Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada

Volume 1
Chapters 1-9

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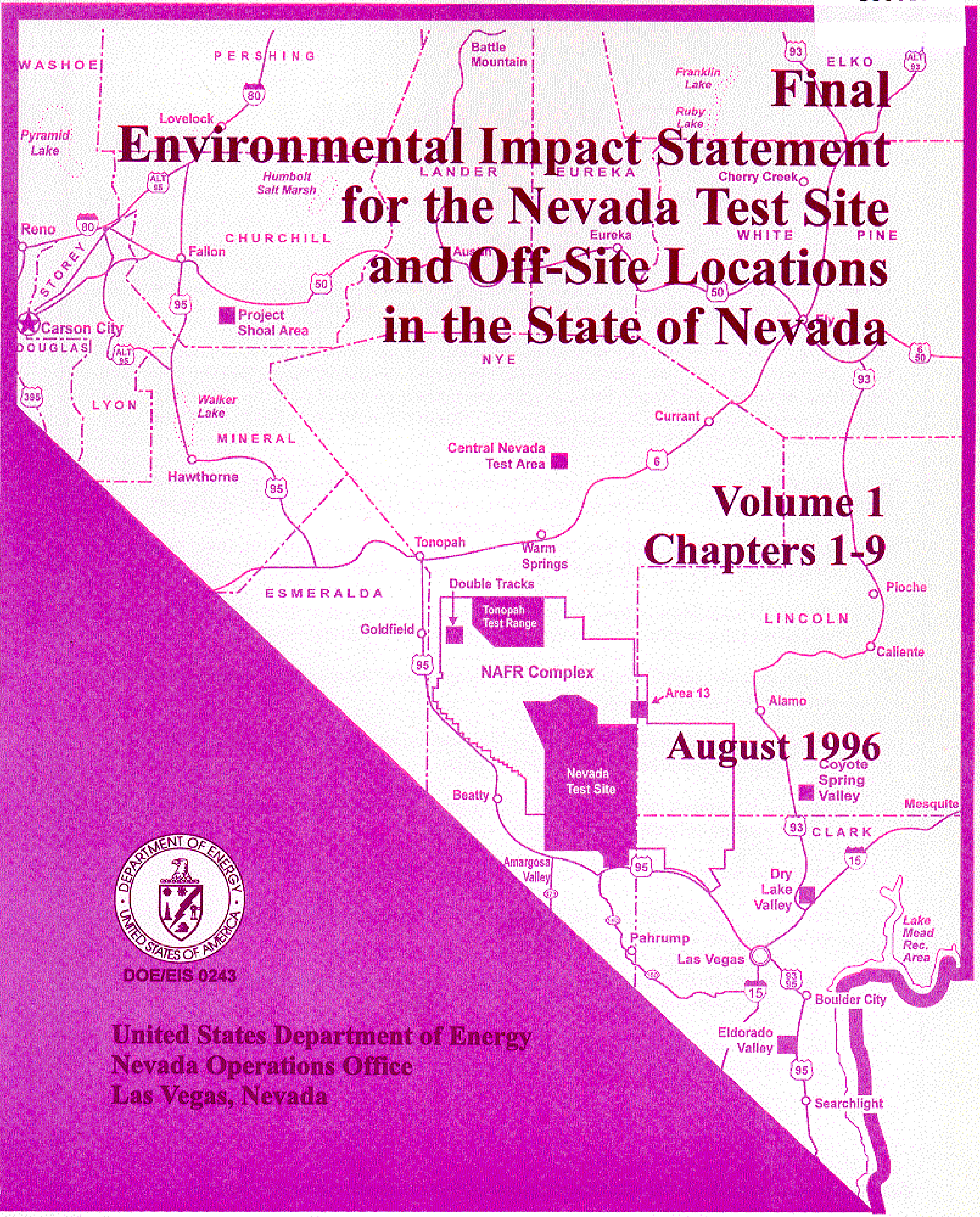

DOE/EIS 0243

United States Department of Energy
Nevada Operations Office
Las Vegas, Nevada

THE NEVADA TEST SITE

The U.S. Department of Energy (DOE) coordinates and administers the energy functions of the federal government, including the nuclear weapons program, research and development of energy technologies, and basic science research. The Nevada Test Site (NTS) has been the continental location of the U.S. nuclear weapons testing program for over 40 years, because following World War II, a suitable site was needed to conduct nuclear weapons tests. The NTS occupies 3,496 square kilometers (1,350 square miles) in southern Nevada and is located approximately 105 kilometers (65 miles) northwest of Las Vegas.

The DOE also manages several other sites located in central Nevada. The sites include the Tonopah Test Range, Central Nevada Test Area, and Project Shoal Area located southeast of Fallon, Nevada. The Central Nevada Test Area and Project Shoal Area were nuclear underground test sites in the 1970s. The Tonopah Test Range is an active research facility managed by the DOE and operated by Sandia National Laboratories. This facility is jointly used by the DOE and U.S. Air Force.

Most work on the NTS has been and continues to be related to national defense; however, there is growing emphasis on environmental restoration and waste management programs. Current NTS missions are:

- Support the Threshold Test Ban Treaty and the Peaceful Nuclear Explosives Treaty verification mission, and support the ongoing Comprehensive Test Ban Treaty negotiations

- Provide the capability to respond to nuclear emergencies, such as lost or stolen nuclear weapons and special nuclear materials, nuclear bomb threats, and radiation dispersal threats

- Demonstrate the capability to provide alternate energy sources, including solar energy, to meet power needs for the southwestern United States

- Maintain a state of readiness to conduct underground nuclear testing through the conduct of treaty compliance and permitted experiments and activities

- Maintain the nation's stockpile of nuclear weapons in a safe and secure manner, and fulfill other nonproliferation and national security related missions

- Manage wastes generated on the NTS and at other DOE-approved facilities across the United States

- Perform site characterization and environmental restoration activities required to minimize or eliminate the impacts of past operations

- Supervise operations of non-DOE entities performing research and development related to the safety aspects of hazardous chemicals and liquefied gaseous fuels

- Serve as an outdoor laboratory where scientists and students can conduct research on environmental issues as part of the DOE - National Environmental Research Park Network.

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DOE/EIS--0243-Vol.1-Ch.1-9

Dear Interested Party

The Final Environmental Impact Statement (EIS) for the Nevada Test Site (NTS) and Off-Site Locations in the State of Nevada has been completed. This EIS examines existing and potential impacts to the environment that have resulted, or could result, from current and future Department of Energy activities in southern Nevada. The EIS analyzes four alternatives for managing the activities of Department of Energy programs at the NTS, the Tonopah Test Range, portions of the Nellis Air Force Range Complex, the Central Nevada Test Area, and the Project Shoal Area. In addition, proposed Solar Enterprise Zone facilities in Dry Lake Valley, Eldorado Valley, Coyote Spring Valley and the NTS are also examined.

The EIS identifies the Preferred Alternative as the Expanded Use Alternative (Alternative 3) plus the public education activities from Alternative 4, Alternate Use of Withdrawn Lands. This Preferred Alternative is the most comprehensive alternative in supporting statutory mission responsibilities while providing for a diversification of use to include nondefense, interagency, public, and private uses of the resources and capabilities available. Details on this preferred alternative can be found in the Summary and in Volume 1, Section 3.6, of this EIS. A framework for a Resource Management Plan is included as Volume 2 of this EIS and represents the development of an ecosystem management-based planning process closely integrated with the National Environmental Policy Act process.

The Department of Energy appreciates your participation in the development of this EIS and looks forward to your continued participation in the development of the Resource Management Plan and other activities of the Department of Energy.

Terry A. Vaeth
Acting Manager

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COVER SHEET

RESPONSIBLE AGENCY: U.S. Department of Energy

COOPERATING AGENCIES: Federal: U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, Defense Nuclear Agency; and U.S. Air Force; Local Governments: Nye County, Nevada

TITLE: Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (DOE/EIS-0243)

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ABSTRACT: This sitewide EIS evaluates the potential environmental impacts of four possible land-use alternatives being considered for the Nevada Test Site (NTS), the Tonopah Test Range, and the formerly operated DOE sites in the state of Nevada: the Project Shoal Area, the Central Nevada Test Area, and portions of the Nellis Air Force Range Complex. Three additional sites in Nevada—Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley—are evaluated for colocation of solar energy production facilities. The four alternatives include **Continue Current Operations** (No Action, continue to operate at the level maintained for the past 3 to 5 years); **Discontinue Operations** (discontinue operations and interagency programs); **Expanded Use** (increased use of NTS and its resources to support defense and nondefense programs); and **Alternate Use of Withdrawn Lands** (discontinue all defense-related activities at NTS; continue waste management operations in support of NTS environmental restoration efforts; expand nondefense research). Environmental impacts were assessed for each alternative by analyzing, to the extent possible, the discrete and cumulative environmental impacts associated with Defense Waste Management, Environmental Restoration, Nondefense Research and Development, and Work for Others Programs. A framework for a Resource Management Plan is included as Volume 2 of this EIS and represents the development of an ecosystem based planning process closely integrated with the National Environmental Policy Act process. This EIS, among other things, analyzed the impacts of transportation of low level waste, and site characterization activities related to the Yucca Mountain Project but did not analyze the suitability of the site as a repository. This EIS does not analyze the suitability of the Yucca Mountain site as a repository as this is an action beyond the scope of the EIS. The **Preferred Alternative** is identified as **Expanded Use** plus the public education activities from **Alternate Use of Withdrawn Lands.** Volume 3 of this EIS contains the public comments and the responses to the comments.

Final
Environmental Impact Statement

for
the Nevada Test Site and Off-Site Locations in the State of Nevada

Volume 1

U.S. Department of Energy
Nevada Operations Office
Las Vegas, Nevada

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Chapter 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

The U.S. Department of Energy (DOE) proposes to continue managing the Nevada Test Site (NTS) and its resources in a manner that meets evolving DOE missions and that responds to the concerns of affected and interested individuals and agencies.

This sitewide Environmental Impact Statement (EIS) is a type of programmatic EIS, in that it analyzes the impacts from DOE programs at the following sites: the NTS, the Tonopah Test Range, portions of the Nellis Air Force Range Complex (NAFR Complex), the Central Nevada Test Area, and the Project Shoal Area. These programs include ongoing activities for the stewardship of the nation's nuclear weapons stockpile, management of radioactive waste, and environmental restoration. Also examined in this EIS are newer programs, such as the proposed Solar Enterprise Zone facilities at the NTS, Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley. In addition, Appendices F and J provide project specific analyses for the Big Explosives Experimental Facility and the activities conducted in the Lyner Complex, respectively.

This EIS examines existing and potential impacts to the environment that have resulted, or could result, from current and future DOE operations in Nevada during the next 10-year period. This 10-year planning period accounts for both short-term (0 to 5 years) and long-term (5 to 10 years) potential projects. However, it is a regulatory requirement of the DOE (10 CFR Part 1021) to review a sitewide EIS of multifacility sites at least every 5 years. The DOE Nevada Operations Office (DOE/NV), proposes to accomplish this review through the Resource Management Plan process. Although a framework for the *Resource Management Plan* is being published in conjunction with the NTS EIS, the *Resource Management Plan* will take longer to complete than the NTS EIS. In the future, it will be an integral part of the National Environmental Policy Act process on the NTS. The DOE is committed to completing the *Resource Management Plan*, which is estimated to take approximately 2 years. The 5-year sitewide review required by DOE policy will utilize the *Resource Management Plan* as part of the review of the EIS and in determining whether (1) the existing EIS remains adequate, or (2) a new EIS should be prepared or the existing EIS supplemented. A more detailed discussion on the relationship between the *Resource Management Plan* and the EIS is presented in the *Framework for the Resource Management Plan* (Volume 2, Section 1.4 of the EIS).

In September 1977, the *Final Environmental Impact Statement, Nevada Test Site, Nye County, Nevada*, a broadly scoped NTS EIS, was published (ERDA, 1977). Pursuant to the DOE's mission responsibilities at that time, the 1977 EIS focused on an evaluation of the environmental impacts of underground nuclear tests with yields of less than one megaton. An analysis of other intermittent nuclear and non-nuclear activities that were conducted—and continue to be conducted—at the NTS was included in this earlier EIS. In recent years, nuclear testing policy changes have occurred. These policy changes have caused significant changes in NTS programs. These changes, together with the favorable environmental and infrastructure characteristics at the NTS, have resulted in additional DOE and non-DOE activities being proposed for siting at the NTS. These proposed changes in operations at the NTS, and the DOE policy of reviewing sitewide National Environmental Policy Act documents, have resulted in the preparation of a new NTS EIS. Preparing an EIS at this time responds to public concern and allows for a full dialogue among the DOE and state, tribal, county and municipal governments; other federal agencies; and the general public.

Initially, the DOE/NV planned to prepare two EISs to be separated along programmatic lines. The DOE/NV Environmental Restoration and Waste Management EIS was to address restoration and waste management activities at the NTS and other off-site test areas within Nevada. The sitewide NTS EIS was to address the future mix of Defense Program missions/activities, stockpile stewardship, and alternative uses of the NTS.

The Manager, DOE/NV, decided on May 15, 1994, that one EIS should be prepared for the Defense, Environmental Restoration, and Waste Management Programs, and other potential activities considered for the NTS. Work then began on the preparation of a Notice of Intent (NOI) for this EIS. The NOI was subsequently published in the *Federal Register* on August 10, 1994.

On June 28, 1994, the state of Nevada filed a Complaint for Declaratory Judgment and Injunction against the DOE in the U.S. District Court in Nevada. In its complaint, the state of Nevada sought declaratory judgments that the DOE has failed to comply with National Environmental Policy Act requirements at the NTS, and that the DOE must initiate a single sitewide EIS for all major federal actions at the NTS. Nevada also sought orders to halt shipments of low-level waste from Fernald (a DOE site located in Ohio), as well as all other transportation, receipt, storage, and disposal of mixed waste, hazardous waste, and other DOE approved waste to the NTS. In its complaint, Nevada sought to stop the DOE from pursuing any "Weapons Complex" activities, including nuclear testing, research, and development that would significantly impact the environment, until publication of the NTS EIS.

On July 14, 1994, the state of Nevada amended its original complaint to focus on enjoining only the receipt, disposal, and waste management activities related to off-site waste. The U.S. District Court in Nevada issued an Order on January 12, 1995, that dismissed Nevada's claims regarding shipment of Fernald low-level waste to the NTS based on a pre-enforcement review bar under the Comprehensive Environmental Response, Compensation and Liability Act. The Court also dismissed claims regarding preparation of an Environmental Impact Statement because of mootness since this NTS EIS was underway. Claims regarding the contents of the new EIS were also dismissed as not yet ripe for adjudication. However, the Court did not dismiss Plaintiff's claims seeking injunctive relief from the disposal of low-level waste from other off-site disposal facilities.

On April 29, 1996, the parties filed a Joint Stipulation to Stay Proceedings requesting court approval of their agreement that the complaint should be administratively dismissed from the docket until thirty days following the issuance of the NTS Record of Decision. The DOE agreed to store and dispose of all low-level waste not originating from Fernald at Area 5, rather than Area 3, of the NTS until 30 days following the issuance of the Record of Decision for this EIS. The parties also agreed that, thirty days following issuance of the Record of Decision, they would develop a schedule for filing a Third Amended Complaint, responding to such complaint if one is filed, preparing the Administrative Record and filing summary judgement briefings to the court. At a Status Conference on May 15, 1996, the Court approved the joint Stipulation to Stay Proceedings and scheduled a further Status Conference for Friday, August 30, 1996.

1.1 Organization of This Environmental Impact Statement

This EIS is organized into three volumes. Volume 1 contains the EIS, and Volume 2 presents the framework within which a *Resource Management Plan* will be developed. Volume 3 contains a compilation of comments received on the Draft NTS EIS and responses to those comments.

Volume 1 is organized into 9 chapters and 10 appendices. Chapter 2 provides a description of the purpose and need for the action analyzed in this EIS. Chapter 3 provides a description of the four alternatives analyzed in this EIS and brief reviews of the alternatives eliminated from further consideration, and identifies the DOE's preferred alternative. Chapter 3 also provides a comparative summary of the impacts of the alternatives on the local communities and the natural environment. Chapter 4 contains a description of the affected environments under current conditions, and provides a baseline for analyzing the impacts of the alternatives. The results of the environmental impact analysis are presented in Chapter 5. Chapter 6 contains the cumulative impacts discussions. Chapter 7 presents mitigation measures. Chapter 8 contains the list of individuals and organizations consulted during the preparation of this EIS. Chapter 9 contains the list of NTS EIS preparers and contributors. References are listed at the end of the chapter in which they are cited. A glossary and an index follow Chapter 9.

In addition to the body of this EIS, the following appendices are included:

- Appendix A - Detailed Project and Activity Information
- Appendix B - Notice of Intent
- Appendix C - Relevant Regulatory Requirements
- Appendix D - Distribution of the Final EIS
- Appendix E - Impact Assessment Methods
- Appendix F - Project-Specific Environmental Analysis (Big Explosives Experimental Facility)
- Appendix G - American Indian Assessments: Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada
- Appendix H - Human Health Risk and Safety Impacts Study
- Appendix I -Transportation Study
- Appendix J - Classified Supplement: Project-Specific Information for Activities Conducted at the Lyner Complex.

As part of the process for this EIS, guidance on addressing American Indian concerns, provided in an Executive Policy Memorandum (DOE, 1994), was considered. For this EIS, the DOE implemented the executive policy by inviting representatives of the Consolidated Group of Tribes and Organizations to write sections of the document so that their concerns and viewpoints regarding the alternatives and the technical analyses would be presented. In many instances, viewpoints of the American Indians differ widely from the DOE's. To facilitate review, the viewpoints of the Consolidated Group of Tribes and Organizations are included in the text of the NTS EIS as italicized sections. The full text of American Indian concerns related to the alternatives evaluated in this EIS is located in Appendix G.

Two additional studies were undertaken in support of this EIS: the Human Health Risk and Safety Impacts Study, and the Transportation Study. These studies are published as Appendices H and I of this EIS and contain the detailed information and analyses that led to the transportation, human health effects, and safety impacts conclusions contained in this EIS.

As part of this EIS the DOE prepared two project-specific appendices. Appendix F is a project-specific environmental analysis for the Big Explosive Experimental Facility and Appendix J is a classified appendix containing information on the activities conducted at the Lyner Complex. The Big Explosive Experimental Facility is an existing facility in Area 4 of the NTS and has appropriate National Environmental Policy Act compliance review for its ongoing bunker-certification tests and shaped-charge experiments (described as Alternative 1 in Appendix F). The project-specific impact analysis in Appendix F has been incorporated into Chapter 5 of the NTS EIS. This EIS is intended to complete the National Environmental Policy Act requirements for the Big Explosive Experimental Facility by evaluating the potential impacts resulting from the alternatives of ongoing or expanded use of the facility.

The classified appendix was completed concurrently with the unclassified portion of this NTS EIS. It discusses the potential for adverse impacts to the environment under routine operating conditions during experiments with special nuclear material at the Lyner Complex. The classified appendix contains information on material quantities and design concepts that are classified by the DOE for nonproliferation and national security reasons. The environmental impacts and public safety and health risks associated with these experiments are not classified and are included in Chapter 5, Environmental Consequences, under Defense Program activities.

1.2 Alternatives Analyzed

This EIS analyzes the environmental impacts associated with managing the NTS and its resources. The alternatives are structured to provide scenarios of current and future uses of the DOE facilities in Nevada that range from discontinued use to expanded use. The use alternatives have been designed to allow the DOE to analyze and compare the potential environmental effects of a wide range of use options. The use the DOE ultimately selects, however, may not be one of the alternatives described in its entirety, but a hybrid created by selecting specific options from within the alternatives analyzed.

This EIS identifies the impacts of past, current, and potential programs of the DOE. The programs are included in one or more of the four alternatives and fall into three basic levels: (1) current activities, (2) planned projects, and (3) proposed projects. Current activities are those that are presently part of the normal operations of the NTS, the Tonopah Test Range, portions of the NAFR Complex, and other areas considered in this EIS, such as the Area 5 Radioactive Waste Management Site. Planned projects are those that are within the 5-year planning cycle and are likely to be implemented, such as a Solar Enterprise Zone facility. These projects are not yet included in the 5-year planning window, but have undergone sufficient conceptual development to allow a reasonable assessment. The most reliable data are clearly derived from ongoing activities. Planned projects would present slightly less reliable data. Data for proposed projects would be the least defined, but were determined to be essential to a full and open evaluation and disclosure of the potential effects of the alternative. To provide an adequate analysis, conservative assumptions and parameter values were used to evaluate potential impacts of the less-defined activities.

Four alternatives are presented in this EIS:

- Alternative 1 - Continue Current Operations (No Action) - Ongoing DOE and interagency programs and activities at the NTS and other associated areas in Nevada would be continued under this alternative
- Alternative 2 - Discontinue Operations - All current and planned program activities and NTS operations would be discontinued under this alternative. Only the environmental monitoring and site-security functions necessary for human health, safety, and security would be maintained
- Alternative 3 - Expanded Use - The NTS and its resources would be made available for increased use to support national programs of both a defense and nondefense nature
- Alternative 4 - Alternate Use of Withdrawn Lands - All defense-related activities and most Work for Others Program activities would be discontinued at the NTS. Certain programs and activities that are not currently included in NTS mission responsibilities are also evaluated. This alternative could include other activities, such as the relinquishment of portions of the NTS, that would be dependent upon future land-use designations and withdrawal status.

1.3 Laws and Regulations

This document was prepared in accordance with the National Environmental Policy Act of 1969; the Council on Environmental Quality (CEQ) regulations, which implement the Act (Title 40 Code of Federal Regulations [CFR] Parts 1500-1508), and the DOE's implementing regulations for the National Environmental Policy Act (10 CFR Part 1021).

Appendix C identifies and summarizes the primary federal and state laws, regulations, executive orders, and DOE orders that may apply to the proposed action and alternatives at the NTS. It also provides information on the current status of permits and regulatory compliance for the NTS and DOE off-site locations in Nevada.

1.4 Relationship of This Environmental Impact Statement and Other Statements

The DOE is preparing several other National Environmental Policy Act documents that may affect the scope of this EIS because they include the

NTS as an alternative location for the action under consideration. The documents are discussed in the remainder of this section. In addition, Section 3.2.6.1 addresses the EIS that the DOE plans to prepare for the Yucca Mountain Repository Project.

The NTS EIS is a sitewide EIS. A sitewide EIS is intended to support decisionmaking at a given geographic location; this EIS addresses environmental impacts that occur as a result of past, present, and reasonably foreseeable future activities at the site. In some circumstances, a sitewide EIS must take into account proposals originating elsewhere (such as in other DOE program-level documents) that may affect facilities management or land use planning at the site. Such external proposals would be subject to separate National Environmental Policy Act review and decisionmaking processes, but would be identified, and their impacts incorporated in the sitewide EIS.

When the NTS has been proposed and analyzed as an alternative in one of these DOE program-level documents, the impact of additional activities is included as part of the Alternative 3, Expanded Use impacts of this sitewide EIS. The discussion of cumulative impacts in this EIS incorporates the analysis presented in other geographically-related environmental documents, and is intended to reflect the maximum expected impacts for each of the four alternatives considered in this EIS. The National Environmental Policy Act reviews considered for analysis in the NTS EIS include those discussed in the following paragraphs.

Waste Management Programmatic EIS—The Waste Management Programmatic EIS provides a department-wide evaluation of management alternatives for treating, storing, and disposing of radioactive and hazardous waste. The NTS is a site considered for the central or regional management for DOE wastes; 13 other sites are also being considered. Under other options, the NTS would manage only its own wastes or ship some, or all, of its wastes to another DOE site. The Final Waste Management Programmatic EIS, which is in preparation, will more clearly define the role of the NTS within the DOE Waste Management Complex.

Stockpile Stewardship and Management Programmatic EIS—The Stockpile Stewardship and Management Programmatic EIS addresses the activities required to ensure the safety and reliability of the nation's nuclear weapons stockpile and the maintenance, evaluation and repair or replacement of weapons and associated components. This programmatic EIS provides information to assess the environmental impacts of alternatives for conducting the stockpile stewardship and management program, assist with decisions to identify specific capabilities and facilities for conducting the program, and help determine the configuration (or sites for facilities) of the nuclear weapons complex that would most efficiently implement the program.

Stockpile stewardship activities for which the NTS has been identified as an alternative, although not as part of the Preferred Alternative, include the National Ignition Facility and the next generation of nuclear weapons simulators. The next generation of simulators cannot be defined to the degree necessary to perform meaningful environmental analysis. However, two conceptual facilities are analyzed in this EIS for land-use planning purposes only: (1) Next Generation Radiographic Facility and (2) Next Generation Magnetic Flux Compression Generation Facility. In the Stockpile Stewardship and Management Programmatic EIS, these facilities are described as the Advanced Hydrotest Facility and the High-Explosive Pulsed Power Facility, respectively. Under stockpile management activities, the NTS Device Assembly Facility, and the P-Tunnel, located on Rainier Mesa, are proposed as alternative sites for weapons assembly and disassembly. The DOE began the Stockpile Stewardship and Management Programmatic EIS in June 1995 (60 FR 31291), and issued the Draft Programmatic EIS in February 1996. The Final NTS EIS is currently being prepared.

Disposition of Surplus Highly Enriched Uranium EIS—The Disposition of Surplus Highly Enriched Uranium EIS evaluates the disposition alternatives of surplus highly enriched uranium. The NTS is a candidate for receipt of low-level waste generated by blending high-enriched uranium with low-enriched uranium. The Draft Highly

Enriched Uranium EIS was issued in October 1995; the final Highly Enriched Uranium EIS was issued in June, 1996. There are no functions or facilities for the NTS identified in the Preferred Alternative of this EIS. Decisions related to the disposal of any low-level waste generated by blending will be consistent with the Record of Decision issued after completion of the Waste Management Programmatic EIS.

Storage and Disposition of Weapons-Usable Fissile Materials Programmatic EIS—The Storage and Disposition of Weapons-Usable Fissile Materials Programmatic EIS evaluates sites for the storage and several technologies considered for the dispositioning of plutonium and other weapons-usable fissile materials, except the surplus of highly enriched uranium. This programmatic EIS included consideration of strategic reserves of special nuclear materials; because the storage of strategic reserves is covered in both the Storage and Disposition of Weapons-Usable Fissile Materials Programmatic EIS and the Stockpile Stewardship and Management Programmatic EIS, the decision for location of storage of the strategic reserves will not be made until completion of both EIS documents, in a Record of Decision which will jointly consider both proposals.

The NTS is a candidate site for two of the storage alternatives considered in the Storage and Disposition of Weapons-Usable Fissile Materials Programmatic EIS; Consolidation of Plutonium Alternative and Collocation of Plutonium and Highly Enriched Uranium Alternative. The programmatic EIS also evaluates the technology or technology mix to be employed for achieving the Spent Fuel Standard for disposal. For the purpose of analysis, the programmatic EIS considered the NTS as a location for a disposal technology or technology mix including Pit Disassembly/ Conversion Facility, Mixed Oxide Fuel Fabrication Facility, and an Evolutionary Light Water Reactor. However, the record of decision for the Storage and Disposition of Weapons-Usable Fissile Materials Programmatic EIS would only select the technology, not the site. This Draft Programmatic EIS was issued in February 1996. The Final Programmatic EIS is currently being prepared.

Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons and Components Draft EIS—The Pantex Sitewide EIS addresses continued operations of the DOE's Pantex Plant, located near Amarillo, Texas, as well as the possible relocation of the interim storage of these plutonium pits. A decision on the interim storage of pits is being considered as a contingency and will not be necessary if a decision on the long-term storage and disposition of plutonium is made following the Fissile Materials Programmatic EIS. An expanded Device Assembly Facility and the P-Tunnel, both located on the NTS, have been proposed as candidate sites for the interim relocation of up to 20,000 pits although not as part of the Preferred Alternative. The DOE began this EIS in May 1994 (59 FR 26635). The Draft NTS EIS was issued for review in 1996.

Los Alamos National Laboratory Sitewide EIS—The Los Alamos National Laboratory Sitewide EIS addresses continued operations of the Los Alamos National Laboratory in New Mexico. The EIS may also evaluate the use of the NTS facilities for disposal in the waste management section of the document. The DOE began this EIS in May 1995 (60 FR 25697).

Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes. In the Final NTS EIS, the DOE proposed to create a domestic source for the production of medical isotopes for maintaining a stable supply to the United States' health care community. These isotopes would be produced in concert with the DOE's national laboratories. The NTS was identified as the preferred location for the disposal of approximately 100 drums of low-level waste generated each year under this proposed medical isotope production project. The Final Molybdenum-99 and Related Isotopes EIS was issued in May 1996.

Nellis Air Force Range Legislative EIS—In addition to the National Environmental Policy Act documents that the DOE is preparing, the U.S. Air Force will be preparing a legislative EIS for the NAFR Complex. This document will include a discussion of all activities on the Tonopah Test Range. The Tonopah Test Range will be evaluated as part of the 2001 land withdrawal review of the NAFR Complex. Under Public Law 99-606 (which consolidated the NAFR Complex under one withdrawal order) over 3 million acres of land in Clark, Nye, and Lincoln counties were withdrawn. The withdrawal and reservation terminates on November 6, 2001. Renewal actions require an EIS to address the environmental impacts of continued land withdrawal. The land withdrawal alternatives evaluated in the NAFR Complex Legislative EIS may result in proposed changes that could affect DOE operations, such as the use of Pahute Mesa by the DOE . It is anticipated that the NTS EIS will provide baseline information and will be used in the cumulative impact analysis section for the NAFR Complex Legislative EIS.

1.5 Public Comment Process on the Draft NTS Environmental Impact Statement

The Draft NTS EIS was developed after a series of public scoping meetings. The scoping process and issues raised during the scoping phase are described in the Final Implementation Plan (DOE/NV, 1995). This Draft EIS was distributed for review and comment to congressional members and committees; the state of Nevada; tribal governments; several county governments; other federal agencies; and the general public. The DOE invited comments to correct factual errors or to provide insights on any other matter related to this environmental analysis. During the comment period, public hearings were held in St. George, UT; Reno, Pahrump, and Las Vegas, NV; and additional workshops were held in Caliente, Tonopah, Boulder City, and North Las Vegas, NV. In addition, the public was encouraged to provide comments via mail, fax, e-mail, and telephone (toll-free 800 number).

In response to public feedback critical of DOE's traditional hearing format, the public hearings and workshops held on the Draft NTS EIS were conducted using various formats selected by representatives of the host community. The formats chosen allowed for a two-way interaction between the DOE and the public; increased public awareness and understanding on project-related impacts discussed in the Draft NTS EIS; and encouraged informed public input and comments on the document. Community facilitators were present at the workshops to direct and clarify discussions and comments.

All public hearing and workshop comments received by mail, fax, e-mail, or telephone during the public comment period are presented in Volume 3 of this EIS, the comment response document. Volume 3 describes the public comment process in detail, presents broad issue summaries and responses, and includes copies of all comments received.

The DOE provided the draft classified Appendix J, "Classified Supplement: Project-Specific Environmental Impact Analysis (Lyner Complex)," for review by appropriately cleared parties. The parties included the EPA and the state of Nevada. Neither party had any recommendations for changes to the classified supplement.

1.6 Changes from the Draft Sitewide Environmental Impact Statement

The DOE has revised the Draft NTS EIS in response to comments received from the state of Nevada, the Consolidated Group of Tribes and Organizations and Indian Tribes, local governments and federal agencies (including the Department of the Interior and the Environmental Protection Agency), nongovernmental organizations, the general public, and the DOE and laboratory reviewers. The text of the NTS EIS has been changed in some areas to provide additional environmental baseline information, to correct inaccuracies and make editorial corrections, and provide additional discussion of technical considerations to respond to comments and to clarify text. In addition, the DOE has updated coverage due to events or decisions made in other documents since the Draft NTS EIS was provided for public comment in January, 1996. Finally, the DOE has identified a preferred alternative. New and changed text has been identified by a side-bar on the modified text.

1.6.1 Alternatives

DOE has provided additional information to clarify the alternatives, including repeating material from Alternative 1 in Alternative 3.

1.6.2 Preferred Alternative

Alternative 3 has been identified as the DOE's Preferred Alternative, with the addition of public education options from Alternative 4. This Preferred Alternative is viewed as the alternative which best meets the objectives of the DOE, and addresses comments from the public regarding other uses for the NTS. The Preferred Alternative satisfies the purpose and need cited as the reason DOE needs to take action. The Record of Decision may select this alternative or a combination of this alternative and the other alternatives for DOE's future activities at the Nevada Test Site and off-site locations in the state of Nevada.

1.6.3 Summary of Significant Changes

Volume 3 of this EIS, the comment response volume, contains responses to individual comments. The comments can be grouped based on their content, and the changes resulting from them can be summarized. Below is a summary of changes made in Volumes 1 and 2 as a result of the comments and other considerations cited above:

With regard to the Defense Program, there were comments which questioned the rationale for conducting subcritical experiments, as well as the characterization of subcritical experiments as part of the No-Action Alternative. Information has been added that explains the historical basis for having conducted the tests in the past and defines the program for the future. The relationship to current Comprehensive Test Ban Treaty negotiations is also clarified. Changes have been made in various sections of Chapters 2, 3 and 4 to clarify the nature of these experiments.

With regard to waste management, many comments noted the differences in waste volume numbers cited in this EIS and in other DOE documents. The waste volume numbers have been updated and clarified. Changes in the waste volumes have resulted in changes in the values used in the Transportation Study (Appendix I) and the Human Health Risk and Safety Impacts Study Assessment (Appendix H) as well. Questions about waste categories and what is disposed on the NTS have been addressed and clarifying language has been added to the text. Changes have been made in various sections of Chapters 2, 3, 4, and 5 and Appendices A, H, and I of the NTS EIS.

Commentors raised questions about the radioactive source term data discussed in the groundwater and public health impacts sections. Additional information has been provided about the development of the source term and the models used in the evaluation of groundwater contaminant transport. This information has also been referenced in the Human Health Risk and Safety Impacts Study Assessment (Appendix H) to better clarify the results of consequence and impact assessments in the public environment off the NTS/NAFR Complex controlled lands. Changes have been made in Section 4.1.4.2 of the NTS EIS.

Comments regarding the impacts to biological resources have been addressed by adding clarifying information to the text. The recently completed Biological Opinion provided by the U.S. Fish and Wildlife Service has been referenced as well. Changes have been made in the text in various sections of Chapters 5 and 8 of the NTS EIS.

The Consolidated Group of Tribes and Organizations have continued their evaluation of the NTS EIS and development of their information pertaining to the DOE activities and conclusions. The American Indian Assessments: Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (Appendix G), has been revised and additional assessments have been incorporated. These assessments have been added, in italics, to the text of the NTS EIS.

There were many comments on the cumulative impacts assessment. Chapter 6 has been revised to incorporate more information and to better reflect the role of DOE activities as contributing to the overall impacts of the region.

Many comments were received on DOE's waste transportation activities and transportation-related issues. These issues have been addressed through revisions to the Transportation Study, and by fully incorporating and assessing the full scope of transporting defense program materials as well as hazardous materials in relation to activities at the NTS. The concerns of the local governments and the public have been addressed as well. American Indian concerns will be identified and addressed through a recently initiated American Indian Transportation Study and continued government-to-government consultation. The DOE will continue all dialogue initiated through the transportation study development.

1.7 Next Steps

The Record of Decision will explain all factors, including environmental impacts, that the DOE considered in reaching its decision (see inside back cover). The Record of Decision will also identify the environmentally preferred alternative, or alternatives. If mitigation measures, monitoring, or other conditions are adopted as part of the DOE's decision, these will be summarized in the Record of Decision, as applicable, and will be included in a Mitigation Action Plan that would be prepared following the issuance of the Record of Decision. The Mitigation Action Plan would explain how and when mitigation measures would be implemented and how the DOE would monitor the mitigation measures over time to judge their effectiveness. The Record of Decision and the Mitigation Action Plan will also be placed in the DOE Reading Room in Las Vegas and made available to interested parties upon request.

The DOE is committed to completing the *Resource Management Plan* in accordance with the Final Framework as described in Volume 2 of this Final EIS. During the *Resource Management Plan* process, consultation with federal agencies and sovereign nations, and interaction with local governments and interested members of the public will continue.

1.8 References

REGULATION, ORDER, LAW

10 CFR Part 1021	U.S. Department of Energy (DOE), "Energy: Compliance with the National Environmental Policy Act," *Code of Federal Regulations,* Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC, 1992.
40 CFR Part 1500-1508	Council on Environmental Quality (CEQ), "Protection of the Environment: Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act," *Code of Federal Regulations,* Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC, 1993.
59 FR 26635	DOE, "Preparation of an Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components, Notice of Intent," *Federal Register,* Washington, DC, 1994.
60 FR 25697	DOE, "Notice of Intent to Prepare a Sitewide Environmental Impact Statement for the Los Alamos National Laboratory," *Federal Register*, Washington, DC, 1995.
60 FR 31291	DOE, "Stockpile Stewardship and Management Programmatic Environmental Impact Statement, Notice of Intent," *Federal Register*, Washington, DC, June 14, 1995.

GENERAL

DOE, 1994	DOE, Memorandum for the Heads of Executive Departments and Agencies, Government-to-Government Relations with Native American Tribal Governments, Washington, DC, 1994.
DOE/NV, 1995	U.S. Department of Energy, Nevada Operations Office (DOE/NV), *Implementation Plan for the Nevada Test Site Environmental Impact Statement* Revision O, DOE/NV-390, pp. 3 and 4, 3-14, Las Vegas, NV, 1995.
ERDA, 1977	U.S. Energy Research and Development Administration (ERDA), *Nevada Test Site, Nye County, Nevada Final Environmental Impact Statement*, Report No. ERDA-1551, Washington, DC, 1977.
MLWA, 1986	Military Lands Withdrawal Act of 1986, Public Law 99-606.
NEPA, 1969	National Environmental Policy Act (NEPA), Public Law 91-190, 42 U.S.C. 4341, et seq., amended by Public Laws 94-52 and 94-83, 1969.

Chapter 2

PURPOSE AND NEED FOR DOE ACTION

CHAPTER 2
PURPOSE AND NEED FOR DOE ACTION

Among the major responsibilities of the DOE are the continued stewardship of the nation's nuclear weapons stockpile and the maintenance of a testing capability. The purpose and need for the proposed actions analyzed in this EIS arise in part from those responsibilities. The DOE proposes to continue managing the NTS and its many resources in a manner consistent with national needs during a period in which the missions of the DOE and the NTS continue to evolve.

2.1 Background

Historically, the primary mission of the NTS was to conduct nuclear weapons tests. Since the current moratorium on testing began in October 1992, this mission has changed to maintain a readiness to conduct tests, if so directed, in the future. The NTS, because of its favorable environment and infrastructure, has also supported DOE waste management, as well as other national-security-related research, development, and testing programs. With the end of the Cold War, the United States is now challenged with a complete re-evaluation of its national security needs and priorities in a way that emphasizes the nation's commitment to a comprehensive ban on nuclear weapons testing and reduction of the global nuclear danger.

This EIS is being prepared pursuant to DOE regulations (10 CFR Part 1021) and is part of a long-term management process. The first step in this process is evaluating all actions planned for the NTS, defining the baseline environment, and identifying potential impacts that might occur as a result of the planned actions. Beyond these elements common to all EISs, this document also serves as the framework for developing a long-term *Resource Management Plan* for the NTS.

This EIS represents one level of a tiered management process. Tiering refers to the coverage of general matter in broader environmental impact statements, such as national program statements,

Evolution of National Policy

The alternatives considered in this EIS reflect the importance of the NTS within the overall national defense policy. Over the last 4 years, major shifts in policy have occurred. These shifts are highlighted below.

DATE	*EVENT/POLICY CHANGE*
September 1991	The President made the first of three announcements on significant reductions in the nuclear weapons stockpile.
September 1992	The last underground nuclear test was performed at the NTS.
October 1992	The President signed a 9-month moratorium, stopping all nuclear testing until July 1993.
July 1993	The President announced an extension of the moratorium and directed the DOE to develop alternative means for a stockpile stewardship program.
November 1993	Congress, through the National Defense Authorization Act (Public Law 103-160) instructed the Secretary of Energy to "establish a stewardship program to ensure the preservation of the core intellectual and technical competencies of the United States in nuclear weapons."
May 1995	The Nonproliferation Treaty was extended indefinitely.
August 1995	The President announced the decision to seek a zero-yield Comprehensive Test Ban Treaty and established the conduct of a science-based stockpile stewardship program as a condition of the United States' entry into the treaty. Maintenance of a safe and reliable stockpile is considered "a supreme national interest of the United States."

with subsequent narrower environmental statements or analyses, such as project or site-specific statements. The narrower statement incorporates by reference the general discussions of the broader statement and concentrates solely on the issues specific to the statement subsequently prepared. For the NTS EIS, such documents as the Waste Management Programmatic EIS or the Stockpile Stewardship and Management Programmatic EIS address broader national issues and include the NTS as a potential location for implementing an action considered in the program. The NTS EIS evaluates the impacts of those potential decisions. Similarly, actions considered in the NTS EIS may, at a later time, be more explicitly analyzed in an environmental assessment which could address only the narrower topic being considered without restating information contained in the NTS EIS.

Between the issuance of this EIS as a final document and the first planned review, there will, no doubt, be new activities identified that were not considered. Each of these actions will be evaluated on a case-by-case basis, and a tiered National Environmental Policy Act document will be prepared if necessary. Tiered documents include supplemental EISs and environmental assessments. As a hypothetical example, during the planned investigations of the Underground Testing Area's Corrective Action Unit, it might be necessary to conduct some type of land-disturbing test that was not considered in this EIS. If the hypothetical test required the collection of deep seismic data using shallow boreholes and high explosives, the specific impacts and consequences of performing the seismic study would be evaluated and documented in a tiered report. If the environmental consequences were projected to be significant, a supplemental EIS might be prepared that would address only the specific proposed test and its alternatives.

On the other hand, some new actions could trigger a National Environmental Policy Act review as a result of regulatory requirements, and a tiered National Environmental Policy Act document might not be sufficient. In such instances, a National Environmental Policy Act compliance review would be performed and, if necessary, a separate EIS prepared. In other instances, the new action might be included in future reviews and updates of this EIS.

This EIS provides tiered project-specific National Environmental Policy Act documentation for two facilities at the NTS. Appendix F analyzes the continued and potential expanded use of the Big Explosives Experimental Facility. Appendix J presents classified information for activities conducted at the Lyner Complex. The environmental impacts of the activities are not classified and are discussed in the appropriate sections of Chapter 5.

In addition to National Environmental Policy Act documents, other analyses that deal with the human environment are used to support DOE decisionmaking and public participation processes. These other documents include Safety Analysis Reports, Safety Evaluation Reports, Hazard Analyses, Human Health Risk Assessments, Transportation Studies, Environmental Restoration Assessments, Performance Evaluations, and Performance Assessments. Some of these studies perform very focused and specific functions with respect to decisionmaking, and are triggered when an appropriate stage of the project is reached. When these other studies precede or are concurrent with a National Environmental Policy Act document and are relevant to the analysis, their findings are incorporated into the National Environmental Policy Act document. These analytical processes and their relationship to the NTS EIS are discussed further in Section 2.5 with the exception of the Safety Analysis Reports, Safety Evaluation Reports, and Hazard Analysis. These three analyses are designed to identify and resolve sources of potential injury to workers and are disclosed in National Environmental Policy Act documents.

2.2 Policy Considerations

In responding to the nation's need to ensure the safety, security, and reliability of the nuclear weapons stockpile, the DOE must consider national deterrence and stockpile stewardship policies. The NTS plays an integral part in helping the DOE meet this mission, and the policies outlined below are a major factor in developing the long-term management framework for the NTS.

A moratorium on nuclear weapons testing is currently in effect. In September 1992, Congress imposed a 9-month moratorium on underground nuclear weapons testing. President Clinton has extended the moratorium on three occasions. The latest extension occurred in January 1995, and continues the moratorium through September 1996. Under the moratorium, President Clinton directed the DOE to maintain the capability to conduct nuclear tests. On August 11, 1995, President Clinton reaffirmed this commitment and announced his intention to seek a zero-yield Comprehensive Test Ban Treaty. A zero-yield Comprehensive Test Ban Treaty would ban any nuclear weapon test explosion or any other nuclear explosion. President Clinton also established specific safeguards that define the conditions under which the United States can enter into a Comprehensive Test Ban Treaty. These safeguards are as follows:

- The conduct of a science-based stockpile stewardship program to ensure a high level of confidence in the safety and reliability of nuclear weapons in the active stockpile, including the conduct of a broad range of effective and continuing experimental programs
- The maintenance of modern nuclear laboratory facilities and programs in theoretical and exploratory nuclear technology that would attract, retain, and ensure the continued application of our human scientific resources to those programs upon which continued progress in nuclear technology depends
- The maintenance of the basic capability to resume nuclear test activities prohibited by the Comprehensive Test Ban Treaty should the United States cease to be bound to adhere to such a treaty
- The continuation of a comprehensive research and development program to improve treaty-monitoring capabilities and operations
- The continuing development of a broad range of intelligence gathering and analytical capabilities and operations to ensure accurate and comprehensive information on worldwide nuclear arsenals, nuclear weapons development programs, and related nuclear programs
- The understanding that if the President of the United States is informed by the Secretary of Defense and the Secretary of Energy, advised by the Nuclear Weapons Council, the Directors of DOE's nuclear weapons laboratories, and the Commander of the U.S. Strategic Command, that a high level of confidence in the safety and reliability of a nuclear weapon type that the two Secretaries consider to be critical to our nuclear deterrent could no longer be certified, the President, in consultation with Congress, would be prepared to withdraw from the Comprehensive Test Ban Treaty under the standard "supreme national interest" clause in order to conduct whatever testing might be required.

The NTS has a demonstrated or potential role in implementing each of these Comprehensive Test Ban Treaty safeguard elements. For example, the NTS's role in the implementation of the first of these safeguards is to participate in full partnership, for a common purpose, with the scientific and academic communities, business and industry, and stakeholders to advance the NTS as a valued national resource. The NTS provides the modern nuclear laboratory platform for theoretical and exploratory nuclear technology that can attract and retain the human scientific resources required for continued progress in nuclear technology development. As the nation moves away from full-scale nuclear testing, the DOE must enhance its capability to use other tools to predict weapons safety, performance, and reliability. In particular, the DOE must enhance its capability to perform zero-yield science-based stockpile stewardship. Uncertainty in the behavior of aging stockpiled weapons will continue to increase with time and in the absence of testing (Thorn and Westervelt, 1987). To ensure continued confidence in the safety and reliability of the United States' nuclear weapons stockpile, the DOE needs to maintain the basic capability to conduct underground nuclear testing activities should a situation arise from unanticipated technical problems in the enduring stockpile. To maintain this capability, the National Laboratories have identified 33 already drilled vertical holes, which are an inventory of potential sites for stockpile stewardship exercises and experiments. The DOE also needs to enhance its capability to perform dynamic experiments (including subcritical experiments involving special nuclear materials) and hydrodynamic tests to assess the condition and behavior of nuclear weapons.

The NTS, through its Work for Others Program, has supported the stewardship programs since their inception. For example, in support of improved treaty-monitoring capabilities, chemical explosions at the NTS are being used to develop and calibrate seismic and hydrodynamic detection and analysis techniques (e.g., Chemical Kiloton and Kuchen experiments). Sensitive isotope analysis techniques, derived from nuclear chemistry applications to tests, are being developed for treaty monitoring and intelligence analysis. Development is being advanced by analysis of underground test residue and environmental studies at the NTS. Ongoing NTS activities that support the development of intelligence gathering and analytic capabilities include projects conducted at the Spill Test Facility, a demonstrated test bed for developing remote sensors for nonproliferation, environmental, and other national security programs. Non-nuclear high-explosive experiments at the NTS support design calculations for technologies that would disarm improvised nuclear devices, thereby preventing nuclear yield (see Appendix F).

In its Programmatic EIS for the Stockpile Stewardship and Management Program, the DOE is examining the future missions and configurations of the nuclear weapons complex (60 FR 31291). The Programmatic EIS will address the long-term capabilities required to carry out the DOE's Stockpile Stewardship and Management Program, as well as site the locations of these activities. Under this Programmatic EIS, the NTS is a candidate for future increased missions, as well as continuing operations. Until the Record of Decision for that Programmatic EIS is issued and the decisions are implemented, the DOE must continue its defense mission in light of the changes in stockpile stewardship and the continued moratorium on nuclear weapons testing.

Environmental restoration and waste management have been part of NTS operations since the beginning of the nation's nuclear testing program. Early restoration efforts were focused on cleaning detonation locales in order to reuse them for subsequent tests. The generated debris was disposed of through the on-site Waste Management Program. A formalized Waste Management Program commenced at the NTS in 1961. An inventory of radioactive waste has accumulated at numerous sites throughout the DOE complex through several decades of the Cold War. Beginning in 1976, some Defense Program radioactive waste generated at the Mound, Ohio, site was disposed of at the NTS. Increasing attention to the complexwide inventory brought more waste from a greater number of DOE sites to the NTS for disposal. Low-level waste has been generated through the weapons development, testing, and production activities at DOE facilities as well as the environmental cleanup and restoration programs. As DOE missions have changed, there has been an increasing volume of waste generated through the environmental restoration activities. This increase will continue into the future.

While the NTS does not currently accept transuranic or mixed waste from other sites, the management of low-level, mixed, and transuranic wastes generated at the NTS and other DOE-approved facilities across the United States has been an ongoing mission of the NTS. Wastes have been and are now generated as a result of a variety of DOE activities, including nuclear energy research, defense projects, and, more recently, as a result of environmental restoration activities. This waste must be disposed of in accordance with applicable regulations and DOE orders. The DOE has a need to continue providing the practical, cost-effective, and environmentally sound means of low-level waste disposal offered by the NTS.

Another change in NTS mission priorities is evidenced by an increase in environmental restoration efforts. Environmental restoration activities are planned for various sites at the NTS and other test locations in Nevada. Through 1992, there have been 928 nuclear tests conducted on the NTS; no nuclear tests have been conducted since entering into the moratorium. Defense research and weapons-test verification activities were also conducted at the

Project Shoal Area and the Central Nevada Test Area. From 1957 to 1963, several safety tests were conducted at sites at the NTS, the NAFR Complex, and the Tonopah Test Range to test the safety of nuclear weapons in accident situations. Because these tests were not contained and used special nuclear materials and chemical explosives, they resulted in the release of radioactive materials and surface contamination. The DOE must develop site remediation goals and cleanup levels for the NTS and off-site test areas based on future land use and management goals for the protection of environmental resources. The DOE is working in cooperation with other agencies to define remediation and cleanup levels to ensure that the disposition of withdrawn lands is consistent with the controlling agencies' existing land-use or resource management plans.

2.3 Purpose and Need for DOE Action

As a result of the changing mission priorities discussed in the preceding sections, the DOE has a need to focus on new national security, energy, and environmental issues challenging the nation and to redefine the role of the NTS within the DOE complex.

Other changes in DOE policy regarding land and facility use require the DOE to manage all its land and facilities as valuable national resources, with stewardship based on the principles of ecosystem management and sustainable development. This policy has resulted in the need for a comprehensive plan for the NTS that will guide land- and facility-use decisions and integrate mission, economic, ecologic, social, and cultural factors. As the first step in the development of such a comprehensive plan, the DOE has developed the framework of a *Resource Management Plan* for the NTS that will benefit from the public participation and review afforded by the National Environmental Policy Act process (see Volume 2).

The purpose of the *Resource Management Plan* document is to publicize how the DOE/NV proposes to develop and use a *Resource Management Plan* for the NTS so the public can comment on and assist with:

- Developing the methods for creating and using the plan
- Identifying the values people place on manmade and natural resources found on the NTS
- Developing the goals DOE/NV will use to guide the conservation and use of those resources
- Identifying the management actions needed to meet constraints and resource management goals
- Incorporating the principles of ecosystem management into land and resource management on the NTS.

The framework for the *Resource Management Plan* is being developed in conjunction with the NTS EIS to take advantage of the extensive data collection and public participation activities associated with the National Environmental Policy Act. Following receipt of public information during the comment period for the Draft NTS EIS, the DOE/NV revised this description of the *Resource Management Plan* in order to publish the revision with the Final NTS EIS. The revision includes the goals the DOE/NV has developed for managing resources and land-use constraints. The revision also includes the final plans for developing the *Resource Management Plan.* These plans will guide the DOE/NV as it develops a *Resource Management Plan* in the coming years.

2.4 Nevada Test Site Programs

For review purposes, the projects and activities at the NTS have been categorized into five programs: Defense, Waste Management, Environmental Restoration, Nondefense Research and Development, and Work for Others. Services, such as fire protection and communications, for each of these programs are provided through the NTS support services infrastructure. Brief summaries of each program are presented in this section.

Programs Conducted at the NTS

The DOE accomplishes its mission at the NTS through the management of activities that are organized into five programs:

Defense - The primary mission of this program is stockpile stewardship, including the maintenance of readiness to conduct underground nuclear tests, if directed.

Waste Management - This program provides for the safe and permanent disposal of waste through either disposal on the NTS or to off-site commercial waste treatment or disposal facilities.

Environmental Restoration - The goal of this program is to identify contaminated areas and clean-up those areas, as appropriate.

Nondefense Research and Development - This program includes original research efforts by the DOE, universities, industry, and other federal agencies.

Work for Others - This program provides for the use of NTS areas and facilities by other groups and agencies for activities such as military training exercises.

2.4.1 Defense Program

The primary mission of the Defense Program at the NTS is to help ensure the safety and reliability of the nation's nuclear weapons stockpile. The NTS has a long history of participating in the Stockpile Stewardship Program. This stewardship program includes maintaining the readiness and capability to conduct underground nuclear weapons tests and conducting such tests if so directed by the President or Congress. Other aspects of stockpile stewardship include conventional high-explosive tests, dynamic experiments (including subcritical experiments), and hydrodynamic testing. Although the term "subcritical" was not used in previous EISs for the NTS, some tests or experiments conducted over the past decades, as well as the impacts of those tests or experiments, are substantially the same as those contemplated by the new terminology. The term "subcritical experiments," rather than defining a new form of activity, is intended instead to clarify the fact that such experiments involving the use of special nuclear material would not achieve the condition of criticality.

