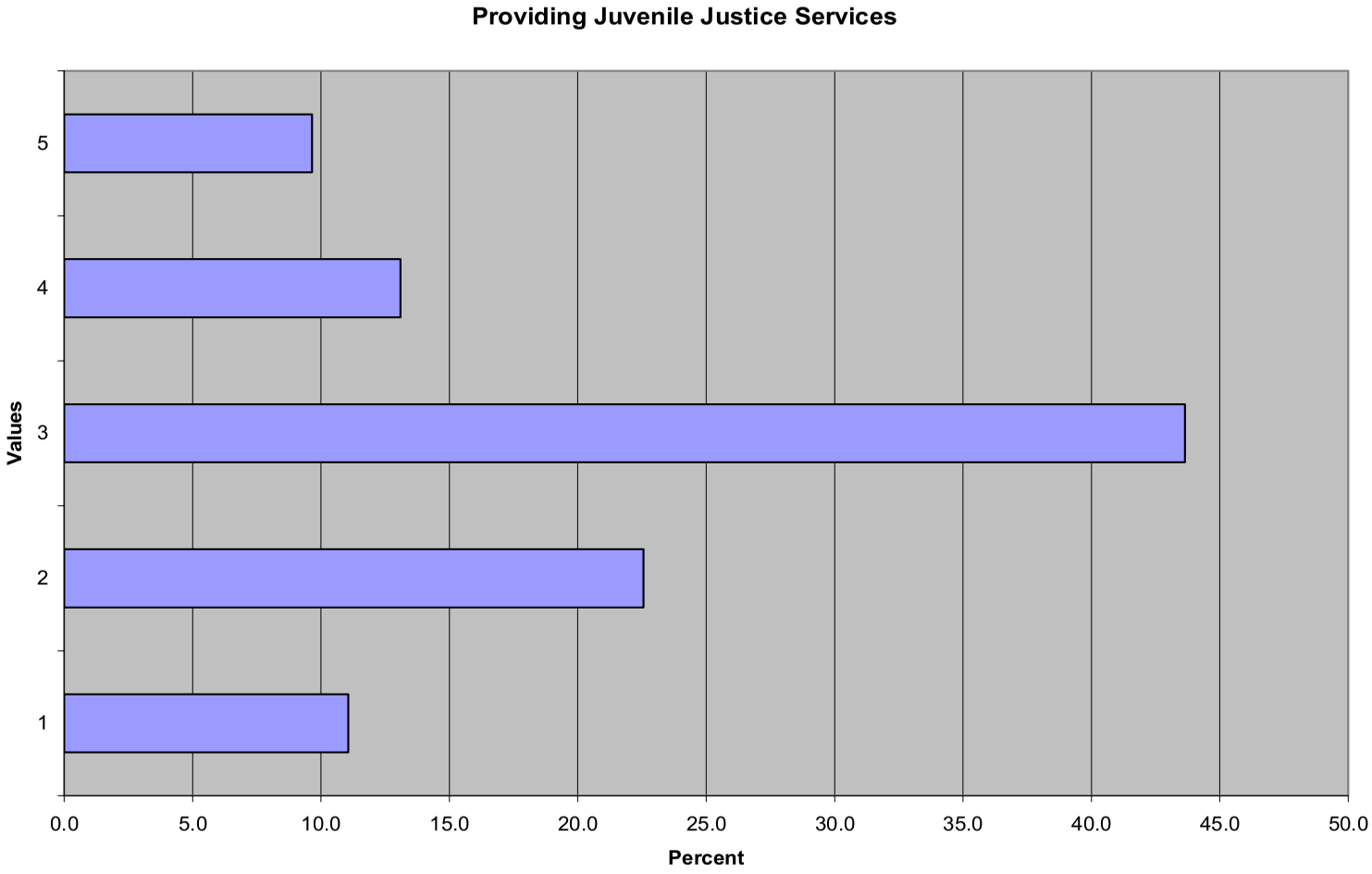
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



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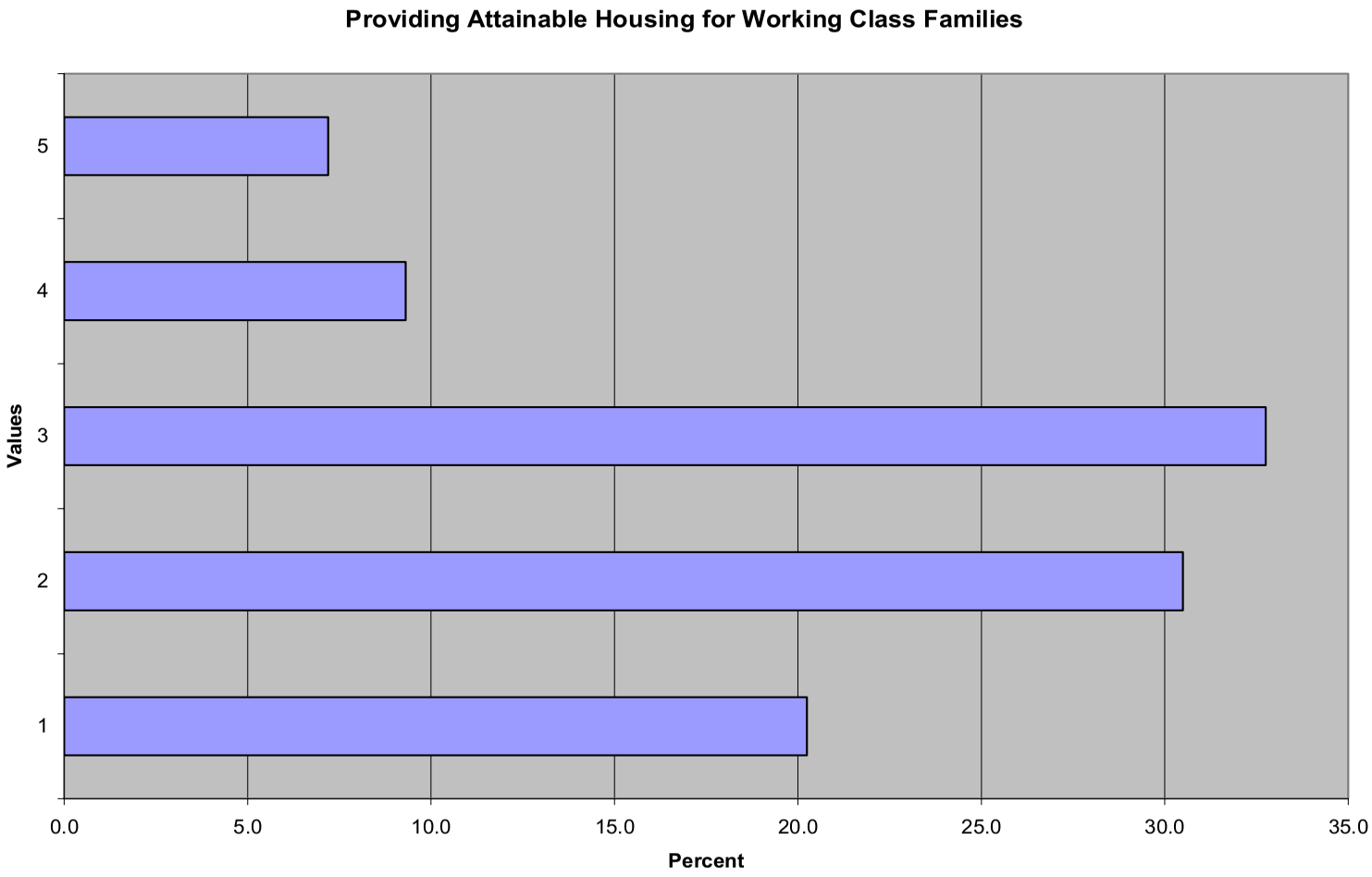
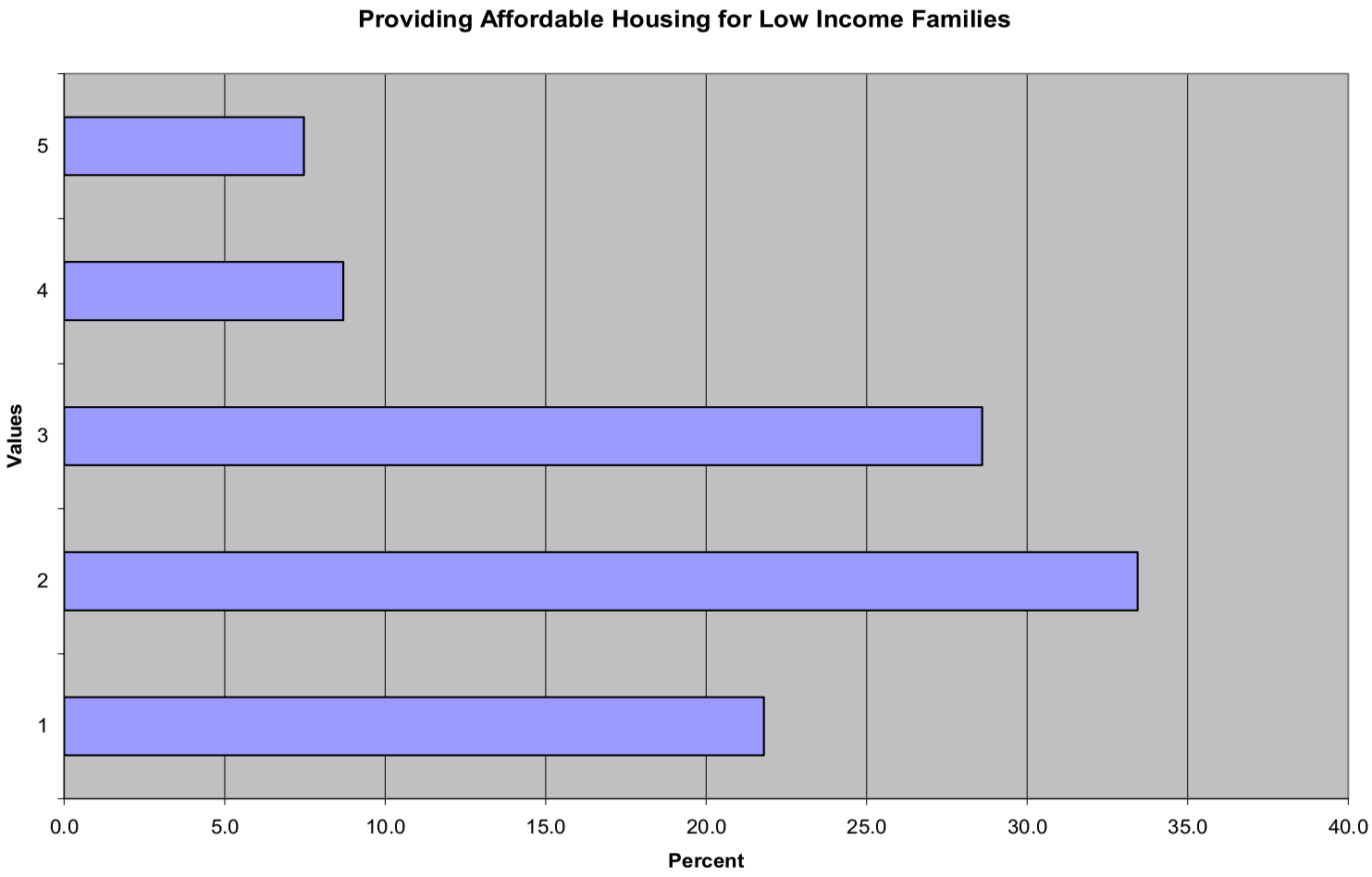
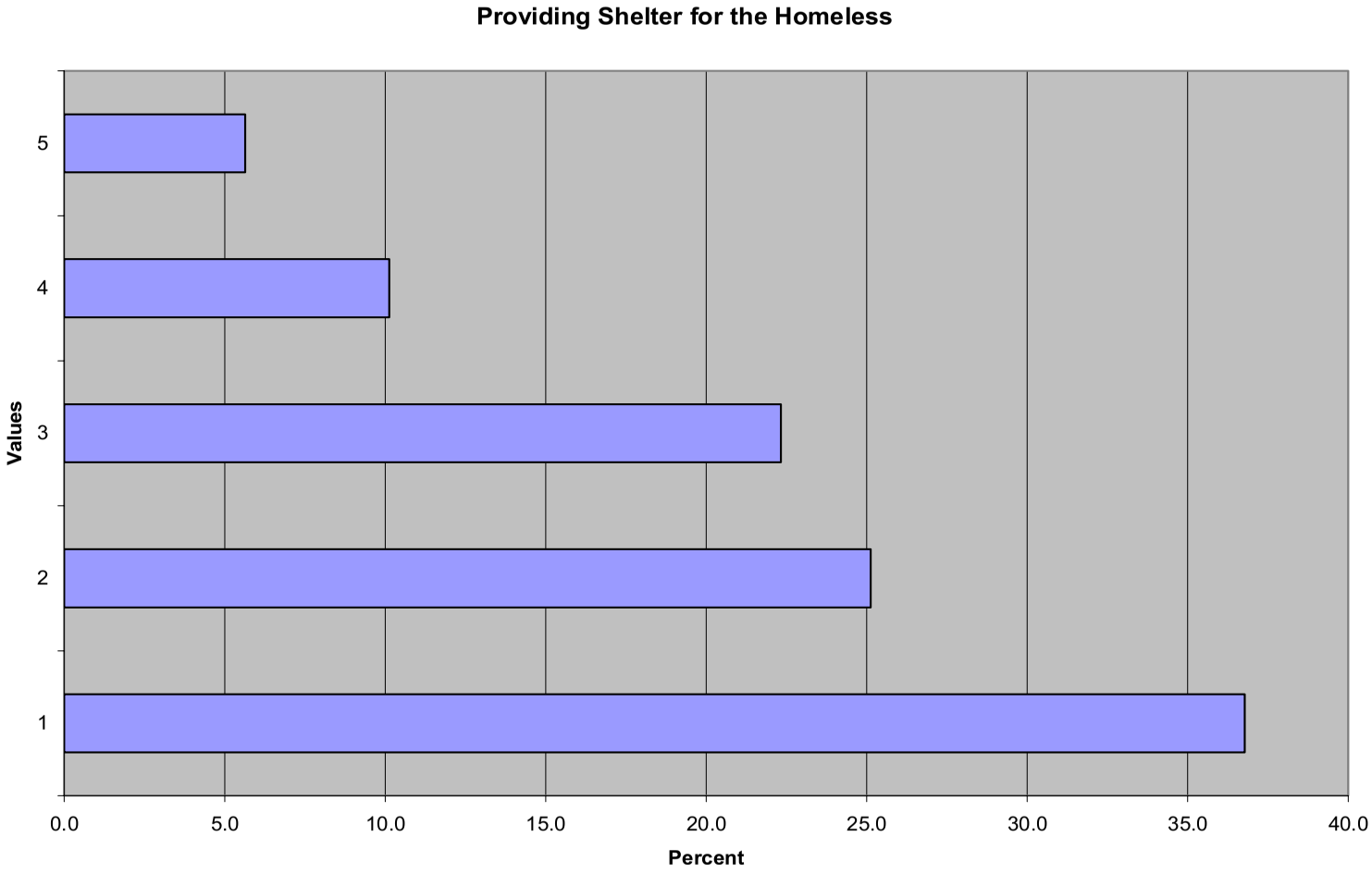
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



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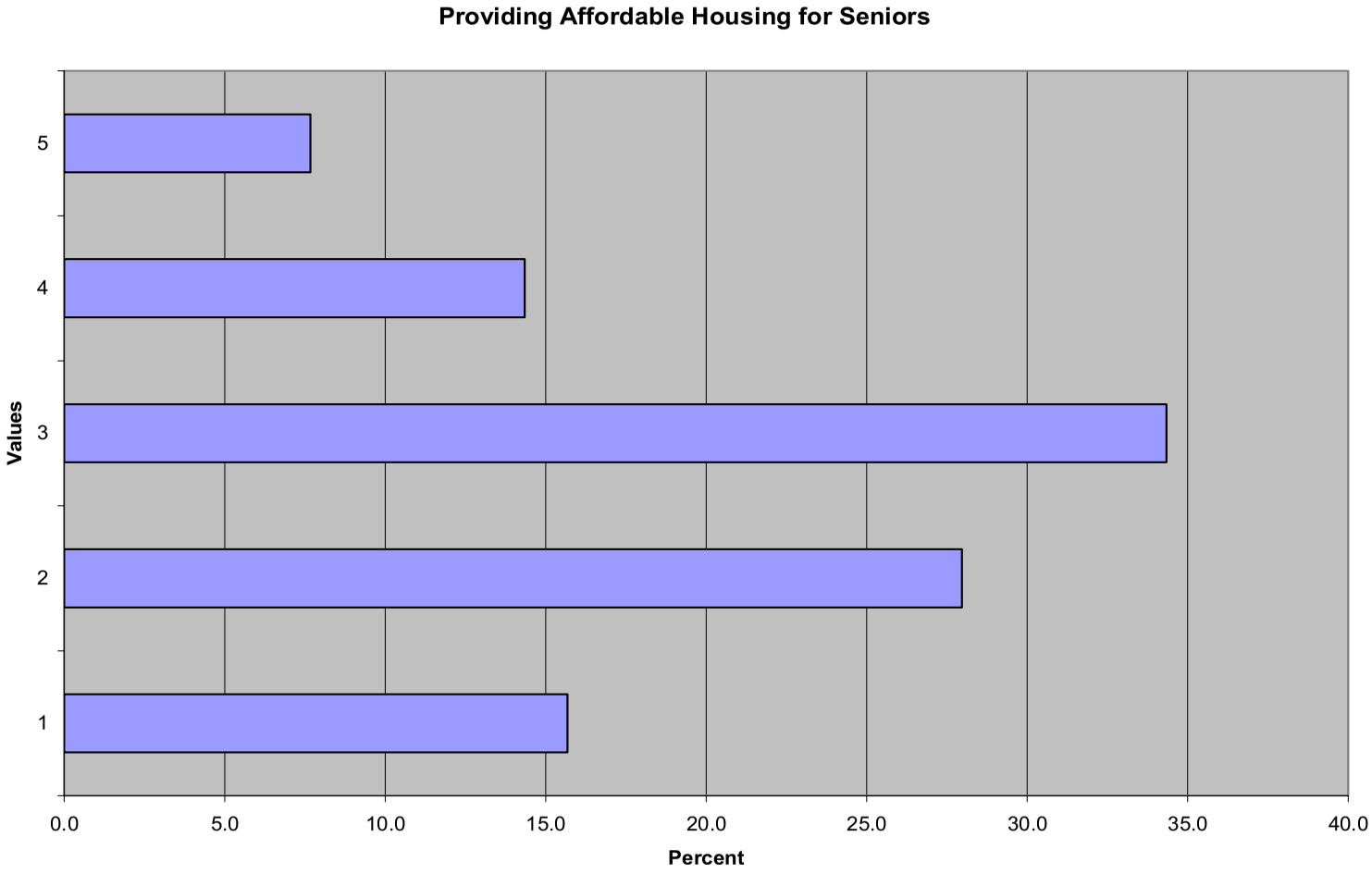
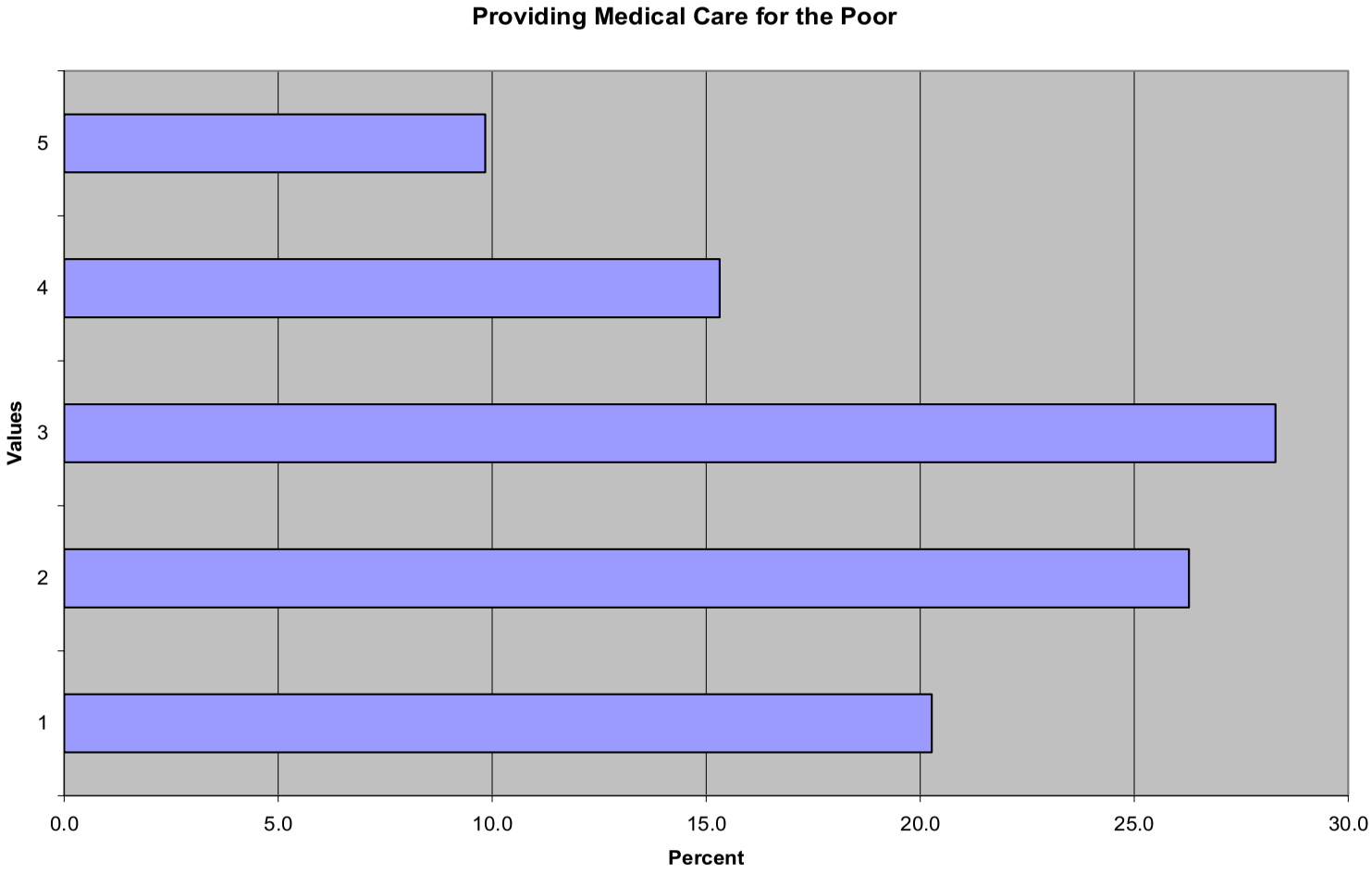
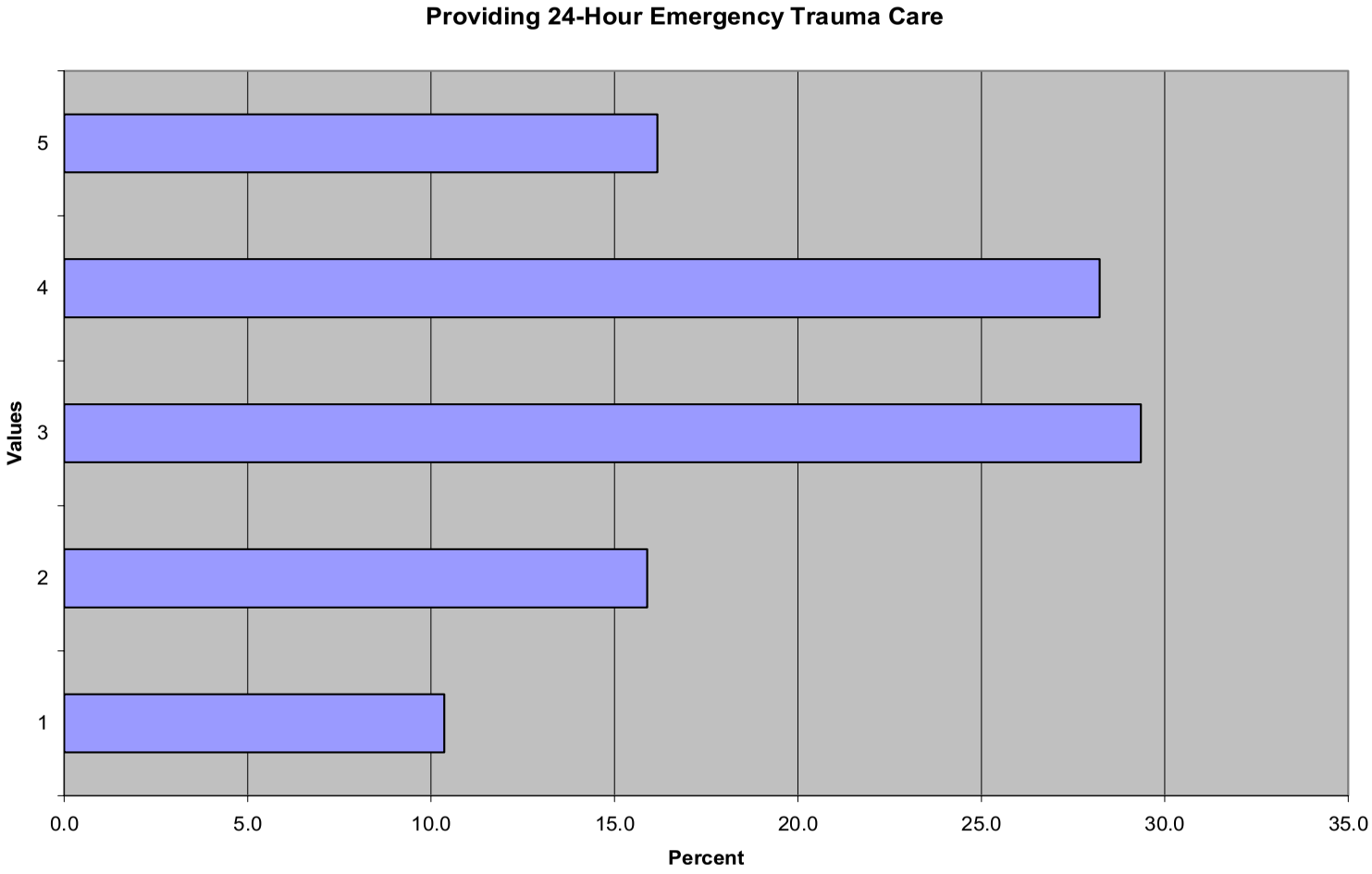
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



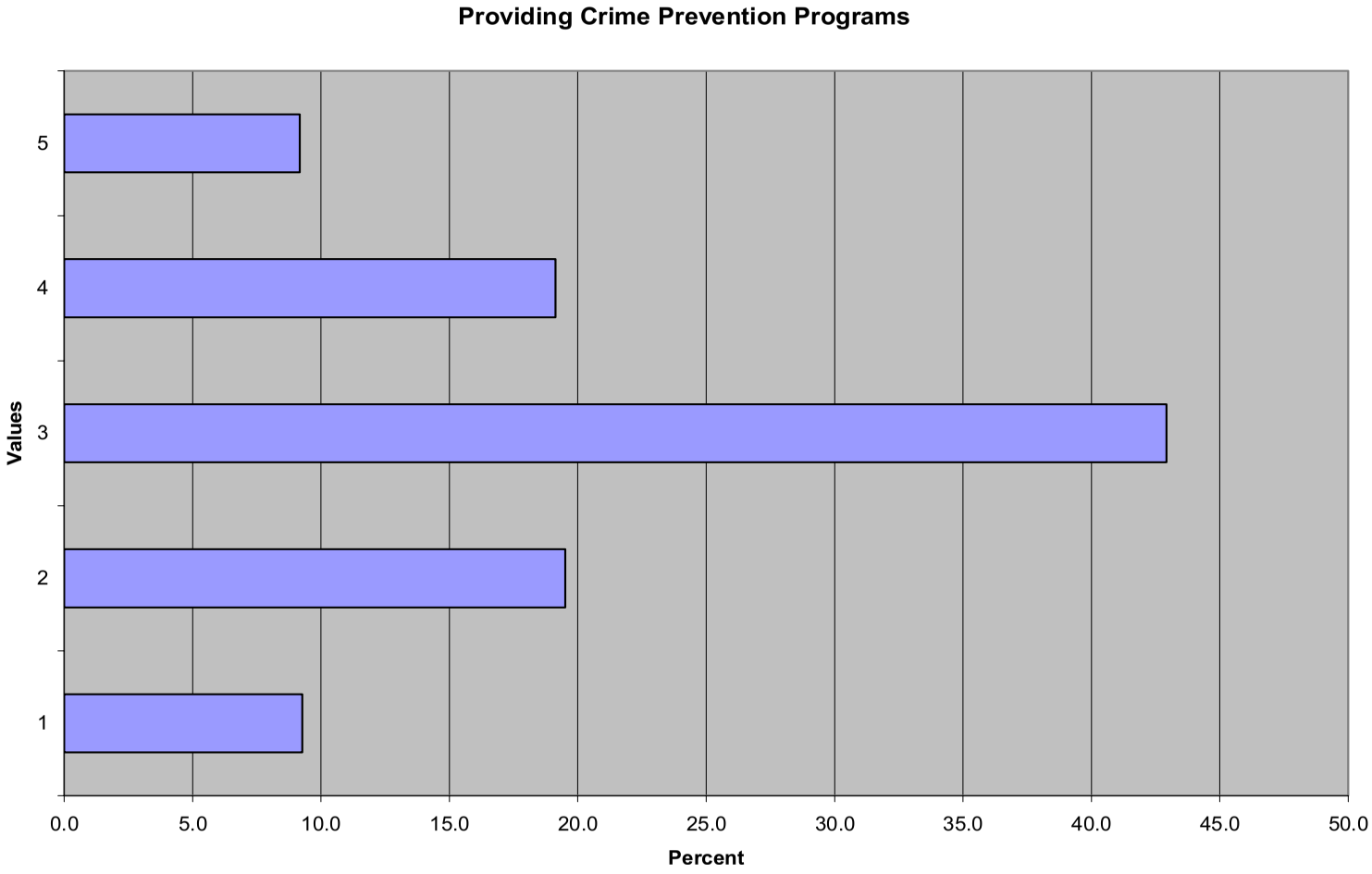
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



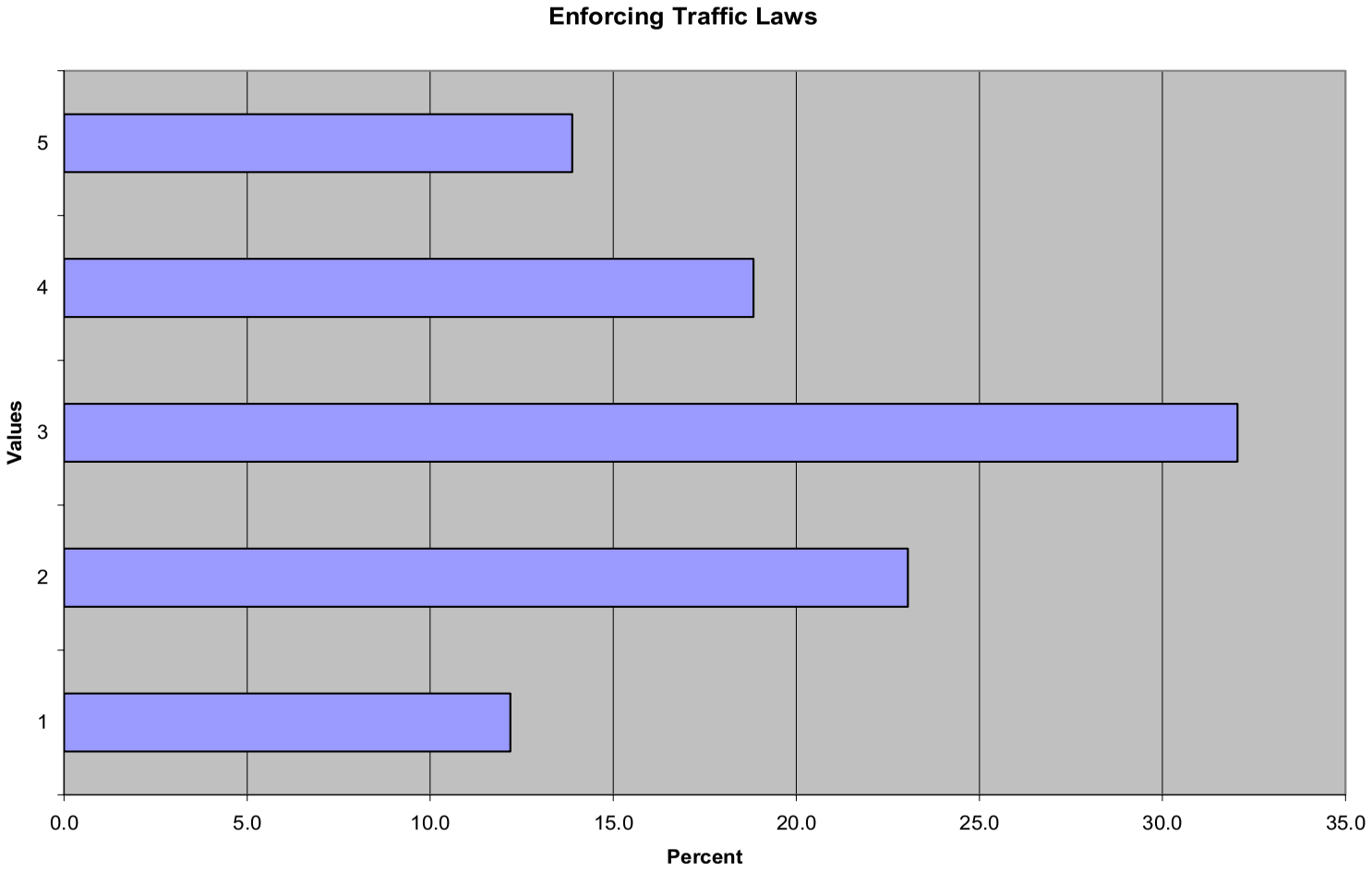
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



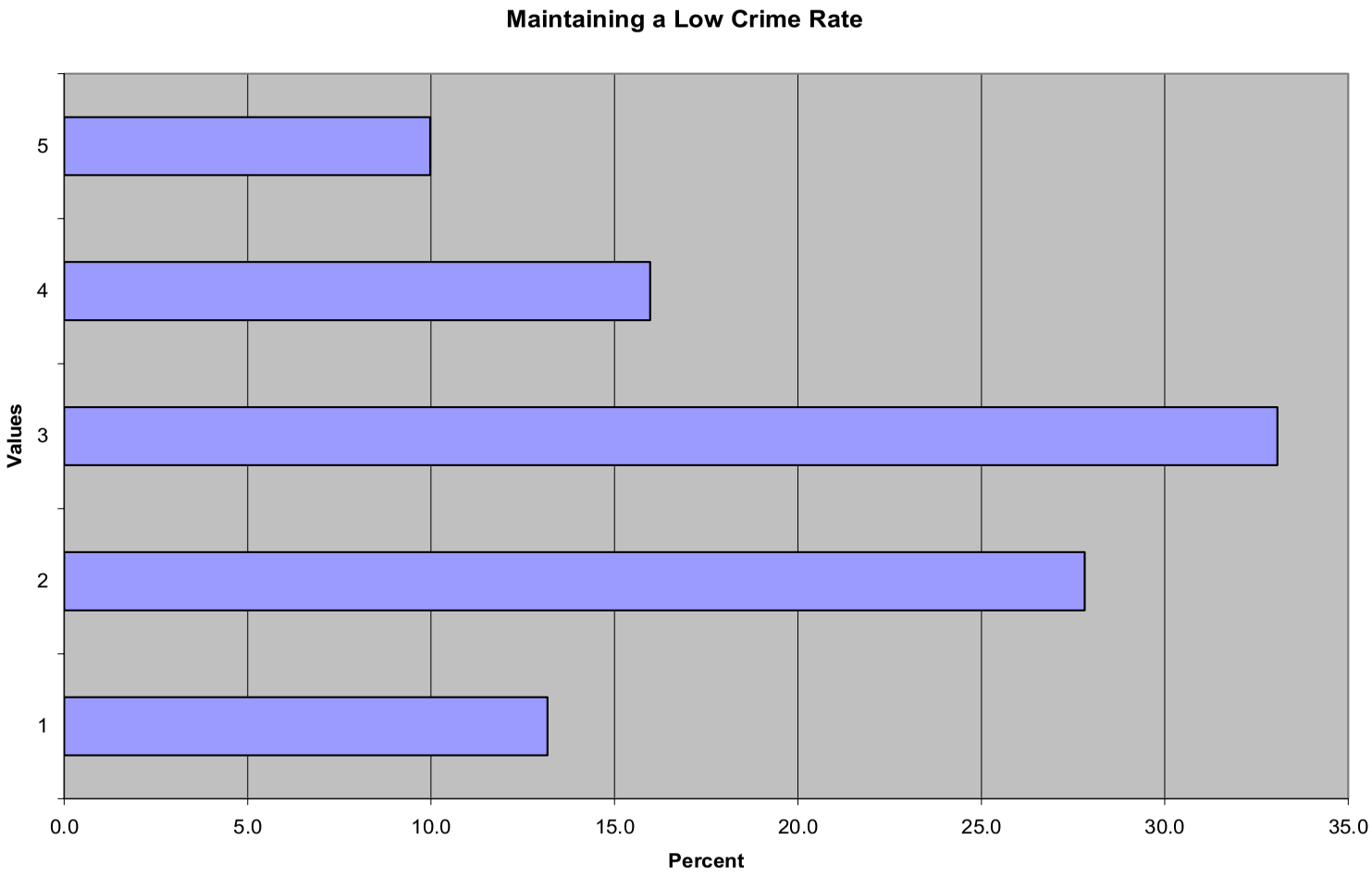
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



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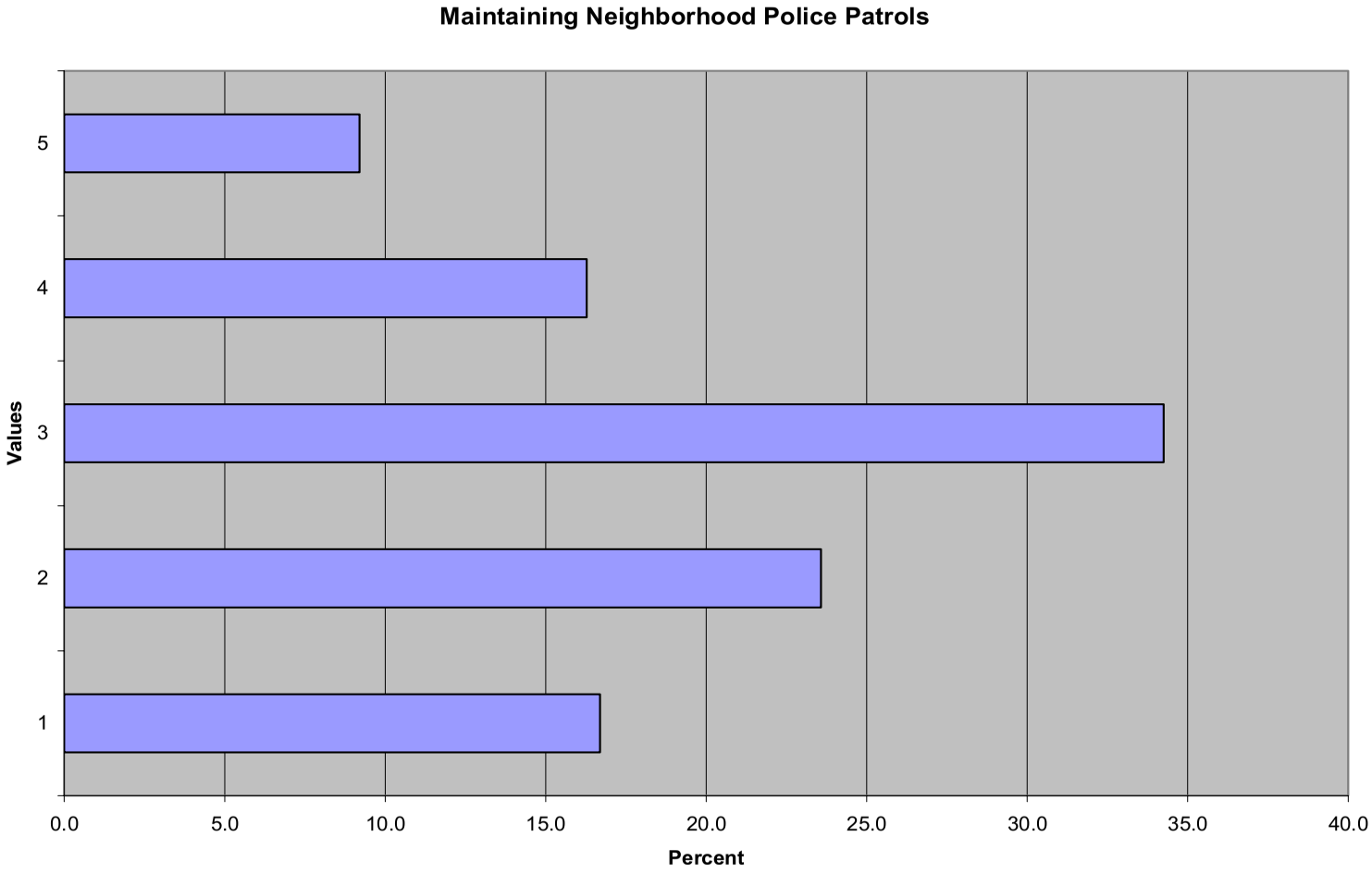
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



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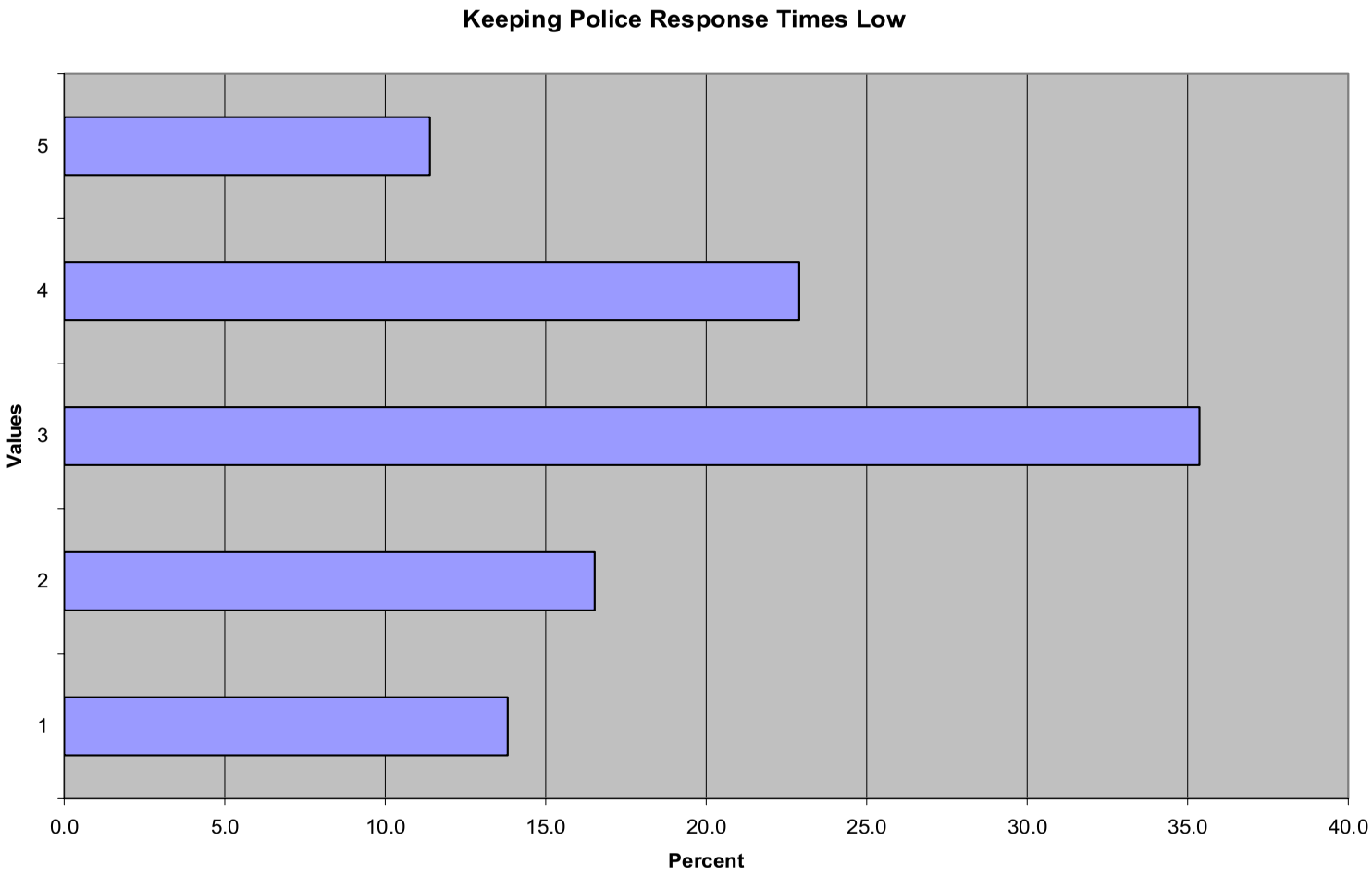
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



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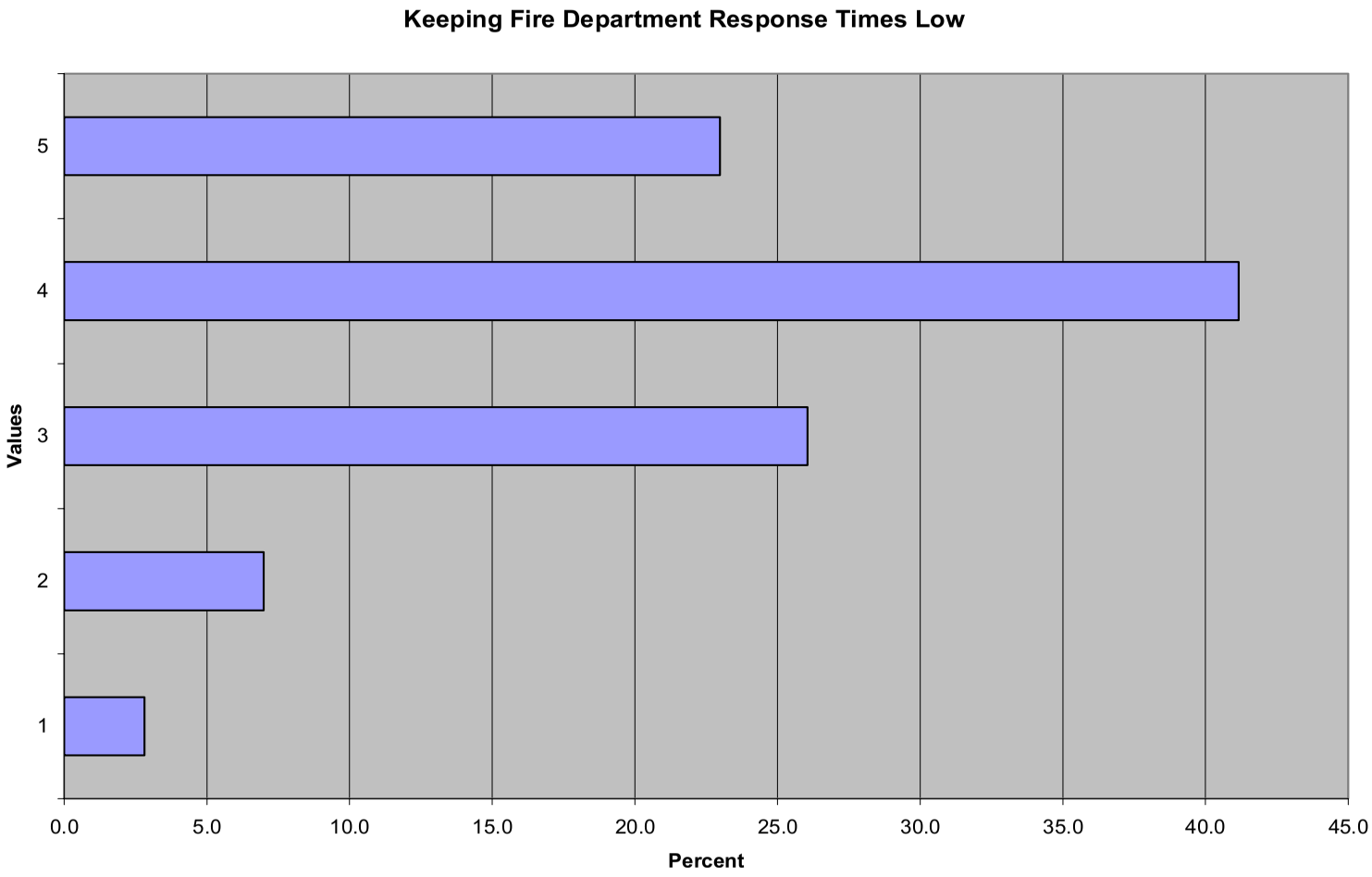
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