Historically, the nation's nuclear emergency response capability has been based at the NTS. The Nuclear Emergency Search Team maintains the readiness to respond to any type of nuclear emergency, including search and identification for lost or stolen weapons, and conducts training exercises related to nuclear bomb threats and radiation dispersal threats.

The NTS has also been a key site for past efforts in the areas of nuclear nonproliferation and verification of international treaties. This work was exemplified recently by the Joint Treaty Verification Project, a cooperative effort between the United States and the former Soviet Union.

2.4.2 Waste Management Program

The NTS presently serves as a disposal site for low-level waste generated by DOE defense-related facilities and also as a storage site for a limited amount of transuranic mixed wastes pending opening of the Waste Isolation Pilot Plant in New Mexico. Waste Management Program activities are conducted in four primary NTS areas: Areas 3, 5, 6, and 11. Areas 3 and 5 are the two existing radioactive waste management sites at the NTS.

- The Area 3 Radioactive Waste Management Site accepts bulk and packaged low-level waste for disposal.
- The Area 5 Radioactive Waste Management Site accepts low-level waste and NTS-generated mixed waste for disposal, and packaged transuranic and NTS generated transuranic mixed waste for storage.
- Area 6 includes a waste accumulation building for polychlorinated biphenyl (PCB) wastes and a landfill. Area 6 is also the identified site for the Liquid Waste Treatment System. (See Appendix A for a detailed description.)
- The Area 11 Explosive Ordnance Disposal Unit is not a disposal unit. It is a thermal treatment unit where explosive wastes are detonated or

treated. (See Appendix A for a detailed description.)

Radioactive waste disposal operations began at the NTS in 1961. Radioactive (low-level, transuranic, mixed, and classified low-level) wastes were disposed of in selected pits, trenches, landfills, and greater confinement (deeper) disposal boreholes on the NTS. Near-surface burial (3 to 18 meters [m] deep [10 to 60 feet (ft)]) of low-level waste and low-level mixed waste in subsidence craters, pits, and trenches has been the historical practice at the NTS (Areas 3 and 5 Radioactive Waste Management Sites). In 1981, the DOE adopted the concept of greater confinement burial (21 to 37 m deep [70 to 120 ft]) for wastes that are not appropriate for near-surface disposal because of their radioactive exposure levels. Specifically, these waste types include a waste similar to greater-than-Class C low-level waste; certain high-specific activity low-level waste (for example, fuel rod claddings and sealed sources); transuranic waste; and some classified wastes. The term "similar to greater-than-Class C low-level waste" indicates that the waste disposed of at the Area 5 Radioactive Waste Management Site was DOE-generated, not commercially generated waste subject to Nuclear Regulatory Commission (NRC) regulations.

The Low-Level Radioactive Waste Policy Amendments Act of 1985 (Public Law 99-240) made the federal government responsible for the disposal of greater-than-Class C waste generated by licensees of the NRC. Such disposal must be performed in a facility licensed by the NRC. Implementation of this provision may not occur for 20 years or more, and although the DOE is currently studying possible approaches for disposal of this waste, the DOE has not yet formulated a proposal for action. Therefore, disposal of greater-than-Class C waste is not addressed in this EIS.

Questions were raised in comments on the Draft EIS regarding DOE's handling of "special case wastes." "Special case waste" is not a formal technical waste category in the same sense as

Waste Definitions

Radioactive Waste—Solid, liquid, or gaseous material that contains radioactive nuclides regulated under the Atomic Energy Act of 1954, as amended, and of negligible economic value considering costs of recovery.

Specific Activity — The concentration of radioactivity, given as the number of Becquerels (Bq) or curies (Ci) per unit mass.

Transuranic Waste — Radioactive waste containing alpha-emitting radionuclides having an atomic number greater than 92 and half-lives greater than 20 years, in concentrations greater than 100 nanocuries (nCi) per gram.

Low-Level Waste — Radioactive waste not classified as high-level waste, transuranic waste, or spent nuclear fuel, or the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level waste, provided the concentration of transuranic elements is less than 100 nCi per gram.

High-Level Waste—The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing of and any solid waste derived from the liquid, that contains a combination of transuranic waste and fission products in concentrations requiring permanent isolation.

Byproduct Waste — Tailings or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.

Greater-Than-Class C Waste — Low-level waste that is generated by the commercial sector and that exceeds U.S. Nuclear Regulatory Commission concentration limits for Class-C low-level waste as specified in 10 CFR Part 61. DOE is responsible for the disposal of greater-than-Class C wastes from commercial sources.

Hazardous Waste — Wastes that are designated as hazardous by the Environmental Protection Agency (EPA) or State of Nevada regulations. Hazardous waste, defined under the Resource Conservation and Recovery Act, is waste from production or operation activities that poses a potential hazard to human health or the environment when improperly treated, stored, or disposed. Hazardous wastes that appear on special EPA lists or possess at least one of the following characteristics: (1) ignitability, (2) corrosivity, (3) reactivity, and (4) toxicity.

Waste Definitions (Cont.)

Mixed Waste — Waste containing both radioactive and hazardous components, as defined by the Atomic Energy Act and the Resource Conservation and Recovery Act, respectively. Mixed waste intended for disposal must meet the Land Disposal Restrictions as listed in Title 40 CFR Part 268. Mixed waste is a generic term for specific types of mixed waste such as low-level mixed waste, and transuranic mixed waste.

Low-Level Mixed Waste — Low-level waste that also includes hazardous components, as identified in 40 CFR Part 261, Subparts C and D.

Transuranic Mixed Waste — Waste containing both transuranic and hazardous components, as identified in 40 CFR Part 261, Subparts C and D.

Radioactive Waste Management Site — Designated location where radioactive waste handling, storage, or disposal operations are conducted under management control.

Classified Waste — Although not a regulatory term, includes weapons components and assemblies designated by the U.S. Government, pursuant to Executive Order, statute, or regulation, that require protection against unauthorized information or material disclosure for reasons of national security. Additional security and safeguards management activities are required in the handling of these materials.

"transuranic waste" or "low-level waste"; rather, "special case waste" is a temporary, informal designation used by the generator to identify wastes that exhibit characteristics which indicate that greater analysis may be necessary to properly categorize it, or which may require special handling, storage, or disposal methods. For this reason, the term "special case waste" is not included in the sidebar definitions of the various waste types. The DOE intends to clarify its use of the term "special case waste" in the Final Waste Management Programmatic Environmental Impact Statement. This clarification will update the use of the term to reflect the dynamic nature of DOE's special case waste inventory. It will also reflect the DOE's intent to manage this waste within existing waste categories as options arise and plans are developed.

Since the 1980s, hazardous waste generated on the NTS has been shipped off site to commercial facilities. Receipt of transuranic waste for disposal at the NTS ceased in 1988; receipt of mixed waste for disposal from off-site generators ceased in 1990. Certain mixed waste generated from activities on the NTS can be disposed of at the disposal facilities on the NTS while others must be stored on the state-authorized storage pad, pending identification of treatment technologies for the hazardous constituents (see definition). Historically (since the mid-1960s), the Area 3 Radioactive Waste Management Site was used primarily for the disposal of contaminated waste generated from the NTS Atmospheric Testing Debris Disposal Program, which involved the cleanup of atmospheric testing sites. Today, Area 3 is used for the disposal of bulk and packaged low-level waste from on-site and off-site DOE-approved generators. Current waste disposal cells at the Area 3 Radioactive Waste Management Site comprise four subsidence craters (U-3ax, U-3bl, U-3ah, and U-3at), with areas between craters U-3ax and U-3bl and between craters U-3ah and U-3at excavated to make two oval-shaped landfill units. Conventional landfill methods are used to dispose of waste in each cell; each layer of waste is covered with 1 m (3 ft) of fill before additional waste materials are disposed. The U-3ax/bl disposal cell contains low-level mixed waste; this cell is inactive, temporarily covered, and awaiting closure. The U-3ah/at cell is currently being used for low-level waste disposal; mixed waste is not accepted. Three additional subsidence craters have been reserved for use as low-level waste cells: U-3bh, U-3bg, and U-3az.

In 1961, the Area 5 Radioactive Waste Management Site was established for the disposal of low-level waste and classified low-level waste from both on-site and off-site DOE generators. The developed waste area within the Area 5 Radioactive Waste Management Site consists of 17 landfill cells (pits and trenches), 13 greater confinement disposal boreholes, and the transuranic waste storage pad. The low-level waste and low-level mixed waste disposal units within the Area 5 Radioactive Waste Management Site include the following:

- Pits for the disposal of low-level waste and on-site generated low-level mixed waste
- Trenches for the disposal of low-level waste and classified low-level waste.

The 13 greater confinement disposal boreholes contain low-level waste, low-level mixed waste, waste similar to greater-than-Class C low-level waste, high-specific-activity low-level waste, transuranic waste, transuranic mixed waste, and classified waste. The transuranic waste storage pad is a Resource Conservation and Recovery Act compliant unit for the storage of mixed waste (low-level and transuranic). Additional information can be found in Chapter 4, Affected Environments. Section 4.1.1.5 contains a description of existing Waste Management Program activities, and Section 4.1.2.3 identifies out-of-state waste generators.

DOE is committed to preventing pollution and reducing waste generation at the NTS. This is accomplished through establishing partnerships with private industry, and complying with local, state, and federal regulations. The elements of the DOE/NV Waste Minimization/Pollution Prevention Program addresses reporting requirements, compliance costs, waste reduction costs, employee concerns, environmental liability, training, and the reduction, recycle, and reuse of commodities. Appendix C.6 provides a description of the DOE/NV Waste Minimization/Pollution Prevention Program.

2.4.3 Environmental Restoration Program

As noted previously, the Environmental Restoration Program and its predecessors have been effectively working toward the decontamination of the NTS since the inception of testing. Prior to the early 1980s, the major focus of environmental restoration was the decontamination of testing areas for future use and the identification of contaminated areas that required restricted access.

Starting in the 1980s, environmental restoration at the NTS grew significantly. Characterization, remediation, and closures were primarily driven by the Resource Conservation and Recovery Act. Abandoned underground storage tanks and PCBs were removed. Hazardous waste disposal trenches were closed using the Resource Conservation and Recovery Act process.

The DOE is committed to the goal of remediating contaminated sites in accordance with the requirements of the responsible agencies. Current operations will comply with environmental regulations, and the health and safety of employees and the public will be safeguarded. An ongoing assessment to identify and remediate contamination will continue in pursuit of these goals.

The goal of the Environmental Restoration Program (a detailed discussion of which can be found in Appendix A) is to ensure that risks to the environment and to human health and safety, as posed by inactive and surplus facilities and sites, are either eliminated or reduced to protective levels. Protective levels are determined through site conditions, risk assessments, and consultation with federal and state regulatory authorities.

Specific investigations and risk assessments are being conducted for each corrective action unit (grouping of environmental restoration sites) to determine the levels and extent of contamination, to ascertain the potential human health or environmental exposure to that contamination, and to compare that exposure to established standards for protection of human health and the environment.

Factors Related to Prioritization of Environmental Restoration Program Activities:

- Risk Assessment
- Available Technology
- Cost (Funding Appropriated by Congress)
- Future Land and Resources Use
- Geographic Location
- Interdependency of Actions
- Optimization of Resources
- DOE, Defense Nuclear Agency, State Priorities
- Presence of Cultural Resources or Sensitive Species
- Regulatory Requirements
- Scheduling (Optimizing Labor and Equipment)
- Stakeholder Concerns
- Time Required to Complete Action
- Waste Management Concerns (Adequate Facilities)

Based on the information gathered and in consideration of the factors listed in the sidebar, the DOE/NV will prioritize environmental restoration activities through interaction with the state of Nevada and interested members of the public. A major driver for this process is the Federal Facility Agreement and Consent Order (State of Nevada, 1996), which has been signed.

2.4.4 Nondefense Research and Development Program

The DOE has historically supported a variety of research and development activities at the NTS and at other locations in Nevada in cooperation with universities, industry, and other federal agencies. The DOE continues to support ongoing nondefense research and development projects. The National Environmental Research Park Program supports environmental research activities at the NTS. Research on the safety aspects of handling, shipping, and storing hazardous fluids and liquefied gaseous fuels are conducted at the Spill Test Facility. The Corporation for Solar Technology and Renewable Resources, with development funding provided by the DOE, continues to study the feasibility of locating and constructing a solar energy facility in Nevada; it is proposed that these solar power generating facilities should be collocated at the NTS and at one or more of the three other Nevada locations under evaluation: Eldorado Valley, Dry Lake Valley, or Coyote Spring Valley.

The Environmental Management and Technology Development project continues to conduct research and development focused on overcoming major obstacles to progress in cleaning up the DOE sites. The principal mission of the Tonopah Test Range is to provide research and development test support for DOE-funded weapons projects. However, the Tonopah Test Range represents a unique test environment, both in location and capabilities, and is available for use by other government agencies and their contractors. The Tonopah Test Range management schedules a broad spectrum of tests to make effective use of range capabilities for multiple users.

2.4.5 Work for Others Program

The Work for Others Program is hosted by the DOE and includes the shared use of certain facilities and resources. Historically, the DOE has hosted projects by other federal agencies, especially the Department of Defense (DoD), that require the large, remote, and secured areas offered by the NTS. Typical past uses under this program have included co-use of NTS airspace, training exercises, and research and development projects.

2.5 Evaluation of Environmental Impacts and Risk

In addition to the NTS EIS, several DOE studies are in progress that address the consequences and risks associated with the DOE's operations at the NTS and other Nevada locations. Although all of these studies relate to the risk or the consequences of DOE activities, each of these studies has a unique scope and purpose. It is important to understand the differences in study scopes, how these different studies relate to each other, and how the information gained from them has been used in this EIS. Several of these other studies are discussed in the following sections. Figure 2-1 illustrates the scope and purpose of each of these studies and describes their relationship to the NTS EIS.

2.5.1 Nevada Test Site Environmental Impact Statement

The NTS EIS identifies the environmental consequences or impacts that could occur as a result of implementing various resource management alternatives at the NTS. These alternatives encompass a range of resource uses, including current level of operation (Alternative 1), minimum resource use (Alternative 2), maximum use of resources (Alternative 3), and alternative uses of NTS resources (Alternative 4). Consequences resulting from the various alternatives are described as physical impacts (e.g., surface disturbance, degradation of air quality, and availability of water resources). These impacts are assessed and reported for each alternative to inform the decisionmakers of

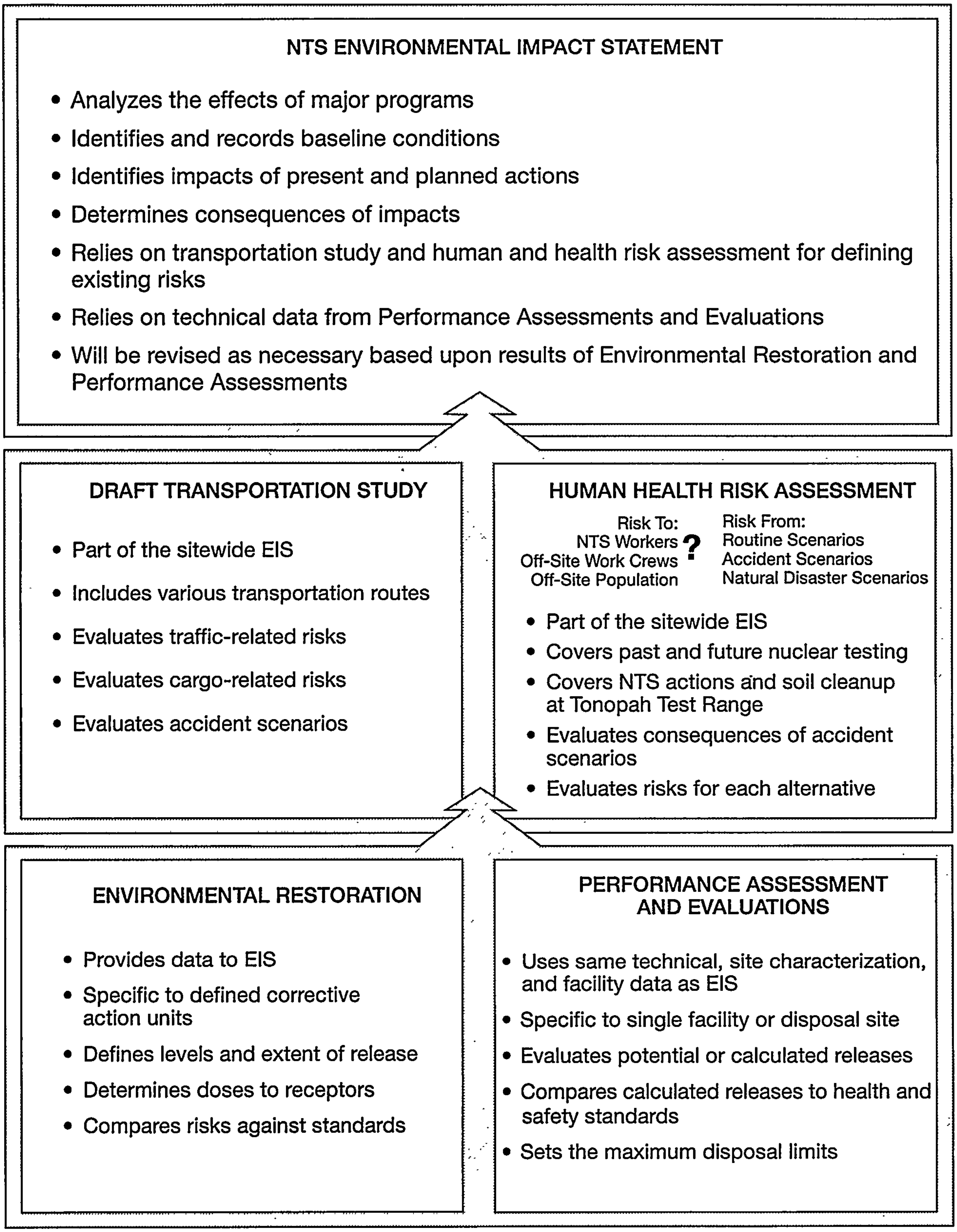

Figure 2-1. NTS studies that were used in the EIS analysis

the associated environmentalimpacts and any potential actions that may be required to mitigate those impacts.

The foundation for the impact analysis conducted in this EIS is the technical data developed and used in the studies and reports noted above and discussed later in this section. Site characterization data, facility information, environmental data, and other information from these other studies, as well as the most current technical information about site uses, were used to perform the impact analyses reported in this EIS.

2.5.2 Human Health Risk Assessment

In addition to describing the physical impacts to the environment that have resulted from past NTS operations and could result from a range of future NTS uses, the NTS EIS includes a human health risk assessment (see Appendix H). The risk assessment quantifies the potential chance of occupational injuries and facilities, cancer deaths, and detriment to workers and the public that could result from the overall operation of the NTS as defined in each alternative. Underlying the assessment of each alternative are the historical operations and their consequences that contribute to the current environmental conditions, or baseline, of the NTS. Thus, the risk assessment encompasses risks contributed from past operations and the risk potentially contributed from each of the future-use alternatives. This EIS considered the consequences of events that have a low probability of occurrence but have high consequences should they occur. There are many events or scenarios that have a very low probability of occurring, but the consequences of such an event are so high that even remotely credible scenarios are considered and evaluated. The results of these analyses provide additional information that was used in this EIS.

2.5.3 Transportation Study

Of utmost importance to the DOE's stakeholders and the sovereign nations regarding the transportation of radioactive material are the human health risks associated with exposure to ionizing radiation. The health risks of transporting low-level

Performance Assessment and Risk Evaluation Terms

Receptors – Plants, animals, and people that may be exposed to contamination. A receptor can be exposed via the air and soil pathways (for example, by inhalation, ingestion, and contact), and the surface and groundwater pathways (by contact and ingestion).

Pathway – The route by which a contaminant reaches a human receptor. Common pathways considered in performance assessments include, but are not limited to, air, groundwater, and surface water.

Limiting Concentrations – The radioactivity that remains in a waste after treatment, that poses a limitation or bounding condition to disposal options. The radionuclide that tends to be most mobile, or has the highest potential to affect human health and the environment, becomes the limiting factor for the disposal facility.

Residuals – The composition and form of a waste after treatment. For example, solidified incineration ash would be a residual.

Carbon-14 – An isotope of carbon that occurs both naturally and from the decay of certain radioactive isotopes. Carbon-14 is a well-known tool used to date archaeological finds. Carbon-14 can be generated from wastes as a gas and can rise upward to the surface if precautions are not taken.

Human Intruder – A hypothetical individual (in a future scenario) who unknowingly contacts the waste(s) in a disposal unit(s) after the loss of institutional control and with no prior knowledge of the waste disposal activities at the site. Intrusion scenarios include, but are not limited to, drilling into the waste or farming on or near the waste disposal facility.

Groundwater Recharge – Water that infiltrates the land surface and is not lost to evaporation or consumed by plants can percolate downward and replenish the groundwater aquifers. This deep percolation is called recharge. Much of the recharge at the NTS is from mountainous areas as much as 48 km (30 mi) away.

Infiltration – Water that falls on the land surface that does not run off but percolates into the ground. Some of this water evaporates, some is used by plants, and some percolates downward to the groundwater.

Unsaturated Zone – The subsurface zone between the land surface and the top of the groundwater. The unsaturated zone at the NTS is thick, ranging from 160 m (525 ft) to almost 914 m (3,000 ft) in some areas.

waste, mixed waste, and nuclear material to and on the NTS were evaluated in a transportation risk analysis (see Appendix I). The transportation study identifies the risks to the public resulting from traffic deaths and exposure to radiation from the shipments along the various routes. The transportation study uses current and future projections of the sources and movements of materials and wastes to the NTS. The results of the transportation analyses are incorporated in the appropriate impact analysis section of this EIS.

2.5.4 Environmental Restoration Assessments

A different type of risk assessment is performed as part of studies conducted for the Environmental Restoration Program. First, a risk assessment that defines the nature and extent of the release of contaminants from a source area is performed for each corrective action unit. Next, the pathways whereby the contamination could lead to an exposure to a worker or off-site resident are identified. The doses to these potential receptors are then estimated for each pathway, and the risk associated with that dosage is evaluated. If the dose exceeds a regulatory standard, some action could be required either to remediate the contamination or otherwise protect the receptor. The available technical information used in these types of assessments is used as appropriate in the NTS EIS and forms the basis for the larger restoration program assessments that are discussed in this EIS. Because these assessments are performed on a project or Corrective Action Unit basis, the assessments will be developed by the DOE in cooperation with the state of Nevada to identify the preferred closure actions. The results will also be incorporated into the National Environmental Policy Act document that analyzes the closure proposal.

2.5.5 Performance Evaluation

The Federal Facility Compliance Act of 1992 requires the DOE to work with its regulators and with members of the public to establish plans for treatment of DOE's low-level mixed waste. Although the Federal Facility Compliance Act does not specifically address the disposal of treated low-level mixed waste, both the DOE and the States recognize that disposal issues are an integral part of treatment discussions. The performance evaluation concept was developed by the DOE and the States to address this concern. The performance evaluation process started by identifying DOE sites across the defense complex which were managing mixed waste, and then developed a screening process that eliminated all but 15 sites from consideration as a disposal site. The NTS is one of the remaining sites. The Performance Evaluation of the Technical Capabilities of DOE Sites For the Disposal of Mixed Low-Level Waste, prepared by Sandia National Laboratories (SNL, 1996) contains a description of how sites were eliminated, and contains information on the results of the performance evaluation for the NTS.

The process and technical approach for the performance evaluations were presented to State regulators at several joint State and DOE meetings facilitated by the National Governors' Association. The technical process, methodology, and data used for the performance evaluations have been continuously reviewed by an independent senior review panel made up of nongovernment experts from academia and industry. The principal goal in developing the performance evaluation was to determine the limiting concentrations of radionuclides in residuals resulting from treatment of low-level mixed waste that can be disposed of at various DOE sites.

A performance evaluation is a screening tool. Its objective is to estimate permissible concentrations of radionuclides in low-level mixed waste disposal facilities so that releases of radionuclides to the environment would not result in exposures to humans at levels greater than some predetermined performance measures. Calculations of release for three pathways (water, atmospheric, and hypothetical inadvertent intruder) form the foundation of the performance evaluation. The technical data and information used in performance evaluations is the same information available for the analyses reported in the NTS EIS. The performance evaluation is not intended to be a substitute for the detailed analysis of a performance assessment, nor is it intended for siting or permitting.

Based on the results of the performance evaluation analysis (SNL, 1996), low-level mixed waste disposal at the NTS is almost exclusively limited by the intrusion scenario. Only the radionuclide carbon-14 shows more restrictive waste limits from the atmospheric pathway. The extremely dry conditions at the NTS, where infiltration is negligible and distance to the groundwater is great, inhibit the migration of radionuclides by means of the water pathway.

Transport of radionuclides downward along a groundwater pathway does not appear to be a mechanism for movement in the subsurface at the NTS Radioactive Waste Management Sites. This conceptual model is based on hydrologic studies performed at the NTS which concluded that groundwater recharge at the Area 5 Radioactive Waste Management Site is negligible. In addition, the performance assessment for disposal of low-level waste at Area 5 demonstrates and concludes a "no groundwater pathway" conceptual model for the site hydrologic conditions during the 10,000-year performance period considered in the performance evaluation.

The performance evaluation is a means for the DOE and the States to begin evaluating options for disposal of low-level mixed waste treatment residuals that have been treated pursuant to the requirements of the Federal Facility Compliance Act of 1992. The ultimate identification of sites that might host low-level mixed waste disposal activities will follow state and federal regulations for siting and permitting, and will include public involvement in the decisionmaking. Site-specific performance assessments for the two existing Radioactive Waste Management Sites at the NTS, as described in the following sections, will also be completed.

2.5.6 Performance Assessment and Composite Analysis

The DOE orders for low-level waste and EPA regulations for transuranic waste disposal require that each radioactive waste disposal site prepare and maintain a site-specific radiological performance assessment. A performance assessment is a systematic analysis of potential risks, posed by waste management systems, to the public and to the environment and a comparison of those risks to established performance objectives. A performance assessment is an iterative process that proceeds sequentially from site characterization to conceptual model development, to outcome modeling, and back to site characterization, as necessary. The results of performance assessment analyses are used to guide site characterization activities and to refine subsequent analyses. The process ends when further site characterization would not yield information that could change the decision regarding safety of the site.

The site characterization data used in the performance assessments conducted for the NTS facilities have been used in the impact analyses performed for this EIS. The technical data and information used in the preparation of these performance assessments have also been used in the preparation of the NTS EIS. The technical conclusions of both documents are the same, and the technical data and information used remain relevant to both documents.

The DOE is responsible for disposing of a variety of radioactive wastes, including low-level, transuranic, and high-level waste. Low-level waste disposal is governed by DOE Order 5820.2A, which establishes policies and guidelines for the disposal of radioactive waste in general. The U.S. Nuclear Regulatory Commission regulations in 10 CFR Part 61 include similar requirements for performance assessment of shallow-land burial of commercial radioactive waste. Most low-level waste is disposed of using near-surface burial techniques. Disposal operations at the NTS are described in greater detail in Chapter 4, Section 4.1.1.5. Disposal of transuranic waste must meet the standards established by the EPA in 40 CFR Part 191. While transuranic waste is planned for disposal generally at the Waste Isolation Pilot Plant near Carlsbad, New Mexico, a few tens of cubic meters of transuranic waste were disposed of in the past at the NTS, and the DOE is in the process of assuring that this disposal is consistent with 40 CFR Part 191. Congress has directed the DOE to study the suitability of Yucca Mountain as a potential permanent repository for spent nuclear fuel and high-level radioactive waste from commercial and DOE-owned sources.

The DOE/NV has conducted, and continues to conduct, performance assessments of low-level waste disposal units at the NTS. The first performance assessment conducted on NTS disposal units was a draft for the Area 5 Radioactive Waste Management Sites prepared by Idaho National Engineering Laboratory (dated August 1, 1988). This performance assessment was prepared prior to the issuance of DOE Order 5820.2A, which contains the requirement for preparing a performance assessment. The performance assessment has been, and continues to be, revised; the next publication is scheduled for the fall of 1996. The first draft performance assessment for the Area 3 Radioactive Waste Management Sites was prepared by Oak Ridge National Laboratory/Grand Junction and was completed in September 1991. Several revisions of the Area 3 performance assessment have occurred, and a major revision is scheduled for completion in 1998.

The performance assessments for the Areas 3 and 5 RWMSs address the post-1988 low-level radioactive waste disposal source term (Shott et al., 1995) for each respective facility, as required under DOE Order 5820.2A. The Order specifies that performance assessments are required only for waste disposed after the effective date of the Order, September 26, 1988. In response to the Defense Nuclear Facilities Safety Board Recommendation 94-2, that the scope of performance assessments be expanded to account for past, present, and future inventories of low-level radioactive waste at the site, the DOE is developing a comprehensive environmental management systems approach to ensure long-term protection from all sources of radioactive materials left in the ground after remediation and disposal programs are completed. The comprehensive approach will include requirements that integrate DOE's land-use planning, facility decommissioning, environmental restoration, and waste disposal efforts.

Specifically, the long-term radioactive impact of the disposal operations will be analyzed by combining performance assessments under DOE Order 5820.2A for the post-1988 waste source term, with a composite analysis of the pre-1988 waste source terms, as well as other sources of radioactive contamination in the ground that are potentially interactive with the low-level waste facility (DOE, 1996). The composite analysis guidance and review criteria are to include 100 millirem (mrem) and 30 mrem in a year as criteria for evaluating results at site-determined compliance points and boundaries. The composite analysis serves as a long-term management planning tool.

Two types of performance assessments are conducted at the NTS: (1) low-level waste performance assessments pursuant to DOE Order 5820.2A for the Areas 3 and 5 Radioactive Waste Management Sites, and (2) transuranic waste performance assessments in the Area 5 Radioactive Waste Management Site pursuant to the EPA's regulations at 40 CFR Part 191. The following is a brief description of the low-level waste performance assessments and composite analysis in peer review or under development, their purpose, and the tentative schedule for completion. The transuranic waste performance assessments are discussed in Appendix A, Section A.2.

2.5.6.1 Low-Level Waste Performance Assessments

Two low-level waste performance assessments are in review or preparation stages: (1) the Area 5 Radioactive Waste Management Site Performance Assessment and (2) the Area 3 Radioactive Waste Management Site Performance Assessment. Each performance assessment must evaluate facility operation based on four performance objectives (DOE Order 5820.2A):

1. Protect public health and safety in accordance with standards specified in applicable environmental health orders and DOE orders, specifically DOE Order 5400.5, Radiation Protection of the Public and the Environment.

2. Assure that external exposure to the waste and concentrations of radioactive material that might be released into surface water, groundwater, soil, plants, and animals result in an effective dose equivalent that does not exceed 25 mrem per year (mrem/yr) to any member of the public. Releases to the atmosphere must meet the requirements of 40 CFR Part 61, the National Emission

Standards for Hazardous Air Pollutants. Releases of radioactivity in effluent to the general environment must be maintained using the "as-low-as-reasonably-achievable" process. (NV/YMP Radiological Control Manual, DOE/NV, 1994.)

3. Assure that the committed effective dose equivalents received by individuals who inadvertently intrude into the waste after loss of institutional control (100 years) will not exceed 100 mrem/yr for continuous exposure or 500 mrem for a single acute exposure (a 10,000-year compliance period).

4. Protect groundwater resources consistent with federal, state, and local regulations and requirements.

Area 5 Radioactive Waste Management Site Performance Assessment—The Area 5 Radioactive Waste Management Site Performance Assessment (Shott et al., 1995) addresses the post-1988 waste source term for the facility and was submitted to the DOE peer review panel in August 1995 for technical review and recommendation. Panel review is now concluding and a final publication is scheduled for submittal to DOE Headquarters by January 1997 (DOE, 1996). Depending on the extent of the panel's review comments and recommendations, the Area 5 report should be published by January 1997 or earlier. The next update of the Area 5 Radioactive Waste Management Site Performance Assessment will include the pre-1988 waste source-term and composite analysis, as stated in the Draft Implementation Plan, Defense Nuclear Facilities Safety Board Recommendation 94-2 (DOE, 1995).

The total estimated dose to the general public from all pathways was predicted to be approximately 0.6 mrem/yr. This estimate was obtained through analysis of several scenarios and represents an increase in annual dose of one-sixth of one percent. This compares favorably to the 25 mrem/yr performance objective dose limit for members of the general public set in DOE Order 5820.2A. Appendix A provides additional details on this and other on-going NTS performance assessments.

Area 3 Radioactive Waste Management Site Performance Assessment—The Area 3 Radioactive Waste Management Site Performance Assessment will address the post-1988 waste disposal source term and is scheduled for submittal to DOE/HQ in March 1998 (DOE, 1996). Site characterization of the facility is ongoing to acquire additional subsurface information to support performance assessment analyses in Fiscal Year 1997.

Site characterization of Area 3 in 1996 focuses on completion of exploratory boreholes beneath subsidence craters U-3bh (a reserve low-level waste cell at the Area 3 Radioactive Waste Management Site), U-3ah/at, and U-3ax/bl. The primary objective of the exploratory borehole in Area 3 is to characterize the physical and hydrologic properties of the chimney and to assess the potential for downward groundwater movement and radionuclide transport. The underground shot cavity beneath the subsidence craters at approximately 189 m (620 ft) is much deeper than active hydrologic surface processes (infiltration, redistribution, and evapotranspiration) operating beneath the waste unit, from the ground surface to a depth of approximately 30 m (100 ft). Current scientific hypotheses suggest that the rubble chimney beneath the low-level waste unit does not enhance or promote vertical groundwater flow between the waste unit (subsidence crater) and the deep shot cavity (see Chapter 4, Section 4.1.5.2). This conceptual model was confirmed by recent hydrologic data (Van Cleave, 1996). Given the proximity of Area 5 to Area 3 (23 km [14 mi]) and very similar hydrogeologic conditions, the defensible conceptual hydrogeologic model for Area 5 will be tested and validated for the Area 3 Radioactive Waste Management Site.

2.5.6.2 Composite Analyses

The long-term impact of the disposal operations at the Areas 3 and 5 Radioactive Waste Management Sites will be analyzed by combining the site-specific performance assessments for the post-1988 waste source term with complementary composite analyses taking into account the pre-1988 waste source terms, and other sources of proximal radioactive contamination in the ground (DOE, 1996). The Area 3 Radioactive Waste Management Site

Composite Analysis is scheduled to be submitted to DOE Headquarters together with the Performance Assessment by March 1998. The corresponding Area 5 Radioactive Waste Management Site Composite Analysis is due to DOE Headquarters by September 1999.

2.6 Summary

The purpose of the actions addressed in this sitewide EIS is to provide a management framework for the continued operation of the NTS. The actions are influenced by policy considerations, history, and the ongoing activities of the various programs as discussed in this chapter.

The NTS is a critical facility in the DOE's efforts to meet the nation's need to safely maintain the nuclear weapons stockpile, to retain the capability to conduct underground tests, and to focus on new and challenging issues of national security, energy, and the environment.

The DOE has historically performed rigorous evaluations of any actions that pose a threat to worker safety, public health, or the environment. The results of these studies have been used in the impact analyses conducted for this EIS. These evaluations will continue to be conducted as appropriate, and their results will be disclosed and incorporated in future National Environmental Policy Act documents. These evaluations include the detailed safety analysis done by the Defense Program, the comprehensive performance assessments developed in conjunction with the operation of waste management facilities, and the safety planning and risk assessments performed by the Environmental Restoration Program during the characterization and remediation of sites on the NTS. These activities were summarized in Section 2.4.

This sitewide EIS is not the "final word" and is not designed to cover all potential future activities at the NTS. Rather, this EIS includes only those actions and alternatives that are reasonably foreseeable at this time. Any new actions or projects will receive National Environmental Policy Act reviews prior to their implementation and will be supported through an additional tiered National Environmental Policy Act document. These reviews will include updated information on the various ongoing studies and assessments, as appropriate.

2.7 References

REGULATION, ORDER, LAW

10 CFR Part 61	U.S. Nuclear Regulatory Commission, "Energy, Licensing Requirements for Land Disposal of Radioactive Waste," *Code of Federal Regulations*, Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC, 1993.
10 CFR Part 1021	U.S. Department of Energy (DOE), "Energy: Compliance with the National Environmental Policy Act," *Code of Federal Regulations*, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC, 1994.
40 CFR Part 61	U.S. Environmental Protection Agency (EPA), "Protection of Environment: Nation Emission Standards for Hazardous Air Pollutants," *Code of Federal Regulations*, Office of Federal Registrar, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC, 1993.
40 CFR Part 191	U.S. Environmental Protection Agency (EPA), "Protection of Environment: Environmental Standards for the Management and Disposal of Spent Nuclear Fuel High-Level and Transuranic Radioactive Wastes," *Code of Federal Regulations*, Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC, 1992.
40 CFR Part 261	EPA, "Protection of Environment: Identification and Listing of Hazardous Waste," *Code of Federal Regulations*, Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC, 1993.
40 CFR Part 268	EPA, "Protection of Environment: Land Disposal Restrictions," *Code of Federal Regulations*, Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC, 1993.
60 FR 31291	U.S. Department of Energy (DOE), "Stockpile Stewardship and Management Programmatic Environmental Impact Statement," *Federal Register*, Washington, DC, 1995.
DOE Order 5400.5	DOE, "Radiation Protection of the Public and the Environment," Washington, DC, 1990.
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Chapter 3

DESCRIPTION OF ALTERNATIVES

CHAPTER 3
DESCRIPTION OF ALTERNATIVES

This chapter contains the descriptions of the alternatives that are being evaluated for the NTS, Project Shoal Area, Central Nevada Test Area, Tonopah Test Range, and the DOE sites located on the NAFR Complex. Solar Enterprise Zone projects proposed for the NTS, Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley are also described. Section 3.1 contains the alternatives and the associated land-use descriptions. Specific projects and activities included under each alternative are described in greater detail in Appendix A. Section 3.2 lists the alternatives the DOE is no longer considering and the reasons for their elimination. Section 3.3 provides a comparison of the alternatives and their environmental impacts based on analyses from the remainder of the NTS EIS. Sections 3.4 and 3.5 are the American Indian overview of Environmental Impacts and Responses to the NTS Action Alternatives. Section 3.6 identifies the DOE Preferred Alternative.

Chapters 4 and 5 of this EIS identify the impacts of past, present, and proposed future programs, projects and activities of the DOE/NV. Projects and activities are included in one or more of the four alternatives and fall into three basic levels: (1) current activities, (2) planned projects, and (3) proposed projects. Current activities are those that are presently part of the normal operations of the NTS, the Tonopah Test Range, portions of the NAFR Complex, and other areas considered in this EIS. Planned projects are those that are within the 5-year planning cycle and are likely to be implemented. Projected projects are not yet included within the 5-year planning window, but have undergone sufficient conceptual development to allow a reasonable assessment. The most reliable data are clearly derived from ongoing activities. Planned projects would present slightly less reliable data. Data for projected projects would be the least defined, but were determined to be essential to a full and open evaluation and disclosure of the potential effects of the alternative. To provide an adequate analysis, conservative assumptions and parameter values were used to evaluate potential impacts of the less-defined activities. In addition, site-support activities are analyzed for each of the environmental resources and resource elements.

3.1 Alternatives

Four use alternatives are evaluated in this EIS: Alternative 1, Continue Current Operations (No Action Alternative); Alternative 2, Discontinue Operations; Alternative 3, Expanded Use; and Alternative 4, Alternate Use of Withdrawn Lands. Each alternative is described with respect to the five program categories representing DOE/NV's primary mission: Defense, Waste Management, Environmental Restoration, Nondefense Research and Development, and Work for Others (defense-related research, development, and testing).

These alternatives are structured to provide scenarios of current and future uses of DOE facilities in Nevada that range from discontinued use to expanded use. The use alternatives have been designed to allow the DOE to analyze and compare the potential environmental effects of a wide range of use options.

The Tonopah Test Range has been managed by DOE/Albuquerque and operated by Sandia National Laboratories as a remote research and testing facility since the 1950s. In 1995, the DOE/NV and the DOE/Albuquerque entered into a memorandum of agreement, transferring the management of Environmental, Safety and Health responsibilities of the Tonopah Test Range to the DOE/NV. This action also transferred some of the operational management of the Tonopah Test Range to the DOE/NV with the exception of DOE/Albuquerque Stockpile Stewardship and Management Program and other weapons-related responsibilities for the DOE's mission.

Following the description of each alternative are the site and zoning category definitions and a land-use map that illustrates the zoning that would be implemented for each alternative. The land-use maps identify the locations of waste management, industrial, research, and support sites and define the general physical and political boundaries of activities conducted on the NTS. These zones can include compatible defense and nondefense research development and testing projects and activities as well. The Continue Current Operations Alternative (Alternative 1) is considered as the baseline land-use condition. Alternatives 2, 3, and 4 are variations developed to represent and support the uses described in each alternative.

3.1.1 Alternative 1, Continue Current Operations (No Action Alternative)

Alternative 1 is defined as the continuation of the DOE/NV and interagency programs and operations in the five program categories of: Defense, Waste Management, Environmental Restoration, Nondefense Research and Development, and Work for Others. Under Alternative 1, these activities would continue in the same manner and degree as they have within the past 3 to 5 years. Site-support activities would also continue in the same manner and degree as they have for the past 3 to 5 years. Current institutional controls would continue.

3.1.1.1 Defense Program under Alternative 1. Defense Program operations would continue at the NTS under the conditions of the ongoing nuclear testing moratorium and the negotiations of the Comprehensive Test Ban Treaty as described in Chapter 2. Two scenarios were evaluated. In the first scenario, the President would not direct any nuclear testing and the DOE's nuclear testing-related activities would be limited to maintaining a readiness to test. This scenario emphasizes the NTS's science-based stockpile stewardship experiments and operations. In the second scenario, which the DOE believes unlikely but consistent with the site's historical mission, there is a contingent possibility that the President, through an end of the moratorium or through the "supreme national interest" clause of a test ban treaty, would direct the DOE to conduct one or more nuclear tests in order to achieve a high level of confidence in the safety and reliability of the weapon type in question. These types of stockpile tests would be conducted on Pahute Mesa or on Yucca Flat, which are the only nuclear testing locations considered in this EIS. The first scenario would comprise the following current Defense Program operations at the NTS. The second scenario would include the same operations, plus the contingent possibility of conducting underground nuclear tests.

- Stockpile stewardship, including the following:

  First Scenario:

  - Maintaining readiness to conduct underground nuclear tests
  - Performing treaty compliant and permitted dynamic experiments (including subcritical experiments)[1] and hydrodynamic tests (subcritical experiments would be conducted only where containment is assured)
  - Conducting high explosive tests and experiments
  - Destroying damaged nuclear weapons.

  Second Scenario:

  - Conducting underground nuclear testing if directed by the President. This contingent possibility would occur only under the second scenario.

- Nuclear Emergency Response. The Site provides widespread flexible support to the following programs for training and exercises:
  - Nuclear Emergency Search Team
  - Federal Radiological Monitoring and Assessment Center
  - Aerial Measuring System
  - Accident Response Group
  - Radiological Assistance Program
  - Internal Emergency Management Program.

The primary mission of Defense Program activities at the Tonopah Test Range is to ensure that the

[1] The term "Subcritical Experiments," does not define a new form of activity. It is intended instead to clarify the fact that dynamic experiments that involve the use of special nuclear materials do not achieve the condition of criticality.

nation's nuclear weapons systems meet the highest standards of safety and reliability. The primary activities include:

- Stockpile stewardship:
  - Assess the surety condition of existing systems, verifying required modification to existing systems, and verifying and maintaining surety of systems
  - Conducting experiments with special nuclear materials where containment is assured.

All testing activities are non-nuclear.

3.1.1.2 Waste Management Program under Alternative 1. Radioactive waste has been generated by the weapons development, testing, and production activities at DOE facilities as well as the environmental cleanup and restoration of these facilities. As DOE missions have changed, there has been an increasing volume of waste generated through the environmental restoration activities. This increase will continue into the future. Although no new initiatives or projects would be pursued or added under Alternative 1, the following ongoing waste management activities, as described in Chapter 2, would continue at the NTS:

- Providing low-level and mixed waste disposal capability to the NTS generators and low-level waste disposal capability to currently approved waste generators. This includes disposal in existing cells as well as creating new cells. Low-level waste includes those waste streams that may be inappropriate for shallow land disposal
- Continuing to study and pursue capabilities that lead to the development of disposal units
- Storing transuranic and existing transuranic mixed waste, pending the development of DOE off-site treatment, certification, handling, and disposal facilities
- Accepting no off-site transuranic mixed waste for storage
- Storing hazardous waste pending off-site shipment for treatment, storage, and/or disposal
- Storing mixed waste, pending development of treatment options and/or certification for disposal
- Continuing closure activities of inactive waste sites, as planned
- Storing PCB waste, pending off-site shipment for treatment, storage, and/or disposal
- Treating explosives at the Explosive Ordnance Disposal Unit
- Providing disposal capability for on-site generated solid waste
- Continuing the Waste Minimization/Pollution Prevention Program.

3.1.1.3 Environmental Restoration Program under Alternative 1. Environmental Restoration Program activities would continue in the form of characterization and remediation of contaminated areas or facilities, as identified in the recently completed site inventory (DOE, 1994). Environmental restoration is not considered a land use, but an activity necessary for reuse or disposition of land and facilities. The Environmental Restoration Program projects in Nevada that would continue under Alternative 1 are as follows:

- Underground Test Area Corrective Action Unit
- Soils Media Corrective Action Unit (including portions of the NAFR Complex)
- Industrial Sites Corrective Action Unit
- Decontamination and decommissioning facilities
- Tonopah Test Range

- Central Nevada Test Area
- Project Shoal Area
- Defense Nuclear Agency sites.

The Defense Nuclear Agency sites are being identified as part of the Environmental Restoration Program activities because Defense Nuclear Agency site activities are environmental remediations. However, it should be noted that the Defense Nuclear Agency is responsible for the operation and the funding. In this sense, it is a Work for Others project.

3.1.1.4 Nondefense Research and Development Program under Alternative 1. The DOE would continue supporting ongoing program operations, but no new program initiatives would be pursued. Ongoing and planned nondefense research and development operations and activities at the NTS that would continue under this alternative are as follows:

- Support for the Solar Enterprise Zone concept
- Demonstration projects
- Spill Test Facility activities
- Environmental Management and Technology Development Programs
- National Environmental Research Park Program activities.

3.1.1.5 Work for Others Program under Alternative 1. The Work for Others Program is hosted by the DOE and includes the shared use of certain facilities and resources at the NTS and the Tonopah Test Range. Under Alternative 1, the DOE would continue to host the projects and activities of other federal agencies (for example, DoD) at activity levels not exceeding those of the past 3 to 5 years.

Work for Others Program activities that would be expected to continue include the following:

- Treaty verification
- Nonproliferation projects
- Counterproliferation
  - researching, developing, and characterizing counterproliferation technologies
- Conventional weapons demilitarization
- Defense research and development, land navigation training, exercises, and use of air space.

3.1.1.6 Land Use and Zones under Alternative 1. The following information describes the site and zone categories (for the NTS) under Alternative 1. The zone categories are depicted on the land use map in Figure 3-1.

Industrial, Research, and Support Site—An industrial site is used for the manufacturing, processing, and/or fabrication of any article, substance, or commodity. A research site is used for projects and conventional laboratory operations for the development, quality assurance, or reliability of materials and equipment under controlled conditions to verify theories or concepts. Support sites are used for office space, training, equipment storage, maintenance, security, feeding and housing, fire protection services, and health services.

Waste Management Site—These sites are used for the disposal, storage, and/or treatment of wastes.

Nuclear Test Zone—This land area is reserved for dynamic experiments, hydrodynamic tests, and underground nuclear weapons and weapons-effects tests.

Nuclear and High Explosive Test Zone—This land area is designated within the Nuclear Test Zone for additional underground and surface high-explosive tests or experiments.

Research, Test, and Experiment Zone—This land area is designated for small-scale research and development projects for the development, quality assurance, or reliability of materials and equipment under controlled conditions.

Radioactive Waste Management Zone—This land area is designated for the management of radioactive waste.

Critical Assembly Zone—This land area is used for conducting nuclear explosives operations. Operations generally include assembly, disassembly or modification, staging, storage, repair, retrofit, and surveillance.

Spill Test Facility Impact Zone—This downwind geographic area, or footprint, would define the impacts of the largest planned tests of any material released.

Reserved Zone—This land area includes areas and facilities that provide widespread flexible support for diverse short-term testing and experimentation. The Reserved Zone is also used for short-duration exercises and training, such as the Nuclear Emergency Search Team and Federal Radiological Monitoring and Assessment Center training and DoD land-navigation exercises and training.

No designated land-use zones currently exist at the Tonopah Test Range. Activities on this range are conducted in industrial and testing areas.

3.1.2 Alternative 2, Discontinue Operations

Alternative 2 is defined as the discontinuation of the DOE/NV and interagency programs and operations at the NTS. Site-support activities would be maintained, but would be limited to environmental monitoring and security functions necessary for human health and security. Control of the NTS would be maintained by the DOE, but no activities would take place. All facilities, after decommissioning operations have ceased, would be placed in cold standby.

3.1.2.1 Defense Program under Alternative 2. Under Alternative 2, the DOE/NV would not maintain a state of readiness for nuclear testing, and there would be an overall discontinuation of other defense-related activities at the NTS. The Tonopah Test Range would continue hosting Stockpile Stewardship activities as described under Alternative 1.

3.1.2.2 Waste Management Program under Alternative 2. Under Alternative 2, the DOE/NV would maintain only minimum low-level and mixed waste disposal capability until NTS waste-generating activities are completely shut down. After shutdown, monitoring and security functions on the NTS would be reduced and become part of the sitewide monitoring activity. Transuranic and transuranic mixed waste would be shipped to other DOE facilities for certification, handling, and disposal. Active waste sites would be covered with approximately 3 m (10 ft) of soil prior to shutdown.

3.1.2.3 Environmental Restoration Program under Alternative 2. Under Alternative 2, the currently inventoried Environmental Restoration Program sites would be discontinued and left abandoned as is. All reports, studies, field investigations, characterization, and decommissioning and/or decontamination would cease. All remediation projects under way would be discontinued, with the goal of progressing to a suitable conclusion within one calendar year of the decision to pursue this alternative.

3.1.2.4 Nondefense Research and Development Program under Alternative 2. Under Alternative 2, the DOE would discontinue support of ongoing program operations. The National Environmental Research Park Program would be terminated. The Spill Test Facility would be abandoned. The Environmental Management and Technology Development Program would be discontinued at the NTS. New DOE projects, such as a Solar Enterprise Zone facility, would not be sited on the NTS.

3.1.2.5 Work for Others Program under Alternative 2. Under Alternative 2, the DOE would not host the projects and activities of other federal agencies. The use of NTS airspace and certain lands by branches of the military would be discontinued. Any subsequent airspace restrictions

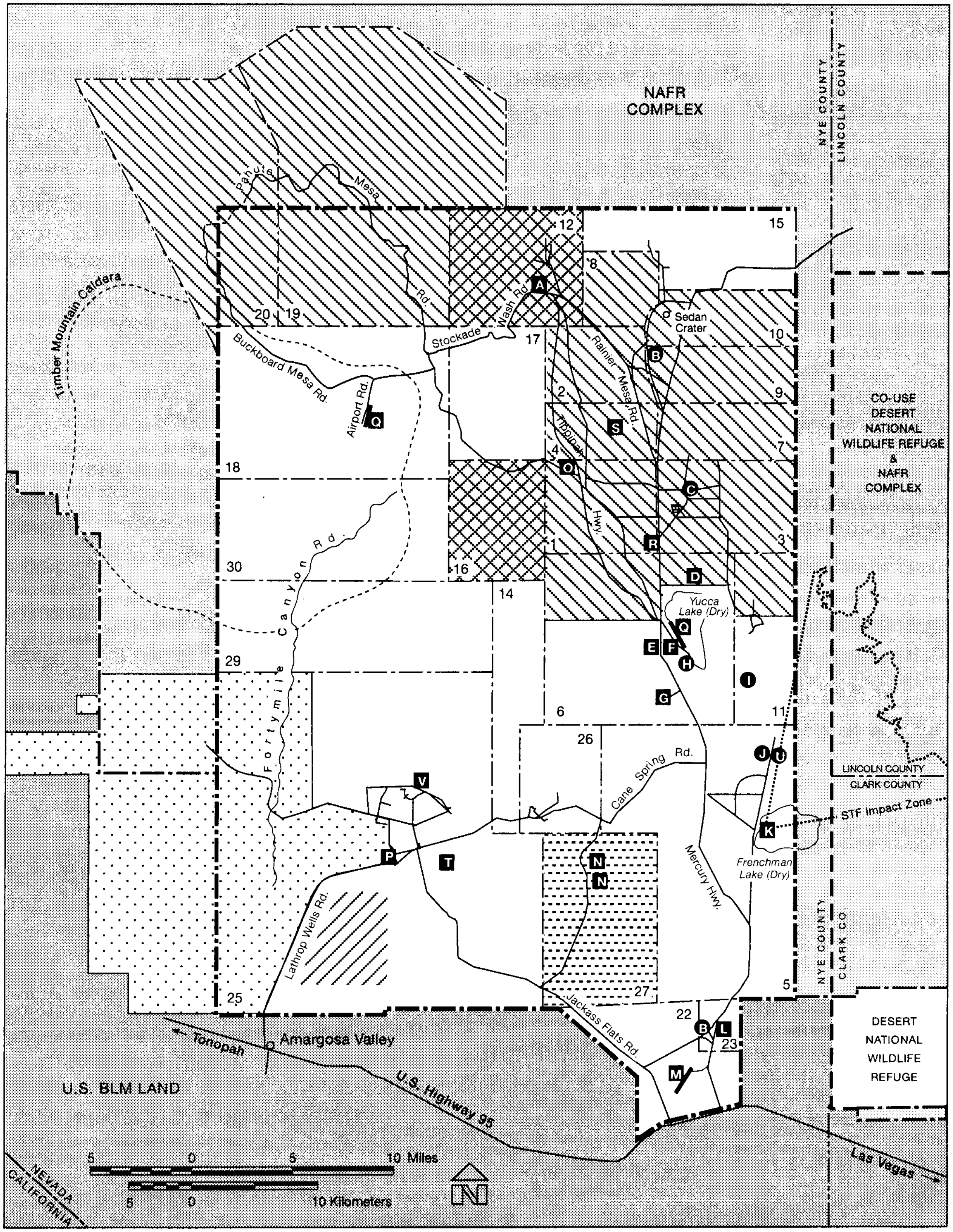

Figure 3-1. NTS Alternative 1 land use map

LEGEND

- Nuclear Test Zone
- Nuclear and High Explosive Test Zone
- Research, Test, and Experiment Zone
- Radioactive Waste Management Zone
- Yucca Mtn. Site Characterization Zone
- Reserved Zone (within the NTS areas)
- Critical Assembly Zone
- U.S. Bureau of Land Management (BLM)
- NAFR Complex
- Co-Use Desert National Wildlife Range and NAFR Complex
- Desert National Wildlife Refuge Boundary
- Spill Test Facility (STF) Impact Zone Boundary
- County Line
- NTS Boundary Line
- NTS Area Boundary Line

- ● Waste Management Site
- ■ Industrial, Research, and Support Site
- A Area 12 Camp (closed)
- B Sanitary Landfill
- C Area 3 Radioactive Waste Management Site (Zone)
- D Area 6 Construction Facilities
- E Control Point
- F Yucca Lake Facilities
- G Device Assembly Facility
- H Hydrocarbon Contaminated Soils Disposal Site
- I Explosive Ordnance Disposal Site
- J Area 5 Radioactive Waste Management Site
- K Spill Test Facility
- L Mercury
- M Desert Rock Airport
- N Area 27 Assembly/Staging Facilities
- O Area 1 Industrial Complex
- P Area 25 Central Support Site
- Q Airstrip
- R Lyner Complex
- S Big Explosives Experimental Facility
- T BREN Tower
- U Hazardous Waste Storage Site
- V Treatability Test Facility

Figure 3-1 (continued). Legend for NTS Alternative 1 land use map

would be required to allow for overflights and inspections of the NTS in accordance with international arms control treaties, such as the Open Skies Treaty.