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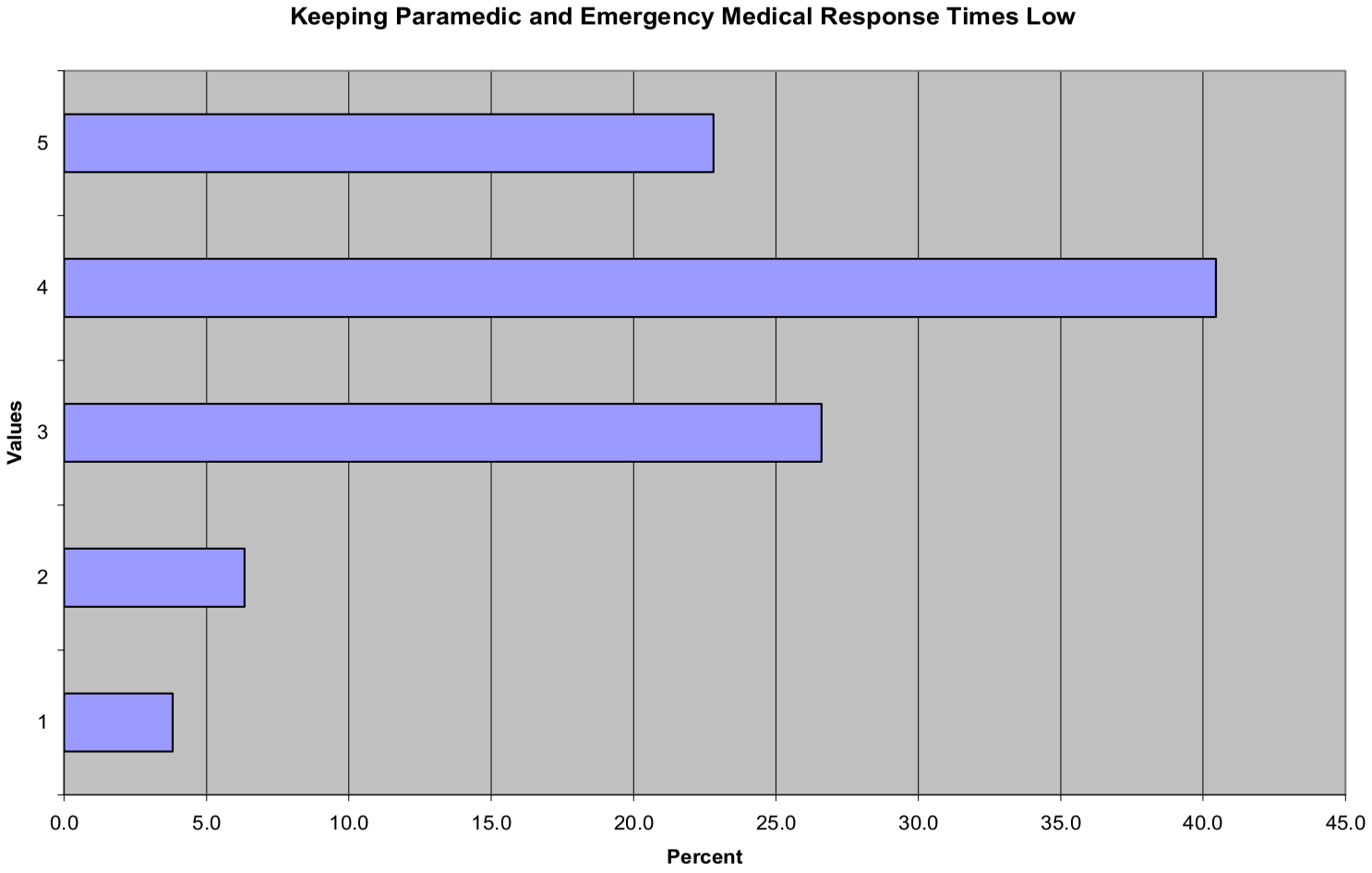
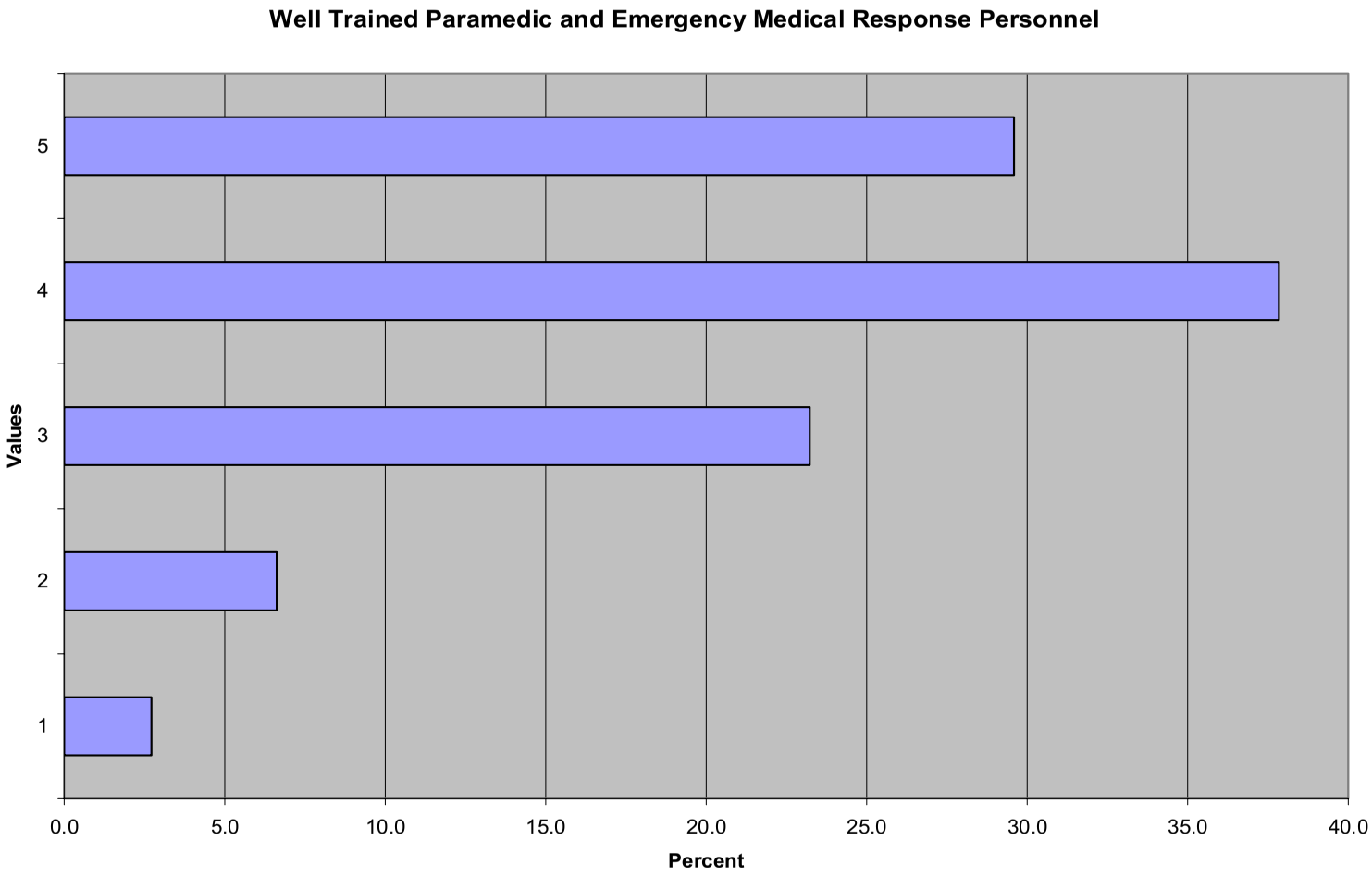
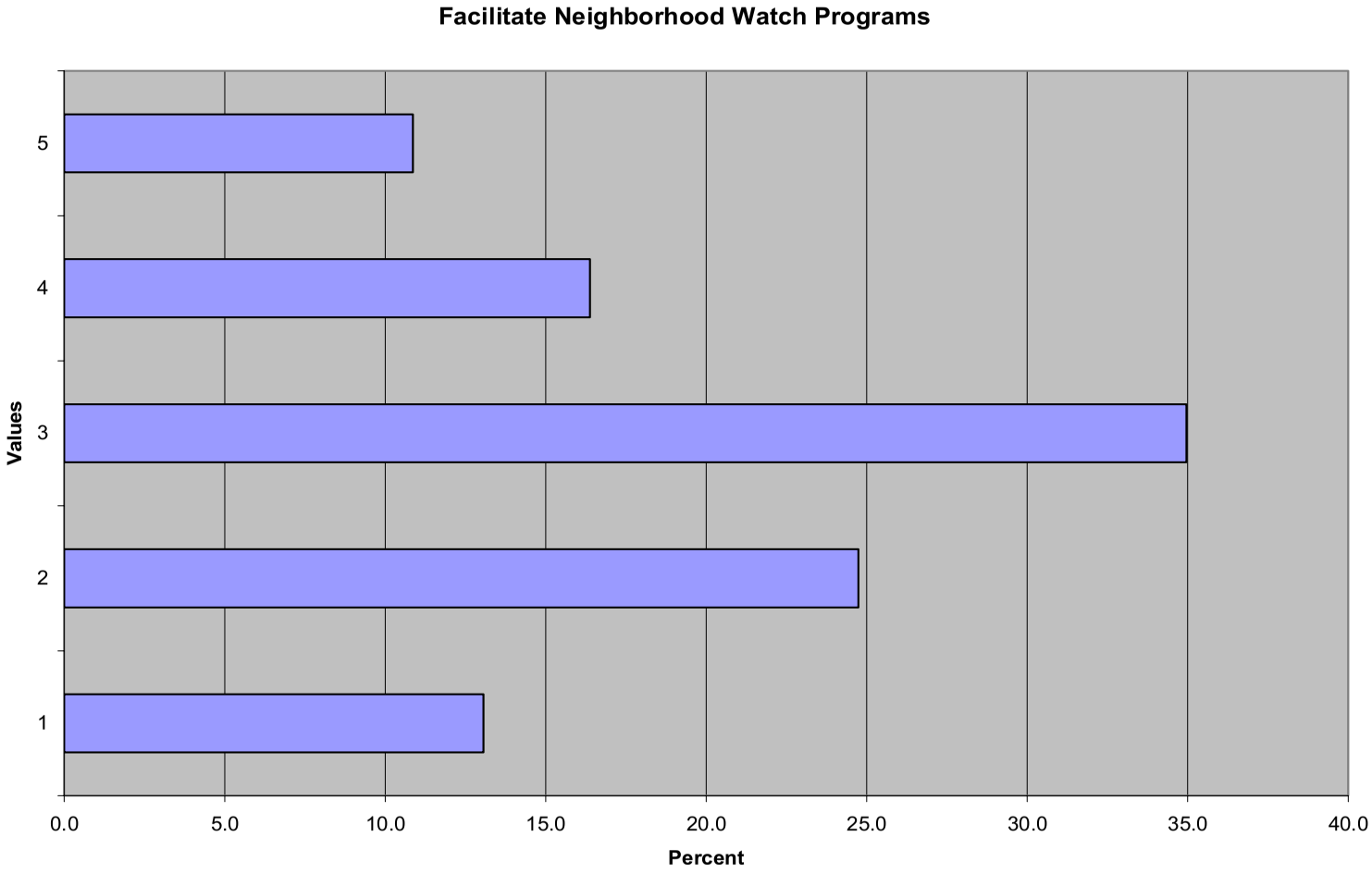
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



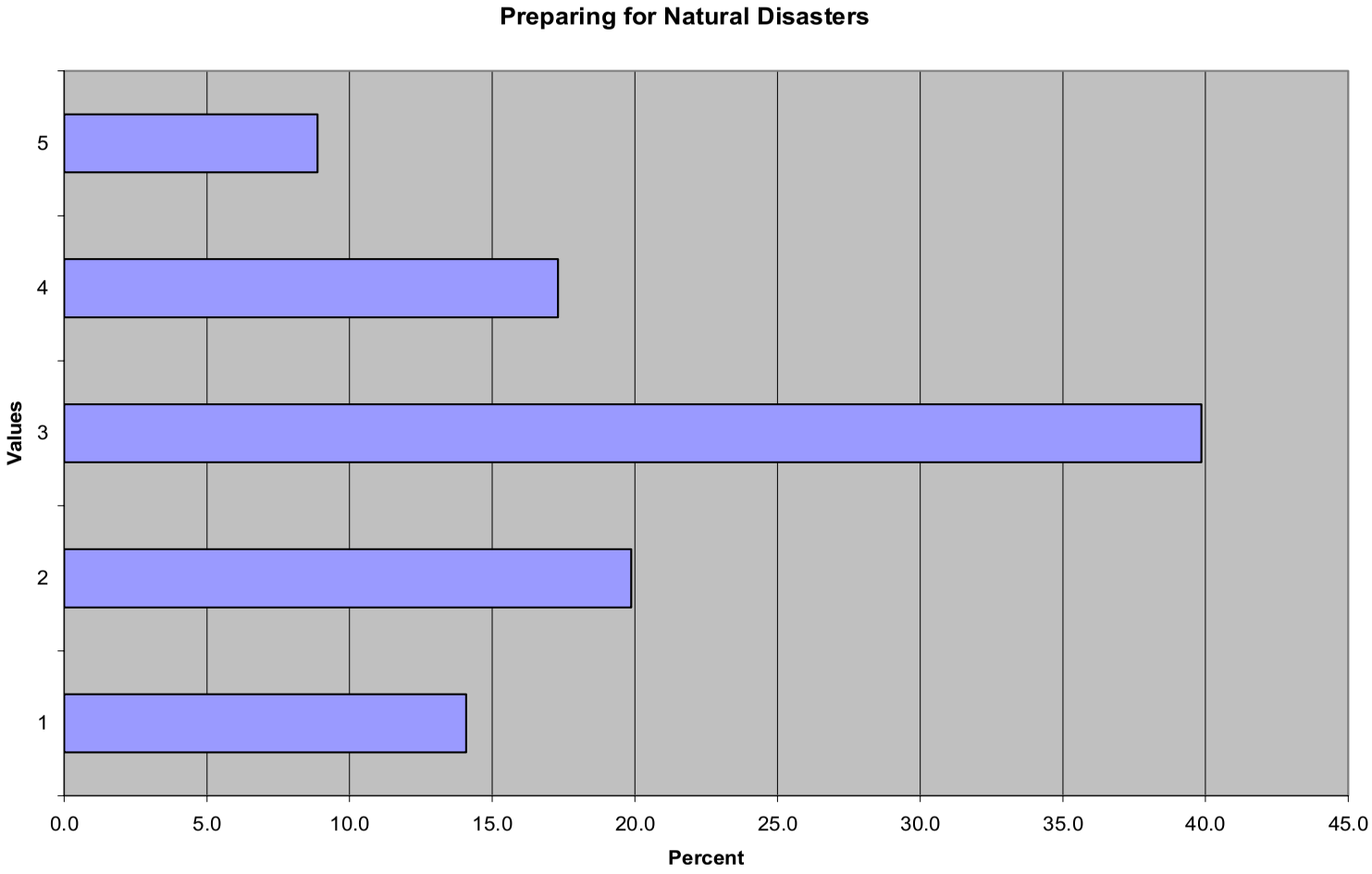
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



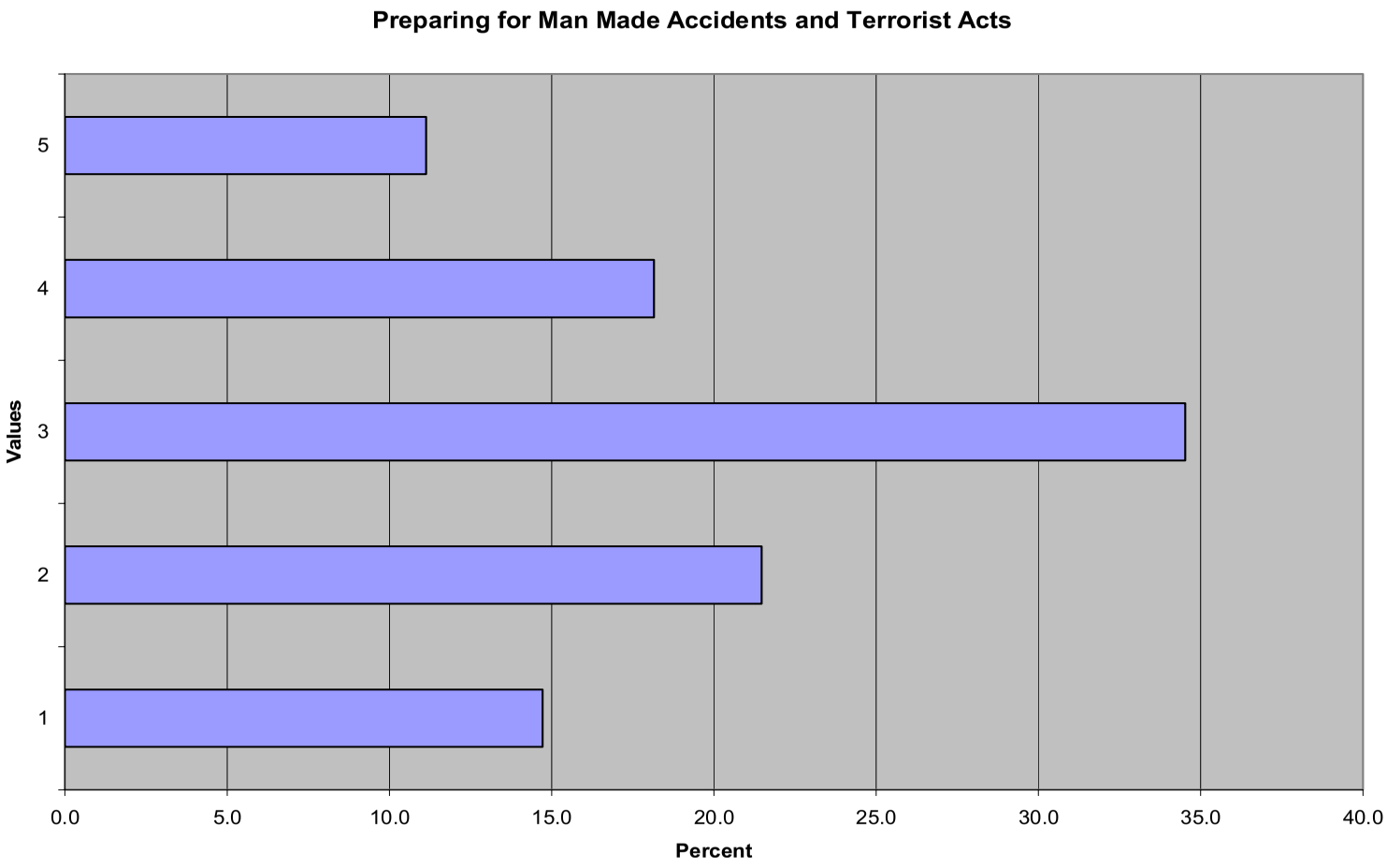
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



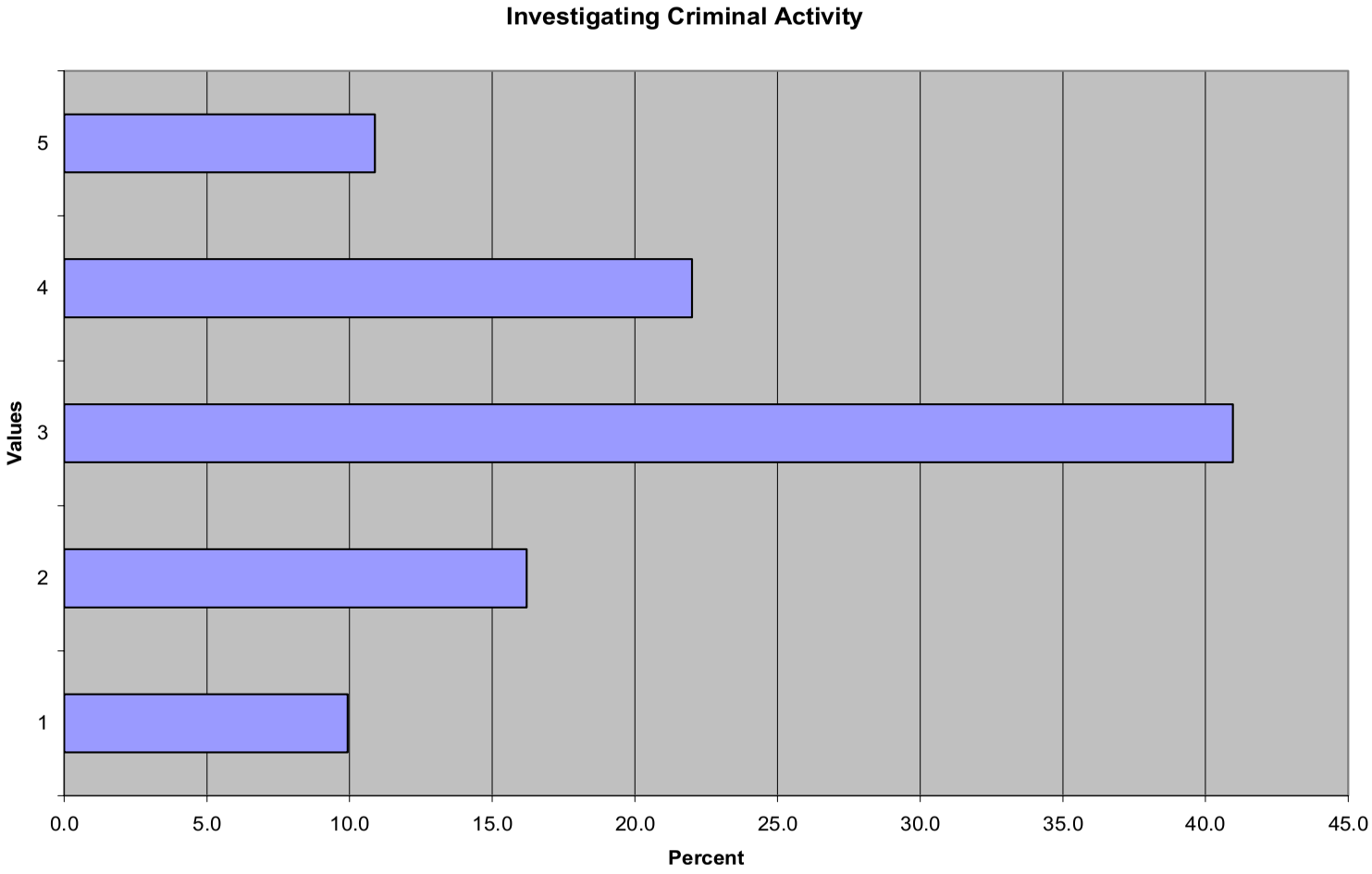
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



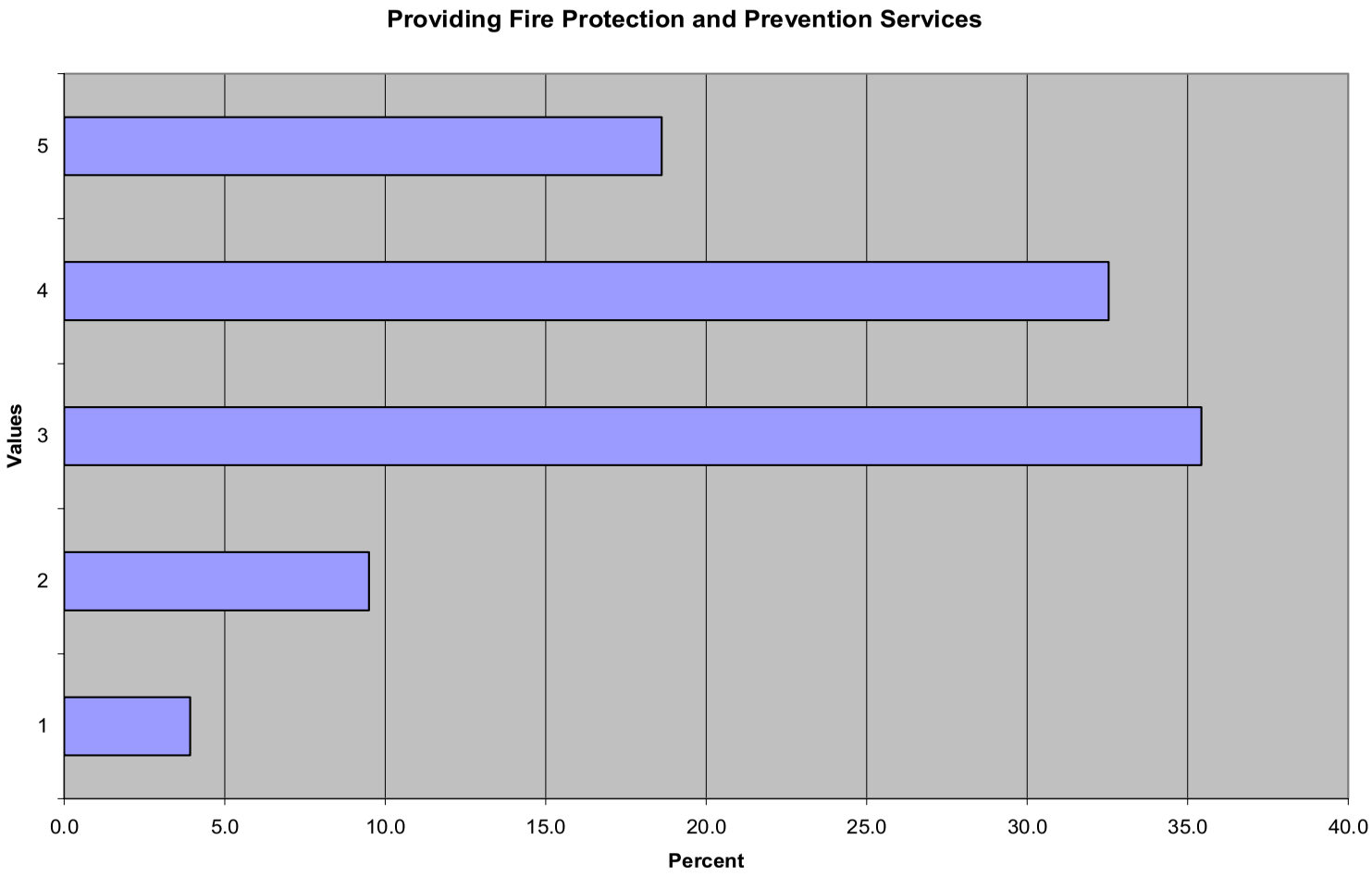
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



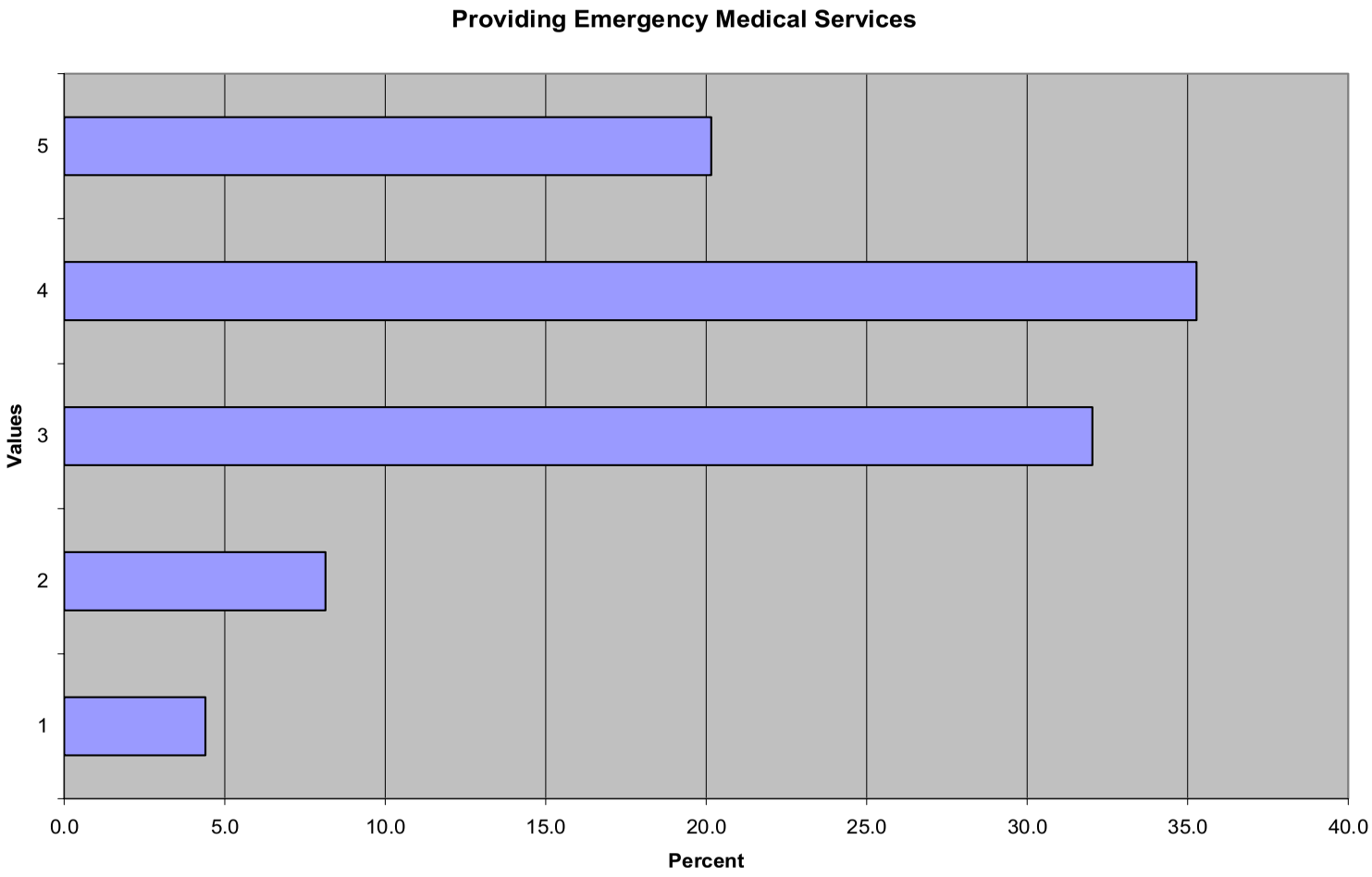
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



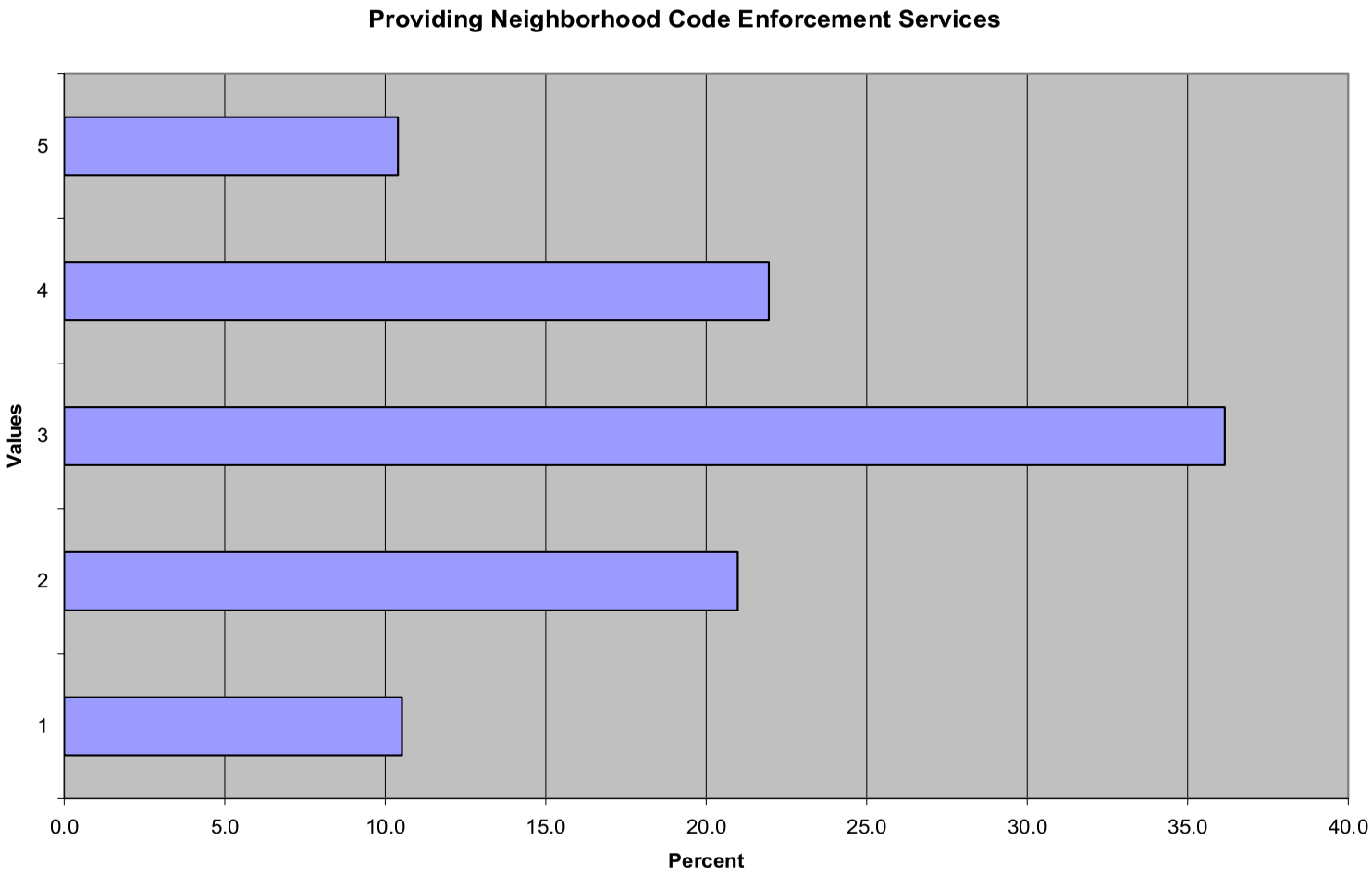
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



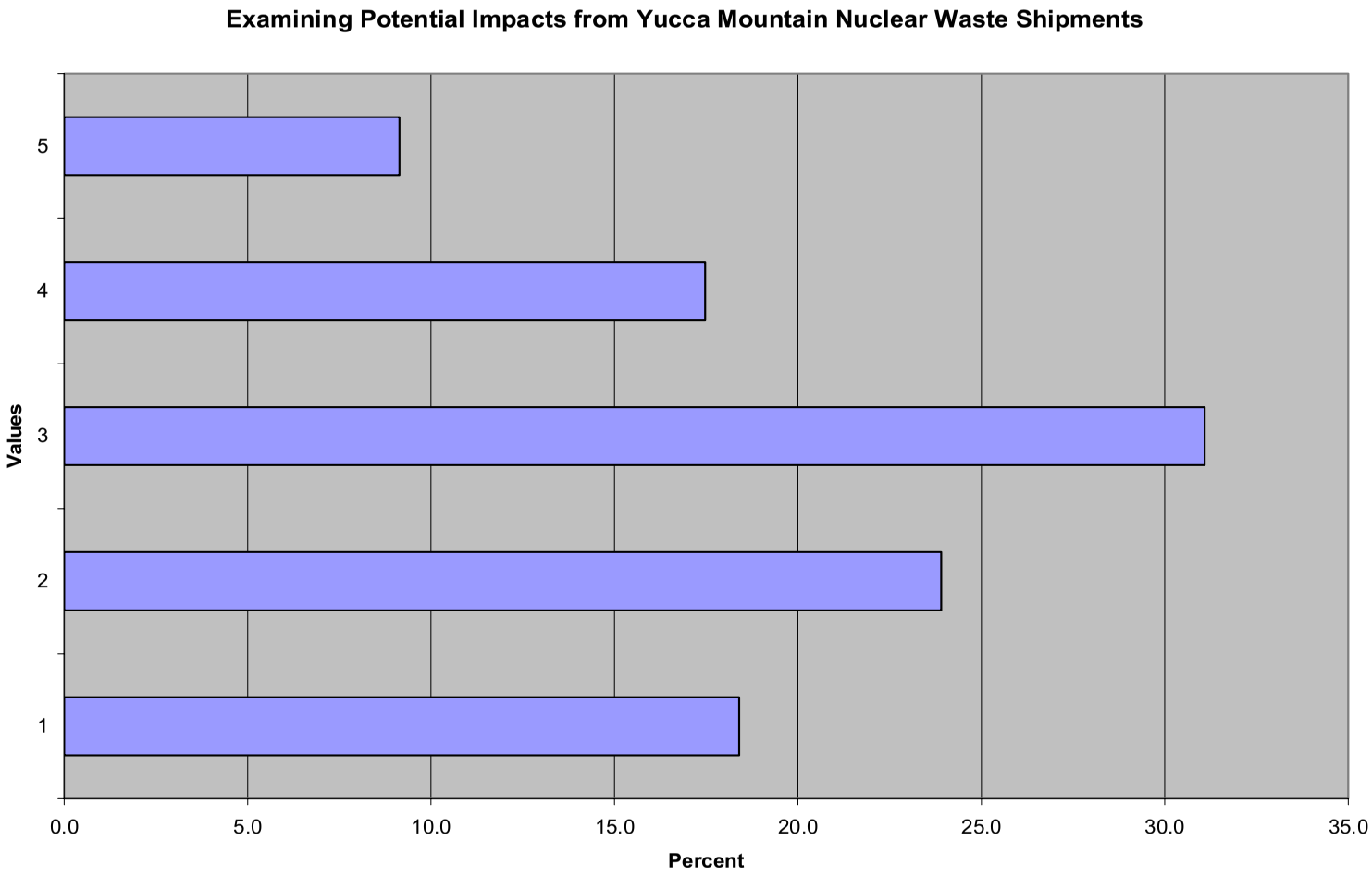
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



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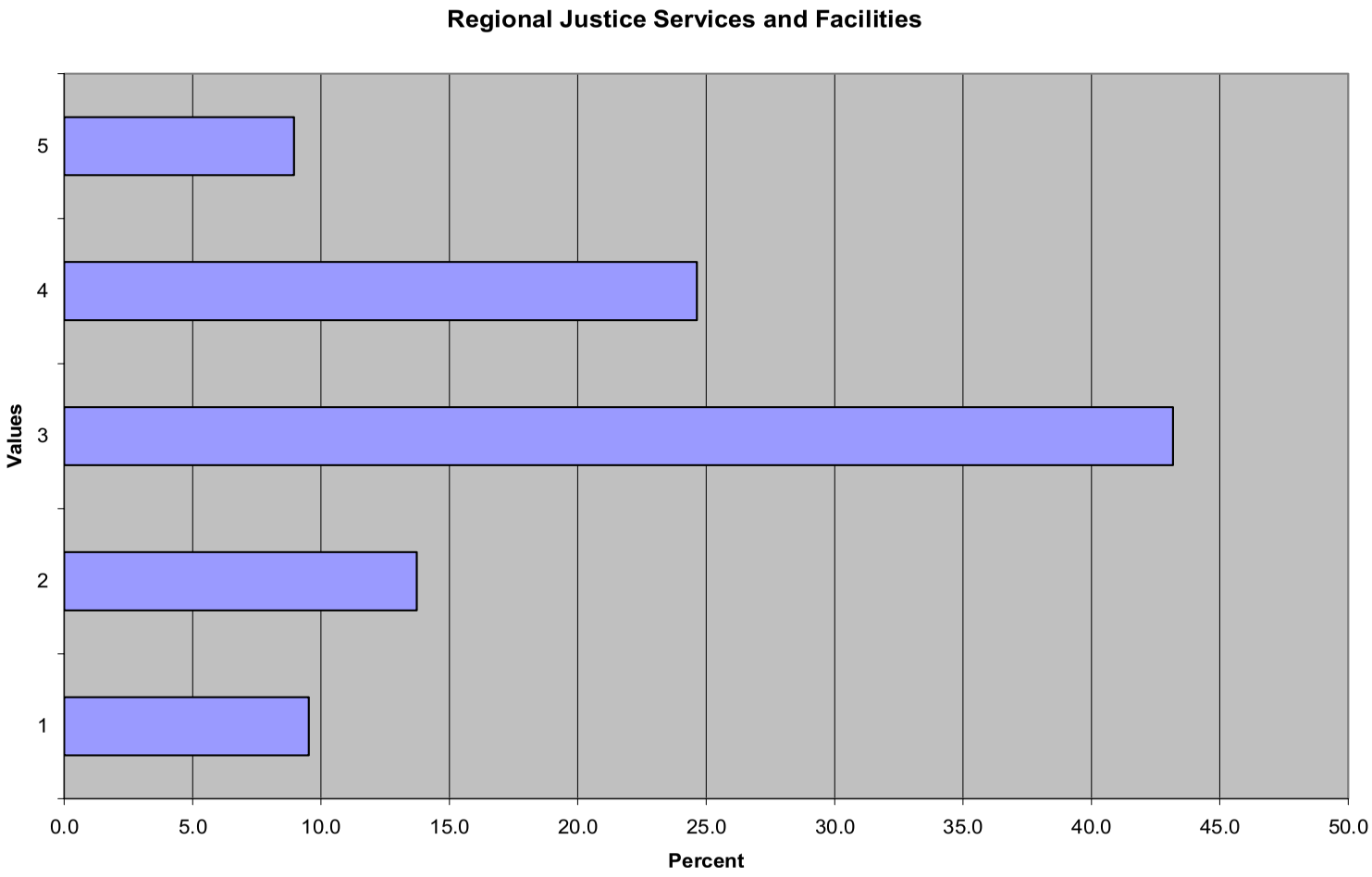
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



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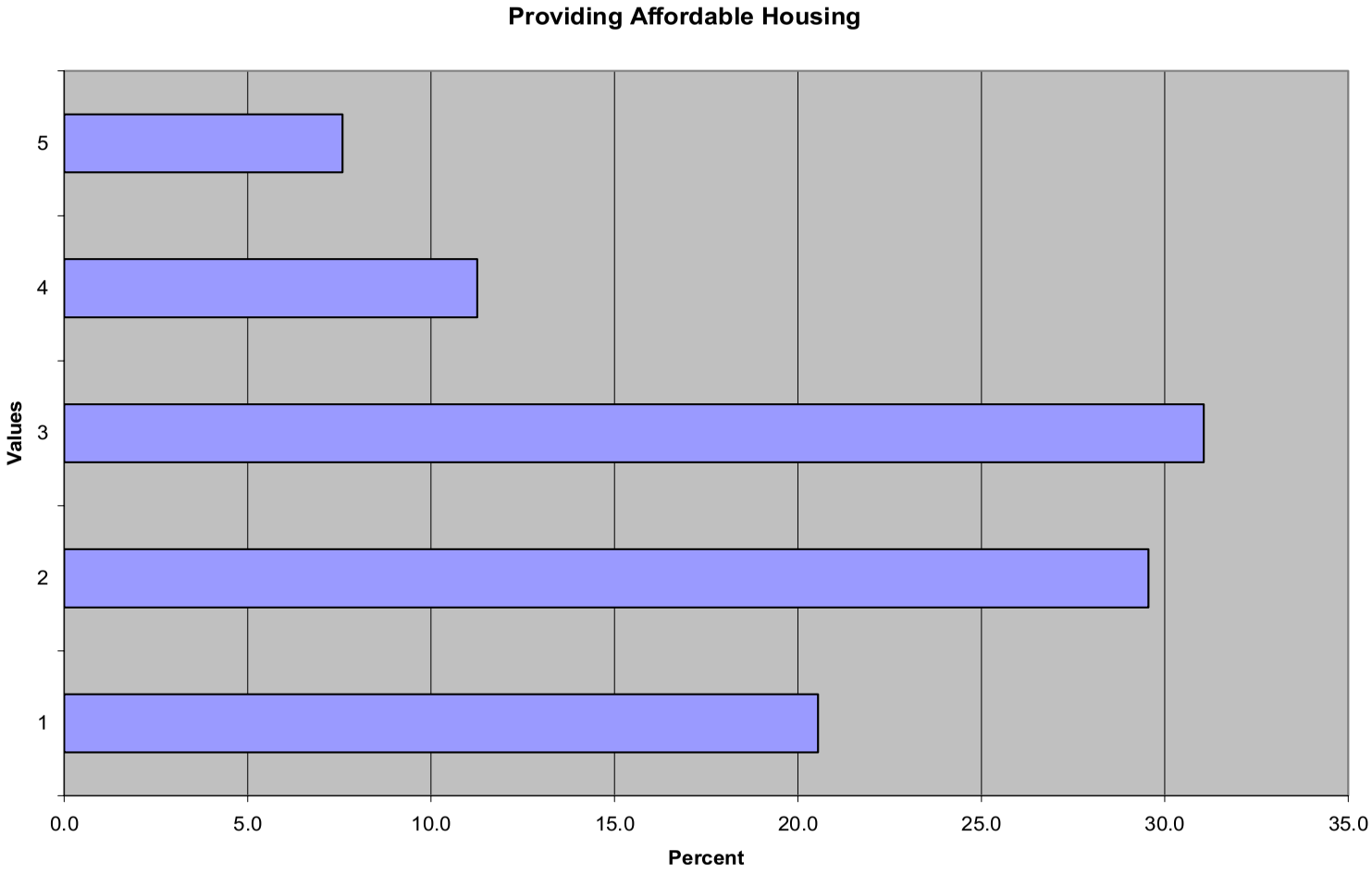
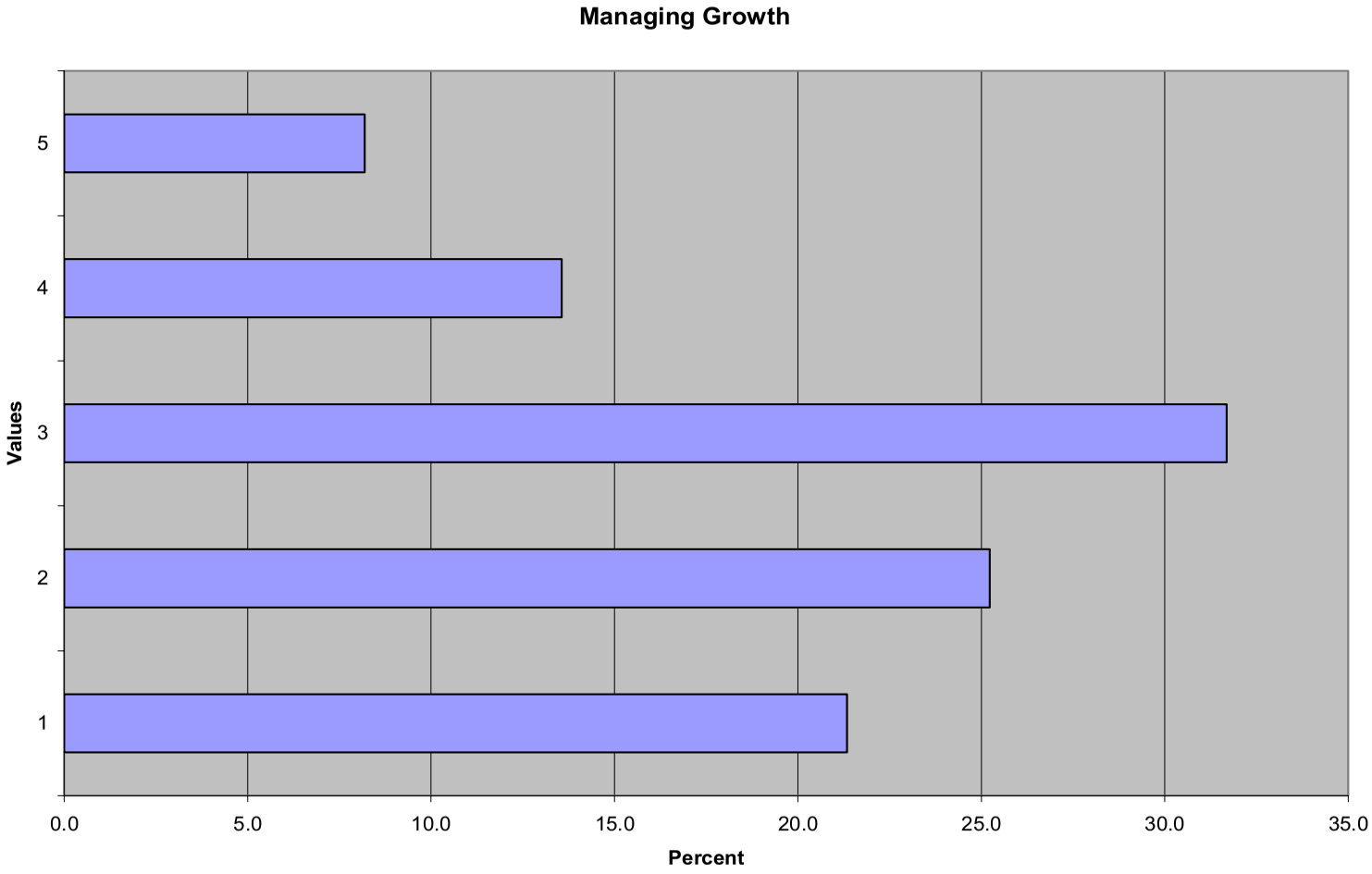
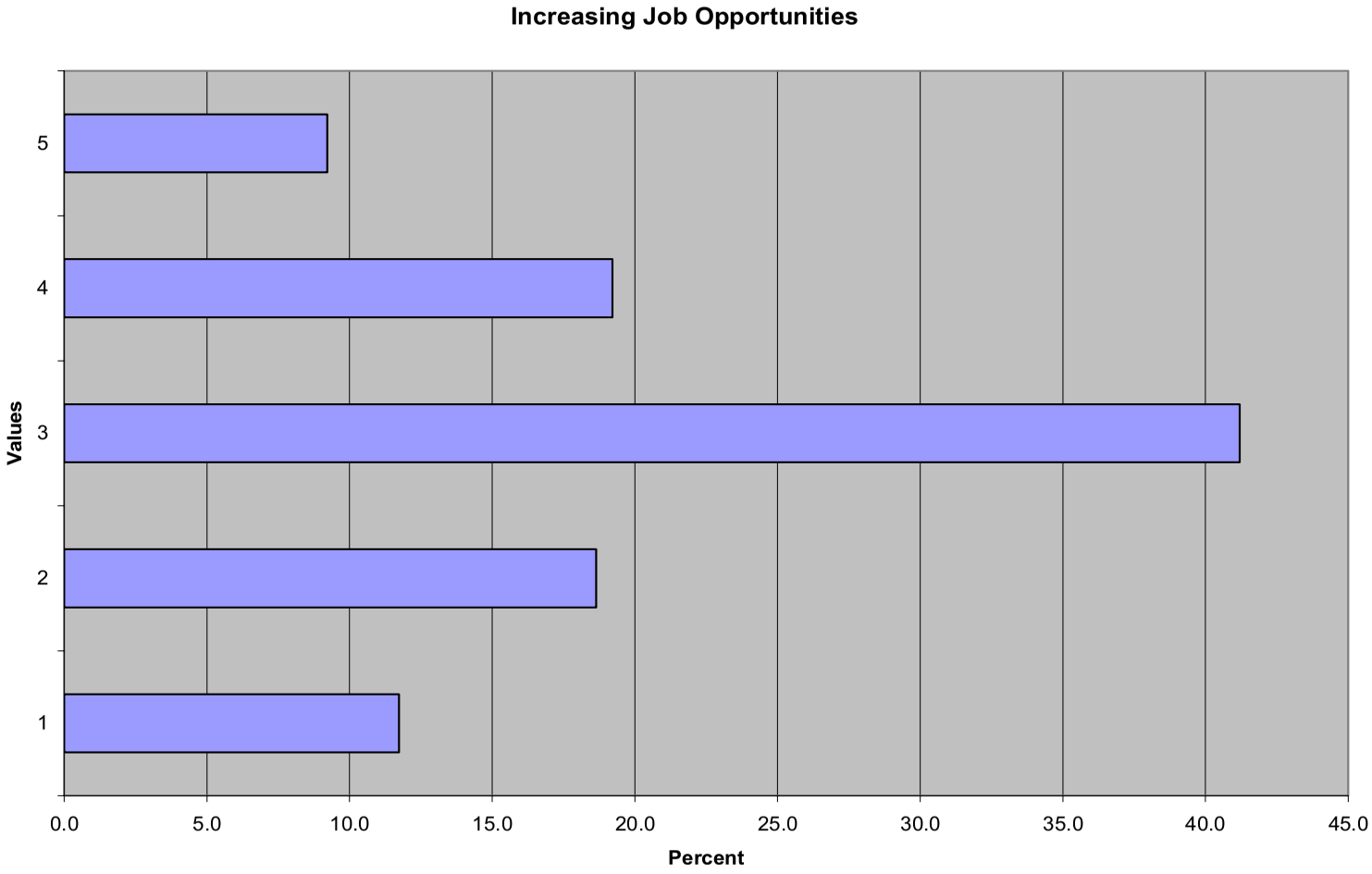
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



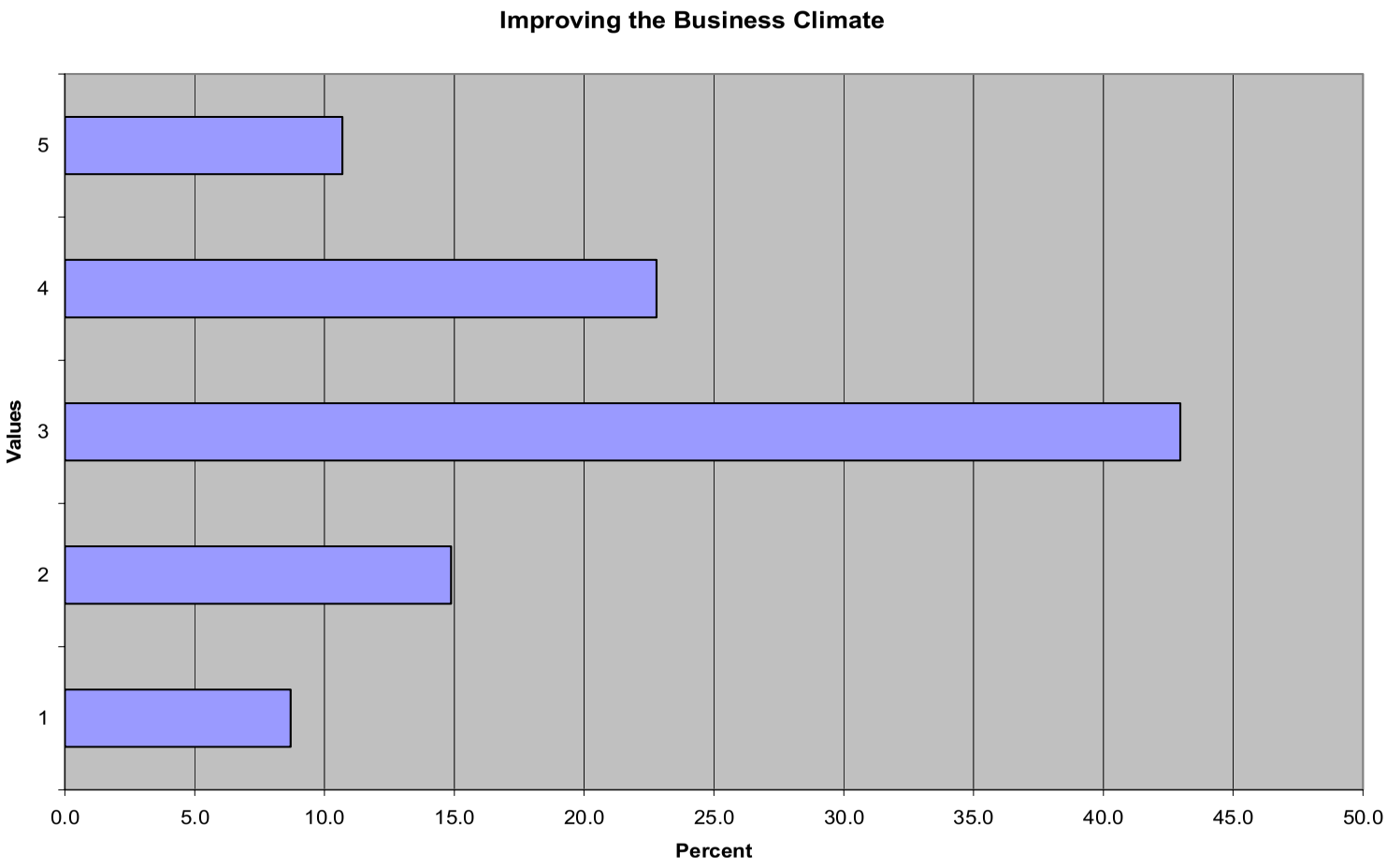
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



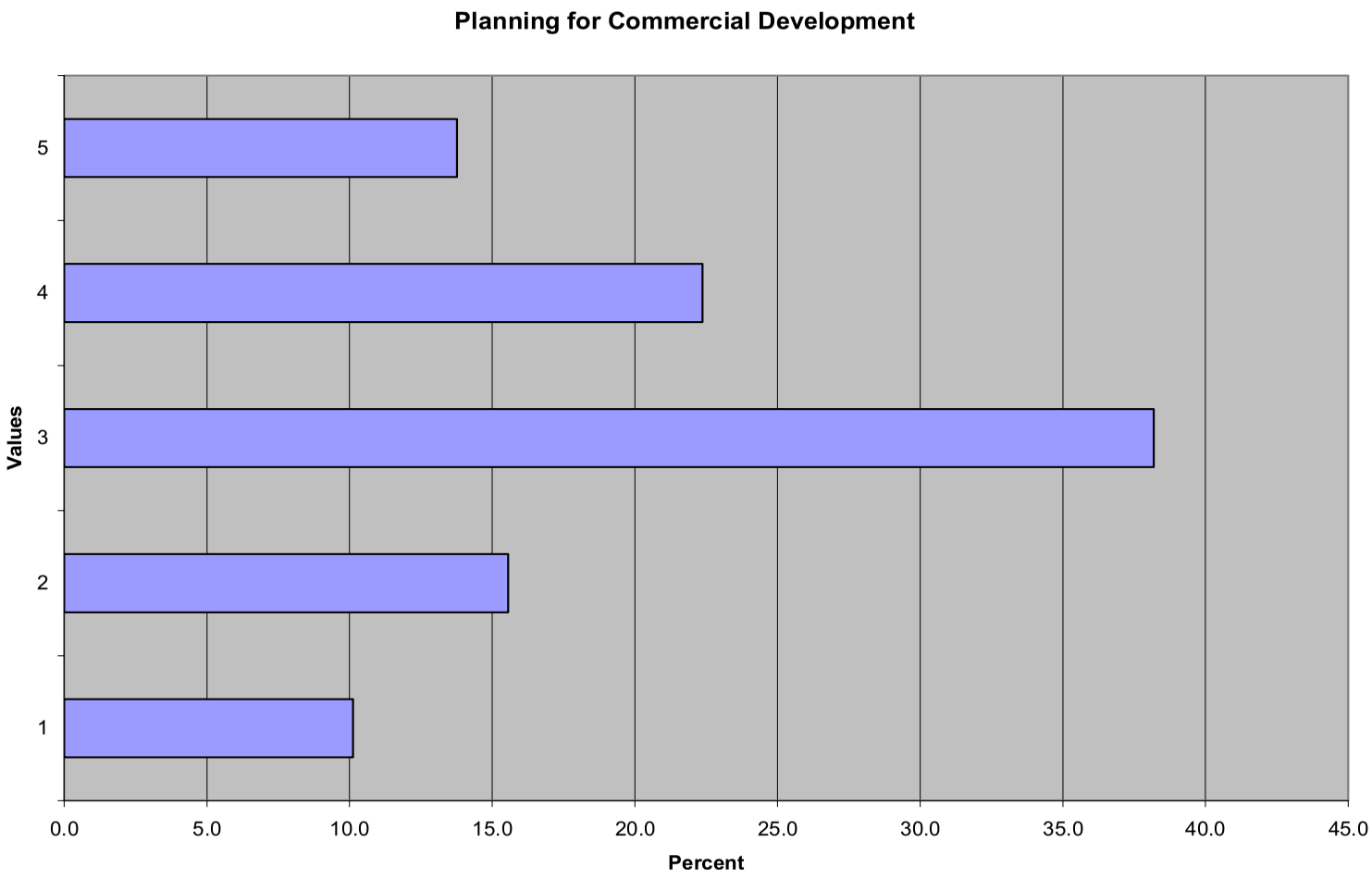
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



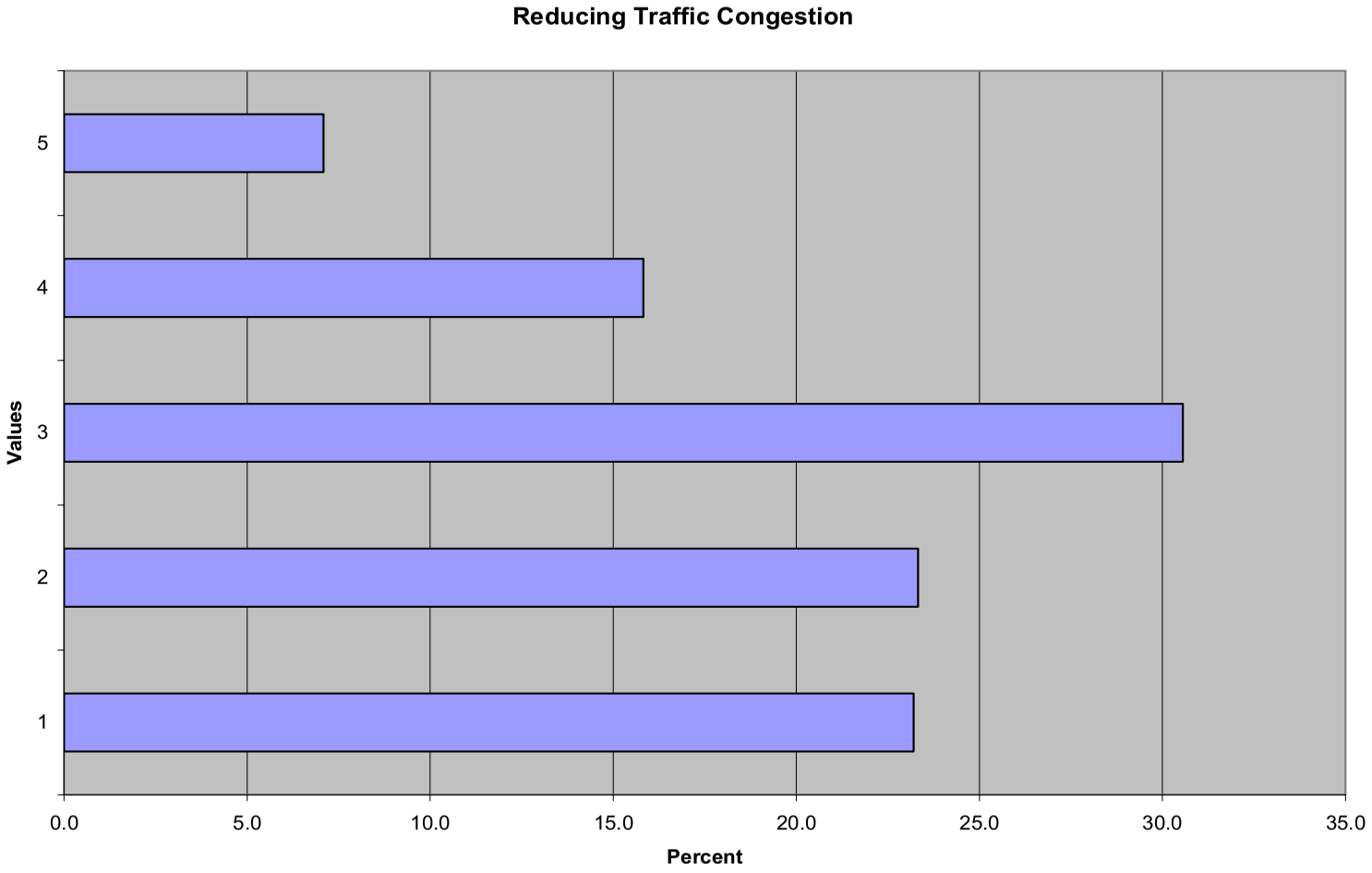
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



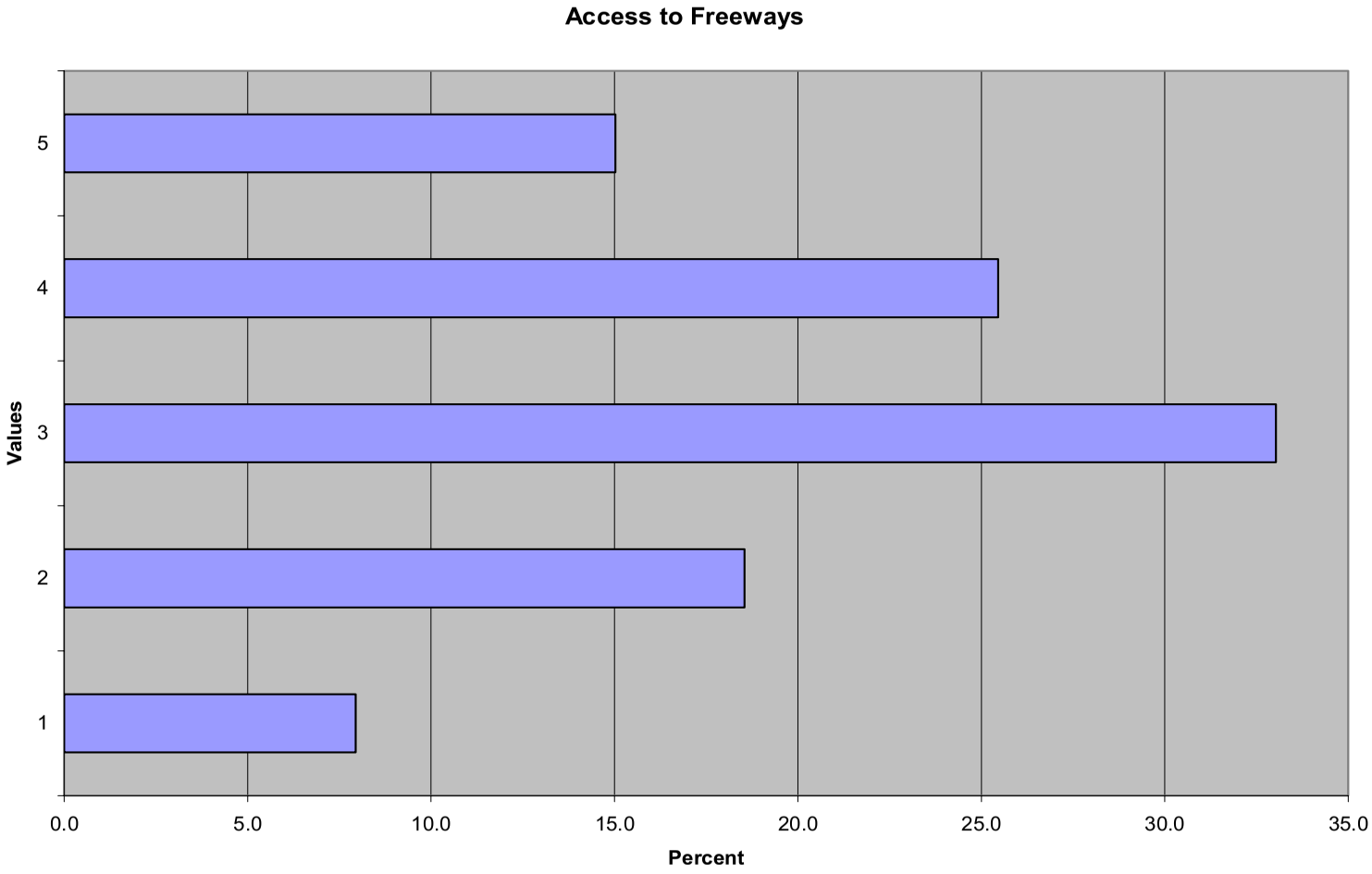
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



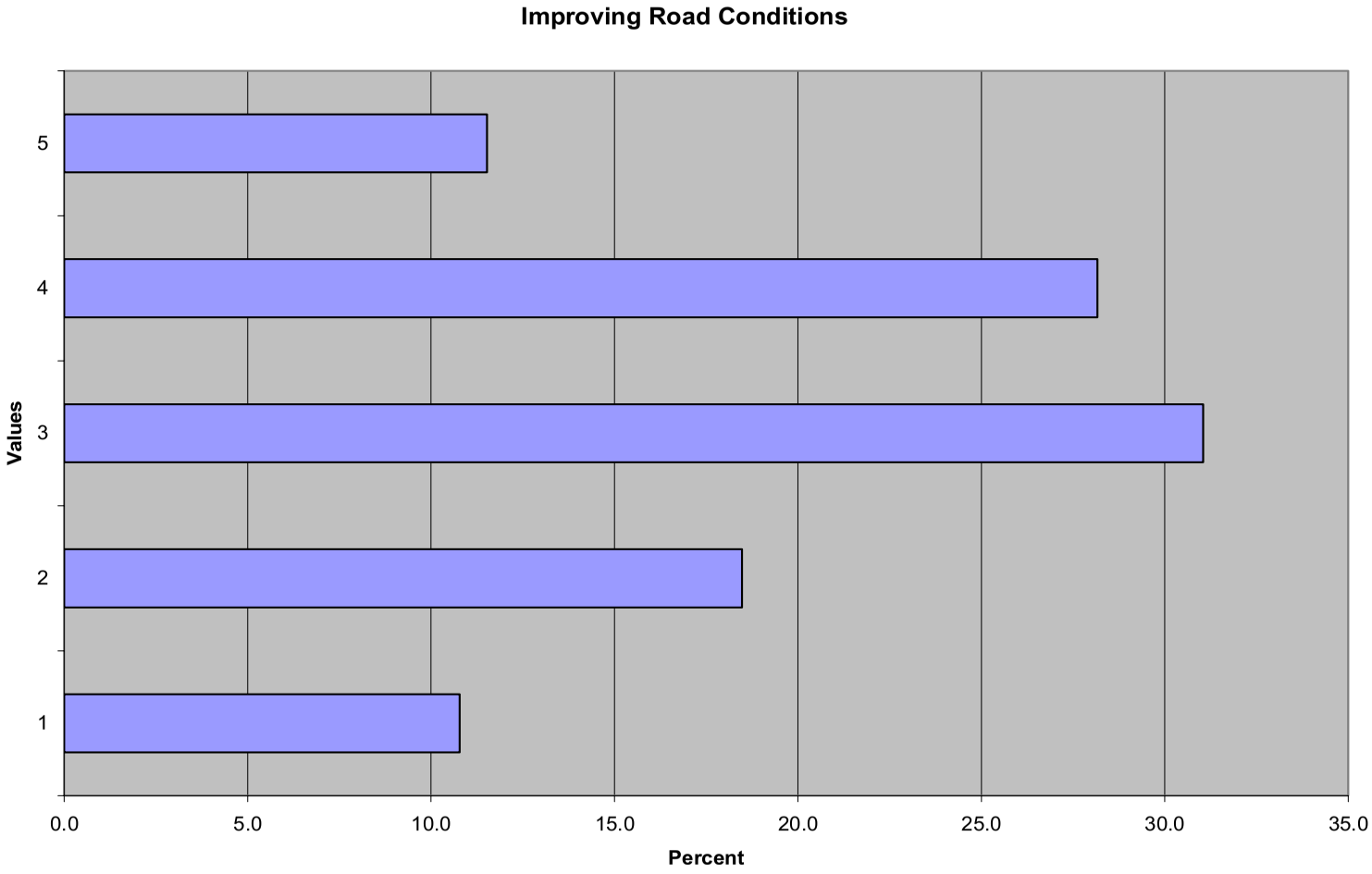
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



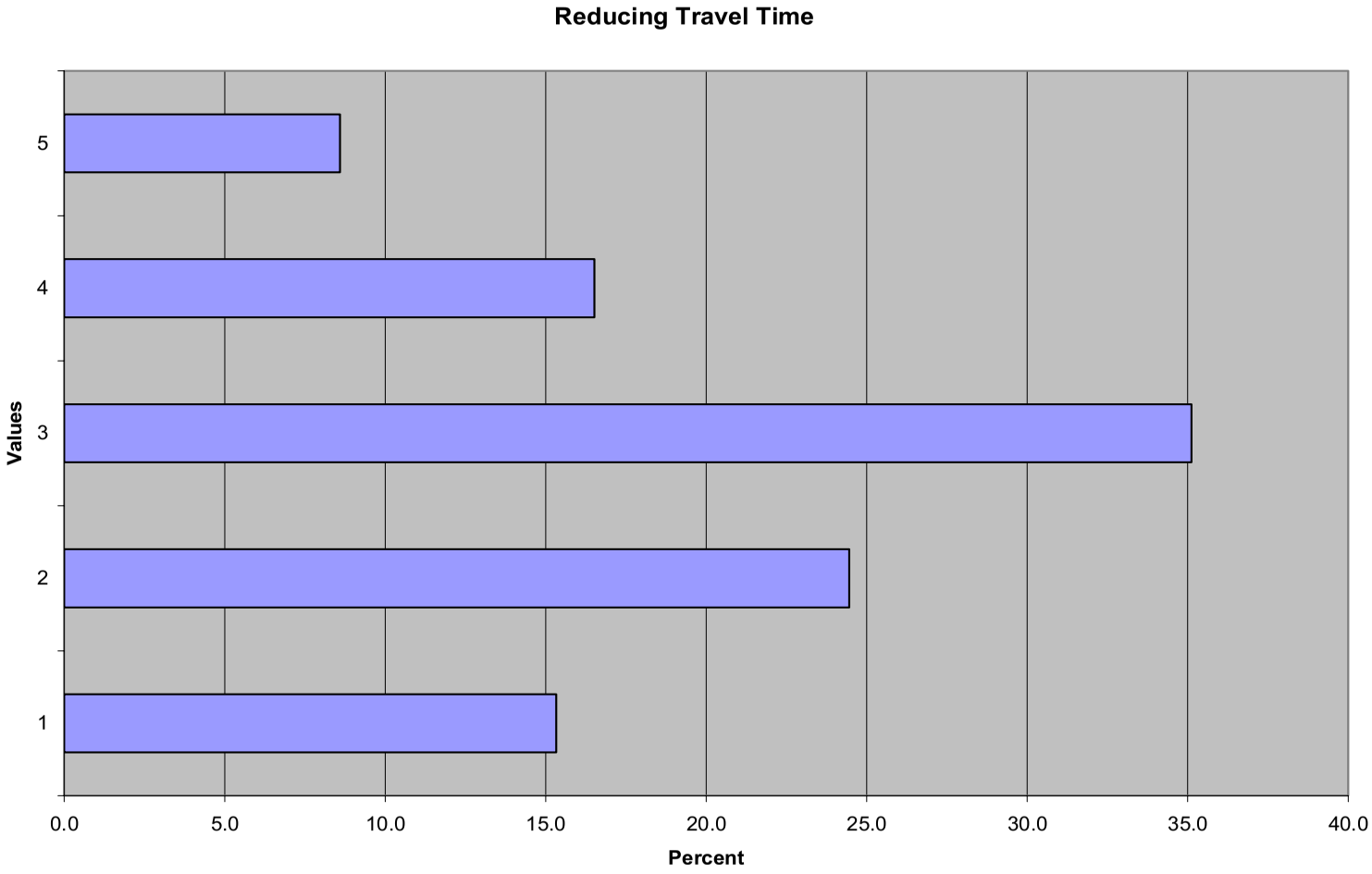
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



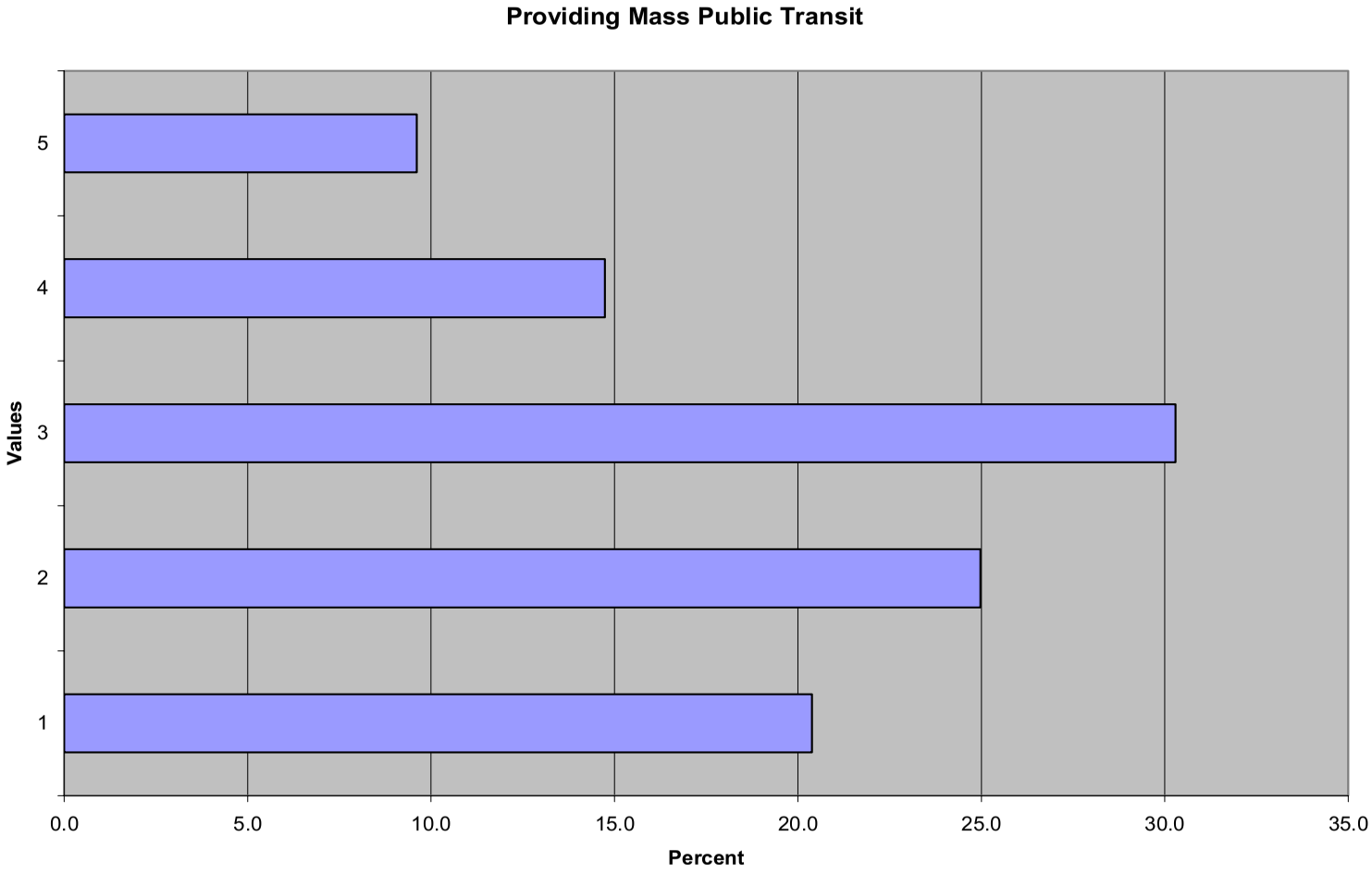
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



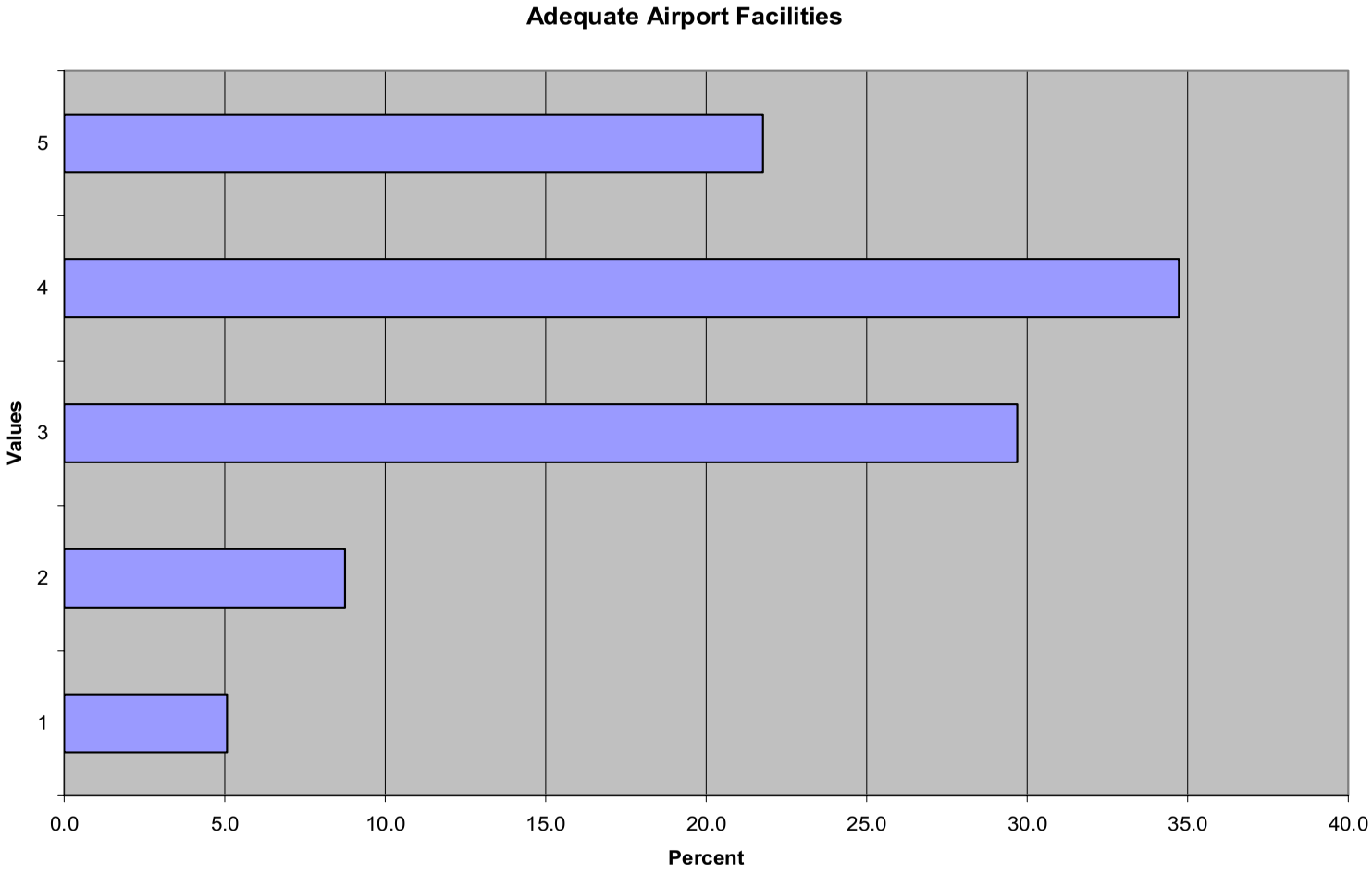
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



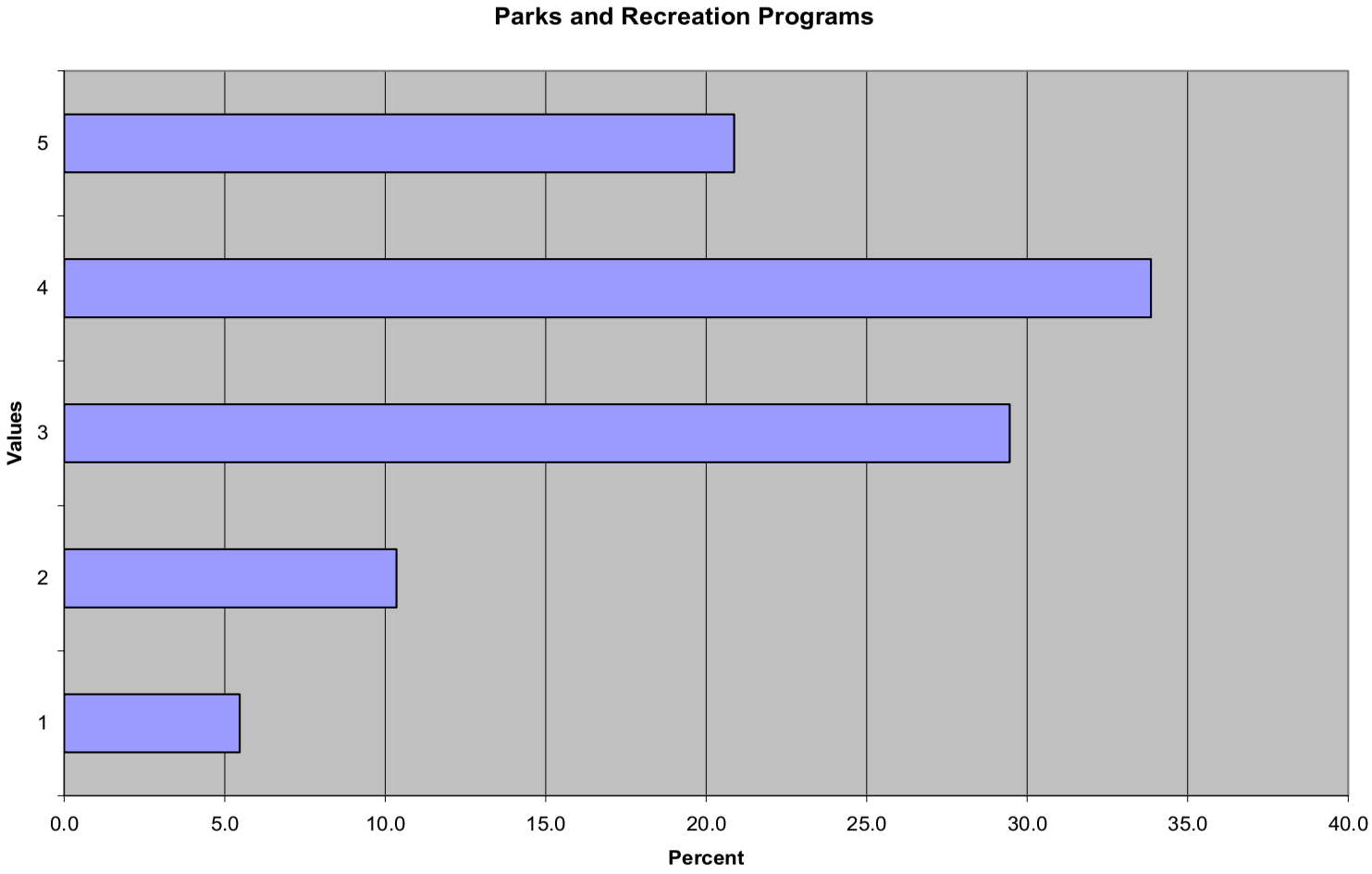
Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix II Continued
Performance Score for Selected Services
Ranking 1-5 (1 being low 5 being high)



Appendix II
Performance Score for Selected Services
Summary Statistics by Jurisdiction

General Government Importance Measure	Region	N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
Road maintenance	Unincorporated Clark County	235	1	3.18	0.069	3.00	3	1.056	-0.126	0.159	-0.362	0.316	1	5
	City of Las Vegas	189	2	3.23	0.077	3.00	3	1.063	-0.199	0.177	-0.291	0.352	1	5
	North Las Vegas	69	0	3.13	0.145	3.00	3	1.209	-0.221	0.288	-0.620	0.569	1	5
	Henderson	78	2	3.20	0.122	3.00	3	1.083	-0.304	0.272	-0.145	0.537	1	5
	Boulder City	14	0	3.41	0.334	4.00	2	1.249	-0.010	0.597	-1.724	1.154	2	5
	Mesquite	9	0	3.75	0.370	4.00	4	1.113	-1.697	0.715	4.432	1.395	1	5
Revitalizing older neighborhoods	Unincorporated Clark County	227	10	2.63	0.072	3.00	3	1.087	0.368	0.162	-0.347	0.322	1	5
	City of Las Vegas	183	7	2.65	0.080	3.00	2	1.081	0.463	0.179	-0.285	0.357	1	5
	North Las Vegas	67	2	2.63	0.147	3.00	3	1.208	0.187	0.292	-0.839	0.577	1	5
	Henderson	78	3	2.84	0.127	3.00	3	1.124	0.322	0.273	-0.378	0.539	1	5
	Boulder City	14	0	2.92	0.256	3.00	3	0.958	0.346	0.597	0.438	1.154	1	5
	Mesquite	9	0	2.68	0.438	3.00	3	1.319	-0.022	0.715	-0.913	1.395	1	5
Flood control	Unincorporated Clark County	228	8	3.55	0.068	4.00	4	1.033	-0.446	0.161	-0.250	0.321	1	5
	City of Las Vegas	180	11	3.63	0.073	4.00	4	0.982	-0.645	0.181	0.382	0.360	1	5
	North Las Vegas	67	2	3.45	0.114	4.00	4	0.936	-0.362	0.293	-0.065	0.578	1	5
	Henderson	81	0	3.50	0.116	3.73	3	1.043	-0.201	0.268	-0.641	0.530	1	5
	Boulder City	14	0	3.02	0.311	3.00	3	1.163	-0.272	0.597	0.141	1.154	1	5
	Mesquite	9	0	3.42	0.410	3.03	3	1.235	-0.632	0.715	0.932	1.395	1	5
Budget management	Unincorporated Clark County	224	12	2.76	0.074	3.00	3	1.102	0.059	0.163	-0.643	0.324	1	5
	City of Las Vegas	185	5	2.71	0.081	3.00	3	1.098	0.144	0.178	-0.461	0.355	1	5
	North Las Vegas	68	2	2.75	0.137	3.00	3	1.127	-0.114	0.291	-0.572	0.574	1	5
	Henderson	80	1	2.42	0.113	2.00	2	1.009	0.380	0.270	-0.163	0.533	1	5
	Boulder City	13	1	2.59	0.231	3.00	3	0.844	-0.446	0.611	0.098	1.180	1	4

	Mesquite	8	1	2.99	0.478	3.00	3	1.369	0.268	0.744	-0.621	1.461	1	5
Communicate Clark County's local government views about Yucca Mountain to federal decision makers	Unincorporated Clark County	229	7	2.88	0.081	3.00	3	1.220	0.082	0.161	-0.825	0.320	1	5
	City of Las Vegas	186	5	2.87	0.094	3.00	3	1.287	0.108	0.178	-0.927	0.355	1	5
	North Las Vegas	68	1	2.73	0.168	3.00	1	1.384	0.041	0.290	-1.308	0.573	1	5
	Henderson	76	5	2.64	0.126	2.00	2	1.095	0.467	0.276	-0.448	0.546	1	5
	Boulder City	14	0	2.62	0.260	3.00	3	0.971	0.356	0.597	0.834	1.154	1	5
	Mesquite	9	0	2.31	0.365	2.00	2	1.098	0.372	0.715	-0.870	1.395	1	4
Monitor and report to the public on how well government services are being performed	Unincorporated Clark County	231	5	2.62	0.069	3.00	3	1.047	0.279	0.160	-0.239	0.319	1	5
	City of Las Vegas	180	10	2.63	0.073	3.00	3	0.984	0.351	0.181	0.032	0.360	1	5
	North Las Vegas	66	3	2.52	0.147	2.00	2	1.197	0.278	0.294	-0.961	0.581	1	5
	Henderson	78	3	2.38	0.129	2.00	2	1.141	0.709	0.272	-0.066	0.538	1	5
	Boulder City	13	1	3.00	0.365	3.00	2	1.330	0.195	0.611	-1.020	1.180	1	5
	Mesquite	9	0	2.58	0.324	3.00	3	0.975	0.617	0.715	3.103	1.395	1	5

Appendix II
Performance Score for Selected Services
Summary Statistics by Jurisdiction

General Government Importance Measure	Region	N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
Water conservation programs	Unincorporated Clark County	228	8	2.80	0.082	3.00	3	1.233	0.230	0.161	-0.833	0.321	1	5
	City of Las Vegas	185	6	2.78	0.087	3.00	3	1.180	0.193	0.179	-0.720	0.356	1	5
	North Las Vegas	68	2	2.77	0.159	3.00	3	1.312	0.114	0.291	-1.011	0.575	1	5
	Henderson	78	3	2.54	0.136	3.00	3	1.198	0.365	0.273	-0.644	0.539	1	5
	Boulder City	13	1	2.89	0.237	3.00	3	0.861	0.238	0.613	1.667	1.185	1	5
	Mesquite	8	1	3.12	0.548	3.00	3	1.570	-0.235	0.744	-1.094	1.461	1	5
Providing child protection services	Unincorporated Clark County	229	7	2.85	0.075	3.00	3	1.128	0.151	0.161	-0.522	0.320	1	5
	City of Las Vegas	185	6	2.84	0.081	3.00	3	1.094	0.222	0.179	-0.492	0.356	1	5
	North Las Vegas	69	0	2.71	0.153	3.00	2	1.271	0.176	0.288	-1.055	0.569	1	5
	Henderson	80	1	2.60	0.121	3.00	3	1.083	0.078	0.269	-0.555	0.531	1	5
	Boulder City	12	2	2.83	0.250	3.00	3	0.882	-0.255	0.627	-0.331	1.213	1	4
	Mesquite	9	0	2.85	0.377	3.00	3	1.136	0.045	0.715	0.014	1.395	1	5
Providing child welfare services	Unincorporated Clark County	230	7	2.96	0.073	3.00	3	1.101	0.191	0.161	-0.383	0.320	1	5
	City of Las Vegas	184	6	2.89	0.077	3.00	3	1.049	0.189	0.179	-0.180	0.356	1	5
	North Las Vegas	69	0	2.88	0.148	3.00	3	1.233	0.095	0.288	-0.729	0.569	1	5
	Henderson	78	3	2.67	0.117	3.00	3	1.030	0.046	0.273	-0.153	0.539	1	5
	Boulder City	14	0	2.64	0.192	3.00	3	0.720	-0.308	0.597	0.518	1.154	1	4
	Mesquite	8	1	2.64	0.281	2.24	2	0.807	0.875	0.744	-0.556	1.461	2	4
Providing juvenile justice services	Unincorporated Clark County	232	4	2.61	0.076	2.00	2	1.152	0.552	0.160	-0.301	0.318	1	5
	City of Las Vegas	185	5	2.54	0.083	3.00	3	1.135	0.434	0.178	-0.363	0.355	1	5
	North Las Vegas	69	0	2.48	0.131	3.00	3	1.090	0.083	0.288	-0.675	0.569	1	5
	Henderson	75	6	2.32	0.124	2.00	2	1.071	0.464	0.277	-0.430	0.548	1	5
	Boulder City	14	0	2.47	0.289	2.36	3	1.081	0.389	0.597	0.113	1.154	1	5

	Mesquite	9	0	2.29	0.422	2.00	2	1.269	0.844	0.715	0.276	1.395	1	5
Providing attainable housing for working class families	Unincorporated Clark County	230	6	2.60	0.079	2.00	2	1.205	0.604	0.160	-0.423	0.320	1	5
	City of Las Vegas	184	6	2.41	0.081	2.00	2	1.105	0.586	0.179	-0.200	0.356	1	5
	North Las Vegas	67	2	2.36	0.141	2.00	1	1.160	0.246	0.292	-1.060	0.577	1	5
	Henderson	78	2	2.38	0.118	2.00	3	1.043	0.459	0.272	-0.022	0.537	1	5
	Boulder City	13	1	2.22	0.264	2.00	2	0.957	0.993	0.613	2.747	1.185	1	5
	Mesquite	9	0	1.99	0.381	2.00	1	1.147	1.446	0.715	3.319	1.395	1	5
Providing affordable housing for low income families	Unincorporated Clark County	230	6	2.31	0.082	2.00	1	1.252	0.652	0.160	-0.609	0.319	1	5
	City of Las Vegas	182	8	2.19	0.084	2.00	1	1.132	0.676	0.180	-0.308	0.358	1	5
	North Las Vegas	69	0	2.15	0.150	2.00	1	1.246	0.612	0.288	-0.810	0.569	1	5
	Henderson	76	5	2.20	0.147	2.00	1	1.282	0.763	0.276	-0.551	0.546	1	5
	Boulder City	14	0	1.95	0.255	2.00	1	0.953	0.536	0.597	-0.721	1.154	1	4
	Mesquite	9	0	2.03	0.306	2.00	2	0.922	0.610	0.715	0.262	1.395	1	4
Providing shelter for the homeless	Unincorporated Clark County	226	10	2.81	0.078	3.00	3	1.171	0.246	0.162	-0.638	0.322	1	5
	City of Las Vegas	185	6	2.67	0.077	3.00	3	1.048	0.255	0.179	-0.347	0.355	1	5
	North Las Vegas	65	5	2.62	0.155	3.00	3	1.245	0.128	0.297	-1.032	0.587	1	5
	Henderson	77	4	2.56	0.127	2.00	2	1.120	0.389	0.274	-0.466	0.541	1	5
	Boulder City	13	1	2.72	0.269	3.00	3	0.983	0.260	0.611	1.558	1.180	1	5
	Mesquite	9	0	2.52	0.340	2.00	2	1.022	1.317	0.715	2.408	1.395	1	5
	Unincorporated Clark County	230	6	2.84	0.086	3.00	3	1.309	0.190	0.160	-0.992	0.319	1	5
Providing affordable housing for seniors	City of Las Vegas	181	10	2.64	0.087	3.00	2	1.164	0.282	0.181	-0.738	0.359	1	5
	North Las Vegas	69	0	2.59	0.156	2.88	1	1.298	0.346	0.288	-0.929	0.569	1	5
	Henderson	75	5	2.50	0.132	2.00	2	1.144	0.301	0.277	-0.757	0.547	1	5
	Boulder City	14	0	2.49	0.230	2.36	2	0.862	0.036	0.597	-0.230	1.154	1	4
	Mesquite	8	1	1.97	0.311	2.00	2	0.891	0.949	0.744	1.814	1.461	1	4
Providing medical care for the poor	Unincorporated Clark County	228	9	3.36	0.080	3.00	3	1.206	-0.326	0.161	-0.736	0.321	1	5
	City of Las Vegas	184	7	3.33	0.086	3.00	4	1.164	-0.317	0.179	-0.662	0.357	1	5
	North Las Vegas	66	3	2.95	0.159	3.00	3	1.295	-0.048	0.294	-0.968	0.581	1	5
	Henderson	78	3	3.01	0.134	3.00	4	1.181	-0.244	0.273	-0.937	0.539	1	5
	Boulder City	14	0	2.95	0.287	3.00	3	1.075	-0.282	0.597	-0.009	1.154	1	5

	Mesquite	9	1	2.93	0.390	3.00	3	1.138	-0.026	0.734	-0.019	1.438	1	5
Providing 24 hour emergency trauma care	Unincorporated Clark County	228	8	2.80	0.082	3.00	3	1.233	0.230	0.161	-0.833	0.321	1	5
	City of Las Vegas	185	6	2.78	0.087	3.00	3	1.180	0.193	0.179	-0.720	0.356	1	5
	North Las Vegas	68	2	2.77	0.159	3.00	3	1.312	0.114	0.291	-1.011	0.575	1	5
	Henderson	78	3	2.54	0.136	3.00	3	1.198	0.365	0.273	-0.644	0.539	1	5
	Boulder City	13	1	2.89	0.237	3.00	3	0.861	0.238	0.613	1.667	1.185	1	5
	Mesquite	8	1	3.12	0.548	3.00	3	1.570	-0.235	0.744	-1.094	1.461	1	5

Appendix II
Performance Score for Selected Services
Summary Statistics by Jurisdiction

Public Safety Importance Measure	Region	N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
Providing crime prevention programs	Unincorporated Clark County	226	10	3.01	0.073	3.00	3	1.099	0.055	0.162	-0.426	0.322	1	5
	City of Las Vegas	177	13	3.00	0.075	3.00	3	1.003	-0.185	0.182	-0.086	0.363	1	5
	North Las Vegas	69	0	2.84	0.142	3.00	3	1.179	0.234	0.288	-0.674	0.569	1	5
	Henderson	80	1	2.95	0.108	3.00	3	0.963	-0.023	0.269	-0.069	0.532	1	5
	Boulder City	14	0	3.23	0.235	3.00	3	0.877	0.505	0.597	0.156	1.154	2	5
	Mesquite	9	1	3.85	0.398	4.00	5	1.160	-0.458	0.734	-1.192	1.438	2	5
Enforcing traffic laws	Unincorporated Clark County	234	2	2.98	0.081	3.00	3	1.247	0.146	0.159	-0.840	0.317	1	5
	City of Las Vegas	184	6	3.03	0.088	3.00	3	1.200	-0.064	0.179	-0.869	0.356	1	5
	North Las Vegas	68	2	3.13	0.137	3.00	3	1.128	0.055	0.291	-0.768	0.574	1	5
	Henderson	81	0	2.75	0.132	3.00	3	1.183	0.271	0.268	-0.670	0.530	1	5
	Boulder City	14	0	3.33	0.309	3.39	4	1.155	-0.282	0.597	-0.594	1.154	1	5
	Mesquite	9	0	3.03	0.443	3.00	3	1.332	0.163	0.715	-0.703	1.395	1	5
Maintaining low crime rates	Unincorporated Clark County	234	2	2.79	0.077	3.00	3	1.180	0.262	0.159	-0.687	0.317	1	5
	City of Las Vegas	187	4	2.78	0.081	3.00	3	1.101	0.264	0.178	-0.403	0.354	1	5
	North Las Vegas	68	2	3.02	0.147	3.00	4	1.210	-0.051	0.291	-0.982	0.574	1	5
	Henderson	81	0	2.67	0.116	3.00	3	1.042	0.345	0.268	-0.186	0.530	1	5
	Boulder City	14	0	3.17	0.381	3.00	4	1.426	-0.236	0.597	-1.149	1.154	1	5
	Mesquite	9	0	3.65	0.449	4.00	5	1.352	-0.266	0.715	-1.965	1.395	2	5
Maintaining neighborhood police patrols	Unincorporated Clark County	235	1	2.83	0.075	3.00	3	1.146	0.072	0.159	-0.639	0.316	1	5
	City of Las Vegas	180	10	2.75	0.088	3.00	3	1.177	0.280	0.181	-0.511	0.360	1	5
	North Las Vegas	67	2	2.79	0.160	3.00	4	1.316	0.061	0.292	-1.310	0.577	1	5
	Henderson	79	2	2.52	0.125	2.52	3	1.107	0.318	0.271	-0.527	0.535	1	5
	Boulder City	13	1	3.38	0.293	3.00	3	1.063	-0.301	0.613	0.448	1.185	1	5