3.1.2.6 Land Use and Zones under Alternative 2. The following information describes the site and zone categories depicted on the land use map (Figure 3-2) under Alternative 2.

Security and Monitoring Operations Control Point—The site is used as the base of operations location for environmental monitoring and security patrols.

Industrial, Research, and Support Sites—An industrial site is used for manufacturing, processing, and/or fabricating any article, substance, or commodity. A research site is used for projects and conventional laboratory operations for the development, quality assurance, or reliability of materials and equipment under controlled conditions to verify theories or concepts. Support sites are used for office space, training, equipment storage, maintenance, security, feeding and housing, fire protection services, and health services.

Closed Site—These sites are industrial, research, or support sites that are no longer in use or maintained.

Closed Waste Management Site—This site is a waste management site that is no longer in use or maintained.

Monitored and Restricted Zone—Public access to this land area is restricted. Visits, patrols, and/or data collection on a periodic basis is conducted to provide for human health and safety and for the protection of assets and the environment.

3.1.3 Alternative 3, Expanded Use

The scope of Alternative 3 (Expanded Use) in this EIS is defined as including all currently planned and proposed projects, and all currently ongoing DOE/NV and interagency programs and operations described in Alternative 1, Continue Current Operations (No Action Alternative) and the potential project activities resulting from other DOE EISs. These additional project activities include the modification and/or expansion of existing facilities, and the construction of new facilities. In the case of potential activities resulting from other DOE EISs, this alternative identifies the action to reserve land and infrastructure pending a programmatic decision. An analysis of the environmental impacts associated with siting these potential projects is included in the consequences analysis (Chapter 5) for this alternative.

The following is a program-by-program description under Alternative 3, Expanded Use. To clarify the differences between Alternative 1 and Alternative 3 activities, asterisks are used to identify those activities that represent the expanded uses described by Alternative 3.

3.1.3.1 Defense Program under Alternative 3. Defense Program operations would continue at the NTS under the conditions of the ongoing nuclear testing moratorium and the negotiations of the Comprehensive Test Ban Treaty. These operations would emphasize NTS science-based stockpile stewardship experiments and operations to maintain the safety and reliability of the stockpile without underground nuclear testing. In addition, because there can be no absolute guarantee of the complete success in the development of enhanced experimental and computational capabilities, this alternative includes those activities necessary to maintain the capability to conduct nuclear tests under a "supreme national interest" provision in the anticipated Comprehensive Test Ban Treaty. These activities include maintaining the necessary infrastructure, and more importantly, exercising the research and engineering disciplines of the nation's nuclear weapons programs to assure the continued competence of its technical staff. Defense Programs activities would include:

- Stockpile Stewardship and Management
  - Performing treaty compliant and permitted dynamic experiments (including subcritical experiments)[2], and

[2] The term "Subcritical Experiments," does not define a new form of activity. It is intended instead to clarify the fact that dynamic experiments which involve the use of special nuclear materials do not achieve the condition of criticality.

hydrodynamic tests (subcritical experiments would be conducted only where containment is assured)

- Maintaining readiness to conduct underground nuclear tests

- Conducting high explosive tests and experiments to include hydrodynamic tests and pulse power experiments. These tests and experiments may contain potentially hazardous materials such as beryllium, depleted uranium, deuterium, and tritium. At the Big Explosives Experimental Facility no experiments utilizing special nuclear materials would be performed

- Disposition of damaged nuclear weapons

* Reserve land and infrastructure for a large, heavy-industrial facility

- Conducting underground nuclear testing if directed by the President under a "supreme national interest" provision in the anticipated Comprehensive Test Ban Treaty

* Reserve land and infrastructure for next generation nuclear weapons simulators pending programmatic decisions

* Reserve land and infrastructure for nuclear weapon assembly/disassembly operations and associated storage of strategic reserves of special nuclear materials as proposed in the Pantex Sitewide EIS. Interim storage of nuclear weapons components (pits) as proposed as an alternative in the Pantex Sitewide EIS, pending programmatic decisions.

- Materials Disposition

  * Reserve land and infrastructure for long-term storage and facilities for the disposition of weapons-usable fissile material pending programmatic decisions

- Nuclear Emergency Response

Although no land area is specifically dedicated to Nuclear Emergency Response activities, the NTS provides a broad support base for the National Emergency Response Programs. The NTS provides an excellent test bed for training and exercise activities, and provides technical, operational, and logistical expertise in planning and deployment operations of the following programs.

  - Nuclear Emergency Search Team
  - Federal Radiological Monitoring and Assessment Center
  - Aerial Measuring System
  - Accident Response Group
  - Radiological Assistance Program
  - Internal Emergency Management Program.

The primary mission of Defense Program activities at the Tonopah Test Range is to ensure that the nation's nuclear weapons systems meet the highest standards of safety and reliability. These activities include several activities:

- Stockpile Stewardship

  - Assess surety conditions of existing systems, verifying required modification to existing systems, and verifying and maintaining surety of systems
  - Conducting experiments with special nuclear materials where containment is assured.

3.1.3.2 Waste Management Program under Alternative 3. Waste Management operations would continue to support DOE research and environmental cleanup and restoration programs. The DOE's Waste Management objective for the NTS would be to conduct proper disposal and monitoring of wastes generated from the NTS and other DOE sites. The specific waste management

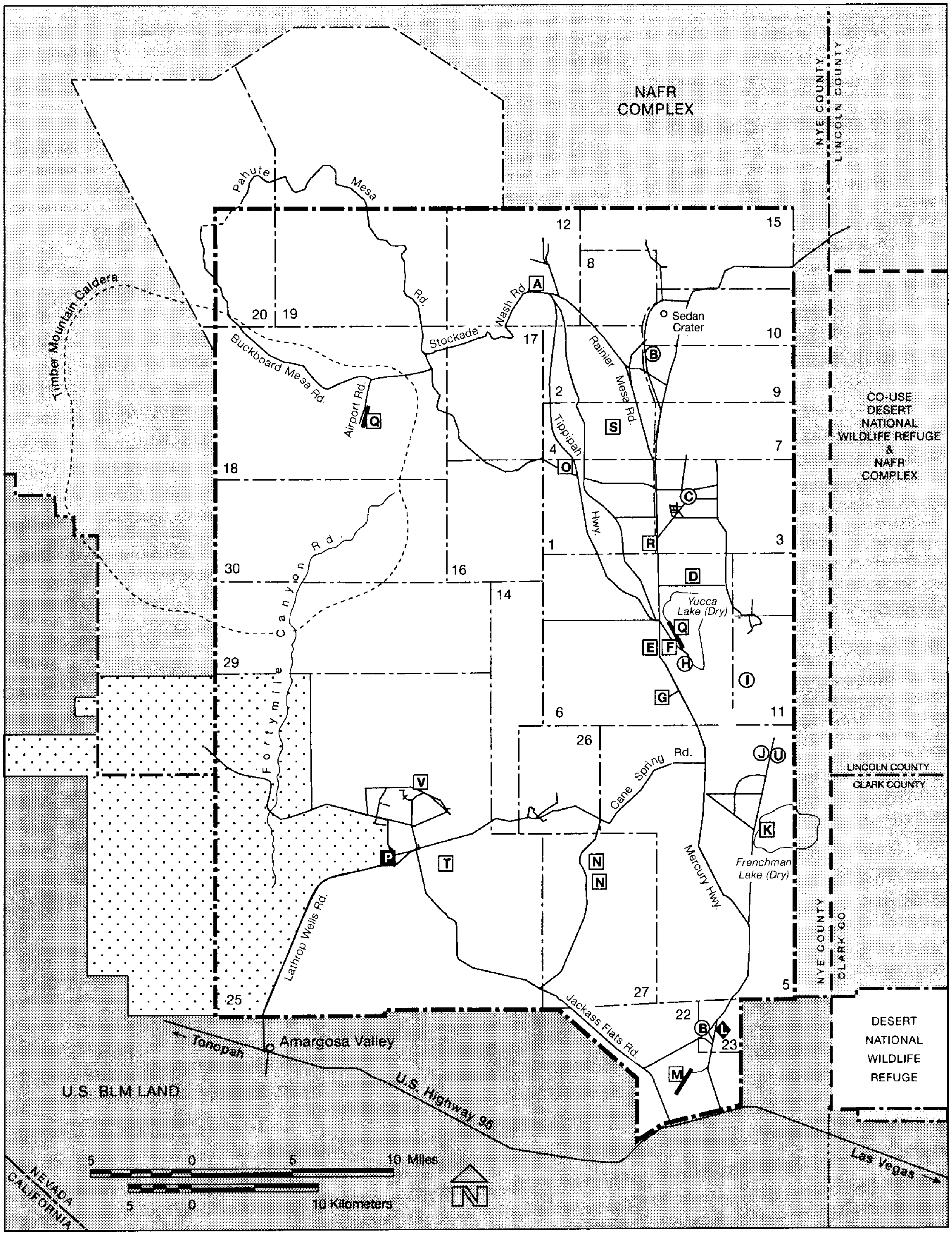

Figure 3-2. NTS Alternative 2 land use map

LEGEND

- ◆ Security and Monitoring Operations Control Point
- ■ Industrial, Research, and Support Site
- □ Industrial, Research, and Support Site (closed)
- ○ Waste Management Site (closed)
- Yucca Mtn. Site Characterization Zone
- Monitored and Restricted Zone (within the NTS areas)
- U.S. Bureau of Land Management (BLM)
- NAFR Complex
- Co-Use Desert National Wildlife Range and NAFR Complex
- Desert National Wildlife Refuge Boundary
- County Line
- NTS Boundary Line
- NTS Area Boundary Line

- A Area 12 Camp
- B Sanitary Landfill
- C Area 3 Radioactive Waste Management Site (Zone)
- D Area 6 Construction Facilities
- E Control Point
- F Yucca Lake Facilities
- G Device Assembly Facility
- H Hydrocarbon Contaminated Soils Disposal Site
- I Explosive Ordnance Disposal Site
- J Area 5 Radioactive Waste Management Site
- K Spill Test Facility
- L Mercury
- M Desert Rock Airport
- N Area 27 Assembly/Staging Facilities
- O Area 1 Industrial Complex
- P Area 25 Central Support Site
- Q Airstrip
- R Lyner Complex
- S Big Explosives Experimental Facility
- T BREN Tower
- U Hazardous Waste Storage Site
- V Treatability Test Facility

Figure 3-2 (continued). Legend for NTS Alternative 2 land use map

activities proposed in Alternative 3 are listed in Table 3-4. The following Waste Management activities would occur in appropriately designated Waste Management zones or sites:

- Providing low-level and mixed waste disposal capability to approved waste generators. This includes expanding and creating new disposal units. Low-level waste includes waste streams inappropriate for shallow land burial.

- Storing transuranic and transuranic mixed waste, pending the development of the DOE off-site treatment and disposal facilities

* Construct and operate on-site facilities for the certification and handling of transuranic and transuranic mixed waste for off-site treatment and disposal

* Expanding the existing capacity for the storage of hazardous waste pending off-site disposal

- Storing mixed waste, pending development of treatment options and/or certification for disposal

* Constructing and operating a mixed waste storage pad

- Continuing closure activities of inactive waste sites, as planned

- Storing PCB waste pending off-site disposal

* Constructing and providing storage capability for low-level waste

* Constructing and operating treatment facilities for on-site generated low-level and mixed waste

- Treating explosives at the Explosive Ordnance Disposal Unit

* Constructing and operating additional disposal facilities for solid waste generated on the NTS and in adjacent rural counties.

3.1.3.3 Environmental Restoration Program under Alternative 3. Environmental Restoration Program activities would continue in the form of characterization and remediation of contaminated areas or facilities, as identified in the recently completed site inventory. Environmental Restoration is not considered a land use, but an activity necessary for reuse or disposition of land and facilities. The Environmental Restoration Program subprojects in Nevada that would continue under Alternative 3 include:

- Underground Test Area Corrective Action Unit

- Soils Median Corrective Action Unit (including sites on the NAFR Complex)

- Industrial Sites Corrective Action Unit

- Decontamination and decommissioning facilities

- Tonopah Test Range

- Central Nevada Test Area

- Project Shoal Area

- Defense Nuclear Agency sites.

3.1.3.4 Nondefense Research and Development Program under Alternative 3. Under Alternative 3, the DOE would continue supporting ongoing program operations and pursue new initiatives. New initiatives would include constructing and operating a solar power production facility and siting an Alternative Fuels Demonstration Project at the NTS. Alternative 3 reserves land and infrastructure for public and private institutions to use portions of the NTS for compatible research, development, and testing activities. For example, the Kistler Aerospace Corporation identified during the public comment period of this EIS their interest in a commercial satellite delivery system as a future activity in this program area. Nondefense research, development, and testing activities that would continue or be pursued at the NTS would include:

- Supporting the Solar Enterprise Zone facility concept

* Reserve land on the NTS as a Solar Enterprise Zone facility. Construct and operate a solar power generation facility on the selected site

* Increased Spill Test Facility (Hazardous Materials Spill Center) activities

* Increased Environmental Management and Technology Development Programs

- National Environmental Research Park Program activities

- Additional demonstration projects.

Solar Enterprise Zone facility land use area is proposed under Alternative 3. In addition to a facility at the NTS, three sites in southern Nevada are being considered: Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley.

The Tonopah Test Range activities that would be pursued include programs in the field of robotics technology, infrastructure maintenance, and transportation.

3.1.3.5 Work for Others Program under Alternative 3. Use of NTS airspace and certain lands by branches of the military for training and for defense-related research and development would increase under Alternative 3. The DOE would continue to host projects and activities of other federal agencies (for example, DoD) and share use of certain facilities and resources at the NTS and the Tonopah Test Range. This alternative reserves land and infrastructure for other federal agencies to use portions of the NTS for compatible activities. Work for Others Program activities that would continue include the following:

- Treaty verification

- Increased nonproliferation projects

- Expanded counterproliferation projects

  – Researching, developing, and characterizing counterproliferation technologies

* Additional conventional weapons demilitarization projects

* Expanded defense-related research and development, land navigation training, exercises, and use of airspace.

Furthermore, under Alternative 3, various facilities at the NTS would be used to conduct research and development of advanced conventional weapons technologies, including the Big Explosives Experimental Facility (see Section A.1.1.1.3 and Appendix F).

Tonopah Test Range airspace and the use of certain lands by the military for training and defense-related research and development would increase.

3.1.3.6 Land Use and Zones under Alternative 3. The following information describes the site and zone categories depicted on the land use map (Figure 3-3) under Alternative 3.

Waste Management Site—These sites are used for the disposal, storage, and/or treatment of wastes.

Industrial, Research, and Support Site—An industrial site is used for manufacturing, processing, and/or fabricating any article, substance, or commodity. A research site is used for projects and conventional laboratory operations for the development, quality assurance, or reliability of materials and equipment under controlled conditions to verify theories or concepts. Support sites are used for office space, training, equipment storage, maintenance, security, feeding and housing, fire protection services, and health services.

Nuclear Test Zone—This land area is reserved for dynamic experiments, hydrodynamic tests, and underground nuclear weapons and weapons-effects tests. This zone includes compatible defense and nondefense research, development and testing projects and activities.

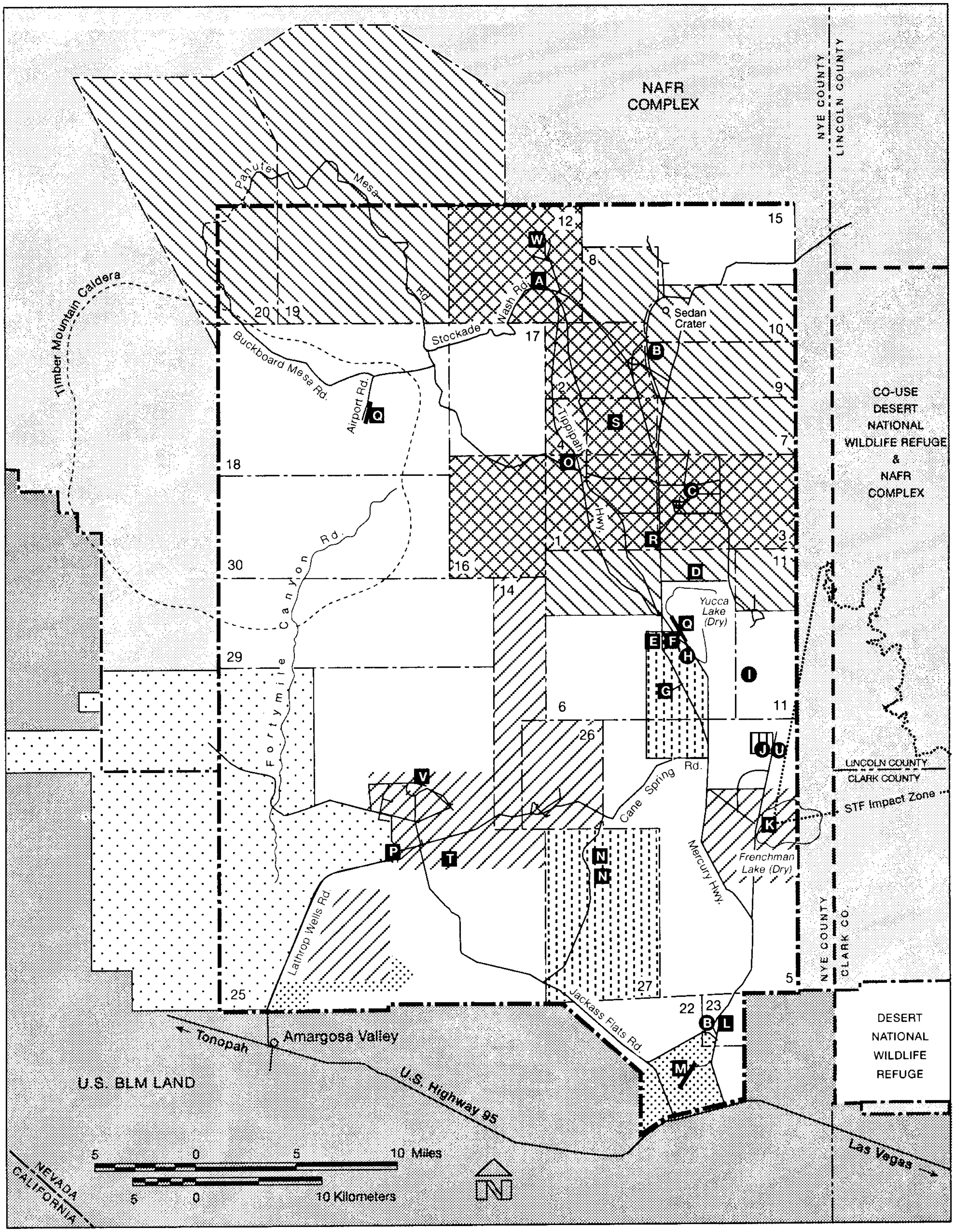

Figure 3-3. NTS Alternative 3 land use map

LEGEND

- Nuclear Test Zone
- Nuclear and High Explosive Test Zone
- Research, Test, and Experiment Zone
- Radioactive Waste Management Zone
- Yucca Mtn. Site Characterization Zone
- Solar Enterprise Zone
- Reserved Zone (within the NTS areas)
- Defense Industrial Zone
- U.S. Bureau of Land Management (BLM)
- NAFR Complex
- Co-Use Desert National Wildlife Range and NAFR Complex
- Desert National Wildlife Refuge Boundary
- Spill Test Facility (STF) Impact Zone Boundary
- County Line
- NTS Boundary Line
- NTS Area Boundary Line

- ● Waste Management Site
- ■ Industrial, Research, and Support Site
- A Area 12 Camp
- B Non Hazardous Waste Landfill
- C Area 3 Radioactive Waste Management Site (Zone)
- D Area 6 Construction Facilities
- E Control Point
- F Yucca Lake Facilities
- G Device Assembly Facility
- H Hydrocarbon Contaminated Soils Disposal Site
- I Explosive Ordnance Disposal Site
- J Area 5 Radioactive Waste Management Site
- K Spill Test Facility
- L Mercury
- M Desert Rock Airport
- N Area 27 Assembly/Storage Facilities
- O Area 1 Industrial Complex
- P Area 25 Central Support Site
- Q Airstrip
- R Lyner Complex
- S Big Explosives Experimental Facility
- T BREN Tower
- U Hazardous Waste Storage Site
- V Treatability Test Facility
- W P-Tunnel Complex

Figure 3-3 (continued). Legend for NTS Alternative 3 land use map

Nuclear and High Explosive Test Zone—This land area is designated within the Nuclear Test Zone for additional underground and outdoor high-explosive tests or experiments. This zone includes compatible defense and nondefense research, development and testing projects and activities.

Research, Test, and Experiment Zone—This land area is designated for small-scale research and development projects; demonstrations; pilot projects; outdoor tests; and experiments for the development, quality assurance, or reliability of materials and equipment under controlled conditions. This zone includes compatible defense and nondefense research, development and testing projects and activities.

Radioactive Waste Management Zone—This land area is designated for the management of radioactive wastes.

Solar Enterprise Zone—This land area is designated for the development of a solar energy power-generation facility, and light industrial equipment and commercial manufacturing capability.

Spill Test Facility Impact Zone—This downwind geographic area would confine the impacts of the largest planned tests of any material released.

Defense Industrial Zone—This land area is designated for stockpile management of weapons, including production, assembly, disassembly or modification, staging, repair, retrofit, and surveillance. Also included in this zone are permanent facilities for stockpile stewardship operations involving equipment and activities such as radiography, lasers, materials processing, and pulsed power.

Reserved Zone—This land area includes areas and facilities that provide widespread flexible support for diverse short-term testing and experimentation. The reserved zone is also used for short-duration exercises and training, such as the Nuclear Emergency Search Team and Federal Radiological Monitoring and Assessment Center training and DoD land-navigation exercises and training.

3.1.4 Alternative 4, Alternate Use of Withdrawn Lands

Under Alternative 4, the DOE would discontinue all defense-related activities at the NTS and most Work for Others Program activities. The U.S. Air Force could increase its use of airspace. The continuation of waste management operations in support of NTS environmental restoration and waste-generating activities associated with projects sited at the NTS would be the primary activities under this alternative.

3.1.4.1 Defense Program under Alternative 4. The DOE would not maintain a state of readiness for nuclear testing, and there would be an overall down scaling and discontinuation of other defense-mission activities. However, the DOE would be required to provide for overflights and inspections of the NTS in accordance with international arms control treaties. Tonopah Test Range activities associated with maintaining readiness would be in accordance with treaty requirements consistent with the Tonopah Test Range mission.

3.1.4.2 Waste Management Program under Alternative 4. Waste Management Program operations and construction would include all the activities listed under Alternative 3, with the restriction that these services be provided solely for DOE waste generated within Nevada.

3.1.4.3 Environmental Restoration Program under Alternative 4. The Environmental Restoration Program would continue at current or accelerated rates. More stringent remediation levels greater than protection of human health and the environment may be implemented (where applicable), based on designated land use and/or the potential return of some lands to public domain.

3.1.4.4 Nondefense Research and Development Program under Alternative 4. Under Alternative 4, Nondefense Research and Development Program activities would include those described under Alternative 3, but with a reduction in the scope of the Alternative Fuels Demonstration Projects.

3.1.4.5 Work for Others Program under Alternative 4. Under Alternative 4, it is anticipated that portions of the restricted NTS airspace would be relinquished. Conventional weapons demilitarization activities would not be sited at the NTS under this alternative, and defense-related research and training by other government agencies would not be conducted at the NTS. The DOE would be required to provide for overflights and inspections of the NTS and the Tonopah Test Range in accordance with international arms control treaties such as the Open Skies Treaty.

3.1.4.6 Potential Public Uses of NTS Lands under Alternative 4. The activities described in the following sections are other potential public uses of the NTS.

- Public Education:

  Educational tour routes would be established for the public. Tours would allow the public to see firsthand some of the history of the Nuclear Era and impacts of past nuclear testing. A Nuclear Era museum at the NTS that highlights the testing activities would be an important contribution to understanding the nation's nuclear history.

  Educational field trips to the NTS have occurred to a limited extent. This type of education would allow students to see firsthand some of the impacts of nuclear testing and contrast this destruction to the pristine and relatively undisturbed ecosystems that exist on the NTS.

- Public Recreation:

  Recreation on the NTS could focus on natural scenic areas, such as Timber Mountain and the isolated forested areas. The Timber Mountain Caldera is a national natural landmark and, with all its associated volcanic features, is one of the best examples of a caldera. This area is also the location of American Indian petroglyphs.

  The road system on the NTS would provide a location for such events as foot races, marathons, closed-circuit bicycle and car races, and other similar activities. The desert terrain and the existing facilities make Alternative 4 attractive.

  Deer herds and other game animals on the NTS have not been actively hunted for many decades. Consequently, a limited trophy deer hunt could be established similar to the bighorn sheep trophy hunt, as on the NAFR Complex, with a drawing to select a limited number of hunters. Each hunter must attend a one-day training session. The Nevada Division of Wildlife manages the bighorn sheep trophy hunt.

3.1.4.7 Land Use and Zones under Alternative 4. The following information describes the site and zone categories depicted on the land use map (Figure 3-4) under Alternative 4:

Waste Management Site—These sites are used for the disposal, storage, and/or treatment of wastes.

Industrial, Research, and Support Sites—An industrial site would be used for the manufacturing, processing, and/or fabrication of any article, substance, or commodity. A research site would be used for projects and conventional laboratory operations for the development, quality assurance, or reliability of materials and equipment under controlled conditions to verify theories or concepts. Support sites are used for office space, training, equipment storage, maintenance, security, feeding and housing, fire protection services, and health services.

Closed Site—These are closed industrial, research, and support sites that are no longer in use or maintained.

Radioactive Waste Management Zone—This land area is designated for the management of radioactive waste.

Spill Test Facility Impact Zone—This downwind geographic area would confine the impacts of the largest planned tests of any material released at the Spill Test Facility.

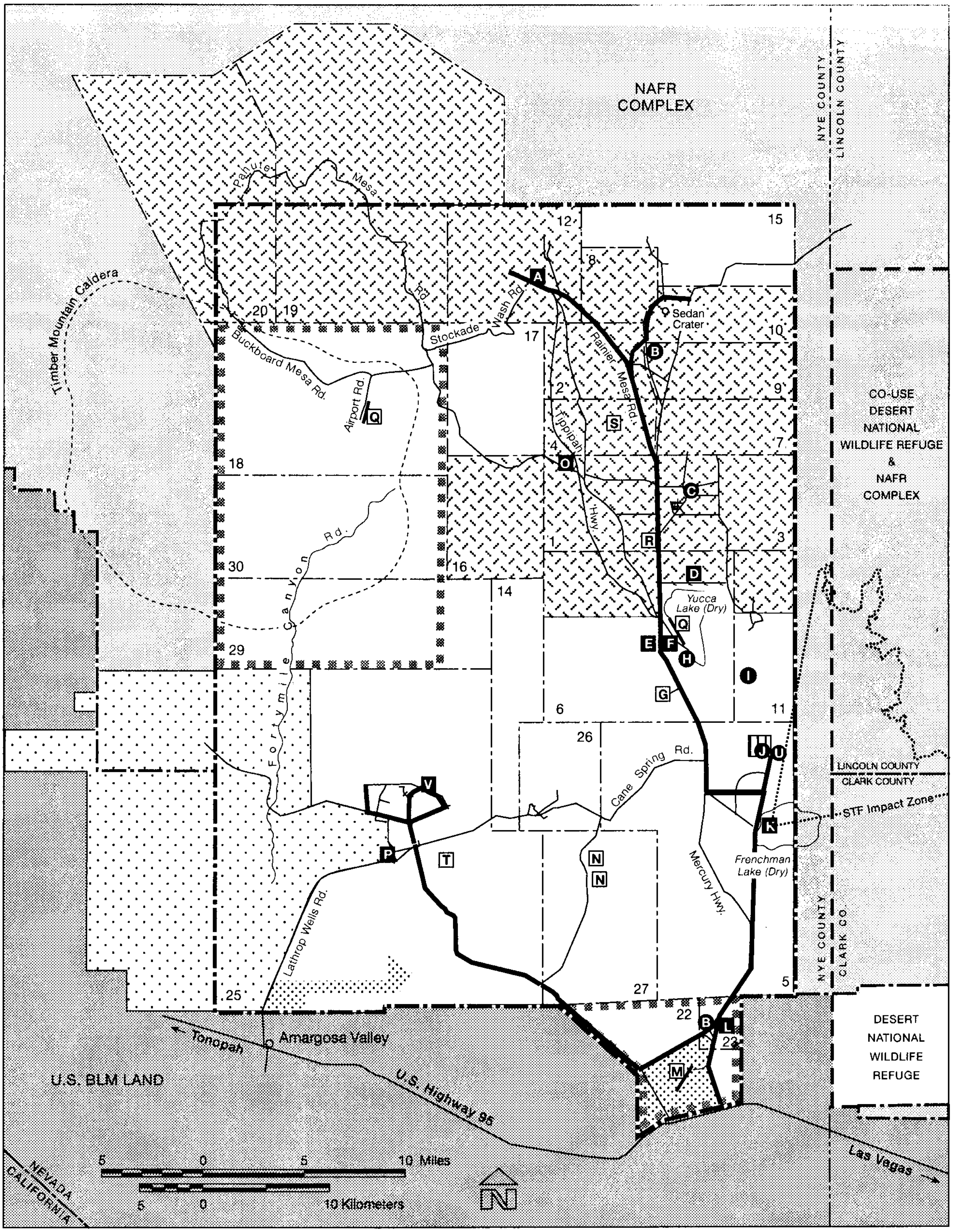

Figure 3-4. NTS Alternative 4 land use map

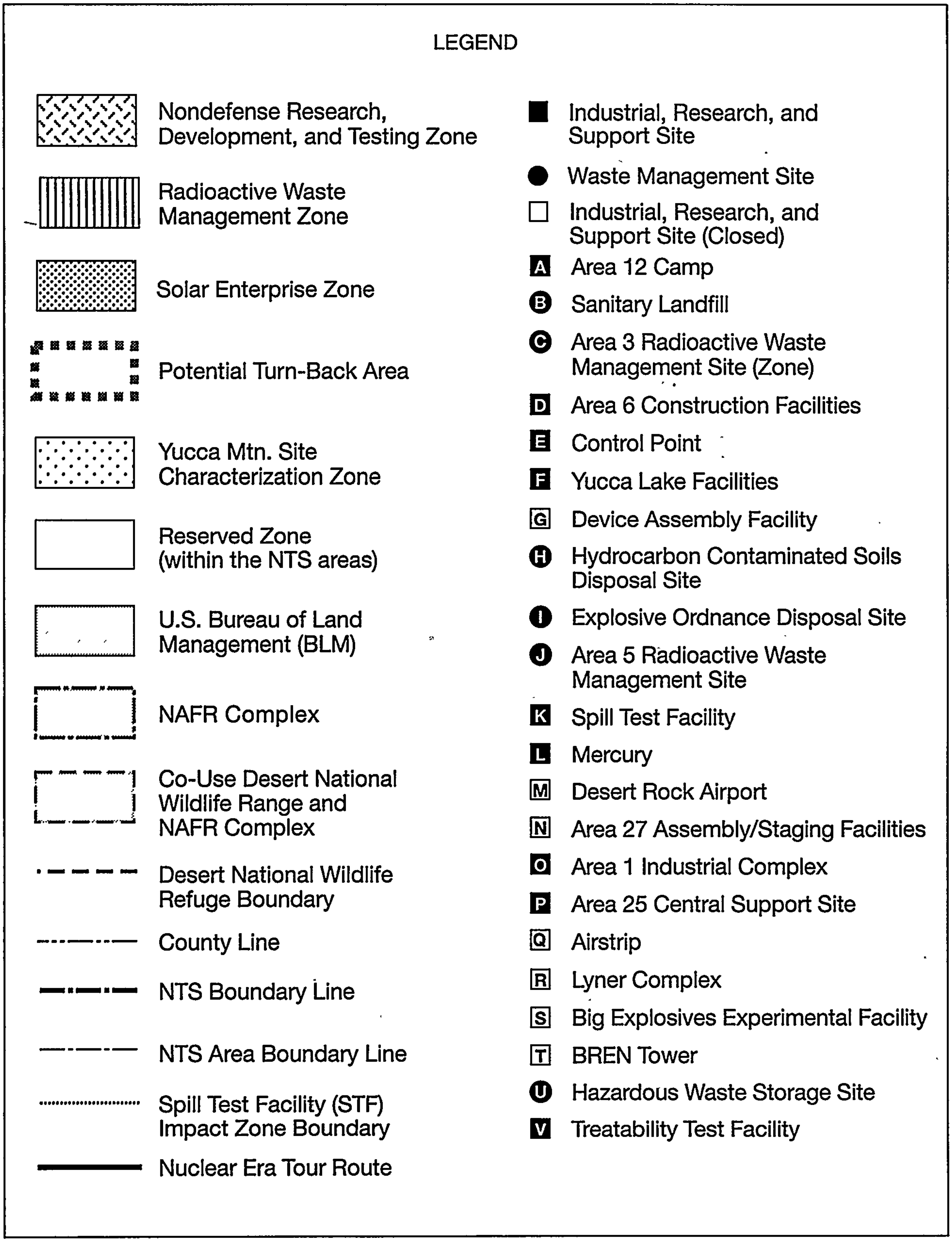

Figure 3-4 (continued). Legend for NTS Alternative 4 land use map

Reserved Zone—The reserved zone includes areas and facilities that provide widespread flexible support for diverse short-term nondefense research, testing, and experimentation.

Nondefense Research, Development, and Testing Zone—This monitored restricted-access land area has been designated for nondefense-related research, development, and testing activities.

Potential Turn Back Area—This zone encompasses the land area designated for potential return to the U.S. Bureau of Land Management who would determine the proper management prescription for the land consistent with area land use policies.

3.2 Alternatives Eliminated from Further Consideration

A National Environmental Policy Act review specifies the purpose and need for an agency to take action, describes the action that the agency proposes to meet for that purpose and need, and identifies reasonable alternatives to meet all or part of the purpose and need. A potential alternative might be eliminated from detailed consideration if the alternative would take too long to implement, or would be prohibitively expensive, or highly speculative in nature and thus is considered unreasonable. During scoping for the NTS EIS, commentors suggested several alternatives that could be considered in the document. The DOE considered those alternatives, but did not analyze them in detail in this EIS. This section identifies the alternatives that were eliminated from further consideration and provides a brief explanation of the reason for elimination. These alternatives include the following:

- Site uses defined by the program
- Site closure with full environmental restoration
- Site closure with direct turn back of surplus lands to the sovereign nations, public, county, and state
- No Action Alternative that excludes receipt of waste from out-of-state waste generators
- Other alternatives within the range of alternatives considered
- Alternatives including rail routes for waste transport.

3.2.1 Site Uses Defined by Program

As an alternative to managing the NTS to support multiple programs, the DOE considered, but dismissed as unreasonable, the alternatives that would dedicate the NTS to a single program. The most commonly cited alternatives included the five programs evaluated in this EIS: Defense, Environmental Restoration, Waste Management, Nondefense Research and Development (including alternative energy research), and Work for Others. In each alternative, only one program would be conducted at the NTS, with the NTS being fully dedicated to conducting the program under consideration. The NTS has historically been a multipurpose facility because of its remote location, arid climate, controlled access, and size. For these reasons, this alternative fails to meet the DOE's need for a site that can support evolving DOE missions.

3.2.2 Site Closure with Complete Environmental Restoration

The DOE considered, but dismissed as too speculative, the alternative to fully remediate and close the NTS in the next 10-year period. In accordance with the DOE's National Environmental Policy Act EIS policy, the NTS EIS evaluates site uses for the next 5- to 10-year period and because of the unique nature of past NTS activities (nuclear weapons tests), complete site characterization and subsequent remediation activities could not be completed before the year 2035. Additionally, technologies to fully and economically remediate certain areas of the NTS (such as the underground testing areas) do not currently exist and are not anticipated to be available in the next 10-year period.

3.2.3 Site Closure with Direct Relinquishment of Surplus Lands to the Sovereign Nations, the Public, Nye County, or the state of Nevada following Remediation

The DOE considered, but dismissed as unreasonable, the alternative of relinquishing the withdrawn NTS land directly to the sovereign nations, the state of Nevada, Nye County, or the public. This alternative would require a redirection of the policies of the U.S. Bureau of Land Management, which administers the federal lands that are withdrawn for use by the DOE. Current U.S. Bureau of Land Management policies and regulations require lands that were formerly withdrawn from the public domain, and are no longer needed, to be relinquished to the U.S. Bureau of Land Management. For this reason, this alternative was considered too speculative and outside the scope of the NTS EIS. Alternative 4 addresses, to the extent reasonable, the identification of possible surplus land within the NTS and the return of that land to the U.S. Bureau of Land Management for public use.

3.2.4 Other Alternatives within the Range of Alternatives Considered

Several alternatives were identified by sovereign nations, stakeholders, and the public that fall within the range of the four alternatives being evaluated in this EIS. Such alternatives involved varying combinations of the five major programs (Defense, Environmental Restoration, Waste Management, Nondefense Research and Development, and Work for Others). Such alternatives included expanding nondefense research and development and minimizing waste management; continuing current operations except excluding receipt of waste from outside generators; and, expanding defense activities to include all stockpile stewardship and management functions. The DOE believes that the range of alternatives considered in this EIS bounds these other suggested alternatives. At one end of the spectrum, the alternatives include site closure with no activities other than monitoring; the opposite extreme is the expanded use of NTS resources. Encompassed within these extremes are the continuation of current operations (no action) and a reduced level of resource use that eliminates all defense-related activities and that limits waste management activities to support the environmental restoration of the NTS.

3.2.5 Alternatives Including Rail Routes for Waste Transport

Several stakeholders urged that rail routes for the transport of all waste types, including high-level waste and spent nuclear fuel, should be included in one or more of the alternatives. The DOE considered the inclusion of rail routes as part of the alternatives. As stated earlier, no action to construct rail access to the NTS is considered in this EIS or in the Record of Decision. The DOE/NV recognizes, however, that a rail option would be a feasible alternative should the NTS be named the sole low-level waste disposal site for the DOE complex and defers any decision to such time that a decision is made in the Waste Management Programmatic Environmental Impact Statement. The Transportation Study undertaken to support this EIS presents and analyzes, for purposes of comparison, the rail routes and highway truck transportation routes that could support low-level waste shipments only (see Appendix I).

The Yucca Mountain Project Repository EIS will evaluate the potential consequences associated with the construction and operation of a rail spur to ship spent nuclear fuel and high-level waste. The implications of such a spur for the NTS will be addressed as part of the cumulative impacts analysis in the Repository EIS. Should the DOE decide to construct and operate a rail spur, the DOE/NV would perform additional evaluations associated with the use of this resource by low-level waste generators.

3.2.6 Alternatives Considered But Eliminated from Consideration Prior To Scoping

Prior to the public scoping period, the DOE determined that a number of issues would not be considered in this EIS. The eliminated alternatives are considered to be outside the scope of this EIS because they will be evaluated in other EISs or because they represent policy decisions on actions defined by mechanisms outside the DOE/NV or the

DOE control including the Yucca Mountain Repository construction, operation, and closure.

*3.2.6.1 Yucca Mountain Repository **Construction, Operation, and Closure**.* The NTS EIS addresses operations and activities at the Nevada Test Site that could potentially occur over a 10-year period. These proposed operations and activities are the responsibility of the DOE Nevada Operations Office (DOE/NV). The Yucca Mountain Project is governed by the provisions of the Nuclear Waste Policy Act of 1982, as amended, and is under the Office of Civilian Radioactive Waste Management, a separate DOE office whose mission is distinct from that of the DOE/NV. The Yucca Mountain Project is currently engaged in activities which characterize the mountain to determine its suitability for development as a repository. The evaluations include analyzing the anticipated performance of such a repository, if it were constructed, over many thousands of years. Even if Yucca Mountain is eventually found suitable for development as a repository, and Congress authorizes such development, construction would not begin within the 10-year timeframe addressed in the NTS EIS.

The Council on Environmental Quality's National Environmental Policy Act regulation, Title 40 CFR Part 1501.7(a)(5), instructs the DOE, as lead agency, to indicate any public EISs that will be prepared and that are related to, but are not part of, the scope of the impact statement under consideration. The Office of Civilian Radioactive Waste Management is currently preparing an EIS, the Yucca Mountain Project Repository EIS, to evaluate the potential environmental impacts from the construction, operation, and eventual closure of a repository at Yucca Mountain for the geologic disposal of commercial and DOE-owned spent nuclear fuel and high-level radioactive waste (60 FR 40164, August 7, 1995).

During the scoping process for the Yucca Mountain Project Repository EIS, the DOE identified the construction, operation, and closure of a Yucca Mountain spent nuclear fuel and high-level radioactive waste repository as outside the scope of this EIS. Section 113 of the Nuclear Waste Policy Act, (NWPA, 1983) as amended, categorizes the current site characterization activities at Yucca Mountain as "preliminary activities" and specifically excludes them from the requirement of preparing an EIS. However, the NTS EIS includes these activities as part of the description of the existing environment at the NTS (see Chapter 4) as well as in the discussion of cumulative impacts (in Chapter 6). The Repository EIS will consider other relevant information and analyses, including the NTS EIS and other EISs prepared by the DOE to address other proposed actions. The Repository EIS will incorporate information from the NTS EIS, as appropriate, in its description of the existing environment as well as in its analysis of cumulative impacts. The analysis of cumulative impacts will include the combined effects of transporting waste to the repository and to the NTS. In this way, DOE will ensure that the cumulative effects from all activities taking place or contemplated at the NTS are considered in its decisionmaking process, along with the public's comments on these activities.

3.2.6.2 Monitored Retrievable Storage of Spent Nuclear Fuel and High-Level Radioactive Waste at the NTS or in Lincoln County, Nevada. The Nuclear Waste Policy Act of 1982, as amended, directed the DOE to work with interested states and sovereign nations to identify a host for the monitored retrievable storage facility. However, that provision has now expired. In addition, the Nuclear Waste Policy Act of 1982, as amended, prohibits the siting by the Secretary of a monitored retrievable storage facility for the interim storage of spent nuclear fuel in the state of Nevada (Section 145(g)). Although bills have been introduced into Congress that may eliminate or nullify this prohibition, attempting to predict the outcome of such legislative proposals would be highly speculative, at best. Therefore, the DOE considered the inclusion of a facility for the interim storage of spent nuclear fuel within any of the NTS EIS sitewide alternatives to be beyond the scope of this EIS.

3.2.6.3 Claims for Past Damages Resulting from Atmospheric Testing. In accordance with the provisions of the Radiation Exposure Compensation Act of 1990, as amended, which is administered by the Department of Justice, members of the public who reside within the geographic boundaries and time period therein defined may be eligible for monetary benefits as compensation for illness or damage related to specific diseases and death.

Historical dose estimates for past activities at the NTS, such as atmospheric weapons testing and belowground weapons testing, are available from a variety of sources (Church et al., 1990; Gesella and Voilleque, 1990). It is not within the scope of this assessment to recalculate the current information available on dose reconstruction at the NTS and the surrounding communities. Because none of the alternatives considered in the NTS EIS involve the resumption of atmospheric weapons testing, the risks for those activities are not assessed here. The risk to human health due to underground weapons testing is assumed to be similar to the past venting event detailed in the Special Nevada Report (SAIC/DRI, 1991). A wealth of information is available from the Off-site Radiation Exposure Review Project that was initially established by the DOE to collect historical exposure estimates and reconstruct the doses received by individuals off the NTS due to fallout.

To better understand the human health and safety issues posed by each of the alternatives, the DOE conducted a human health risk assessment as part of this EIS (see Appendix H). The human health risk assessment incorporates information on waste inventories, radioactive materials associated with nuclear weapons testing and defense program activities, and other hazardous materials that are used at the NTS under each of the alternatives considered. Risks that are examined include both fatal and non-fatal health effects that could result from transportation or other work-related accidents and from exposures to hazardous and radioactively contaminated materials.

3.3 Comparison of Alternatives and Environmental Impacts

The NTS EIS presents the discussion of environmental impacts of four alternatives for five DOE programs and site-support activities at the NTS and six other sites within Nevada. Tables 3-1 through 3-4 show site programs and projects for each alternative. Chapter 4 describes the affected environments of each of these sites by resource area, addressing, where applicable, the following resource areas: land use, airspace, transportation, socioeconomics, geology and soils, water resources, biology, air quality, noise, visual quality, cultural resources, occupational and public health and safety, and Environmental Justice. Chapter 5 describes the potential impacts of each of the alternatives on each of the resource areas. The discussion of impacts is arranged by resource area within each site so that the reader may find a discussion of the impact of a specific program for each alternative at a particular site. The following section presents a brief qualitative summary of the major impacts of each of the five programs. For each of the programs, there are resource areas that are of more interest than others. These major areas are summarized here. For further detail on these areas or for discussions of other resource areas, the reader should consult the relevant sections in Chapters 4 and 5.

Defense Program. Evaluation of the alternatives in this EIS for the Defense Program does not identify significant physical environmental impacts that would change the environmental baseline established by past activities. This would include Alternatives 1 and 3, which address a scenario to conduct one or more underground nuclear tests if directed by the President. Stockpiled holes for potential underground tests are isolated from other NTS activities. The construction of new facilities would have a minor, localized impact to the physical environment of the site but would not lead to off-site impacts. The most significant impacts would be the loss of income and jobs resulting from the elimination of the Defense Program activities under Alternatives 2 and 4.

Based on the more than 40 years of operations and information, many of the consequences of past Defense Program activities and other activities have been documented. Additional Defense Program impacts resulting from the alternatives considered in this EIS are significant, although small, compared to the impacts of previous testing. More than 800 underground nuclear tests have been conducted at the NTS. As discussed in the *Final Environmental Impact Statement, Nevada Test Site, Nye County, Nevada* (ERDA, 1977), underground testing has resulted in unavoidable adverse impacts to portions

Table 3-1. Comparison of Defense Program Activities for the Alternatives

Alternative 1	Alternative 2	Alternative 3	Alternative 4
Stockpile Stewardship - Maintain Readiness to Test - Conduct Underground Nuclear Weapons Testing (if directed) - Conduct Dynamic Experiments, including Subcritical Experiments, and Hydrodynamic Tests - Conduct Conventional High-Explosive Testing - Destroy Damaged Nuclear Weapons **Nuclear Emergency Response** - Nuclear Emergency Search Team - Federal Radiological Monitoring and Assessment Center - Aerial Measuring System - Accident Response Group - Radiological Assistance Program - Internal Emergency Management Program **Tonopah Test Range** - Impact Tests - Passive Tests - Chemical Tests	**Stockpile Stewardship** - Discontinue All Activities **Tonopah Test Range** - Impact Tests - Passive Tests - Chemical Tests	**Stockpile Stewardship** - Maintain Readiness to Test - Conduct Underground Nuclear Weapons Testing (if directed) - Conduct Dynamic Experiments, including Subcritical Experiments, and Hydrodynamic Tests - Conduct Conventional High-Explosive Testing - Construct Nuclear Weapons Simulators - National Ignition Facility (if selected in Stockpile Stewardship and Management Programmatic EIS) - Destroy Damaged Nuclear Weapons **Stockpile Management** - Store Nuclear Weapons - Disassemble Nuclear Weapons - Assemble Nuclear Weapons - Modify and Maintain Nuclear Weapons - Test Weapons Components for Quality Assurance - Provide Interim Storage of Pits **Nuclear Emergency Response** - Nuclear Emergency Search Team - Federal Radiological Monitoring and Assessment Center - Aerial Measuring System - Accident Response Group - Radiological Assistance Program - Internal Emergency Management Program **Storage and Disposition of Weapons-Usable Fissile Materials** - Store Weapons-Usable Fissile Material - Disposition Weapons-Usable Fissile Material - Construct New or Modify Tunnel Complexes - Increase Robotic Technology Experiment - Construct New or Modify Existing Structures - Heavy Industrial Facility **Tonopah Test Range** - Impact Tests - Passive Tests - Chemical Tests	**Stockpile Stewardship** - Discontinue All Activities **Tonopah Test Range** - Impact Tests - Passive Tests - Chemical Tests

Table 3-2. Comparison of Waste Management Program Activities for the Alternatives

Alternative 1	Alternative 2	Alternative 3	Alternative 4
Area 3 Disposal: - Nevada Generated Low-Level Waste - Non-Nevada Generated Low-Level Waste Closure: - Disposal Crater Complex UE3ax/bl - Disposal Crater Complex UE3ah/at **Area 5** Disposal: - Nevada Generated Low-Level Waste - Non-Nevada Generated Low-Level Waste - Nevada Generated Mixed Waste - Greater Confinement Waste Storage: - Nevada Generated Mixed Waste - Transuranic Waste - Mixed Transuranic Waste - Hazardous Waste Closure Activities: - Close Designated Low-Level Waste Disposal Units - Close Designated Mixed Waste Disposal Units - Close Designated Greater Confinement Disposal Units **Area 6** Storage Activities: - PCB Waste Disposal Activities: - Hydrocarbon Landfill **Area 11** Treatment Activities: - Explosive Ordnance Disposal Unit	No Activity	**Area 3** Disposal: - Nevada Generated Low-Level Waste - Non-Nevada Generated Low-Level Waste Closure: - Disposal Crater Complex UE3ax/bl - Disposal Crater Complex UE3ah/at Construction: - Future Low-Level Waste Disposal Pit - Building 3-302 (expansion) - Area 3 Truck Decon Station **Area 5** Disposal: - Nevada Generated Low-Level Waste - Non-Nevada Generated Low-Level Waste - Nevada Generated Mixed Waste - Greater Confinement Waste Storage: - Nevada Generated Mixed Waste - Transuranic Waste - Mixed Transuranic Waste - Hazardous Waste Facility Construction Activities: - Breaching and Sampling Facility - Real-Time Radiography - Transuranic Waste Certification Facility - Transuranic Waste Handling and Loading Facility - Mixed Waste Storage Pad - Mixed Waste Disposal Units - Low-Level Waste Disposal Units - Greater Confinement Disposal Units - Hazardous Waste Storage Pad (expansion) - Water Supply Line - Access Control Building - Maintenance Building - 5-01 Road Reconstruction (may not be necessary) - 5-07 Road Reconfiguration (may not be necessary) - 500-Year Flood Protection - Low-Level Waste Storage Facility - Fire Protection Utilities - Telephone System Closure Activities: - Close Designated Low-Level Waste Disposal Units - Close Designated Mixed Waste Disposal Units - Close Designated Greater Confinement Disposal Units Treatment Facility: - Cotter Concentrate Mixed Waste **Area 6** Storage Activities: - PCB Waste Treatment Activities: - Low-Level Liquid Waste Treatment Facility - Mixed Liquid Waste Treatment Facility Disposal Activities: - Hydrocarbon Landfill **Area 11** Treatment Activities: - Explosive Ordnance Disposal Unit	**Area 3** Disposal: - Nevada Generated Low-Level Waste Closure: - Disposal Crater Complex UE3ax/bl - Disposal Crater Complex UE3ah/at **Area 5** Disposal: - Nevada Generated Low-Level Waste Storage: - Transuranic Waste - Mixed Transuranic Waste - Hazardous Waste Closure Activities: - Close Designated Low-Level Waste Disposal Units - Close Designated Mixed Waste Disposal Units - Close Designated Greater Confinement Disposal Units Facility Construction Activities: - Water Supply Line - Access Control Building - Maintenance Building - 5-07 Road Reconfiguration - 500-Year Flood Protection - Fire Protection Utilities - Telephone System Treatment Facility: - Cotter Concentrate Mixed Waste **Area 6** Storage Activities: - PCB Waste Treatment Activities: - Low-Level Liquid Waste Treatment Facility Disposal Activities: - Hydrocarbon Landfill **Area 11** Treatment Activities: - Explosive Ordnance Disposal Unit

Table 3-3. Comparison of Environmental Restoration Program Activities for the Alternatives

Alternative 1	Alternative 2	Alternative 3	Alternative 4
Underground Test Area Corrective Action Unit - Continue Groundwater Monitoring - Continue Drilling Characterization Wells - Evaluate and Implement Remediation Strategies **Soils Media Corrective Action Unit and Part of NAFR Complex** - Continue Studies to Identify, etc. Alternate Remedial Measures - Remove Contaminated Soils on NTS and Nellis Lands - Dispose of Contaminated Soils in Permitted Facilities - Select Alternate Remedial Action Method and Implement **Industrial Sites Corrective Action Unit** - Characterize and Dispose of Environmental Restoration Sites - Continue Field Program to Identify Sites - Dispose of Waste in Approved Facilities - Continue to Characterize and Remediate the Resource Conservation and Recovery Act Industrial Sites **Decontamination and Decommissioning Facilities** - Continue Remediation Action and Planning **Defense Nuclear Agency Sites** - Continue Operations to Stop Contaminant Migration - Characterize and Remediate Contaminated Muck Piles and Ponds - Select and Implement Alternate Remedial Action or Redesign **Tonopah Test Range** - Continue Characterization and Remediation **Central Nevada Test Area** - Continue Characterization and Remediation **Project Shoal Area** - Continue Characterization and Remediation	No Activity	**Underground Test Area Corrective Action Unit** - Continue Groundwater Monitoring - Continue Drilling Characterization Wells - Evaluate and Implement Remediation Strategies - Intensify Groundwater Monitoring - Accelerate, Evaluate, and Implement Remediation Strategies - Alternate Uses May Require Stricter Cleanup Levels **Soils Media Corrective Action Unit and Part of NAFR Complex** - Continue Studies to Identify, etc. Alternate Remedial Measures - Remove Contaminated Soils on NTS and Nellis Lands - Dispose of Contaminated Soils in Permitted Facilities - Activities Would Accelerate Above Present Levels - After Studies, Select Alternate Remedial Action Method and Implement - Alternate Uses May Require Stricter Cleanup Levels **Industrial Sites Corrective Action Unit** - Characterize and Disposition of Environmental Restoration Sites - Continue Field Program to Identify Sites - Continue to Characterize and Remediate the Resource Conservation and Recovery Act Industrial Sites - Activities Would Accelerate Above Present Levels - Alternate Uses May Require Stricter Cleanup Levels **Decontamination and Decommissioning Facilities** - Accelerate Remedial Actions - Alternative May Require Clean Closure, Not Closure In Place **Defense Nuclear Agency Sites** - Accelerate Operations to Stop Radiation and Hazardous Contaminated Migration - Select and Implement Alternate Remedial Action or Redesign - Alternate Uses May Require Stricter Cleanup Levels - Characterize and Remediate Contaminated Muck Piles and Ponds. **Tonopah Test Range** - Accelerate Characterization and Remediation of Site **Central Nevada Test Area** - Accelerate characterization and remediation **Project Shoal Area** - Continue Characterization and Remediation - Accelerate Characterization and Remediation of Site	**Underground Test Area Corrective Action Unit** - Continue Groundwater Monitoring - Continue Drilling Characterization Wells - Evaluate and Implement Remediation Strategies - Intensify Groundwater Monitoring - Accelerate, Evaluate, and Implement Remediation Strategies - Alternate Uses May Require Stricter Cleanup Levels **Soils Media Corrective Action Unit and Part of NAFR Complex** - Continue Studies to Identify, etc. Alternate Remedial Measures - Remove Contaminated Soils on NTS and Nellis Lands - Dispose of Contaminated Soils in Permitted Facilities - Activities Would Accelerate Above Present Levels - After Studies, Select Alternate Remedial Action Method and Implement - Alternate Uses May Require Stricter Cleanup Levels **Industrial Sites Corrective Action Unit** - Characterize and Disposition Environmental Restoration Sites - Continue Field Program to Identify Sites - Continue to Characterize and Remediate the Resource Conservation and Recovery Act Industrial Sites - Activities Would Accelerate Above Present Levels - Alternate Uses May Require Stricter Cleanup Levels **Decontamination and Decommissioning Facilities** - Accelerate Remedial Actions - Alternative May Require Clean Closure, Not Closure In Place **Defense Nuclear Agency Sites** - Accelerate Operations to Stop Radiation and Hazardous Contaminated Migration - Select and Implement Alternate Remedial Action or Redesign - Alternate Uses May Require Stricter Cleanup Levels - Characterize and Remediate Contaminated Muck Piles and Ponds. **Tonopah Test Range** - Accelerate Characterization and Remediation of Site **Central Nevada Test Area** - Accelerate characterization and remediation **Project Shoal Area** - Continue Characterization and Remediation - Accelerate Characterization and Remediation of Site

Table 3-4. Comparison of Nondefense Research and Development, Work for Others, and Site Support Activities for the Alternatives

Alternative 1	Alternative 2	Alternative 3	Alternative 4
Nondefense Research and Development Program			
- Establish Solar Enterprise Zone - Spill Test Facility - Alternate Fuel Demonstration Project (16 vehicles) - Technology Development (normal) - Environmental Research Park	- No Activity	- Establish Solar Enterprise Zone - Construct and Operate Solar Production Facilities - Spill Test Facility. - Alternate Fuel Demonstration Project (16 vehicles plus fueling station) - Technology Development (expanded) - Environmental Research Park	- Establish Solar Enterprise Zone - Construct and Operate Solar Production Facilities - Spill Test Facility - Alternate Fuel Demonstration Project (16 vehicles) - Technology Development (expanded) - Environmental Research Park
Work for Others Program			
Treaty Verification - Threshold Test Ban Treaty - Peaceful Nuclear Explosion Treaty - Chemical Weapons Convention Treaty - Treaty on Open Skies **Nonproliferation Projects** **Counterproliferation Research and Development** - Dipole Hail - Big Explosives Experimental Facility - Cut and Cover **Conventional Weapons Demilitarization** **Nondefense Research and Development** - Conduct Munitions Research and Development - Training Exercises	- No Activity	**Increased activity levels for:** **Treaty Verification** - Threshold Test Ban Treaty - Peaceful Nuclear Explosion Treaty - Chemical Weapons Convention Treaty - Treaty on Open Skies **Nonproliferation Projects** **Counterproliferation Research and Development** - Dipole Hail - Big Explosives Experimental Facility - Cut and Cover **Conventional Weapons Demilitarization** **Nondefense Research and Development** - Conduct Munitions Research and Development - Training Exercises	**Treaty Verification** - Treaty on Open Skies No Activity - Increased Use of Airspace by DoD
Site Support Activities			
No change in: - Facilities - Services - Utilities - Communications	- Facilities (cold standby) - Services (minimal) - Utilities (minimal) - Communications (minimal) **Tonopah Test Range** - Maintain Site Support for Stockpile Stewardship	**Expand as necessary:** - Facilities - Services - Utilities - Communications	**Modify as Necessary:** - Facilities - Services - Utilities - Communications

of the land, geologic, and groundwater resources, making them unusable for most purposes. Formation of craters, surface subsidence, and the release of radioactivity into the environment have been the most significant impacts to the physical environment as a result of historical testing operations at the NTS. Pockets of radioactive contamination surround each expended underground test location. The quantity of radioactivity remaining in the subsurface media can be estimated, based on the half-life of the fission products. From data on the number and dates of the underground tests at the NTS, a total quantity of radioactivity remaining underground is estimated to be 3.0 x 10^8 curies (Ci). Much of this radioactivity, exclusive of tritium, remains captured in the original cavity, and thus is not available to leach into the groundwater.

The impacts of conducting subcritical experiments underground would be much less than those for nuclear testing since no self-sustaining fission chain reactions occur and much less radioactivity is deposited to the geologic environment. As in the case of nuclear testing, the radioactivity is captured underground.

Radioactively-contaminated surface areas on the NTS resulted primarily from atmospheric testing of nuclear weapons from 1951 to 1962. Additionally, safety tests conducted at the surface from 1954 to 1963 resulted in the radioactive contamination of the soil. More than 200 radiation-contaminated controlled areas have been identified and mapped on the NTS.

The DOE has established a monitoring program on and off the NTS to detect radionuclides in air and in groundwater. To date, no radioactive contamination attributable to DOE activities has been detected in monitoring wells off the NTS. Detection of significant contamination is limited to underground testing areas on the NTS. Potable supply wells on the NTS utilize quality groundwater, meeting Safe Drinking Water Act Standards.

In addition to the historic and ongoing monitoring, the DOE has developed groundwater models, which continue to be refined, for addressing the concerns for potential groundwater transport of radionuclides. Health effects to the public from subsurface radioactivity have been modeled, based on predictions of future tritium concentrations in well water, even though predicted concentrations are well below current regulatory limits. Any public exposure to elevated tritium concentrations resulting from underground nuclear testing would necessarily occur outside the boundaries of DOE/DoD controlled areas. Modeling results to date consistently indicate that any such tritium levels would be below the U.S. Environmental Protection Agency guidelines for drinking water. The most recent model results from the Nevada Environmental Restoration Program (GeoTrans, 1995) predict that no tritium above natural background levels would appear outside of NTS/NAFR Complex controlled areas. The earlier screening study by Daniels et al., (1993) predicts a tritium peak of 4000 pCi/L. Therefore, calculations of the lifetime dose to a maximally exposed member of the public in the uncontrolled area around the time of peak tritium concentration indicate a lifetime probability of contracting a fatal cancer between 8 x 10^{-13} (about one in one trillion) and 1 x 10^{-5} (about one in 100,000).

Waste Management. The incremental environmental impacts over baseline conditions from waste management activities under Alternatives 1 and 3 would be negligible. Under Alternative 3, some new facilities would create a slight increase beyond the impacts under Alternative 1. Under Alternatives 2 and 4, little change in impact would be seen over present conditions because most of the land clearing, waste transportation, and geologic disturbance have already occurred.

Waste management has been an integral part of the NTS operations since the establishment of the NTS in 1951. The environmental impacts related to the Waste Management Program are minor compared to those of the other programs. The issues related to waste management are waste transportation and protection of the hydrologic, geologic, and biologic resources. A summary of the issues and impacts related to these topics is presented.

Impacts from waste management activities are mostly a result of transportation of waste from other sites to the NTS. The majority of the postulated injuries and fatalities would be a result of normal traffic accidents and not a result of exposure to the transported waste. Accident scenarios that involve release of radioactive waste were factored into the risk evaluation. The DOE is committed to continue working with stakeholders and the American Indian Sovereign Nations into the future as issues arise.

Low-level waste at the Area 3 Radioactive Waste Management Site is disposed of in subsidence craters formed from past underground nuclear tests. Underground nuclear detonations create underground cavities into which the overlying soil and rock above the cavity then collapse. The final result is a crater on the surface. The craters that are and would continue to be used at the Area 3 Radioactive Waste Management Site represent the unavoidable adverse impacts that resulted from past underground nuclear tests. Use of the craters for waste disposal is a beneficial use of lands that have been significantly and unavoidably impacted by past actions. These craters have significantly altered the topography and have significantly impacted the surface drainage. Emplacement of waste in the craters and subsequent engineered closure of the cells would return portions of the surface topography to a natural grade, help to partially restore drainage patterns, and prevent the downward migration of precipitation into the waste. Additionally, recent hydrologic data support the current conceptual hydrogeologic model that no groundwater pathway exists beneath the Area 3 UE3ax/bl disposal craters.

Waste Management Program operations in Area 5 are more diverse and include facilities for hazardous and mixed waste management in addition to low-level waste management facilities. After 30 years of waste disposal operations, groundwater monitoring in wells recently completed near the Area 5 Radioactive Waste Management Site has not detected any contamination. In addition, field studies conducted to support the performance assessment models, which include monitoring of soil moisture and chloride ion concentrations, indicate that water falling on the surface (precipitation) in Frenchman Flat does not reach the groundwater. These studies and the absence of contamination support the conclusion that no groundwater pathway exists beneath the Area 5 Radioactive Waste Management Site. Thus, no impact to groundwater from waste management operations would be expected to occur. Cultural resource surveys will be performed prior to construction or expansion of any facility.

The long-term effects of waste disposal operations have been evaluated as a part of the performance assessment process. Scenarios developed in the performance assessment process are used to evaluate the potential for public exposure to radionuclides from the disposed waste. These scenarios consider transport of radionuclides by surface water and groundwater, by air, and by human intrusion pathways. Preliminary results of the Area 5 Radioactive Waste Management Site Performance Assessment (Shott et al., 1995) indicate that the risk of potential exposure to the public from waste disposal activities through surface water is not significant. Based on results of field studies, the groundwater pathway and air pathways are not considered credible transport mechanisms.

The limiting scenarios identified in the Area 5 performance assessment are the inadvertent intruder scenarios, which are postulated to occur thousands of years in the future when areas previously used for waste disposal would be inadvertently mined or farmed. The significant exposure would result from a person living on the former waste disposal site consuming food and water (assumed to be contaminated) for a lifetime. The results of this very conservative approach to estimating exposure are then used to establish design, operation, closure, and waste acceptance criteria for the waste management facilities. The performance assessment is a continuous process used to improve the design and operation of DOE waste management facilities.

Environmental Restoration Program. Environmental restoration activities would continue at varying levels of intensity under all but Alternative 2. Approximately 10,000 acres of land would be disturbed during the restoration activities under Alternatives 1, 3 and 4. After the corrective action, which would be based on potential future land uses as determined through the

Federal Facility Agreement and Consent Order process, these lands would be available for uses which may range from unrestricted public uses to various levels of restriction. Under Alternative 2, the environmental restoration activities would cease. This would result in a condition of noncompliance with environmental requirements (i.e., the Resource Conservation and Recovery Act) and limit the future use of the land.

Nondefense Research and Development. Historic environmental impacts from this program have been minimal. The most significant impact from Nondefense Research and Development would occur under Alternatives 3 and 4 and would result from the siting and construction of a Solar Enterprise Zone facility. This facility would disturb over 2,000 acres of disturbed and undisturbed habitat and require 6.2×10^6 m^3/yr (5,000 acre feet/yr) of water and would provide a net positive increase in terms of jobs and economic stability.

Work for Others. The Work for Others Program under Alternatives 1 and 3 is similar to historic activities and not expected to have significant impacts. Under Alternative 2, the program is discontinued, and under Alternative 4, the program is minimal.

A comparison of the environmental impacts of the four alternatives is summarized by resource or issue in Table 3-5. The alternatives, as described in Section 3.1, are Alternative 1, Continue Current Operations (No Action Alternative); Alternative 2, Discontinue Operations; Alternative 3, Expanded Use; and, Alternative 4, Alternate Use of Withdrawn Lands.

3.4 American Indian Overview of Environmental Impacts

As part of the consultation with the Consolidated Group of Tribes and Organizations, summary assessments and recommendations were prepared by the American Indian Writers Subgroup. The DOE has taken these CGTO recommendations under consideration. This section provides a summary of each project and a general response by the CGTO that includes at least one recommended action.

This section contains the overall and integrated responses of the Consolidated Group of Tribes and Organizations (CGTO) to five categories of actions as contained in the (1) Defense Program, (2) Waste Management Program, (3) Environmental Restoration Program, (4) Nondefense Research and Development Program, and (5) Work for Others Program. The CGTO recommends that funding be provided so that American Indians can conduct systematic studies of waste management and environmental restoration activities, and develop an American Indian public education program for the NTS.

Defense Program. *The Defense Program involves actions that range from complying with the nuclear weapons test moratorium of 1992, that precludes new underground nuclear testing, to maintaining a state of readiness to resume nuclear tests if so instructed by the President or Congress. The CGTO believes that any future nuclear testing will continue to adversely impact American Indian cultural resources. Studies have shown that nuclear testing has caused rockshelters and petroglyph panels to be destroyed when the edges of rock outcrops break off due to ground vibrations generated by the test (Stoffle, et al., 1994). Studies have also shown that plants have been removed so that roads, power lines, drill pads, and water ponds can be built as part of constructing the underground test chambers. American Indians express the opinion that some plants have been polluted due to releases of radioactivity from underground tests. American Indians also express the opinion that some plants are dying or do not flourish because they are not being prayed for ("talked to") and used in a traditional manner by American Indian people. American Indian people express concern that future underground tests will continue to crack the earth, thereby releasing radioactivity into the large underground water systems who are themselves alive, as well as being a basis for all other life and a part of the earth itself. Many American Indian people indicated that they were emotionally and spiritually troubled by ground-disturbing activities and underground nuclear tests. Even in areas where American Indian studies have occurred, there have not been studies of petroglyphs, power places, or cultural landscapes. Some areas have not been studied at*

Table 3-5. Summary comparison of environmental impacts of the alternatives (Page 1 of 7)

Alternative 1	Alternative 2	Alternative 3	Alternative 4
Land Use, Site Support Activities; Airspace			
Minimal land-use impacts would occur from continuation of current operations. All land uses would be consistent with current site and zone designations. Because of the location of the sites analyzed, and because similar land uses generally would be located on the borders of the sites, surrounding land uses would not be affected by this alternative.	Surrounding land-use impacts would be the same as those listed under Alternative 1. Closure without environmental restoration would not meet requirements of federal and state laws and signed agreements and memorandums.	Surrounding land-use impacts would be the same as those listed under Alternative 1. There would be minimal land-use impacts on site from increased intensity of operations and land-use conditions. Land uses at the Tonopah Test Range, Project Shoal Area, and Central Nevada Test Area would be similar to Alternative 1. The new Solar Enterprise Zone facility could result in up to 2,402 acres of new land disturbance.	Potential public uses of relinquished NTS lands would be located in designated areas surrounded by buffer zones. Current defense-related designated areas would be redesignated for nondefense activities. Land uses at the Tonopah Test Range, Project Shoal Area, and Central Nevada Test Area would be similar to those listed under Alternative 1. New Solar Enterprise Zone facility activities could occur at the NTS, Eldorado Valley, Dry Lake Valley, or Coyote Spring Valley; these activities would be compatible with existing land uses. Surrounding land-use impacts would be the same as those listed under Alternative 1. Land-use designations and zones would be incompatible with existing designations and zones.
Site support activities would continue at current levels.	Site support activities would decrease and facilities would be closed.	Site support activities and structures would be modified and expanded, as needed.	Site support activities would be reduced and facilities would be closed.
Airspace activities would be maintained at the current level of air traffic, navigational aid services, and airspace structure.	The NTS and Tonopah Test Range would experience reduced flight operations; otherwise, there would be no impacts to airspace.	Impacts to NTS airspace would be the same as those listed under Alternative 1. Minimal impacts would be experienced at the Tonopah Test Range, Central Nevada Test Area, Project Shoal Area, Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley.	Airspace impacts would be the same as those listed under Alternative 1.
Land Disturbance[a]			
10,000 acres	0 acres	21,000 acres	15,500 acres

[a]The total amount of land currently disturbed on the NTS is approximately 60,000 acres. Numbers shown represent additional estimated disturbed acreage under each alternative after 10 years (acres to be reclaimed are not included).

Table 3-5. Summary comparison of environmental impacts of the alternatives (Page 2 of 7)

Alternative 1	Alternative 2	Alternative 3	Alternative 4
Transportation (On-site, Off-site, Transportation of Materials and Waste, Other Transportation)			
Minimal on-site impacts would exist at the NTS, Tonopah Test Range, Project Shoal Area, and Central Nevada Test Area. The NTS would average 3,370 trips per day. This would not change the level of service on affected highways and roads.	A total of 60 one-way vehicle trips per day would occur on the site. This would not change the level of service on affected highways and roads.	A total of 16,310 on-site vehicle trips per day are estimated under this alternative. No roadway would experience any significant traffic congestion. All key NTS roadways would have a capacity exceeding 2,000 vehicles per hour. Minimal impacts would be felt at the Tonopah Test Range, Project Shoal Area, Central Nevada Test Area, Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley.	A total of 12,180 on-site vehicle trips per day are estimated. No roadway would experience any significant traffic congestion. All key NTS roadways have a capacity exceeding 2,000 vehicles per hour. Minimal impacts would be experienced at the Tonopah Test Range, Project Shoal Area, Central Nevada Test Area, Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley.
A total of 1,480 one-way vehicle trips per day would occur off site by 2005. All key roads in the vicinity of the site would continue to operate at level of service C or better. However, while NTS-generated traffic would be relatively minimal, segments of I-15, U.S. Hwy. 95, and U.S. Hwy. 93 within metropolitan Las Vegas could deteriorate to unacceptable levels of service by 2000 because of cumulative traffic growth without state and local governmental transportation improvement projects. Minimal impacts to off-site traffic would be experienced at the Tonopah Test Range, Central Nevada Test Area, and Project Shoal Area.	A decrease over Alternative 1 of 1,480 one-way vehicle trips per day would occur off site by 2005. All key roads in the vicinity of the site would continue to operate at level of service C or better.	An increase over Alternative 1 of 1,030 one-way vehicle trips off site per day would occur by 2005. Most key roads in the vicinity of the site would continue to operate at level of service C or better. While the NTS-generated traffic would be relatively minimal, segments of I-15, U.S. Hwy. 95, and U.S. Hwy. 93 within metropolitan Las Vegas could deteriorate to unacceptable levels of service by 2000 because of cumulative traffic growth without state and local governmental transportation improvement projects.	A decrease from Alternative 1 of 610 one-way vehicle trips off site per day would be experienced by 2005. All key roads in the vicinity of the site would continue to operate at level of service C or better. However, while the NTS-generated traffic would be relatively minimal, segments of I-15, U.S. Hwy. 95, and U.S. Hwy. 93 within metropolitan Las Vegas could deteriorate to unacceptable levels of service by 2000 because of cumulative traffic growth without state and local governmental transportation improvement projects.
Approximately 350,000 m^3 (457,783 yd^3) of low-level waste and 50,000 m^3 (65,398 yd^3) of mixed waste would be generated on and off the site in a 10-year period.	Minimal generation of materials and waste would occur under Alternative 2.	Approximately 100,000 m^3 (130,795 yd^3) low-level waste and 300,500 m^3 (393,039 yd^3) of mixed waste would be generated on and off the site in a 10-year period.	Approximately150,000 m^3 (196,193 yd^3) of low-level waste and 500 m^3 (654 yd^3) of mixed waste would be generated on and off the site in a 10-year period.
Transportation risks along the entire route for low-level radioactive and mixed waste during the 10-year study period from vehicular accidents is expected to be 2 fatalities and 27 injuries. Latent cancer fatalities associated with this level of radioactive waste transport for the 10-year study period would be 0.0025. There would be no impact on direct use of local railroads, air transportation, or other modes of transportation.	There would be no impact on direct use of local railroads, air transportation, or other modes of transportation.	Risks associated with transporting radioactive waste would increase to 8 vehicle-related fatalities, 103 injuries, and 0.075 latent cancer fatality over the 10-year period of study. Minimal impacts would occur on direct use of local railroads, air transportation, or other modes of transportation.	No off-site transportation of radioactive materials and waste would occur. There would be minimal impacts on direct use of local railroads, air transportation, or other modes of transportation.

Table 3-5. Summary comparison of environmental impacts of the alternatives (Page 3 of 7)

Alternative 1	Alternative 2	Alternative 3	Alternative 4
Socioeconomics (Economic Activity, Population, and Housing)			
Total direct employment would be approximately 6,600 in 2005.	A decrease from Alternative 1 of 6,490 direct jobs in 2005 would occur under Alternative 2.	An increase over Alternative 1 of approximately 4,550 direct jobs in 2005 would occur under Alternative 3.	A decrease from Alternative 1 of approximately 2,750 direct jobs in 2005 would occur under Alternative 4.
Unemployment rate: Clark County, 5.8% Nye County, 5.2%.	Unemployment rate increase over Alternative 1 in 2005: Clark County, +1.9% Nye County, +2.5%.	Unemployment rate decrease from Alternative 1 in 2005: Clark County, -1.1% Nye County, -0.05%.	Unemployment rate increase over Alternative 1 in 2005: Clark County, +1.1% Nye County, +1.7%.
Total personal income in 2005: Clark County, $32,280,885,000 Nye County, $780,701,000.	Total personal income decrease in 2005 from Alternative 1: Clark County, ($884,676,000) Nye County, ($44,609,000).	Total personal income increase in 2005 over Alternative 1: Clark County, +$632,638,000 Nye County, +$31,457,000.	Total personal income decrease in 2005 from Alternative 1: Clark County, ($374,608,000) Nye County, ($18,833,000).
Population in 2005: Clark County, 1,380,920 Nye County, 38,516.	Population decrease from Alternative 1 in 2005: Clark County, -7,946 Nye County, -583.	Population increase over Alternative 1 in 2005: Clark County, +10,020 Nye County, +656.	No substantial employment level would be triggered; therefore, population and housing demand would not change when compared to Alternative 1.
Housing demand in 2005: Clark County, 539,422 Nye County, 14,435.	Housing demand decrease from Alternative 1 in 2005: Clark County, -2,928 Nye County, -218.	Housing demand increase over Alternative 1 in 2005: Clark County, +3,914 Nye County, +246.	
Geology and Soils			
Testing impacts would include ground motion hazards and secondary seismic effects, soil contamination, alteration of natural drainage paths, and decreased surface stability. Impacts from other activities would include dust creation, soil contamination, and an increase in erosion potential. There would be minimal impacts at the Tonopah Test Range, Project Shoal Area, and Central Nevada Test Area.	Discontinuing operations would result in no additional impacts to geology and soils. However, the media that have been contaminated or altered by underground nuclear test would as in alternatives remain unavailable for unrestricted use. No surface areas contaminated by past activities would be remediated and any present access restrictions based on contamination would continue.	Impacts would be the same as those listed under Alternative 1. Minimal impacts would be experienced at the Tonopah Test Range, Project Shoal Area, Central Nevada Test Area, Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley.	Impacts would include dust creation, soil contamination, and an increase in erosion potential. Minimal impacts would occur at the Tonopah Test Range, Project Shoal Area, Central Nevada Test Area, Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley.

Table 3-5. Summary comparison of environmental impacts of the alternatives (Page 4 of 7)

Alternative 1	Alternative 2	Alternative 3	Alternative 4
Hydrology (Surface Hydrology and Groundwater)			
There would be minimal potential impact from the alteration of existing drainage paths caused by testing.	There would be no new impacts to surface hydrology.	There would be minimal potential impacts from alteration of natural drainage paths caused by new construction.	There would be minimal potential impacts from alteration of natural drainage paths caused by new construction.
Total effects from continuing groundwater withdrawals are expected to be minor. Local effects to the Yucca Flat Basin could be substantial if the annual water demand exceeds the basin's perennial yield.	Water demand would be reduced to that required for environmental monitoring and for potable water for the caretaker workforce.	Because of new program activities other potential impacts would be increased slightly over those listed under Alternative 1. However, the Solar Enterprise Zone has been estimated to require up to 6.8×10^6 m^3/yr (5,550 ac-ft/yr) of water. Local effects to the affected basin such as those near Dry Lake Valley could be substantial if the annual water demand exceeds the perennial yield of the basin. Increased waste quantities would not result in impacts.	Other potential impacts generally would be the same as those listed under Alternative 1 except at a decreased level. However, the Solar Enterprise Zone has been estimated to require up to 6.8×10^6 m^3/yr (5,550 ac-ft/yr) of water. Local effects to the affected basin such as those near Dry Lake Valley could be substantial if the annual water demand were to exceed the perennial yield of the basin.
There could be localized impacts related to underground tests conducted under or near the water table. Monitoring has revealed few instances of migration of radionuclides beyond the near test environment. No impacts are anticipated from waste management activities. Other potential quality impacts would be minimal. Minimal impacts would occur at the Tonopah Test Range, Project Shoal Area, and Central Nevada Test Area.	Contaminated areas would not be restored, resulting in continued possibility of groundwater contamination.	Minimal impacts would be experienced at the Tonopah Test Range, Project Shoal Area, Central Nevada Test Area, Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley.	Minimal impacts are expected at the Tonopah Test Range, Project Shoal Area, Central Nevada Test Area, Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley.
Biological Resources			
Approximately 7,360 acres of generally undisturbed habitat would be disturbed, primarily in support of the Environmental Restoration Program at the NTS, Tonopah Test Range, and Central Nevada Test Area. This would represent approximately 1 percent of total undisturbed habitat in these areas. There would be minimal impact to desert tortoise population viability and on biodiversity or ecosystem functions.	There would be no effect on undisturbed natural habitat. Discontinuation of man-made water sources would change the distribution of horses, deer, and chukar. However, there would be no sitewide ecosystem impacts.	Approximately 10,420 acres of generally undisturbed habitat would be disturbed, primarily in support of the Environmental Restoration Program at the NTS, Tonopah Test Range, Project Shoal Area, and Central Nevada Test Area. This would represent an increase of 3,060 acres over Alternative 1. A portion of this area (3,015 acres) could be desert tortoise habitat. The Solar Enterprise Zone could minimally impact biodiversity or ecosystem functions at Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley. Coyote Spring Valley lies within critical habitat for the desert tortoise.	Approximately 9,275 acres of generally undisturbed habitat would be disturbed, primarily for the Environmental Restoration Program and the Solar Enterprise Zone at NTS. The NTS, Tonopah Test Range, Central Nevada Test Area, and Project Shoal Area impacts would generally be the same as those listed under Alternative 1. The Solar Enterprise Zone could minimally impact biodiversity or ecosystem functions at all sites and areas. Coyote Spring Valley lies within critical habitat for the desert tortoise.

Table 3-5. Summary comparison of environmental impacts of the alternatives (Page 5 of 7)

Alternative 1	Alternative 2	Alternative 3	Alternative 4
Air Quality and Radiological Air Quality			
Pollutant emissions from stationary and mobile sources would be generated on site and off site. These emissions would be dispersed over a wide area. No major air emission sources are planned. Pollutant concentrations related to NTS activities would be well below ambient air quality standards. No substantial increases in air pollution are expected by 2005 and Nye County would continue its present attainment designation for all criteria pollutants. No additional violations of air quality standards would be provided in the nonattainment area of Clark County. The region is expected to conform with the applicable State Implementation Plan for all National Ambient Air Quality Standards (NAAQS). Radiological air quality impacts would not reach the maximum CAP-88 air dose assessment modeled dose. Impacts would be minimal.	Pollutant emissions associated with stationary sources would be essentially eliminated following discontinuance of operations, and mobile source emissions would be substantially reduced. Radiological air quality impacts would be the same as those listed under Alternative 1.	Impacts would be the same as those listed under Alternative 1. Pollutant concentrations related to NTS activities, though higher than the Alternative 1, would remain below ambient air quality standards. Selected values for two pollutants of concern are PM_{10} : 600 tons/ year; less than one percent of regional burden. CO_2 : 224 tons/year of which 90 tons/year would be in the Las Vegas Valley; less than 0.2 percent of Clark County emissions.	Impacts would be the same as those listed under Alternative 1. Pollutant concentrations related to NTS activities would be lower than those of Alternative 1. All pollutants would remain below ambient air quality standards.
Noise			
Transportation noise levels on site would be minimal and would not produce any noise impacts off site. Temporary noise impacts from construction-related noise would occur within the immediate vicinity of construction sites. Noise impacts would be negligible because the sites are located within remote areas. No sensitive receptors are close to construction areas. Noise from other activities would decrease with distance and would be barely distinguishable from background noise levels.	A minor amount of noise would result from operations vehicles. Other noise levels would be a result of noises typically found in uninhabited desert areas.	Impacts would be the same as those listed under Alternative 1.	Impacts would be the same as those listed under Alternative 1, except for the Defense Program, which would have the same impacts as Alternative 2.
Visual Resources			
New land disturbance would be located in areas of scenic quality common to the region, but none would be visible from any public viewpoints. Although there would be short-term, local adverse effects because of environmental restoration, there would be long-term beneficial effects because of revegetation.	There would be little change in the overall appearance of the existing landscape.	Most new land disturbance would be located in areas of scenic quality common to the region. However, the areas proposed for the Solar Enterprise Zone facility in Eldorado Valley, Dry Lake Valley, or Coyote Spring Valley have a high visual sensitivity because they cross major highways. Furthermore, Coyote Spring Valley has extensive panoramic views of linear mountain ranges and valleys.	There would be slight changes in the overall appearance of the existing landscape. New ground disturbance would be located in areas of scenic quality common to the region, but none of these areas would be visible from any public viewpoints. The impacts of the Solar Enterprise Zone would be the same as those listed under Alternative 3.

Table 3-5. Summary comparison of environmental impacts of the alternatives (Page 6 of 7)

Alternative 1	Alternative 2	Alternative 3	Alternative 4
Cultural Resources			
There would be impacts to cultural resources as a result of ground disturbing activities resulting from construction of new facilities, utilities, road upgrades, and decommissioning of existing buildings. Continued visitation and vehicular traffic could indirectly affect recorded archaeological sites and archaeologically sensitive areas. The precise location of these resources is unknown until archaeological survey is conducted. Surveys will be conducted prior to any ground disturbing activities. Modification of existing buildings would include an evaluation of their historic significance, especially in relation to Cold War/nuclear development themes, to minimize impacts. According to the CGTO, under Alternative 1, access to American Indian culturally significant places would continue to be reduced. The potential would exist for unauthorized artifact collection and culturally inappropriate environmental restoration techniques.	Discontinuance of activities would eliminate most impacts to cultural resources. The degree of impact to American Indian cultural sites, as stated by the CGTO, would be less than that associated with Alternative 1.	The amount of acreage disturbed as a result of activities described for Alternative 3 would double as compared to Alternative 1. Approximately 20,930 acres of ground disturbance are anticipated. Construction of new facilities, wells, utilities roads, and burial of contaminated soils may affect cultural resources. Large-scale activities associated with the Solar Enterprise Zone facility could affect cultural resources. Modification of existing buildings would include an evaluation of their historic significance, especially in relation to Cold War/nuclear development themes, to minimize impacts. According to the CGTO, under Alternative 3, access to American Indian culturally significant places would continue to be reduced. Increased visits by students and researchers who collect artifacts, visit sacred areas, and remove plants or animals, and the scraping of land would affect American Indian cultural resources.	Most impacts would be the same as those listed under Alternative 3. Access impacts, according to the CGTO, for American Indians would be less than that experienced under Alternative 1. However, the potential for unauthorized artifact collection would be increased from Alternative 1 because of increased public access.
Land Use Land Zone Areas			
1. Nuclear Test Zone (includes Areas 19 and 20) - 1,120 km² (435 mi²) 2. Nuclear and High Explosive Zone - 180 km² (70 mi²) 3. Research, Test, and Experiment Zone - 45 km² (20 mi²) 4. Radioactive Waste Management Zone - 5 km² (2 mi²) 5. Yucca Mountain Site Characterization Zone (within NTS boundary) - 225 km² (90 mi²) 6. Critical Assembly Zone - 130 km² (50 mi²) 7. Spill Test Impact Zone (within NTS boundary - 15 km² (5 mi²) 8. Reserved Zones on NTS (within NTS boundary) - 1,775 km² (685 mi²)	1. Yucca Mountain Site Characterization Zone (within NTS boundary) 225 km² (87 mi²) 2. Monitored/Restricted Zone (within NTS boundary) - 3,255 km² (1,260 m²)	1. Nuclear Test Zone (includes Areas 19) - 705 km² (275 mi²) 2. Nuclear and High Explosive Zone - 381 km² (147 mi²) 3. Research, Test, and Experiment Zone - 575 km² (222 mi²) 4. Radioactive Waste Management Zone - 5 km² (2 mi²) 5. Yucca Mountain Site Characterization Zone (within NTS boundary) - 225 km² (90 mi²) 6. Solar Enterprise Zone - 34 km² (13 mi²) 7. Spill Test Impact Zone (within NTS boundary - 15 km² (5 mi²) 8. Defense Industrial Zone - 170 km² (65 mi²) 9. Reserved Zones on NTS (within NTS boundary) - 1,375 km² (530 mi²)	1. Non-Defense Research/Development/Testing Zone (includes Areas 19 and 20) - 1,295 km² (500 mi²) 2. Radioactive Waste Management Zone - 5 km² (2 mi²) 3. Yucca Mountain Site Characterization Zone (within NTS boundary) - 225 km² (90 mi²) 4. Solar Enterprise Zone - 35 km² (13 mi²) 5. Spill Test Impact Zone (within NTS boundary) - 15 km² (5 mi²) 6. Reserved Zones (within NTS boundary) - 1,310 km² (505 mi²) 7. Potential Turnback Area (includes Area 22 Solar Enterprise Zone) - 610 km² (235 mi²)

NOTE: CGTO = Consolidated Group of Tribes and Organizations.

Table 3-5. Summary comparison of environmental impacts of the alternatives (Page 7 of 7)

Alternative 1	Alternative 2	Alternative 3	Alternative 4
Occupational and Public Health and Safety (Routine and Accident Operations)			
The health impacts to workers due to occupational exposure and accidents could result in a probability of 1 in 8 of a single latent cancer fatality and 1 in 21 of a single other detrimental health effect in the worker population. The risk of life-threatening noncarcinogenic effects on workers involved with an accidental release of hazardous chemicals has a hazard index of 0.58.	The health impacts to workers due to occupational exposure and accidents could result in a probability of 1 in 47 of a single latent cancer fatality and 1 in 120 of any other detrimental health effect in the worker population. The risk of life-threatening noncarcinogenic effects on workers involved with an accidental release of hazardous chemicals has a hazard index of 0.48.	The health impacts to workers due to occupational exposure and accidents could result in a probability of 1 in 8 of a single latent cancer fatality and 1 in 20 of any other detrimental health effect in the worker population. The risk of life-threatening noncarcinogenic effects on workers involved with an accidental release of hazardous chemicals has a hazard index of 2.4.	The health impacts to workers due to occupational exposure and accidents could result in a probability of 1 in 13 of a single latent cancer fatality and in 1 in 30 of any other detrimental health effect in the worker population. The risk of life-threatening noncarcinogenic effects of workers involved with an accidental release of hazardous chemicals has a hazard index of 0.58.
Health impacts to the public from accidental release of radionuclides could result in a probability of 1 in 18,000 of a single latent cancer fatality and 1 in 40,000 of any other detrimental health effect in the population within 50 miles. Potential public exposure to accident release of hazardous chemicals could result in a probability of 1 in 4,000 of a single incidence of cancer in the population. No noncarcinogenic detrimental health effects are expected.	Health impacts to the public from accidental release of radionuclides could result in a probability of 1 in 20,000 of single latent cancer fatality and 1 in 50,000 of any other detrimental health effect in the population within 50 miles. Potential public exposure to accidental release of hazardous chemicals could result in probability of 1 in 50,000 of a single incidence of cancer in the population. No noncarcinogenic detrimental health effects are expected.	Health impacts to the public from accidental release of radionuclides could result in a probability of 1 in 18,000 of a single latent cancer fatality and 1 in 40,000 of any other detrimental health effect in the population within 50 miles. Potential public exposure to accidental release of hazardous chemicals could result in a probability of 1 in 4,000 of a single incidence of cancer in the population. No noncarcinogenic detrimental health effects are expected.	Health impacts to the public from accidental release of radionuclides could result in a probability of 1 in 20,000 of a single latent cancer fatality and 1 in 43,000 of a single other detrimental health effect in the population within 50 miles. Potential public exposure to accidental release of hazardous chemicals could result in a probability of 1 in 4,000 of a single incidence of cancer in the population. No noncarcinogenic detrimental health effects are expected.
Potential accidental venting of radionuclides from an underground test could result in a probability of 1 in 180 of a single latent cancer fatality and 1 in 400 of any other detrimental health effect in the population within 50 miles.		Potential accidental venting of radionuclides from an underground test could result in a probability of 1 in 180 of a single latent cancer fatality and 1 in 400 of a single other detrimental health effect in the population within 50 miles.	
The maximum reasonably foreseeable radiological accident has a probability of 1 in 10 million years and involves a non-nuclear explosion in a nuclear weapons storage bunker at Area 27. This accident could result in public impacts of 3 to 55 latent cancer fatalities and 1 to 25 other detrimental health effects.	The maximum reasonably foreseeable radiological accident has a probability of 1 in 10 million years and involves a failure of an artillery-fired test assembly at the Tonopah Test Range. This accident would result in only small fractional increases in the probability of latent cancer fatality or other detrimental health effects in the offsite population.	The maximum reasonably foreseeable radiological and chemical accidents are the same as for Alternative 1.	The maximum reasonably foreseeable radiological accident has a probability of 1 in 2 million years and involves an airplane crash into the Area 5 transuranic waste storage unit. This accident could result in public impacts of 1 to 13 latent cancer fatalities and 0 to 6 other detrimental health effects.
The maximum reasonably foreseeable chemical accident has a probability of 1 in 10 million years and involves an airplane crash into the Spill Test Facility. This accident could result in 0 to 3 latent cancers in the offsite population, but no noncancer health effects would be expected.	The maximum reasonably foreseeable chemical accident has a probability of 1 in 13,000 years and involves a multi-container fire at the Area 5 hazardous waste storage unit. This accident would result in only small fractional increases in the probability of latent cancer in the offsite population, and no noncancer health effects would be expected.		The maximum reasonably foreseeable chemical accident is the same as for Alternative 1.
Environmental Justice			
American Indian impacts would only consider American Indian groups and would, therefore, be disproportionately high according to the CGTO's method of defining impacts.	Impacts would be the same as those listed under Alternative 1.	Impacts would be the same as those listed under Alternative 1.	Impacts would be the same as those listed under Alternative 1.

all. It is not possible to completely assess the potential impacts of future underground tests on these cultural resources.

Another major component of the Defense Program involves expanding stockpile management responsibility, storage and disposal of weapons-useable fissile materials, and counterproliferation research and development. The CGTO believes American Indians lack sufficient information and understanding of these issues to make a complete assessment of their impacts on cultural resources. Some observations can be made at this time. The NTS is a holy area that is central to these American Indian people. In general, the more fearful activities that occur here and the more ground disturbance that occurs, the more cultural risks will be involved if American Indian people use these lands. The more such activities occur on these lands, the longer and more difficult it will be to restore these lands to their natural condition.

Waste Management Program. *The storage of low-level and mixed waste generated by the DOE will be an ongoing responsibility regardless of which EIS alternative is selected. This program minimally involves the storage of existing waste and waste generated during the environmental restoration of NTS lands. Under Alternative 3, waste could be received from any DOE-approved facility, which would cause current NTS waste disposal locations to be filled and new waste facilities to be sited and operated. American Indian people hold both traditional and scientific views of radioactivity. The former builds on the view that rocks are alive; radioactive rocks are powerful, but they can become "angry rocks" if they are removed without proper ceremony, used in a culturally inappropriate way, disposed of without ceremony, and placed where they don't want to be (Stoffle, et al., 1989; Stoffle, et al., 1990). Another issue is the ethics of agreeing to receive radioactive waste from other Native American lands so those people can live without fear of radioactivity (see Project Chariot, DOE/NV, 1994). In general, after properly removed rocks have been used, they are either returned to their place of origin or to a place of cultural significance. The practice of dealing with "bad medicine" or neutralizing negative forces was a part of the traditional culture. So, the question of "how to dispose of radioactive waste in a culturally appropriate manner" could be resolved if the time and resources were provided for American Indian people to participate in a formal study of this issue. American Indian people have not studied the cultural impacts of siting any of the existing waste facilities. So, American Indian people would like to become a part of a retrospective assessment of these facilities, as well as to participate in the assessment of siting all new waste facilities.*

Environmental Restoration Program. *The Environmental Restoration Program involves actions that would return disturbed land to its natural condition. Up to 1,800 monitoring wells and access roads are a part of this effort. All alternatives involve some environmental restoration and monitoring; however, Alternative 3 would require more restoration because it would disturb more land. American Indian people believe that the natural condition of the land existed before 1492 when the Europeans arrived. The land was in a natural condition when it was managed and used by American Indian people. For example, American Indian plant management techniques involved spiritual interactions like praying and conducting ceremonies for the plants, as well as physical actions like selective burning, transplanting cuttings and seeds, pruning of plants like Tumar (Stanleyappinnata) and willow, and "whipping" pine nut trees to make them fuller. American Indian water management techniques involved spiritual interactions that satisfied the water and its occupants like Water Babies, who need to know why American Indian people are using the water. Water ceremonies assured both rain and snowfall, for example, by praying for a continued relationship between wet snow and the little black bugs who are responsible for making the snow become wet. Generally, American Indian people managed the land according to religious teachings. From the American Indian perspective, environmental restoration should proceed according to American Indian culture and with the participation of American Indian people.*

Nondefense Research and Development Program. *There is a variety of planned actions considered within this category. Many of these are related to* *the National Environmental Research Park, which permits universities and other federal agencies to conduct research. Other projects involve testing alternative vehicle fuels, testing techniques for handling chemical spills, and building alternative energy generators like solar collectors. American Indian people view each of these as potentially impacting cultural resources. More cars potentially endanger the desert tortoises. University students studying biology may find and collect arrowheads or remove plants that are significant to American Indian people. Solar collectors involve scraping the land. American Indian people believe they should be involved in assessing the impacts of all these proposed actions.*

Only American Indian people know which places are appropriate for visits by non-Indian people and how to collect plants, animals, and soil samples so they do not disrupt the land and its associated spirituality. Only American Indian people can provide guidance for proper behavior; however, a guidance document has not been collectively produced and approved by the CGTO. On the other hand, with proper guidance by American Indian people, university students and other members of the public may learn about the beauty and cultural significance of these lands and begin to change national perceptions of these lands from one as a wasteland to one as an American Indian holy land.

***Work for Others Program.** This program contains two major subcategories of activities: the Conventional Weapons Demilitarization Program and Defense-related Research and Development Program. The first program involves the shipment, storage, disposal, and destruction of conventional weapons. The second program involves military training exercises and weaponry tests.*

The CGTO, in principle, approves of the Conventional Weapons Demilitarization Program, because world peace will reduce the need to use the NTS for nuclear weapon production, storage, assembly, and testing. On the other hand, the CGTO believes that if the NTS becomes the place where most or all weapons are stored, disassembled, and disposed, then the NTS lands will be polluted. The presence of conventional and nuclear weapons defines the NTS as a place of destruction, which promotes an image that is inappropriate for a place for peaceful relations between American Indian ethnic groups.

The CGTO knows from past experience, but not formal study, that military training exercises and weaponry tests can adversely impact cultural resources. Military people move across the land on foot and in vehicles without either the time or the purpose to pay attention to the plants that are being crushed, the animals that are being dislocated, or the archaeology materials underfoot. Cultural resources are damaged when conventional weapons are fired nearby. Often, geographically distinctive power places, like the big white rock near Rattlesnake Ridge, are targeted without regard or knowledge of their cultural significance. Without a formal study, the exact impacts of military training exercises will not be fully understood.

3.5 Summary of American Indian Responses to the NTS Action Alternatives

The response of the CGTO to the four alternatives proposed for NTS and discussed site-by-site in the previous paragraphs can be summarized as follows:

***Alternative 1: Continue Current Operations.** Under this alternative, the DOE will continue with its current operations and interagency project activities in each of the programs listed above. There will be little or no change planned for the future mission of NTS. To this effect, the CGTO opposes Alternative 1 because of our strong cultural ties to the land. NTS operations have adversely impacted the land, causing irreparable damage to traditional resources. If NTS operations continue, it is expected that damage will be increased and more land will be wasted. Access to culturally significant spiritual places and use of animals, plants, water, and lands may cease because Indian people's perception of health and spiritual risks will increase if nuclear weapon testing, assembly, storage, disassembly, and disposal continues. Nondefense programs are expected to cause adverse impacts if these produce* *more ground disturbance or if they bring people who trample and destroy traditional resources.*

Alternative 2: Discontinue Operations and Decommission. *Under this alternative, all current and planned programs, activities, and operations would be discontinued. Only activities conducted in support of decommissioning, radiation monitoring, and security functions necessary for human health, safety, and security would be maintained. Environmental restoration would not be done. All defense and nondefense programs would be discontinued. Inactive waste disposal sites would be abandoned. Only a minimum of low-level radioactive and mixed waste disposal capacity would be maintained to support closure of the NTS.*

The CGTO supports Alternative 2 because it would allow the land to heal and perhaps return to its natural condition. The CGTO recommends that an evaluation of areas that can be restored for human use be made and that environmental restoration activities be included in this alternative. Access to culturally significant places should be allowed. The DOE should continue to protect all cultural resource sites.

Alternative 3: Expanded Use. *Under this alternative, expanded use of the NTS and its resources would be made to support national programs for both defense and nondefense. Current defense programs would continue, and a variety of defense-related projects currently under consideration would be pursued. Waste management operations would increase and storage/disposal areas expanded. Waste transportation would be increased as well. Environmental restoration and research and development activities would continue and expand. A solar-energy production facility would be built.*

The CGTO opposes Alternative 3 because of our strong cultural ties to the land. Under expanded use, it is expected that the continuation and expansion of current operations as well as the implementation of additional defense and nondefense project activities and programs would irreparably damage American Indian cultural resources present at the NTS. Expansion of NTS operations would conceivably require use of land that is yet untouched, and would worsen the risk of radioactive contamination. Potentially, Native American access to resources and sacred sites would be even more restricted. Expanded use would be detrimental for the socioeconomic development and health of Indian communities.

Alternative 4: Alternate Use of Withdrawn Lands. *This alternative will evaluate the impacts associated with locating new programs and project activities at the NTS, including nondefense research and development programs, expansion of the liquefied gaseous fuel spill test facility in Area 5, and various types of personnel training for locating, containing, handling, or transporting hazardous material, radioisotopes, fuels, explosives, and other material. Under this alternative, waste management operations, waste-generating operations, and ongoing NTS environmental restoration activities would continue. However, the DOE would not maintain a state of readiness for nuclear testing at the NTS. The NTS would be opened for unprecedented public access to some of the most remote areas, including areas that contain American Indian rock shelters, archaeological sites, and petroglyphs. Education and recreational activities would be pursued. The potential for turning back lands to the public domain would depend upon the ability to achieve established clean up and safety levels.*

The CGTO tentatively supports Alternative 4 with reservations regarding certain components of this alternative. Aside from the concerns already expressed regarding waste-related pollution and ground disturbance, the CGTO expects that opening the NTS to the public will adversely impact traditional resources, particularly petroglyphs, archaeological sites, and rock shelters, because of their appeal as tourist attractions. Heavy traffic will trample plants, hurt animals, limit American Indian access to sacred sites and power places, and interfere with traditional practices.

The CGTO would like to have the right of first refusal in the event that the NTS lands are turned back to public use.

3.6 Identification of the Preferred Alternative

The DOE Preferred Alternative is Alternative 3, Expanded Use, plus the public education activities from Alternative 4. The Expanded Use Alternative represents a continuation of the multipurpose, multi-program use of the site, and further represents a continuation and diversification of the DOE/NV and interagency programs and operations at the NTS. The Expanded Use Alternative includes support for ongoing DOE/NV program categories defined in Alternative 1, Continue Current Operations (No Action), and also provides for increased use of the NTS and its resources and capabilities. This alternative would also make the NTS more available to both public and private institutions for purposes of demonstrating new technologies.

Public education activities from Alternative 4 include establishing educational tour routes on the NTS and promoting the concept of creating a nuclear era museum that highlights the NTS testing activities. Tours would allow the public to see firsthand some of the history and impacts of past nuclear testing. These activities would be an important contribution to public understanding of the nation's nuclear testing and Cold War history.

The Draft NTS EIS pointed out that the use the DOE ultimately selected as the Preferred Alternative might not be a single NTS EIS alternative in its entirety, but rather a hybrid created by selecting specific options from among the various alternatives described. This approach was the starting point in the process of identifying the Preferred Alternative. Initially, the universe of activities included under any of the alternatives, by program, were combined and subjected to a process of elimination. This Preferred Alternative identification process began concurrently with the public hearings on the Draft EIS and continued through the comment response process and review of the Final NTS EIS.

The criteria used for eliminating various activities from the combined alternatives were: inconsistency with strategic planning, failure to fulfill statutory mission responsibilities, public concern and perceptions, incompatibility of uses, and consideration of pending programmatic analyses and decisions. Appendix A, *Descriptions of Projects and Activities*, was used extensively in this process for detailed descriptive information. The result of this process was the identification of Alternative 3, Expanded Use, as the most comprehensive alternative in terms of supporting statutory mission responsibilities and providing for a diversification of use to include nondefense, interagency, public and private uses. The Expanded Use Alternative was generically identified in the original Notice of Intent for the NTS EIS; however, the specific nature of the Expanded Use Alternative was not fully realized, nor was its comprehensiveness appreciated by the DOE, until this systematic process was applied.

The Preferred Alternative identification process also led to better programmatic definition of the alternatives in general. In the case of potential activities resulting from other DOE Programmatic EISs, Alternative 3 now states clearly that the specific action contemplated under this alternative is to reserve land and infrastructure pending a programmatic decision. This realistically identifies the nature of the decisions to be made based on the NTS EIS with respect to activities that are currently under programmatic review. Other clarifications include the description of potential public uses of NTS lands in Alternative 4. This concept, in the Draft NTS EIS, was incorrectly described as limited to potential uses of relinquished NTS lands. However, the lands analyzed for potential return to the public were not the only lands on which public education or recreation activities could occur. In the Preferred Alternative process, public education activities were identified as another form of public use. Although this activity is not included in the Expanded Use Alternative, this aspect of Alternative 4 was chosen for inclusion in the Preferred Alternative.

In the Preferred Alternative identification process, the land use zones and maps in the Draft NTS EIS were also considered. Several rezoning concepts were considered in response to concerns that the land use maps would restrict nondefense research use of the site. Rather than adjust boundaries and create additional land use zones and definitions, the definitions of land use categories were amended slightly to include compatible defense and nondefense use in almost every zone of the NTS. As defined in Alternative 3, Expanded Use, only the Defense Industrial Zone is restricted to defense-related activities.

The process of DOE approval of the Preferred Alternative began with the recommendation of the Nevada Operations Office to DOE Headquarters. The DOE continued to consider the Preferred Alternative process, public comments, and comment responses in the preparation of the Final NTS EIS. In this stage of the Preferred Alternative identification process, the various affected program offices considered public comments received with regard to their statutory mission responsibilities. Only after the program offices had concluded that the comments were adequately addressed in the comment response document did they recommend approval of the preferred alternative and the Final NTS EIS to the Secretary of Energy.