	Mesquite	8	1	3.41	0.467	3.00	2	1.340	0.228	0.744	-1.968	1.461	2	5
Keeping police response times low	Unincorporated Clark County	230	6	3.03	0.081	3.00	3	1.228	-0.116	0.161	-0.856	0.320	1	5
	City of Las Vegas	183	8	2.95	0.084	3.00	3	1.135	-0.108	0.180	-0.583	0.358	1	5
	North Las Vegas	67	2	2.88	0.155	3.00	3	1.270	-0.038	0.293	-0.985	0.578	1	5
	Henderson	79	2	3.02	0.120	3.00	3	1.066	-0.140	0.271	-0.343	0.536	1	5
	Boulder City	14	0	3.90	0.230	4.00	4	0.861	-0.383	0.597	-0.156	1.154	2	5
	Mesquite	9	0	3.47	0.474	3.00	3	1.426	-0.214	0.715	-1.008	1.395	1	5
Keeping fire department response times low	Unincorporated Clark County	226	10	3.76	0.067	4.00	4	1.014	-0.747	0.162	0.224	0.322	1	5
	City of Las Vegas	185	6	3.70	0.070	4.00	4	0.946	-0.449	0.179	-0.048	0.356	1	5
	North Las Vegas	65	4	3.75	0.134	4.00	4	1.078	-0.647	0.297	-0.073	0.586	1	5
	Henderson	78	3	3.72	0.102	4.00	4	0.900	-0.827	0.272	1.280	0.538	1	5
	Boulder City	14	0	4.10	0.190	4.00	4	0.712	-0.147	0.597	-0.709	1.154	3	5
	Mesquite	9	0	3.80	0.393	4.00	5	1.182	-0.446	0.715	-1.236	1.395	2	5
Keeping paramedic and emergency medical response times low	Unincorporated Clark County	230	6	3.78	0.068	4.00	4	1.026	-0.798	0.160	0.253	0.319	1	5
	City of Las Vegas	184	7	3.67	0.068	4.00	4	0.926	-0.545	0.179	0.407	0.357	1	5
	North Las Vegas	67	3	3.65	0.140	4.00	4	1.146	-0.578	0.294	-0.304	0.579	1	5
	Henderson	78	2	3.61	0.119	4.00	3	1.053	-0.701	0.272	0.540	0.537	1	5
	Boulder City	14	0	4.06	0.214	4.00	4	0.801	-0.995	0.597	1.995	1.154	2	5
	Mesquite	9	1	4.26	0.243	4.00	4	0.707	-0.434	0.734	-0.305	1.438	3	5
Well trained paramedic and emergency medical response personnel	Unincorporated Clark County	231	5	3.94	0.066	4.00	4	1.011	-0.825	0.160	0.260	0.319	1	5
	City of Las Vegas	184	6	3.70	0.076	4.00	4	1.029	-0.606	0.179	-0.024	0.356	1	5
	North Las Vegas	63	6	4.02	0.106	4.00	4	0.848	-0.502	0.301	-0.395	0.593	2	5
	Henderson	73	8	3.76	0.124	4.00	4	1.056	-0.807	0.282	0.377	0.557	1	5
	Boulder City	14	0	3.87	0.244	4.00	4	0.911	-0.314	0.597	-0.527	1.154	2	5
	Mesquite	9	0	4.13	0.359	4.31	5	1.082	-1.113	0.715	0.434	1.395	2	5
Facilitate neighborhood watch programs	Unincorporated Clark County	225	11	2.91	0.079	3.00	3	1.183	0.208	0.162	-0.673	0.323	1	5
	City of Las Vegas	187	4	2.89	0.082	3.00	3	1.122	0.053	0.178	-0.696	0.354	1	5
	North Las Vegas	67	2	2.97	0.153	3.00	3	1.259	0.207	0.292	-0.913	0.577	1	5
	Henderson	80	1	2.65	0.127	3.00	3	1.131	0.232	0.269	-0.438	0.532	1	5
	Boulder City	14	0	2.77	0.300	3.00	3	1.122	0.049	0.597	-0.150	1.154	1	5

	Mesquite	9	1	3.02	0.416	3.00	3	1.212	-0.051	0.734	0.338	1.438	1	5
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist events	Unincorporated Clark County	232	5	2.85	0.076	3.00	3	1.154	0.115	0.160	-0.596	0.319	1	5
	City of Las Vegas	186	5	2.90	0.082	3.00	3	1.117	-0.065	0.178	-0.518	0.355	1	5
	North Las Vegas	66	3	2.85	0.132	3.00	3	1.072	0.018	0.295	-0.306	0.581	1	5
	Henderson	77	3	2.83	0.136	3.00	3	1.195	0.111	0.273	-0.649	0.541	1	5
	Boulder City	12	2	2.81	0.238	3.00	3	0.831	-0.367	0.632	0.253	1.222	1	4
	Mesquite	8	1	3.44	0.365	3.83	4	1.046	-0.188	0.744	-0.840	1.461	2	5
Preparing for man made (such as hazardous or radiological materials) accidents or terrorist event	Unincorporated Clark County	230	6	2.91	0.081	3.00	3	1.226	0.072	0.160	-0.835	0.320	1	5
	City of Las Vegas	186	4	2.85	0.085	3.00	3	1.165	0.143	0.178	-0.636	0.354	1	5
	North Las Vegas	68	1	2.91	0.147	3.00	3	1.214	0.259	0.290	-0.781	0.573	1	5
	Henderson	79	1	2.93	0.133	3.00	3	1.186	-0.147	0.270	-0.781	0.533	1	5
	Boulder City	13	1	3.02	0.303	3.00	3	1.080	-0.387	0.622	0.506	1.201	1	5
	Mesquite	9	1	2.74	0.410	3.00	3	1.195	-0.527	0.734	-1.113	1.438	1	4
Investigating criminal activity	Unincorporated Clark County	232	4	3.16	0.070	3.00	3	1.070	-0.123	0.160	-0.210	0.318	1	5
	City of Las Vegas	185	6	2.99	0.080	3.00	3	1.085	0.043	0.179	-0.396	0.356	1	5
	North Las Vegas	69	0	3.03	0.157	3.00	3	1.309	-0.022	0.288	-1.055	0.569	1	5
	Henderson	79	1	2.96	0.117	3.00	3	1.039	-0.538	0.270	-0.485	0.534	1	5
	Boulder City	14	0	3.35	0.255	4.00	4	0.954	-0.329	0.597	-1.022	1.154	2	5
	Mesquite	9	0	3.68	0.351	3.69	3	1.056	-0.025	0.715	-1.041	1.395	2	5
Providing fire protection & prevention services	Unincorporated Clark County	232	4	3.49	0.069	3.00	3	1.059	-0.366	0.160	-0.250	0.318	1	5
	City of Las Vegas	188	3	3.55	0.074	4.00	3	1.014	-0.403	0.177	-0.111	0.353	1	5
	North Las Vegas	67	2	3.47	0.135	4.00	4	1.106	-0.426	0.292	-0.382	0.576	1	5
	Henderson	78	3	3.56	0.103	4.00	4	0.909	-0.142	0.272	-0.451	0.538	1	5
	Boulder City	14	0	3.76	0.211	4.00	3	0.791	0.484	0.597	-1.135	1.154	3	5
	Mesquite	8	1	3.58	0.417	3.00	3	1.153	0.445	0.765	-1.534	1.514	2	5
Providing emergency medical services	Unincorporated Clark County	232	4	3.62	0.068	4.00	4	1.041	-0.460	0.160	-0.189	0.318	1	5
	City of Las Vegas	187	3	3.54	0.074	4.00	3	1.008	-0.427	0.178	0.060	0.353	1	5
	North Las Vegas	68	2	3.52	0.146	4.00	4	1.203	-0.614	0.291	-0.506	0.574	1	5
	Henderson	77	4	3.58	0.115	4.00	4	1.007	-0.655	0.274	0.235	0.541	1	5

	Boulder City	14	0	3.85	0.219	4.00	3	0.821	0.303	0.597	-1.412	1.154	3	5
	Mesquite	8	1	3.87	0.271	4.00	4	0.768	0.249	0.752	-0.810	1.480	3	5
Providing for neighborhood code enforcement services	Unincorporated Clark County	229	7	3.00	0.074	3.00	3	1.124	-0.096	0.161	-0.707	0.320	1	5
	City of Las Vegas	185	5	3.01	0.081	3.00	3	1.102	0.056	0.178	-0.414	0.355	1	5
	North Las Vegas	64	5	3.04	0.146	3.00	3	1.170	0.061	0.299	-0.780	0.591	1	5
	Henderson	78	2	2.99	0.134	3.00	3	1.186	0.008	0.272	-0.766	0.537	1	5
	Boulder City	14	0	3.12	0.299	3.00	3	1.119	-0.366	0.597	0.175	1.154	1	5
	Mesquite	9	1	2.91	0.386	3.00	3	1.127	0.018	0.734	0.134	1.438	1	5
Examining potential impacts from Yucca Mountain nuclear waste shipments	Unincorporated Clark County	226	10	2.74	0.080	3.00	3	1.203	0.180	0.162	-0.816	0.322	1	5
	City of Las Vegas	181	9	2.77	0.091	3.00	3	1.225	0.164	0.180	-0.812	0.359	1	5
	North Las Vegas	68	2	2.85	0.157	3.00	3	1.293	0.012	0.291	-1.071	0.574	1	5
	Henderson	80	1	2.68	0.126	3.00	3	1.130	0.296	0.269	-0.558	0.532	1	5
	Boulder City	13	1	2.38	0.296	2.00	2	1.056	0.152	0.622	-1.000	1.201	1	4
	Mesquite	9	0	3.07	0.415	3.00	4	1.250	-0.050	0.715	-0.749	1.395	1	5

Appendix II
Performance Score for Selected Services
Summary Statistics by Jurisdiction

Community Development Importance Measure	Region	N	Missing	Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis	Minimum	Maximum
Regional justice services and facilities	Unincorporated Clark County	228	8	3.21	0.069	3.00	3	1.044	-0.287	0.161	-0.091	0.321	1	5
	City of Las Vegas	180	10	3.03	0.079	3.00	3	1.056	-0.175	0.181	-0.322	0.360	1	5
	North Las Vegas	68	2	3.20	0.139	3.00	3	1.143	-0.164	0.291	-0.413	0.574	1	5
	Henderson	77	3	2.88	0.113	3.00	3	0.990	-0.380	0.273	-0.413	0.540	1	5
	Boulder City	14	0	3.29	0.235	3.00	3	0.881	0.006	0.597	-0.549	1.154	2	5
	Mesquite	9	0	2.41	0.355	3.00	3	1.068	-0.424	0.715	-1.202	1.395	1	4
Providing affordable housing	Unincorporated Clark County	232	5	2.64	0.077	3.00	3	1.174	0.396	0.160	-0.514	0.319	1	5
	City of Las Vegas	182	8	2.45	0.082	2.00	3	1.107	0.380	0.180	-0.478	0.358	1	5
	North Las Vegas	69	0	2.79	0.150	3.00	3	1.252	0.188	0.288	-0.913	0.569	1	5
	Henderson	74	7	2.34	0.125	2.00	2	1.074	0.684	0.279	0.062	0.552	1	5
	Boulder City	13	1	2.43	0.316	2.00	2	1.154	0.693	0.611	0.321	1.180	1	5
	Mesquite	9	0	2.88	0.461	3.00	3	1.386	0.260	0.715	-0.617	1.395	1	5
Managing Growth	Unincorporated Clark County	234	2	2.62	0.079	3.00	3	1.214	0.422	0.159	-0.608	0.317	1	5
	City of Las Vegas	184	6	2.52	0.086	3.00	3	1.165	0.280	0.179	-0.779	0.356	1	5
	North Las Vegas	67	2	2.85	0.153	3.00	3	1.253	0.030	0.292	-0.737	0.577	1	5
	Henderson	79	2	2.48	0.120	2.00	3	1.063	0.260	0.271	-0.609	0.536	1	5
	Boulder City	14	0	3.13	0.339	3.00	4	1.269	-0.387	0.597	-0.604	1.154	1	5
	Mesquite	9	0	3.41	0.457	3.87	4	1.377	-0.558	0.715	-0.536	1.395	1	5
Increasing job opportunities	Unincorporated Clark County	232	4	2.93	0.074	3.00	3	1.123	0.077	0.160	-0.468	0.318	1	5
	City of Las Vegas	187	4	2.92	0.079	3.00	3	1.075	-0.064	0.178	-0.514	0.354	1	5
	North Las Vegas	66	4	3.19	0.164	3.00	3	1.326	-0.316	0.296	-0.898	0.583	1	5
	Henderson	78	3	2.95	0.092	3.00	3	0.814	-0.143	0.272	0.652	0.538	1	5
	Boulder City	12	2	2.59	0.294	3.00	3	1.037	-0.312	0.627	-0.825	1.213	1	4

	Mesquite	9	0	3.31	0.514	3.69	5	1.548	-0.523	0.715	-1.050	1.395	1	5
Improving the business climate	Unincorporated Clark County	230	6	3.04	0.071	3.00	3	1.074	-0.123	0.161	-0.307	0.320	1	5
	City of Las Vegas	185	6	3.08	0.078	3.00	3	1.066	-0.090	0.179	-0.340	0.356	1	5
	North Las Vegas	67	2	3.27	0.147	3.00	3	1.203	-0.226	0.292	-0.663	0.576	1	5
	Henderson	78	3	3.29	0.094	3.00	3	0.830	0.002	0.273	0.339	0.540	1	5
	Boulder City	13	1	2.94	0.330	3.00	3	1.203	-0.421	0.611	-0.572	1.180	1	5
	Mesquite	9	0	3.50	0.460	3.20	5	1.383	-0.398	0.715	-0.689	1.395	1	5
Planning for commercial development	Unincorporated Clark County	230	6	3.14	0.078	3.00	3	1.186	-0.138	0.160	-0.658	0.319	1	5
	City of Las Vegas	182	9	3.15	0.082	3.00	3	1.101	-0.176	0.180	-0.538	0.358	1	5
	North Las Vegas	68	2	3.14	0.136	3.00	3	1.121	-0.147	0.291	-0.274	0.575	1	5
	Henderson	78	3	3.09	0.134	3.00	3	1.188	-0.037	0.272	-0.662	0.538	1	5
	Boulder City	12	2	2.72	0.257	3.00	3	0.907	-0.618	0.627	0.219	1.213	1	4
	Mesquite	9	1	3.92	0.390	4.00	5	1.138	-0.556	0.734	-1.027	1.438	2	5
Reducing traffic congestion	Unincorporated Clark County	235	1	2.68	0.083	3.00	3	1.267	0.219	0.159	-1.012	0.316	1	5
	City of Las Vegas	186	5	2.53	0.083	3.00	3	1.128	0.158	0.178	-0.807	0.355	1	5
	North Las Vegas	69	1	2.60	0.158	3.00	3	1.312	0.383	0.289	-0.799	0.571	1	5
	Henderson	81	0	2.43	0.110	2.23	3	0.992	0.131	0.268	-0.581	0.530	1	5
	Boulder City	14	0	2.61	0.314	3.00	3	1.176	-0.011	0.597	-0.659	1.154	1	5
	Mesquite	9	0	3.70	0.499	4.00	5	1.501	-1.156	0.715	0.382	1.395	1	5
Access to freeways	Unincorporated Clark County	236	0	3.24	0.080	3.00	3	1.234	-0.147	0.158	-0.978	0.316	1	5
	City of Las Vegas	187	4	3.09	0.078	3.00	3	1.059	-0.103	0.178	-0.395	0.354	1	5
	North Las Vegas	69	0	3.11	0.132	3.00	3	1.097	0.219	0.288	-0.592	0.569	1	5
	Henderson	79	2	3.48	0.121	4.00	3	1.077	-0.484	0.270	-0.104	0.534	1	5
	Boulder City	12	2	2.98	0.344	3.00	3	1.213	-0.500	0.627	-0.233	1.213	1	5
	Mesquite	9	1	3.88	0.360	4.00	4	1.049	-0.803	0.734	0.174	1.438	2	5
Improving road conditions	Unincorporated Clark County	236	0	3.15	0.077	3.00	4	1.176	-0.282	0.158	-0.756	0.316	1	5
	City of Las Vegas	188	3	3.04	0.087	3.00	3	1.190	-0.135	0.177	-0.809	0.353	1	5
	North Las Vegas	69	0	2.97	0.150	3.00	3	1.248	0.102	0.288	-0.801	0.569	1	5
	Henderson	81	0	3.16	0.107	3.00	3	0.957	-0.214	0.268	-0.452	0.530	1	5
	Boulder City	14	0	3.29	0.294	3.53	4	1.100	-0.400	0.597	-0.427	1.154	1	5

	Mesquite	9	0	3.89	0.369	4.00	5	1.111	-0.572	0.715	-0.793	1.395	2	5
Reducing travel time	Unincorporated Clark County	232	4	2.76	0.077	3.00	3	1.170	0.190	0.160	-0.738	0.318	1	5
	City of Las Vegas	186	5	2.75	0.085	3.00	3	1.158	0.205	0.178	-0.620	0.355	1	5
	North Las Vegas	69	0	2.82	0.152	3.00	3	1.269	0.157	0.288	-0.820	0.569	1	5
	Henderson	79	2	2.83	0.106	3.00	3	0.941	0.000	0.270	0.048	0.534	1	5
	Boulder City	13	1	2.64	0.330	2.74	4	1.197	-0.120	0.613	-1.551	1.185	1	4
	Mesquite	9	0	3.65	0.351	3.87	3	1.055	-0.102	0.715	-0.917	1.395	2	5
Providing mass public transit	Unincorporated Clark County	231	5	2.67	0.084	3.00	3	1.277	0.338	0.160	-0.863	0.319	1	5
	City of Las Vegas	184	6	2.59	0.082	3.00	3	1.116	0.307	0.179	-0.501	0.356	1	5
	North Las Vegas	67	3	2.91	0.153	3.00	3	1.246	0.023	0.294	-0.758	0.579	1	5
	Henderson	75	5	2.72	0.144	3.00	3	1.253	0.158	0.277	-1.000	0.547	1	5
	Boulder City	13	1	2.37	0.341	2.00	1	1.237	0.268	0.613	-1.574	1.185	1	4
	Mesquite	9	0	3.41	0.448	3.48	5	1.348	-0.241	0.715	-1.102	1.395	1	5
Adequate airport facilities	Unincorporated Clark County	227	9	3.71	0.072	4.00	4	1.080	-0.652	0.162	-0.040	0.322	1	5
	City of Las Vegas	184	6	3.51	0.077	4.00	4	1.049	-0.481	0.179	-0.159	0.356	1	5
	North Las Vegas	69	1	3.56	0.138	4.00	4	1.142	-0.516	0.289	-0.366	0.571	1	5
	Henderson	79	1	3.67	0.112	4.00	4	0.998	-0.666	0.270	0.528	0.534	1	5
	Boulder City	14	0	2.93	0.277	3.00	2	1.037	0.226	0.597	-0.366	1.154	1	5
	Mesquite	8	1	3.05	0.496	3.00	3	1.373	-0.026	0.765	-0.384	1.514	1	5
Parks and Recreation Programs	Unincorporated Clark County	231	5	3.53	0.075	4.00	4	1.135	-0.575	0.160	-0.253	0.319	1	5
	City of Las Vegas	182	8	3.53	0.076	4.00	4	1.020	-0.449	0.180	-0.235	0.358	1	5
	North Las Vegas	69	1	3.39	0.137	3.00	3	1.136	-0.058	0.289	-0.818	0.571	1	5
	Henderson	75	6	3.63	0.134	4.00	4	1.160	-0.703	0.277	-0.072	0.548	1	5
	Boulder City	14	0	3.96	0.203	4.00	4	0.760	0.067	0.597	-1.084	1.154	3	5
	Mesquite	9	0	4.00	0.385	4.31	5	1.158	-0.638	0.715	-1.128	1.395	2	5

Appendix III

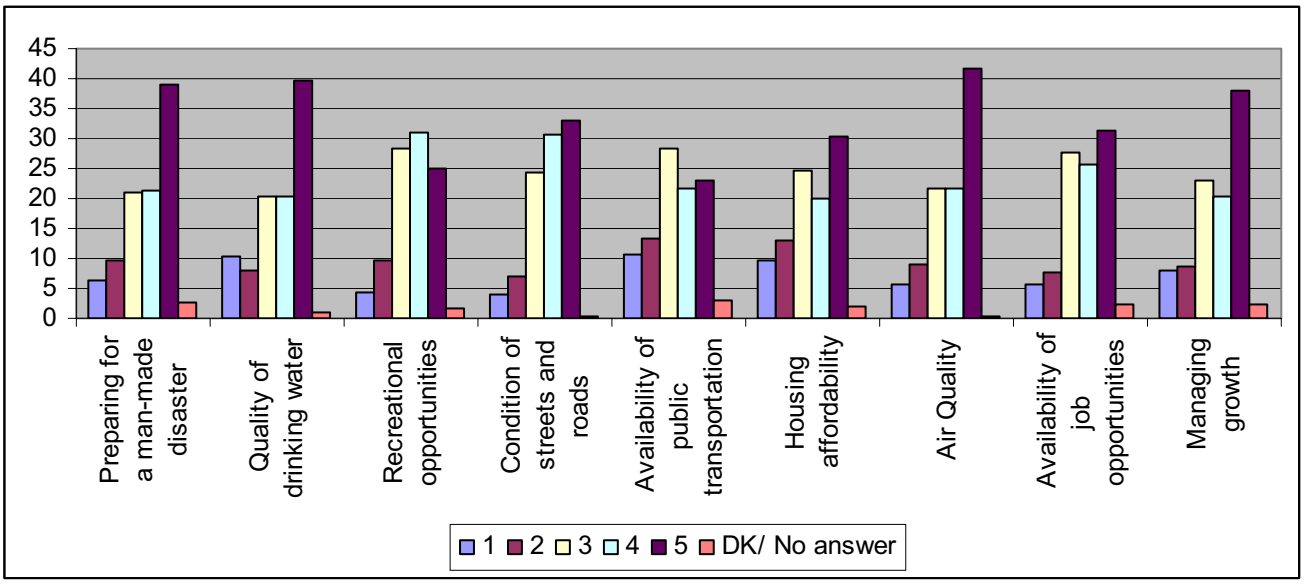
Quality of Life Considerations

Appendix III
Quality of Life Considerations
Summary Statistics

	Overall sense of preparedness in the event of a large scale natural or man made disaster	Quality of drinking water	Recreational opportunities	Condition of streets & roads	Availability of public transportation	Housing affordability	Air quality	Availability of job opportunities	Managing growth
N	600	600	600	600	600	600	600	600	600
Missing	0	0	0	0	0	0	0	0	0
Mean	6.16	4.79	5.16	4.26	6.07	5.42	4.21	5.84	5.78
Median	4.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00
Std. Deviation	14.817	10.071	11.963	6.484	15.931	13.425	5.962	14.085	13.802
Skewness	6.013	9.011	7.591	14.018	5.578	6.707	15.050	6.367	6.496
Std. Error of Skewness	.100	.100	.100	.100	.100	.100	.100	.100	.100
Kurtosis	34.553	81.028	56.334	201.165	29.440	43.595	235.544	38.967	40.737
Std. Error of Kurtosis	.199	.199	.199	.199	.199	.199	.199	.199	.199
Range	97	97	97	97	97	97	97	97	97
Minimum	1	1	1	1	1	1	1	1	1
Maximum	98	98	98	98	98	98	98	98	98

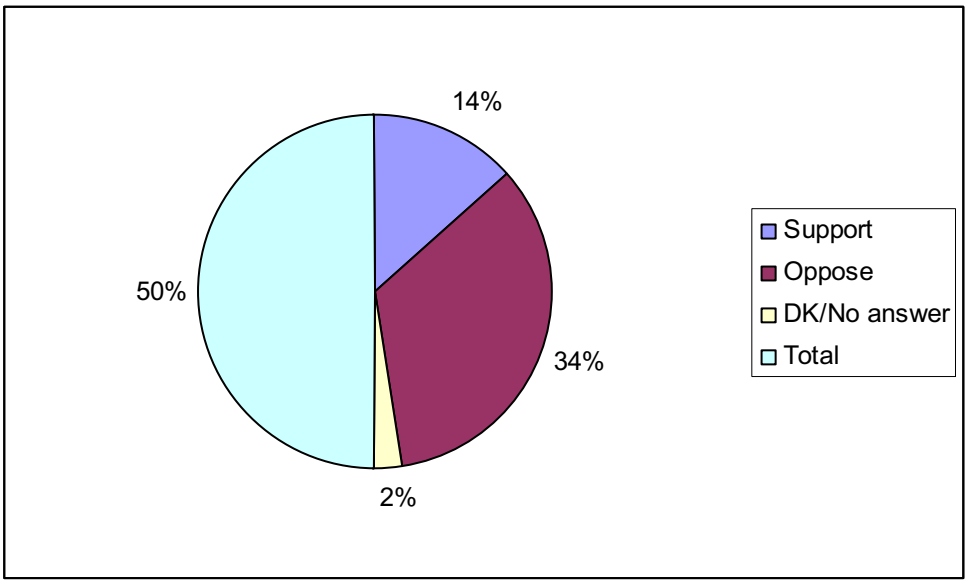
Appendix III
Quality of Life Considerations

	1	2	3	4	5	DK/ No answer	Total
Preparing for a man-made disaster	6.3	9.7	21.0	21.3	39.1	2.5	100.0
Quality of drinking water	10.4	8.0	20.3	20.4	39.7	1.1	100.0
Recreational opportunities	4.5	9.7	28.2	30.8	25.1	1.6	100.0
Condition of streets and roads	4.1	7.1	24.4	30.8	33.1	0.5	100.0
Availability of public transportation	10.8	13.3	28.3	21.8	22.8	2.9	100.0
Housing affordability	9.8	12.9	24.6	20.2	30.5	2.0	100.0
Air Quality	5.8	8.8	21.7	21.6	41.7	0.4	100.0
Availability of job opportunities	5.7	7.6	27.7	25.5	31.2	2.3	100.0
Managing growth	8.0	8.6	23.0	20.4	37.8	2.2	100.0



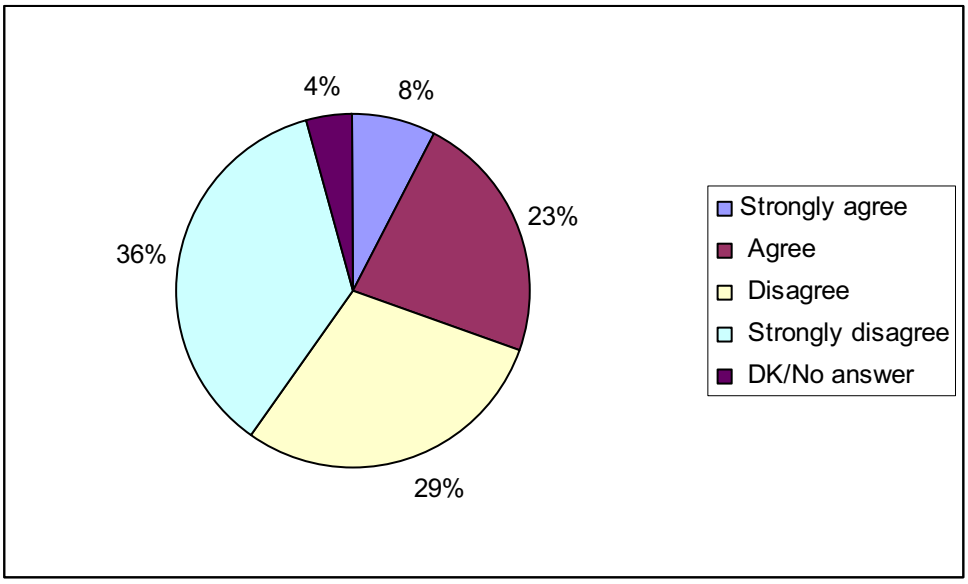
Appendix III
Quality of Life Considerations

The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain. If given the opportunity to vote on this matter, would you support or oppose locating a nuclear waste repository at Yucca Mountain?	Frequency	Percent
Support	163	27.2
Oppose	407	67.9
DK/No answer	29	4.9
Total	600	100.0



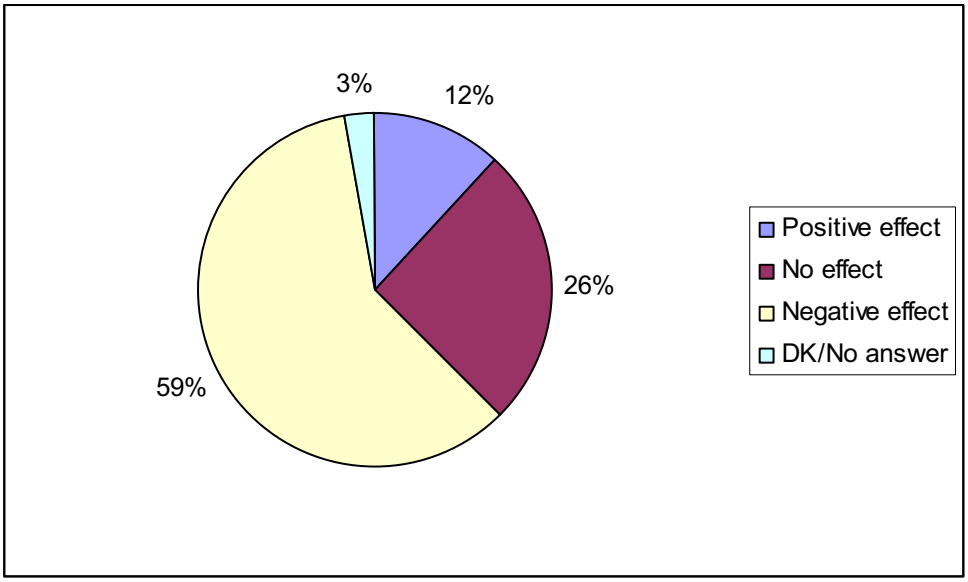
Appendix III
Quality of Life Considerations

The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you agree or disagree with this claim?	Frequency	Percent
Strongly agree	46	7.7
Agree	137	22.8
Disagree	175	29.2
Strongly disagree	217	36.1
DK/No answer	25	4.2
Total	600	100.0



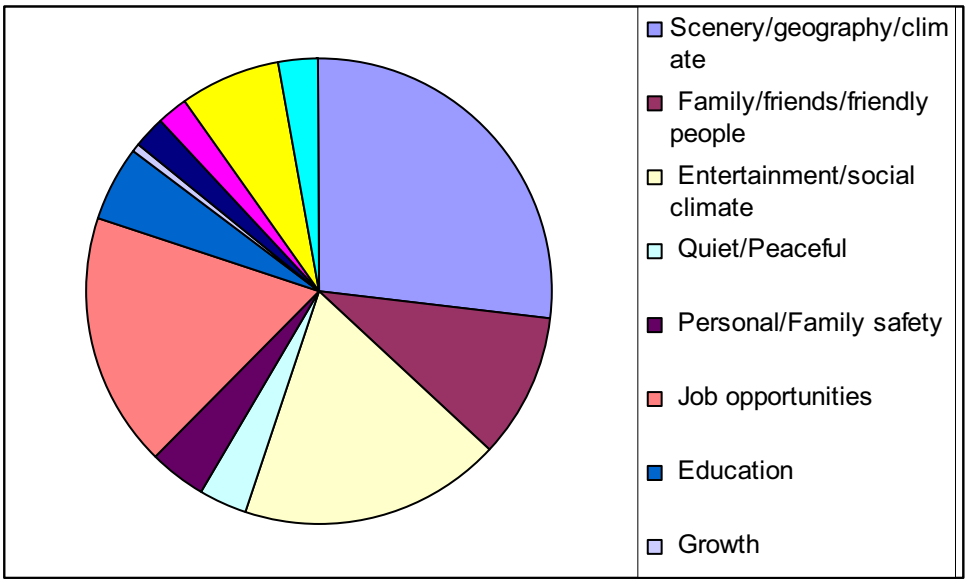
Appendix III
Quality of Life Considerations

Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative effect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.	Frequency	Percent
Positive effect	72	11.9
No effect	153	25.5
Negative effect	359	59.9
DK/No answer	16	2.7
Total	600	100.0



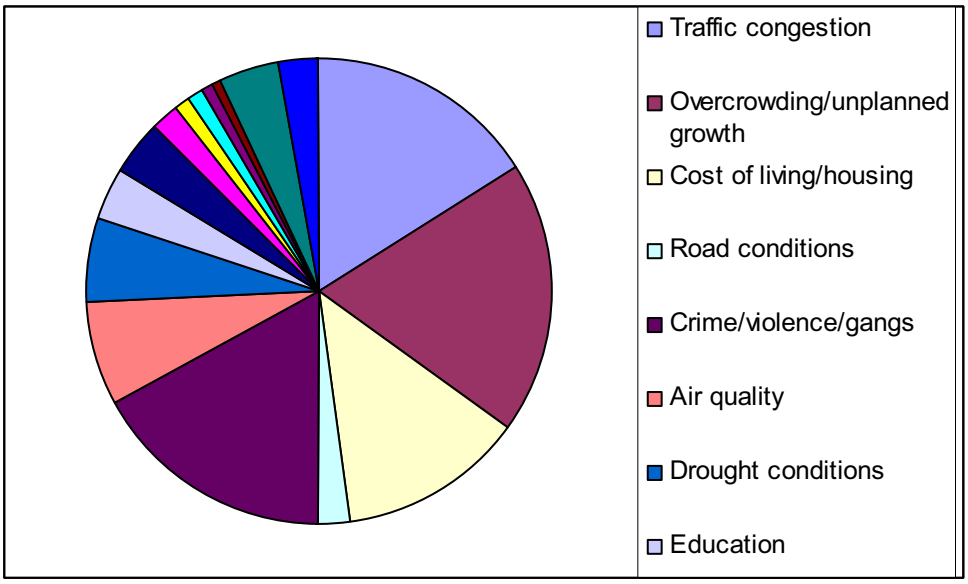
Appendix III
Quality of Life Considerations

Generally speaking, what aspect of living in Clark County, if any, has the greatest positive impact on your quality of life?	Frequency	Percent
Scenery/geography/climate	162	27.0
Family/friends/friendly people	59	9.9
Entertainment/social climate	108	18.0
Quiet/Peaceful	20	3.3
Personal/Family safety	23	3.8
Job opportunities	107	17.9
Education	32	5.3
Growth	3	.6
Low taxes	14	2.4
Strong economy	12	1.9
Nothing	43	7.2
DK/No answer	16	2.7
Total	600	100.0



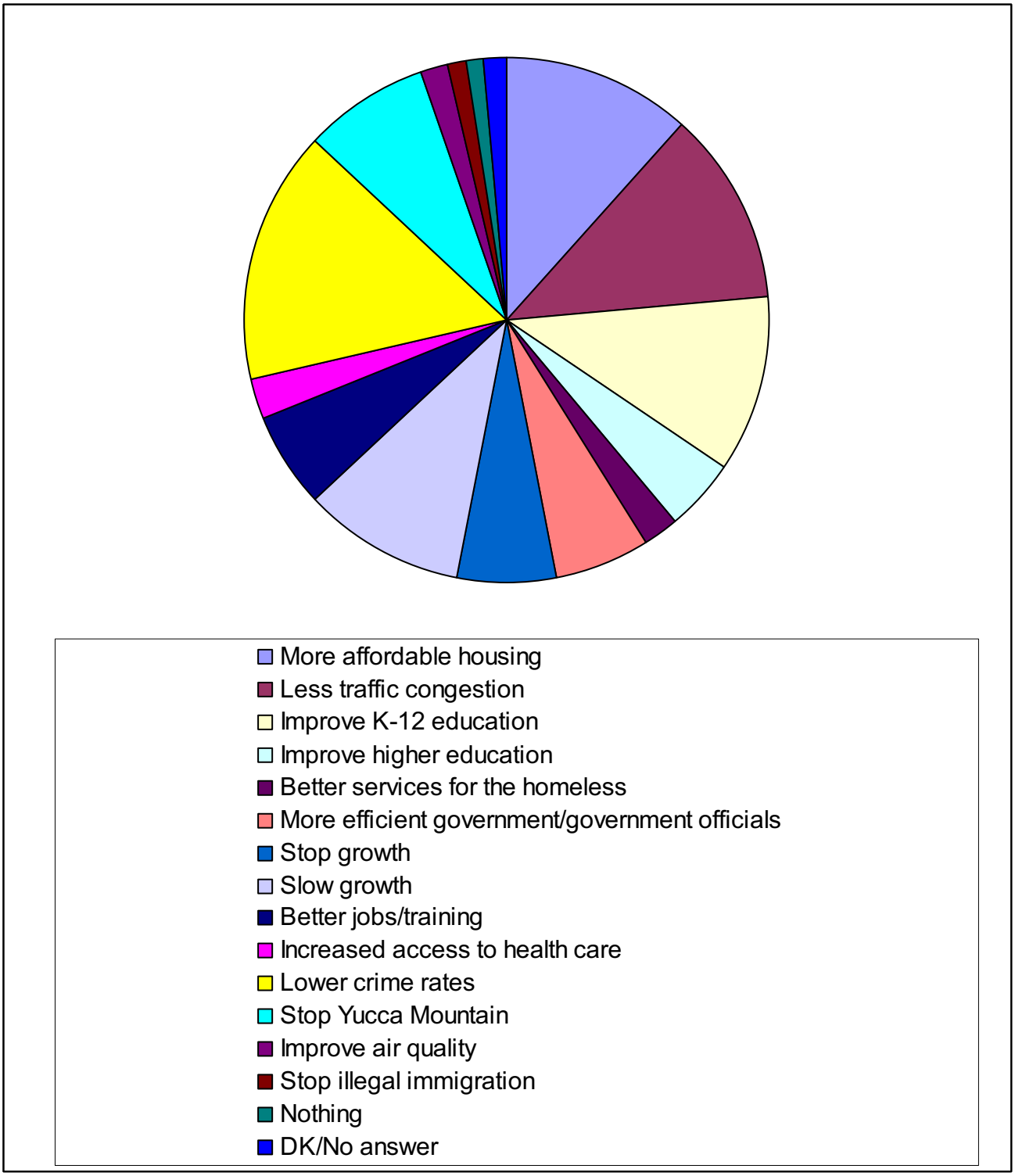
Appendix III
Quality of Life Considerations

Generally speaking, what aspect of living in Clark County, if any, has the greatest negative impact on your quality of life?	Frequency	Percent
Traffic congestion	97	16.2
Overcrowding/unplanned growth	114	19.0
Cost of living/housing	76	12.7
Road conditions	13	2.1
Crime/violence/gangs	103	17.2
Air quality	43	7.1
Drought conditions	35	5.8
Education	22	3.7
Gaming	23	3.8
Illegal immigration	12	2.0
Political corruption	6	.9
Yucca Mountain	7	1.2
Inadequate social services	5	.9
Water quality	3	.5
Nothing	25	4.2
DK/No answer	17	2.8
Total	600	100.0



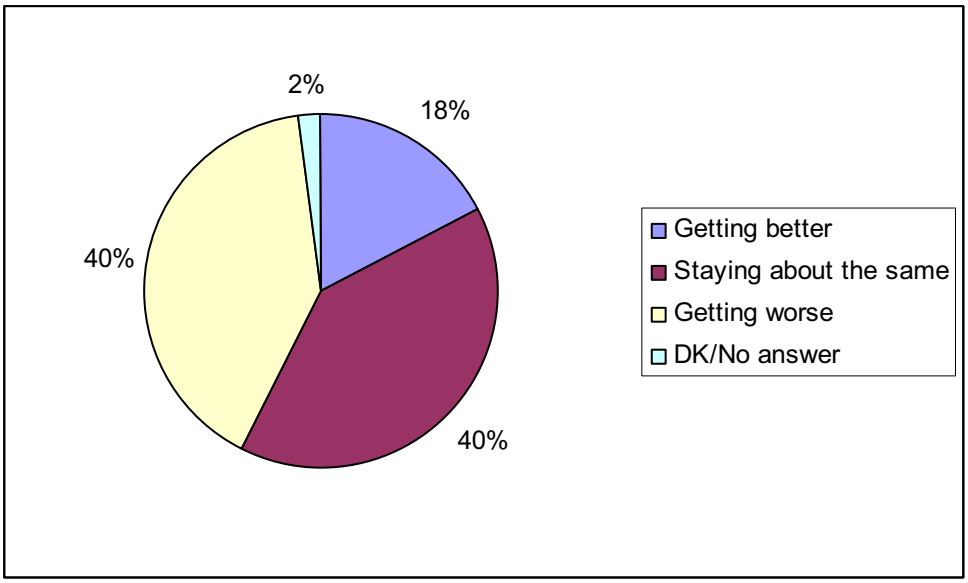
Appendix III
Quality of Life Considerations

In thinking about all of the issues we have talked about today, if you could make one major change locally to improve the quality of life in Clark County, what would it be?	Frequency	Percent
More affordable housing	70	11.6
Less traffic congestion	72	12.0
Improve K-12 education	64	10.7
Improve higher education	28	4.6
Better services for the homeless	13	2.2
More efficient government/government officials	35	5.8
Stop growth	36	6.1
Slow growth	61	10.2
Better jobs/training	34	5.6
Increased access to health care	16	2.6
Lower crime rates	93	15.5
Stop Yucca Mountain	47	7.8
Improve air quality	9	1.4
Stop illegal immigration	7	1.2
Nothing	7	1.2
DK/No answer	8	1.3
Total	600	100.0


More affordable housing
Less traffic congestion
Improve K-12 education
Improve higher education
Better services for the homeless
More efficient government/government officials
Stop growth
Slow growth
Better jobs/training
Increased access to health care
Lower crime rates
Stop Yucca Mountain
Improve air quality
Stop illegal immigration
Nothing
DK/No answer

Appendix III
Quality of Life Considerations

Overall would you say the quality of life in Clark County is getting better, staying the same or getting worse?	Frequency	Percent
Getting better	105	17.6
Staying about the same	238	39.6
Getting worse	246	41.1
DK/No answer	11	1.8
Total	600	100.0



Appendix III
Quality of Life Considerations

Unincorporated Clark County		Overall sense of preparedness in the event of a large scale natural or man made disaster	Quality of drinking water	Recreational opportunities	Condition of streets & roads	Availability of public transportation	Housing affordability	Air quality	Availability of job opportunities	Managing growth
N	Valid	236	236	236	236	236	236	236	236	236
	Missing	0	0	0	0	0	0	0	0	0
Mean		5.77	4.95	4.84	3.81	4.91	4.13	3.87	4.74	4.31
Median		4.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00
Std. Deviation		13.366	10.785	10.488	1.080	12.066	7.377	1.229	9.638	7.362
Skewness		6.758	8.450	8.740	-.691	7.558	12.362	-.819	9.517	12.368
Std. Error of Skewness		.158	.158	.158	.158	.158	.158	.158	.158	.158
Kurtosis		44.440	71.193	75.978	.038	56.328	157.096	-.332	90.699	157.209
Std. Error of Kurtosis		.316	.316	.316	.316	.316	.316	.316	.316	.316
Range		97	97	97	4	97	97	4	97	97
Minimum		1	1	1	1	1	1	1	1	1
Maximum		98	98	98	5	98	98	5	98	98

Appendix III
Quality of Life Considerations

City of Las Vegas		Overall sense of preparedness in the event of a large scale natural or man made disaster	Quality of drinking water	Recreational opportunities	Condition of streets & roads	Availability of public transportation	Housing affordability	Air quality	Availability of job opportunities	Managing growth
N	Valid	191	191	191	191	191	191	191	191	191
	Missing	0	0	0	0	0	0	0	0	0
Mean		7.74	3.70	4.40	4.11	6.11	6.57	4.65	7.63	6.77
Median		4.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00
Std. Deviation		19.084	1.336	8.917	5.243	15.926	17.100	8.725	19.151	16.905
Skewness		4.546	-.701	10.352	17.126	5.623	5.181	10.503	4.538	5.235
Std. Error of Skewness		.176	.176	.176	.176	.176	.176	.176	.176	.176
Kurtosis		18.971	-.676	107.993	310.501	30.137	25.302	111.820	18.882	25.858
Std. Error of Kurtosis		.350	.350	.350	.350	.350	.350	.350	.350	.350
Range		97	4	97	97	97	97	97	97	97
Minimum		1	1	1	1	1	1	1	1	1
Maximum		98	5	98	98	98	98	98	98	98

Appendix III
Quality of Life Considerations

City of North Las Vegas		Overall sense of preparedness in the event of a large scale natural or man made disaster	Quality of drinking water	Recreational opportunities	Condition of streets & roads	Availability of public transportation	Housing affordability	Air quality	Availability of job opportunities	Managing growth
N	Valid	69	69	69	69	69	69	69	69	69
	Missing	0	0	0	0	0	0	0	0	0
Mean		6.63	8.69	7.76	6.78	10.55	7.48	4.65	6.66	10.82
Median		4.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00
Std. Deviation		16.746	21.455	19.522	16.703	25.255	19.119	9.576	15.726	25.415
Skewness		5.395	4.023	4.524	5.411	3.264	4.637	9.756	5.775	3.226
Std. Error of Skewness		.288	.288	.288	.288	.288	.288	.288	.288	.288
Kurtosis		28.133	14.695	19.095	28.245	8.942	20.205	97.779	32.477	8.697
Std. Error of Kurtosis		.569	.569	.569	.569	.569	.569	.569	.569	.569
Range		97	97	97	97	97	97	97	97	97
Minimum		1	1	1	1	1	1	1	1	1
Maximum		98	98	98	98	98	98	98	98	98

Appendix III
Quality of Life Considerations

City of Henderson		Overall sense of preparedness in the event of a large scale natural or man made disaster	Quality of drinking water	Recreational opportunities	Condition of streets & roads	Availability of public transportation	Housing affordability	Air quality	Availability of job opportunities	Managing growth
N	Valid	81	81	81	81	81	81	81	81	81
	Missing	0	0	0	0	0	0	0	0	0
Mean		3.89	3.76	5.05	3.78	5.41	3.53	3.92	4.89	3.88
Median		4.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00
Std. Deviation		1.299	1.348	11.635	1.018	14.610	1.324	1.192	10.819	1.232
Skewness		-.908	-.748	8.000	-.522	6.282	-.469	-.809	8.607	-.757
Std. Error of Skewness		.268	.268	.268	.268	.268	.268	.268	.268	.268
Kurtosis		-.377	-.600	64.132	-.464	38.802	-.901	-.293	74.833	-.540
Std. Error of Kurtosis		.530	.530	.530	.530	.530	.530	.530	.530	.530
Range		4	4	97	4	97	4	4	97	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	98	5	98	5	5	98	5

Appendix III
Quality of Life Considerations

City of Boulder City		Overall sense of preparedness in the event of a large scale natural or man made disaster	Quality of drinking water	Recreational opportunities	Condition of streets & roads	Availability of public transportation	Housing affordability	Air quality	Availability of job opportunities	Managing growth
N	Valid	14	14	14	14	14	14	14	14	14
	Missing	0	0	0	0	0	0	0	0	0
Mean		3.68	3.90	3.59	4.09	8.33	13.69	3.93	2.82	4.07
Median		4.00	4.00	4.00	4.00	3.00	3.95	4.00	3.00	4.71
Std. Deviation		1.123	1.184	1.117	.777	23.478	30.798	1.058	1.175	1.283
Skewness		-.546	-.855	-.541	-.162	4.158	2.791	-.213	-.024	-1.479
Std. Error of Skewness		.597	.597	.597	.597	.597	.597	.597	.597	.597
Kurtosis		.324	.567	.251	-1.190	17.926	6.771	-1.559	-.630	1.583
Std. Error of Kurtosis		1.154	1.154	1.154	1.154	1.154	1.154	1.154	1.154	1.154
Range		4	4	4	2	97	97	3	4	4
Minimum		1	1	1	3	1	1	2	1	1
Maximum		5	5	5	5	98	98	5	5	5

Appendix III
Quality of Life Considerations

City of Mesquite		Overall sense of preparedness in the event of a large scale natural or man made disaster	Quality of drinking water	Recreational opportunities	Condition of streets & roads	Availability of public transportation	Housing affordability	Air quality	Availability of job opportunities	Managing growth
N	Valid	9	9	9	9	9	9	9	9	9
	Missing	0	0	0	0	0	0	0	0	0
Mean		3.75	3.99	12.78	4.14	3.71	3.23	3.57	4.01	3.90
Median		4.00	4.87	4.10	4.00	3.24	3.00	4.00	4.00	4.00
Std. Deviation		1.058	1.467	28.899	.761	1.136	1.140	1.284	.859	.923
Skewness		-.370	-1.372	3.392	-.266	.035	.838	-.946	-.017	.244
Std. Error of Skewness		.715	.715	.715	.715	.715	.715	.715	.715	.715
Kurtosis		-.718	.684	12.251	-.858	-1.564	-.401	.467	-1.669	-1.997
Std. Error of Kurtosis		1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.395
Range		3	4	96	2	3	3	4	2	2
Minimum		2	1	2	3	2	2	1	3	3
Maximum		5	5	98	5	5	5	5	5	5

Appendix IV

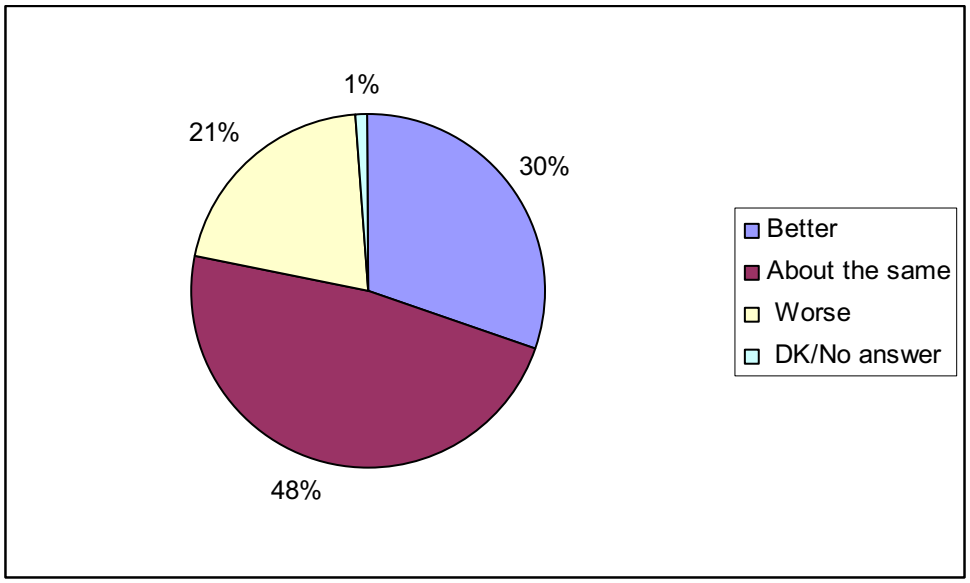
General Economic Considerations

Appendix IV
General Economic Conditions
(Summary Statistics)

		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair or poor?	About a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	600	600	600	600	600
	Missing	0	0	0	0	0
Mean		2.79	3.32	4.61	4.31	5.05
Std. Error of Mean		.376	.509	.614	.632	.744
Median		2.00	2.00	2.00	2.00	2.00
Std. Deviation		9.219	12.470	15.041	15.470	18.215
Skewness		10.203	7.463	6.055	5.902	4.920
Std. Error of Skewness		.100	.100	.100	.100	.100
Kurtosis		103.082	54.056	34.865	33.004	22.302
Std. Error of Kurtosis		.199	.199	.199	.199	.199
Range		97	97	97	97	97
Minimum		1	1	1	1	1
Maximum		98	98	98	98	98

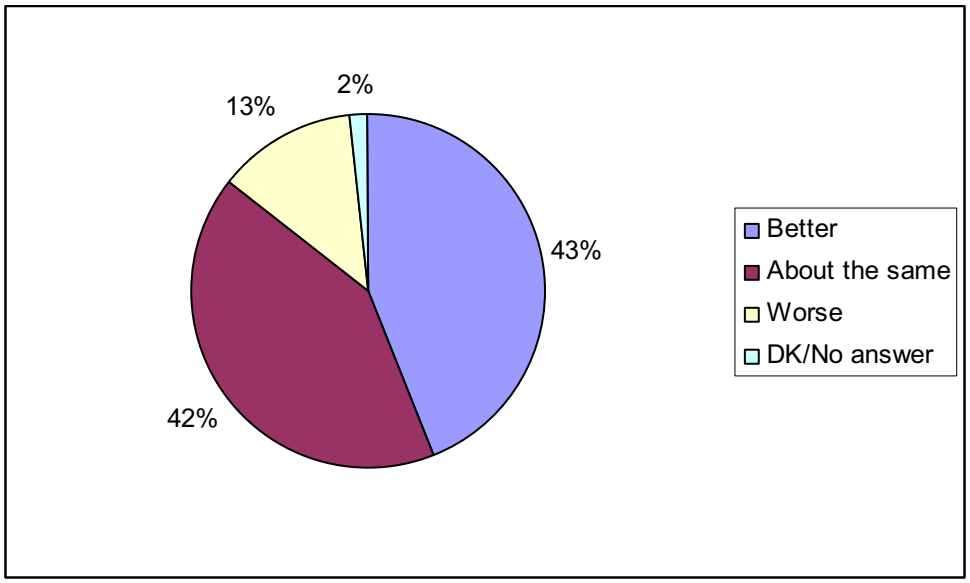
Appendix IV
General Economic Conditions

We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?	Frequency	Percent
Better	182	30.4
About the same	287	47.8
Worse	125	20.9
DK/No answer	6	.9
Total	600	100.0