3.7 References

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Chapter 4

AFFECTED ENVIRONMENTS

CHAPTER 4
AFFECTED ENVIRONMENTS

This chapter contains the description of the existing environmental conditions of the Nevada Test Site (NTS), the Tonopah Test Range, portions of the Nellis Air Force Range (NAFR) Complex, the Project Shoal Area, the Central Nevada Test Area, Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley (Figure 4-1). During Environmental Impact Statement (EIS) preparation, the most up-to-date and accurate information available was used to describe existing environments, facilities, activities, and projects. The information serves as a baseline from which to identify and evaluate environmental changes resulting from the proposed alternatives. The baseline conditions, for the purposes of analysis, are the conditions that currently exist. The regions of influence vary, as dictated by the resources under consideration. For some discussions, such as site-support activities, the regions of influence are limited to the areas circumscribed by each U.S. Department of Energy (DOE) administrative boundary. For other topics, such as transportation, groundwater, and air quality, the regions of influence are much larger and may include all of southern Nevada, as well as portions of Utah, Arizona, and California.

The environmental resources discussed in this chapter include land use, geology and soils, hydrology, biology, air quality, noise, and visual and cultural resources. Where applicable, this chapter also describes existing waste management facilities and other resource elements, including airspace, site-support activities, transportation, socioeconomics, occupational and public health and safety, radiological conditions, and Environmental Justice.

The discussions of the DOE administrative units are organized according to their relative geographic proximity to one another. Because the NTS and the NAFR Complex share a boundary and because the units of interest are within 97 km (60 mi) of each other, they are discussed together in the next section. The Tonopah Test Range, Project Shoal Area, Central Nevada Test Area, Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley are discussed separately in subsequent sections.

4.1 Nevada Test Site and Surrounding Areas

The existing environmental conditions of the NTS and portions of the NAFR Complex are described in this section. The portion of the NAFR Complex that is described is limited to Area 13.

The NTS, a unique national resource managed by the U.S. Department of Energy, Nevada Operations Office (DOE/NV), is located about 105 km (65 mi) northwest of Las Vegas. The 3,496 km^2 (1,350 mi^2) site features desert and mountainous terrain and is larger than Rhode Island, making it one of the largest secured areas in the United States. The NTS is in a remote and arid region, surrounded by federal installations, with strictly controlled access, and public lands that are open to public entry.

The following information pertaining to the NTS is provided by the American Indian Writers Subgroup of the Consolidated Group of Tribes and Organizations (CGTO). Information provided by the American Indians is italicized in this EIS to distinguish it from DOE text.

For many centuries, the NTS has been a central place in the lives of American Indian tribes. The NTS and nearby lands contain traditional gathering, ceremonial, and recreational areas for the American Indian people. From antiquity to contemporary times, this area has been used continuously by many tribes. It contains numerous ceremonial resources and power places that are crucial for the continuation of American Indian culture, religion, and society. Until the mid-1900s, traditional festivals involving religious and secular activities attracted American Indian people to the area from as far as San Bernardino, California. Similarly, groups came to the area from a broad region during the hunting season and used animal

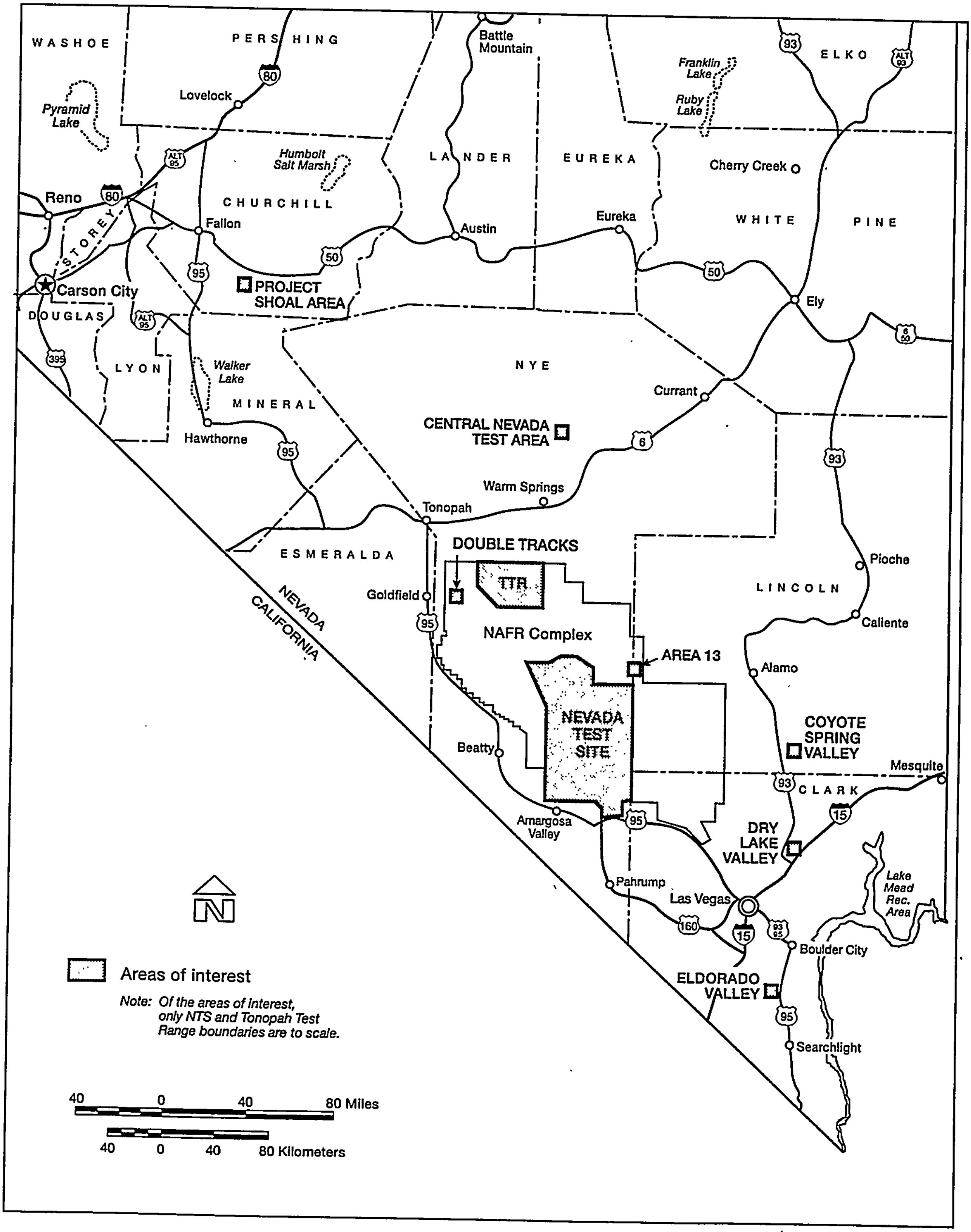


Figure 4-1. NTS and selected areas of interest

and plant resources that were crucial for their survival and cultural practices.

Despite the loss of some traditional lands to pollution and reduced access, the American Indian people have neither lost their ancestral ties to nor have forgotten their cultural resources on the NTS. There is continuity in the American Indian use of and broad cultural ties to the NTS. American Indian people have cared for the NTS resources and will continue to do so.

4.1.1 Land Use

Land resources are important considerations for decisions regarding site use. The land-use analysis determines if there is enough land available for the proposed facilities and required buffers, and identifies conflicts between the proposed project and existing or projected on- and off-site land use. These analyses are necessary to determine whether public lands would be managed in a manner consistent with existing and projected land uses. To make decisions with respect to locating facilities at the NTS, the DOE must consider several issues, particularly the constraints and opportunities related to land resources. These include whether conflicts exist with the administrative framework and whether adequate resources are available and viable.

The known land-use constraints and opportunities at the NTS are outlined in this section and described throughout this chapter. Land-use constraints include those features of the NTS, either natural or manmade, that preclude or limit the future activities that can be conducted in a specific location or area. Opportunities are the best and highest uses of the land that can be accomplished within the constraints. Further definition of land-use opportunities and constraints is planned as part of the *Framework for the Resource Management Plan* (see Volume 2).

Many of the constraints identified throughout Chapter 4 are those resulting from historic land uses, primarily nuclear weapons, rocket and related nuclear testing activities, and to a lesser extent, radioactive waste management activities. Many of these constraints on land use were identified in the *Final Environmental Impact Statement, Nevada Test Site, Nye County, Nevada* (ERDA, 1977) as unavoidable adverse impacts or irreversible actions with irretrievable commitments of resources. Because of the nature of many historic activities and their consequences, specifically the introduction of radionuclides into environmental media, land use will continue to be constrained in some areas of the NTS during the 10-year period covered by this EIS, and likely well into the future. These constraints, and the specific environmental media that are affected, are summarized at the end of this section.

Natural constraints, such as unstable soils or ecologically sensitive areas, are described in the appropriate sections of Chapter 4 (i.e., Geology and Soils and Biological Resources). Land-use opportunities under baseline (i.e., existing environmental and administrative) conditions are presented throughout the remainder of Chapter 4, beginning in Section 4.1.1.1. The remainder of this section summarizes the constraints to land use resulting from the fulfillment of the DOE's missions at the NTS.

Based upon the more than 40 years of operations and information gathered, many of the consequences of past weapons testing and other activities are well understood and documented. Many of the consequences described in this chapter were previously presented in the *Final Environmental Impact Statement, Nevada Test Site, Nye County, Nevada* (ERDA, 1977). While not all of the consequences of historic actions at the NTS and adjacent areas have been fully defined, this section presents an overview of their resulting constraints and establishes a baseline of current conditions. The baseline serves as a basis for evaluating the potential impacts of future actions. Because of the complexity of some issues, a full understanding that removes all uncertainty may never be achieved. Nonetheless, the DOE continues, through many of the programs and actions described in this EIS, to address the remaining data deficiencies and uncertainties.

For purposes of discussion, the past activities at the NTS have been grouped into eight categories. In this section, a brief historical overview is provided, and the known consequences and resulting constraints on use of the physical environment are presented.

Eight historic activities, and their consequences, are included in the baseline discussion within this chapter:

Atmospheric Weapons Testing—A total of 100 atmospheric detonations were conducted before the Limited Test Ban Treaty was signed in August 1963. Atmospheric tests include tests conducted at ground level, from towers or balloons, or by airdrops. Of the 100 atmospheric tests, 16 were safety tests. By design, these safety tests produced little or no nuclear yield.

Underground Nuclear Testing—Approximately 800 underground nuclear tests have been conducted at the NTS. The types of tests conducted include deep underground tests used to study weapons effects, designs, safety, and reliability, and shallow borehole tests used to study the peaceful application of nuclear devices for cratering. The 70 underground safety tests conducted on the NTS, by design, produced little or no nuclear yield.

Safety Tests—Between late 1954 and June 1963, 16 tests were conducted aboveground to test the vulnerability of certain weapon designs to possible accidents. At a location in Area 5, 24 experiments, utilizing relatively small quantities of plutonium, were conducted between 1954 and 1956. These experiments, known as the GMX Project, were so-called "equation-of-state" studies where "instantaneous" changes in the physical properties of plutonium materials subjected to detonations from conventional explosives were measured. By design, these experiments produced little or no nuclear yield.

Safety tests are no longer conducted aboveground; all such tests are performed underground in emplacements that are designed so that radioactive materials will not reach aboveground environments (AEC, 1972; AEC, 1973a; ERDA, 1976; ERDA, 1977). Impacts to soils that resulted from these historic activities are described further in Chapter 4, Section 4.1.4.3.

Nuclear Rocket Development Station—Twenty-six experimental tests of reactors, nuclear engines, ramjets, and nuclear furnaces were conducted between 1959 and 1973.

Shallow Land Radioactive Waste Disposal—Some wastes generated during the testing program, and as a result of nuclear projects, were disposed of in shallow cells, pits, and trenches. Because of the site's characteristics, notably the absence of a groundwater pathway, shallow burial continues to be an important waste disposal activity.

Crater Disposal—Contaminated soils and equipment collected during the decontamination of atmospheric testing areas and the consolidation of radioactively contaminated structures, and other bulk wastes, were disposed of in subsidence craters in Yucca Flat.

Greater Confinement Disposal—In 1981, greater confinement disposal of waste was initiated at Area 5 for certain radioactive low-level wastes not suitable for shallow land disposal.

Site-Support—Like any large facility, the NTS has a large infrastructure that provides all site-support services. Food and housing services, paint shops, vehicle maintenance facilities, machine shops, road maintenance, and other on-site facilities all produce more common short-term impacts, such as localized land disturbance, air emissions, and noise. Site-support facilities are associated with NTS land-use opportunities.

Table 4-1 and Figure 4-2 provide information on the key characteristics of the historic activities that have occurred on the NTS and now constrain the future use of certain NTS land areas. Figure 4-2 summarizes the historical activities and identifies the media of concern in the physical environment that could constrain their future use. Table 4-1 lists information on the nature of the source, the type of area involved, the media affected, the principal contaminants, the depth, and the best available estimate of the remaining inventory of radioactivity. It should be noted that in some cases only approximate values are available; these values are presented solely to illustrate the general characteristics of each source group and to highlight the differences between the groups.

More detailed information for each affected resource is included in the specific resource discussions in this chapter. Section 4.1.1.5, Waste Management Program, describes the existing waste management operations at the NTS, including the locations, types of materials managed, and the quantities of radioactive and nonradioactive wastes that have been disposed. Section 4.1.2.3, Transportation of Materials and Wastes, identifies the out-of-state waste generators that ship low-level waste to the NTS for disposal.

In Section 4.1.4.2, the baseline geological conditions are described. The geology baseline documents the physical disturbances to the subsurface environment that have resulted from 35 years of underground nuclear testing.

Section 4.1.4.3, Soils, identifies the historical activities, such as atmospheric nuclear testing, safety tests, and nuclear rocket and reactor experiments that have resulted in contamination of surface soils. The extent and degree of contamination is also explained.

4.1.1.1 Public Land Orders and Withdrawals. The NTS encompasses 3,496 km^2 (1,350 mi^2) of land area reserved to the jurisdiction of the DOE. Figure 4-3 shows the land area as it has been withdrawn through all forms of appropriation under the public land laws, including mining and mineral-leasing laws through the public land orders and a Memorandum of Understanding. Under Public Land Order 805 (February 12, 1952), approximately 435,000 acres of land were reserved for use by the Atomic Energy Commission as a weapons testing site. Under Public Land Order 1662 (June 20, 1958), 38,400 acres were reserved for the use of the Atomic Energy Commission in connection with the NTS. The lands described under this Public Land Order are not considered in any alternative use by the DOE and are, therefore, not addressed in this EIS. Under Public Land Order 2568 (December 19, 1961), 318,000 acres of land previously reserved for use by the U.S. Air Force were transferred to the jurisdiction of the Atomic Energy Commission for use in connection with the NTS for test facilities, roads, utilities, and safety distances. Under Public Land Order 3759 (August 3, 1965), 21,108 acres of land were reserved for the jurisdiction of the Atomic Energy Commission for use in connection with the NTS. Pahute Mesa, located in the northern portions of Areas 19 and 20, which encompasses 106,240 acres, is managed by the DOE as a part of the NTS in accordance with a 1963 Memorandum of Understanding with the U.S. Air Force. This memorandum was superseded by a Memorandum of Understanding between the U.S. Air Force and DOE/NV in 1982 (DoD, 1982).

In 1983, the U.S. Bureau of Land Management, in accordance with the Federal Land Policy and Management Act of 1976, conducted a review of the existing four land withdrawals that comprise the NTS. The U.S. Bureau of Land Management District Manager concurred with the review's conclusion that the lands were still being used for the purpose for which they were withdrawn. Furthermore, in recognition of a potential end of testing in future years, the U.S. Bureau of Land Management recommended that the land withdrawals again be reviewed in 100 years.

4.1.1.2 Land-Use Designations. The NTS is located in Nye County in southern Nevada; its southernmost point is located about 105 km (65 mi) northwest of Las Vegas, Nevada. The site varies from 46 to 56 km (28 to 35 mi) in width and 64 to 88 km (40 to 55 mi) in length (north to south).

The DOE is in the process of developing a *Resource Management Plan.* The goal of the *Resource Management Plan* will be to establish a process for managing the facilities and national resources of the NTS to ensure long-term diversity and productivity of natural ecosystems and sustain the use of land and facilities at the NTS. The DOE will use this process to evaluate the selection, design, and location of existing and proposed activities. This process will identify the criteria for evaluating the compatibility of these activities with public values, ongoing missions, existing infrastructure, cultural and natural resources, human health and safety, and other resources and land-use constraints on the NTS.

Table 4-1. Summary of radioactivity on the NTS as of January 1996

Source of Radioactivity	Type of Area	Environmental Media	Major Known Isotopes or Wastes	Depth Range	Amount (curies)
Atmospheric & Tower Tests	Above Ground Nuclear Weapon Proving Area	Surficial Soils & Test Structures	Americium Cesium Cobalt Plutonium Europium Strontium	At Land Surface	Approximately 20
Safety Tests	Above Ground Experimental Areas	Surficial Soils	Americium Cesium Cobalt Plutonium Strontium	Less than 0.9 m (3 ft)	Approximately 35
Nuclear Rocket Development Area	Nuclear Rocket Motor, Reactor, & Furnace Testing Area	Surficial Soils	Cesium Strontium	Less than 3 m (10 ft)	Approximately 1
Shallow Borehole Tests	Underground Nuclear Testing Areas	Soils & Alluvium	Americium Cesium Cobalt Europium Plutonium Strontium	Less than 61 m (200 ft)	Approximately 2,000 at land surface; unknown at depth
Shallow Land Disposal	Waste Disposal Landfills	Soils & Alluvium	Dry Packaged Low-level & Mixed Wastes	Less than 9 m (30 ft)	Approximately 500,000[a]
Crater Disposal	Test induced subsidence crater with sidewalls, cover, & drainage	Soils & Alluvium	Bulk contaminated soils & equipment	Less than 30 m (100 ft)	Approximately 1,250[a] (Approximately 205,000 m^3 [7,250,000 ft^3])[b]
Greater Confinement Disposal	Monitored Underground Waste Disposal Borehole	Soils & Alluvium	Tritium Americium	37 m (120 ft)	Approximately 9.3 million[a] (Approximately 300 m^3 [10,000 ft^3])[b]
Deep Underground Tests	Underground Nuclear Testing Areas	Soils, Alluvium, & Consolidated Rock	Tritium, fission, & activation products	Typically less than 640 m (2,100 ft), but may be deeper	Greater than 300 million

[a] Inventory at time of disposal (not corrected for decay)
[b] Amount of waste that was considered for inventory.

Existing land use on the NTS is divided into two site categories and seven zone categories. The site and zone category definitions are as follows:

Industrial, Research, and Support Site—An industrial site is used for the manufacturing, processing, and/or fabrication of articles, substances, or commodities. A research site is used for projects to verify theories or concepts under controlled conditions. Support sites are used for office space, training, equipment storage, maintenance, security, feeding and housing, fire protection services, and health services.

Waste Management Site—A site used for the disposal, storage, and/or treatment of wastes.

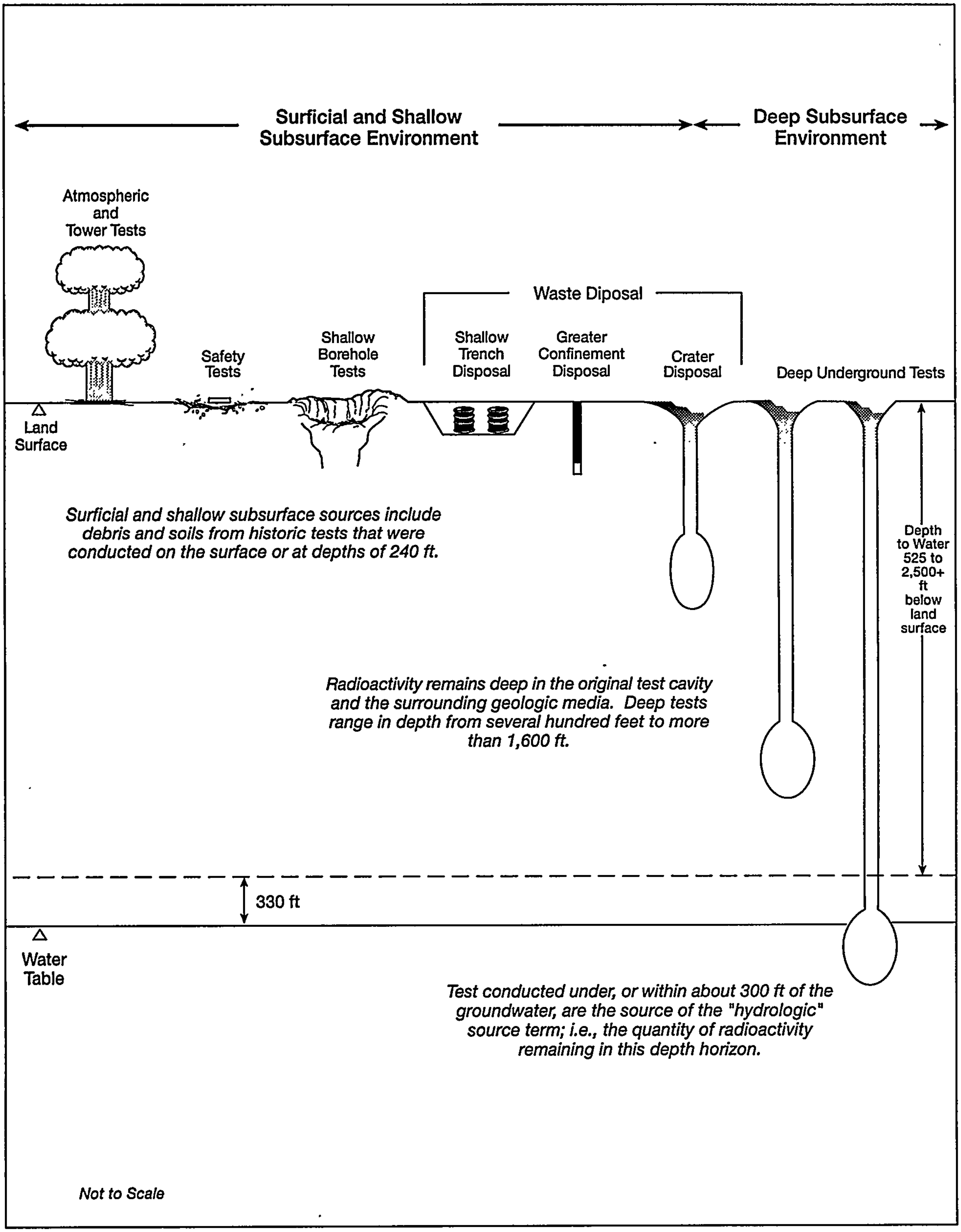


Figure 4-2. Types and depth horizons of radioactivity that remains on the NTS

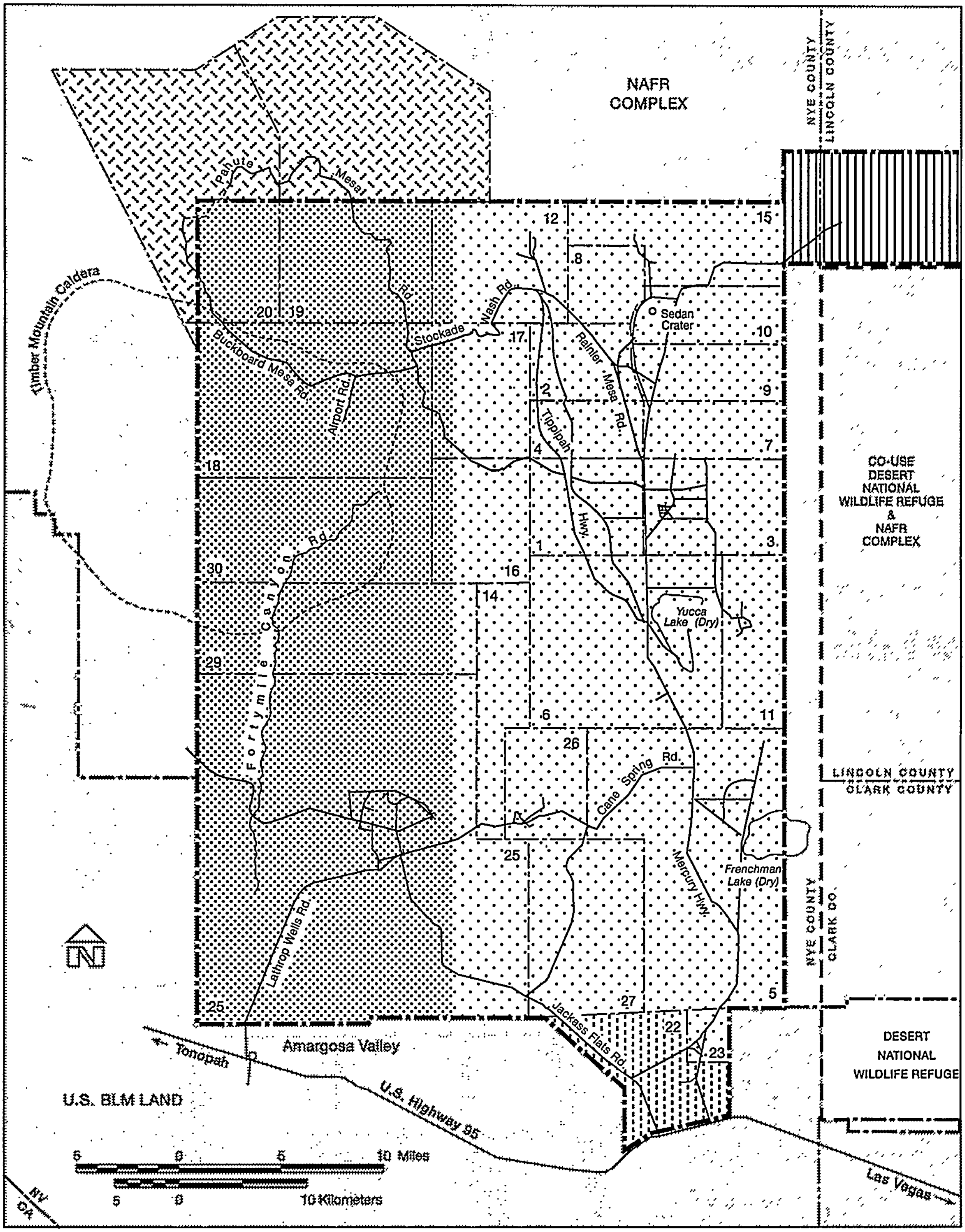


Figure 4-3. NTS land withdrawals and Memorandum of Understanding

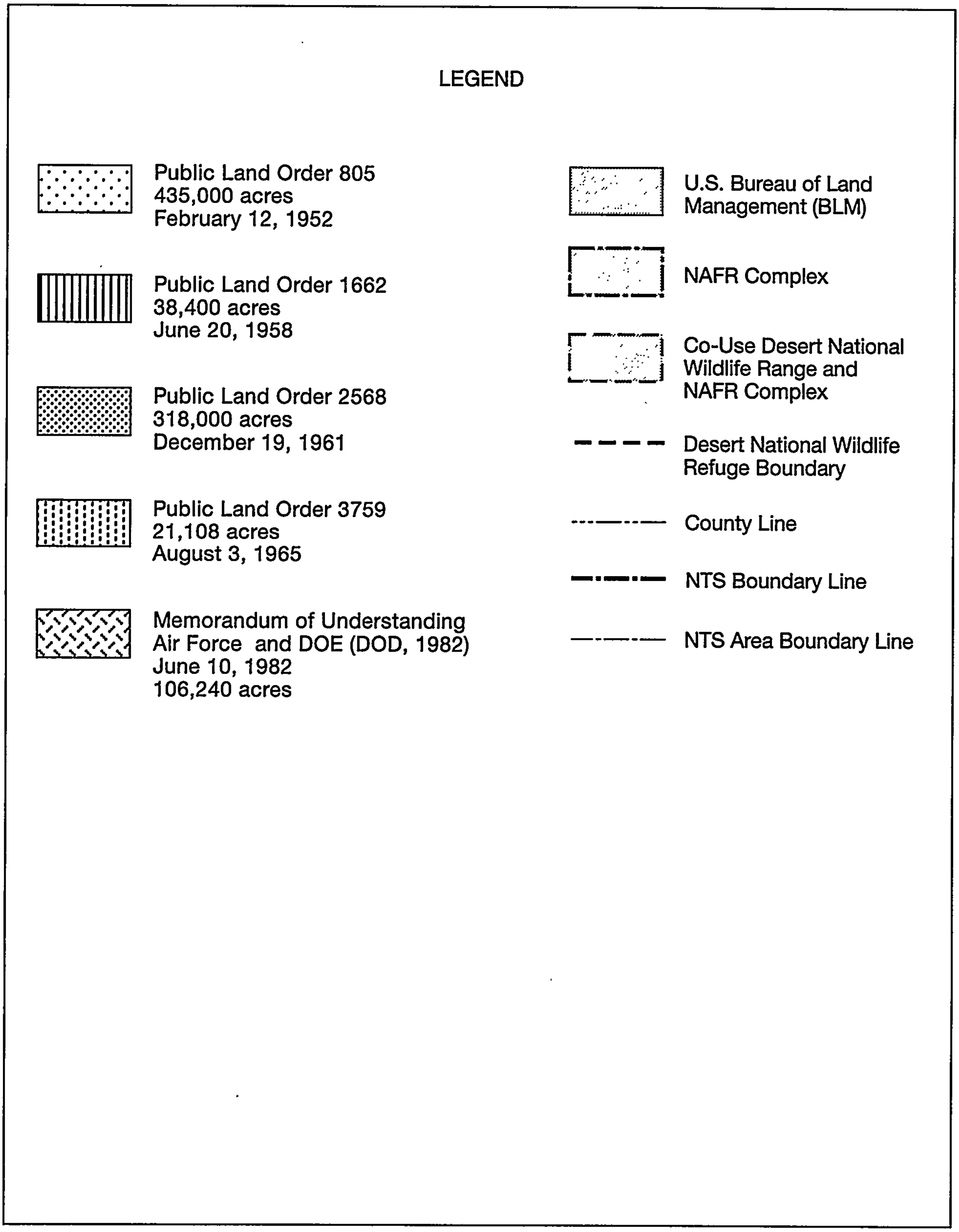


Figure 4-3 (continued). Legend for NTS land withdrawals and Memorandum of Understanding

Nuclear Test Zone—Land area reserved for underground hydrodynamic tests, dynamic experiments, and underground nuclear weapons and weapons effects tests. The stockpile stewardship emplacement hole inventory is located within this zone (Appendix A, Figure A-1).

Nuclear and High Explosive Test Zone—Land area designated within the Nuclear Test Zone for additional underground and aboveground high-explosive tests or experiments.

Research, Test, and Experiment Zone—Land area designated for small-scale research, development projects, pilot projects, and outdoor tests and experiments for the development, quality assurance, or reliability of materials and equipment under controlled conditions.

Radioactive Waste Management Zone—Land area designated for the shallow land burial of low-level and mixed wastes.

Critical Assembly Zone—Land area used for conducting nuclear explosive operations. Operations generally include assembly, disassembly or modification, staging, repair, retrofit, and surveillance. The potential for weapons storage also exists in this zone.

Spill Test Facility Impact Zone—A downwind geographic area that would confine the impacts of the largest planned tests of materials released at the Spill Test Facility.

Reserved Zone—Controlled-access land area that provides a buffer between nondefense research, development, and testing activities. The Reserved Zone includes areas and facilities that provide widespread flexible support for diverse short-term nondefense research, testing, and experimentation. This land area is also used for short-duration exercises and training, such as Nuclear Emergency Search Team and Federal Radiological Monitoring and Assessment Center training, and U.S. Department of Defense (DoD) land navigation exercises and training.

To simplify the distribution, use, and control of resources, the NTS is also divided into numbered areas. The following pages contain an area-by-area description of land use on the NTS. Refer to Chapter 3, Figure 3-1.

Area 1—As a part of the Nuclear Test Zone, this area occupies 70 km^2 (27 mi^2) near the center of the Yucca Flat weapons test basin. Four atmospheric nuclear tests were conducted here between 1952 and 1955. Three underground nuclear tests have also been detonated in Area 1, one in 1971 and two in 1990.

Buildings and structures associated with aboveground nuclear testing are discussed in Section 4.1.10 and listed in Table 4-37 as NT (Nuclear Testing). Although many of these structures are believed to be eligible, no official evaluation or determination of eligibility has been conducted. Should any of these structures be affected by project activities, an evaluation would be completed, eligibility determined, and consultation with the Nevada State Historic Preservation Office (SHPO) would be conducted prior to initialing the project. The project would be conducted in accordance with SHPO recommendations.

The Lyner Complex is a mined underground complex in Area 1 that is available for dynamic experiments (including subcritical experiments involving special nuclear material) and hydrodynamic tests that cannot be conducted aboveground because they may contain hazardous materials. Initial work on what is now known as the Lyner Complex began in the late 1960s with the mining of the U1a shaft to a depth of 305 meters (m) (1,000 feet [ft]) for a nuclear test. It was not used. Further work took place in the 1980s and early 1990s to develop a complex that could be used to perform intentionally designed low-yield tests or experiments, which included safety tests, and other experiments that would be expected to remain subcritical or produce negligible nuclear energy release. The Ledoux nuclear test with a yield of less than 25 kilotons was conducted in 1990 in a drift within this tunnel complex. The Kismet experiment, involving high explosives, tritium, depleted uranium, and other materials, was a dynamic experiment conducted in the Lyner Complex in March 1995. Both Ledoux and Kismet were contained to prevent radiological releases to the rest of the Lyner Complex and the surface environment.

The Area 1 Industrial Complex, at the intersection of Pahute Mesa Road and Tippipah Highway, is the maintenance and storage area for an over $20-million inventory of large-hole drilling equipment and miscellaneous supplies. Typical day-to-day operations include replacing worn cutters on a drill bit with new or rebuilt cutters, straightening drill pipe and tubing, and other drilling tool maintenance tasks. A concrete batch plant and storage area for bulk construction material, as well as a shaker plant that produces stemming material and concrete aggregate, lie to the north of the drilling yard.

There is one stockpile stewardship emplacement hole within Area 1 (Appendix A, Figure A-1).

Area 2—This area, within the Nuclear Test Zone, occupies approximately 52 km^2 (20 mi^2) in the northern half of the Yucca Flat basin. The eastern portion of Area 2 was the site of seven atmospheric nuclear tests conducted between 1952 and 1957. The first in a series of underground nuclear tests in Area 2 took place in late 1962 and continued through 1990. A number of the 137 underground tests detonated in Area 2 were simultaneous detonations of multiple devices in the same emplacement hole; other underground tests involved the firing of two or more devices with the devices in separate emplacement holes.

There are eleven stockpile stewardship emplacement holes within Area 2 (Appendix A, Figure A-1).

Most of the structures that comprised a former construction base camp (consisting generally of Butler buildings, Quonset huts, and trailers) have been relocated to Area 6, and the facilities remaining in Area 2 are in the process of being moved to other locations or are being scrapped.

Area 3—This portion of the Nuclear Test Zone occupies 82 km^2 (32 mi^2) near the center of the Yucca Flat weapons test basin and was the site of 17 atmospheric tests conducted between 1952 and 1958. A total of 251 underground nuclear tests were conducted in Area 3 from 1958 through 1992. This is the largest number of tests of any of the NTS underground test areas. A number of these tests consisted of simultaneous device detonations, and nearly all of these simultaneous tests consisted of single devices in separate emplacement holes. Nine of the underground nuclear tests in Area 3 were conducted in unstemmed holes to minimize, but not eliminate, the release of radioactivity to the atmosphere. These unique tests were carried out between mid-1957 and late 1958.

There are four stockpile stewardship emplacement holes within Area 3 (Appendix A, Figure A-1).

Bulk low-level waste is disposed of in selected Area 3 subsidence craters that, collectively, comprise the Area 3 Radioactive Waste Management Site. This activity commenced in the mid-1960s when the DOE began removing scrap tower steel, vehicles, and other large objects that had been subjected to atmospheric testing. From 1979 to 1990, large amounts of contaminated soil and other debris from the NTS were added to the craters. There are seven disposal craters. Two craters are in use, two are full and temporarily capped, and three are in reserve for potential future use.

Area 4—This area, within the Nuclear Test Zone, occupies 41 km^2 (16 mi^2) near the center of the Yucca Flat basin. Area 4 was the site of five atmospheric nuclear tests conducted between 1952 and 1957. From the mid-1970s through 1991, a total of 35 underground nuclear tests were conducted in Area 4, mainly in the northeast corner. Two of these tests involved the simultaneous detonation of multiple devices in the same emplacement hole.

The Big Explosives Experimental Facility in Area 4 is being evaluated for its suitability as an operational complex for testing large charges of conventional high explosives. Comprised of two earth-covered, steel-reinforced concrete structures, one structure may serve as a manned operational control room facility, and the other may serve as an unmanned camera room with viewing ports to a gravel table where large charges of high explosives can be fired.

There are four stockpile stewardship emplacement holes in Area 4 (Appendix A, Figure A-1).

Area 5—This area, within the Reserved Zone, occupies some 246 km^2 (95 mi^2) in the southeastern portion of the site and includes the Area 5 Radioactive Waste Management Site, the Hazardous Waste Storage Unit, and the Spill Test Facility.

From 1951 through early 1962, 14 atmospheric tests were conducted at Frenchman Flat, several of which were weapons effects tests. Among the remains of the structures tested in Frenchman Flat are simulated motel complexes, metal frames that supported a variety of roofing materials, a window test structure, cylindrical liquid storage vessels, reinforced concrete domes and aluminum domes, bridge pedestals, and a bank vault; all of these remains are of considerable historical interest. Five nuclear weapons tests were conducted underground at Frenchman Flat between 1965 and 1968. However, the presence of the carbonate aquifer makes this area less suitable for underground testing than other locations on the NTS.

In the GMX area, 24 experiments, some utilizing relatively small quantities of fissile materials, were conducted between 1954 and 1956. These experiments were so-called "equation-of-state" studies where "instantaneous" changes in the physical properties of plutonium materials subjected to detonations from conventional explosives were measured. These experiments were conducted on or very near one place, and the source can be considered to be at one site.

The Area 5 Radioactive Waste Management Site is located in a 732-acre Radioactive Waste Management Zone used for low-level waste disposal. Mixed waste, including transuranic mixed waste, has been disposed of at the site in the past, and transuranic wastes are currently being stored there pending disposal at the Waste Isolation Pilot Plant near Carlsbad, New Mexico. Disposal of waste at the NTS is discussed in Section 4.1.1.5.

The Hazardous Waste Storage Unit is an accumulation point for nonradioactive materials, such as paints, chemicals, unused or surplus fuels, and other items. Periodically, all hazardous wastes generated at the NTS are sent to permitted commercial facilities for recycling, incineration, or disposal.

The Spill Test Facility is a complex of fuel tanks, spill pads, meteorological and camera towers, equipment and control buildings, and a wind tunnel used for releasing hazardous materials and measuring their behavior in outdoor conditions.

Area 6—This area occupies 212 km^2 (82 mi^2) between Yucca Flat and Frenchman Flat, straddling Frenchman Mountain. Only one atmospheric nuclear test was conducted in Area 6, and that was in 1957. Between 1968 and mid-1990, five underground nuclear tests were conducted at this location, two of which involved the simultaneous detonation of multiple devices in separate emplacement holes.

There are two stockpile stewardship emplacement holes in Area 6 (Appendix A, Figure A-1).

The Control Point complex serves as the command center, air operations center, and timing and firing center for the Yucca Flat weapons test basin, Frenchman Flat, Pahute Mesa, and surrounding areas. Augmenting facilities near the secured compound include a communications building, several radiological sciences and technical services buildings, a fire and first-aid station, and various maintenance and warehouse structures.

The Area 6 Construction Facilities provide craft and logistical support to activities in the forward areas of the NTS. This forward area complex replaces older construction base camps in Areas 2 and 3. Those elements comprising the Yucca Lake facilities include a variety of equipment storage facilities, a heavy- duty maintenance and equipment repair facility, and decontamination facilities. A 3,353 m (11,000 ft) airstrip and nearby weather station also are located on the Yucca Lake bed.

The Device Assembly Facility, when open, will be the primary location of all nuclear explosive operations at the NTS. Nuclear explosive operations include assembly, disassembly or modification, staging, transportation, testing, maintenance, repair, retrofit, and surveillance. The

Device Assembly Facility contains about 9,290 m^2 (100,000 ft^2) of interior floor space within a Critical Assembly Zone composed of approximately 22 acres.

The Hydrocarbon Contaminated Soils Disposal Site is an existing, state of Nevada-approved, Class III landfill. All non-Resource Conservation and Recovery Act-regulated hydrocarbon contaminated soils and materials generated on the NTS are disposed of at this landfill.

Area 7—This area, within the Nuclear Test Zone, occupies 52 km^2 (20 mi^2) in the northeast quadrant of the Yucca Flat weapons test basin. Twenty-six atmospheric tests were conducted in this area. From late 1964 through the fall of 1991, a total of 62 underground nuclear tests were carried out in Area 7, all consisting of a single nuclear device in a drilled emplacement hole.

There are three stockpile stewardship emplacement holes in Area 7 (Appendix A, Figure A-1).

Area 8—This area, within the Nuclear Test Zone, occupies 34 km^2 (13 mi^2) in the northeast quadrant of the Yucca Flat weapons test basin. Area 8 was the site of three atmospheric nuclear tests conducted in 1958. From mid-1966 through late 1988, 10 underground nuclear tests were carried out at this location. Two of the underground tests involved the simultaneous firing of multiple devices put in the same emplacement hole. Underground shelter structures were tested in the late 1950s, and in 1964 these shelters were used by the University of Florida for shelter habitability studies. Lawrence Livermore National Laboratory has conducted experiments in this area.

Area 9—This area, within the Nuclear Test Zone, occupies 52 km^2 (20 mi^2) in the northeast quadrant of the Yucca Flat weapons test basin. Seventeen atmospheric tests were conducted in this area between 1951 and 1958. Area 9 has been used extensively for underground nuclear testing; 100 such tests were carried out from late 1961 to mid-1992. Of the dozen underground tests involving the simultaneous detonation of multiple devices, most involved the use of separate emplacement holes (two or more holes, each with a single device).

There is one stockpile stewardship emplacement hole in Area 9 (Appendix A, Figure A-1).

The Area 9 sanitary landfill is located in a subsidence crater formed as a result of a subsurface nuclear detonation in the early 1960s. This Class II landfill is allowed to receive all types of nonhazardous waste. In October 1995, the landfill underwent partial closure and will reopen as a Class III construction and demolition debris landfill.

Area 10—This area, incorporated in the Nuclear Test Zone, occupies 54 km^2 (21 mi^2) in the northeast quadrant of the Yucca Flat weapons test basin. Area 10 was the selected location for the nation's first nuclear missile system test, an air-to-air rocket, detonated in mid-1957. This was the only nuclear rocket test ever conducted at the NTS. Two of the earliest shallow nuclear cratering experiments conducted at the NTS were detonated in 1951 and 1955 at this location. Resuming with the deeply buried Sedan cratering experiment in mid-1962 and extending through early 1991, a number of underground nuclear tests were conducted in Area 10. Counting both the cratering and contained underground tests, there were 57 nonatmospheric nuclear tests. A number of the underground tests detonated in Area 10 were simultaneous detonations of multiple devices in the same emplacement hole, while others involved the firing of multiple devices, but with each of the nuclear devices located in separate emplacement holes.

Area 10 is the site of Sedan Crater, which was formed by a thermonuclear device detonated in July 1962. It left a large throw-out crater with a diameter of 390 m (1,280 ft) and a depth of 98 m (320 ft). Sedan was the first in a series of 23 Plowshare experiments conducted at the NTS to develop peaceful uses of nuclear explosives. Sedan Crater is listed on the National Register of Historic Places, a file of cultural resources of national, state, regional, or local significance identified by the National Park Service. The Scooter Crater, also located in Area 10, is the result of a 500-ton conventional high-explosive experiment carried out in 1960.

Area 11—This area, which is split among the Nuclear Test and Reserved Zones, occupies 67 km^2 (26 mi^2) along the eastern border of the NTS. Four atmospheric plutonium-dispersal safety tests were conducted in the northern portion of Area 11 in 1954 and 1956 in what is now known as Plutonium Valley. Because of the radioactive residues that remain from the safety experiments, Area 11 continues to be used on an intermittent basis for realistic drills in radiological monitoring and sampling operations. In addition to the aboveground safety tests, five underground nuclear weapons effects tests were carried out in Area 11 between the spring of 1966 and early 1971.

An explosive ordnance disposal site is located in the southern portion of Area 11. This is a Resource Conservation and Recovery Act permitted treatment unit. The site consists of a detonation pit surrounded by an earthen pad, approximately 8 m (25 ft) by 30 m (100 ft), and supplemental equipment, which includes a bunker, electrical shot box, and electrical wire. Typically, up to six detonations of 45 kilograms (kg) (100 pounds [lb]) or less of explosives are conducted annually.

Area 12—This area, within the Nuclear or High Explosive Test Zone, occupies 104 km^2 (40 mi^2) at the northern boundary of the NTS known as Rainier Mesa. No atmospheric tests were conducted at this location. Rainier Mesa was the site of the nation's first fully contained underground nuclear detonation in the fall of 1957. Of the 61 underground nuclear tests carried out in Area 12 between late 1957 and the fall of 1992, only 2 were detonated in drilled holes, whereas all of the others were detonated in mined tunnels.

Today, there are a number of tunnels mined into Rainier Mesa, within which most DoD horizontal line-of-sight exposure experiments were conducted. In particular, N-, P-, and T-Tunnel complexes were extensively developed during the past several decades. N-Tunnel was also the location for a non-proliferation experiment, detonated in September 1993; this experiment involved 1.3×10^6 kg (2.9 x 10^6 lb) of conventional high explosives. The DoD currently operates a high-explosives research and development tunnel in Area 12. This reusable test bed supports programs involving the detonation of conventional or prototype explosives and munitions.

The Area 12 camp was used to support operations in the northern region of the NTS. The camp includes housing and feeding facilities; other support structures include a major maintenance building, various craft and repair shops, a first-aid facility, and a supply depot. The camp is currently closed.

Area 13—Officially, there is no Area 13 within the NTS boundary; however, there is a land plot on the NAFR Complex, known as NAFR Complex Area 13, which lies off the northeast corner of the NTS. This was the location for a plutonium-dispersal safety experiment conducted in early 1957. The only future DOE activities that would occur in this area would involve environmental restoration.

Area 14—This Reserved Zone area occupies 67 km^2 (26 mi^2) in the south-central portion of the NTS. Relatively isolated from the NTS's major operational and support facilities, no atmospheric or underground nuclear tests have ever been conducted in Area 14.

Area 15—This Reserved Zone area occupies 96 km^2 (37 mi^2) at the northeast corner of the NTS, and no atmospheric tests were conducted at this location. However, between early 1962 to mid-1966, three underground nuclear tests were carried out in Area 15.

Two major complexes are located in Area 15, the Hardhat/Piledriver site and the U.S. Environmental Protection Agency (EPA) Farm Complex, both of which are now closed. The Piledriver experiment in mid-1966 was one of the most complex and expensive DoD underground nuclear tests ever carried out. The purpose of these tests was to investigate the simulated effects of a nuclear surface detonation on a deeply buried, superhard command and control center in a granite rock formation.

From 1978 to 1983, the Spent Fuel Test, Climax was carried out in a separately mined drift at the Hardhat/Piledriver site. The purpose of this study was to learn more about how granite would react to heat and radiation from spent nuclear fuel.

As part of the nation's long-range health and safety program, an experimental 30-acre dairy farm was developed and operated in Area 15 between 1965 and 1981. The purpose of this extensive research program was to study the passage of airborne radionuclides through the soil-forage-cow-milk-food chain.

Area 16—This area, within the Nuclear or High Explosive Test Zone, occupies 73 km^2 (28 mi^2) in the west-central portion of the NTS. No atmospheric tests have ever been conducted at this location. Area 16 was established in 1961 for the DoD's exclusive use in support of a complicated nuclear effects experiment that required a tunnel location in an isolated area away from other active weapons test areas. From mid-1962 through mid-1971, six underground nuclear weapons effects tests (all in the same tunnel complex) were conducted at this location. Currently, the DoD uses this area for high-explosives research and development in support of programs involving the detonation of conventional or prototype explosives and munitions.

Area 17—This area, within the Reserved Zone, occupies 80 km^2 (31 mi^2) in the north-central portion of the NTS. This area has been used primarily as a buffer between other testing activities. No atmospheric tests or experimental activities of programmatic consequence have been conducted in Area 17.

Area 18—This area, within the Reserved Zone, occupies 231 km^2 (89 mi^2) in the northwest quadrant of the NTS. The inactive Pahute airstrip is located in the east-central portion of the area. When in operational status, the airstrip was primarily used for shipment of supplies and equipment for Pahute Mesa test operations.

Area 18 was the site of five nuclear weapons tests: four were conducted in mid-1962 and one underground test was conducted in 1964. Two of these were atmospheric tests, two were cratering experiments, and one was a stemmed underground nuclear test. In 1964, the Lawrence Livermore National Laboratory used the area for a Plowshare-sponsored test using chemical high explosives to investigate the potential use of nuclear explosives for ditch digging in dense hard rock.

Area 19—This area, within the Nuclear Test Zone, occupies 388 km^2 (150 mi^2) in the northwest corner of the NTS. Area 19 was developed for high-yield underground nuclear tests. No atmospheric nuclear tests were conducted in Area 19. From the mid-1960s through 1992, a total of 35 underground nuclear tests were conducted.

There are five stockpile stewardship emplacement holes in Area 19 (Appendix A, Figure A-1).

Area 20—This area, within the Nuclear Test Zone, occupies 259 km^2 (100 mi^2) and is in the extreme northwest corner of the NTS. Area 20, like Area 19, was developed in the mid-1960s as a suitable location for high-yield underground nuclear tests. No atmospheric nuclear tests were conducted in Area 20. Three underground nuclear tests in the megaton and greater yield range were carried out on Pahute Mesa between 1966 and 1976. These tests were the well-publicized Boxcar, Benham, and Handley events. From the mid-1960s through 1992, a total of 46 contained, underground nuclear tests were conducted in Area 20. All of these Pahute Mesa tests have consisted of single nuclear devices being detonated in drilled emplacement holes.

In addition to weapons development tests, one nuclear test detection experiment and three Plowshare tests were conducted on Pahute Mesa. The Plowshare tests in Area 20 included the nuclear cratering experiments Palanquin, Cabriolet, and Schooner. Palanquin, detonated in the spring of 1965, was the first nuclear test on Pahute Mesa.

There are two stockpile stewardship emplacement holes in Area 20 (Appendix A, Figure A-1).

Area 21—There is no Area 21 on the NTS.

Area 22—This area, within the Reserved Zone, occupies 83 km^2 (32 mi^2) in the southeastern corner of the NTS and serves as the main entrance area. Before 1958, this area included Camp Desert Rock, a Sixth Army installation used for housing troops taking part in military exercises at the NTS. After 1958, the camp was essentially removed, with the exception of the Desert Rock Airport. In 1969, the runway was extended to a length of 2,286 m (7,500 ft). The airport currently is open, but provides no services.

Area 23—This area, within the Reserved Zone, occupies 13 km^2 (5 mi^2) in the southeastern portion of the NTS and is the location of the largest operational support complex. Mercury was established in 1951 and serves as the main administrative and industrial support center at the NTS. Permanent structures and services include housing and feeding, laboratory, maintenance, communication and support facilities, computer facilities, warehouses, storage yards, motor pools, and administrative offices. Mercury is located approximately 8 km (5 mi) from U.S. Highway 95.

The Area 23 Class II sanitary landfill, located just west of Mercury, is open to receive all types of nonhazardous solid waste. Wastes are compacted and covered to form layers. The Area 23 landfill receives approximately 830 tons of solid waste annually. The landfill is an open, rectangular pit with steep, nearly vertical sides. The current capacity of the landfill is approximately 4.5×10^5 cubic meters (m^3) (5.9×10^5 cubic yards [yd^3]).

Area 24—There is no Area 24 on the NTS. However, Las Vegas and North Las Vegas are sometimes referred to as Area 24.

Area 25—This is the largest area on the NTS. It occupies some 578 km^2 (223 mi^2) in the southwestern corner of the site and includes an entrance gate to the NTS.

Located roughly in the center of Area 25, Jackass Flats was the site selected for a series of ground tests of reactors, engines, and rocket stages as part of a program to develop nuclear reactors for use in the nation's space program. In the early 1960s, the Atomic Energy Commission and the National Aeronautics and Space Administration negotiated an interagency agreement to establish and manage a test area at the NTS, designated as the Nuclear Rocket Development Station. These facilities, inactive since 1973, remain today in various stages of disrepair. They consist of three widely separated reactor test stands; two maintenance, assembly, and disassembly facility buildings; a Control Point complex; an administrative area complex; and a radioactive materials storage area.

Area 25 is divided into multiple zone categories: Yucca Mountain Site Characterization Zone; Research, Test, and Experiment Zone; and Reserved Zone. The Yucca Mountain Site Characterization Zone within the boundaries of the NTS represents a land assignment area for site characterization activities. The former Nuclear Rocket Development Station administrative area complex in Area 25 has been rededicated as the Yucca Mountain Site Characterization Central Support Site. Limited Yucca Mountain characterization activities are also conducted off site and beyond Area 25. Similarly, the NTS has monitoring activities off site. The Research, Test, and Experiment Zone in Area 25 is used by the U.S. Army's Ballistic Research Laboratory for depleted uranium testing. Two classifications of tests are conducted under this program, open-air tests and X-tunnel tests. These tests include hazard classification and system tests. Research sites within the Reserved Zone include the Treatability Test Facility and Bare Reactor Experiment Nevada (BREN) Tower. The Treatability Test Facility was established in Area 25 for bench-scale testing of physical processes for separating plutonium and uranium from contaminated soils.