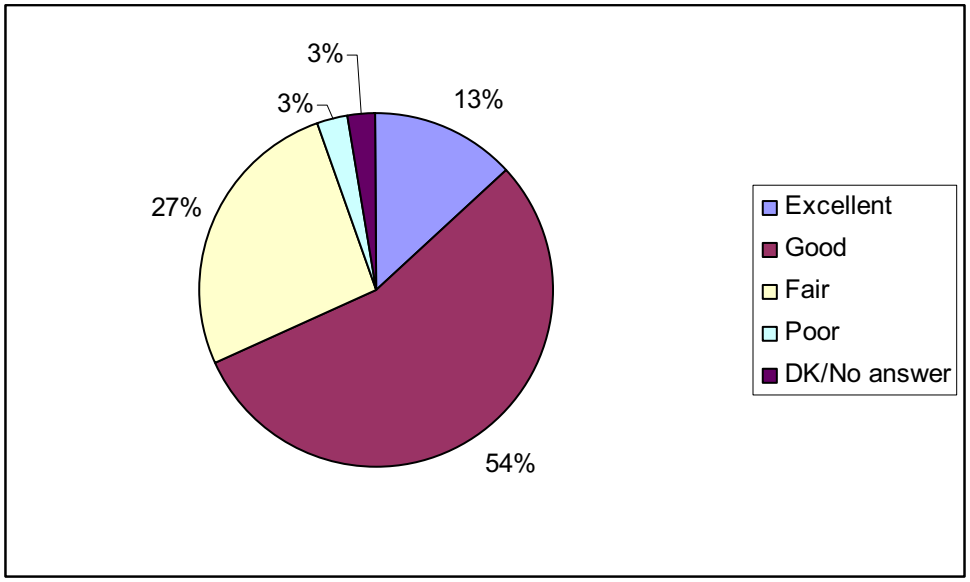
Appendix IV
General Economic Conditions

Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?	Frequency	Percent
Better	263	43.9
About the same	250	41.7
Worse	76	12.7
DK/No answer	10	1.7
Total	600	100.0



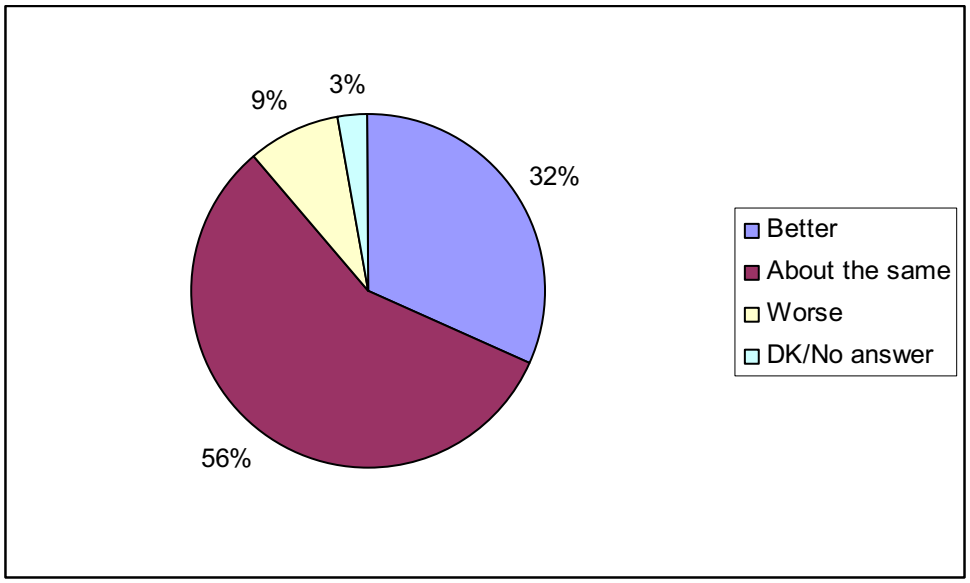
Appendix IV
General Economic Conditions

Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair or poor?	Frequency	Percent
Excellent	80	13.3
Good	327	54.6
Fair	161	26.9
Poor	16	2.7
DK/No answer	15	2.5
Total	600	100.0



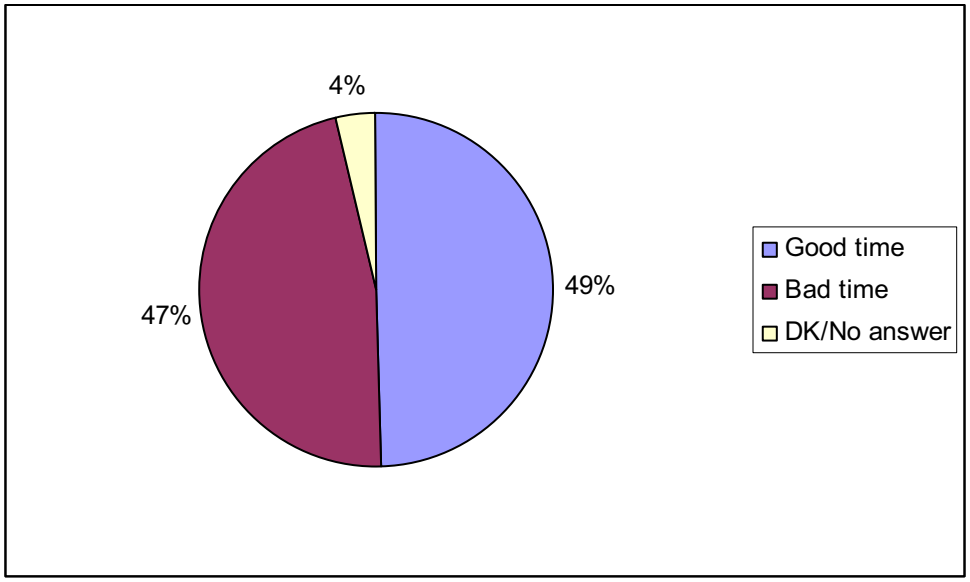
Appendix IV
General Economic Conditions

About a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Frequency	Percent
Better	190	31.7
About the same	343	57.2
Worse	51	8.5
DK/No answer	16	2.6
Total	600	100.0



Appendix IV
General Economic Conditions

Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?	Frequency	Percent
Good time	296	49.3
Bad time	282	47.0
DK/No answer	22	3.7
Total	600	100.0



Appendix IV
General Economic Conditions
Summary Statistics by Jurisdiction

Unincorporated Clark County		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair or poor?	About a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	236	236	236	236	236
	Missing	0	0	0	0	0
Mean		2.68	3.86	4.16	5.73	5.26
Std. Error of Mean		.544	.936	.882	1.254	1.216
Median		2.00	2.00	2.00	2.00	2.00
Std. Deviation		8.353	14.381	13.549	19.269	18.689
Skewness		11.341	6.434	6.821	4.615	4.799
Std. Error of Skewness		.158	.158	.158	.158	.158
Kurtosis		128.619	39.832	45.043	19.485	21.229
Std. Error of Kurtosis		.316	.316	.316	.316	.316
Range		97	97	97	97	97
Minimum		1	1	1	1	1
Maximum		98	98	98	98	98

Appendix IV
General Economic Conditions
Summary Statistics by Jurisdiction

City of Las Vegas		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair or poor?	About a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	191	191	191	191	191
	Missing	0	0	0	0	0
Mean		1.86	2.55	4.00	2.97	4.13
Std. Error of Mean		.052	.656	.945	.766	1.148
Median		2.00	2.00	2.00	2.00	1.00
Std. Deviation		.718	9.050	13.039	10.572	15.849
Skewness		.217	10.504	7.126	8.943	5.810
Std. Error of Skewness		.176	.176	.176	.176	.176
Kurtosis		-1.037	110.112	49.442	79.074	32.129
Std. Error of Kurtosis		.350	.350	.350	.350	.350
Range		2	97	97	97	97
Minimum		1	1	1	1	1
Maximum		3	98	98	98	98

Appendix IV
General Economic Conditions
Summary Statistics by Jurisdiction

City of North Las Vegas		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair or poor?	About a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	69	69	69	69	69
	Missing	0	0	0	0	0
Mean		4.97	5.07	7.81	5.13	7.92
Std. Error of Mean		2.042	2.151	2.695	2.163	2.923
Median		2.00	2.00	2.00	2.00	1.00
Std. Deviation		17.010	17.921	22.450	18.018	24.351
Skewness		5.436	5.135	3.879	5.105	3.533
Std. Error of Skewness		.288	.288	.288	.288	.288
Kurtosis		28.427	25.140	13.455	24.803	10.801
Std. Error of Kurtosis		.569	.569	.569	.569	.569
Range		97	97	97	97	97
Minimum		1	1	1	1	1
Maximum		98	98	98	98	98

Appendix IV
General Economic Conditions
Summary Statistics by Jurisdiction

City of Henderson		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair or poor?	About a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	81	81	81	81	81
	Missing	0	0	0	0	0
Mean		3.72	2.52	5.29	2.61	4.33
Std. Error of Mean		1.476	1.004	1.956	1.002	1.818
Median		2.00	2.00	2.00	2.00	2.00
Std. Deviation		13.257	9.018	17.570	9.001	16.333
Skewness		7.125	10.691	5.211	10.721	5.698
Std. Error of Skewness		.268	.268	.268	.268	.268
Kurtosis		50.194	115.941	25.837	116.376	31.281
Std. Error of Kurtosis		.530	.530	.530	.530	.530
Range		97	97	97	97	97
Minimum		1	1	1	1	1
Maximum		98	98	98	98	98

Appendix IV
General Economic Conditions
Summary Statistics by Jurisdiction

City of Boulder City		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair or poor?	About a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	14	14	14	14	14
	Missing	0	0	0	0	0
Mean		1.75	1.70	2.25	1.95	6.42
Std. Error of Mean		.182	.178	.193	.172	5.831
Median		2.00	2.00	2.00	2.00	2.00
Std. Deviation		.679	.665	.723	.643	21.812
Skewness		.352	.417	.378	.038	4.638
Std. Error of Skewness		.597	.597	.597	.597	.597
Kurtosis		-.515	-.454	.775	-.014	22.794
Std. Error of Kurtosis		1.154	1.154	1.154	1.154	1.154
Range		2	2	3	2	97
Minimum		1	1	1	1	1
Maximum		3	3	4	3	98

Appendix IV
General Economic Conditions
Summary Statistics by Jurisdiction

City of Mesquite		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?	Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?	Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair or poor?	About a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?	Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?
N	Valid	9	9	9	9	9
	Missing	0	0	0	0	0
Mean		1.79	1.51	1.98	7.69	1.23
Std. Error of Mean		.243	.215	.161	8.167	.149
Median		2.00	1.00	2.00	2.00	1.00
Std. Deviation		.732	.648	.484	24.582	.447
Skewness		.369	.957	-.111	4.401	1.539
Std. Error of Skewness		.715	.715	.715	.715	.715
Kurtosis		-.578	.435	4.512	22.411	.403
Std. Error of Kurtosis		1.395	1.395	1.395	1.395	1.395
Range		2	2	2	97	1
Minimum		1	1	1	1	1
Maximum		3	3	3	98	2

Appendix IV
General Economic Conditions
Jurisdiction Cross-Tabulations

Respondent Jurisdiction * We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?

		We are interested in how people are getting along financially these days. Would you say that you, and any family members living with you, are better or worse off financially than you were a year ago, or about the same?				
		Better	About the same	Worse	DK/No answer	Total
Respondent Jurisdiction:	Unincorporated Clark County	61	122	51	2	236
	City of Las Vegas	64	89	37	0	190
	City of North Las Vegas	19	34	14	2	69
	City of Henderson	29	30	20	2	81
	City of Boulder City	5	7	2	0	14
	City of Mesquite	3	4	1	0	8
Total		181	286	125	6	598

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.085(a)	15	.519
Likelihood Ratio	15.067	15	.447
Linear-by-Linear Association	1.069	1	.301
N of Valid Cases	598		

a 11 cells (45.8%) have expected count less than 5. The minimum expected count is .08.

Appendix IV
General Economic Conditions
Jurisdiction Cross-Tabulations

Respondent Jurisdiction * Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?

		Now looking ahead - do you think that a year from now your financial situation, and the financial situation of any family members living with you, will be better, worse or about the same?				
		Better	About the same	Worse	DK/No answer	Total
Respondent Jurisdiction:	Unincorporated Clark County	104	97	30	5	236
	City of Las Vegas	79	86	23	2	190
	City of North Las Vegas	31	26	9	2	68
	City of Henderson	38	30	12	1	81
	City of Boulder City	6	7	1	0	14
	City of Mesquite	5	3	1	0	9
Total		263	249	76	10	598

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.888(a)	15	.993
Likelihood Ratio	5.238	15	.990
Linear-by-Linear Association	.355	1	.551
N of Valid Cases	598		

a 10 cells (41.7%) have expected count less than 5. The minimum expected count is .15.

Appendix IV
General Economic Conditions
Jurisdiction Cross-Tabulations

Respondent Jurisdiction: * Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair or poor?

		Now turning to business conditions in Clark County, would you say that business conditions in Clark County are excellent, good, fair or poor?					
		Excellent	Good	Fair	Poor	DK/No answer	Total
Respondent Jurisdiction:	Unincorporated Clark County	32	122	73	5	5	237
	City of Las Vegas	22	110	49	6	4	191
	City of North Las Vegas	8	31	23	3	4	69
	City of Henderson	15	49	11	2	3	80
	City of Boulder City	2	8	4	1	0	15
	City of Mesquite	1	7	1	0	0	9
Total		80	327	161	17	16	601

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.592(a)	20	.422
Likelihood Ratio	21.550	20	.365
Linear-by-Linear Association	.320	1	.572
N of Valid Cases	601		

a 13 cells (43.3%) have expected count less than 5. The minimum expected count is .24.

Appendix IV
General Economic Conditions
Jurisdiction Cross-Tabulations

Respondent Jurisdiction: * About a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?

		About a year from now, do you expect that business conditions in Clark County will be better than they are today, worse than they are today, or about the same as they are today?				
		Better	About the same	Worse	DK/No answer	Total
Respondent Jurisdiction:	Unincorporated Clark County	77	133	16	10	236
	City of Las Vegas	57	112	20	2	191
	City of North Las Vegas	24	39	4	2	69
	City of Henderson	26	46	8	1	81
	City of Boulder City	3	9	2	0	14
	City of Mesquite	3	5	1	1	10
Total		190	344	51	16	601

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.430(a)	15	.722
Likelihood Ratio	11.363	15	.726
Linear-by-Linear Association	.652	1	.419
N of Valid Cases	601		

a 8 cells (33.3%) have expected count less than 5. The minimum expected count is .27.

Appendix IV
General Economic Conditions
Jurisdiction Cross-Tabulations

Respondent Jurisdiction: * Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?

		Generally speaking, do you think now is a good time or a bad time to buy a single-family home in Clark County?			
		Good time	Bad time	DK/No answer	Total
Respondent Jurisdiction:	Unincorporated Clark County	112	115	9	236
	City of Las Vegas	98	87	5	190
	City of North Las Vegas	37	28	5	70
	City of Henderson	37	41	2	80
	City of Boulder City	5	8	1	14
	City of Mesquite	7	2	0	9
Total		296	281	22	599

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.380(a)	10	.496
Likelihood Ratio	9.339	10	.500
Linear-by-Linear Association	.003	1	.959
N of Valid Cases	599		

a 6 cells (33.3%) have expected count less than 5. The minimum expected count is .33.

Appendix V

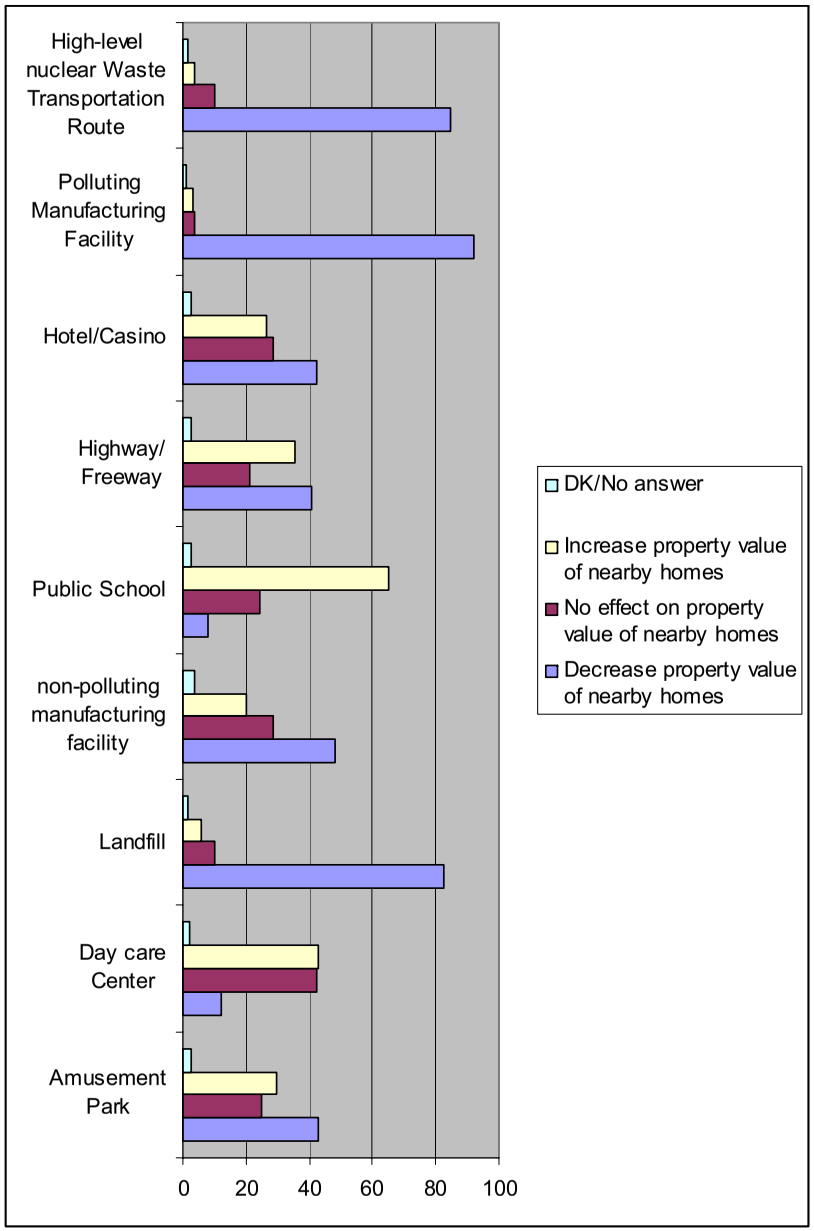
Property Value Considerations

Appendix V
Property Value Conditions
(Summary Statistics)

		Amusement park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/ freeway	Hotel-casino	Polluting manufacturing facility	High-level nuclear waste transportation route
N	Valid	600	600	600	600	600	600	600	600	600
	Missing	0	0	0	0	0	0	0	0	0
Mean		4.63	4.53	2.70	5.15	4.83	4.38	4.47	2.15	2.76
Std. Error of Mean		.657	.589	.486	.731	.592	.617	.642	.411	.502
Median		2.00	2.00	1.00	2.00	3.00	2.00	2.00	1.00	1.00
Std. Deviation		16.102	14.429	11.896	17.896	14.487	15.119	15.730	10.064	12.287
Skewness		5.629	6.330	7.896	5.003	6.284	6.030	5.781	9.436	7.636
Std. Error of Skewness		.100	.100	.100	.100	.100	.100	.100	.100	.100
Kurtosis		29.881	38.293	60.686	23.158	37.703	34.614	31.624	87.474	56.589
Std. Error of Kurtosis		.199	.199	.199	.199	.199	.199	.199	.199	.199
Range		97	97	97	97	97	97	97	97	97
Minimum		1	1	1	1	1	1	1	1	1
Maximum		98	98	98	98	98	98	98	98	98

Appendix V
Property Value Conditions

	Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	DK/No answer	Total
Amusement Park	42.6	24.7	29.8	2.9	100.0
Day care Center	12.3	42.5	42.9	2.3	100.0
Landfill	82.6	10.1	5.7	1.5	100.0
non-polluting manufacturing facility	48.0	28.5	19.9	3.6	100.0
Public School	8.2	24.3	65.2	2.4	100.0
Highway/ Freeway	40.8	21.2	35.5	2.5	100.0
Hotel/Casino	42.3	28.4	26.5	2.7	100.0
Polluting Manufacturing Facility	92.2	3.6	3.2	1.1	100.0
High-level nuclear Waste Transportation Route	84.4	10.0	3.9	1.6	100.0


High-level nuclear Waste Transportation Route
Polluting Manufacturing Facility
Hotel/Casino
Highway/ Freeway
Public School
non-polluting manufacturing facility
Landfill
Day care Center
Amusement Park
0
20
40
60
80
100
DK/No answer
Increase property value of nearby homes
No effect on property value of nearby homes
Decrease property value of nearby homes

Appendix V
Property Value Conditions
Jurisdiction Cross-Tabulations

Jurisdiction * Amusement park

		Amusement park				Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	DK/No answer	
Respondent Jurisdiction:	Unincorporated Clark County	108	47	74	6	235
	City of Las Vegas	83	52	49	6	190
	City of North Las Vegas	17	22	26	4	69
	City of Henderson	35	22	23	1	81
	City of Boulder City	7	3	4	0	14
	City of Mesquite	6	2	2	0	10
Total		256	148	178	17	599

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.970(a)	15	.264
Likelihood Ratio	19.190	15	.205
Linear-by-Linear Association	.188	1	.665
N of Valid Cases	599		

a 9 cells (37.5%) have expected count less than 5. The minimum expected count is .28.

Appendix V
Property Value Conditions
Jurisdiction Cross-Tabulations

Jurisdiction * Day care center

		Day care center				Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	DK/No answer	
Respondent Jurisdiction:	Unincorporated Clark County	23	109	99	5	236
	City of Las Vegas	28	74	84	4	190
	City of North Las Vegas	7	31	27	4	69
	City of Henderson	10	33	38	0	81
	City of Boulder City	4	5	5	1	15
	City of Mesquite	2	3	4	0	9
Total		74	255	257	14	600

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.528(a)	15	.414
Likelihood Ratio	15.528	15	.414
Linear-by-Linear Association	.000	1	.982
N of Valid Cases	600		

a 9 cells (37.5%) have expected count less than 5. The minimum expected count is .21.

Appendix V
Property Value Conditions
Jurisdiction Cross-Tabulations

Jurisdiction * Landfill

		Landfill				Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	DK/No answer	
Respondent Jurisdiction:	Unincorporated Clark County	198	24	13	2	237
	City of Las Vegas	158	22	7	4	191
	City of North Las Vegas	54	4	8	4	70
	City of Henderson	70	7	4	0	81
	City of Boulder City	11	2	1	0	14
	City of Mesquite	5	3	1	0	9
Total		496	62	34	10	602

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.930(a)	15	.066
Likelihood Ratio	20.892	15	.140
Linear-by-Linear Association	.063	1	.802
N of Valid Cases	602		

a 12 cells (50.0%) have expected count less than 5. The minimum expected count is .15.

Appendix V
Property Value Conditions
Jurisdiction Cross-Tabulations

Jurisdiction * Non-polluting manufacturing facility

		Non-polluting manufacturing facility				
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	DK/No answer	Total
Respondent Jurisdiction:	Unincorporated Clark County	104	70	55	8	237
	City of Las Vegas	99	56	31	5	191
	City of North Las Vegas	25	20	21	4	70
	City of Henderson	49	19	10	3	81
	City of Boulder City	7	3	2	1	13
	City of Mesquite	4	4	2	0	10
Total		288	172	121	21	602

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.930(a)	15	.217
Likelihood Ratio	18.995	15	.214
Linear-by-Linear Association	.137	1	.711
N of Valid Cases	602		

a 9 cells (37.5%) have expected count less than 5. The minimum expected count is .35.

Appendix V
Property Value Conditions
Jurisdiction Cross-Tabulations

Jurisdiction * Public school

		Public school				Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	DK/No answer	
Respondent Jurisdiction:	Unincorporated Clark County	22	55	157	2	236
	City of Las Vegas	20	41	124	6	191
	City of North Las Vegas	4	15	46	4	69
	City of Henderson	2	25	51	2	80
	City of Boulder City	1	5	8	0	14
	City of Mesquite	1	4	4	0	9
Total		50	145	390	14	599

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.695(a)	15	.279
Likelihood Ratio	18.667	15	.229
Linear-by-Linear Association	.929	1	.335
N of Valid Cases	599		

a 9 cells (37.5%) have expected count less than 5. The minimum expected count is .21.

Appendix V
Property Value Conditions
Jurisdiction Cross-Tabulations

Jurisdiction * Highway/freeway

		Highway/freeway				Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	DK/No answer	
Respondent Jursidiction:	Unincorporated Clark County	102	47	84	4	237
	City of Las Vegas	77	36	72	6	191
	City of North Las Vegas	25	14	26	4	69
	City of Henderson	29	25	25	2	81
	City of Boulder City	9	1	4	0	14
	City of Mesquite	4	3	2	0	9
Total		246	126	213	16	601

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.009(a)	15	.451
Likelihood Ratio	14.815	15	.465
Linear-by-Linear Association	.172	1	.678
N of Valid Cases	601		

a 9 cells (37.5%) have expected count less than 5. The minimum expected count is .24.

Appendix V
Property Value Conditions
Jurisdiction Cross-Tabulations

Jurisdiction * Hotel-casino

		Hotel-casino				Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	DK/No answer	
Respondent Jursidiction:	Unincorporated Clark County	95	63	76	3	237
	City of Las Vegas	84	51	47	8	190
	City of North Las Vegas	24	20	21	5	70
	City of Henderson	37	30	14	0	81
	City of Boulder City	10	4	0	0	14
	City of Mesquite	4	3	2	0	9
Total		254	171	160	16	601

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	28.314(a)	15	.020
Likelihood Ratio	32.908	15	.005
Linear-by-Linear Association	.012	1	.912
N of Valid Cases	601		

a 9 cells (37.5%) have expected count less than 5. The minimum expected count is .24.

Appendix V
Property Value Conditions
Jurisdiction Cross-Tabulations

Jurisdiction * Polluting manufacturing facility

		Polluting manufacturing facility				Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	DK/No answer	
Respondent Jursidiction:	Unincorporated Clark County	220	9	6	0	235
	City of Las Vegas	176	6	7	1	190
	City of North Las Vegas	59	4	3	5	71
	City of Henderson	76	2	3	1	82
	City of Boulder City	13	1	0	0	14
	City of Mesquite	9	0	0	0	9
Total		553	22	19	7	601

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	29.002(a)	15	.016
Likelihood Ratio	21.669	15	.117
Linear-by-Linear Association	3.605	1	.058
N of Valid Cases	601		

a 14 cells (58.3%) have expected count less than 5. The minimum expected count is .10.

Appendix V
Property Value Conditions
Jurisdiction Cross-Tabulations

Jurisdiction * High-level nuclear waste transportation route

		High-level nuclear waste transportation route				Total
		Decrease property value of nearby homes	No effect on property value of nearby homes	Increase property value of nearby homes	DK/No answer	
Respondent Jurisdiction:	Unincorporated Clark County	205	22	7	2	236
	City of Las Vegas	162	16	9	3	190
	City of North Las Vegas	52	7	6	4	69
	City of Henderson	66	13	2	0	81
	City of Boulder City	13	1	0	0	14
	City of Mesquite	8	1	0	0	9
Total		506	60	24	9	599

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.532(a)	15	.121
Likelihood Ratio	19.322	15	.200
Linear-by-Linear Association	.078	1	.780
N of Valid Cases	599		

a 12 cells (50.0%) have expected count less than 5. The minimum expected count is .14.

Appendix V
Property Value Conditions
Summary Statistics by Jurisdiction

Unincorporated Clark County		Amusement park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/ freeway	Hotel-casino	Polluting manufacturing facility	High-level nuclear waste transportation route
N	Valid	236	236	236	236	236	236	236	236	236
	Missing	0	0	0	0	0	0	0	0	0
Mean		4.37	4.22	2.05	4.86	3.42	3.57	3.20	1.09	2.00
Std. Error of Mean		1.003	.871	.588	1.105	.582	.816	.720	.024	.588
Median		2.00	2.00	1.00	2.00	3.00	2.00	2.00	1.00	1.00
Std. Deviation		15.419	13.379	9.035	16.982	8.938	12.532	11.062	.376	9.036
Skewness		5.939	6.909	10.579	5.336	10.520	7.428	8.475	4.168	10.597
Std. Error of Skewness		.158	.158	.158	.158	.158	.158	.158	.158	.158
Kurtosis		33.677	46.248	111.246	26.768	110.232	53.921	70.873	17.008	111.495
Std. Error of Kurtosis		.316	.316	.316	.316	.316	.316	.316	.316	.316
Range		97	97	97	97	97	97	97	2	97
Minimum		1	1	1	1	1	1	1	1	1
Maximum		98	98	98	98	98	98	98	3	98

Appendix V
Property Value Conditions
Summary Statistics by Jurisdiction

City of Las Vegas		Amusement park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/ freeway	Hotel-casino	Polluting manufacturing facility	High-level nuclear waste transportation route
N	Valid	191	191	191	191	191	191	191	191	191
	Missing	0	0	0	0	0	0	0	0	0
Mean		4.96	4.51	2.97	4.23	5.41	4.99	5.98	1.75	2.94
Std. Error of Mean		1.244	1.045	.945	1.135	1.179	1.218	1.426	.571	.940
Median		2.00	2.00	1.00	1.00	3.00	2.00	2.00	1.00	1.00
Std. Deviation		17.168	14.428	13.041	15.670	16.271	16.809	19.691	7.884	12.970
Skewness		5.278	6.377	7.216	5.865	5.564	5.395	4.499	12.221	7.259
Std. Error of Skewness		.176	.176	.176	.176	.176	.176	.176	.176	.176
Kurtosis		26.208	39.188	50.677	32.832	29.329	27.483	18.476	149.339	51.308
Std. Error of Kurtosis		.350	.350	.350	.350	.350	.350	.350	.350	.350
Range		97	97	97	97	97	97	97	97	97
Minimum		1	1	1	1	1	1	1	1	1
Maximum		98	98	98	98	98	98	98	98	98

Appendix V
Property Value Conditions
Summary Statistics by Jurisdiction

City of North Las Vegas		Amusement park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/ freeway	Hotel-casino	Polluting manufacturing facility	High-level nuclear waste transportation route
N	Valid	69	69	69	69	69	69	69	69	69
	Missing	0	0	0	0	0	0	0	0	0
Mean		7.13	8.20	6.34	7.85	8.53	6.99	8.87	7.50	7.24
Std. Error of Mean		2.576	2.782	2.598	2.793	2.771	2.576	3.005	2.903	2.811
Median		2.00	2.00	1.00	2.00	3.00	2.00	2.00	1.00	1.00
Std. Deviation		21.456	23.170	21.640	23.268	23.085	21.461	25.031	24.180	23.418
Skewness		4.115	3.725	4.118	3.723	3.726	4.120	3.377	3.581	3.726
Std. Error of Skewness		.288	.288	.288	.288	.288	.288	.288	.288	.288
Kurtosis		15.404	12.245	15.418	12.231	12.250	15.450	9.702	11.152	12.247
Std. Error of Kurtosis		.569	.569	.569	.569	.569	.569	.569	.569	.569
Range		97	97	97	97	97	97	97	97	97
Minimum		1	1	1	1	1	1	1	1	1
Maximum		98	98	98	98	98	98	98	98	98

Appendix V
Property Value Conditions
Summary Statistics by Jurisdiction

City of Henderson		Amusement park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/ freeway	Hotel-casino	Polluting manufacturing facility	High-level nuclear waste transportation route
N	Valid	81	81	81	81	81	81	81	81	81
	Missing	0	0	0	0	0	0	0	0	0
Mean		3.31	2.35	1.19	5.30	5.11	3.79	1.71	1.92	1.20
Std. Error of Mean		1.318	.077	.057	2.108	1.702	1.475	.083	1.008	.050
Median		2.00	2.00	1.00	1.00	3.00	2.00	2.00	1.00	1.00
Std. Deviation		11.836	.687	.511	18.938	15.290	13.250	.743	9.052	.452
Skewness		8.035	-.590	2.703	4.805	6.055	7.120	.524	10.769	2.210
Std. Error of Skewness		.268	.268	.268	.268	.268	.268	.268	.268	.268
Kurtosis		64.505	-.730	6.399	21.663	35.598	50.149	-1.007	117.082	4.366
Std. Error of Kurtosis		.530	.530	.530	.530	.530	.530	.530	.530	.530
Range		97	2	2	97	97	97	2	97	2
Minimum		1	1	1	1	1	1	1	1	1
Maximum		98	3	3	98	98	98	3	98	3

Appendix V
Property Value Conditions
Summary Statistics by Jurisdiction

City of Boulder City		Amusement park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/ freeway	Hotel-casino	Polluting manufacturing facility	High-level nuclear waste transportation route
N	Valid	14	14	14	14	14	14	14	14	14
	Missing	0	0	0	0	0	0	0	0	0
Mean		1.73	5.92	1.30	10.24	2.49	1.68	1.26	1.05	1.05
Std. Error of Mean		.234	5.220	.173	7.660	.178	.249	.122	.060	.060
Median		1.12	2.00	1.00	1.01	3.00	1.00	1.00	1.00	1.00
Std. Deviation		.876	19.527	.646	28.655	.664	.933	.455	.226	.226
Skewness		.608	5.262	2.167	3.217	-.986	.755	1.232	4.642	4.642
Std. Error of Skewness		.597	.597	.597	.597	.597	.597	.597	.597	.597
Kurtosis		-1.453	30.070	3.959	9.744	.141	-1.514	-.589	22.821	22.821
Std. Error of Kurtosis		1.154	1.154	1.154	1.154	1.154	1.154	1.154	1.154	1.154
Range		2	97	2	97	2	2	1	1	1
Minimum		1	1	1	1	1	1	1	1	1
Maximum		3	98	3	98	3	3	2	2	2

Appendix V
Property Value Conditions
Summary Statistics by Jurisdiction

City of Mesquite		Amusement park	Day care center	Landfill	Non-polluting manufacturing facility	Public school	Highway/ freeway	Hotel-casino	Polluting manufacturing facility	High-level nuclear waste transportation route
N	Valid	9	9	9	9	9	9	9	9	9
	Missing	0	0	0	0	0	0	0	0	0
Mean		1.59	2.22	1.52	1.79	2.34	1.83	1.72	1.00	1.13
Std. Error of Mean		.286	.279	.244	.254	.225	.274	.277	.000	.120
Median		1.00	2.03	1.00	2.00	2.00	2.00	1.59	1.00	1.00
Std. Deviation		.860	.839	.736	.765	.678	.826	.834	.000	.362
Skewness		1.046	-.500	1.169	.407	-.526	.377	.655		2.591
Std. Error of Skewness		.715	.715	.715	.715	.715	.715	.715	.715	.715
Kurtosis		-.641	-1.318	.464	-.837	-.186	-1.319	-1.122		6.023
Std. Error of Kurtosis		1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.395
Range		2	2	2	2	2	2	2	0	1
Minimum		1	1	1	1	1	1	1	1	1
Maximum		3	3	3	3	3	3	3	1	2

Appendix VI

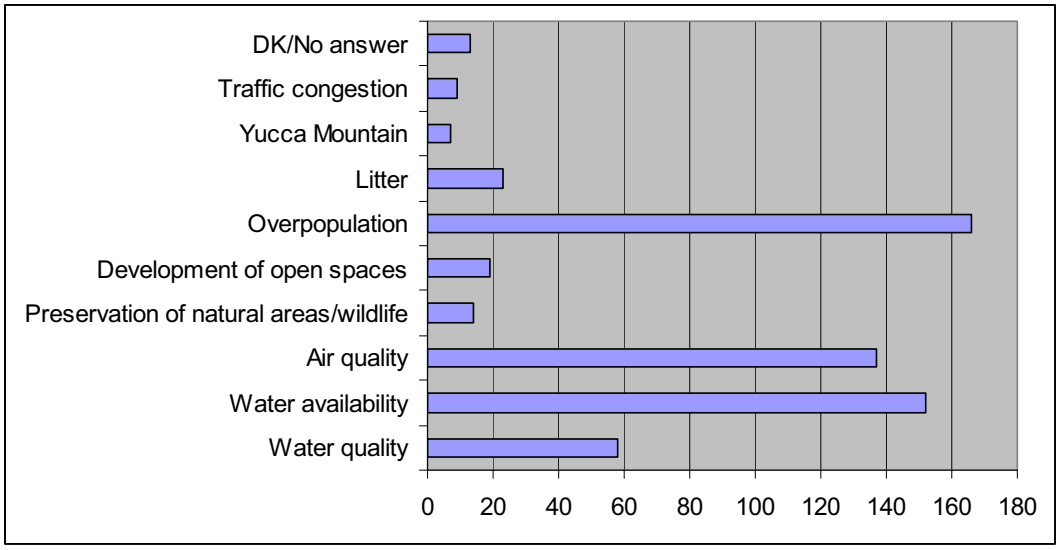
Environmental Considerations

Appendix VI
Environmental Considerations
Summary Statistics

		In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?	How would you rate local government's performance in preserving natural resources in Clark County?	Which of the following best describes your level of concern, if any, about the current drought in Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	600	600	600	600	600
	Missing	0	0	0	0	0
Mean		5.86	4.28	2.19	3.97	3.28
Std. Error of Mean		.567	.503	.269	.378	.197
Median		3.00	3.00	2.00	3.00	3.00
Std. Deviation		13.876	12.312	6.584	9.258	4.821
Skewness		6.356	7.467	14.297	9.984	19.183
Std. Error of Skewness		.100	.100	.100	.100	.100
Kurtosis		39.554	54.237	206.435	99.113	376.503
Std. Error of Kurtosis		.199	.199	.199	.199	.199
Minimum		1	1	1	1	1
Maximum		98	98	98	98	98

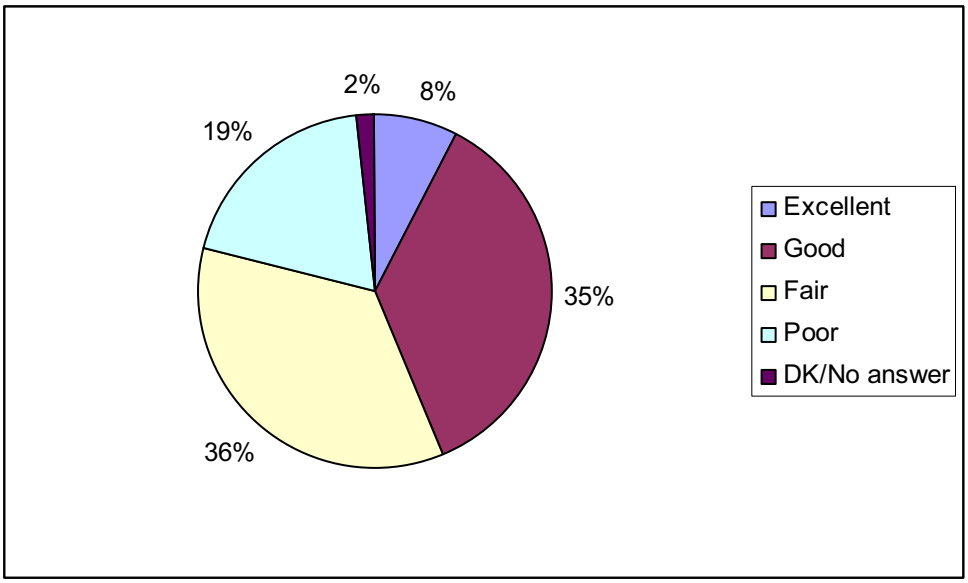
Appendix VI
Environmental Considerations

In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?	Frequency	Percent
Water quality	58	9.7
Water availability	152	25.3
Air quality	137	22.9
Preservation of natural areas/wildlife	14	2.4
Development of open spaces	19	3.1
Overpopulation	166	27.8
Litter	23	3.8
Yucca Mountain	7	1.2
Traffic congestion	9	1.6
DK/No answer	13	2.2
Total	600	100.0



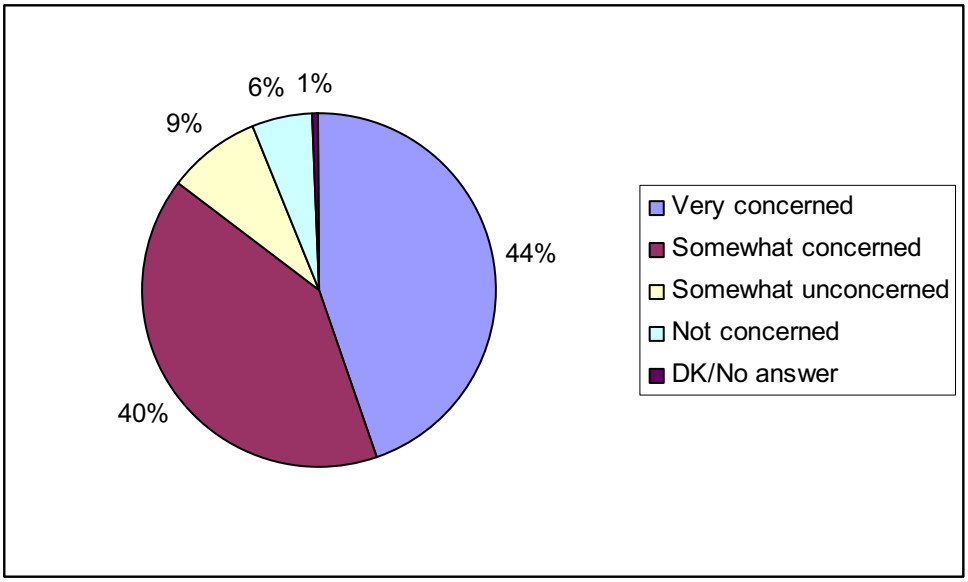
Appendix VI
Environmental Considerations

How would you rate local government's performance in preserving natural resources in Clark County?	Frequency	Percent
Excellent	46	7.7
Good	215	35.8
Fair	213	35.6
Poor	116	19.3
DK/No answer	10	1.7
Total	600	100.0



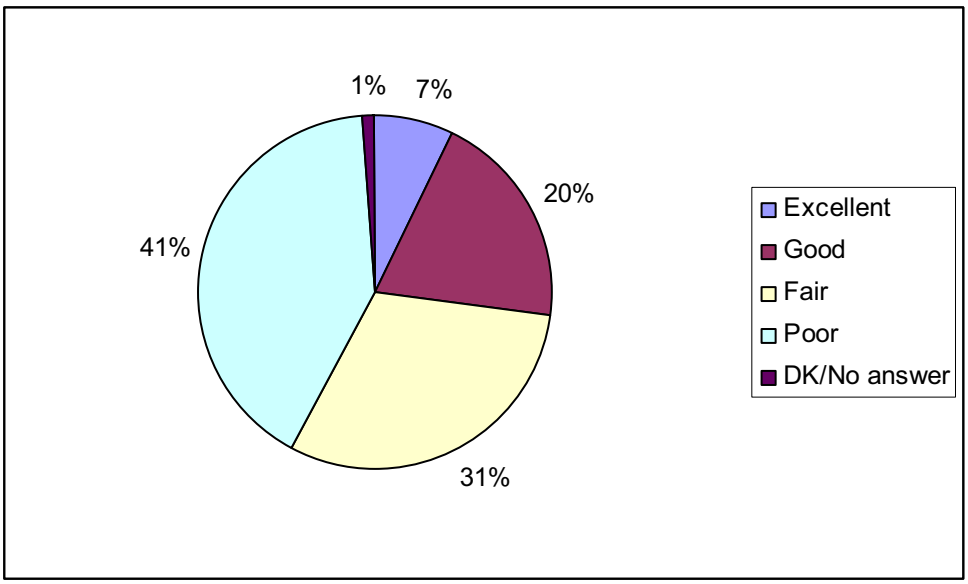
Appendix VI
Environmental Considerations

Which of the following best describes your level of concern, if any, about the current drought in Clark County?	Frequency	Percent
Very concerned	268	44.7
Somewhat concerned	244	40.6
Somewhat unconcerned	51	8.5
Not concerned	34	5.6
DK/No answer	3	.5
Total	600	100.0



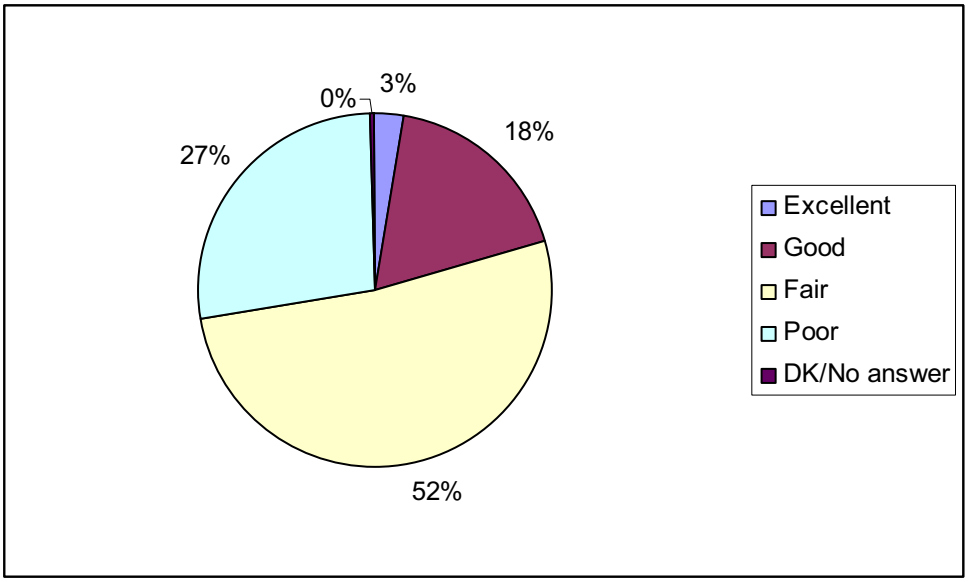
Appendix VI
Environmental Considerations

In general, how would you rate the quality of Clark County's drinking water?	Frequency	Percent
Excellent	43	7.1
Good	120	20.0
Fair	184	30.7
Poor	247	41.2
DK/No answer	6	.9
Total	600	100.0



Appendix VI
Environmental Considerations

In general, how would you rate Clark County's air quality?	Frequency	Percent
Excellent	16	2.7
Good	108	18.0
Fair	310	51.7
Poor	164	27.3
DK/No answer	2	.3
Total	600	100.0



Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

Unincorporated Clark County		In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?	How would you rate local government's performance in preserving natural resources in Clark County?	Which of the following best describes your level of concern, if any, about the current drought in Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	236	236	236	236	236
	Missing	0	0	0	0	0
Mean		5.09	4.09	2.03	4.96	3.07
Std. Error of Mean		.724	.760	.310	.881	.048
Median		3.00	3.00	2.00	3.00	3.00
Std. Deviation		11.131	11.686	4.766	13.534	.733
Skewness		7.996	7.944	19.609	6.753	-.380
Std. Error of Skewness		.158	.158	.158	.158	.158
Kurtosis		64.939	61.921	398.546	44.222	-.276
Std. Error of Kurtosis		.316	.316	.316	.316	.316
Minimum		1	1	1	1	1
Maximum		98	98	98	98	4

Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

City of Las Vegas		In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?	How would you rate local government's performance in preserving natural resources in Clark County?	Which of the following best describes your level of concern, if any, about the current drought in Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	191	191	191	191	191
	Missing	0	0	0	0	0
Mean		6.51	4.62	1.68	3.48	2.99
Std. Error of Mean		1.119	.971	.063	.462	.058
Median		3.00	3.00	1.00	3.00	3.00
Std. Deviation		15.443	13.404	.864	6.382	.797
Skewness		5.697	6.863	1.328	14.541	-.542
Std. Error of Skewness		.176	.176	.176	.176	.176
Kurtosis		31.501	45.817	1.214	217.029	-.017
Std. Error of Kurtosis		.350	.350	.350	.350	.350
Minimum		1	1	1	1	1
Maximum		98	98	4	98	4

Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

City of North Las Vegas		In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?	How would you rate local government's performance in preserving natural resources in Clark County?	Which of the following best describes your level of concern, if any, about the current drought in Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	69	69	69	69	69
	Missing	0	0	0	0	0
Mean		7.19	4.09	3.76	3.26	5.16
Std. Error of Mean		2.163	1.412	1.702	.100	1.676
Median		3.00	3.00	2.00	3.00	3.00
Std. Deviation		18.017	11.764	14.174	.830	13.965
Skewness		4.921	8.038	6.678	-1.009	6.676
Std. Error of Skewness		.288	.288	.288	.288	.288
Kurtosis		23.242	64.935	43.968	.529	43.957
Std. Error of Kurtosis		.569	.569	.569	.569	.569
Minimum		1	1	1	1	1
Maximum		98	98	98	4	98

Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

City of Henderson		In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?	How would you rate local government's performance in preserving natural resources in Clark County?	Which of the following best describes your level of concern, if any, about the current drought in Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	81	81	81	81	81
	Missing	0	0	0	0	0
Mean		5.92	4.69	1.79	3.17	3.14
Std. Error of Mean		1.684	1.528	.092	.103	.075
Median		3.00	3.00	2.00	3.00	3.00
Std. Deviation		15.128	13.723	.829	.928	.673
Skewness		5.968	6.791	.909	-.647	-.381
Std. Error of Skewness		.268	.268	.268	.268	.268
Kurtosis		35.156	45.470	.345	-.851	.087
Std. Error of Kurtosis		.530	.530	.530	.530	.530
Minimum		1	1	1	1	1
Maximum		98	98	4	4	4

Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

City of Boulder City		In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?	How would you rate local government's performance in preserving natural resources in Clark County?	Which of the following best describes your level of concern, if any, about the current drought in Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	14	14	14	14	14
	Missing	0	0	0	0	0
Mean		4.03	2.39	6.91	2.78	2.71
Std. Error of Mean		.628	.268	5.802	.294	.211
Median		3.00	2.00	2.00	2.53	2.85
Std. Deviation		2.350	1.003	21.704	1.100	.790
Skewness		.897	.147	4.632	-.057	.603
Std. Error of Skewness		.597	.597	.597	.597	.597
Kurtosis		.742	-.814	22.756	-1.520	-1.027
Std. Error of Kurtosis		1.154	1.154	1.154	1.154	1.154
Minimum		1	1	1	1	2
Maximum		10	4	98	4	4

Appendix VI
Environmental Considerations
Summary Statistics by Jurisdiction

City of Mesquite		In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?	How would you rate local government's performance in preserving natural resources in Clark County?	Which of the following best describes your level of concern, if any, about the current drought in Clark County?	In general, how would you rate the quality of Clark County's drinking water?	In general, how would you rate Clark County's air quality?
N	Valid	9	9	9	9	9
	Missing	0	0	0	0	0
Mean		4.54	2.85	1.72	2.85	2.42
Std. Error of Mean		.733	.311	.307	.404	.312
Median		5.07	2.69	1.80	3.00	2.00
Std. Deviation		2.207	.936	.923	1.216	.939
Skewness		-.089	.370	1.718	-.506	.494
Std. Error of Skewness		.715	.715	.715	.715	.715
Kurtosis		-2.249	-1.994	4.138	-1.346	-.013
Std. Error of Kurtosis		1.395	1.395	1.395	1.395	1.395
Minimum		2	2	1	1	1
Maximum		7	4	4	4	4

Appendix VI
Environmental Considerations
Jurisdictional Cross-tabulations

Jurisdiction: * In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?