Area 25 was used in the early 1980s for MX (Peacekeeper) missile siting studies and canister ejection certification tests.

The 465-m (1,527-ft) BREN Tower has been used intermittently by a number of organizations to conduct sonic-boom research, meteorological studies, and free-fall/gravity-drop tests. More recently, the facility has been used in support of the Brilliant Pebbles program, as well as in studies to develop the technology and measurement techniques for advanced infrared imaging from space satellites. A Brilliant Pebble is a relatively small computer-operated, rocket-powered vehicle that uses sensors and a small laser to detect and track an oncoming ballistic missile, which the Brilliant Pebble vehicle is designed to destroy by kinetic energy.

The Rock Valley Study Area, not shown on the map, is located south of Jackass Flats Road on the southern boundary of Area 25. This location was selected in 1960 for controlled studies relating to the effects of radiation on a desert ecosystem. During the past three decades, these fenced study plots have been used by a number of government-sponsored scientists, as well as students and others conducting environmental research projects and experiments.

Portions of the Area 25 Reserved Zone are used by the military for land navigation and training exercises.

Area 26—This area, within the Reserved Zone, occupies 57 km^2 (22 mi^2) in the south-central area of the NTS. The southern portions of this area were used in the past for nuclear-powered ramjet engine tests known as Project Pluto. The residual test facilities include a control point, test bunker, compressor house and air-storage facilities, and a disassembly building.

Area 27—This area, within the Critical Assembly Zone, occupies 130 km^2 (50 mi^2) in the south-central portion of the NTS. Area 27's principal assembly facilities include five assembly bays, four storage magazines, two combination assembly bay/storage magazines, and three radiography buildings. The Area 27's critical assembly facilities are an alternate to the Device Assembly Facility.

Area 27 was also used in the past for the Super Kukla Reactor Facility.

Area 28—No longer in existence, the Area 28 designation formerly applied to a portion of the NTS that has since been absorbed into Areas 25 and 27.

Area 29—This area, within the Reserved Zone, occupies 161 km^2 (62 mi^2) on the west-central border of the NTS. The site of a communications repeater station for the NTS is located in the Shoshone Mountains.

Area 30—This area, within the Reserved Zone, occupies 150 km^2 (58 mi^2) and, like Area 29, is on the western edge of the NTS. Area 30 also has fairly rugged terrain and includes the northern reaches of Fortymile Canyon. In the past, Area 30 has had limited use in support of the nation's nuclear testing programs, but in the spring of 1968 it was the site of Project Buggy, the first nuclear row-charge experiment in the Plowshare Program.

<u>SURROUNDING LAND USE</u>—Figure 4-4 shows the status and use of lands around the NTS. The NTS is surrounded by other federal lands. The NTS is bordered by the NAFR Complex on the north, east, and west and by U.S. Bureau of Land Management lands on the south and southwest.

Beyond the federal lands that surround the NTS, principal land uses in Nye County in the vicinity of the NTS include mining, grazing, agriculture, and recreation. Currently, Nye County does not have a land-zoning ordinance; however, measures are being reviewed by the Board of Supervisors for approval. Of the total land area within Nye County, only a small number of isolated areas are under private ownership and, therefore, subject to general planning guidelines. Urban and residential land uses occur beyond the immediate vicinity of the NTS, in fertile valley regions such as the Owens and San Joaquin to the west, the Virgin River to the east, Pahrump to the south, the Moapa River to the southeast, and Hike and Alamo to the northeast. The nearest population centers surrounding the NTS are Amargosa Valley, Indian Springs, Beatty, and Pahrump Valley. These are all rural communities, with Amargosa Valley being the closest to the NTS. Las Vegas is the closest major metropolitan area and is located about 105 km (65 mi) southeast of the NTS. Amargosa Valley (formerly Lathrop Wells) lies 3 km (2 mi) south of the NTS border.

Clark County, to the southeast, consists of 20,461 km^2 (7,900 mi^2), of which about 95 percent is owned by the federal government. The primary land uses of these federal lands include open grazing, mining, and recreation. The remaining 5 percent of the land in Clark County is used for state and local government, residential, industrial, and commercial purposes. Numerous

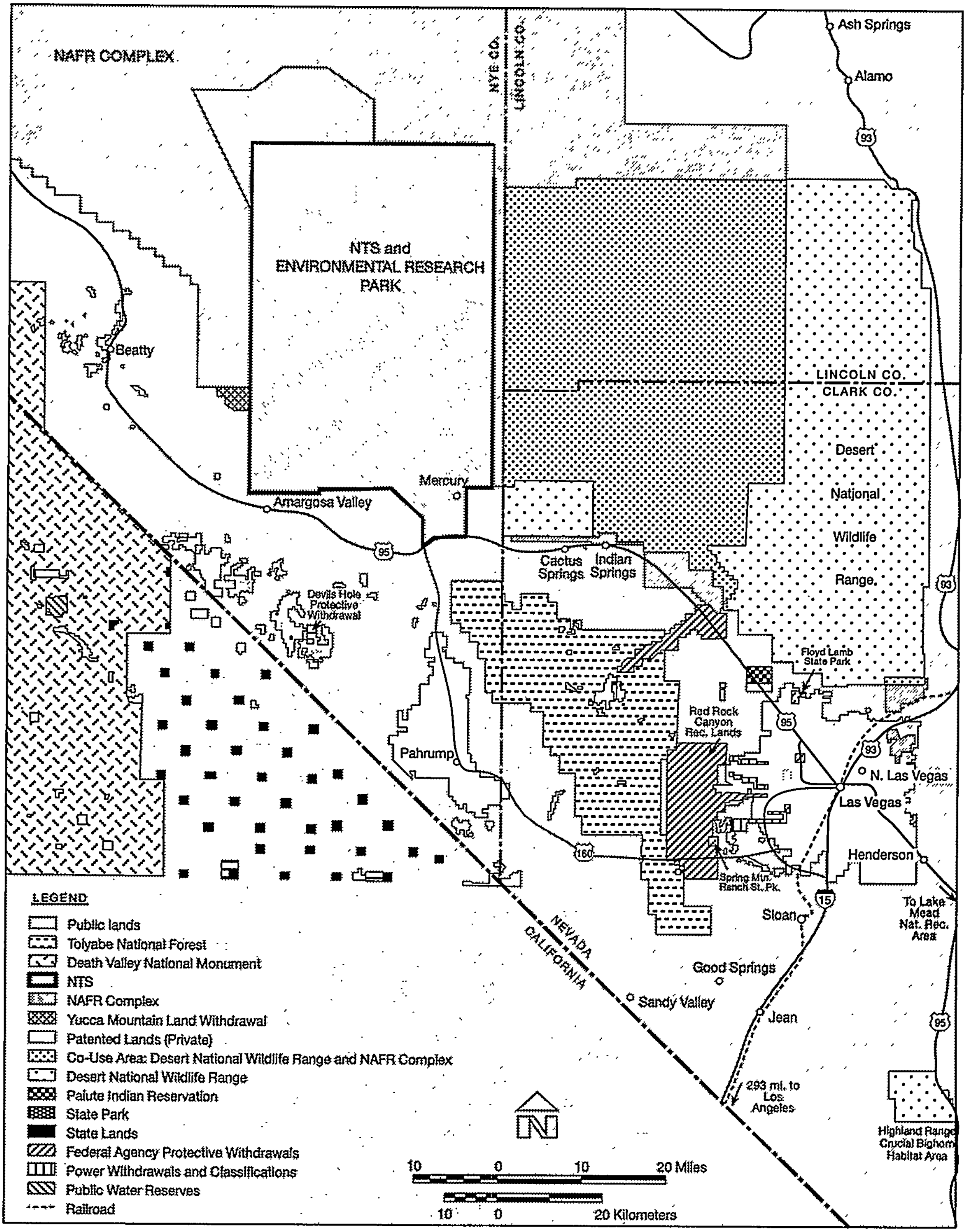


Figure 4-4. NTS and surrounding land use

national, state, and local public recreation areas exist within the region. Outdoor recreational areas include the Lake Mead National Recreation Area, located 121 km (75 mi) east; the Death Valley National Monument, located 19 km (12 mi) to the west-southwest; the Red Rock National Conservation Area, located 64 km (40 mi) to the southwest; and the Desert National Wildlife Range, located 5 km (3 mi) east. Portions of the Desert National Wildlife Range overlap the NAFR Complex and come within 3 km (2 mi) of the boundary of the NTS. State parks include Spring Mountain Ranch State Park, located 80 km (50 mi) southwest, and the Floyd R. Lamb State Park, located 72 km (45 mi) southwest. Other recreational areas include year-round campsites and picnic areas in the Toiyabe National Forest, located 40 km (25 mi) to the southwest. In addition, numerous camping and fishing sites that are used during the spring, summer, and fall months are located in the outlying areas north of the site.

The North Las Vegas Facility occupies approximately 80 acres in the city of North Las Vegas, Nevada. The North Las Vegas Facility is zoned for general industrial use and is bordered on the north, south, and east by general industrial zoning. The western border of the site is adjacent to a street, which acts as a buffer zone, separating the site from fully-developed, single family, residential-zoned property.

The North Las Vegas Facility is divided into three distinct areas. The first area covers 20 acres and houses support for the Lawrence Livermore National Laboratory test program. The second area covers 20 acres and houses support for the Los Alamos National Laboratory test program. The third area covers 38.3 acres and houses a computer center and administrative and engineering support functions.

4.1.1.3 Site-Support Activities. The following sections provide a brief discussion of the current NTS site-support services (infrastructure). Additional details regarding site support are provided in Section A.6 of Appendix A.

FACILITIES—The NTS contains approximately 1,500 buildings that provide approximately 269,419 m^2 (2.9 x 10^6 ft^2) of space. A breakdown of the types of facilities and their cumulative space is given in Table 4-2. Many of these facilities have been either mothballed or abandoned because of the reduction of program activities at the NTS.

SERVICES—Services available at the NTS include law enforcement and security, fire protection, and health care.

Law Enforcement and Security—Law enforcement on the NTS is provided by the Nye County Sheriff's Department through a substation located at Mercury. Security enforcement is the responsibility of Wackenhut Services, Inc. The NTS is a controlled-access area. Wackenhut Services, Inc., a private contractor, provides sitewide protective services following guidelines established by the DOE/NV Safeguards and Security Division.

The DOE currently contracts with the Nye County Sheriff's Department for five officers at the NTS substation to assist in civilian law enforcement. There is no holding facility at the NTS; most people arrested at the NTS are transported to Pahrump. If the individual cannot pay bail, he is sent to Tonopah, Nevada (Willen, 1995).

Security facilities at the main gate include a badging and security office. Other facilities include firing ranges, an ammunition dump, a security training facility, and an obstacle course. Mobile ground patrols provide security throughout the site. Helicopters and light aircraft are used to check perimeter barricades and other remote locations in the forward area. Teams of armed guards are available to respond to emergency situations and to escort the movement of nuclear explosives and special nuclear materials within the NTS. Response teams are equipped with all-terrain, high-speed armored vehicles (Raytheon Services Nevada, 1994b).

Fire Protection—The fire protection capacity of the NTS is structured to accommodate current mission requirements, with a self-contained fire-fighting department responsible for suppression and prevention. Other services include rescue, hazardous material response, training of fire personnel, fire prevention inspection, installation of all fire

Table 4-2. Building space on the NTS

Functional Unit	Square Meters	Square Feet
Administrative	72,081	775,874
Temporary Housing	22,499	242,178
Storage	68,886	741,483
Services	62,667	674,539
Research and Development	38,215	411,338
Reactor and Accelerator	305	3,286
Other Known Assets	101	1,088
Other Storage	3,713	39,971
Industrial/Production Process	3,290	35,418
Service Structures	205	2,208
Communication and Related Systems	797	8,575
Distribution Systems	36	390

extinguishers at the NTS, and fire prevention awareness programs (Raytheon Services Nevada, 1994).

A fire department staffed with support-contractor personnel provides 24-hour fire-fighting services for the NTS. In addition, fire protection and crash rescue services are provided for two airstrips, upon request. Within site boundaries, the fire department provides support during the transportation, transfer, and storage of toxic and flammable gases. The fire department maintains one fire station in Mercury. Support equipment used by the fire department include one engine company, one tanker truck, and one UNMOG used for wildlands support (Raytheon Services Nevada, 1994).

Health Care—An eight-bed dispensary in Mercury serves as a clinic for the NTS. Facilities include rooms for emergency care, examination and treatment, X-ray, and associated darkroom equipment, as well as offices and storage. The facility can respond rapidly to normal and emergency situations, including in-patient treatment, emergency surgery, and radiation accidents. First-aid stations are located near field activities so that personnel can be treated quickly. Ambulances are available for emergencies that occur on the site, in nearby communities, or on highways (Raytheon Services Nevada, 1994).

UTILITIES—The utilities at the NTS include water systems, wastewater systems, and electrical systems.

Water Systems—The NTS is presently served by a water system consisting of 11 operating wells for potable water, one well for non-potable water (Table 4-3), 27 usable storage tanks, 13 usable construction water sumps, and 6 water transmission systems (with 5 permitted water distribution systems). The wells are not being used to their full capacity and are capable of producing much more water if needed. Additional inactive wells are available (Table 4-4) or wells may be drilled and developed if increased water production is required. Wells, sumps, and storage tanks are used, as required, to support construction or operational activities. Five water storage tanks are currently under construction at the NTS. Domestic, construction, and fire protection water are supplied by this system through over 161 km (100 mi) of supply line. Potable water is trucked to support facilities that are not connected to the potable water

Table 4-3. Active water supply wells on the NTS

Well*	Water Service Areas	Area Served	Type	Status	Sumps & Reservoirs Storage Capacity		Flow Rate	
					L	gal	L/min	gal/min
U-20a	A	19, 20	Nonpotable	Active	154,400,000	40,780,000	1,060	280
8	B	2, 12	Potable	Active	2,100,000	553,000	2,045	540
UE-16d	B	1	Potable	Active	None	None	735	194
C	C	6, 3	Potable	Active	4,880,000	1,290,000	1,100	290
C-1	C	6, 3	Potable	Active	See Well C	See Well C	1,100	290
4 and 4a	C	6	Potable	Active	See Well C	See Well C	2,651	700
5b	C	5, 22, 23	Potable	Active	2,700,000	710,000	871	230
5c	C	5, 22, 23	Potable	Active	190,000	50,000	871	230
J-12	D	25	Potable	Active	13,510,000	3,555,000	2,878	760
J-13	D	25	Potable	Active	190,000	50,000	2,574	680
Army Well 1	C	22, 23	Potable	Active	None	None	371	98

* The locations of these wells are shown on Figure 4-5.

Table 4-4. Inactive water supply wells on the NTS

Well[a]	Water Service Areas	Area Served	Type	Status	Sumps & Reservoirs Storage Capacity		Flow Rate	
					L	gal	L/min	gal/min
UE-19c	A	19, 20	Nonpotable	Inactive	13,984,000	2,900,000	1,363	360
UE-15d	B	15	Nonpotable	Inactive	56,781	15,000	1,022	270
2	B	2, 4, 7, 9, 10	Potable (chlorinator)	Inactive (pump failed)	3,293,308	870,000	643	170
UE-1r	B	1	Nonpotable	Inactive	None	None	1,022	270
UE-5c	C	5	Nonpotable	Active for environmental sampling only	None	None	1,325	350
5a	C	5	Potable	Abandoned	None	None	341	90
F	C	27	Nonpotable	Inactive	None	None	901	238
3	C	3	Nonpotable	Inactive	None	None	None	None
J-11	D	25	Potable	Abandoned	See Well J-12[b]	See Well J-12[b]	None	None

[a] The locations of these wells are shown on Figure 4-5.
[b] Table 4-3.

system. The NTS used approximately 1.7 billion liters (L) (457 million gallons [gal]) of water in 1994. Mercury was the primary user of this water, using 40 percent of the total water pumped. The forward areas of the NTS used approximately 7.0 x 10^8 L (1.9 x 10^8 gal).

For evaluation purposes, the NTS water system has been divided into four water service areas (A, B, C, and D) according to the location of the water system and support facilities (Figure 4-5). Water service area A includes NTS Areas 19 and 20; service area B covers Areas 2, 4, 7, 8, 9, 10, 12, 15, 17, and 18; service area C supplies Areas 1, 3, 5, 6, 11, 22, 23, 26, and 27; and service area D supplies water to the remaining areas of the NTS.

Non-potable water distribution in water service area A is through an aboveground 152 millimeter (mm) (6-inch [in.]) pipe line that runs along the Pahute Mesa Road between Well UE-19c, the Area 20 camp, and Well U-20a. Water in this system must maintain a constant flow to prevent freezing in the extreme temperatures.

Water service area B has two potable water distribution systems to serve water needs in this area. The Area 17 support facilities are supplied by the system from Well UE-16d. The other transmission system in this area feeds from Well 8 to the Area 12 camp through 152-mm (6-in.) pipe line and 102-mm (4-in.) pipe line and then into the Area 2 facilities through 152-mm (6-in.) pipe line connecting to Well 2.

The two distribution systems in water service area C feed several wells and use 203-mm (8-in.), 102-m (4-in.), and 152-mm (6-in.) underground pipelines. The Area 6 distribution system is supplied by Wells 4, C, C1, and 4a, and provides potable water service to the Device Assembly Facility, the Yucca Lake facilities, the Control Point, and the Well 3 yard. This system contains segments of old asbestos pipe. Area 5, Mercury, and Desert Rock facilities are supplied by a system connecting Wells 5b, 5c, and Army Well 1.

Wells J-12 and J-13 supply potable water to the single transmission system in water service area D. This system (in NTS Area 25) supplies several reservoirs and the former Nuclear Rocket Development Station facilities through 152 mm (6-in.), 203-mm (8-in.), and 304-mm (12-in.) pipe lines.

Wastewater Systems—Wastewater on the NTS is disposed of either by a combination septic tank and leach field system or by a lagoon system. At areas not serviced by a permanent wastewater system, portable sanitary units are provided. The size and type of wastewater systems used are determined by anticipated discharge and cost effectiveness.

Electrical System—Electric power is delivered to the NTS at the Mercury switching center in Area 22 by a primary 138-kilovolt (kV) supply line from the Nevada Power Company system near Las Vegas. A second Nevada Power Company-owned 138-kV line connects the Mercury switching center to the Jackass Flats substation in Area 25. Valley Electric Cooperative, serving the Pahrump, Nevada area also has a transmission connection to the Jackass Flats substation. The dual transmission and station connections provide the NTS with the ability to receive service from either transmission source depending on contractual arrangements. A DOE-owned 138-kV loop extends this primary power supply into the NTS forward areas where smaller, lower-voltage distribution lines feed power to individual facilities. During the last several years, the NTS has been provided power under contracts with Nevada Power Company and the Western Area Power Administration. Additionally, the DOE has periodically operated oil-fired diesel generators at Area 25 for peak and back-up power supply purposes (Raytheon Services Nevada, 1994).

Electric power on the NTS is carried over 426 km (265 mi) of transmission and subtransmission lines (Raytheon Services Nevada, 1994). The power subtransmission uses an extensive 34.5-kV system and two small 69-kV systems. These systems provide distribution voltages of 4.16 kV and 12.47 kV at various substations. Distribution voltages are transformed to both 480/277-volt and 208/120-volt three-phase systems for most NTS loads, with a few single-phase 120-volt services.

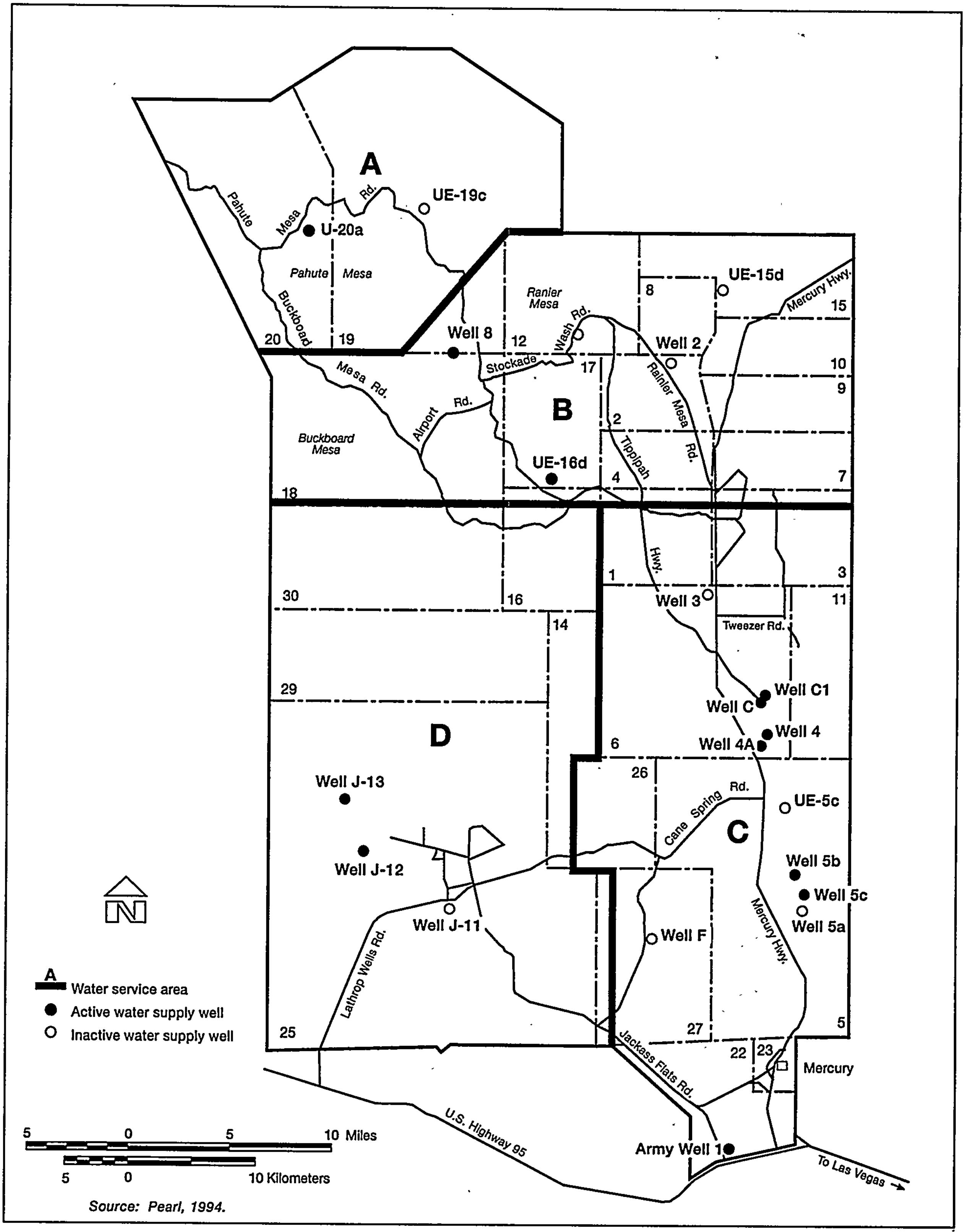


Figure 4-5. Existing water service areas and supply wells on the NTS

Power transmission/subtransmission lines and substations located on the NTS are shown on Figure 4-6.

COMMUNICATIONS—Communication systems cover not only the entire area of the NTS, but also reach far beyond its boundaries. The NTS telecommunications system employs digital telephone switching, fiber-optic transmission, microwave, two-way radio, voice privacy, data transmission systems, general- and special-purpose data communications, and teleconferencing services (secure as necessary).

Communications support also includes automated data processing equipment, automated office support systems, and information systems. Computer systems encompass general purpose, stand alone, data management, word processing, engineering, computer-aided drafting, and computer-aided manufacturing.

4.1.1.4 Airspace. Airspace must be managed and used in a manner that best serves the competing needs of commercial, general, and military aviation interests. The Federal Aviation Administration is responsible for the overall management of airspace and has established different airspace designations that are designed to protect aircraft during flights to or from an airport, transiting between airports, or operating within "special use" areas identified for defense-related purposes. Rules of flight and air traffic control procedures have been established to govern how aircraft must operate within each type of designated airspace. All aircraft operate under either instrument flight rules or visual flight rules.

The type and dimension of individual airspace areas established within a given region and their spatial and procedural relationship to one another are contingent upon the different aviation activities conducted in that region. When any significant change in airspace use is planned for a region, the Federal Aviation Administration will reassess the airspace configuration to determine if such changes will adversely affect (1) air traffic control systems and/or facilities, (2) movement of other air traffic in the area, or (3) airspace already designated and used for other purposes (i.e., military operating areas or restricted areas). Approximately 16,000 sorties were flown on the Tonopah Test Range by the DOE in Fiscal Year 1994. These sorties included employee transportation and activities associated with Defense and Work for Others Programs.

Airspace associated with the NTS and vicinity is shown on Figure 4-7. The NTS airspace is part of the NAFR Complex, which includes 4 restricted areas, the desert military operating areas/air traffic control assigned airspace, 2 low-altitude tactical navigation areas, 29 military training routes, and 3 air refueling routes. Greater detail of the airspace configuration is shown on Figure 4-8. Restricted area R-4808 is the airspace over the NTS. Airspace control over portions of the restricted areas and all desert military operating areas has been delegated to the Nellis Air Traffic Control Facility by the Federal Aviation Administration Air Route Traffic Control centers serving the surrounding airspace. The Nellis Air Traffic Control Facility controls the entry and exit of military aircraft in this airspace, while the Range Control Center monitors mission activities within this airspace. Because activities in restricted areas can be hazardous, nonparticipating aircraft are restricted from this airspace except when released by the controlling agency for joint use. The Nellis Air Traffic Control Facility may release and authorize use of R-4806 and R-4807 for nonparticipating aircraft when these areas are not required for defense-related activities. Restricted areas R-4808 and R-4809 are managed by the DOE and are never authorized for use by civilian aircraft.

The desert military operating areas comprise the eastern half and northern portion of the airspace associated with the NAFR Complex. The training conducted within the desert military operating areas consists of high-speed operations, including abrupt aircraft maneuvers and supersonic flight at or above 1,524 m (5,000 ft) above ground level. Within the military operating areas, military aircraft are exempted from the provisions of Federal Aviation Regulation 91.71, which normally restrict abrupt aircraft maneuvers or aerobatics within federal airways and control zones. The desert military operating areas are active during daylight hours Monday through Saturday and at other times by authorization.

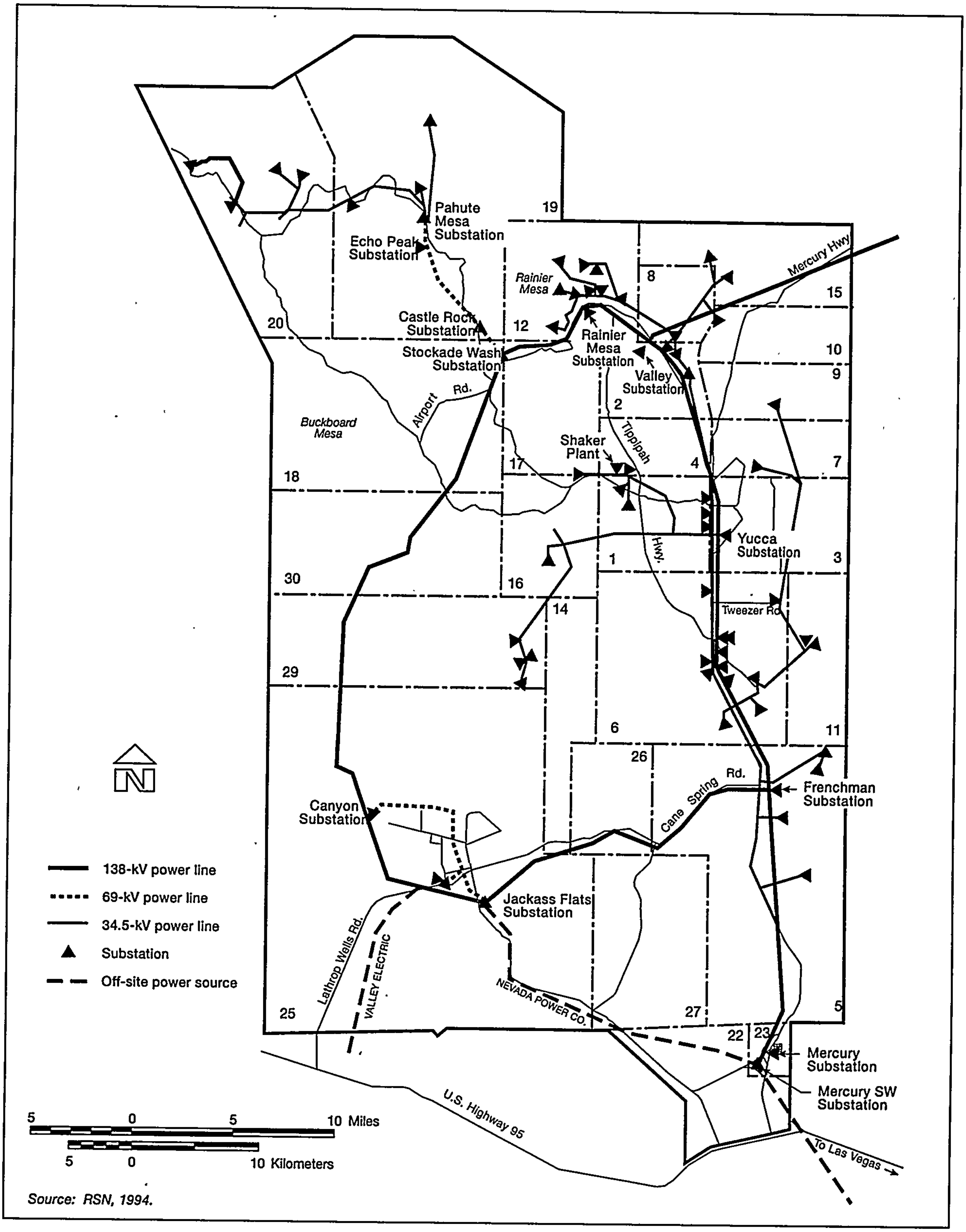


Figure 4-6. NTS sitewide power distribution.

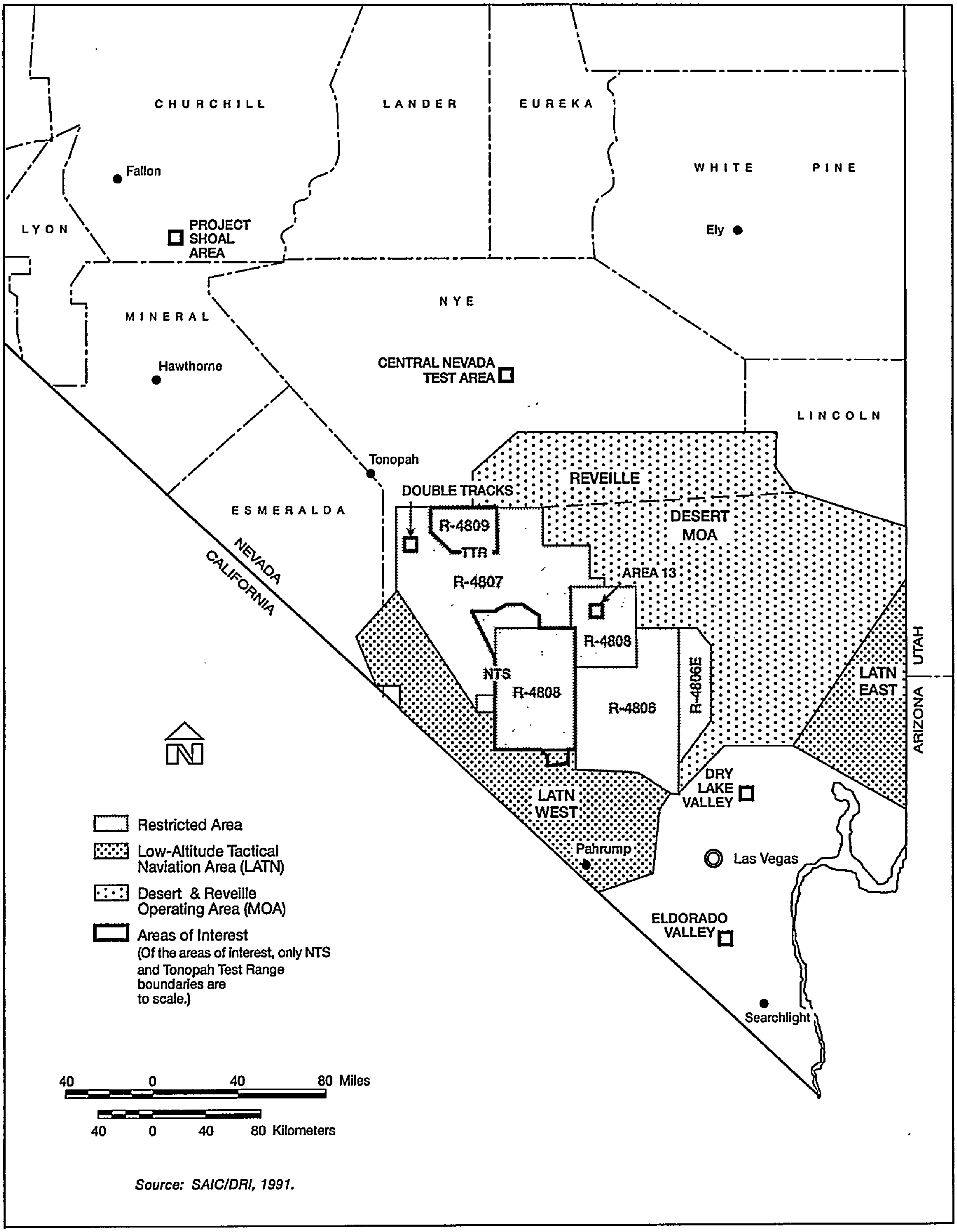


Figure 4-7. NTS and vicinity airspace

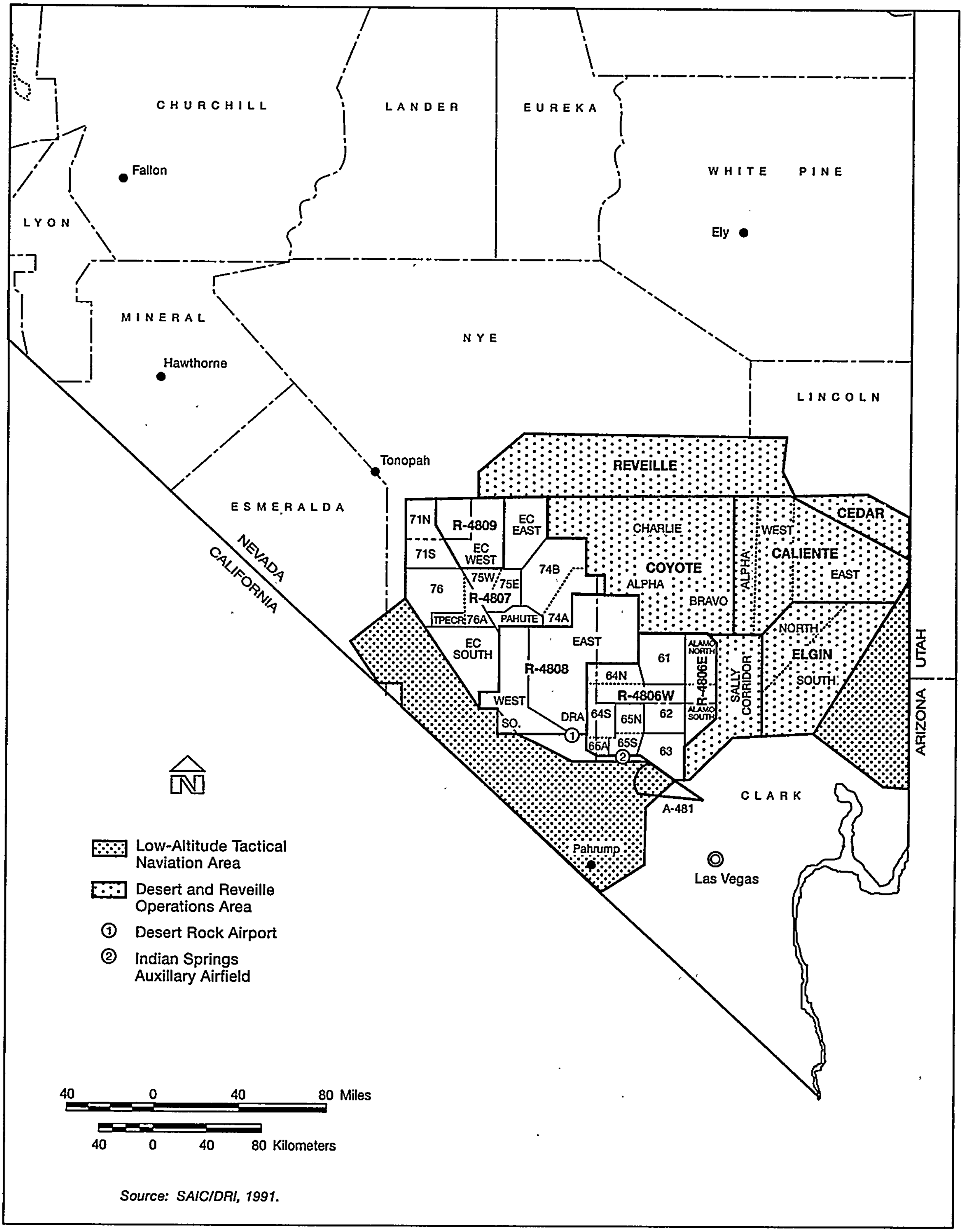


Figure 4-8. Detailed configuration of the NTS and vicinity airspace

Even though military aircraft are scheduled for flight activity within the military operating areas, civilian aircraft flying under visual flight rules can fly through the area. In addition, both military and civilian aircraft operating under instrument flight rules may be cleared through the military operating areas by Nellis Air Traffic Control Facility if in-flight separation can be provided.

The low-altitude tactical navigation areas are unrestricted airspace used intermittently by the military. These areas allow A-10 aircraft to practice random tactical navigation and formations between 30 m (100 ft) and 457 m (1,500 ft) above ground level at airspeeds at or below 250 knots (288 mi/hr).

These areas are normally used when no airspace is available for this type of training within the NAFR Complex.

The military training routes and air refueling routes are located within or at the boundaries of airspace associated with the NAFR Complex. Several of these military training routes overlap or are reversals of each other. Generally, military training routes are established below 3,048 m (10,000 ft) mean sea level for operations at speeds in excess of 250 knots (288 mi/hr). However, some military training route segments may be at higher altitudes because of terrain or climb and descent requirements. There are instrument-flight-rule military training routes and visual-flight-rule military training routes. The normal width of an instrument-flight-rule military training route from the centerline is 8 km (5 mi) and 8 to 16 km (5 to 10 mi) for visual-flight-rule military training routes, although some segments of these routes may be as narrow as 3 km (2 mi) and as wide as 32 km (20 mi). Figure 4-9 shows the complexity of military training routes.

There are several other types of designated airspace around the NAFR Complex/Las Vegas area. The following are brief descriptions of these types:

- Indian Springs Air Force Auxiliary Airfield Class D airspace encompasses a 8 km (5-statute mile) radius around the airfield from the surface to 914 m (3,000 ft) aboveground level within which aircraft are provided air traffic control service by the Indian Springs tower. The tower can advise civilian aircraft of military operations occurring at Indian Springs

- Desert Rock Airport is a controlled, but unmanned, airfield operated by the DOE, located southwest of Mercury along U.S. Highway 95 (Figure 4-8). Only periodic flights involving general-aviation single-engine to multi-engine jet aircraft occur at this airport

- Las Vegas Class B airspace encompasses Nellis Air Force Base and McCarran International Airport. All aircraft operating within the Class B airspace must be in contact with an air traffic control facility. In the northern portion of the Class B airspace, air traffic control is provided by the Nellis Approach Control. The southern portion is controlled by the Las Vegas Approach Control

- Alert Area 481 is a designated airspace extending from Nellis Air Force Base westward to advise civilian aviation of high-density military operation transiting between the base and the NAFR Complex. The alert area begins at 2,134 m (7,000 ft) mean sea level and extends to a ceiling of 5,791 m (19,000 ft) mean sea level.

The Nevada Airport System Plan (NDOT, 1995) indicates that in 1994 there were 824,570 civilian aircraft operations in Nevada. In 1994, there were 2,031 general aviation aircraft based at airports in Nevada, the locations of which are indicated in Figure 4-10.

Because of airspace restrictions associated with the NTS/NAFR Complex, commercial and general aviation aircraft must normally use routes of flight that remain clear of this range complex. With respect to commercial aviation (certificated air carrier operations), flight is generally conducted along an en route "highway" system defined by ground- or space-based radio navigational aids. In the NTS/NAFR Complex area, the federal airways (low altitude) (Figure 4-11) and jet route (high altitude) systems circumvent airspace used for defense-related purposes in a direct manner, or vertical separation is provided between military

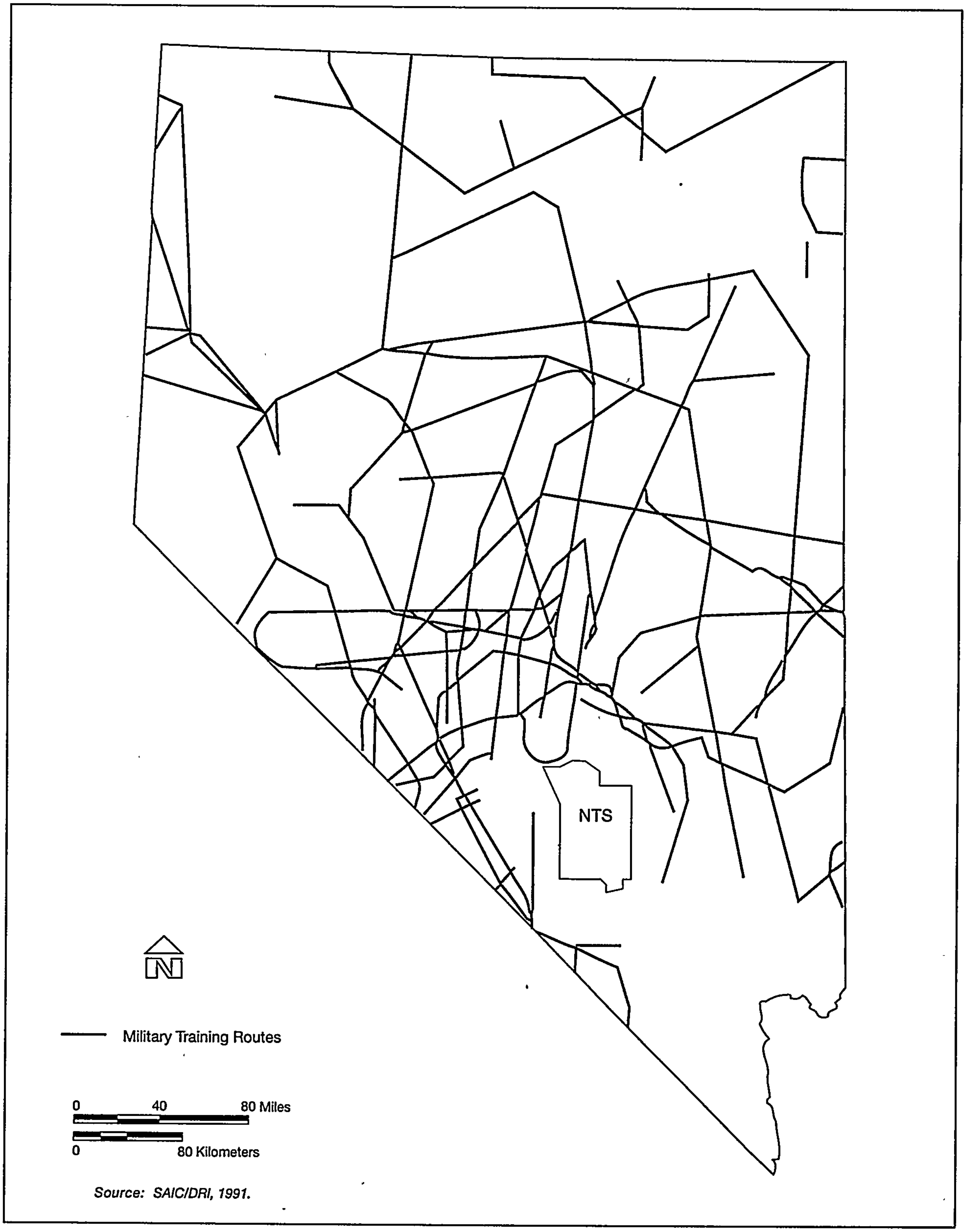
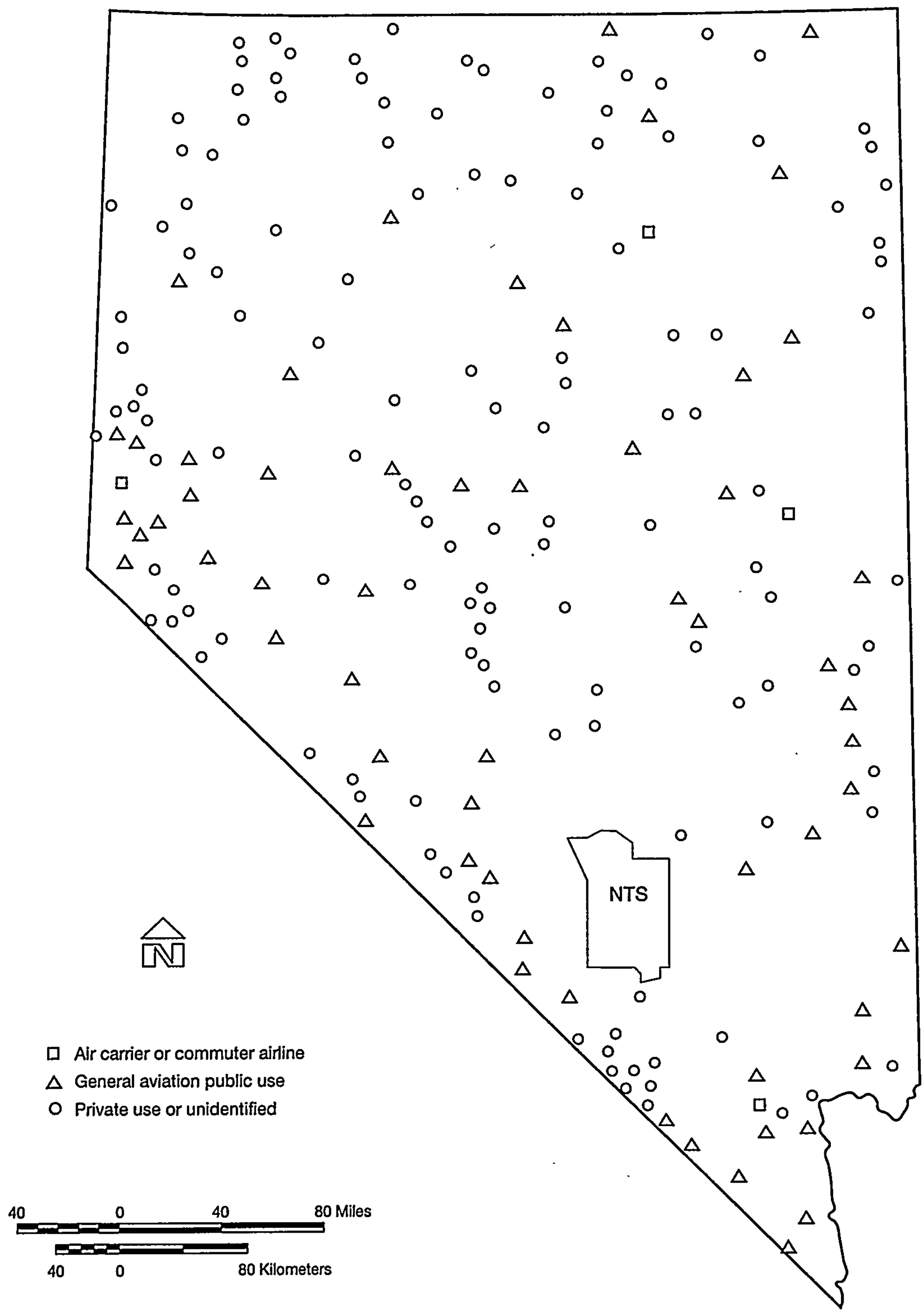


Figure 4-9. Military training routes in Nevada.



Source: SAIC/DRI, 1991.

Figure 4-10. Commercial, general, and private aviation airports and airfields in Nevada

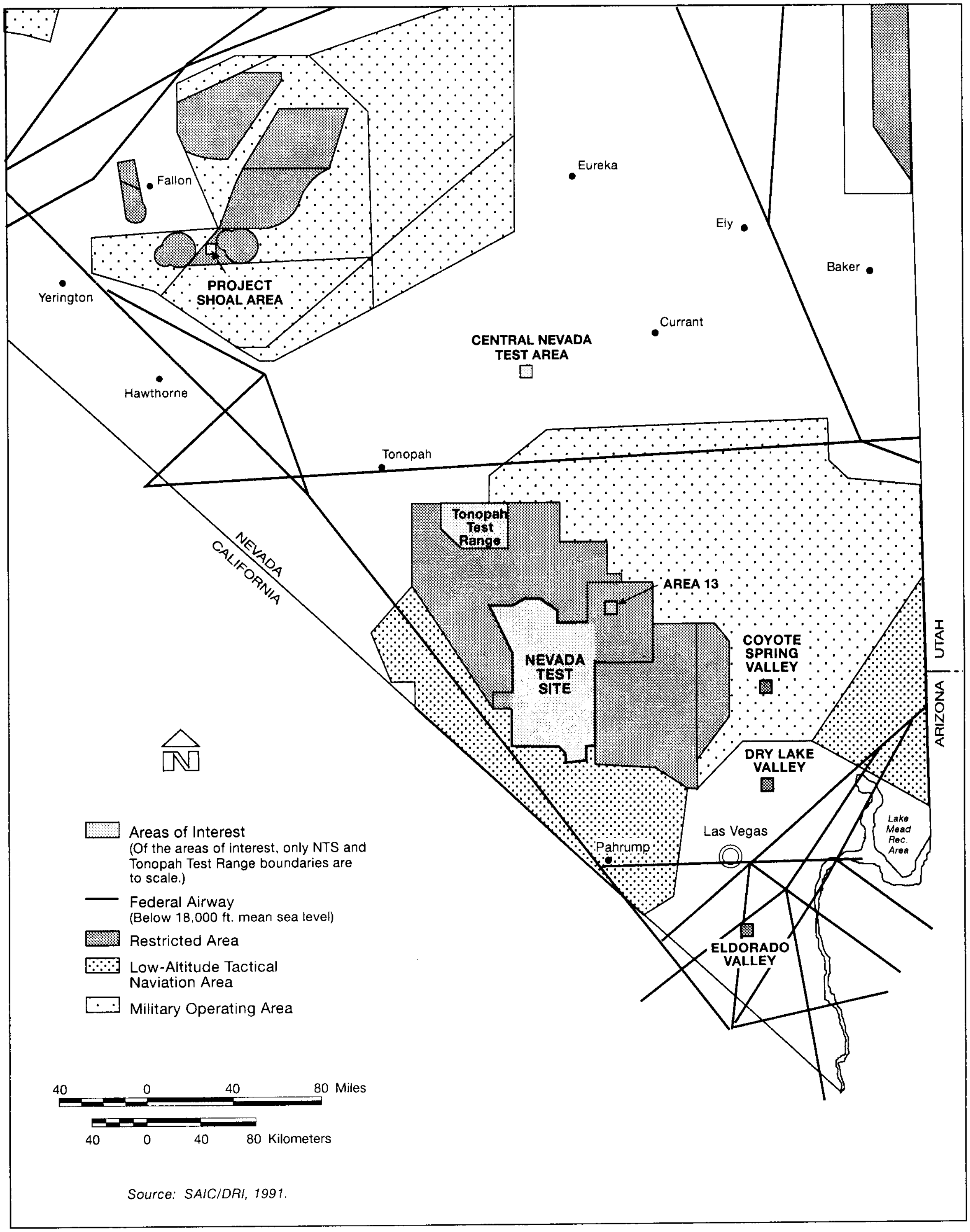


Figure 4-11. Federal low-altitude airways in southern Nevada

aircraft and the en route commercial traffic on these systems (Figure 4-12).

General aviation includes business or corporate air transportation and private, recreational, or training activities. General aviation aircraft operate within the framework of the en route airway system, as well as within the uncontrolled airspace outside the structured airway and terminal airspace. Recreational flying occurs on weekends when airspace is not normally used for defense-related training. However, occasional diversions around defense-related airspace that increase flying distance and fuel consumption may occur.

4.1.1.5 Waste Management Program. Waste Management Program activities include disposal, storage, treatment, closure operations and the activities of the Waste Minimization/Pollution Prevention Program. Each waste and operation type is discussed in this section; the waste Minimization/Pollution Prevention Program is discussed in Appendix C, Section C.6, and is summarized at the end of this section.

Wastes, such as nonhazardous, nonradioactive sanitary, and industrial wastes from the NTS programs are disposed of in several industrial landfills, sewage treatment systems, and septic tank systems located at the NTS. Five types of wastes are managed at the NTS: low-level waste, mixed wastes (transuranic and low-level), hazardous wastes, Toxic Substances Control Act wastes, and nonhazardous solid wastes.

The following sections summarize existing waste management operations by type: disposal, storage, treatment, and closure. Within the discussion of each type of operation, the different waste types managed and the locations of the facilities are identified. All of these wastes are managed in three types of management facilities: treatment facilities, storage facilities, and disposal facilities (Figure 4-13).

DISPOSAL OPERATIONS—In 1961, the Area 5 Radioactive Waste Management Site was established for the disposal of low-level waste from both on-site and off-site DOE generators. The developed area or unit within the Area 5 Radioactive Waste Management Site consists of 17 landfill cells (pits and trenches) and 13 greater confinement disposal boreholes. The operational mixed waste and low-level waste disposal cells within the Area 5 Radioactive Waste Management Site include the following:

- Pits for the disposal of on-site generated mixed waste and low-level waste
- Trenches for the disposal of low-level waste.