		In your opinion, what is the most urgent environmental issue affecting the quality of life in Clark County?										Total
		Water quality	Water availability	Air quality	Preservation of natural areas/wildlife	Development of open spaces	Over population	Litter	Yucca Mountain	Traffic congestion	DK/No answer	
Jurisdiction:	Unincorporated Clark County	25	60	52	4	8	74	4	4	3	3	237
	City of Las Vegas	16	46	44	6	5	49	12	2	5	5	190
	City of North Las Vegas	7	18	16	2	3	17	3	2	0	3	71
	City of Henderson	9	23	20	1	3	20	1	0	1	2	80
	City of Boulder City	1	3	3	1	1	4	1	0	1	0	15
	City of Mesquite	0	2	2	0	0	2	2	0	0	0	8
Total		58	152	137	14	20	166	23	8	10	13	601

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	36.467(a)	45	.814
Likelihood Ratio	34.270	45	.878
Linear-by-Linear Association	.282	1	.596
N of Valid Cases	601		

a 38 cells (63.3%) have expected count less than 5. The minimum expected count is .11.

Jurisdiction: * How would you rate local government's performance in preserving natural resources in Clark County?

		How would you rate local government's performance in preserving natural resources in Clark County?					
		Excellent	Good	Fair	Poor	DK/No answer	Total
Jurisdiction:	Unincorporated Clark County	12	89	99	32	4	236
	City of Las Vegas	15	68	58	45	4	190
	City of North Las Vegas	9	19	26	14	1	69
	City of Henderson	7	28	24	19	2	80
	City of Boulder City	3	5	4	2	0	14
	City of Mesquite	0	4	2	3	0	9
Total		46	213	213	115	11	598

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.824(a)	20	.208
Likelihood Ratio	24.871	20	.206
Linear-by-Linear Association	.004	1	.947
N of Valid Cases	598		

a 14 cells (46.7%) have expected count less than 5. The minimum expected count is .17.

Appendix VI
Environmental Considerations
Jurisdictional Cross-tabulations

Jurisdiction: * Which of the following best describes your level of concern, if any, about the current drought in Clark County?

		Which of the following best describes your level of concern, if any, about the current drought in Clark County?					Total
		Very concerned	Somewhat concerned	Somewhat unconcerned	Not concerned	DK/No answer	
Jurisdiction:	Unincorporated Clark County	99	99	23	15	1	237
	City of Las Vegas	98	69	11	13	0	191
	City of North Las Vegas	30	32	5	1	2	70
	City of Henderson	34	33	10	4	0	81
	City of Boulder City	2	8	2	1	1	14
	City of Mesquite	4	4	0	1	0	9
Total		267	245	51	35	4	602

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	32.176(a)	20	.041
Likelihood Ratio	28.320	20	.102
Linear-by-Linear Association	2.143	1	.143
N of Valid Cases	602		

a 14 cells (46.7%) have expected count less than 5. The minimum expected count is .06.

Jurisdiction: * In general, how would you rate the quality of Clark County's drinking water?

		In general, how would you rate the quality of Clark County's drinking water?					Total
		Excellent	Good	Fair	Poor	DK/No answer	
Jurisdiction:	Unincorporated Clark County	17	49	79	86	5	236
	City of Las Vegas	16	37	55	82	1	191
	City of North Las Vegas	3	8	27	32	0	70
	City of Henderson	3	19	19	39	0	80
	City of Boulder City	1	6	2	5	0	14
	City of Mesquite	2	2	2	4	0	10
Total		42	121	184	248	6	601

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.973(a)	20	.202
Likelihood Ratio	25.481	20	.184
Linear-by-Linear Association	3.410	1	.065
N of Valid Cases	601		

a 14 cells (46.7%) have expected count less than 5. The minimum expected count is .10.

Jurisdiction: * In general, how would you rate Clark County's air quality?

		In general, how would you rate Clark County's air quality?					Total
		Excellent	Good	Fair	Poor	DK/No answer	
Jurisdiction:	Unincorporated Clark County	4	43	121	68	0	236
	City of Las Vegas	9	35	97	50	0	191
	City of North Las Vegas	2	8	40	18	2	70
	City of Henderson	1	11	46	23	0	81
	City of Boulder City	0	7	5	3	0	15
	City of Mesquite	1	5	2	1	0	9
Total		17	109	311	163	2	602

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	43.274(a)	20	.002
Likelihood Ratio	32.708	20	.036
Linear-by-Linear Association	.676	1	.411
N of Valid Cases	602		

a 15 cells (50.0%) have expected count less than 5. The minimum expected count is .03.

Appendix VII

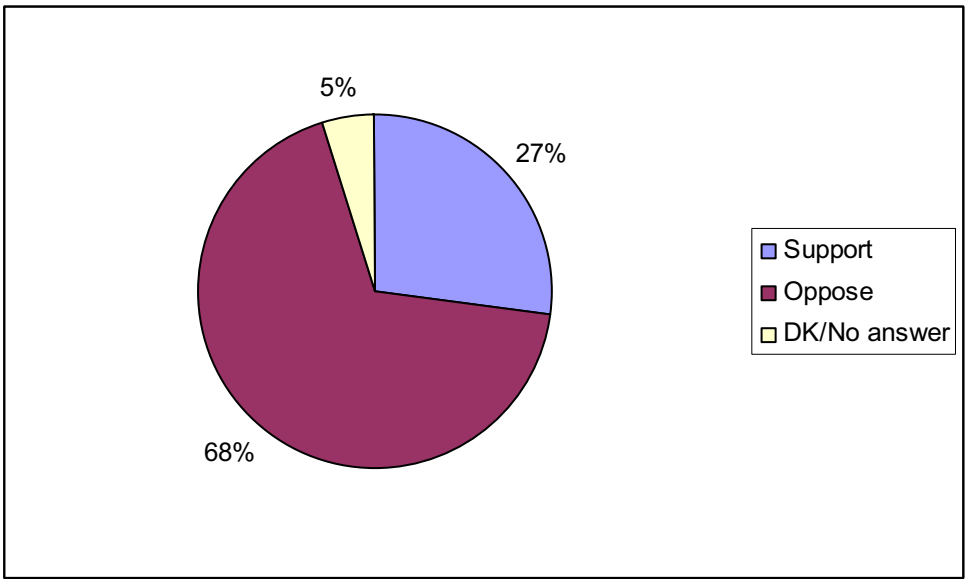
Yucca Mountain Considerations

Appendix VII
Yucca Mountain Considerations
Summary Statistics

		Keeping local decision makers up to date on Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourist sector	Assess impacts on the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	580	569	581	582	571	578	580	579	582
	Missing	19	31	19	18	29	22	20	21	18
Mean		3.89	3.93	3.84	3.96	3.66	3.61	3.57	3.68	3.91
Median		4.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Std. Deviation		1.328	1.328	1.314	1.235	1.272	1.313	1.250	1.254	1.343
Skewness		-.855	-.939	-.861	-.983	-.633	-.575	-.519	-.631	-.983
Std. Error of Skewness		.101	.102	.101	.101	.102	.102	.101	.102	.101
Kurtosis		-.571	-.402	-.417	-.099	-.613	-.802	-.648	-.563	-.317
Std. Error of Kurtosis		.202	.204	.202	.202	.204	.203	.203	.203	.202
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

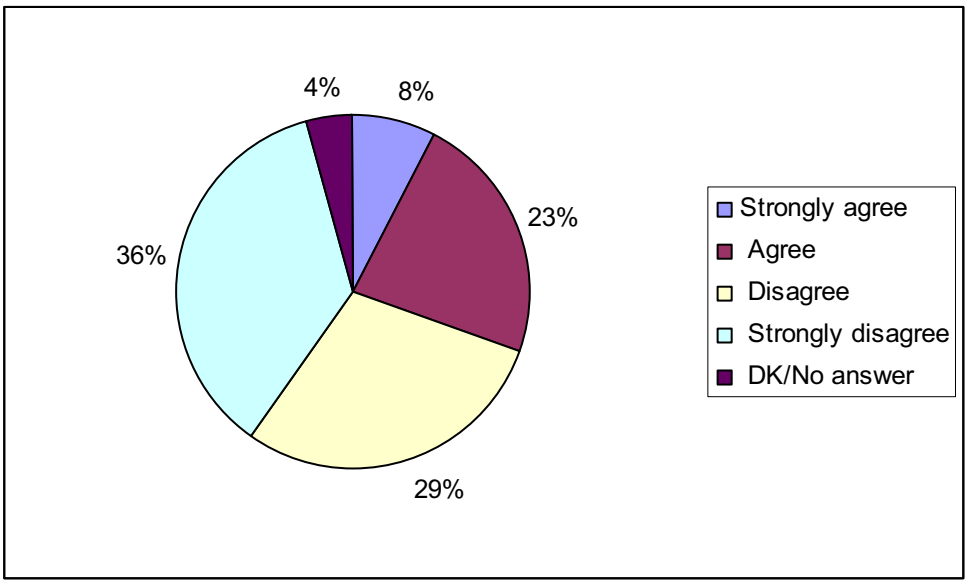
Appendix VII
Yucca Mountain Considerations

The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain. If given the opportunity to vote on this matter, would you support or oppose locating a nuclear waste repository at Yucca Mountain?	Frequency	Percent
Support	163	27.2
Oppose	407	67.9
DK/No answer	29	4.9
Total	600	100.0



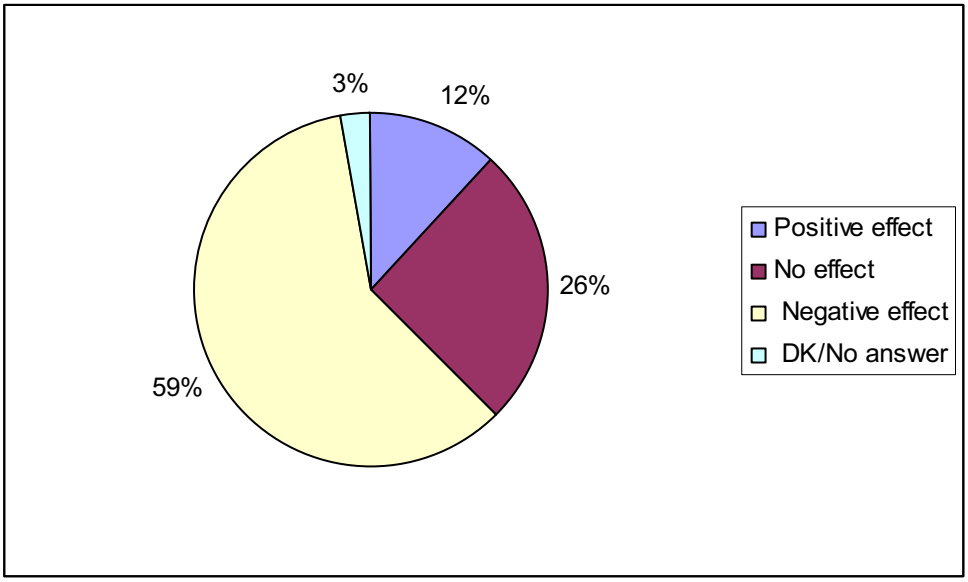
Appendix VII
Yucca Mountain Considerations

The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you agree or disagree with this claim?	Frequency	Percent
Strongly agree	46	7.7
Agree	137	22.8
Disagree	175	29.2
Strongly disagree	217	36.1
DK/No answer	25	4.2
Total	600	100.0



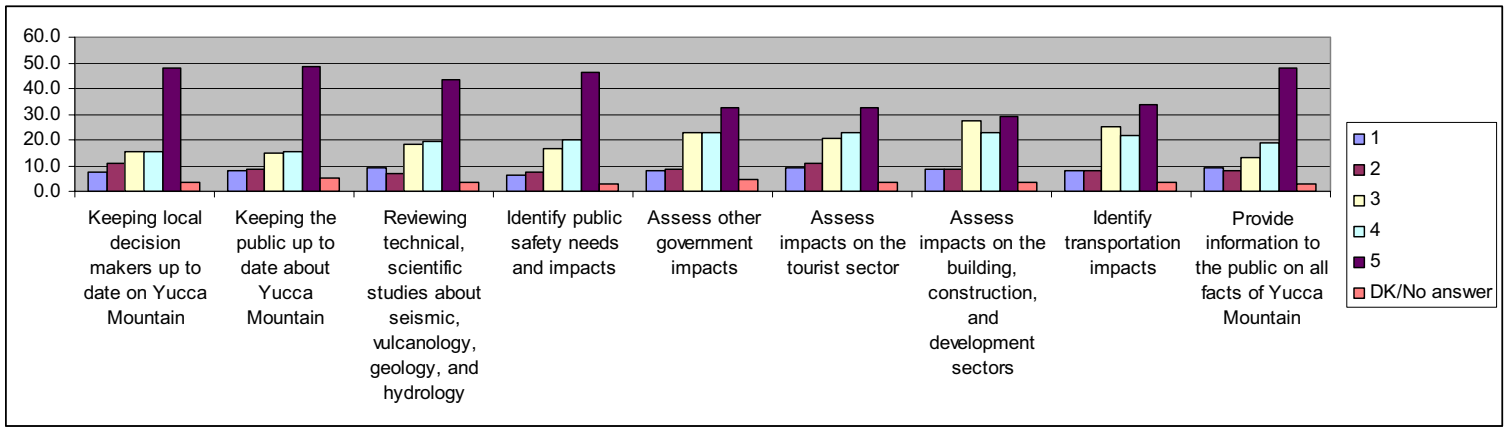
Appendix VII
Yucca Mountain Considerations

Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative effect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.	Frequency	Percent
Positive effect	72	11.9
No effect	153	25.5
Negative effect	359	59.9
DK/No answer	16	2.7
Total	600	100.0



Appendix VII
Yucca Mountain Considerations

	1	2	3	4	5	DK/ No answer	Total
Keeping local decision makers up to date on Yucca Mountain	7.3	10.6	15.5	15.6	47.8	3.2	100.0
Keeping the public up to date about Yucca Mountain	7.8	8.6	14.9	15.3	48.3	5.1	100.0
Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology	8.9	7.0	18.4	19.3	43.2	3.2	100.0
Identify public safety needs and impacts	6.1	7.4	16.8	20.2	46.5	3.0	100.0
Assess other government impacts	8.2	8.7	22.7	22.7	32.8	4.8	100.0
Assess impacts on the tourist sector	9.3	11.1	20.5	22.9	32.6	3.6	100.0
Assess impacts on the building, construction, and development sectors	8.5	8.8	27.4	22.8	29.1	3.4	100.0
Identify transportation impacts	7.9	7.8	25.2	21.7	34.0	3.5	100.0
Provide information to the public on all facts of Yucca Mountain	9.2	7.9	13.2	18.7	48.0	3.0	100.0



Appendix VII
Yucca Mountain Considerations
Jurisdiction

Unincorporated Clark County		Keeping local decision makers up to date on Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourist sector	Assess impacts on the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	226	225	228	228	226	227	228	229	233
	Missing	10	11	8	8	10	9	8	8	3
Mean		3.91	3.93	3.83	3.98	3.67	3.66	3.65	3.73	4.02
Median		4.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00
Std. Deviation		1.302	1.356	1.321	1.212	1.298	1.302	1.247	1.255	1.291
Skewness		-.916	-.995	-.866	-1.030	-.722	-.580	-.523	-.716	-1.180
Std. Error of Skewness		.162	.162	.161	.161	.162	.161	.161	.161	.159
Kurtosis		-.382	-.314	-.408	.081	-.496	-.872	-.752	-.476	.214
Std. Error of Kurtosis		.322	.323	.321	.321	.322	.322	.321	.321	.317
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdiction

City of Las Vegas		Keeping local decision makers up to date on Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourist sector	Assess impacts on the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	187	180	182	185	179	186	182	187	182
	Missing	4	11	9	5	12	5	9	4	8
Mean		3.75	3.90	3.78	3.93	3.66	3.68	3.57	3.72	3.82
Median		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Std. Deviation		1.375	1.314	1.319	1.253	1.277	1.293	1.260	1.209	1.389
Skewness		-.711	-.943	-.771	-.915	-.562	-.685	-.549	-.597	-.900
Std. Error of Skewness		.178	.181	.180	.179	.182	.178	.180	.178	.180
Kurtosis		-.815	-.285	-.554	-.263	-.791	-.597	-.559	-.482	-.493
Std. Error of Kurtosis		.354	.361	.359	.355	.362	.355	.359	.354	.358
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdiction

City of North Las Vegas		Keeping local decision makers up to date on Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourist sector	Assess impacts on the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	65	64	68	67	64	66	67	63	65
	Missing	5	5	1	3	5	4	2	6	4
Mean		3.92	3.84	3.91	3.89	3.57	3.45	3.49	3.41	3.74
Median		5.00	4.00	5.00	4.83	4.00	4.00	4.00	3.00	4.00
Std. Deviation		1.401	1.331	1.422	1.365	1.371	1.359	1.324	1.316	1.410
Skewness		-.853	-.698	-1.064	-.923	-.563	-.522	-.468	-.460	-.848
Std. Error of Skewness		.298	.299	.290	.294	.299	.295	.293	.301	.297
Kurtosis		-.757	-.865	-.208	-.426	-.815	-.836	-.855	-.674	-.603
Std. Error of Kurtosis		.588	.591	.573	.579	.591	.583	.578	.593	.586
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdiction

City of Henderson		Keeping local decision makers up to date on Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourist sector	Assess impacts on the building, construction, and development sectors	Identify transportati on impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	80	78	80	80	80	78	80	78	78
	Missing	1	3	1	1	1	3	1	3	2
Mean		4.20	4.12	3.96	4.10	3.72	3.46	3.51	3.71	3.97
Median		5.00	5.00	4.00	5.00	4.00	3.00	4.00	4.00	5.00
Std. Deviation		1.180	1.278	1.223	1.183	1.172	1.313	1.195	1.311	1.328
Skewness		-1.221	-1.134	-.957	-1.212	-.631	-.442	-.528	-.620	-.891
Std. Error of Skewness		.269	.273	.269	.269	.269	.273	.269	.273	.271
Kurtosis		.181	-.145	-.057	.502	-.433	-.771	-.413	-.825	-.671
Std. Error of Kurtosis		.532	.539	.532	.532	.532	.539	.532	.539	.537
Range		4	4	4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdiction

City of Boulder City		Keeping local decision makers up to date on Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourist sector	Assess impacts on the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	14	14	14	13	13	12	14	13	13
	Missing	0	0	0	1	1	2	0	1	1
Mean		3.51	3.86	3.71	3.81	3.38	3.11	2.96	3.35	3.97
Median		3.00	4.00	4.00	4.00	3.00	3.00	3.00	4.00	4.81
Std. Deviation		1.402	1.252	1.337	1.056	1.068	1.448	1.339	1.366	1.204
Skewness		-.313	-.770	-.837	-.936	-.180	-.137	-.473	-.771	-.503
Std. Error of Skewness		.597	.597	.597	.611	.611	.627	.597	.613	.611
Kurtosis		-1.096	-.225	-.217	1.774	.435	-1.200	-.879	-.382	-1.528
Std. Error of Kurtosis		1.154	1.154	1.154	1.180	1.180	1.213	1.154	1.185	1.180
Range		4	4	4	4	4	4	4	4	3
Minimum		1	1	1	1	1	1	1	1	2
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdiction

City of Mesquite		Keeping local decision makers up to date on Yucca Mountain	Keeping the public up to date about Yucca Mountain	Reviewing technical, scientific studies about seismic, vulcanology, geology, and hydrology	Identify public safety needs and impacts	Assess other government impacts	Assess impacts on the tourist sector	Assess impacts on the building, construction, and development sectors	Identify transportation impacts	Provide information to the public on all facts of Yucca Mountain
N	Valid	9	9	9	9	9	9	9	9	9
	Missing	0	0	0	0	0	0	0	0	0
Mean		3.83	3.44	3.73	3.81	4.17	3.65	3.66	3.82	3.70
Median		4.00	4.00	4.00	4.00	4.87	4.00	3.87	4.00	4.74
Std. Deviation		1.378	1.550	1.199	1.301	.993	1.526	.727	1.058	1.619
Skewness		-1.143	-.553	-.505	-.537	-.427	-.837	.659	-.240	-.706
Std. Error of Skewness		.715	.715	.715	.715	.715	.715	.715	.715	.715
Kurtosis		.976	-1.382	-1.179	-1.561	-2.218	-.640	-.371	-1.097	-1.181
Std. Error of Kurtosis		1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.395
Range		4	4	3	3	2	4	2	3	4
Minimum		1	1	2	2	3	1	3	2	1
Maximum		5	5	5	5	5	5	5	5	5

Appendix VII
Yucca Mountain Considerations
Jurisdictional Cross-tabulations

Respondent Jurisdiction: * The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain.
If given the opportunity to vote on this matter, would you support or oppose locating a nuclear waste repository at Yucca Mountain?

		The federal Department of Energy (DOE) wants to build the nation's first high-level waste repository at Yucca Mountain. If given the opportunity to vote on this matter, would you support or oppose locating a nuclear waste repository at Yucca Mountain?			
		Support	Oppose	DK/No answer	Total
Respondent Jurisdiction:	Unincorporated Clark County	71	154	11	236
	City of Las Vegas	49	128	13	190
	City of North Las Vegas	17	50	3	70
	City of Henderson	21	58	2	81
	City of Boulder City	2	12	0	14
	City of Mesquite	4	5	0	9
Total		164	407	29	600

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.045(a)	10	.624
Likelihood Ratio	9.165	10	.516
Linear-by-Linear Association	1.351	1	.245
N of Valid Cases	600		

a 6 cells (33.3%) have expected count less than 5. The minimum expected count is .44.

Respondent Jurisdiction: * The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and
the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you agree or disagree with this claim?

		The Department of Energy (DOE) maintains that it can be trusted to manage the Yucca Mountain repository and the transportation of radioactive waste to the repository so that the publics' safety is ensured. Do you agree or disagree with this claim?					
		Strongly agree	Agree	Disagree	Strongly disagree	DK/No answer	Total
Respondent Jurisdiction:	Unincorporated Clark County	18	54	74	81	9	236
	City of Las Vegas	16	38	60	65	12	191
	City of North Las	5	16	25	21	2	69

	Vegas						
	City of Henderson	6	24	13	36	2	81
	City of Boulder City	0	1	1	11	0	13
	City of Mesquite	1	3	1	4	0	9
Total		46	136	174	218	25	599

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	30.195(a)	20	.067
Likelihood Ratio	31.855	20	.045
Linear-by-Linear Association	.883	1	.347
N of Valid Cases	599		

a 12 cells (40.0%) have expected count less than 5. The minimum expected count is .38.

Respondent Jurisdiction: * Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative effect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.

		Do you believe the storage of high-level nuclear waste at Yucca Mountain will have a positive or negative effect on the quality of life of Southern Nevada residents? If you feel it will have no impact you can tell me that too.				
		Positive effect	No effect	Negative effect	DK/No answer	Total
Respondent Jurisdiction:	Unincorporated Clark County	31	65	135	5	236
	City of Las Vegas	23	46	116	5	190
	City of North Las Vegas	10	12	45	2	69
	City of Henderson	5	25	48	3	81
	City of Boulder City	0	3	11	0	14
	City of Mesquite	2	2	3	2	9
Total		71	153	358	17	599

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.276(a)	15	.061
Likelihood Ratio	19.742	15	.182
Linear-by-Linear Association	3.416	1	.065
N of Valid Cases	599		

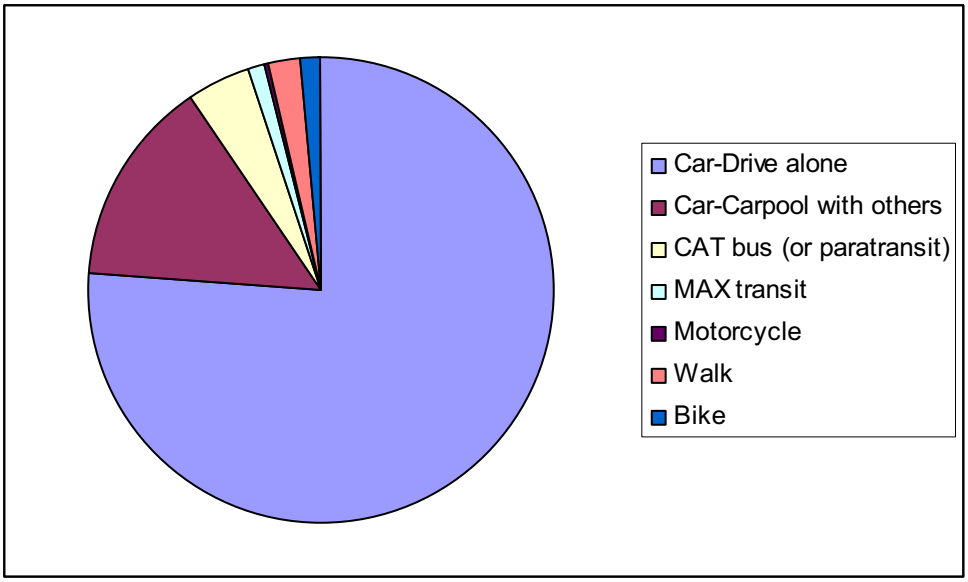
a 8 cells (33.3%) have expected count less than 5. The minimum expected count is .26.

Appendix VIII

Community Profile

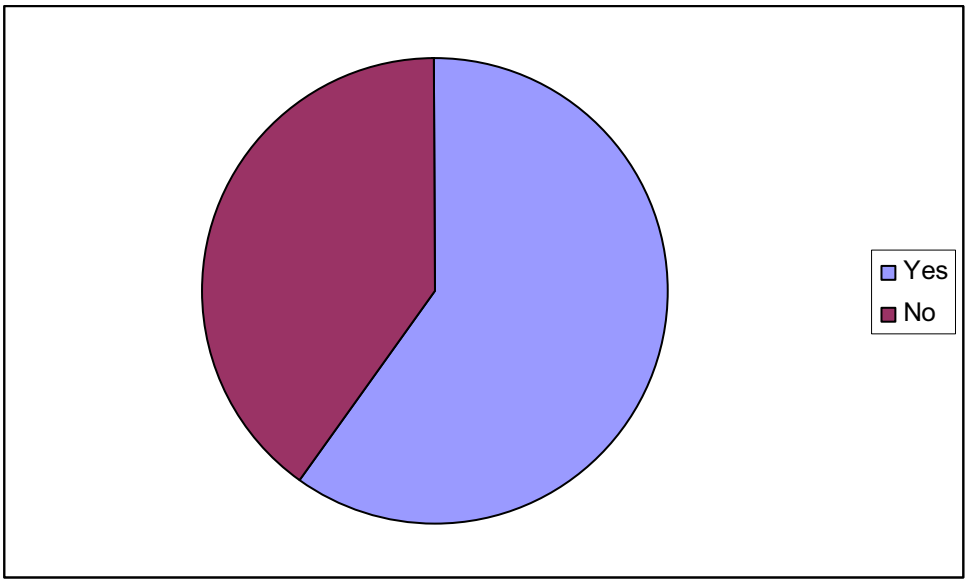
Appendix VIII
Community Profile

What is your most frequently used mode of transportation?	Frequency	Percent
Car-Drive alone	458	76.3
Car-Carpool with others	86	14.3
CAT bus (or paratransit)	27	4.5
MAX transit	6	1.0
Motorcycle	3	.5
Walk	13	2.2
Bike	8	1.3
Total	600	100.0



Appendix VIII
Community Profile

Do you currently commute on a daily basis?	Frequency	Percent
Yes	358	59.7
No	242	40.3
Total	600	100.0

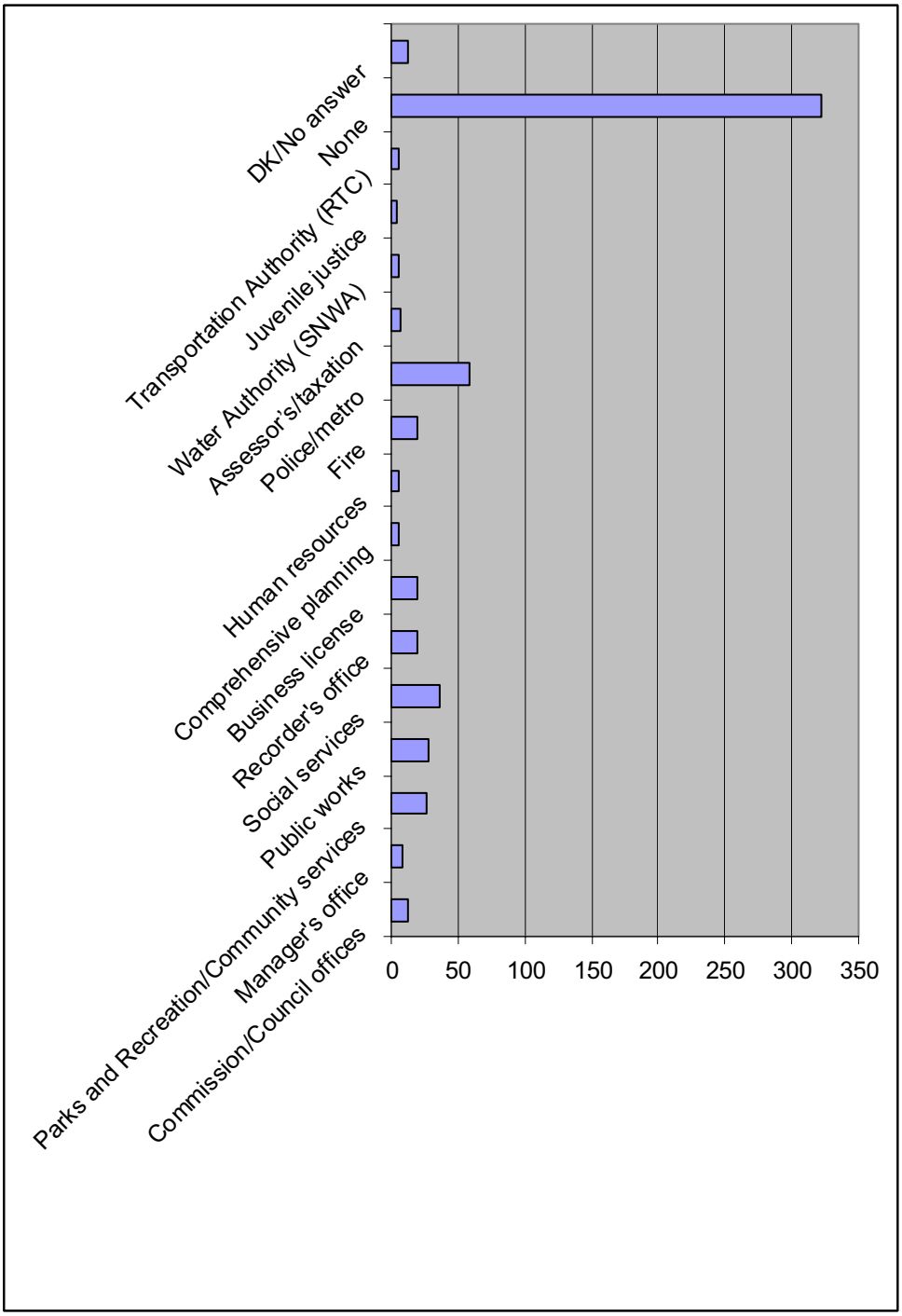


Appendix IX

Local Government Interaction

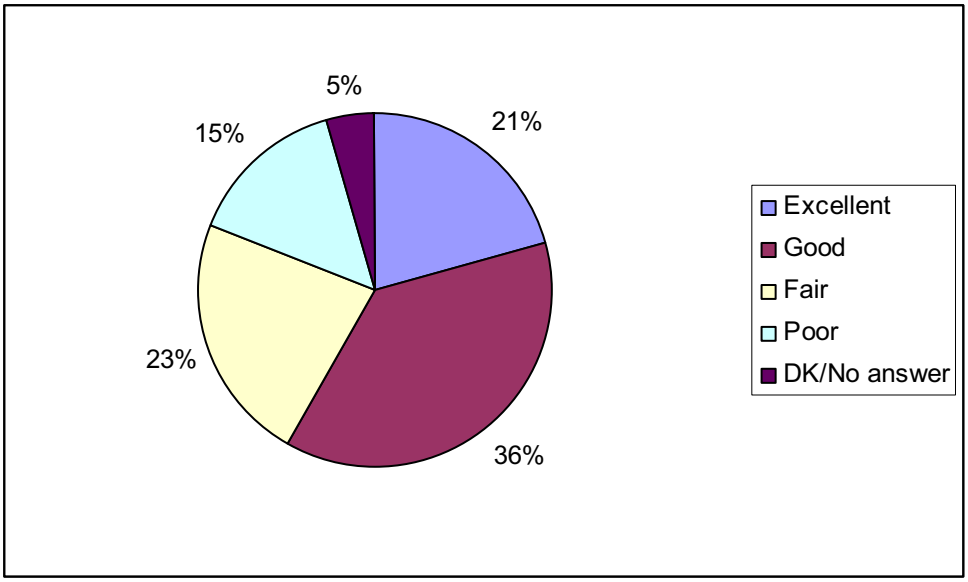
Appendix IX
Local Government Interaction

Which government department, if any, have you interacted with in the past year?	Frequency	Percent
Commission/Council offices	13	2.2
Manager's office	9	1.6
Parks and Recreation/Community services	27	4.5
Public works	28	4.6
Social services	36	6.0
Recorder's office	20	3.3
Business license	20	3.4
Comprehensive planning	6	1.0
Human resources	6	1.0
Fire	20	3.3
Police/metro	59	9.9
Assessor's/taxation	7	1.1
Water Authority (SNWA)	5	.8
Juvenile justice	4	.7
Transportation Authority (RTC)	5	.8
None	322	53.7
DK/No answer	12	2.1
Total	600	100.0


DK/No answer
None
Transportation Authority (RTC)
Juvenile justice
Water Authority (SNWA)
Assessor's/taxation
Police/metro
Fire
Human resources
Comprehensive planning
Business license
Recorder's office
Social services
Public works
Parks and Recreation/Community services
Manager's office
Commission/Council offices
0
50
100
150
200
250
300
350

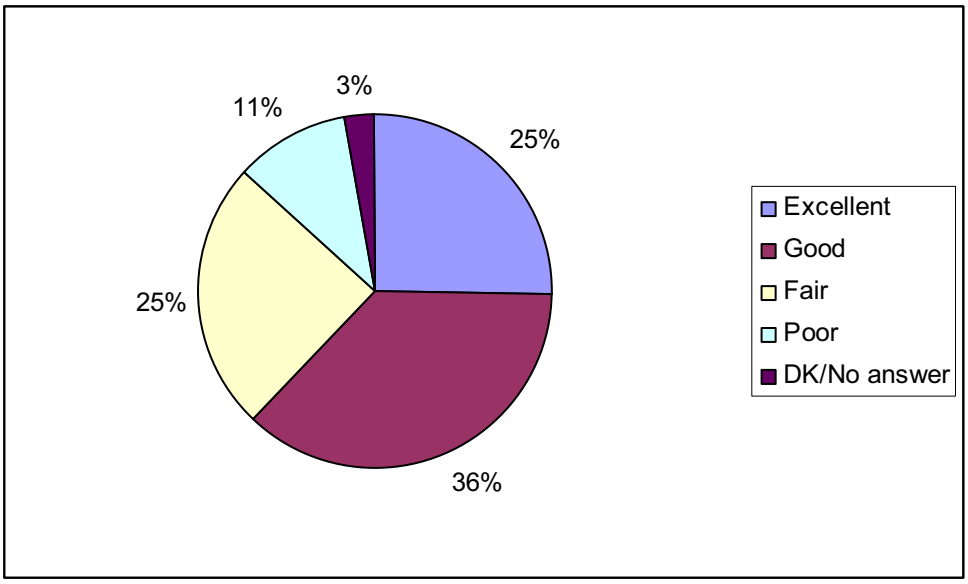
Appendix IX
Local Government Interaction

Timeliness of response	Frequency	Percent
Excellent	55	20.9
Good	99	37.4
Fair	60	22.6
Poor	39	14.7
DK/No answer	12	4.5
Total	265	100.0



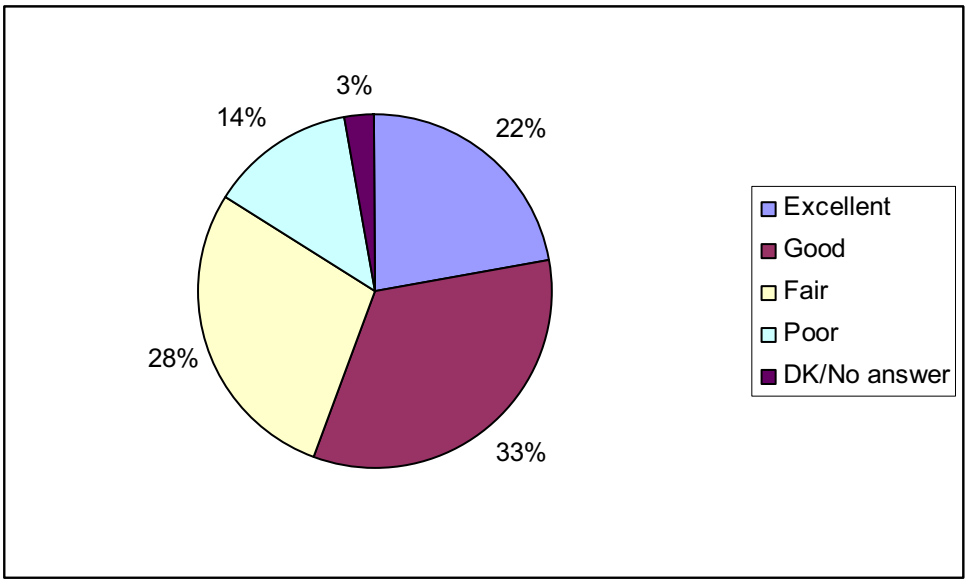
Appendix IX
Local Government Interaction

Courtesy	Frequency	Percent
Excellent	67	25.1
Good	97	36.6
Fair	66	25.0
Poor	28	10.7
DK/No answer	7	2.5
Total	265	100.0



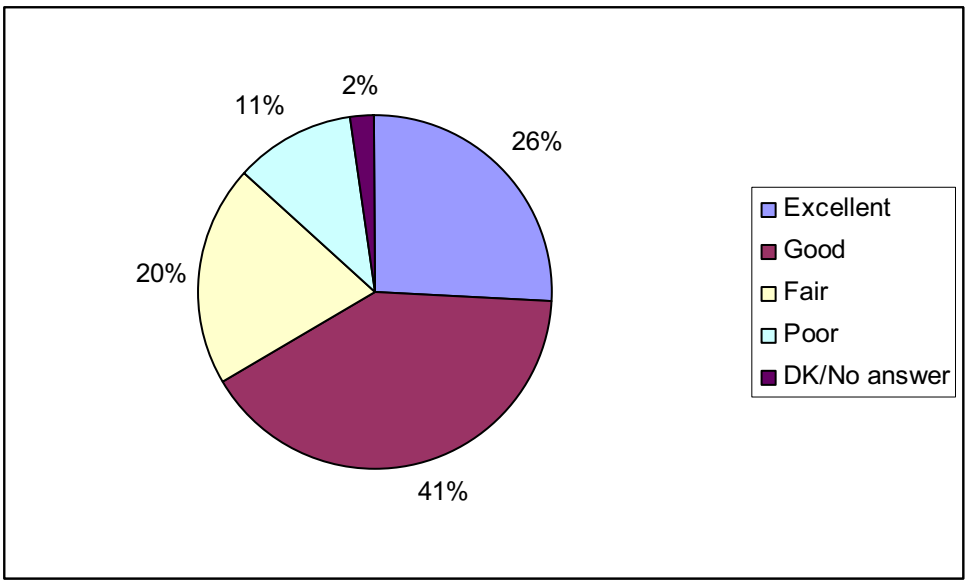
Appendix IX
Local Government Interaction

Professionalism	Frequency	Percent
Excellent	59	22.4
Good	88	33.2
Fair	75	28.4
Poor	36	13.5
DK/No answer	7	2.5
Total	265	100.0



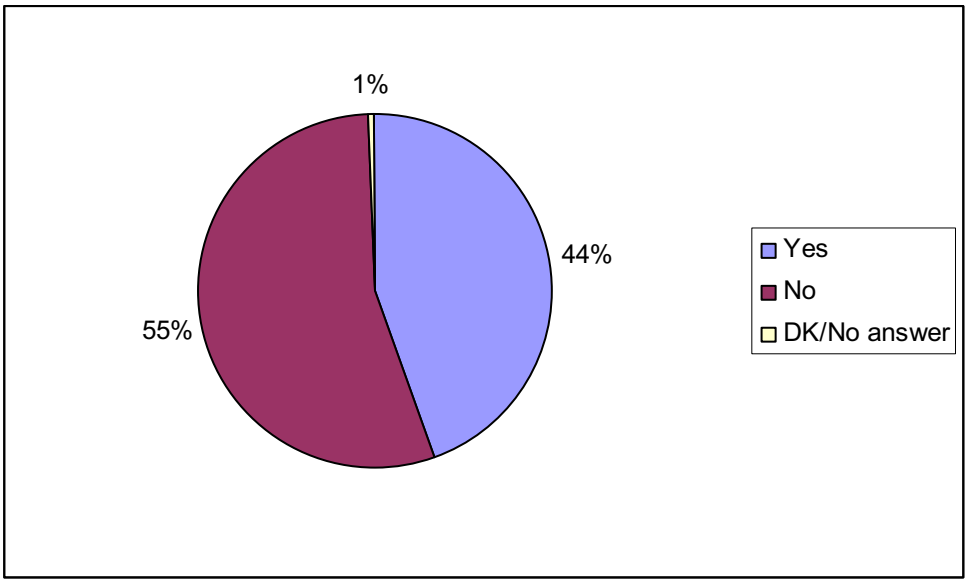
Appendix IX
Local Government Interaction

For the following questions please rate the service levels provided by your local government's employees as excellent, good, fair, or poor: Professionalism	Frequency	Percent
Excellent	68	25.8
Good	107	40.5
Fair	54	20.4
Poor	29	11.0
DK/No answer	6	2.3
Total	265	100.0



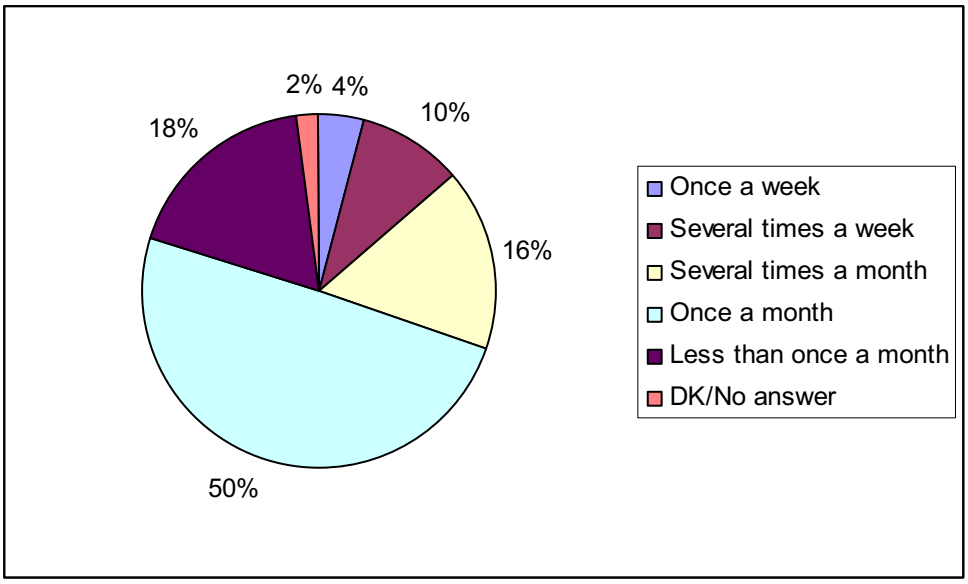
Appendix IX
Local Government Interaction

Have you ever visited your local government's website?	Frequency	Percent
Yes	266	44.4
No	330	55.1
DK/No answer	3	.5
Total	600	100.0



Appendix IX
Local Government Interaction

In any given month, how often would you say you visit your local government's website?	Frequency	Percent
Once a week	11	3.9
Several times a week	26	9.9
Several times a month	44	16.5
Once a month	132	49.4
Less than once a month	49	18.3
DK/No answer	5	2.0
Total	266	100.0

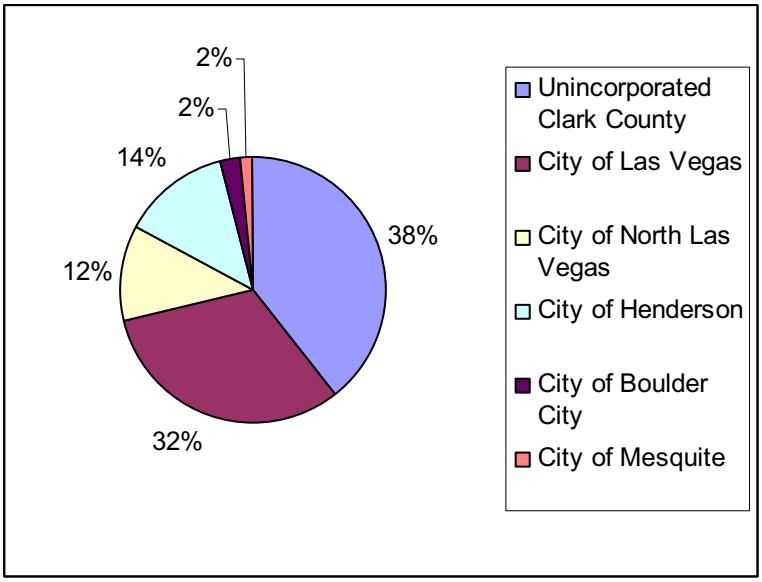


Appendix X

Local Distribution Summary

Appendix X
Local Distribution Summary

Jurisdiction	Frequency	Percent
Unincorporated Clark County	236	39.4
City of Las Vegas	191	31.8
City of North Las Vegas	69	11.6
City of Henderson	81	13.5
City of Boulder City	14	2.3
City of Mesquite	9	1.5
Total	600	100.0



Appendix XI

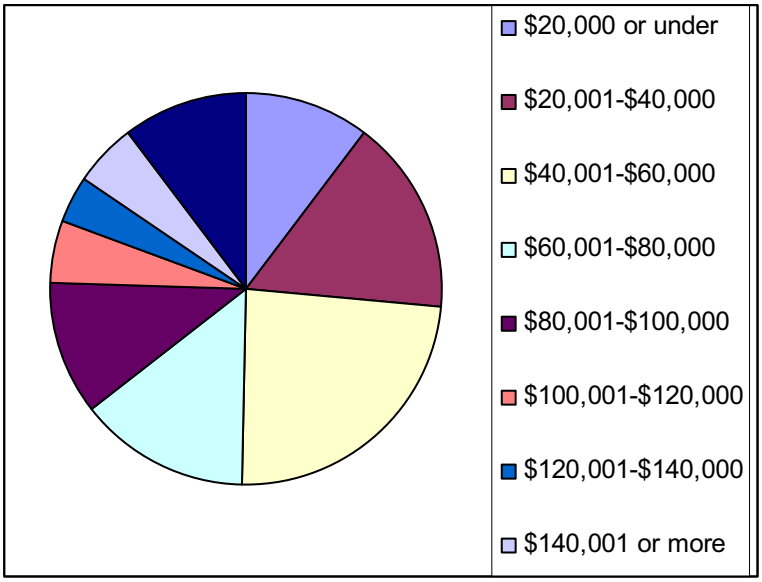
Respondent Demographic Profile

Appendix XI
Respondent Demographic Profile
Summary Statistics

		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	600	600	600	600
	Missing	0	0	0	0
Mean		13.35	3.17	3.86	1.53
Std. Error of Mean		1.175	.287	.215	.020
Median		3.00	3.00	3.00	2.00
Std. Deviation		28.770	7.028	5.275	.499
Skewness		2.599	13.248	16.654	-.129
Std. Error of Skewness		.100	.100	.100	.100
Kurtosis		4.811	176.978	296.347	-1.990
Std. Error of Kurtosis		.199	.199	.199	.199
Minimum		1	1	1	1
Maximum		98	98	98	2

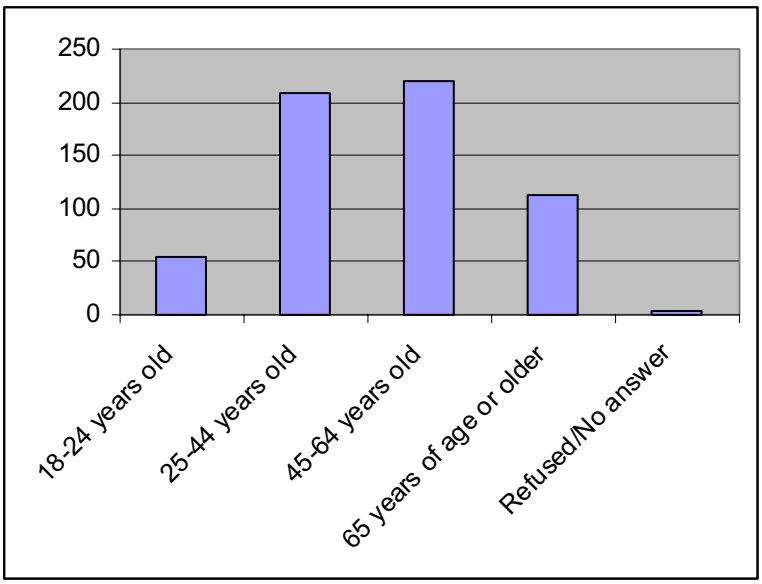
Appendix XI
Respondent Demographic Profile

Which category best describes your total household income before taxes?	Frequency	Percent	Valid Percent	Cumulative Percent
$20,000 or under	61	10.2	10.2	10.2
$20,001-$40,000	97	16.2	16.2	26.4
$40,001-$60,000	143	23.8	23.8	50.1
$60,001-$80,000	86	14.4	14.4	64.6
$80,001-$100,000	67	11.1	11.1	75.7
$100,001-$120,000	29	4.9	4.9	80.6
$120,001-$140,000	23	3.9	3.9	84.4
$140,001 or more	32	5.3	5.3	89.7
Refused/No answer	62	10.3	10.3	100.0
Total	600	100.0	100.0	



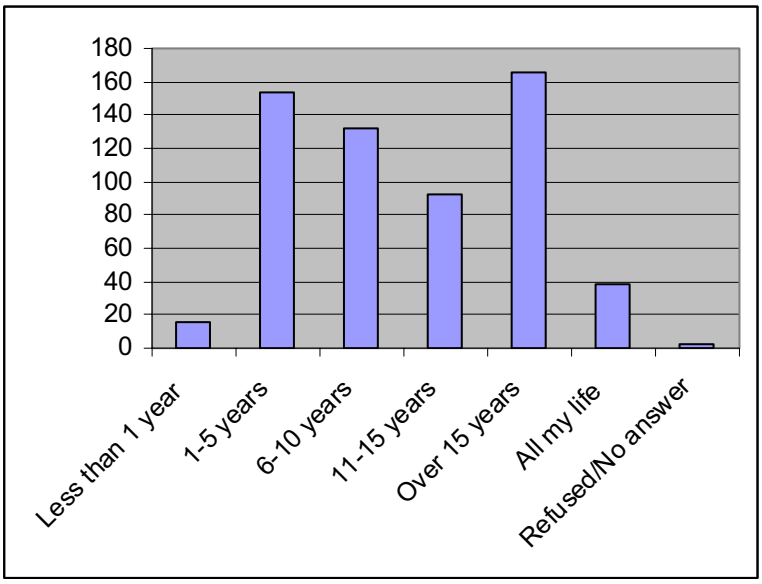
Appendix XI
Respondent Demographic Profile

In what age group do you fall?	Frequency	Percent
18-24 years old	54	9.0
25-44 years old	209	34.9
45-64 years old	220	36.7
65 years of age or older	113	18.9
Refused/No answer	3	.5
Total	600	100.0



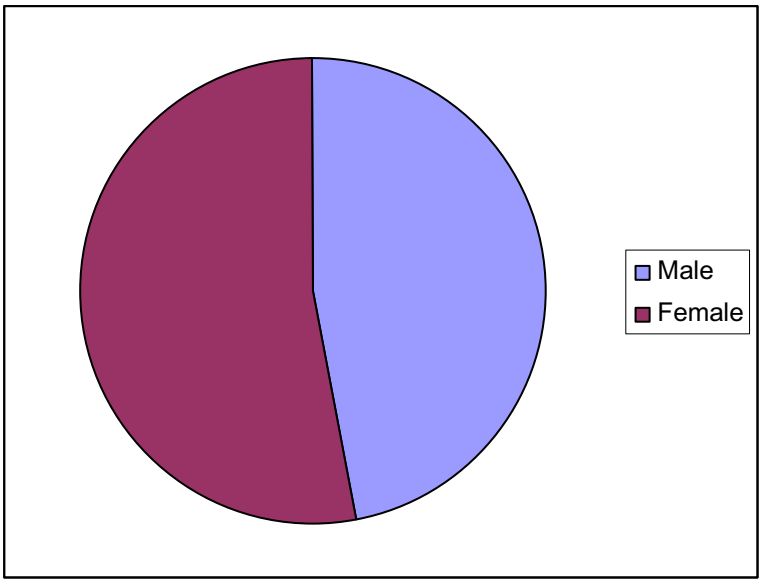
Appendix XI
Respondent Demographic Profile

How long have you lived in Clark County?	Frequency	Percent
Less than 1 year	16	2.7
1-5 years	154	25.6
6-10 years	132	22.1
11-15 years	92	15.3
Over 15 years	166	27.7
All my life	38	6.3
Refused/No answer	2	.3
Total	600	100.0



Appendix XI
Respondent Demographic Profile

Gender observation	Frequency	Percent
Male	281	46.8
Female	319	53.2
Total	600	100.0



Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

Unincorporated Clark County		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	236	236	236	236
	Missing	0	0	0	0
Mean		13.39	3.09	4.04	1.53
Std. Error of Mean		1.891	.457	.345	.033
Median		3.00	3.00	4.00	2.00
Std. Deviation		29.059	7.027	5.309	.500
Skewness		2.580	13.311	16.636	-.130
Std. Error of Skewness		.158	.158	.158	.158
Kurtosis		4.735	179.876	296.703	-2.000
Std. Error of Kurtosis		.316	.316	.316	.316
Minimum		1	1	1	1
Maximum		98	98	98	2

Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

City of Las Vegas		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	191	191	191	191
	Missing	0	0	0	0
Mean		11.47	3.43	3.50	1.49
Std. Error of Mean		1.915	.594	.098	.036
Median		3.00	3.00	3.00	1.00
Std. Deviation		26.440	8.205	1.347	.501
Skewness		2.984	11.423	.088	.034
Std. Error of Skewness		.176	.176	.176	.176
Kurtosis		7.036	131.460	-1.196	-2.020
Std. Error of Kurtosis		.350	.350	.350	.350
Minimum		1	1	1	1
Maximum		98	98	6	2

Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

City of North Las Vegas		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	69	69	69	69
	Missing	0	0	0	0
Mean		19.30	3.34	3.49	1.54
Std. Error of Mean		4.260	1.037	.177	.060
Median		4.00	3.00	3.00	2.00
Std. Deviation		35.483	8.639	1.478	.502
Skewness		1.820	11.088	.181	-.159
Std. Error of Skewness		.288	.288	.288	.288
Kurtosis		1.368	125.711	-1.193	-2.034
Std. Error of Kurtosis		.569	.569	.569	.569
Minimum		1	1	1	1
Maximum		98	98	6	2

Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

City of Henderson		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	81	81	81	81
	Missing	0	0	0	0
Mean		12.74	2.65	4.49	1.61
Std. Error of Mean		2.958	.090	1.211	.055
Median		5.00	2.34	3.00	2.00
Std. Deviation		26.572	.812	10.875	.490
Skewness		2.957	.375	8.587	-.480
Std. Error of Skewness		.268	.268	.268	.268
Kurtosis		6.979	-.806	74.577	-1.815
Std. Error of Kurtosis		.530	.530	.530	.530
Minimum		1	1	1	1
Maximum		98	4	98	2

Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

City of Boulder City		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	14	14	14	14
	Missing	0	0	0	0
Mean		19.29	3.30	4.10	1.57
Std. Error of Mean		9.822	.215	.347	.137
Median		3.39	3.36	5.00	2.00
Std. Deviation		36.742	.803	1.297	.514
Skewness		1.986	-.632	-.374	-.304
Std. Error of Skewness		.597	.597	.597	.597
Kurtosis		2.273	-1.065	-1.283	-2.256
Std. Error of Kurtosis		1.154	1.154	1.154	1.154
Minimum		1	2	2	1
Maximum		98	4	6	2

Appendix XI
Respondent Demographic Profile
Summary by Jurisdiction

City of Mesquite		Which category best describes your total household income before taxes?	In what age group do you fall?	How long have you lived in Clark County?	Gender observation:
N	Valid	9	9	9	9
	Missing	0	0	0	0
Mean		2.88	2.99	3.87	1.54
Std. Error of Mean		.525	.179	.585	.176
Median		3.00	3.00	4.13	1.83
Std. Deviation		1.582	.539	1.762	.529
Skewness		.730	-.023	.077	-.177
Std. Error of Skewness		.715	.715	.715	.715
Kurtosis		.932	2.781	-2.069	-2.620
Std. Error of Kurtosis		1.395	1.395	1.395	1.395
Minimum		1	2	2	1
Maximum		6	4	6	2

Appendix XI
Respondent Demographic Profile
Crosstabulations by Jurisdiction

Jurisdiction: * Which category best describes your total household income before taxes?

		Which category best describes your total household income before taxes?									Total
		$20,000 or under	$20,001-$40,000	$40,001-$60,000	$60,001-$80,000	$80,001-$100,000	$100,001-$120,000	$120,001-$140,000	$140,001 or more	Refused/No answer	
Respondent Jurisdictions:	Unincorporated Clark County	25	41	61	32	25	11	6	11	25	237
	City of Las Vegas	20	38	45	30	19	5	8	9	16	190
	City of North Las Vegas	8	10	13	10	8	4	4	2	12	71
	City of Henderson	3	7	15	13	13	8	6	8	7	80
	City of Boulder City	3	1	3	1	2	1	0	1	2	14
	City of Mesquite	2	1	4	1	0	1	0	0	0	9
Total		61	98	141	87	67	30	24	31	62	601

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	42.651(a)	40	.358
Likelihood Ratio	44.422	40	.291
Linear-by-Linear Association	.012	1	.911
N of Valid Cases	601		

a 24 cells (44.4%) have expected count less than 5. The minimum expected count is .36.

Appendix XI
Respondent Demographic Profile
Crosstabulations by Jurisdiction

Respondent Jurisdiction: * In what age group do you fall?

		In what age group do you fall?					Total
		18-24 years old	25-44 years old	45-64 years old	65 years of age or older	Refused/No answer	
Respondent Jurisdiction:	Unincorporated Clark County	29	84	80	43	1	237
	City of Las Vegas	17	55	78	39	1	190
	City of North Las Vegas	5	29	26	9	1	70
	City of Henderson	3	38	26	15	0	82
	City of Boulder City	0	3	4	7	0	14
	City of Mesquite	0	1	7	1	0	9
Total		54	210	221	114	3	602

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	33.193(a)	20	.032
Likelihood Ratio	33.272	20	.031
Linear-by-Linear Association	.004	1	.949
N of Valid Cases	602		

a 13 cells (43.3%) have expected count less than 5. The minimum expected count is .04.

Appendix XI
Respondent Demographic Profile
Crosstabulations by Jurisdiction

Respondent Jurisdiction: * How long have you lived in Clark County?

		How long have you lived in Clark County?							Total
		Less than 1 year	1-5 years	6-10 years	11-15 years	Over 15 years	All my life	Refused/No answer	
Respondent Jurisdiction:	Unincorporated Clark County	6	49	50	39	74	17	1	236
	City of Las Vegas	6	51	43	30	51	9	0	190
	City of North Las Vegas	3	20	14	10	15	7	0	69
	City of Henderson	1	28	20	12	17	2	1	81
	City of Boulder City	0	2	4	1	7	1	0	15
	City of Mesquite	0	3	1	1	2	2	0	9
Total		16	153	132	93	166	38	2	600

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	27.171(a)	30	.614
Likelihood Ratio	27.084	30	.619
Linear-by-Linear Association	.002	1	.962
N of Valid Cases	600		

a 21 cells (50.0%) have expected count less than 5. The minimum expected count is .03.

Appendix XI
Respondent Demographic Profile
Crosstabulations by Jurisdiction

Respondent Jurisdiction: * Gender observation:

		Gender observation:		Total
		Male	Female	
Respondent Jurisdiction:	Unincorporated Clark County	110	126	236
	City of Las Vegas	97	94	191
	City of North Las Vegas	32	37	69
	City of Henderson	31	50	81
	City of Boulder City	6	8	14
	City of Mesquite	4	5	9
Total		280	320	600

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.698(a)	5	.594
Likelihood Ratio	3.723	5	.590
Linear-by-Linear Association	1.163	1	.281
N of Valid Cases	600		

a 2 cells (16.7%) have expected count less than 5. The minimum expected count is 4.20.

Appendix XII

Importance/ Performance Comparisons

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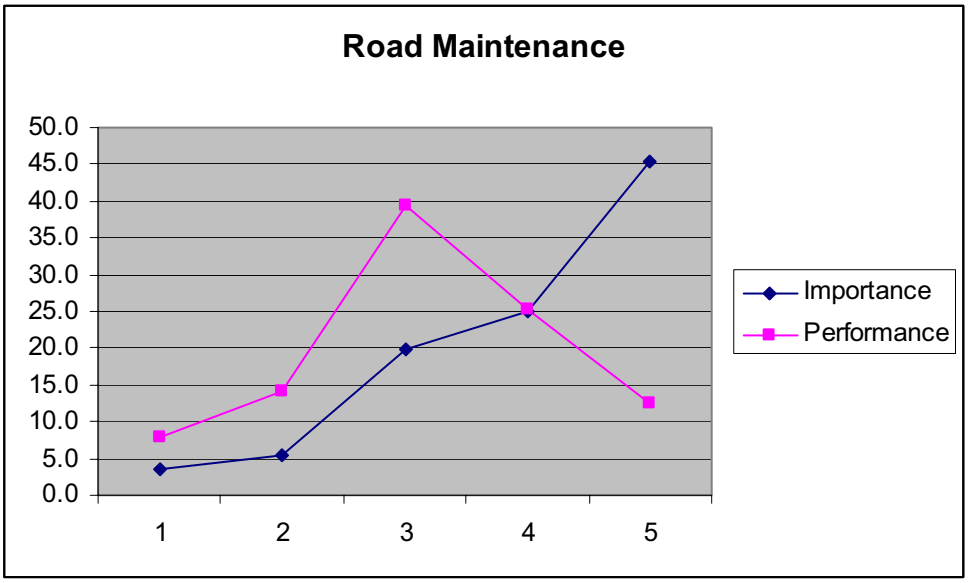
Importance/Performance Comparisons



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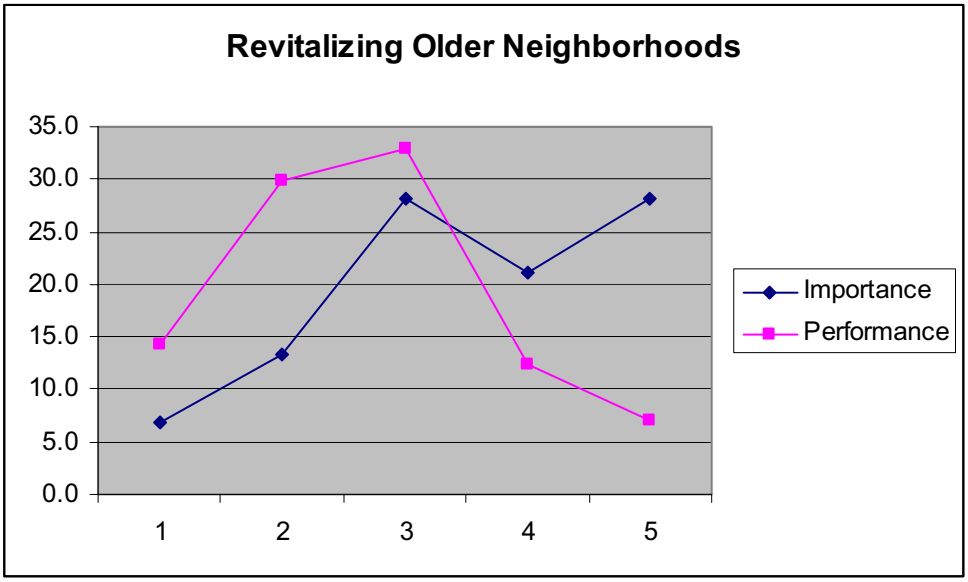

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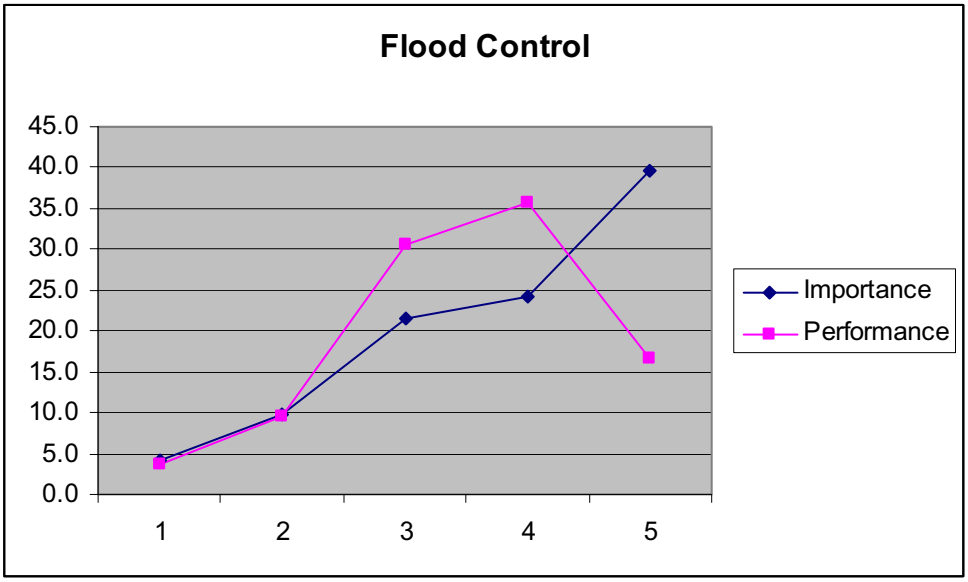

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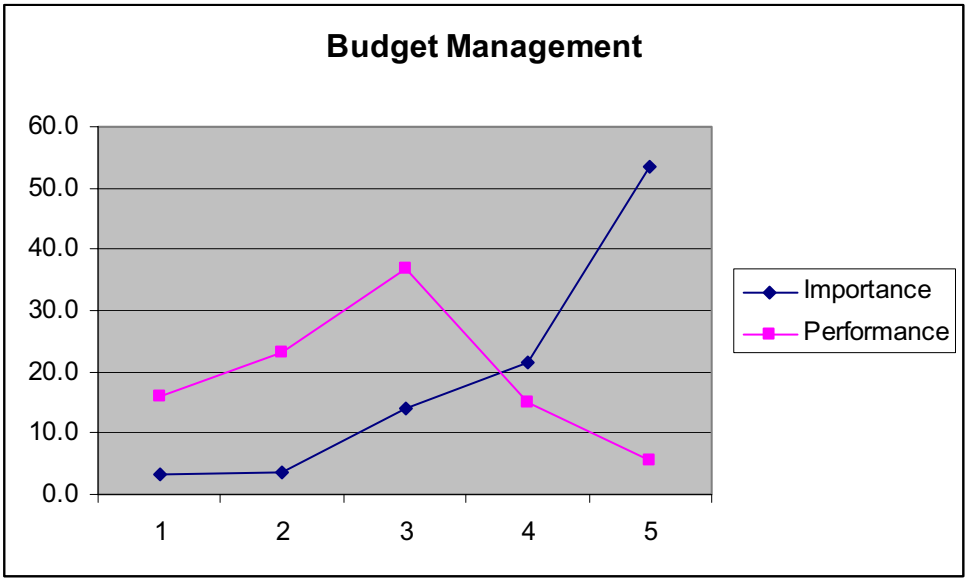

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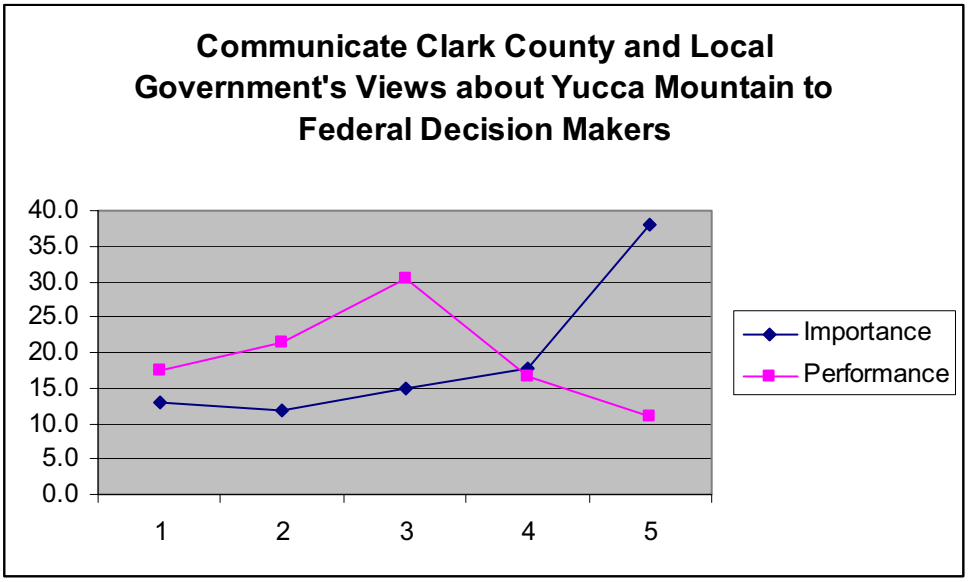

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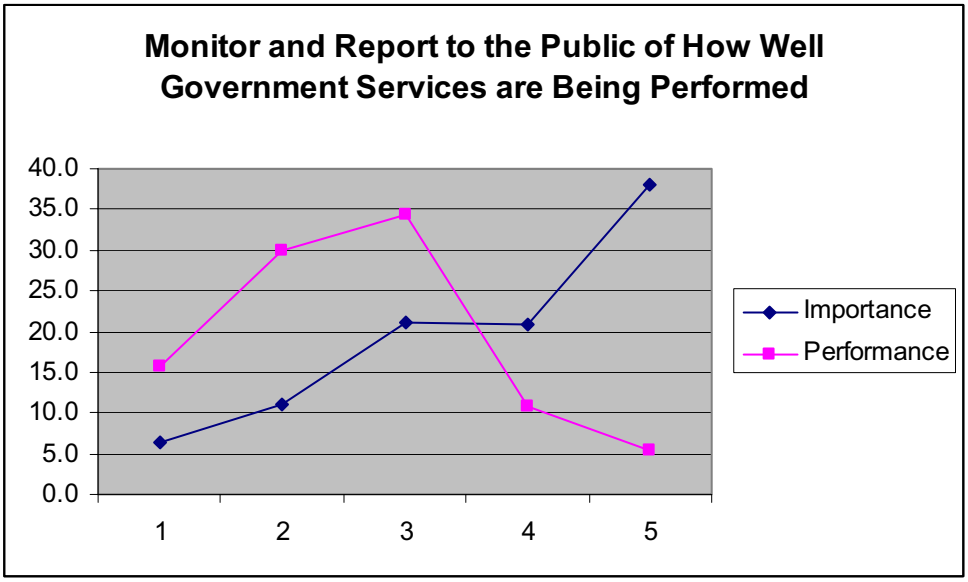

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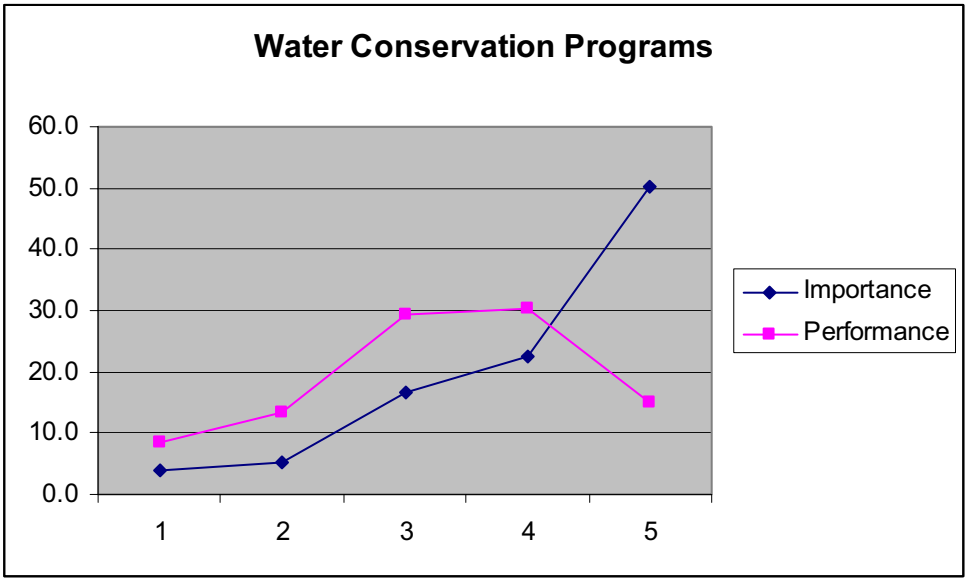

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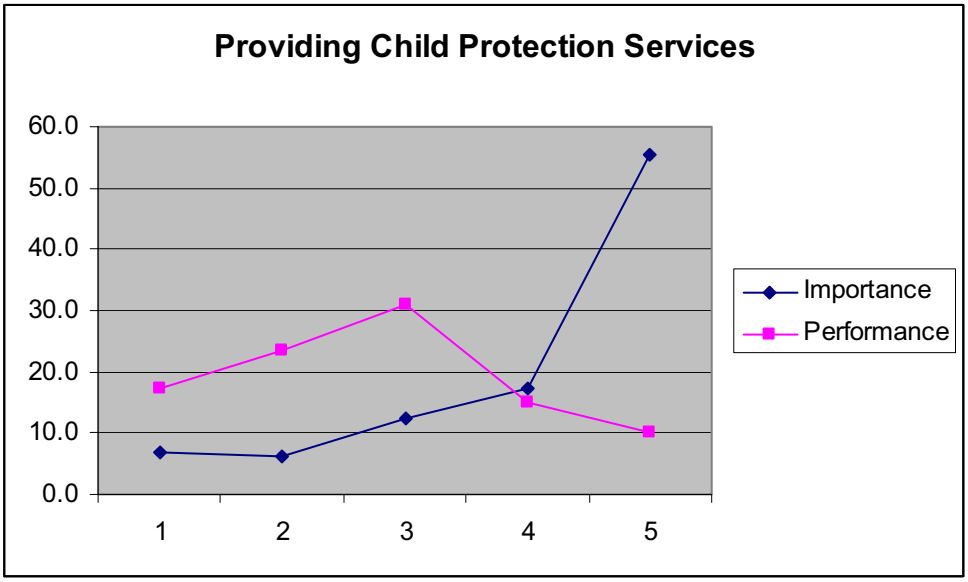

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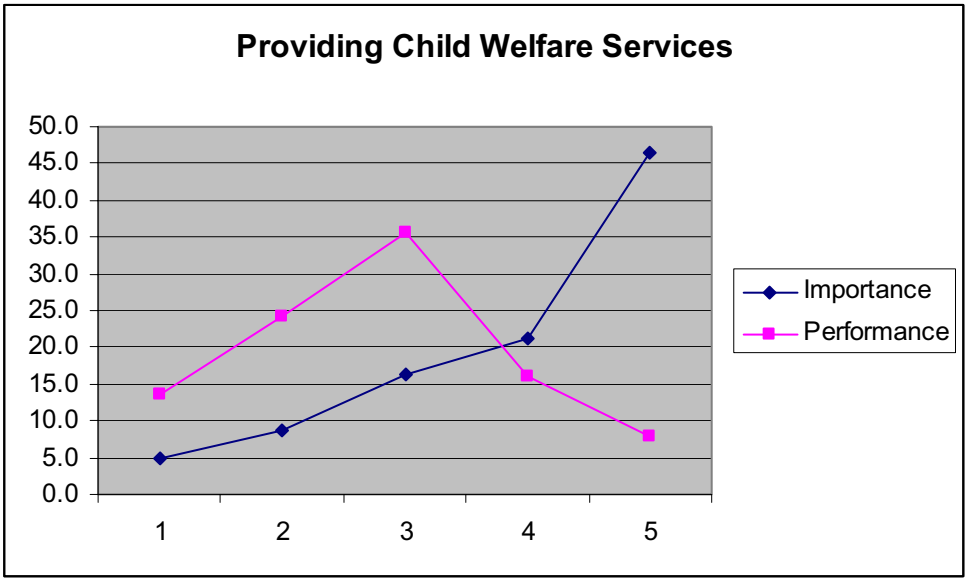

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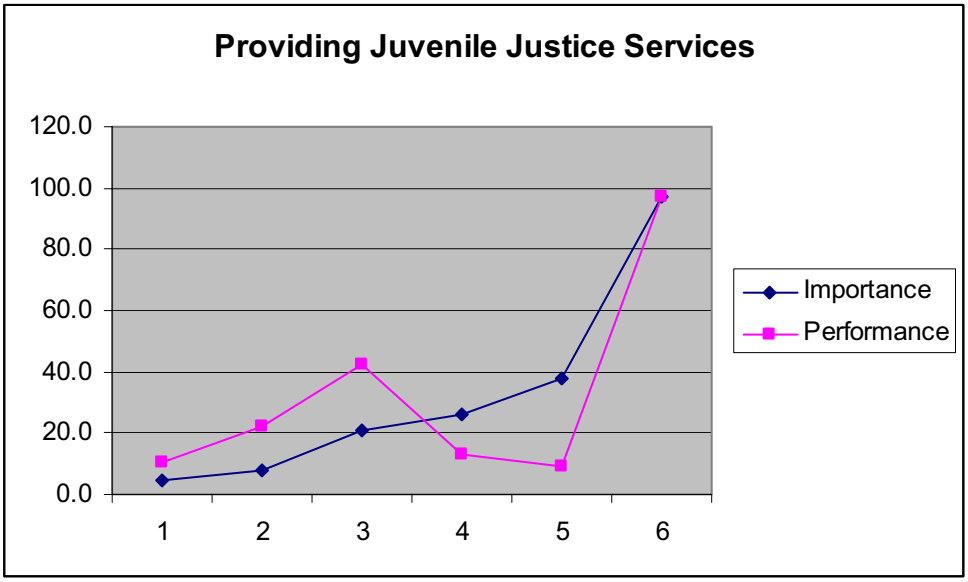

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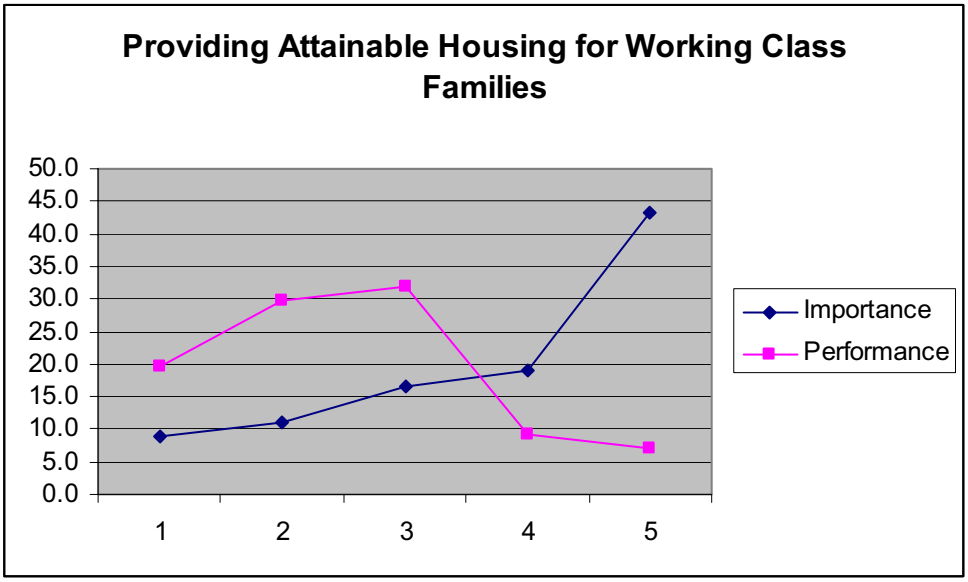

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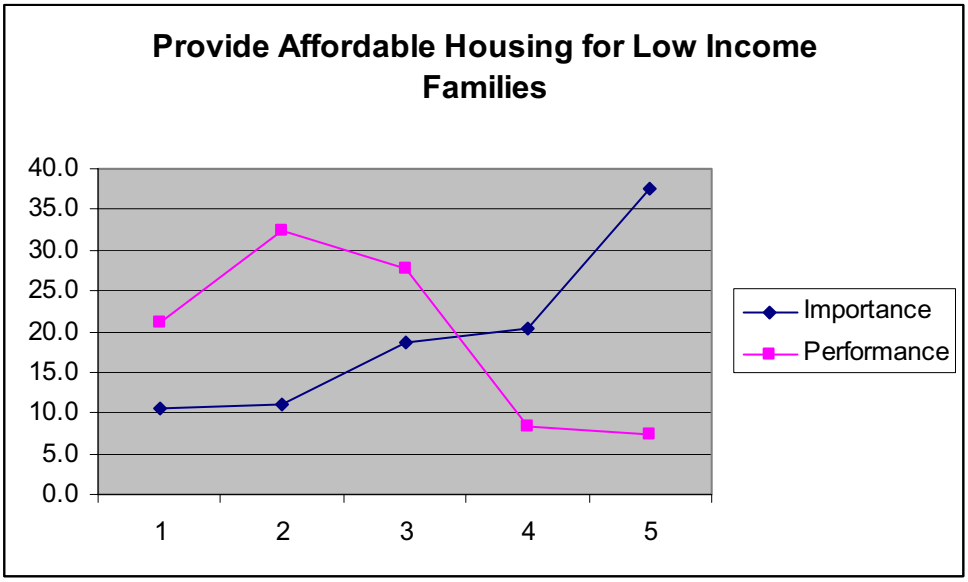

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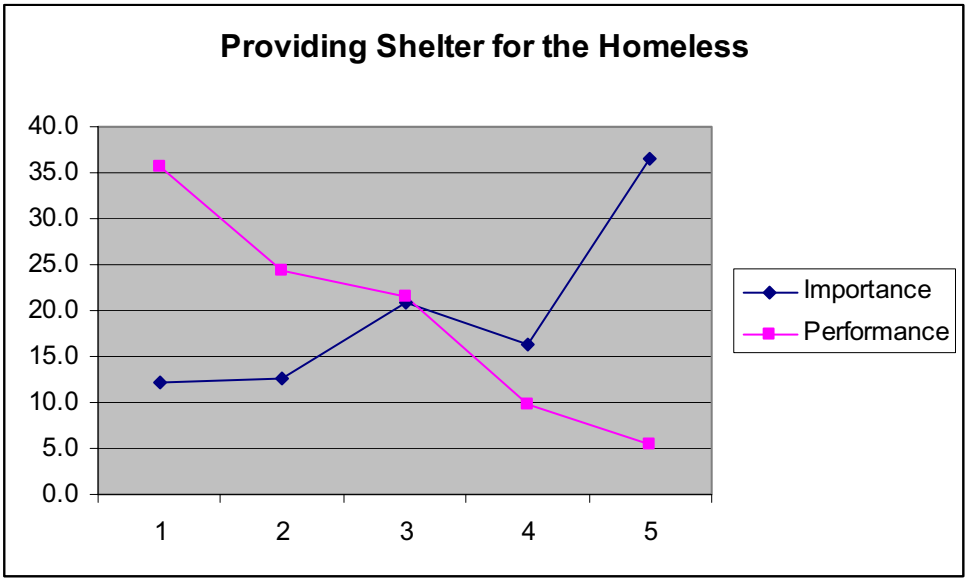

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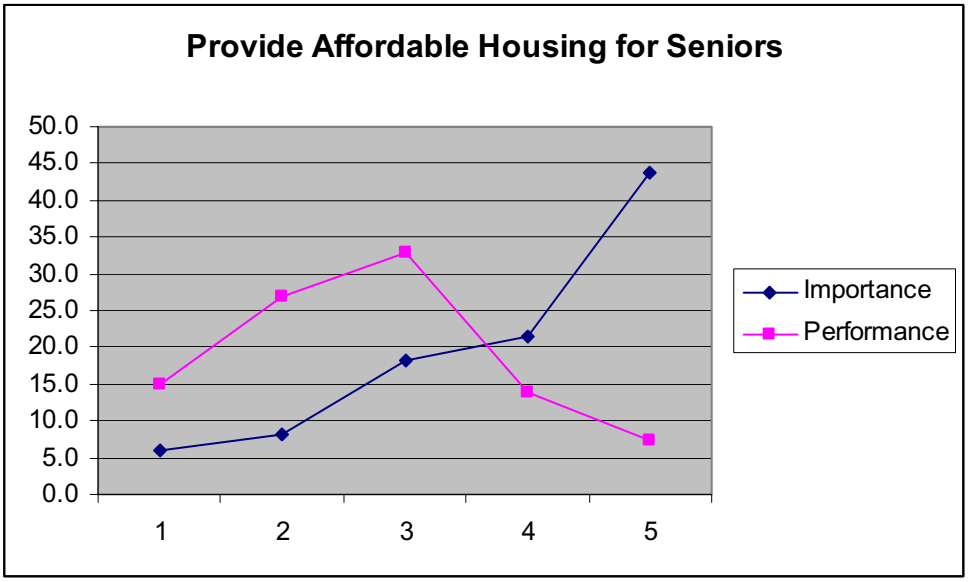

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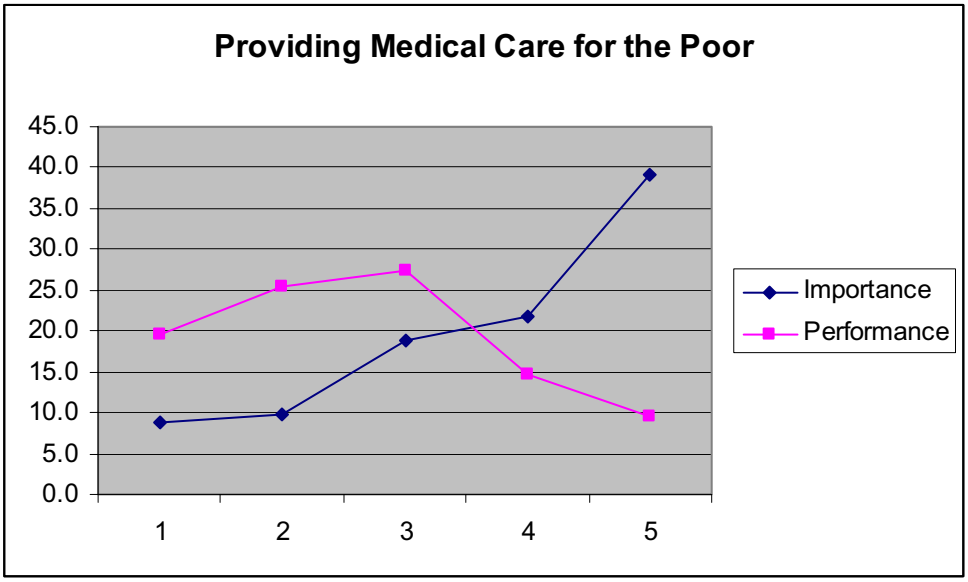

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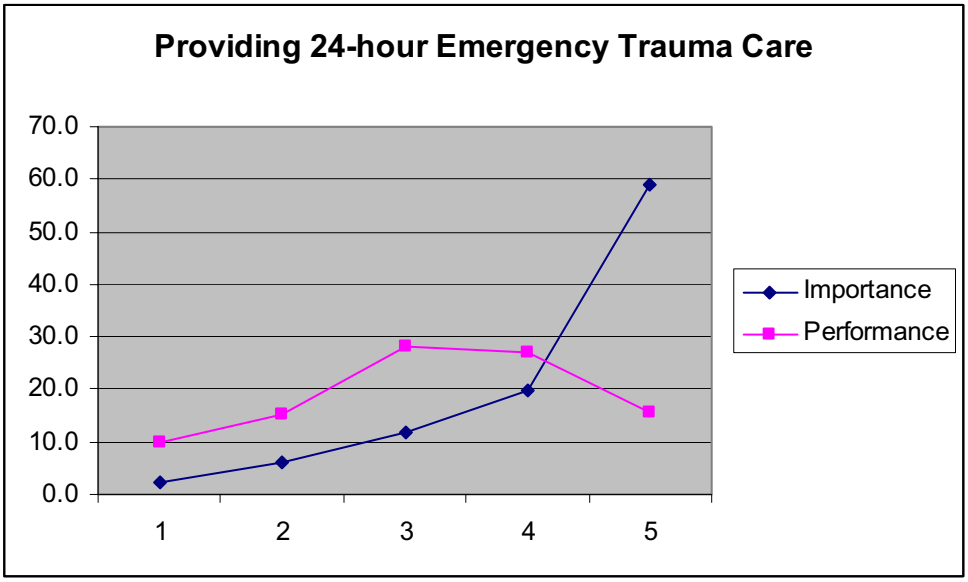

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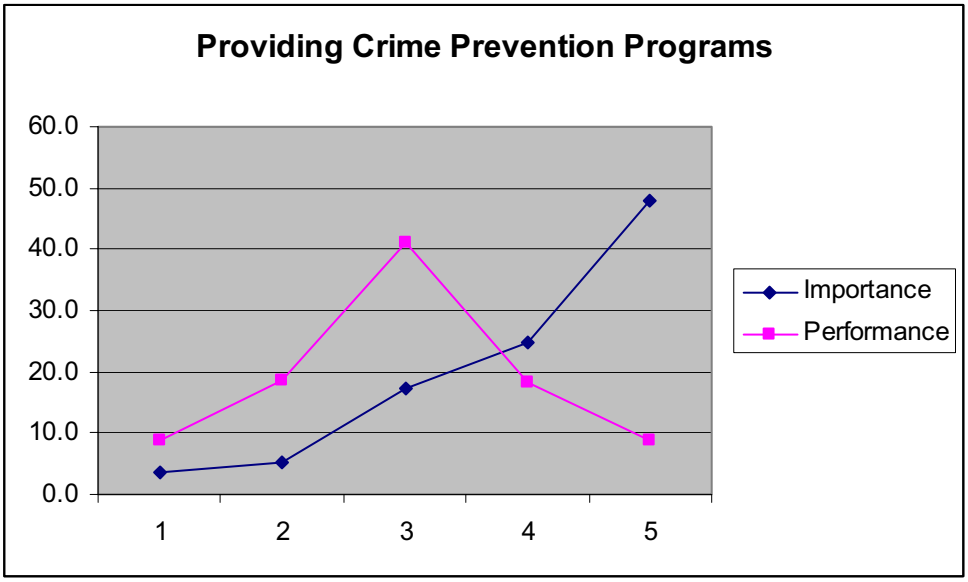

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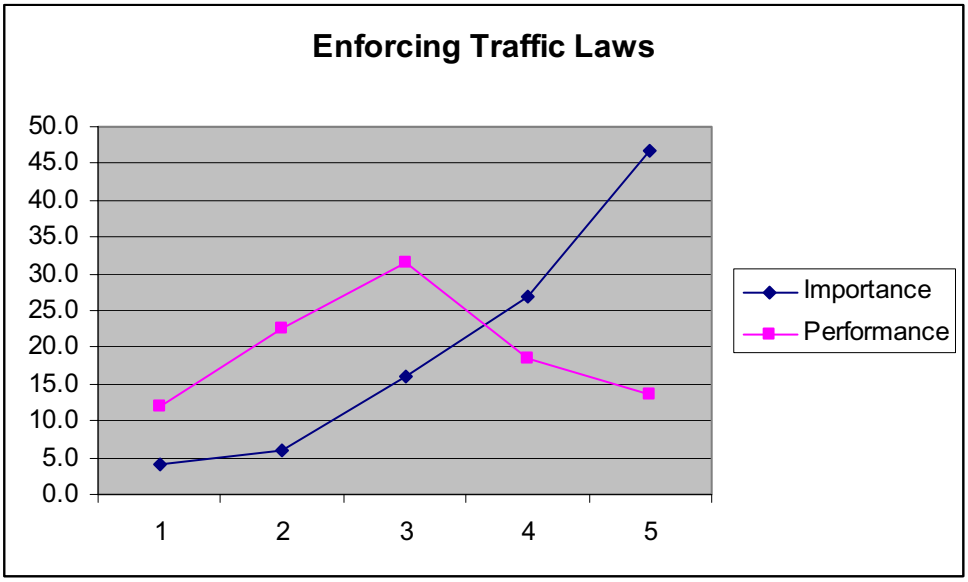

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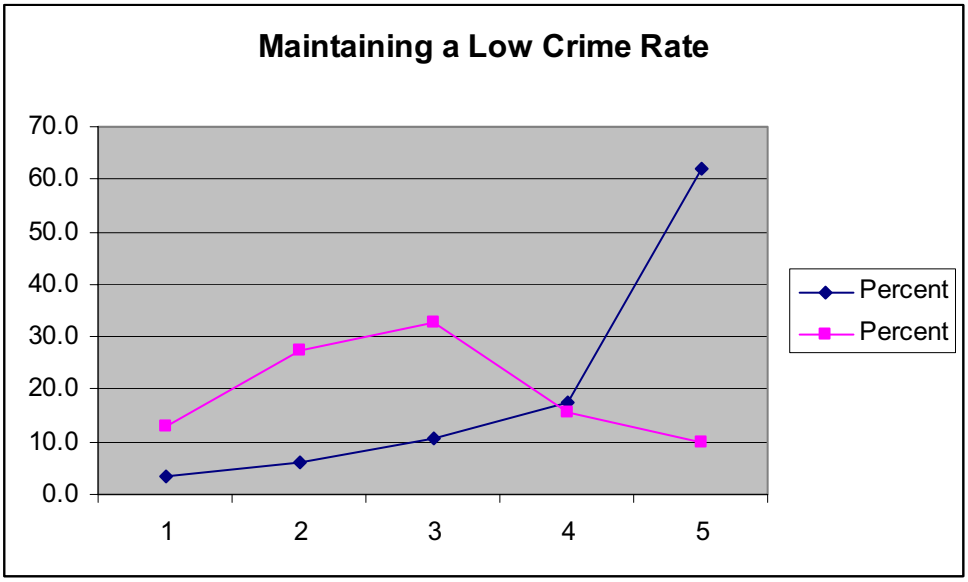

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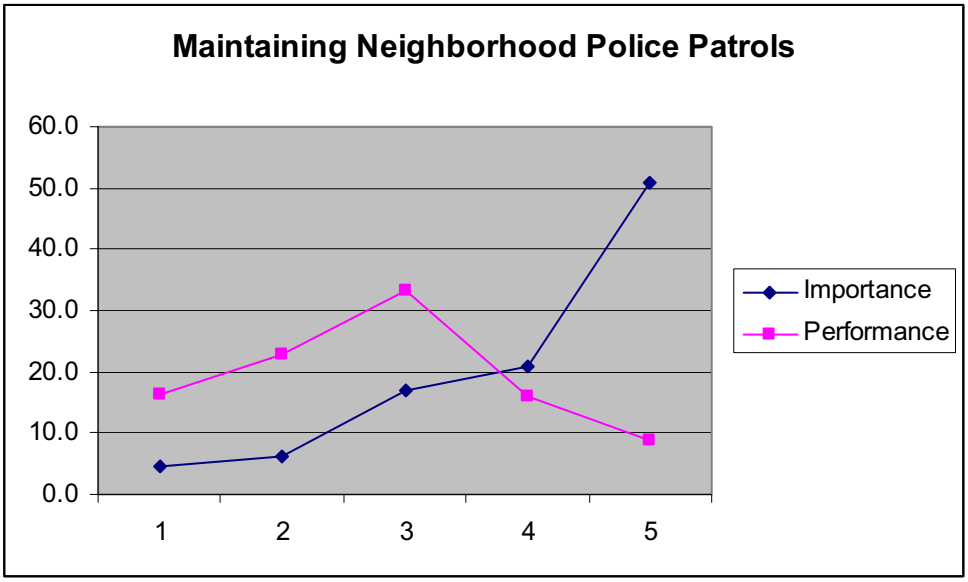

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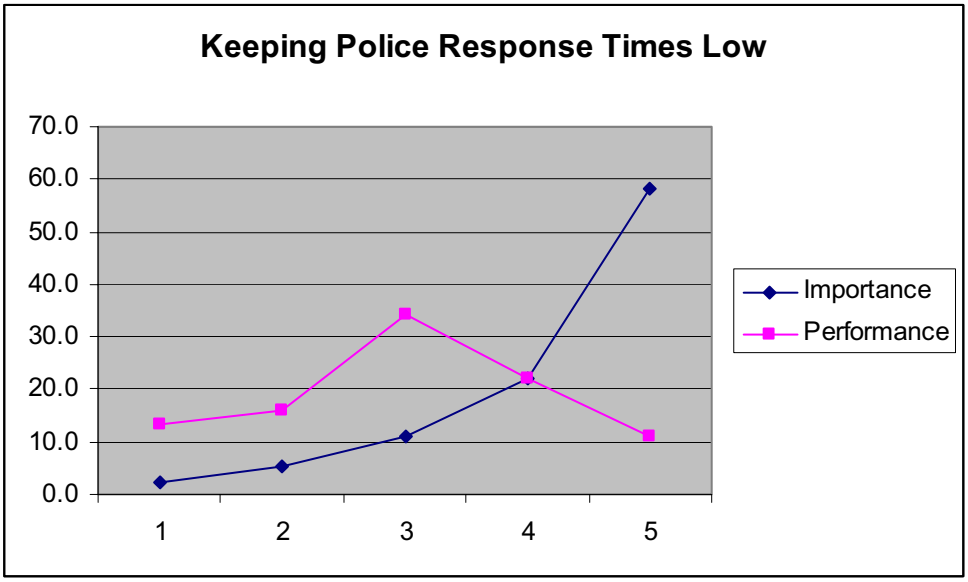

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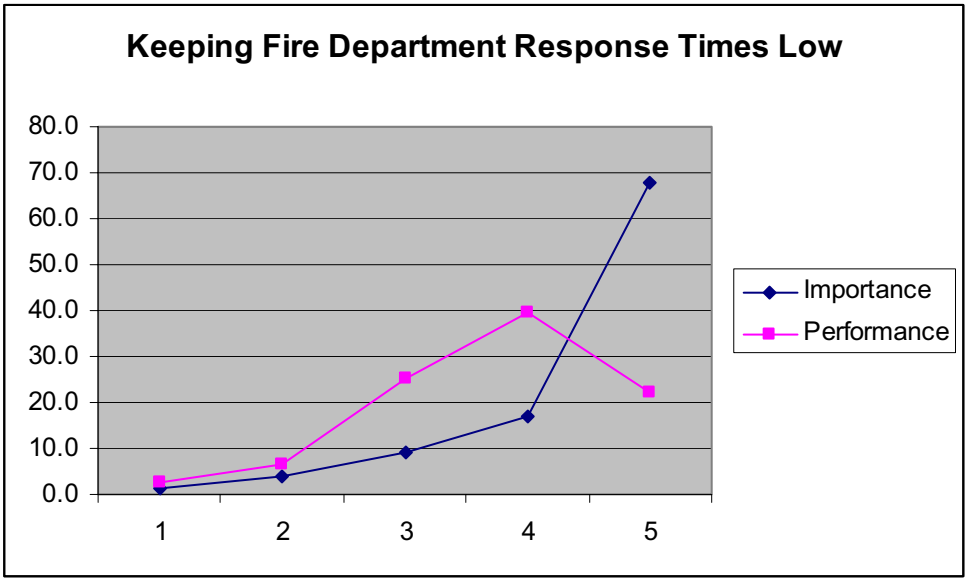