Approximately 500,000 Curies (Ci) of low-level waste have been disposed of in Area 5 pits and trenches. High-specific-activity wastes have been disposed of in greater confinement disposal units. Approximately 9.3×10^6 Ci of high-specific-activity waste, primarily tritium, have been disposed of in greater confinement disposal units in Area 5.

Historically (since the mid-1960s), the Area 3 Radioactive Waste Management Site was used primarily for the disposal of contaminated waste generated from the NTS Atmospheric Testing Debris Disposal Program, which involved the cleanup of atmospheric testing sites. Total volume of waste disposed of in Area 3 as of September 1994 was 3.0×10^5 m^3 (1.1×10^3 ft^3) and consists of tower assemblies, metal cable, miscellaneous metal scrap, and soil from the blading (scraping) of the first few inches of the site to remove the surficial radioactive contamination.

Approximately half of the radioactive waste disposed of in the Areas 3 and 5 Radioactive Waste Management Sites is atmospheric testing debris generated during the cleanup of the NTS aboveground nuclear detonation areas. The remainder of the waste was received from other DOE and defense-related facilities conducting environmental restoration activities, research and development projects, and nuclear weapons production. This waste was generally in the form of soil, construction rubble, compactible trash, glass, plastics, filters, and process residues. Today, Area 3 is used for the disposal of bulk and packaged low-level waste from on-site and off-site DOE generators.

Current waste management disposal cells at the Area 3 Radioactive Waste Management Site are

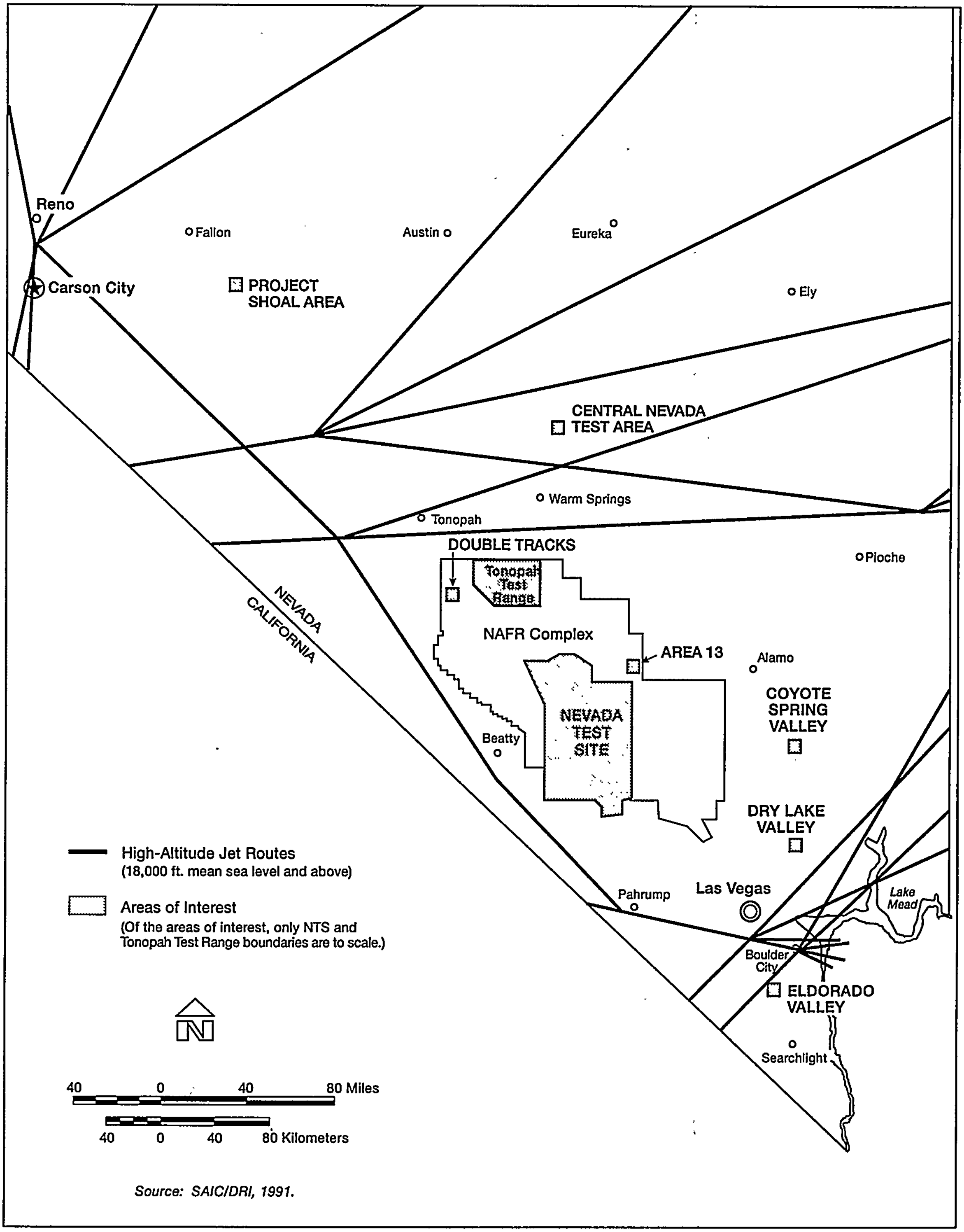


Figure 4-12. High-altitude jet routes in southern Nevada

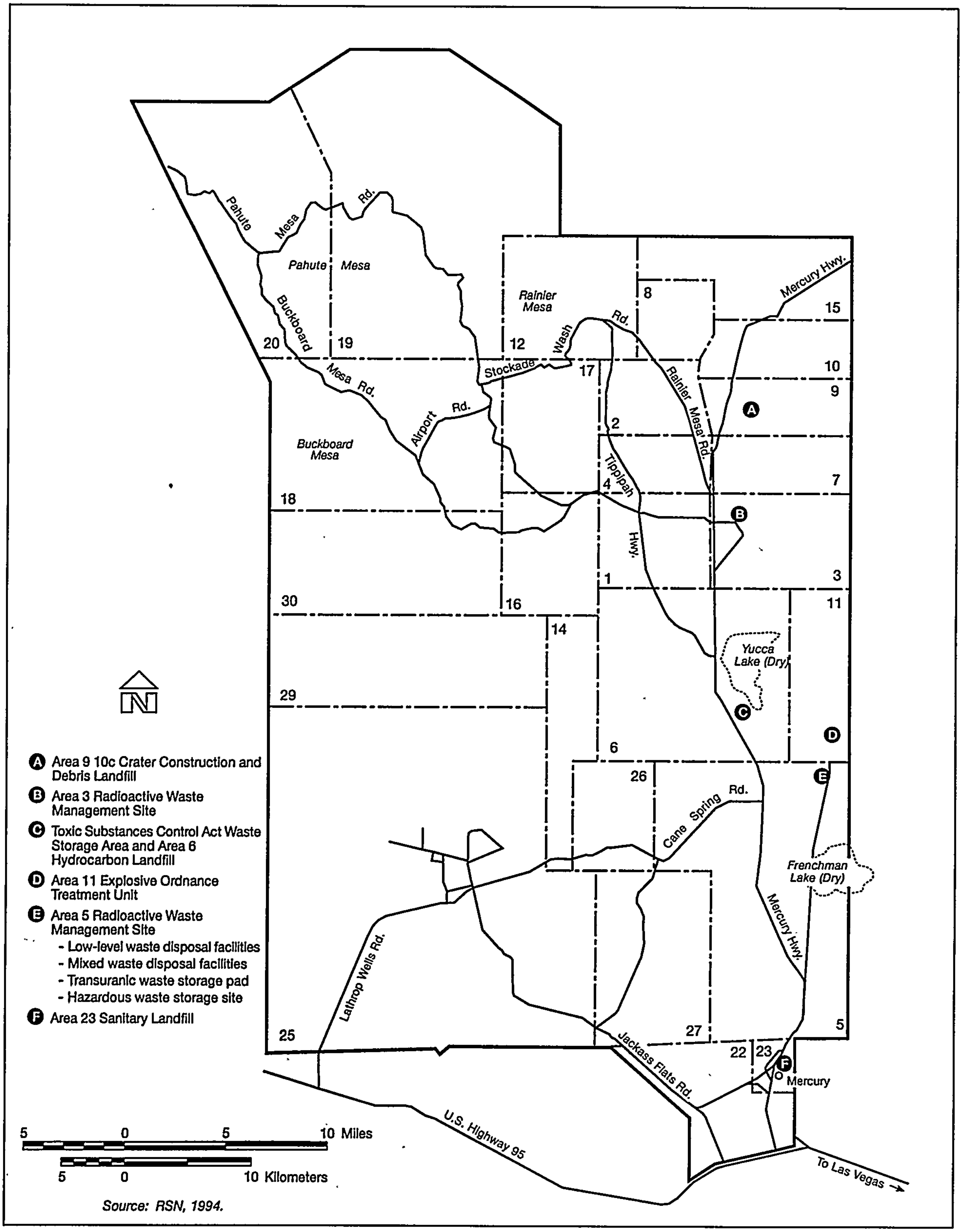


Figure 4-13. Existing treatment, storage, and disposal facilities on the NTS

comprised of four subsidence craters (U-3ax, U-3bl, U-3ah, and U-3at), with areas between craters excavated to make two oval-shaped landfill cells. Conventional landfill methods are used to dispose of waste in each cell; each layer of waste is covered with 1 m (3 ft) of fill before additional waste materials are disposed. The U-3ax/bl disposal cell contains mixed waste and low-level waste. It is inactive, temporarily covered, and awaiting closure. The U-3ah/at cell is currently being used for low-level waste disposal; mixed waste is not accepted. To date, approximately 1,250 Ci have been disposed of in the Area 3 subsidence craters. Three additional subsidence craters are reserved for low-level waste cells: U-3bh, U-3bg, and U-3az.

Several factors were considered in selecting subsidence craters for the disposal of waste. The degree of bulking, sometimes called compaction, that occurs during the collapse of the rubble chimney is an important consideration. Subsidence crater and cavity volumes were compared to establish the changes in the bulk density of the collapsed material. This was done to ensure that the resulting bulk density of the chimney rubble is equal to or greater than the density of the original, undisturbed geologic media. Such siting practices have ensured that additional compaction of the rubble below the waste management unit does not occur (Hawkins and Kunkle, 1996a).

The 13 greater confinement disposal boreholes contain mixed waste; low-level waste; waste similar to greater-than-Class C low-level waste; high-specific-activity low-level waste; and transuranic and transuranic mixed wastes. Limited quantities of transuranic waste were also disposed of in Trench 4C and in greater confinement units located in Area 5.

Since the 1980s, hazardous waste generated on the NTS has been shipped off site to commercial facilities. Receipt of transuranic waste for disposal at the NTS ceased in 1988; receipt of mixed waste for disposal from off-site generators ceased in 1990.

Low-level Waste—The NTS currently operates the Areas 3 and 5 Radioactive Waste Management Sites for the disposal of low-level waste from both the NTS and off-site defense generators. The Area 5 Radioactive Waste Management Site uses pits and trenches for shallow land burial of standard-packaged low-level waste. Included in the category of low-level waste is classified waste. Classified waste is low-level waste that is 'classified' because of the physical shape or specific composition of the material contained in the waste. Classification creates a need for the use of separate disposal units which are controlled with additional security measures. Area 3 uses subsidence craters generated during underground nuclear weapons testing for disposal of bulk low-level waste.

All waste coming to the NTS for disposal is subject to rigid waste acceptance criteria that mandate waste form, packaging, and certification. All generators are required to prepare a quality assurance program that ensures the NTS waste acceptance criteria are met; this program is audited by the DOE/NV for compliance. Only after all discrepancies are resolved does the generator receive permission to ship waste to the NTS. Once approved, generators are audited annually to ensure the continued adequacy of the program (DOE, 1992).

Mixed Waste—Pit 3, at the Area 5 Radioactive Waste Management Site, has Resource Conservation and Recovery Act interim status to accept mixed waste. Only NTS generators are currently allowed by the state of Nevada to dispose of waste in Pit 3, provided the mixed waste meets the requirements in the Resource Conservation and Recovery Act land disposal restrictions. No mixed waste has been certified or disposed of in Pit 3 in recent years, even though the capability exists.

The state of Nevada must approve the submitted Resource Conservation and Recovery Act Part B permit application for Mixed Waste Disposal Units prior to construction of the new units, which are intended for use as disposal units for off-site mixed waste primarily. The state of Nevada will defer review and comment on the application submitted until the completion of negotiations between all states and the DOE under the Federal Facility Compliance Act. Pit 3 at the Area 5 Radioactive Waste Management Site contains an inventory of 8,024 m^3 (283,372 ft^3) of mixed waste. Pit 3 currently has interim status under Resource Conservation and Recovery Act for disposal of mixed waste generated by the DOE/NV. The disposal cell U-3ax/bl at the Area 3 Radioactive Waste Management Site also contains mixed waste. However, unlike Pit 3 in Area 5, this cell is completely filled and is awaiting closure. There are other disposal cells that contain constituents that would be considered hazardous according to current standards. The disposal cells at the Area 3 and Area 5 Radioactive Waste Management Sites will be closed with a Resource Conservation and Recovery Act-compliant closure cap, if required.

Nonhazardous Solid Waste—Currently, three nonhazardous solid waste landfills are being used for the disposal of solid waste at the NTS. The landfills are located in Areas 6, 9, and 23. The Area 6 landfill is a Class III landfill that accepts hydrocarbon-burdened soil and debris. The Area 9 and Area 23 landfills are currently considered Class II landfills because they each accept less than 20 tons per day of solid waste for disposal.

The Area 9 landfill is located in Crater U-10c. This landfill is an open, circular pit with steep, almost vertical sides which was formed from an underground nuclear test. The current capacity of the landfill is approximately 9.9×10^5 m^3 (3.5×10^7 million ft^3). Prior to the development in 1976 of Resource Conservation Recovery Act regulations governing the disposal of hazardous wastes, solid and liquid wastes were disposed of in the landfill. Since 1976, the Area 9 landfill has received construction and demolition waste, including paper, cardboard, vehicle parts, glass, concrete, gypsum board, nonsalvageable scrap metal and wood, and other materials. As a Class II landfill, the Area 9 landfill was allowed to receive all types of nonhazardous solid waste, excluding radioactive waste, free liquids, and asbestos. The Area 9 landfill receives an estimated 6,800 tons of solid wastes annually.

The Area 23 landfill is an open, rectangular pit with steep, nearly vertical sides. The current capacity of this landfill is approximately 4.5×10^5 m^3 (1.6×10^7 ft^3). The Area 23 landfill receives all types of nonhazardous solid waste. Nonpathogenic hospital waste, dead animals, and asbestos-containing materials are buried in separate cells that are identified by concrete markers. The Area 23 landfill receives approximately 830 tons of solid waste annually.

Although both landfills are currently classified as Class II landfills, changes in State regulatory requirements will cause the Area 9 landfill to undergo partial closure and reopen as a Class III construction and demolition landfill. The Area 23 landfill will remain in operation as a Class II landfill, but will be modified to comply with new State regulations. The modifications to both landfills and the associated potential impacts to the environment are presented in *Environmental Assessment for Solid Waste Disposal* (DOE, 1995a).

WASTE STORAGE OPERATIONS—Waste storage operations are discussed under separate subheadings for transuranic and transuranic mixed waste, mixed waste, low-level waste, hazardous waste, and polychlorinated biphenyl (PCB) waste.

Transuranic and Transuranic Mixed Waste—Currently, transuranic and transuranic mixed waste is stored on the Area 5 transuranic waste storage pad in accordance with a Settlement Agreement with the state of Nevada, signed June 23, 1992. Provisions of this agreement include permission to store transuranic mixed waste on the pad until the Waste Isolation Pilot Plant in New Mexico, or another DOE site, is available as a possible treatment, storage, or disposal destination. The agreement does not allow a volume increase for additional transuranic mixed waste to be received from outside of the state of Nevada. The agreement does not pertain to transuranic waste without hazardous components. A facility is planned to allow the DOE to characterize and certify that the existing transuranic waste meets the Waste Isolation Pilot Plant waste acceptance criteria and to prepare it for shipment to the Waste Isolation Pilot Plant. Facilities for staging and loading the transuranic waste into special containers will be in place. Some DOE/NV Environmental Restoration Program projects might generate a limited amount of transuranic waste; such waste will be stored on the pad and certified before it is transported to the Waste Isolation Pilot Plant.

Mixed Waste—Mixed waste is currently accepted for storage at the Area 5 transuranic waste storage pad under a Mutual Consent Agreement between the state of Nevada and the DOE that allows storage of incidental mixed waste discovered or generated during NTS cleanup activities. In accordance with this agreement, the DOE submitted a Resource Conservation and Recovery Act Part B permit application to the State in January 1995 for the construction of a Mixed Waste Storage Unit. Final disposition of this mixed waste is subject to the agreements reached between the DOE and the State under the Federal Facility Compliance Act. These agreements will cover the location and development of new facilities, the use of mobile units, and the transportation of mixed waste to specified facilities.

Low-level Waste—The NTS has a formal storage facility for NTS-generated low-level waste. This facility is located in Area 6 in the vicinity of the Decontamination Shop. The NTS-generated low-level waste is stored at this facility while characterization and certification activities are being completed prior to disposal at the Areas 3 or 5 Radioactive Waste Management Sites.

Hazardous Waste—The Resource Conservation and Recovery Act Part B permit for the Hazardous Waste Storage Unit does not allow for storage longer than one year. Therefore, the inventory of hazardous waste is stored for less than one year prior to shipment to an off-site permitted treatment or disposal facility.

PCB Waste—PCB waste disposal is regulated as hazardous by the state of Nevada. All other PCB activities are regulated under the Toxic Substances Control Act. This waste is accumulated and stored for up to nine months in the Area 6 Toxic Substances Control Act waste accumulation unit. This unit accepts only PCB and PCB-contaminated waste generated at the NTS. Accumulated PCB waste is shipped off site to a commercial Toxic Substance Control Act-permitted treatment, storage, and disposal facility.

WASTE TREATMENT OPERATIONS—Waste treatment operations are discussed under separate subheadings for low-level, mixed waste, and hazardous waste.

Low-level Waste—Currently, no radioactive waste treatment operations occur at the NTS.

Mixed Waste—Currently, no mixed waste treatment operations occur at the NTS.

Hazardous Waste—Currently, only the Explosive Ordnance Disposal Unit treats hazardous waste at the NTS. Operating under a Resource Conservation and Recovery Act Part B permit, the Explosive Ordnance Disposal Unit is capable of treatment by detonation of waste explosives, including damaged or expired conventional explosives. No other types of hazardous waste are treated at the unit.

CLOSURE OPERATIONS—The DOE/NV is developing a site-specific design for closure for the Area 5 Radioactive Waste Management Site that will take into consideration the climate, geology, surface water and regional hydrology, and waste forms. This project, part of the Integrated Closure Program, will investigate the optimum design for successful closure integrity in the arid NTS environment. Closure of the Area 5 Radioactive Waste Management Site will not occur until after the end of the active life of this area, beyond the year 2005. A number of alternatives are being considered, from one large closure cap for the entire Area 5 Radioactive Waste Management Site to caps for individual waste units. Closure performance standards include minimum maintenance requirements, provisions for protection of human health and the environment, provisions for minimizing or eliminating contaminant release, and complying with applicable regulations and DOE orders. The Area 3 low-level waste disposal cell, U-3ax/bl, will be closed under Resource Conservation and Recovery Act requirements because of the presence of hazardous waste components disposed of before the Resource Conservation and Recovery Act was implemented.

WASTE MINIMIZATION/POLLUTION PREVENTION PROGRAM—The DOE is committed to preventing pollution and reducing waste generation at the NTS. This is accomplished through establishing partnerships with private industry, and complying with federal, state, and local regulations. The elements of the DOE/NV Waste Minimization/Pollution Prevention Program addresses reporting requirements, compliance costs, reduction costs, employee concerns, environmental liability, training, and the reduction, recycle, and reuse of commodities. Appendix C.6 provides a description of the DOE/NV Waste Minimization/ Pollution Prevention Program.

4.1.2 Transportation

The following sections address baseline transportation activities with respect to on-site traffic, off-site traffic, transportation of materials and wastes, and other transportation. Figure 4-14 illustrates the NTS transportation system.

4.1.2.1 On-Site Traffic. The main access to the NTS is the Mercury Highway, which originates at U.S. Highway 95, 105 km (65 mi) northwest of Las Vegas, Nevada, and accesses the main gate in Mercury. Eight kilometers (5 mi) to the west of Mercury is another entrance, which is a turnoff to Jackass Flats Road; however, this entrance is presently barricaded. The NTS has a restricted access into Area 25 from U.S. Highway 95 at Lathrop Wells Road, approximately 32 km (20 mi) west of Mercury. A fourth entrance, seldom used, is located in the northeast corner of the NTS and can be reached from State Route 375. Other existing roadways, although unpaved, could provide entrance or exit routes in case of an emergency. Access to the NTS is restricted, and guard stations are located at all entrances, as well as throughout the site.

The 1,127-km (700-mi) road network consists of 644 km (400 mi) of paved primary roads and 482 km (300 mi) of unpaved secondary roads. Most paved roadways are two-way and two-lane with 89 km per hour (kph) (55 mi per hour [mph]) speed limits unless posted otherwise. The speed limit in developed areas is 32 kph (20 mph). The maximum speed limit on dirt roads is 56 kph (35 mph). In addition, the NTS contains numerous event-related unpaved roads that are not maintained after a test has been conducted. Traffic flow and control throughout the NTS is maintained by conventional stop and yield signs at major intersections. Traffic regulations are enforced by the Nye County Sheriff's Department.

SOUTHERN ROAD NETWORK—The primary paved roads in the southern part of the NTS include Mercury Highway, Jackass Flats Road, Cane Spring Road, and Lathrop Wells Road (Figure 4-14).

Mercury Highway is the primary route from the interchange at U.S. Highway 95. Most of this road is 8 m (26 ft) wide; however, the shoulders vary from 1 to 2 m (4 to 6 ft) wide. Traffic consists of light- and heavy-duty trucks and cars, security vehicles, and emergency vehicles. The Mercury bypass is a well-constructed road and runs from just north of Gate 100, the main entrance to the NTS. This 8-m (26-ft)-wide road was built to enable rerouting of all traffic with a forward area destination.

Jackass Flats Road from Mercury to the Area 25 support area is a hot-mix asphalt road, which is in fair condition. Currently, some repair work is needed to meet current standards. The road system in Area 25 is made up of 7-m (22-ft)-wide roadways with 5-centimeter (cm) (2-in.) hot-mix asphalt surfaces. This roadway provides the principal access to the Area 25 support region. The Lathrop Wells Road provides access to Area 25 and the southwestern NTS from U.S. Highway 95. This plant-mix, oil-and-chip road with no shoulders extends to Guard Station 500 (east of the Area 25 support region) where it becomes Cane Spring Road. Cane Spring Road extends east to Mercury Highway, where it terminates. Cane Spring Road is also an oil-and-chip road, except for an asphalt-overlaid section 3 km (2 mi) west of Mercury Highway.

Vehicles delivering waste shipments to Area 5 use Road 5-01, which was not constructed to withstand the current or proposed Radioactive Waste Management Site traffic load. Road 5-01 branches off Mercury Highway approximately 8 km (5 mi) north of Mercury. It is the main access into Frenchman Flat where the Spill Test Facility, the Hazardous Waste Storage Unit, and the Radioactive Waste Management Site are located. Road 5-01 was constructed in 1965 to access the Defense Nuclear Agency weapons compound located northeast of the Area 5 Radioactive Waste Management Site. The road was built over the existing terrain without runoff drainage

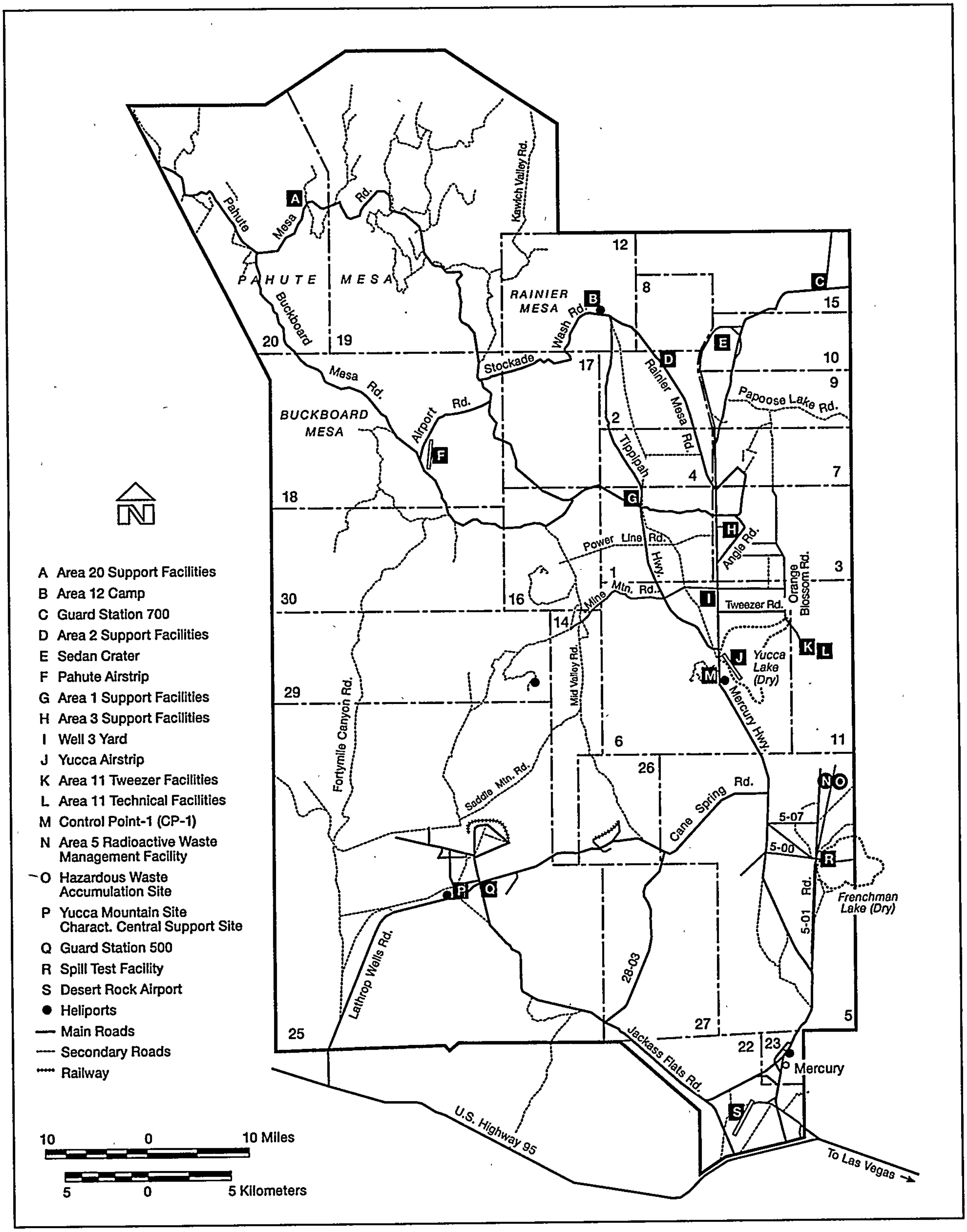


Figure 4-14. NTS transportation system

considerations and without formal design engineering. It is less than 6 m (20 ft) wide and has been used for five years beyond its expected 25-year service life. Road 5-07 provides a secondary access to this area, which is 8 km (5 mi) south of Control Point-1.

A new road will be constructed to provide access for waste shipments to the Area 5 Radioactive Waste Management Site. A new route from the Mercury Highway to the Radioactive Waste Management Site will be provided. The 5.0-km (3.1-mi) new roadway will be constructed by extending Cane Spring Road east from Mercury Highway to intersect with Road 5-01, 0.3 km (0.2 mi) south of the existing Radioactive Waste Management Site. In addition, improvements will be made to the Road 5-01 from this intersection into the Radioactive Waste Management Site.

Although Road 28-03 is a low-traffic road, it is adequately maintained because Area 27 is a high-security area. Tweezer, Angle, and Orange Blossom Roads are narrow, secondary, oil-and-chip roads with no shoulders. These roads require periodic maintenance. Orange Blossom Road has been abandoned, and signs have been posted warning drivers to use at their own risk.

Paved, local traffic streets in Mercury are approximately 6 m (18 ft) wide, which is sufficient for the current traffic loads. However, streets do not have curbs or gutters, and surface drainage is carried in ditches parallel with streets. Traffic flow through the numerous intersections in Mercury is controlled by the use of stop signs and yield signs. There is no real pathway system; pedestrians walk along the side of the roads or through open areas.

The remainder of the roadway network is composed of graded gravel roads and jeep trails. Gravel roads to event sites are maintained as requirements dictate. Gravel roads that remain in good condition include Mine Mountain and Mid-Valley/Saddle Mountain Roads.

<u>NORTHERN ROAD NETWORK</u>—The primary paved roads in the northern part of the NTS are Mercury Highway, Pahute Mesa Road, Buckboard Mesa Road, and Tippipah Highway. Other roads providing access to the northern areas are Rainier Mesa Road, Stockade Wash Road, and Circle Road. Pahute Mesa Road from Yucca Flat weapons test basin to the Area 20 camp is a typical hot-mix paved road. At the higher elevations, the road is winding and crosses rugged terrain, which is extremely hazardous under winter conditions. Chains or snow tires are essential when these conditions prevail. From the Area 20 camp to the intersection of Buckboard Mesa Road, Pahute Mesa Road consists of graded gravel.

Tippipah Highway extends from the Area 12 camp on Rainier Mesa Road south to Mercury Highway in Area 6. It is an adequately drained, all-weather highway that bypasses areas where testing has damaged Mercury Highway. This 8-m (26-ft)-wide road has 2.5-m (8-ft) compacted shoulders and was constructed with 7.5-cm (3-in.) hot-mix asphalt over a 30.5-cm (12-in.) base.

Rainier Mesa Road, which provides access to the Area 12 camp from Mercury Highway, was one of the first gravel roads on the NTS. Currently, this narrow oil-and-chip road with no shoulders requires minimum maintenance.

In the Yucca Flat weapons test basin, the segment of Mercury Highway from the intersection with Rainier Mesa Road north to Sedan Crater is not passable for normal traffic because of damage from numerous local underground nuclear weapons events. Although there are many detours and bypasses from Sedan Crater to Guard Station 700, the 6-m (20-ft)-wide road is in good condition.

Stockade Wash Road from Area 12 camp to Pahute Mesa Road is a hot-mix asphalt road in good condition; however, the mountain pass section through Eleana Ridge is weathered and requires maintenance.

Buckboard Mesa Road from Road 18-03 north to Pahute Mesa Road is a relatively new 18-km (11-mi)-long paved road that provides convenient access to the mesa testing areas.

Orange Road, which was constructed during the early development of the NTS, was abandoned in favor of the Tippipah Highway. Because this road has not been maintained for a number of years, most of the paving has deteriorated.

NTS VEHICLES AND TRANSPORTATION SERVICES—The Maintenance and Operations contractor for the NTS maintains and repairs the fleet of 2,342 government-owned vehicles at the NTS. Vehicles include sedans, station wagons, ambulances, and light- and heavy-duty trucks. The vehicle fleet reached a peak of 3,370 vehicles in 1988. The total mileage of the fleet in 1994 was 2.5 x 10^7 km (1.6 x 10^7 mi). The peak mileage for the fleet was 4.9 x 10^7 km (3.1 x 10^7 mi) in 1985. Regular and compact pickup trucks, compact sedans, and 3/4-ton four-wheel drive trucks accumulated most of the mileage (Stowell, 1995).

Commuter buses provide daily passenger service to the NTS from Las Vegas and Pahrump by way of U.S. Highway 95. The number of buses entering the NTS varies daily, depending on the on-site activities in progress. Currently, there are 54 buses serving Las Vegas, and 5 buses serving Pahrump. The commuter bus service provides dedicated routes to the forward areas, and paved parking areas for the buses are located at the support facilities within Areas 6, 23 (Mercury), and 25. Limited bus parking is also available at other support facilities on the NTS. Parking for government and private commuter vehicles is available at most buildings on the NTS (Thomas, 1995).

4.1.2.2 Off-Site Traffic. Background traffic on key roads in the vicinity of the NTS has experienced rapid growth in the last ten years. This growth varied widely by location. An average annual growth ranging from 6 to 12 percent was experienced on Interstate 15, a 4- to 7-percent increase on Interstate 80, a 2- to 5-percent increase on U.S. Highway 95, a 4- to 7-percent increase on U.S. Highway 93, and less than 2 percent elsewhere on rural highways. While background traffic has increased in Nevada, traffic volumes at the Mercury interchange have decreased by approximately 2 percent per year during the last ten years because of reductions in the NTS workforce.

The region of influence for the transportation analysis includes principal road, air, and rail networks leading to the NTS, with emphasis on the immediate area surrounding the site. In the region of influence, continuous traffic counts available from automatic traffic recorders show seasonal peaks in traffic demand (i.e., highest volumes occur in August and September). Recreational routes, such as Interstate 15 to Las Vegas and Interstate 80 to Reno, Nevada, also experience weekend peaks. Daily morning and late afternoon peaks are apparent on all routes; however, the late afternoon peak is generally more intense than the morning peak.

Traffic volumes on a roadway vary; that is, during any particular hour, traffic volume may be greater in one direction than in the other. In the region of influence, for example, data show as much as a 2:1 imbalance on rural routes, but almost a 1:1 split on urban routes.

The potential for congestion and other problems of a roadway segment is generally expressed in terms of level of service. The level of service scale ranges from A to F, with each level defined by a range of volume-to-capacity ratios. Level of service A, B, and C are considered good operating conditions where minor or tolerable delays are experienced by motorists. Level of service D represents below average conditions. Level of service E corresponds to the maximum capacity of the roadway. Level of service F represents a jammed situation. The level of service designations and their associated volume-to-capacity ratios are presented in Table 4-5. These levels are based primarily on the *Highway Capacity Manual Special Report 209* (Transportation Research Board, 1994) and are adapted for local conditions.

The region surrounding the NTS is served by a network of interstate, U.S. and state highways and city streets. Figure 4-15 shows the general local road network now in place in the immediate vicinity of the NTS. For the purpose of this analysis, key roads are identified as those roads providing access to the site and most frequented by personnel, visitors, construction workers, vehicles carrying materials for construction, and radioactive waste delivery trucks. Key roads in the immediate vicinity of the site include Interstate 15; U.S. Highways 6, 93, and 95; and Nevada State Route 375. In addition, Interstate 80 and U.S. Highways 40 and 50 provide regional access to the site from the

Table 4-5. Road transportation levels of service

LOS[a]	Description	Criteria (Volume-to-Capacity) Freeway[b]	Multilane Highway[c]	2-Lane Highway[d]
A	Free flow with users unaffected by presence of other users of roadway.	0-0.35	0-0.33	0-0.12
B	Stable flow, but presence of users in traffic stream becomes noticeable.	0.36-0.54	0.34-0.50	0.13-0.24
C	Stable flow, but operation of single users becomes affected by interactions with others in traffic stream.	0.55-0.77	0.51-0.65	0.25-0.39
D	High density but stable flow; speed and freedom of movement are severely restricted; poor level of comfort and convenience.	0.78-0.93	0.66-0.80	0.40-0.62
E	Unstable flow; operating conditions at capacity with reduced speeds, maneuvering difficulty, and extremely poor levels of comfort and convenience.	0.94-1.00	0.81-1.00	0.63-1.00
F	Forced or breakdown flow, with traffic demand exceeding capacity; unstable stop-and-go traffic.	>1.00	>1.00	>1.00

[a] Level of service
[b] Level of service for basic freeway sections, 113 kph (70 mph)
[c] Level of service for multilane highway, 97 kph (60 mph) design speed
[d] Level terrain, 20-percent no passing zones, design speed 97 kph (60 mph) or greater; also applicable to three-lane highways.

Source: Transportation Research Board, 1994.

northeast and south, respectively. The following paragraphs describe these major roadways.

Interstate 15 is the major regional access to the site. It runs north-south, connects San Diego, California, to Salt Lake City, Utah, and extends north to the Canadian border. Interstate 15 is generally a four-lane divided highway constructed to full freeway standards with full control of access. Within the Las Vegas metropolitan area, Interstate 15 becomes a six-lane freeway. Interstate 80 and U.S. Highway 50 are both major east-west freeways. They are generally four-lane highways with full control of access. U.S. Highway 40 is also an east-west freeway that does not intersect Nevada.

U.S. Highway 95 is a major north-south roadway extending south to the Mexican border and north to the Canadian border. U.S. Highway 95 is by far the most frequented direct access to the NTS and is used by over 95 percent of the employees working on site. It is the closest and most direct route to the site for hauling materials and waste, whether hauled directly by trucks or by rail. It is a four-lane roadway between Las Vegas and the Mercury interchange and within Las Vegas, and a two-lane rural highway beyond the Mercury interchange to the north. U.S. Highway 93 is a major north-south roadway across Nevada. It extends from Las Vegas to the Canadian border, intersecting Interstate 80 near the town of Wells, Nevada. It is an all-weather, two-lane paved roadway. U.S. Highway 6 is an east-west roadway, located to the north of the NTS and the Tonopah Test Range, and links U.S. Highways 93 and 95. It is also an all-weather, two-lane paved roadway.

Nevada State Route 375 provides vehicular access to the NTS via a connecting road. It runs northwest along the northeastern boundaries of the site. This stretch of two-lane highway links U.S. Highways 6 and 93.

On March 23, 1993, there were 1,375 vehicles of all categories entering or leaving the NTS via Gate 100; this number was found to be representative of the annual average daily traffic. The morning peak hour of the site (as a generator) occurs generally between 5:30 a.m. and 7:30 a.m. Traffic counts were performed during the morning peak hour in March 1995. There were 232 vehicles entering the site via Gate 100 between 6:25 a.m.

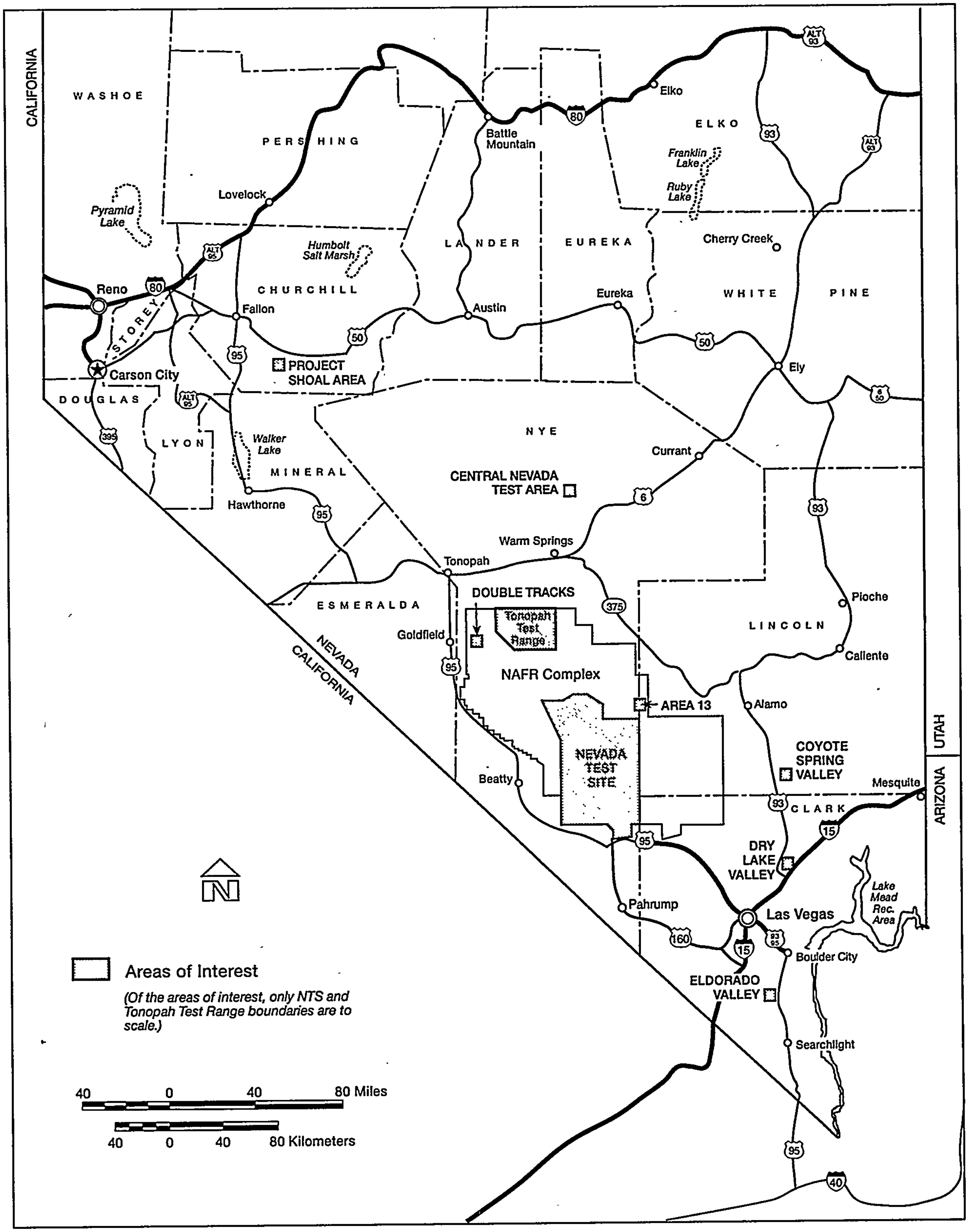


Figure 4-15. General local road network in southern Nevada

and 7:25 a.m. During the same time, there were only ten vehicles exiting the site. The 232 vehicles carried approximately 2,000 passengers (including drivers). The 232 total vehicles included 23 buses (10 percent), 152 one-person cars (66 percent), 47 two-person car pools (20 percent), 8 three-or-more-person car pools (3 percent), and only 2 trucks (less than 1 percent). Of all vehicles entering the site, 98 percent come from the east (Las Vegas area) and the remaining 2 percent from the west (Nye County) (Tetra Tech, Inc., 1995).

Volumes, peak-hour volumes, capacities, and the corresponding level of service on key regional and local roadways in the region of influence are shown in Table 4-6. Some segments of Interstates 15 and 80 and U.S. Highway 95 within the urban areas of Las Vegas and Reno, Nevada, already operate at level of service F because of heavy traffic volumes (recreational, local, and commuter traffic). U.S. Highway 93 at Hoover Dam operates at level of service F because of steep grades and sharp curves. Some segments of Interstate 15 and U.S. Highway 93 in Las Vegas operate at level of service D. All other key roads operate at level of service C or better due mainly to low traffic volumes.

The 1993 annual average daily traffic on key roads varied considerably in both space and time. Traffic volumes on Interstate 15 are highest within Las Vegas. As seen in Table 4-6, in 1993 there were 26,420 annual average daily traffic on Interstate 15 at the California/Nevada state line; 155,795 just north of the Sahara Avenue interchange (the maximum volume recorded on Interstate 15 within Nevada); 84,445 north of Washington Street; 33,770 north of Cheyenne Avenue; and only 11,530 at the Nevada/Utah state line. At the California/Nevada state line, August is the peak month of the year, representing 120 percent of the average month of the year, and Sunday is the peak day of the week, representing 140 percent of the average day of the week. Within Las Vegas, August remains the peak month, representing only 105 percent of the average month, and weekday volumes dominate rather than weekends.

The 1993 annual average daily traffic along Interstate 80 also varied considerably from a low of 5,000 in rural areas to a maximum of approximately 96,000 in urban areas. The highest volume is recorded in Reno, Nevada, at the U.S. Highway 395 junction, and the lowest recorded is at the Nevada/Utah state line. At the California/Nevada state line, August is the peak month, representing approximately 130 percent of the average month, and Saturdays and Sundays are the peak days of the week, representing 120 percent of the average day of the week. Within Reno and vicinity, August remains the peak month, representing only 109 percent of the average month, and weekday volumes dominate. In rural areas, August traffic is by far the highest, being 145 percent of the average month and having little daily variations (all days of the week handle the same amount of traffic).

The 1993 annual average daily traffic on U.S. Highway 95 shows a wide variation in traffic volumes between urban and rural sections. Within the urbanized area of Las Vegas, volumes varied between a low of 20,000 and a high of 145,580 recorded between Interstate 15 and Martin Luther King Boulevard. There were 116,675 vehicles at south Jones Boulevard. Elsewhere, the 1993 annual average daily traffic was well below 10,000.

At the Mercury interchange, the main access to the NTS, annual average daily traffic was 3,635 and 2,175, respectively, south and north of the interchange. West of the Mercury interchange and beyond, daily volumes decrease further to reach 1,720 north of Beatty, Nevada. There are little monthly variations in traffic volumes on this highway, although August remains the peak month with very little weekly variations.

In 1993, U.S. Highway 93 carried 1,160 annual average daily traffic just north of Nellis Air Force Base, and 1,210 farther north near Crystal Springs. In 1993, State Route 375 and U.S. Highway 6 in the vicinity of the site carried, in general, less than 500 annual average daily traffic.

4.1.2.3 Transportation of Materials and Waste. This section presents the types of materials and waste that are currently transported to and on the NTS. Refer to Chapter 2, Section 2.4.2 for definitions of the various waste types.

Table 4-6. Traffic volumes and level of service on key roads (Page 1of 2)

Roadway Segment	Two-Way[a] Capacity VPH[b]	1993 AADT[c]	1993 DDHV[d] One Direction	1993 Baseline LOS[e]
Regional				
I–15 at California/Nevada state line	6,800	26,420	2,403	D
I–15 north of Sahara Avenue interchange	10,200	155,795	6,050	F
I–15 north of the downtown expressway interchange	10,200	91,985	3,572	D
I–15 just north of the D Street and Washington Street interchange	10,200	84,445	3,280	C
I–15 north of the Cheyenne Avenue interchange	6,800	33,770	1,311	B
I–15 south of the Lamb Blvd. interchange	6,800	12,905	501	A
I–15 north of West Mesquite interchange (Nevada/Utah state line)	6,800	11,530	448	A
I–80 east of Apex interchange (California/Nevada state line)	6,800	22,825	1,568	B
I–80 west of the U.S. Hwy. 395 interchange (Reno)	6,800	95,955	4,423	F
I–80 west of the West Vista Blvd. interchange (east Reno)	6,800	26,445	1,219	B
I–80 east of Winnemucca interchange	6,800	6,495	408	A
I–80 east of U.S. 93 Hwy. interchange east of Wells	6,800	4,405	259	A
I–80 east of the West Wendover interchange (Nevada/Utah state line)	6,800	4,495	264	A
Local				
U.S. Hwy. 95 south of Jones Blvd. interchange	10,200	116,675	5,907	F
U.S. Hwy. 95 north of Sunset Road interchange (east Las Vegas)	6,800	41,770	2,092	C
Rancho Road, (SR[f] 599) east of the northern U.S. Hwy. 95/Rancho Road interchange	6,800	12,700	636	A
U.S. Hwy. 95 south of SR 157 north of Las Vegas	6,800	7,880	733	A
U.S. Hwy. 95 just east of Mercury interchange	6,800	3,635	338	A
U.S. Hwy. 95 interchange at Mercury				
Southbound off ramp	1,500	140	13	C
Southbound on ramp	1,500	560	52	C
Northbound off ramp	1,500	565	53	C
Northbound on ramp	1,500	145	13	C
Local				
SR 433, between U.S. Hwy. 95 and Mercury	2,000	1,375	128	B
U.S. Hwy. 95 3.8 miles north of Mercury interchange	2,000	2,715	253	C
U.S. Hwy. 95 from Amargosa Valley to Beatty	2,000	615	57	A
U.S. Hwy. 95 north of Beatty	2,000	1,720	160	B

Table 4-6. Traffic volumes and level of service on key roads (Page 2of 2)

Roadway Segment	Two-Way[a] Capacity VPH[b]	1993 AADT[c]	1993 DDHV[d] One Direction	1993 Baseline LOS[e]
U.S. Hwy. 93 south of the Nevada/Arizona state line (Hoover Dam)	1,500	747	695	F
U.S. Hwy. 93 east of Westbound off ramp of Railroad Pass interchange	6,800	24,605	2,289	D
U.S. Hwy. 93 north of I–15/U.S. Hwy. 93 interchange	2,000	1,160	108	A
U.S. Hwy. 93 south of SR 375 Junction near Crystal Springs	2,000	1,210	113	B
U.S.Hwy. 93 west of SR 375 Junction near Crystal Springs	2,000	440	41	A
SR 375 west of U.S. 93 Junction at Crystal Springs	1,500	195	29	A
SR 375 east of Warm Springs	1,500	85	13	A
U.S. Hwy. 6 east of Warm Springs at SR 375 Junction	1,700	145	15	A
U.S. Hwy. 6 west of Warm Springs at SR 375 Junction	1,700	210	20	A
U.S. Hwy. 6 east of Tonopah west of SR 376 Junction	1,700	1,095	105	B

[a] Based on 1985 Highway Capacity Manual
[b] Vehicles per hour
[c] Annual average daily traffic
[d] This is the directional design hourly volume per the 1985 Highway Capacity Manual. It considers the 30th peak hour of the year and the peaking and directional characteristics on various segments as supplied by the Nevada Department of Transportation, Annual Traffic Report 1993a. For two-lane highways, directional factors are applied, in general, a 70/30 split
[e] Level of service
[f] SR=State Route.

Source: NDOT, 1993a.

TRANSURANIC WASTE—The NTS expects no additional transuranic or transuranic mixed wastes to be transported to the NTS from off-site generators. It is expected that approximately 204,663 kg (451,201 lb), having a total volume of 612 m^3 (800 yd^3), of transuranic waste currently stored at the NTS would eventually be transported to the Waste Isolation Pilot Plant for disposal (DOE/NV, 1994a).

MIXED WASTE—On-site transportation of mixed waste to the Area 5 Radioactive Waste Management Site is anticipated because it will likely be generated during environmental restoration and decontamination projects at the NTS. Off-site transportation of mixed waste from the NTS is not anticipated.

LOW-LEVEL WASTE—Low-level waste may be generated during normal NTS operations. It is packaged and transported to one of two low-level waste disposal facilities in operation at the NTS: the Area 5 Radioactive Waste Management Site or the Area 3 Radioactive Waste Management Site (DOE/NV, 1992a). Low-level waste from other DOE facilities is transported to both sites for disposal. In addition, the DOE/NV accepts classified low-level waste from DoD facilities if DOE Headquarters has designated the activity to ship waste to the NTS. The total low-level waste transported to the Area 5 Radioactive Waste Management Site during 1961 to 1991 was 3.96×10^5 m^3 (1.4×10^7 ft^3). During Fiscal Year 1993, approximately 1.9×10^4 m^3 (6.71×10^5 ft^3) of low-level waste was transported from on-site and off-site generators to the NTS (DOE/NV, 1994a). As of August 10, 1995, the following generators are approved to ship low-level waste to the NTS for disposal:

- Aberdeen Proving Grounds, Aberdeen, Maryland (temporary suspension)
- Allied-Signal, Kansas City Plant, Kansas City, Missouri
- Ann Arbor Inertial Confinement Fusion Facility, Ann Arbor, Michigan
- Fernald Environmental Management Project, Cincinnati, Ohio
- General Atomics, San Diego, California
- Inhalation Toxicology Research Institute, Albuquerque, New Mexico
- Lawrence Livermore National Laboratory, Livermore, California, including Site 300
- Mound Plant, Miamisburg, Ohio
- Pantex Plant, Amarillo, Texas
- Bechtel Nevada Corporation (formerly Reynolds Electrical and Engineering Co., Inc.), NTS, Nevada (on site)
- Rocky Flats Plant, Golden, Colorado
- Reactive Metals Inc., Extrusion Plant, Ashtabula, Ohio
- Rockwell-Rocketdyne, Canoga Park, California
- Sandia National Laboratories, Livermore, California
- Sandia National Laboratories, Albuquerque, New Mexico.

The following generators are awaiting approval pending DOE Headquarters's concurrence:

- Oak Ridge National Laboratory, Oak Ridge, Tennessee (Melton Valley Waste Stream)
- Pinellas Plant, Largo, Florida.

The following generators are in the process of applying for approval to dispose of waste at the NTS:

- Babcock & Wilcox, Lynchburg, Virginia
- Defense Nuclear Agency, Johnston Atoll
- Defense Nuclear Agency, NTS, Nevada

- General Atomics, San Diego, California (new production reactor waste)
- Grand Junction Project Office, Grand Junction, Colorado
- IT Corporation, Las Vegas, Nevada (Project Chariot)
- U.S. Army Armament, Munitions and Chemical Command, Rock Island, Illinois.

These three sets of waste generators—approved, pending, and in process—represent the majority of waste generators who have historically shipped waste to the NTS.

Off-site shipments of low-level waste are made by commercial motor carriers. Transportation of low-level waste is performed in compliance with the packaging, loading, and driver training requirements of the U.S. Department of Transportation, the Nuclear Regulatory Commission, and the Nuclear Regulatory Commission Agreement State Regulation, and is subject to additional oversight by the DOE.

HAZARDOUS WASTE—Hazardous waste cannot be disposed of at the NTS landfill; therefore, it is transported to the Hazardous Waste Storage Unit where it is prepared for off-site shipment. Waste in this category includes, but is not limited to wastes that are ignitable, corrosive, toxic, or reactive. For example, hazardous waste may be generated on the NTS during drilling and tunneling operations and their support activities.

Waste from the use of explosive ordnance detonated by the Defense Nuclear Agency, the DOE Maintenance and Operations contractor, the Wackenhut Firing Range used by the NTS security force, and resident national laboratories is transported to the Area 11 Explosive Ordnance Disposal Facility for treatment. This facility is a Resource Conservation and Recovery Act miscellaneous unit (40 CFR Part 270.23) for conventional explosives.