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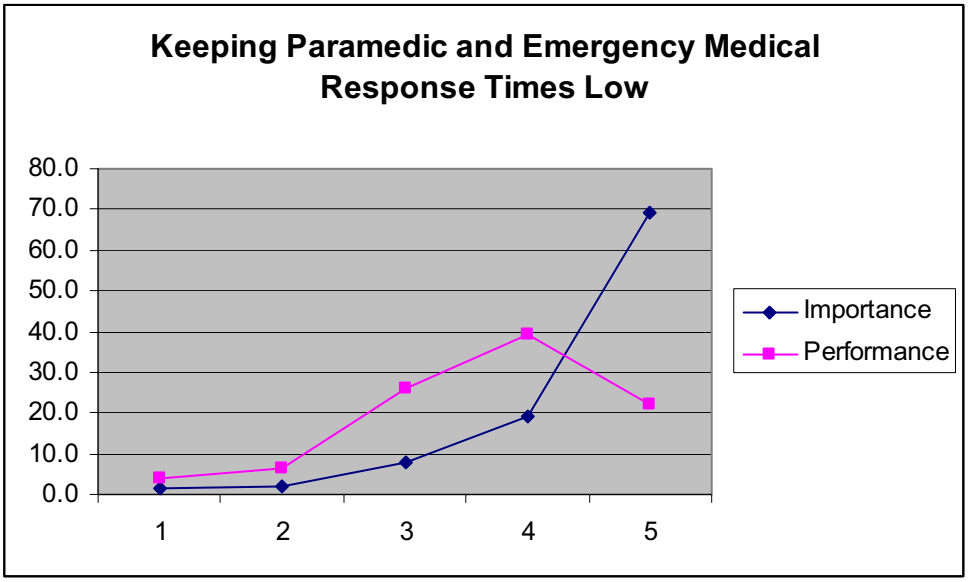

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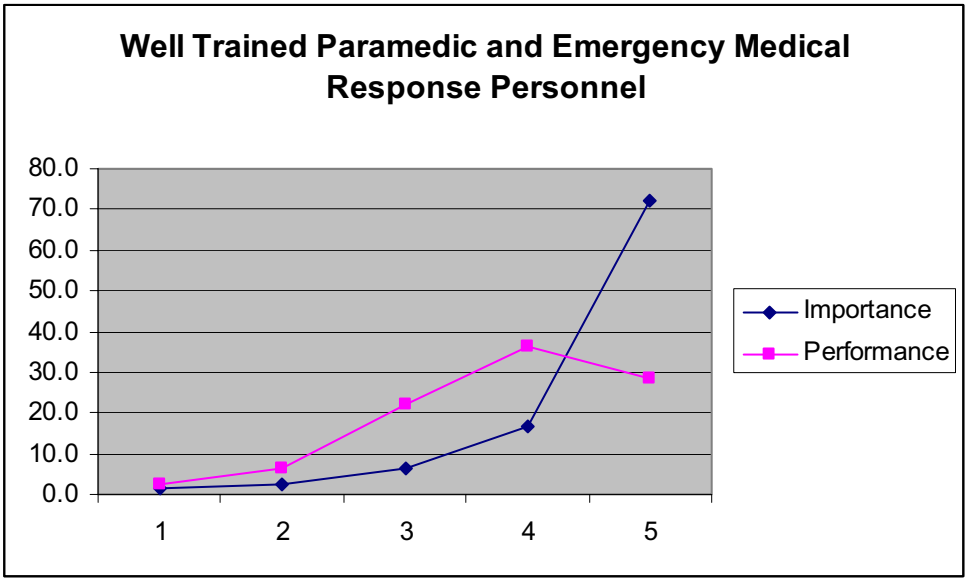

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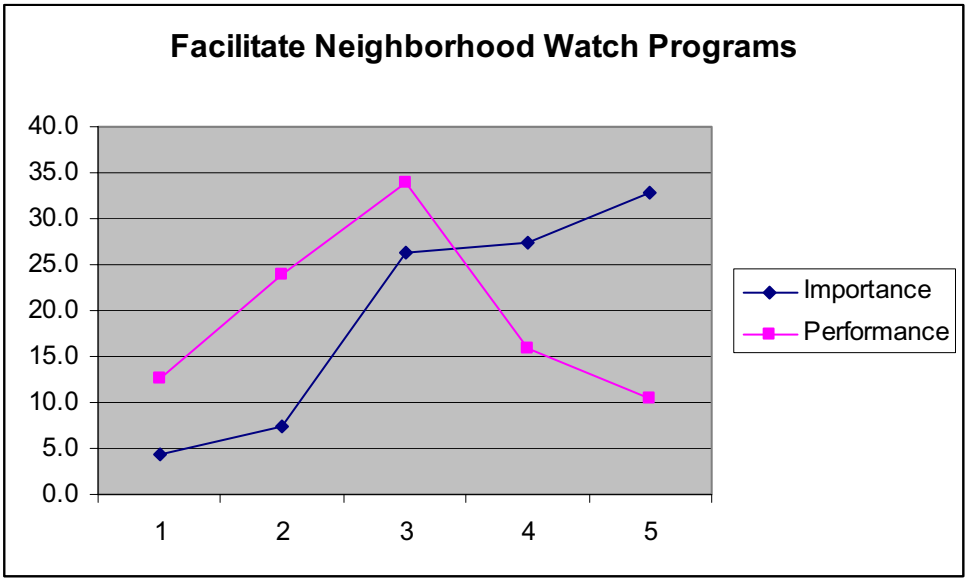

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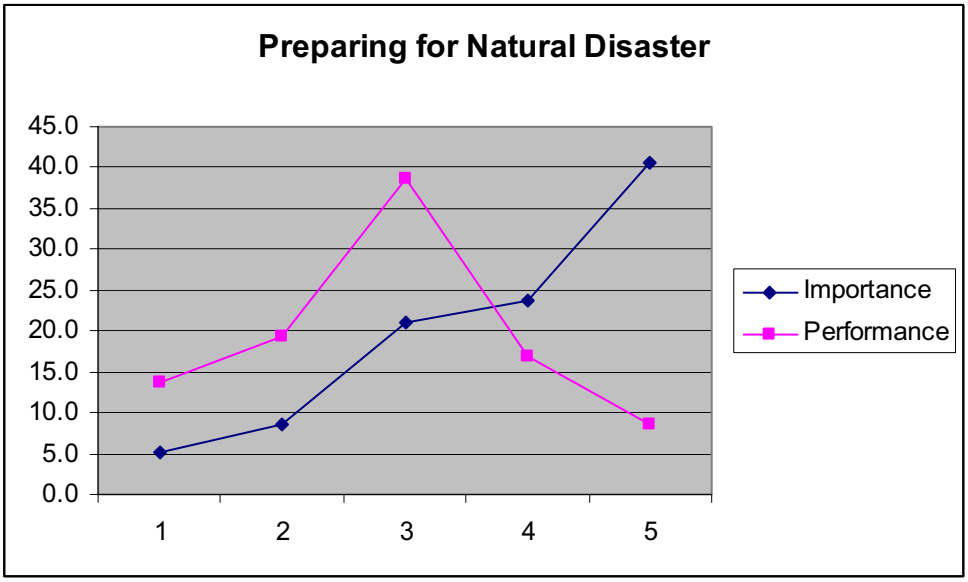

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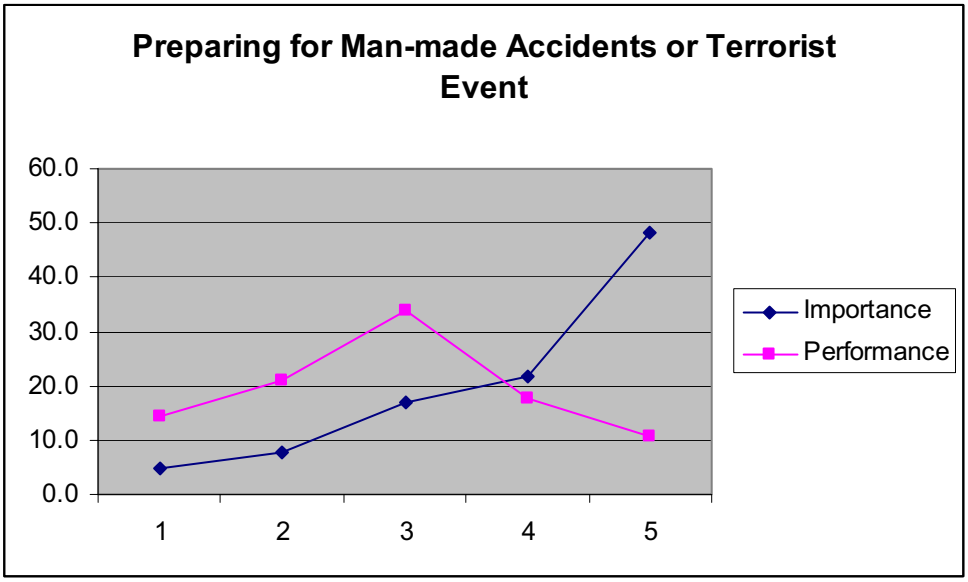

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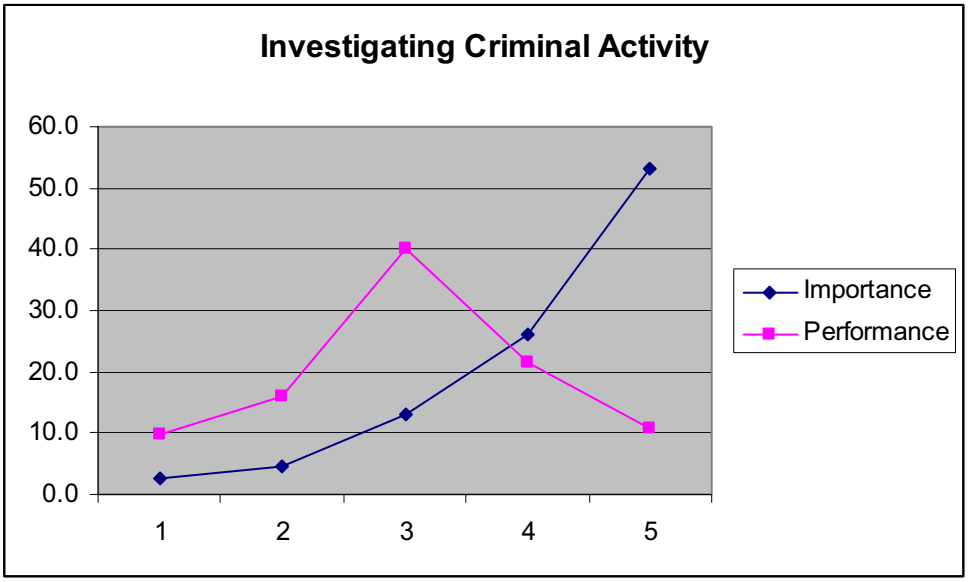

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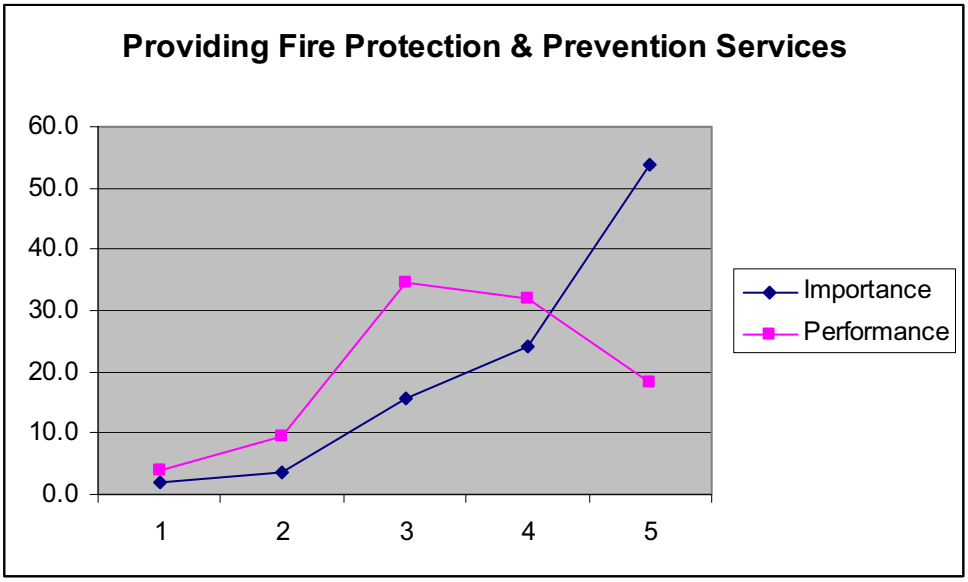

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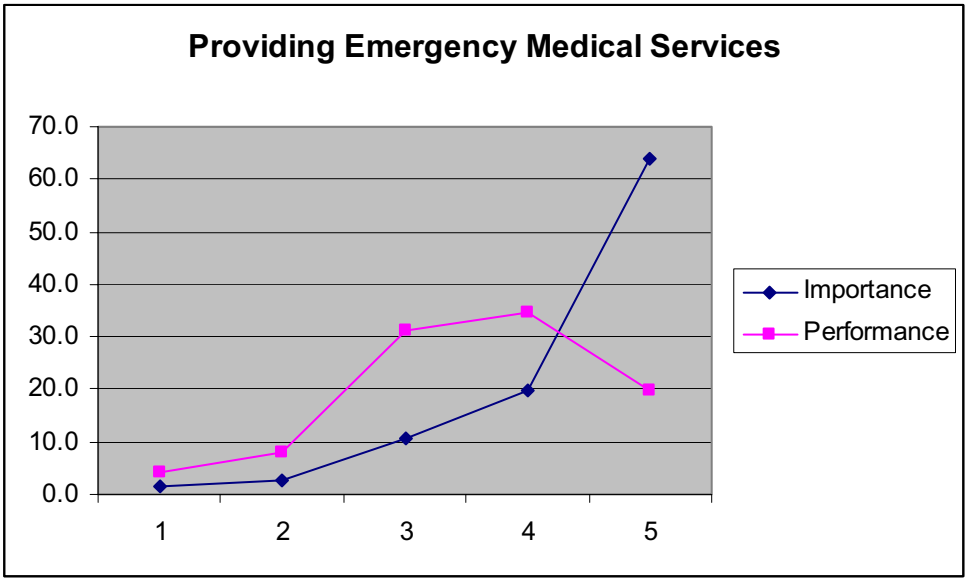

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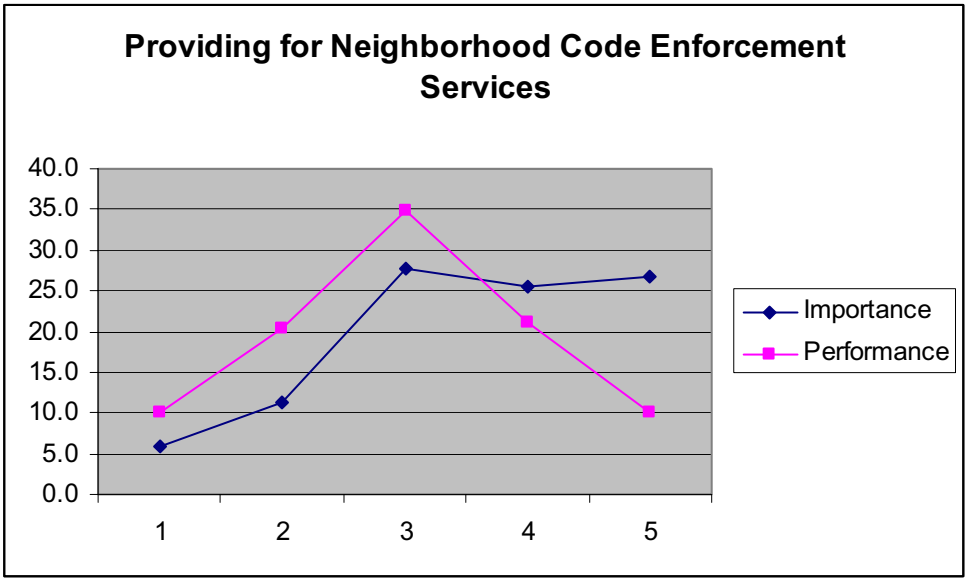

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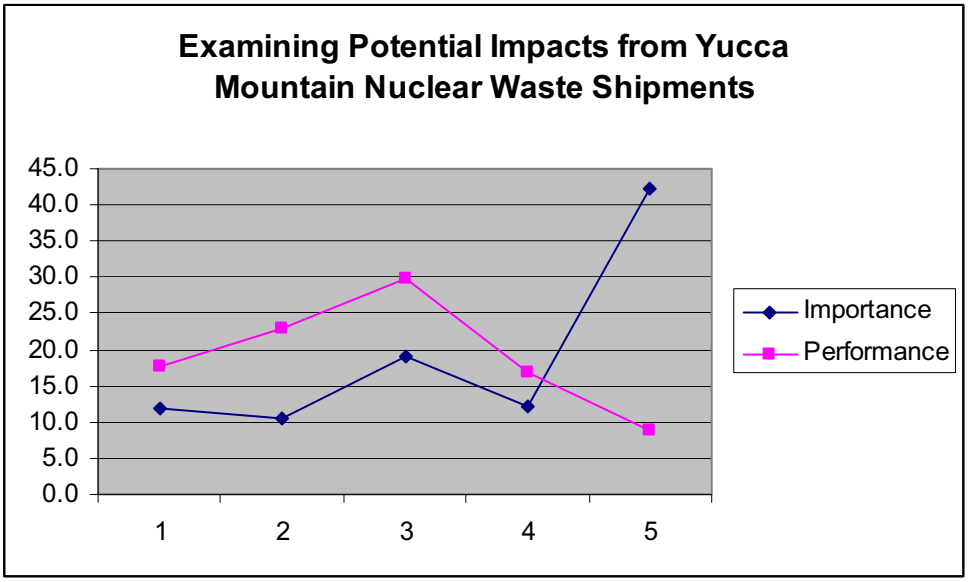

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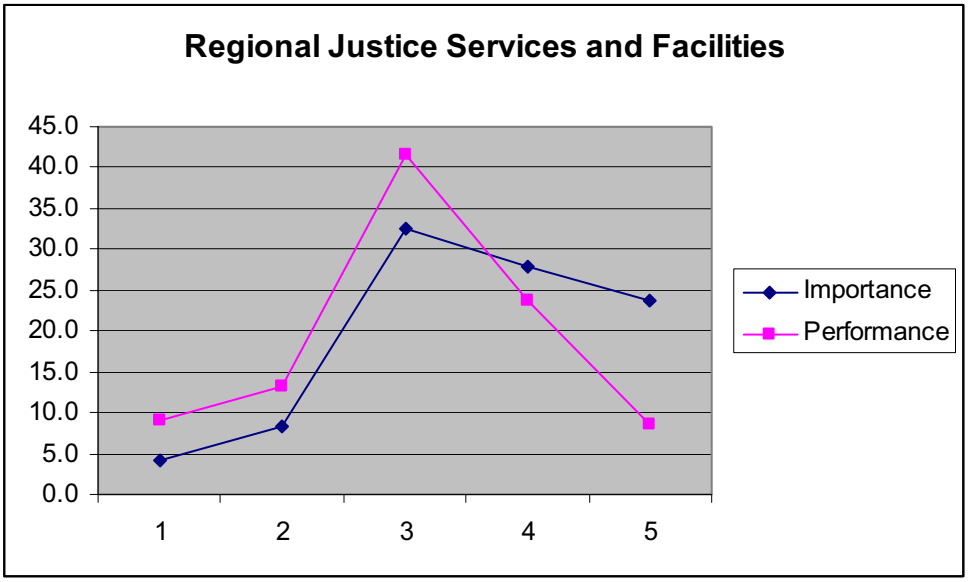

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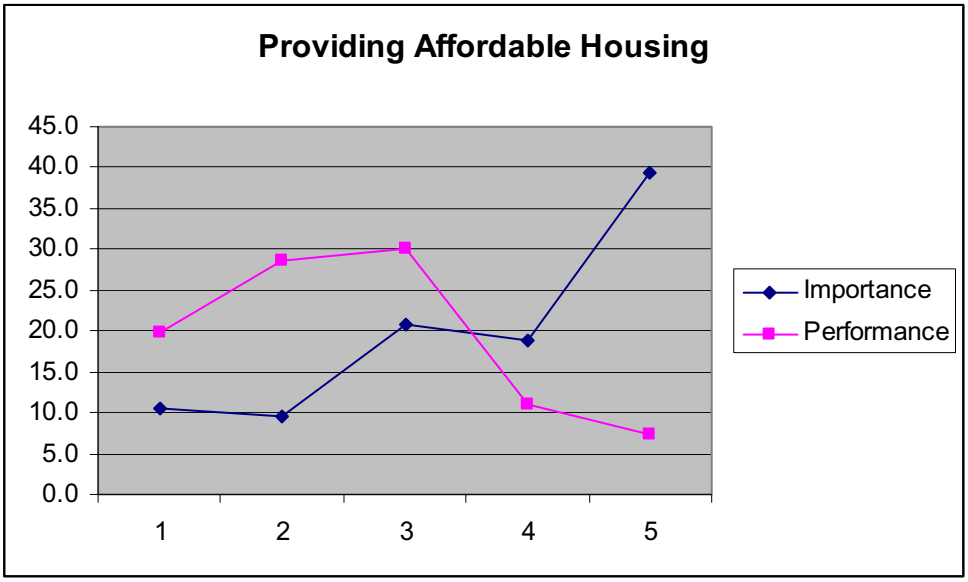

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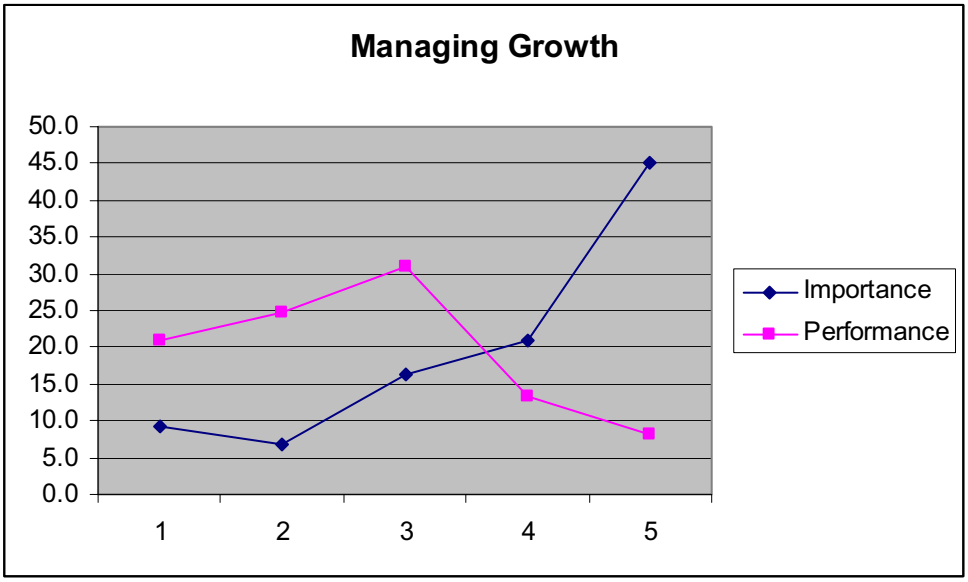

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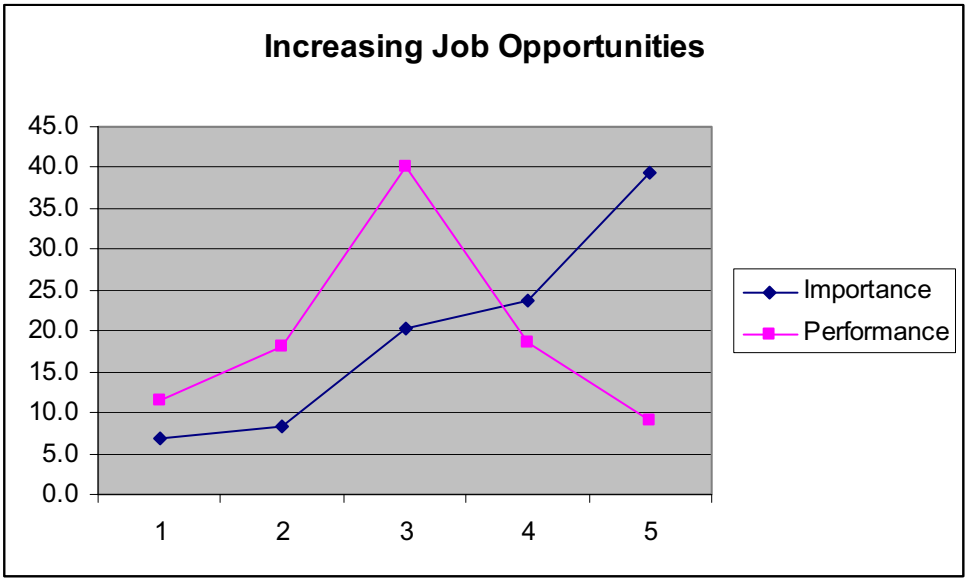

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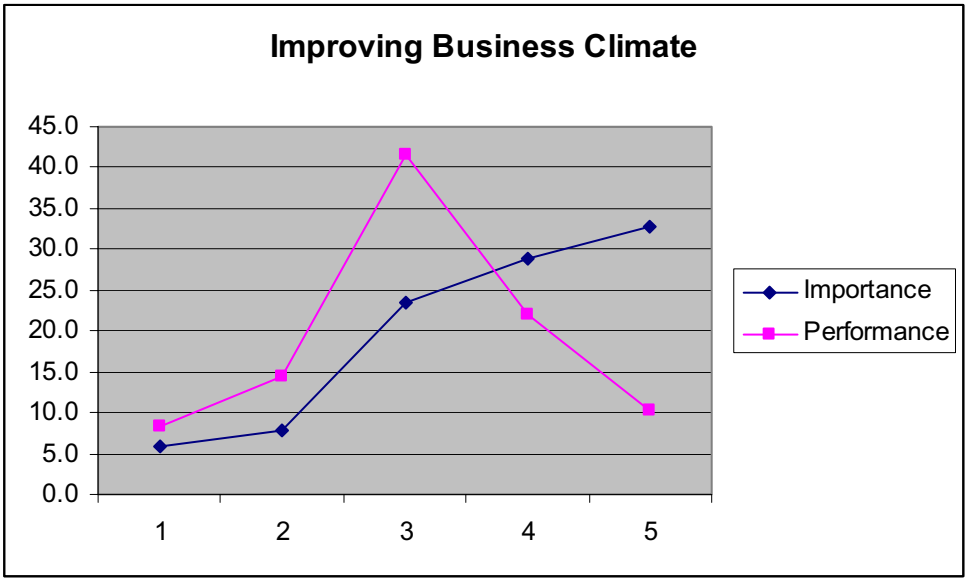

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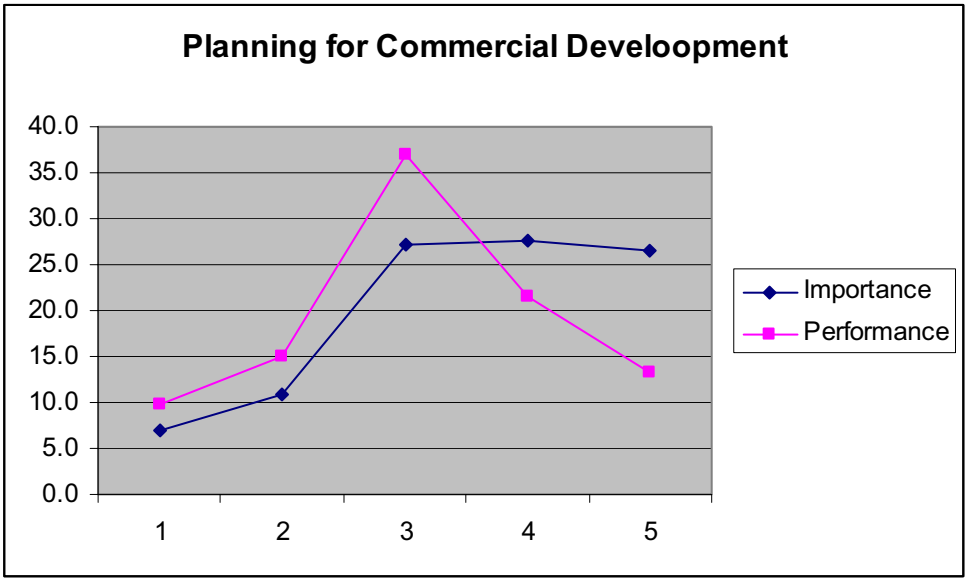

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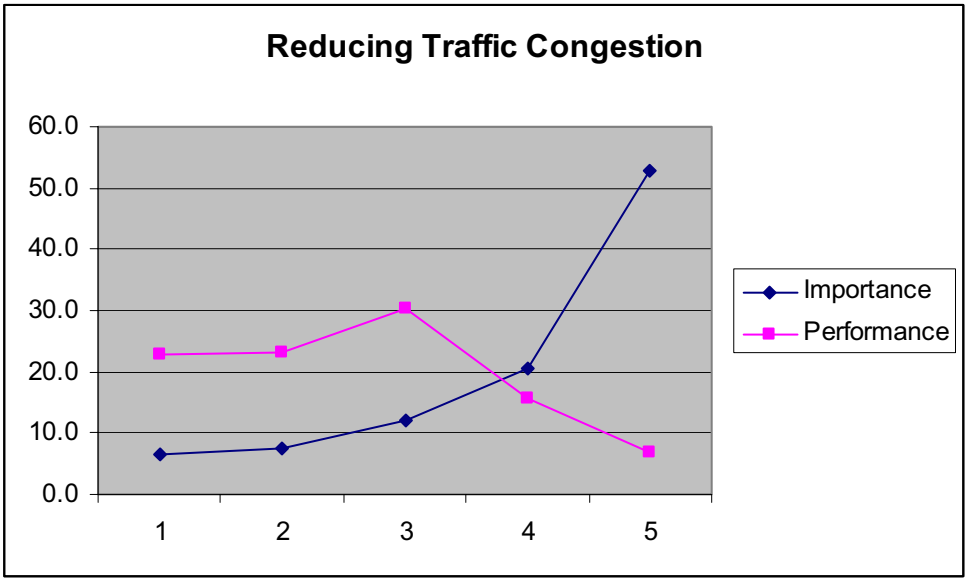

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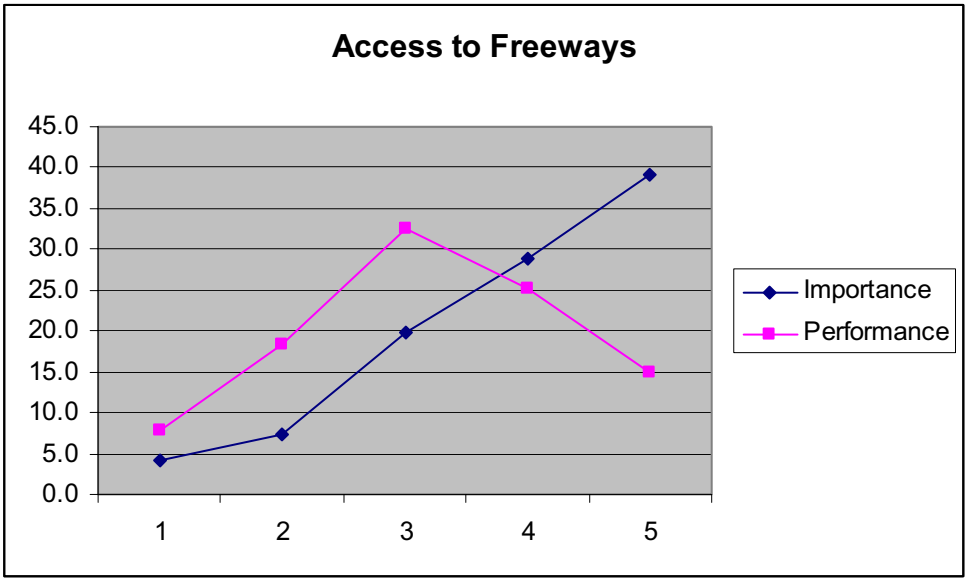

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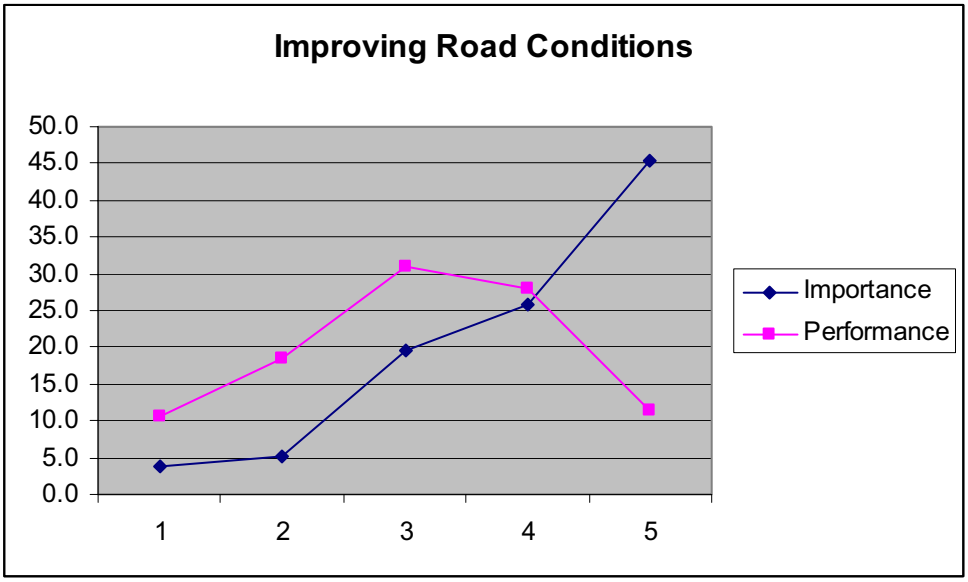

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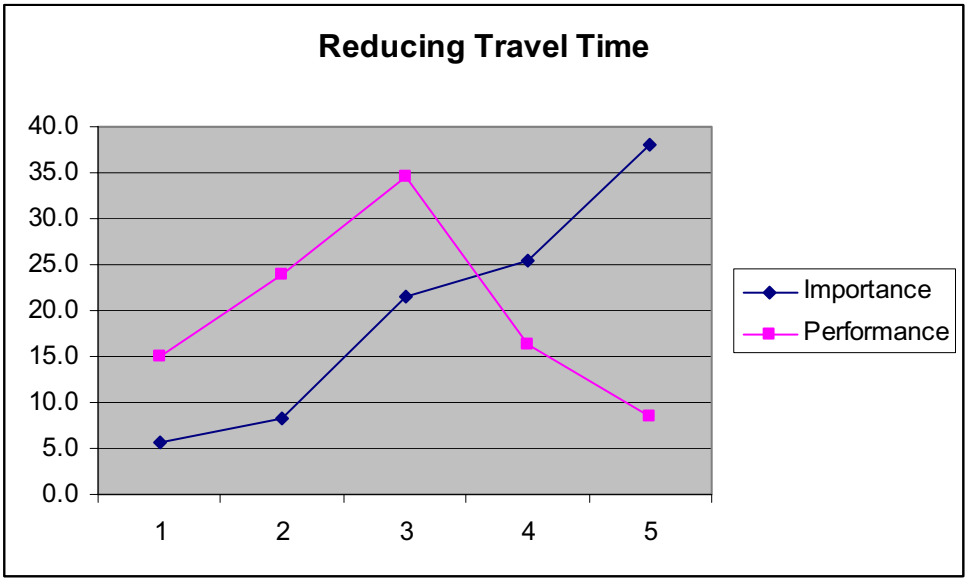

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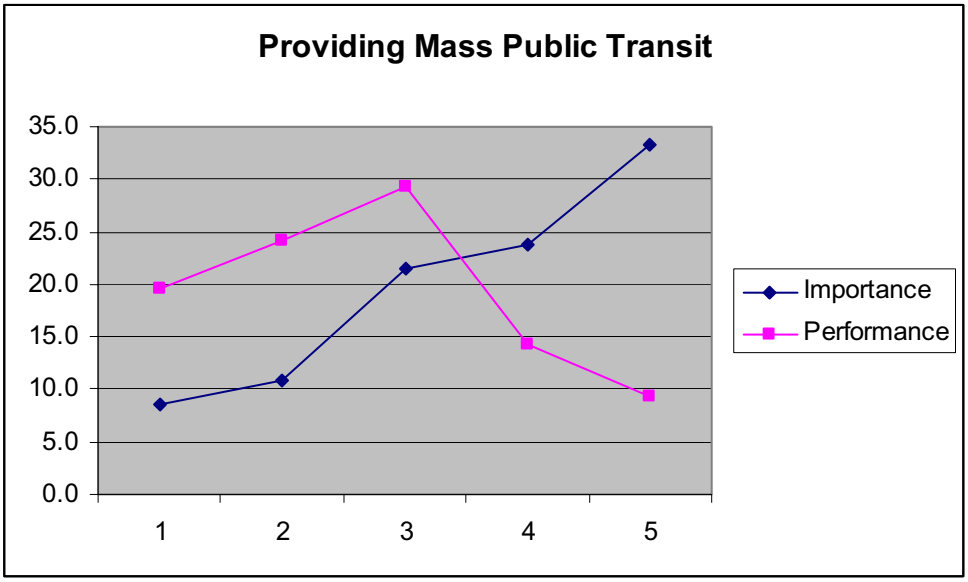
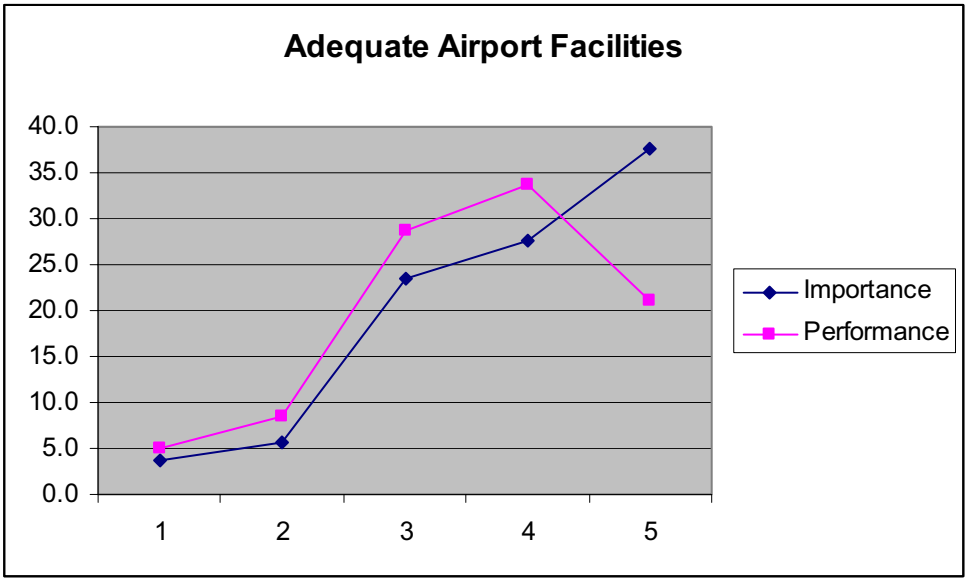


Appendix XII
Importance/Performance Comparisons



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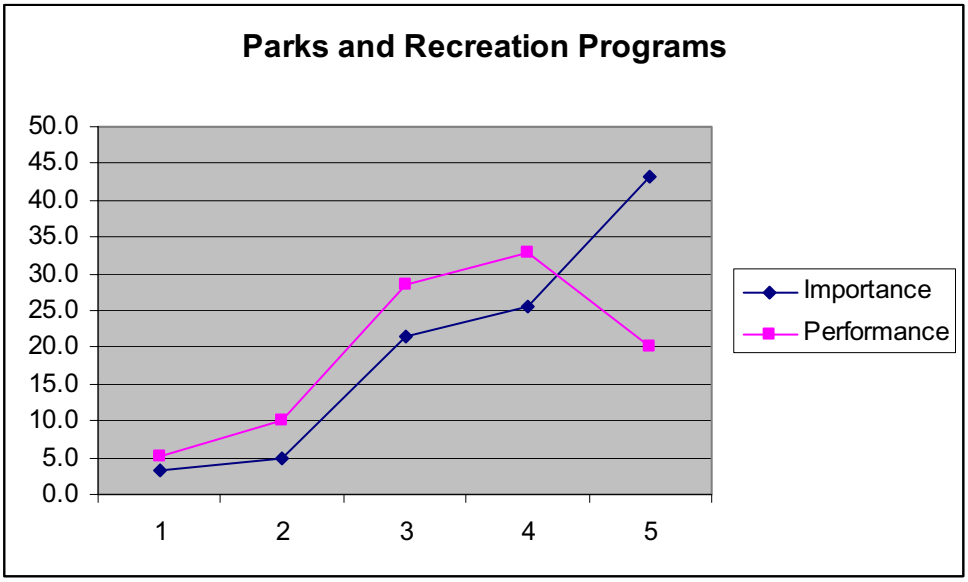

Attachment 17

Schweer, K. UNLV Center for Business and Economic Research (2001)

REMI Analysis Utilizing UER Property Losses to Determine Economic Impacts on Clark County's Scenarios

Prepared by

R. Keith Schwer, PhD

The Center for Business and Economic Research

Prepared for

Clark County Comprehensive Planning

December 26, 2001

The Center for Business and Economic Research
University of Nevada, Las Vegas

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Economic impacts work through backward and forward linkages. Backward linkages have been referred to as indirect effects and follow from the basics of production activities. For example, an expansionary change calls for increased inputs, thereby adding additional activity to the original direct change. On the other hand, the indirect effects associated with an initial adversity will further affect conditions negatively. In short, initial effects do not fully reflect final economic impacts. Forward linkages also may create effects. For example, the sale of goods and services increases incomes, thereby inducing additional expenditures. Rising employment and wages create opportunities for additional consumer spending, thus, measuring the full impacts of an event calls for an accounting of direct, indirect, and induced effects.

A full accounting of economic impacts can be reached through modeling forward and backward linkage, the degree of respending of dollars within an economy, and spending leakages. Input-output and econometric models have proved useful in accomplishing this task for studying the full impacts of changes in regional economies.

Clark County asked the Center for Business and Economic Research (CBER) at UNLV to estimate the full-employment, income, and expenditure effects resulting from estimated direct effects for three scenarios associated with the transportation of nuclear waste through Clark County. This report details estimates of these alternative scenarios using a modeling scheme developed by Regional Economic Models, Inc (REMI) and calibrated to local conditions by CBER. The initial impacts, reductions to specific property values, used in this analysis were developed and estimated by Urban Environmental Resource, LLC (UER) in conjunction with lenders and appraisers within Clark County. We have taken these estimates as prepared by UER and developed estimates for leading economic indicators.

Each of the three scenarios have possible outcomes, ranging from a minimum to a maximum, altogether resulting in six separate direct impacts that we modeled. The three scenarios are as follows:

1. Scenario I -- The identification of nuclear waste transported through Clark County.
2. Scenario II -- The occurrence of an accident without a nuclear spill within Clark County.
3. Scenario III-- The occurrence of an accident with a nuclear spill in Clark County.

The minimum and maximum estimates reflect separate valuation efforts from lenders and appraisers. The valuations comprise estimates associated with residential property losses, commercial and industrial property losses, and the permanent loss in gaming revenue (revenue from the region's major industry).

These initial impacts were transformed for estimation with the REMI model. The loss of residential property values is transformed to an economic flow through consumer spending. A loss of wealth (residential property) is estimated to cut the level of spending by 4 percent per year. This wealth-to-spending adjustment follows a long-established relationship associated with the wealth impact on consumer spending. The loss of business activity from a loss of commercial and industrial property and gaming revenue is estimated from ratios of the number of employees per dollar of property value (estimated from the historical data associated with the REMI model) and the number of employees in hotel and gaming (as reported by the Nevada state government) and gaming revenue for Clark County reported by Nevada's Gaming Control Board.

The full impacts are measured by the differences in the level of employment, income, population, and expenditures without the identified options (identified as the baseline) and with

the impacts of an option (identified as a simulation). The specifics associated with this analysis as they relate to the use of the REMI model are specified in George Treyz's book, Regional Economic Modeling: A Systematic Approach to Economic Forecasting and Policy Analysis. The relationship between impact analysis with REMI and the other two major model schemes (identified as IMPLAN and RIMS) as they relate to Clark County has been discussed in a series of academic publications by Rickman and Schwer. A summary of the key issues relating to impact analysis for Clark County, Nevada, is in Rickman and Schwer's paper, "A Comparison of the Multipliers of IMPLAN, REMI, and RIMSII: Benchmarking Ready-made Models for Comparison," The Annals of Regional Science, (1995) 29: 363-374.

Model Inputs

The model inputs, the loss of consumer spending and the loss of jobs, were introduced in six separate sets of estimates, that is, six separate simulations (three scenarios with two sets of estimates). The job and spending losses were introduced beginning in 2010 and additionally for each year until 2035. Consumer-spending estimates were introduced in terms of inflation-adjusted dollar amounts, what economists refer to as constant dollars. In measuring income and expenditure impacts the distinction between current-dollar measures (unadjusted for inflation) and constant dollars (adjusted for inflation) is important. In addition, the adjustment for inflation can be made with a number of deflators, for example, the GDP deflator or CPI deflator. Deflators were also developed for local areas. The model estimates values in constant 1992 dollars. Values in current dollars will be greater; therefore, these estimates are extremely conservative.

Estimates for lenders and appraisers were made for these options and are shown in Table 1.

Table 1

Property Impacts on Clark County in 2001$

Scenario 1

	Appraisers	Lenders
Residential	$161,875,121	$85,248,577
Commercial	4,935,088	4,936,336
Industrial	3,331,370	7,485,860
Sub-total	170,141,579	97,670,773
Gaming Revenue	172,106,274	136,300,947
TOTAL	342,247,853	233,971,720

Scenario 2

	Appraisers	Lenders
Residential	$411,415,310	$270,425,245
Commercial	11,885,595	26,648,041
Industrial	9,688,140	19,087,447
Sub-total	432,989,045	316,160,733
Gaming Revenue	451,327,642	300,885,093
TOTAL	884,316,687	617,045,826

Scenario 3

	Appraisers	Lenders
Residential	$2,171,118,617	$2,176,536,502
Commercial	75,128,562	246,432,903
Industrial	67,362,912	126,670,956
Sub-total	2,313,610.091	2,549,640,361
Gaming Revenue	992,920,810	752,212,735
TOTAL	$3,306,530,901	$3,301,853,096

Source: UER

An increasing number of possible scenarios also brings a range of additional estimates. Whereas these additional options are of note, their introduction does not appreciably help policy makers understand the impacts better. As a result, the redundancy of alternative options was reduced to selecting the largest and smallest initial impacts for each scenario. In so doing, each scenario has only one estimate by lenders (minimum estimate) and one estimate by appraisers (maximum estimate). The direct impacts provided by UER, shown in Table 1, were translated into impacts described above, and for purposes of analysis are shown in Table 2 on an annual basis.

Table 2

Model Inputs

Scenario 1		
Lender	Translation Ratio	Annual Impact in Lost Spending in Current Dollars or Number of Job Losses
Consumer Spending	4% of loss	$2,848,672.64
Jobs Lost	1 job/$36,323	111.1436280043
Gaming Jobs Lost	1 job/$40,606	3356.670122642
Appraiser		
Consumer Spending	4% of loss	$7,693,369.96
Jobs Lost	1 job/$36,323	934.9605208821
Gaming Jobs Lost	1 job/$40,606	4238.444417081
Scenario 2		
Lender		
Consumer Spending	4% of loss	$9,044,336.32
Jobs Lost	1 job/$36,323	272.8530132423
Gaming Jobs Lost	1 job/$40,606	7409.867827415
Appraiser		
Consumer Spending	4% of loss	$19,501,827.88
Jobs Lost	1 job/$36,323	2462.484958048
Gaming Jobs Lost	1 job/$40,606	11114.80180269
Scenario 3		
Lender		
Consumer Spending	4% of loss	$73,776,357.52
Jobs Lost	1 job/$36,323	2862.522644055
Gaming Jobs Lost	1 job/$40,606	18524.6696301
Appraiser		
Consumer Spending	4% of loss	$102,464,069.24
Jobs Lost	1 job/$36,323	13821.90785453
Gaming Jobs Lost	1 job/$40,606	24452.56390681

The information provided by UER does not directly relate to the set of variables of the model which we may change.

As such, we translated the loss of residential property value to reduced consumer spending through the wealth effect. The lost commercial and industrial property translated to job losses using a fixed ratio between capital and labor through production, one job loss per $36,223 of property value lost. In addition, we distributed the jobs losses proportional to the percentage of jobs in each two digit industry. Lastly, we estimated the impact of the losses to hotels and casinos using a fixed ratio of gaming revenue per worker. Using gaming revenue and employment data, we estimate the ratio as one job for each $40,606 of gaming revenue.

Model Outputs

REMI, an eclectic model combining an input-output structure and econometric relationships, enables the estimation of a long list of impacts. Again, wishing to focus on the most important impacts, we have limited our output evaluation to the four most often used measures—employment, income, expenditures, and population. With respect to income and expenditures, however, we show cumulative effects. We show both the short-term effects (the losses for a given year) and longer-term effects (the cumulative impacts over 25 years). Employment impacts can be cumulated and shown on a job-year basis; but, we did not do so, thereby avoiding possible confusion of interpretation between jobs and job-years measures. The detailed output from the models (which could be used to measure impacts across a host of measures) is appended. The output for the select measures is shown in Table 3.

Table 3

Economic Impacts on Clark County's Scenarios

	Job Losses(1)	Population Losses (1)	Cumulative Economic Losses: 2010-2035 (in 1992 Dollars) Spending (2)	Income (3)
Scenario 1				
Lender	5,393	11,294	$5,663,400,000	$4,700,200.000
Appraiser	7,426	12,707	$8,490,300,000	$5,819,100,000
Scenario 2				
Lender	11,193	19,573	$11,852,400,000	$8,856,500,000
Appraiser	19,522	33,419	$22,333,300,000	$15,300,400,000
Scenario 3				
Lender	31,305	53,984	$35,131,000,000	$24,611,600,000
Appraiser	54,429	90,718	$68,116,000,000	$42,128,000,000

Notes (1). (Average Annual)
(2). (Gross Regional Product)
(3). (Disposable Personal Income)

Findings

The minimum impacts are associated with the lender estimates of Scenario I (trucks utilizing the transportation system of Clark County) and are as follows:

1. Job loss of 5,393 jobs.
2. Expenditure loss of $185 million per year, on average, in 1992 dollars and a cumulation loss of $5.6 billion in1992 dollars.
3. Personal income loss of $282 million per year, on average, in 1992 dollars.
4. Real disposable income loss (accounting for taxes and inflation) of $136 million per year, on average, in 1992 dollars and a cumulative 25-year loss of $4.7 billion in constant 1992 dollars.
5. A population loss of 11,294 persons.

The minimum impact estimates are decidedly less onerous than the impacts expected under Scenario 3 (an accident occurs involving the release of radioactive materials along Clark County roads). The maximum impacts are as follows:

1. Employment loss of 54,429 jobs.
2. Average annual expenditure loss of $1.4 billion and a 25-year cumulative loss of $68.1 billion.
3. Personal income loss of $776 million per year.
4. Real disposable income loss of $686 million per year and a 25-year cumulative loss of $42.1 billion in constant dollars.
5. A population loss of 90,718 persons.

Conclusion

The transportation of nuclear waste without an accident of spillage of radioactive material through a large urban community will have adverse impacts on a community such as Las Vegas which depends on travel and tourism for its economic livelihood. The maximum economic impact of a transportation accident, based upon current available information is devastating to any community, especially one which depends upon travel and tourism as its economic engine. The loss of 54,429 jobs and 90,718 people is of grave concern to this community and greatly exceeds the adverse, but temporary impacts of the September 11, 2001 terrorist attacks on travel and tourism..

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