HAZARDOUS MATERIALS—Live explosives, fuels, corrosives, compressed gas, and limited quantities of nuclear materials such as depleted special nuclear material uranium and radiological calibration source standards are transported onto and within the NTS for use in research, development, well-logging, and testing.

NONHAZARDOUS WASTE—Used petroleum products, uncontaminated tunnel muck, drilling fluids, cement and grout wastes, construction debris, refuse, sludge from wastewater lagoons, septic tank and chemical toilet sludge, and animal carcasses are transported for disposal at either a sanitary landfill, construction landfill, or sewage lagoon.

Sanitary solid waste generated on the NTS is transported via trucks to permitted landfills for disposal. The landfills are at various locations on the site. No off-site shipments of sanitary wastes are made to or from the NTS.

*4.1.2.4 **Other Transportation.*** Other modes of transportation are discussed in the following section. The transportation system includes buses, rail, and air. Greyhound Lines, Inc., provides intercity passenger service to and from Las Vegas. Citizens Area Transit provides bus service to most parts of Las Vegas.

OTHER ON-SITE TRANSPORTATION—No navigable waterways within the region of influence are capable of accommodating waterborne transportation of material shipments to the NTS. Air facilities consist of three airstrips and nine helicopter pads, which serve authorized aircraft. Two on-site rail systems, in Areas 25 and 26, were previously used to transport heavy, oversized, and hazardous payloads between facilities.

Railroads—There are no on-site mainline railroads. A 15-km (9-mi) standard-gauge railroad within Area 25 was abandoned in place. The former Nuclear Rocket Development Station facilities employed a remotely operated train engine to move flatbed cars carrying extremely heavy, large, and highly radioactive materials. A shorter, similar line once connected Project Pluto sites in Area 26. This line is abandoned, and much of the track and equipment have been removed.

Air Transportation—The southern area of the NTS is served by the Desert Rock Airport and Yucca Lake airstrip. Desert Rock Airport (a paved runway, 2 km [6,560 ft] long and 30 m [100 ft] wide) is the primary aircraft support facility at the NTS. It is located 5 km (3 mi) southwest of Mercury, Nevada, in Area 22. Existing features at Desert Rock Airport include an administration/control building, a fireman-standby trailer, an aircraft unloading pad, aircraft parking tie-down spurs, two lighted windsocks, and radio-activated runway lights. The airport also has a landing-arrester cable for use in the recovery of damaged aircraft that require emergency landing facilities. Desert Rock Airport is no longer manned, and no services are available because of funding and program cutbacks. However, Desert Rock Airport is still operational, and the use of this airstrip is controlled by the DOE.

Yucca Lake airstrip is a secondary NTS support facility for authorized aircraft. Features at this facility include an unpaved runway, an abandoned terminal building, and an aircraft refueling station. The runway is subject to flooding following local storms.

The only airstrip in the north is the Buckboard Mesa/Pahute airstrip in Area 18. Classified as a secondary support facility for authorized aircraft at the NTS, the Buckboard Mesa/Pahute airstrip has had minimal use in the last few years. Its primary purpose was to serve as a landing strip for aircraft carrying supplies and personnel to the Pahute Mesa sites. Occasional helicopters and approximately ten fixed-wing aircraft per year landed at the strip when the mesa was in use. Because the runway has no lights, use of the airstrip was restricted to prearranged times during daylight hours. The runway is relatively short. Its surface was unable to withstand the impact from high-speed takeoffs and landings of jet aircraft, so the largest aircraft that can be accommodated was the propeller-driven C-130. The Buckboard Mesa/Pahute airstrip is unusable and no longer serviceable.

Helipads equipped with windsocks, fire extinguishers, and painted markings are located in the following places:

- Area 5 — Radioactive Waste Management Site (Inactive)
- Area 6 — East of Mercury Highway across from the Control Point
- Area 6 — East side of Yucca Lake (Airborne Response Team)
- Area 12 — Area 12 Camp
- Area 18 — Buckboard Mesa/Pahute airstrip
- Area 18 — Pahute Mesa Control Point
- Area 22 — Desert Rock Airport
- Area 23 — Bechtel Nevada Corporation Medical Facility
- Area 25 — West of the Administration Building
- Area 29 — Shoshone Peak.

OTHER OFF-SITE TRANSPORTATION—In this section, other off-site transportation, such as rail and air transport, is described.

Railroads—The closest rail line to the site is the Union Pacific line, which passes through Las Vegas, approximately 80 km (50 mi) east of Mercury. This line connects Los Angeles with Salt Lake City. There is no direct railway link to the site. A 15-km (9-mi) standard-gauge railroad serves Area 25 of the NTS, but does not connect with the Union Pacific. Spurs serve Nellis Air Force Base and a gypsum plant.

Nevada has two other rail lines relevant to this analysis. These lines are part of the transcontinental routes of the Union Pacific and Southern Pacific Railroads. These lines run parallel to each other, close to Interstate 80 in northern Nevada. Over a distance of 290 km (180 mi), the Union Pacific and Southern Pacific lines are operated as a paired track.

The Union Pacific line passing through Las Vegas is designated as a Class A main line, which means heavy freight movement (exceeding 20 million tons per year) and high-quality physical condition for the tracks. Through Nevada, this line crosses rugged desert country and, with the exception of the Las Vegas Valley, almost no other population clusters. The line is primarily single track with frequent sidings. Between Salt Lake City, Utah, and Barstow, California, this line has on average one siding for every 8 km (5 mi). However, as the line enters the Las Vegas area, it becomes a double track for approximately 16 km (10 mi). Las Vegas is the site of a yard and crew change point. The Union Pacific has constructed a new yard for the Las Vegas area, located to the north of downtown.

The daily average number of trains through Las Vegas is 10 to 15. Each train has 60 to 70 cars and a load of 3,000 to 6,000 tons. Because of the importance of the route, Union Pacific adheres to a high maintenance standard: heavy welded rails, long-life concrete ties, frequent sidings, a centralized traffic control system, several types of detectors, and radio communications. With these attributes, it is estimated that the line capacity could accommodate 25 to 54 trains per day, 2 to 4 times the current demand. It is not known how much site-related rail freight is being processed through this line.

The Union Pacific maintains gross weight restrictions for cars on the Los Angeles and Salt Lake lines, including the branches. These restrictions are 119,295 kg (263,000 lb) for four-axle cars; 178,715 kg (394,000 lb) for six-axle cars; and 238,589 kg (526,000 lb) for eight-axle cars. Four-axle cars of 147,417 kg (325,000 lb) gross weight can be handled. Six-axle locomotives are allowed over all portions of the line. The excellent track conditions allow maximum freight train speeds of 112 kph (70 mph) east of Las Vegas and 96 kph (60 mph) west where grades and curves restrict speed.

The Union Pacific is one of the nation's strongest railroads. The routes through Nevada are important transcontinental extensions of Union Pacific routes. Both main lines appear to figure prominently in the railroad's future plans. Future freight growth is projected for the Los Angeles and Salt Lake lines as a result of demands for low-sulfur coal in the Pacific Rim countries. Already, Union Pacific handles 80 percent of the lumber used in Las Vegas, and it is constantly expanding its automobile delivery business.

The Union Pacific's northern rail route parallels the Overland Route across much of northern Nevada. Union Pacific operates 10 to 15 trains per day on this line. Maximum train speeds are 113 kph (70 mph) for freight trains. This line is operated by centralized traffic control, with the dispatcher currently located in Sacramento, California.

The Southern Pacific's northern rail route (the Overland Route) operates 10 to 20 freight trains daily. It is suitable for 113 kph (70 mph) freight train speed. Southern Pacific's major Nevada freight yard is located in Sparks.

Rail passenger services in the region of influence are provided by Amtrak (the Desert Wind), which provides daily trains through Las Vegas; the Amtrak station is located downtown at the Union Plaza Hotel and Casino.

Air Transportation—Commercial air service to and from the region of influence is available through McCarran International Airport, located in Las Vegas, which provides jet air passenger and cargo service from both national and local carriers (Figure 4-16). In addition, three small airports are located in the region of influence: Sky Harbor Airport off Lake Mead Drive; and Boulder City Airport and North Las Vegas Air Terminal. Air transport service is also possible through two U.S. Air Force bases in the area: Nellis Air Force Base in North Las Vegas and the Indian Springs Auxiliary Airfield.

McCarran International Airport is located in Las Vegas, 120 km (75 mi) southeast of the NTS. It is the primary commercial airport in the region. This airport has three runways:1,524 m, 2,979 m, and 3,851 m (5,001 ft, 9,776 ft, and 12,636 ft) long. The North Las Vegas Air Terminal is located northwest of the city, 88 km (55 mi) southeast of the NTS. It has two 1,524 m (5,000 ft) runways.

Accident History—Interstates 15 and 80, and U.S. Highways 40 and 95 are potential routes for the transport of radioactive waste. Accidents on

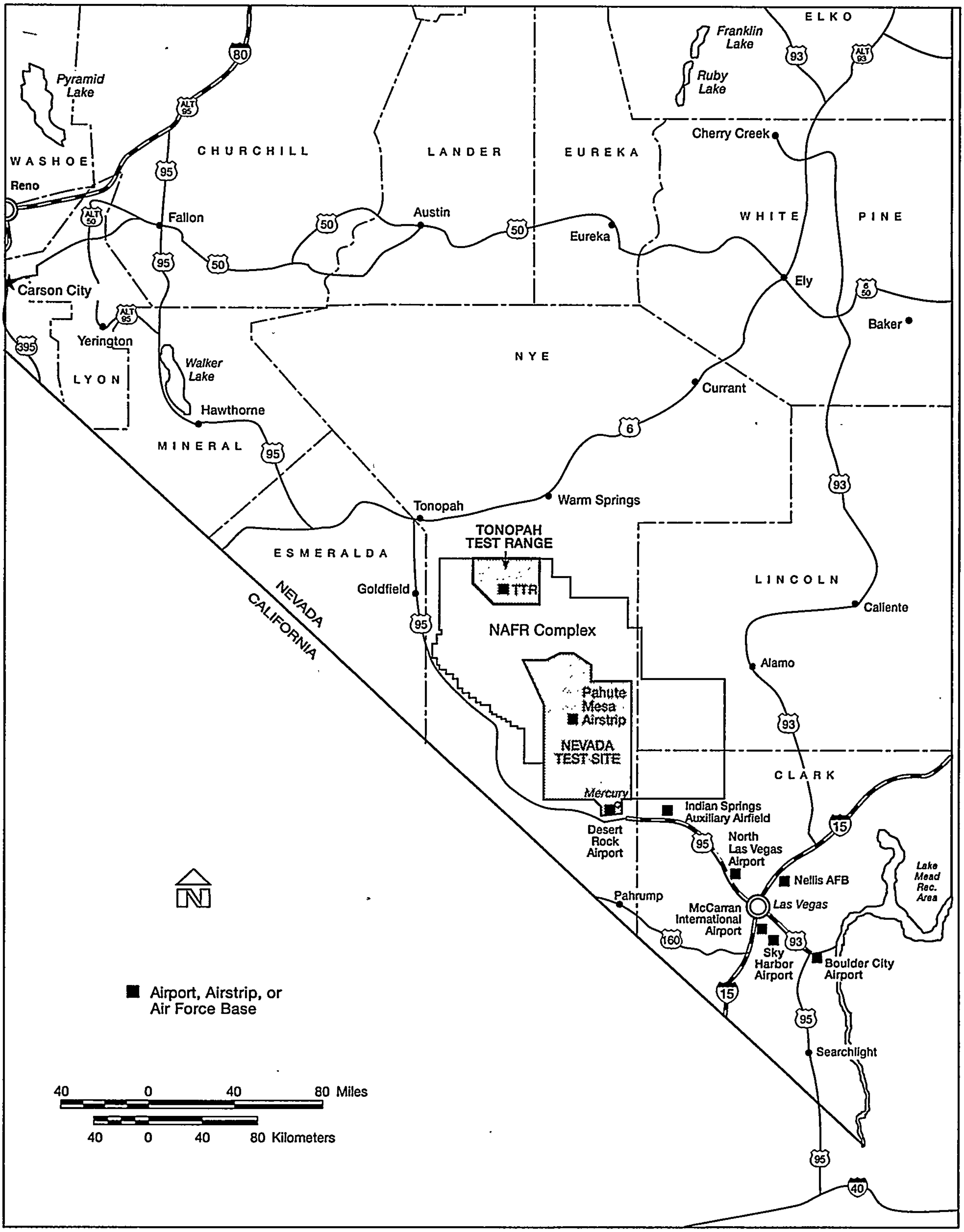


Figure 4-16. Airports in southern Nevada

state highways are generally reported and compiled by location and severity. Three classes of accidents are generally considered: fatality, injury, and property damage. Accident rates on highway segments are generally reported as number of accidents per million vehicle miles. Accident rates used in calculating the transportation risks are listed in Appendix I.

Freeways have the lowest accident rate. Multi-lane conventional highways show higher accident rates. Two-lane highways have the highest accident rates.

Expressed in number of accidents, heavily traveled segments would have the highest number of accidents.

Railroad accident information is available through the Federal Railway Administration. Railroad transport is not used for shipping waste to or from the NTS; therefore, railroad accidents were not analyzed for this study.

4.1.3 Socioeconomics

These sections present recent socioeconomic trends in the region surrounding the NTS, the Project Shoal Area, and the Central Nevada Test Area. Site effects are also discussed. Site-related effects are defined as program-related economic activity (employment, earnings, and personal income), population, housing, public finance, public services (public education, police and fire protection, and health care), and Environmental Justice.

REGION OF INFLUENCE—The region of influence is defined as the area in which the principal direct and secondary socioeconomic effects of site actions are likely to occur and are expected to be of the most consequence for local jurisdictions. The socioeconomic information presented in this EIS discusses current conditions in a region of influence comprised of Nye and Clark counties, Nevada. This region of influence includes most of the residential distribution of the employees of the DOE, its contractor personnel, and supporting government agencies. The region of influence also encompasses the probable location of future off-site contractor operations and indirect economic activities.

The regions of influence addressed in this section vary as appropriate from one socioeconomic issue to another. The public finance region of influence includes the cities of Las Vegas and North Las Vegas, the towns of Tonopah and Pahrump, Clark and Nye counties, and the Clark County and Nye County school districts. The finances of the unincorporated towns of Beatty and Amargosa Valley are administered by Nye County. The pertinent regions of influence for different public services also differ. For example, with public education, the region of influence is the Clark County and Nye County school districts.

American Indian Region of Influence—Within this region of influence, there also are several Indian reservation, tribal enterprises, tribally controlled schools, tribal police departments, and tribal emergency response units. The following reservations are located within the designated region of influence: Duckwater Shoshone Tribe, Las Vegas Paiute Tribe, Moapa Paiute Tribe, and the Yomba Shoshone Tribe. In addition, there are tribes which are located geographically outside of the region of influence, but are potentially impacted by NTS activities. One of these tribes, the Timbisha Shoshone Tribe, based in Death Valley, California, is located closer to the NTS than many towns in northern Nye County. As a consequence of this proximity, people from the Timbisha Shoshone Tribe, are a part of the social and economic region of influence of the NTS. For example, students from the Timbisha Shoshone Tribe attend public school in Beatty, Nevada whereas many Shoshone students from Tacopa, California attend school in Pahrump, Nevada. Timbisha tribal members both work and shop in Clark and Nye counties.

The Pahrump Paiute Tribe, located in Pahrump Valley, is composed of Indian people who have been historically recognized by federal and state agencies as qualified to receive services as Indian people, and who as a group are currently seeking federal acknowledgment.

ECONOMIC ACTIVITY—A survey of the NTS worker residential distributions in 1994 revealed that 90 percent of the workforce live in Clark County and 7 percent live in Nye County. The remaining 3 percent reside in other counties or states. Within Clark County, most employees of the DOE/NV reside in the Las Vegas area (DOE, 1994b).

Analysis of economic activity impacts in the region of influence of Clark and Nye counties is accomplished separately for each county. The differences in size, economies, and contributions would produce a misleading analysis if both were analyzed as one aggregate area. For example, in 1994, the NTS accounted for 1 percent of total Clark County employment, as contrasted with 6 percent of total Nye County employment.

Between 1970 and 1980, total employment in Clark County increased from 1.13×10^5 to 2.64×10^5, or an average of 13.3 percent annually (Table 4-7). Total employment in Nevada in 1970 was approximately 256,000. By 1980, total employment increased to 488,000, an annual average increase of 9.1 percent. In contrast, total employment in the United States increased from 9.11×10^7 in 1970 to 1.14×10^8 in 1980, an annual average increase of 2.5 percent.

Clark County—Clark County, which is comprised of 20,531 km^2 (7,927 mi^2), is located in southern Nevada and is composed of large expanses of unincorporated land and five incorporated cities. These cities are Las Vegas, North Las Vegas, Henderson, Boulder City, and Mesquite. Despite the recent national recession, Clark County has continued to prosper because of expansion in the hotel and gaming industry, relocation of retirees to southern Nevada, expansion of the local government infrastructure, and additional investments. However, all indicators point to slower economic activity in the late 1990s (Schwer, 1995).

By 1990, total employment by place of work in Clark County had increased to 447,625, representing an average annual increase of 6.9 percent from the 1980 figure of 264,849. Between 1980 and 1990, average annual employment growth in Nevada was 5.3 percent, and in the United States, 2.2 percent.

The largest employment sectors in Clark County in 1990 were service industries (45.8 percent), of which the hotel, gaming, and recreation sector accounted for 61 percent. Retail trade, government, and construction accounted for 15.6 percent, 11.4 percent, and 8.6 percent, respectively (Figure 4-17). The remaining 18.6 percent was divided among the following sectors: finance, insurance, and real estate (7.3 percent); transportation and utilities (4.6 percent); wholesale trade (3.0 percent); manufacturing (2.6 percent); agricultural services (0.9 percent); agriculture (0.1 percent); and mining (0.1 percent). Employers of the largest workforces in the region are listed in Table 4-8.

In 1990, average annual earnings in Clark County were $24,382, while per capita income was $18,267 (Table 4-7). Total earnings by place of work reported in 1990 for Clark County were $10,914 million (Figure 4-17). Industrial sectors reporting the largest shares of earnings in Clark County in 1990 included services (47.5 percent), government (13.1 percent), manufacturing (10.6 percent), and retail trade (10.2 percent) (U.S. Bureau of Census, 1991).

According to the state of Nevada Employment Security Department, Clark County had 395,200 members of the total labor force who were employed, while 19,500 of the total labor force, or 4.7 percent, were unemployed (Table 4-9). The unemployment rate for Clark County was slightly lower than for the state (4.9 percent) and the nation (5.5 percent).

According to *Economic Outlook*, employment in Clark County will grow at a 3.9-percent rate during 1995 and at 3.5 percent for 1996 (Schwer, 1995). Although total employment continues to show very strong trends of growth, the unemployment rate has increased from an average of 5.0 percent in 1990 to an average of 7.1 percent in 1993 because of the in-migration rate exceeding the rate of employment opportunities. This is lower than the 1993 fourth quarter rate of 7.3 percent for Nevada and higher than the national unemployment rate of 6.4 percent (State of Nevada, 1993a).

Nye County—Nye County, located northwest of Clark County, is comprised of approximately 46,786 km^2 (18,064 mi^2). The federal government

Table 4-7. Summary of economic indicators (by place of work), Clark and Nye Counties, Nevada, and the United States

				Average Annual Change		
	1970	1980	1990	1970-1980	1980-1990	1970-1990
Clark County, Nevada						
Population	273,288	463,087	797,142	6.9%	7.2%	9.6%
Total Jobs	113,839	264,849	447,625	13.3%	6.9%	14.7%
Civilian Labor Force	116,200	237,700	414,700	10.5%	7.4%	12.8%
Unemployment Rate	5.9%	6.9%	4.7%			
Earnings Per Job	$26,178	$23,958	$24,382	-0.8%	0.2%	-0.3%
Per Capita Income	$15,629	$17,504	$18,267	1.2%	0.4%	0.8%
Nye County, Nevada						
Population	5,599	9,048	17,781	6.2%	9.7%	10.9%
Total Jobs	7,149	7,860	12,889	1.0%	6.4%	4.0%
Civilian Labor Force	2,230	2,580	9,100	1.6%	25.3%	15.4%
Unemployment Rate	1.8%	5.0%	3.5%			
Earnings Per Job	$29,389	$34,041	$31,415	1.6%	-0.8%	0.3%
Per Capita Income	$15,825	$17,991	$16,268	1.4%	-1.0%	0.1%
State of Nevada						
Population (1,000s)	493	801	1,202	6.2%	5.0%	7.2%
Total Jobs (1,000s)	256	488	748	9.1%	5.3%	9.6%
Civilian Labor Force (1,000s)	218	430	626	9.7%	4.6%	9.3%
Unemployment Rate	5.9%	6.2%	4.9%			
Earnings Per Job	$25,351	$23,660	$24,037	-0.7%	0.2%	-0.3%
Per Capita Income	$15,616	$18,051	$19,812	1.6%	1.0%	1.3%
United States						
Population (1,000s)	203,799	227,255	249,466	1.2%	1.0%	1.1%
Total Jobs (1,000s)	91,093	113,726	138,573	2.5%	2.2%	2.6%
Civilian Labor Force (1,000s)	82,771	106,940	124,787	2.9%	1.7%	2.5%
Unemployment Rate	4.9%	7.1%	5.5%			
Earnings Per Job	$23,220	$23,218	$24,278	0.0%	0.5%	0.2%
Per Capita Income	$13,017	$15,652	$18,635	2.0%	1.9%	2.2%

NOTE: Dollars are in constant 1990 dollars.

Sources: State of Nevada, 1990; U.S. Bureau of Census, 1991.

Table 4-8. Workforce in Clark and Nye Counties

Employer	Number of Employees[a]	Percentage of Total
Clark County School District	15,000	3.36
Nellis Air Force Base	9,100	2.04
Nevada Test Site	7,700[b]	1.73
Clark County	4,650	1.04
University of Nevada, Las Vegas	4,600	1.03
University Medical Center (hospital)	2,650	0.59
Humana Hospital-Sunrise	2,400	0.54
Las Vegas Metropolitan Police	2,250	0.50
Smith's Food and Drug	2,225	0.50
City of Las Vegas	1,925	0.43
Las Vegas Post Office	1,875	0.42
Nevada Power Company	1,750	0.39
K-Mart Corporation	1,000	0.22
Other Employment (including hotels and casinos)	389,035	87.20
Total	**446,160**	**100.00**

[a] Numbers are approximate

[b] This number reflects the cumulative total of NTS-related employees (Las Vegas area or at the NTS) who reside in the Las Vegas metropolitan area regardless of their place of employment. This number does not reflect the anticipated layoff of approximately 2,000 for Fiscal Year 1995.

Source: State of Nevada, 1993b.

Table 4-9. 1990 civilian labor force, employment and unemployment, Clark and Nye Counties, Nevada, and the United States

	Civilian Labor Force	Employed	Unemployed	Unemployment Rate
Clark County	414,700	395,200	19,500	4.7%
Nye County	9,100	8,780	320	3.5%
State of Nevada (1,000s)	626	595	31	4.9%
United States (1,000s)	124,787	117,914	6,874	5.5%

Source: State of Nevada, 1990; U.S. Bureau of Census, 1991.

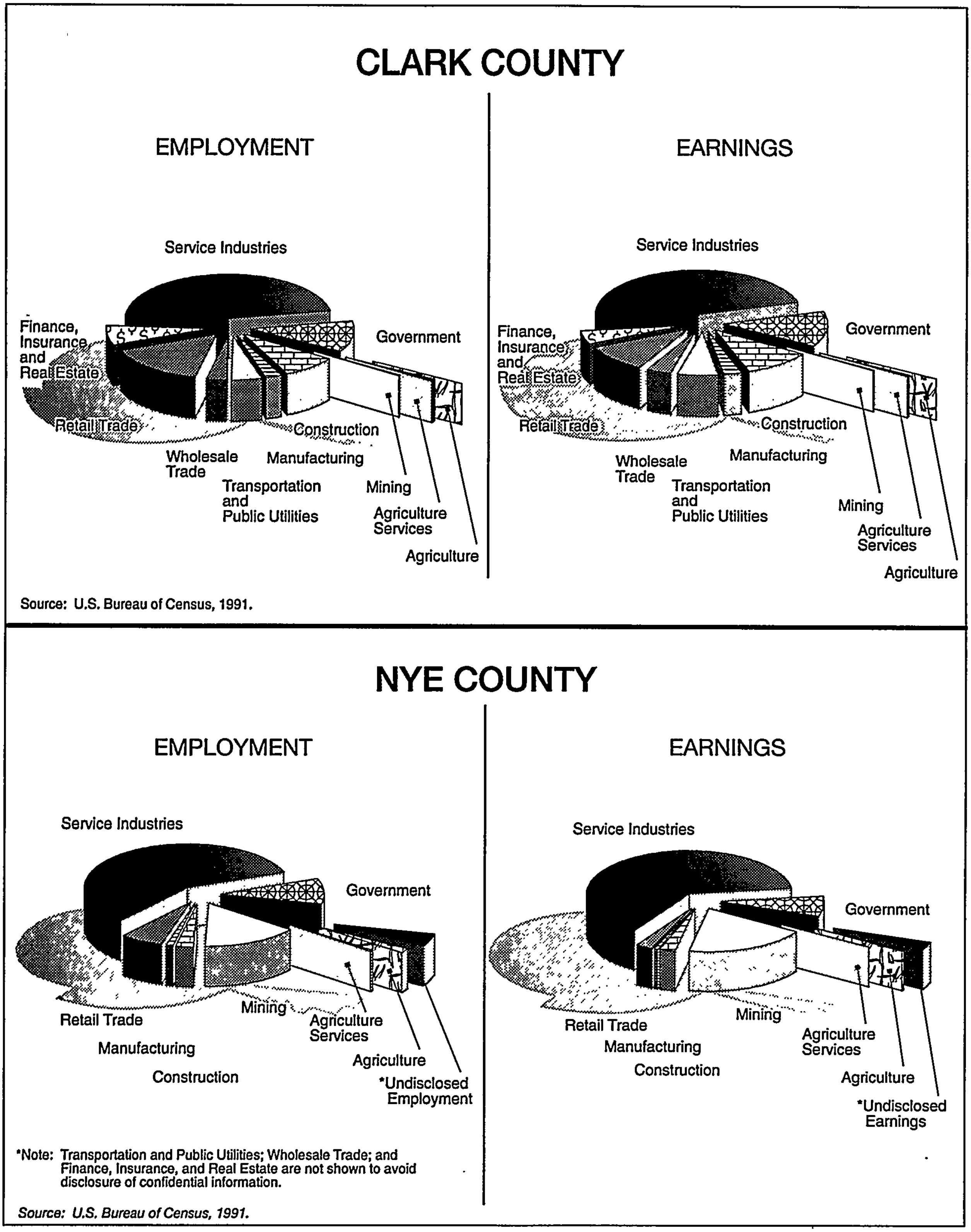


Figure 4-17. Clark County and Nye County 1990 employment and earnings by place of work

controls 93 percent of the land area. Mining, federal installations, tourist and recreation attractions, and grazing allotments all occur largely on public land in Nye County (Nye County Board of Commissioners, 1993).

Nye County is comprised of communities widely separated by distance, each with a distinct and independent economic base. The NTS and Tonopah Test Range have been operating in Nye County for several decades. Federal facilities have provided employment for Nye County residents and a modest amount of procurement for local business. The economy in each community is dependent on different private companies and, in some cases, different industries. Because the communities are widely separated by distance, economic links to each other are limited. Metropolitan economies generally absorb a significant portion of business and residential purchases. Rural economies, such as Nye County, however, often leak large portions of both business and residential purchases to larger communities, resulting in economic loss and a set of economic development needs different from those in more urban areas (Nye County Board of Commissioners, 1994).

Nye County's strategy to increase economic development opportunities from federal facilities is to engage the appropriate divisions of the DOE in a formal set of interactions. Nye County has identified the need for a qualified workforce and business base to fulfill federal requirements. To this end, Nye County has developed programs to inform local businesses of federal procurement opportunities and continuing formal and informal interaction with appropriate federal agencies (NEEDA, 1993a). One example of this proactive approach is Nye County's status as a cooperating agency in the NTS EIS.

Total employment in Nye County between 1970 and 1980 increased from 7,149 to 7,860, or an average of 1.0 percent annually (Table 4-7). Total employment in Nevada in 1970 was approximately 256,000. By 1980, employment increased to 488,000, an annual average increase of 9.1 percent. In contrast, total employment in the United States increased from 9.11×10^7 in 1970 to 1.14×10^8 in 1980, an annual average increase of 2.5 percent.

In the 1970s and 1980s, nuclear weapons testing at the NTS dominated the Nye County economy when described in terms of employment by place of work. While most of the NTS workforce commutes to the Las Vegas area and most food and other services are provided at federally subsidized facilities on the NTS, some county private businesses do provide the NTS with support services.

In 1990, total employment in Nye County expanded to 12,889, an annual increase of 6.4 percent from the 1980 figure of 7,860. This increase in employment was largely composed of employees who lived outside Nye County, as can be seen in Table 4-7 (less than 10 percent live in Nye County). The table lists employees by place of work rather than by place of residence. This accounts for the low number of civilian labor force (9,100) when compared to the total number of jobs (12,889). Between 1980 and 1990, average annual employment growth in Nevada was 5.3 percent, and in the United States, 2.2 percent. While total employment in Nye County was increasing during this period, employment at the NTS and Tonopah Test Range was decreasing. In addition to the loss of an estimated 140 NTS jobs held by Nye County residents, the relocation of the U.S. Air Force 37th Tactical Fighter Wing from the Tonopah Test Range resulted in the loss of an estimated 511 jobs held by Nye County residents (SAIC/DRI, 1991).

In 1990, the largest employment sectors in Nye County were service industries (58.2 percent), mining (15.2 percent), government (9.4 percent), retail trade (6.8 percent), construction (2.6 percent), agriculture (1.7 percent), manufacturing (1.1 percent), and agricultural services (0.4 percent) (Figure 4-17). The large percentage of service jobs can be explained by the large number of jobs at the NTS, which are classified as service. The remaining 4.7 percent was divided among the following sectors: wholesale trade; finance, insurance, and real estate; and transportation and utilities. The specific breakdowns are not shown to avoid disclosure of confidential information.

In 1990, average annual earnings per job in Nye County were $31,415 (inflated by the large number of NTS workers), while per capita income was $16,268 (Table 4-7). Jobs at the NTS and Tonopah Test Range are relatively high paying. For example, the average worker received $47,319 in compensation in 1994. Consequently, Nye County earnings decreased approximately 9 percent over a 3-year period from 1989 to 1992, a result in large part due to the decline in the NTS employment and the relocation of the U.S. Air Force 37th Tactical Fighter Wing from the Tonopah Test Range. Total earnings reported in 1990 for Nye County were $404.9 million. Industrial sectors reporting the largest shares of earnings in Nye County in 1990 included services (64.0 percent), mining (19.2 percent), and government (7.5 percent) (Figure 4-17). According to the state of Nevada Employment Security Department, 8,780 members of the total labor force were employed (Table 4-9), while 320 or 3.5 percent of the total labor force was unemployed. The unemployment rate for Nye County was lower than the State (4.9 percent) and the nation (5.5 percent) (State of Nevada, 1990).

The federal fiscal year is the period between October 1 and September 30. Total employment at the NTS in Fiscal Year 1994 was 7,016 and is expected to be approximately 6,580 in Fiscal Year 1995, a decrease of almost 19 percent. This will be the lowest employment level at the NTS for Fiscal Years 1987 through 1995. In Fiscal Year 1987, employment reached a historical high of 9,908. The subsequent reduction of employment between Fiscal Years 1988 and 1994 can be attributed mainly to budgetary constraints and the nuclear testing moratorium (Table 4-10).

Total expenditures at the NTS have been decreasing over the last five years, from $856.2 million in Fiscal Year 1990 to $769.5 million in Fiscal Year 1994. This decrease can also be attributed to budgetary constraints and the nuclear testing moratorium (Table 4-10).

POPULATION—This section presents the 1990 population for Clark and Nye counties. In addition, two cities, Las Vegas and North Las Vegas in Clark County, and four towns, Tonopah, Pahrump, Beatty, and Amargosa Valley in Nye County, are discussed. Summaries of population can be found in Tables 4-7 and 4-11.

Clark County—According to *Economic Outlook*, in 1990 the population for Clark County was 797,142, an increase of 334,055, or an average annual increase of 7.2 percent from the 1980 level of 463,087 (Schwer, 1995). The overall increase is equivalent to an annual average growth for the county of approximately 9.6 percent over the 1970 to 1990 period. By comparison, the average annual growth for Nevada was approximately 5 percent and nearly 1 percent for the United States between 1980 and 1990.

The population of the city of Las Vegas totaled 268,330 in 1990, an increase of 63 percent from the 1980 level of 164,674 (State of Nevada, 1995b). The average annual growth of 5.7 percent for the 1970 to 1990 period was below the county level. In 1970, the city of Las Vegas accounted for 46.0 percent of the Clark County population (State of Nevada, 1994); by 1990, the City accounted for 33.7 percent of the total population.

The population of the city of North Las Vegas was 50,030 in 1990, an increase of 1.5 percent from the 1980 level. The average annual growth of 1.9 percent for the 1970 to 1990 period was below the county level. In 1970, the city of North Las Vegas accounted for 13.3 percent of the Clark County population; in 1990, the city accounted for 6.3 percent of the total population in Clark County.

Nye County—In 1990, the population for Nye County was 17,781, an increase of 8,733, or an average annual increase of 9.7 percent from the 1980 level (Nye County Board of Commissioners, 1993). The overall increase is equivalent to an annual average growth for the county of about 10.9 percent over the 1970 to 1990 period. By comparison, for the period 1980 through 1990, the average annual population growth for Nevada was about 5 percent and nearly 1 percent for the United States.

As the Nye County seat, Tonopah's economic base includes government employment and a growing travel and tourist economy. However, recent layoffs at area mines and the transfer of the U.S. Air Force 37th Tactical Fighter Wing from the Tonopah Test Range have resulted in population losses in Tonopah (Nye County Board of Commissioners,

Table 4-10. DOE/NV funding and employment, 1990 to 1994

Fiscal Year	Funding (millions)	Employment
1990	$856.2	9,152
1991	$909.1	8,897
1992	$912.3	8,794
1993	$865.8	7,704
1994	$769.5	7,016

Table 4-11. Population in the region of influence, 1990 through 1995

	1990	1991	1992	1993	1994	1995
Clark County	797,142	834,907	870,692	919,388	985,827	1,032,161
Las Vegas	268,330	289,690	303,440	323,300	346,350	362,628
North Las Vegas	50,030	51,060	55,400	60,880	69,700	77,820
Nye County	17,781	19,197	20,613	22,236	23,988	25,976
Tonopah	3,810	3,586	3,375	3,514	3,659	3,810
Pahrump	7,440	8,777	10,355	11,761	13,357	15,170
Beatty	1,652	1,775	1,907	1,915	1,922	1,930
Amargosa	838	916	947	1,010	1,070	1,100

NOTE: 1990 data are U.S. Bureau of the Census counts; all other data are projections.

Sources: Nye County Board of Commissioners, 1993; Schwer, 1995.

1994). The 1990 population in the town of Tonopah was 3,810. Since 1980, the population growth for the town of Tonopah has increased by about 39 percent. In 1990, the town accounted for 21.4 percent of the population in Nye County; this percentage has decreased since 1970 when the town accounted for 30.6 percent of the Nye County population (U.S. Bureau of the Census, 1991).

Pahrump is the largest and most rapidly growing community in Nye County. It nearly tripled in size in the decade between 1980 and 1990 and has continued to grow. It can be anticipated that the community's reputation as a retirement center and bedroom community for Las Vegas will continue to attract new residents (Nye County Board of Commissioners, 1994). The 1990 population for the town of Pahrump was 7,440.

Since 1980, growth in Pahrump has driven growth in Nye County. The average annual growth of 2.5 percent for the 1970 to 1990 period was below the state and national averages. In 1990, the city accounted for 41.8 percent of the population in Nye County; this percentage has increased since 1970 when the city accounted for 17.2 percent of the Nye County population (U.S. Bureau of the Census, 1991).

The population in Beatty increased dramatically between 1985 and 1990 because of the development of the Bond Gold Bullfrog Mine and Mill. The 1990 population was 1,652 and has increased only slightly since. Beatty's economy and population are based predominately on mining, employment at federal facilities, and travel and tourism. Beatty may face potential population losses resulting from the depletion of current mineral reserves (U.S. Bureau of the Census, 1991; Nye County Board of Commissioners, 1994).

The population of the town of Amargosa Valley has ranged from 838 in 1990 to 1,100 in 1995, an increase of 31.3 percent in 5 five years. In 1995, Amargosa Valley accounted for 4.2 percent of the total population in Nye County.

<u>HOUSING</u>—The housing stock and number of building permits are discussed in the following section for Clark County; the cities of Las Vegas and North Las Vegas; Nye County; and the towns of Tonopah, Pahrump, and Beatty in Nye County. Table 4-12 presents housing characteristics in the region of influence.

<u>Clark County</u>—In 1990, the housing stock in Clark County consisted of 317,188 units, an increase of 127,328 units or 67.1 percent over the 1980 total of 189,860. Between 1980 and 1990, Clark County housing unit vacancies increased from 15,969 units or 8.4 percent of the housing stock in 1980 to 30,163 vacant units or 9.5 percent of the housing stock in 1990. The housing market continues to flourish as the demand for new housing consistently exceeds the supply. The increase in demand is attributable to the influx of retirees and other in-migrant population (U.S. Bureau of the Census, 1991; ULI, 1994).

The number of building permits issued annually in Clark County rose sharply in the mid-to-late-1980s, with a peak of 26,432 permits issued in 1988. In the early 1990s, the number of permits dropped, with 13,027 issued in 1992. Building permits issued in a given year may not represent the actual number of units built; however, they are indicative of the level of new residential development in the city (Schwer, 1995).

In 1990, the housing stock in the city of Las Vegas consisted of 109,670 units, an increase of 42,629 units or 63.6 percent over the 1980 total of 67,041. Between 1980 and 1990, the city of Las Vegas housing units vacancies increased from 4,897 units or 7.3 percent of the housing stock in 1980 to 9,935 vacant units or 9.1 percent of the housing stock in 1990.

The outlook for the Las Vegas residential market remains very positive for single-family homes. Job growth, driven by the hotel and gaming industry, should remain strong for the next several years. The addition of over 10,000 new hotel rooms in 1995 will create approximately 15,000 jobs in that sector. Applying the multiplier effect, another 30,000 additional secondary jobs could be created in other areas of the economy. This strong job growth will fuel demand for housing in all market segments. Overall, a strong market is projected though 1995. Projections beyond 1995 will be determined by new economic development activity, such as another large-scale resort and gaming project or the relocation of other major employers to Las Vegas (ULI, 1994).

The city of North Las Vegas' 1990 housing stock consisted of 15,837 units, an increase of 1,738 units or 12.3 percent over the 1980 total of 14,099. Between 1980 and 1990, North Las Vegas housing unit vacancies increased from 1,037 units or 7.4 percent of the housing stock in 1980 to 1,312 vacant units or 8.3 percent of the housing stock in 1990.

<u>Nye County</u>—The availability of affordable housing for senior citizens and low- and middle-income residents and the ability of entry-level buyers to obtain financing for housing are of concern in Nye County (Nye County Board of Commissioners, 1994). In 1990, the housing stock in Nye County consisted of 8,073 units, an increase of 3,871 units or 92.1 percent over the 1980 total of 4,202 (Nye County Board of Commissioners, 1993). Between 1980 and 1990, Nye County housing unit vacancies decreased from 768 units or 18.3 percent of the housing stock in 1980 to 1,409 vacant units or 17.5 percent of the housing stock in 1990. The vacancy rate does not reflect substandard units or houses held for occasional and recreational use.

Table 4-12. 1990 housing characteristics in the region of influence

	Housing Stock	Housing Demand	Vacancy Rate
Clark County	317,188	287,025	9.51%
Las Vegas	109,670	99,735	9.06%
North Las Vegas	15,837	14,525	8.28%
Nye County	8,073	6,664	17.45%
Tonopah	1,767	1,460	17.37%
Pahrump	3,514	3,029	13.80%
Beatty	912	762	16.45%

NOTE: Housing stock is the total number of units; demand is the total number of occupied units.

Source: U.S. Bureau of the Census, 1991.

The 1990 housing stock in the town of Tonopah consisted of 1,767 units. Some 1,460 were occupied and 307 were vacant (17.4 percent). The largest number of houses were built between 1980 and 1984. A major decline in new housing construction has been experienced since 1984 (NEEDA, 1993b).

In 1990, the housing stock in the town of Pahrump consisted of 3,514 units. The vacancy rate was 13.8 percent, and 3,029 were occupied (NEEDA, 1993b). Fifty-eight percent of the houses have been built since 1979, and 92 percent of all housing units have been built since 1969.

In 1990, the housing stock in the unincorporated area of Beatty consisted of 912 units. Of these, 762 were occupied, resulting in a vacancy rate of 16.5 percent. The largest portion of the houses were built between 1970 and 1979. A gradual decline in new housing has been experienced in the past 20 years. Ninety-four new structures were under construction in 1990 (NEEDA, 1993b).

PUBLIC FINANCE—The financial characteristics of potentially affected local jurisdictions are presented in this section. The local jurisdictions include Clark County, the cities of Las Vegas and North Las Vegas, Clark County School District, Nye County, the towns of Tonopah and Pahrump, and the Nye County School District. The finances of Beatty, Amargosa Valley, and Manhattan are administered by Nye County.

Government funds discussed in this section are those through which most government functions of the jurisdiction are financed. Government fund types include the general, special revenues, debt service, and capital project funds. The general fund accounts for financial transactions related to revenues and expenditures of services are not accounted for in other funds. Special revenues funds are those funds accounted for in the proceeds of specific revenue sources that are legally restricted for specified purposes. Debt service funds account for the accumulation of resources for, and the payment of, interest and principal on general long-term debt. Capital project funds are used to account for financial resources for the acquisition or construction of major capital facilities. The fiscal year for all Nevada jurisdictions is the 12-month period from July 1 to June 30.

For many jurisdictions discussed, ad valorem taxes are a major source of revenue. These are taxes that are levied on the assessed valuation of real property. Assessed valuation is a valuation set upon real estate as a basis for levying taxes. Thirty-five percent of the taxable value placed upon real property is used as the basis for levying property taxes in most Nevada jurisdictions.

Table 4-13 summarizes the fiscal position of Clark County and Nye County jurisdictions in Fiscal Year 1994. Columns are presented only to facilitate financial analysis. Such data are not comparable to a consolidation. The fund balances are the

Table 4-13. Financial summary for Fiscal Year 1994, general, special revenues, debt service, and capital project funds, Clark County and Nye County jurisdictions

	Revenues	Expenditures	Revenues Less Expenditures	Debt Service	Current Expense	Fund Balance as Percentage of Current Expense
Clark County	$696,950,016	$767,611,252	($70,661,236)	$65,178,759[a]	$457,379,897[b]	157.95%
Las Vegas	$245,511,322	$249,562,587	($4,051,265)	$10,319,245[c]	$176,253,405[b]	59.67%
North Las Vegas	$51,914,044	$53,747,125	($1,833,081)	$2,528,555[d]	$41,768,530[b]	30.97%
Clark County School District	$716,013,860	$775,193,716	($59,179,856)	$56,980,872[e]	$636,708,860[b]	12.90%
Nye County	$25,450,955	$25,493,176	($42,221)	$19,955[a]	$21,389,278[b]	76.75%
Tonopah	$762,898	$669,800	$93,098	$66,788[c]	$603,012[b]	66.65%
Pahrump	$1,043,164	$944,879	$98,285	$90,014[c]	$711,674[b]	80.35%
Nye County School District	$24,079,470	$25,176,765	($1,097,295)	$4,020,145[f]	$18,840,821[g]	26.86%

[a] Principal and interest
[b] Total expenditures less capital projects and debt service
[c] Principal and interest and fiscal charges
[d] Principal retirement and interest
[e] Principal on loans and bond retirement and interest on bonds
[f] Principal retirement and interest and bond issuance costs
[g] Total expenditures less facilities acquisition and construction and debt service.

Sources: Clark County, 1994a; Clark County School District, 1994b; City of Las Vegas, 1994; City of North Las Vegas, 1994; Nye County, 1994; Nye County School District, 1994; Pahrump, 1994; Tonopah, 1994.

resources remaining from the prior year that are available to be budgeted in the current year. The fund balance as percentage of current expense is a quick look at how much reserve would be used if current (due within a year) expenses had to be paid without considering revenues. The lower the percentage, the less available to pay off current expenses. The following sections focus on Fiscal Year 1994.

Clark County—Clark County, incorporated in 1909, is governed by a Board of County Commissioners and a county manager. This seven-member board is elected by each district to serve staggered four-year terms. Within the county are 5 incorporated cities, including Las Vegas, which is the county seat, and 13 unincorporated towns (Clark County, 1994a). County services provided include the county recorder, assessor, treasurer, social services, airport, hospital, and criminal justice. In addition, the county provides a full range of local services, such as fire, police, road maintenance and construction, animal control, building inspection, and water and sewage systems to county residents living in unincorporated areas.

Total revenues for Fiscal Year 1994 were $696,950,016. The two most significant revenue sources for Clark County in Fiscal Year 1994 were intergovernmental revenues, and ad valorem taxes and special assessments. Intergovernmental revenues were approximately 48 percent of total revenues in Fiscal Year 1994 and have usually been the primary revenue source for Clark County in the past. Sales and use taxes have been a major component of intergovernmental revenues because of growth in the economy. In Fiscal Year 1992, the state of Nevada implemented a "Fair Share" sales tax distribution formula that based distribution on the point of origin rather than need. Since 1981, Clark County had been receiving fewer sales taxes than collected; therefore, this legislation had a positive fiscal impact for the county (Clark County, 1994a).

Ad valorem taxes and special assessments are the second most significant revenue source for Clark County, comprising approximately 23 percent of total revenues in Fiscal Year 1994. Ad valorem taxes were based on an assessed valuation of $17,107,674,808 and a tax rate of $0.7131 per $100 of assessed valuation (Clark County, 1994b).

Expenditures totaled $767,611,252 for Fiscal Year 1994. The two most significant expenditure categories for Clark County in Fiscal Year 1994 were capital projects and public safety. As 32 percent of total expenditures, capital projects include major transportation improvements throughout the county, a new government center, and buildings for family court services. Public safety expenditures were approximately 27 percent of total expenditures in Fiscal Year 1994. Included in this category are expenditures for the county sheriff, fire department, and coroner.

Revenues less expenditures were a negative $70,661,236 in Fiscal Year 1994. Debt service (principal and interest) was $65,178,759. Current expenses, which are total expenditures less capital projects and debt service, were $457,379,897. The ending fund balance was 158 percent of current expense. The ending fund balance is the excess of assets over liabilities and reserves (Clark County, 1994a).

City of Las Vegas—The city of Las Vegas was incorporated in 1911 and has a council manager form of government. The city provides for fire and police protection (through the Las Vegas Metropolitan Police Department), municipal court, sanitation, construction and maintenance of roads, recreation, and general government services for residents within its approximately 233km^2 (90mi^2) incorporated area. Las Vegas is the county seat of Clark County and has the largest population of any incorporated city in the county.

The two most significant revenue sources in Fiscal Year 1994 for the city of Las Vegas were intergovernmental revenues and taxes. Intergovernmental revenues comprised approximately 56 percent of total revenues. Intergovernmental revenues involve federal grants, cigarette taxes, liquor taxes, sales taxes, motor vehicle privilege taxes, the city share of county gaming licenses, and real property transfer taxes. In Fiscal Year 1994, taxes were approximately 16 percent of total revenues. Tax revenues have two components: real property tax and personal property tax. Both are calculated on the assessed valuation of the property. Total assessed value was $4,230,821 in 1994. The property tax rate for 1994 was $0.7247 per $1,000 of assessed value.

In Fiscal Year 1994, the two largest expenditure categories for the city of Las Vegas were public safety and capital outlay. Public safety expenditures, consisting of police, fire, corrections, traffic engineering, and building and safety services, were approximately 37 percent of total expenditures in this year. Capital outlay, the second largest expenditure category, was 25 percent of total expenditures.

Revenues less expenditures were a negative $4,051,265 in Fiscal Year 1994. Debt service was $10,319,245. Current expense was $176,253,405, and the fund balance as a percentage of current expense was 60 percent (City of Las Vegas, 1993 and 1994).

City of North Las Vegas—The city of North Las Vegas was incorporated in 1946 and has a council manager form of government. The city provides a full range of services within its 166-km^2 (64-mi^2) incorporated area, including general government, police, municipal court, public safety, highway and streets, health and sanitation, culture and recreation, community support, and utilities.

In Fiscal Year 1994, the two most significant revenue sources for the city of North Las Vegas were intergovernmental and taxes. Intergovernmental revenue provided approximately 55 percent of total revenues in Fiscal Year 1994. The intergovernmental revenue consisted of grants, shared revenues, and payments in lieu of taxes. Taxes comprised approximately 15 percent of total revenues and included ad valorem, county option motor vehicles fuel, and room taxes. In 1994, the ad valorem tax rate in North Las Vegas was

$3.119 per $100 of assessed valuation. The total assessed valuation in this year was $661,947,000.

The two largest expenditures for the city of North Las Vegas in Fiscal Year 1994 were public safety and capital projects. Public safety expenditures (police, fire, and protective services) comprised approximately 49 percent of total expenditures in Fiscal Year 1994. Capital project expenditures were the second most important expenditure category at 18 percent of all expenditures.

Revenues less expenditures were a negative $1,833,081 in Fiscal Year 1994. Debt service was $2,528,555. Current expense was $41,768,530, and the fund balance as a percentage of current expense was 31 percent (City of North Las Vegas, 1994).

Clark County School District—Clark County School District boundaries are the same as those of Clark County. The continued rapid growth of Clark County has resulted in a shortage of schools and school buildings. In the 1988 and 1994 elections, bonds for school building programs were approved by voters. It is estimated that between 25 and 38 new schools will be built in the immediate future. In addition, the district is involved in asbestos removal and fire safety retrofitting to meet Nevada fire code requirements. The construction and retrofitting bonds are to be paid with ad valorem taxes.

The key revenue sources for the Clark County School District are local and state sources. Local sources are monies generated from sales taxes, ad valorem taxes, and motor vehicle privilege taxes. These revenues were approximately 64 percent of total revenues in Fiscal Year 1994. The Clark County School District portion of the Clark County ad valorem tax rate in Fiscal Year 1992 was $1.1935 per $100 of assessed valuation; this rate has not changed since Fiscal Year 1988. State sources are revenues generated by the state of Nevada and received by the district based on a formula. The formula includes a standard amount per student, plus special educational funding. These revenues were 33 percent of total revenues in Fiscal Year 1994.

The two major expenditures for the district were regular programs and undistributed expenditures. The regular programs category includes expenditures such as instruction, support, and transportation for all regular elementary and secondary students. Regular programs comprised 42 percent of all expenditures. Undistributed expenditures are charges not readily assignable to a program, such as student and instructional staff support; general and administrative costs; and costs of operating, maintaining, and constructing physical facilities of the district. These undistributed expenditures were 28 percent of total expenditures in Fiscal Year 1994.

In Fiscal Year 1994, revenues less expenditures were a negative $59,179,856. Debt service was $56,980,872. Current expense was $636,708,860. The ending fund balance was $82,112,931, which was 13 percent of the current expense (Clark County School District, 1994a and b).

Nye County—Nye County is governed by a five-member Board of County Commissioners. Within the county are six unincorporated towns, including Tonopah, the county seat. The governing body of Nye County has direct oversight responsibility for the unincorporated towns of Amargosa Valley, Beatty, and Manhattan. County services provided include the county recorder, assessor, treasurer, social services, and criminal justice. In addition, the county provides a limited range of local services, such as police, road maintenance and construction, and animal control. Excluded from the Nye County financial statements are the Nye County School District and the towns of Tonopah and Pahrump. These are discussed in the following sections.

The two most significant revenue sources for Nye County in Fiscal Year 1994 were intergovernmental revenues and ad valorem taxes. Intergovernmental revenues were approximately 55 percent of total revenues. Major components of this revenue were supplemental city/county relief taxes and motor vehicle fuel taxes. Ad valorem taxes are the second most significant revenue source for Nye County, comprising approximately 27 percent of total revenues in Fiscal Year 1994. The 1994 assessed valuation was $636,488,641, and the tax rate was $2.6466 per $100 of assessed valuation.

The two key expenditure categories for Nye County in Fiscal Year 1994 were general government and public safety. General government expenditures were approximately 29 percent of total expenditures in Fiscal Year 1994. Included in this category are expenditures for county administration, finance, and building services. Public safety, the second most significant expenditure at 24 percent of total expenditures, includes the sheriff, search and rescue, and fire departments.

In Fiscal Year 1994, revenues less expenditures were a negative $42,221. Debt service was $19,955. Current expense was $21,389,278. The ending fund balance was $16,416,983, which was 77 percent of the current expense (Nye County, 1994).

Tonopah—Tonopah is the county seat of Nye County and the second largest community in the county. The unincorporated town of Tonopah has a town board form of government. The unincorporated town mechanism is often chosen over incorporation for financial considerations. An unincorporated town may provide certain services and may be allowed certain revenues to fund these services. Unincorporated towns may provide a wide range of services, but are not required to do so. They may use Nye County services and benefit from the cost efficiencies of the larger service system (Nye County Board of Commissioners, 1994). The town provides a range of services within its area, including general government, public safety, highways and streets, and culture and recreation.

In Fiscal Year 1994, the two most significant revenue sources for Tonopah were taxes and intergovernmental revenues. Taxes comprised approximately 53 percent of total revenues and included property taxes and room taxes. In 1994, the property tax rate in Tonopah was $3.2403 per $100 of assessed valuation for an assessed valuation of $31,898,884 (Nye County, 1994). Intergovernmental revenue provided approximately 34 percent of total revenues in Fiscal Year 1994. This revenue included county liquor licenses, county gaming licenses, motor vehicle privilege taxes, relief taxes, and gas taxes.

The two largest expenditures for Tonopah in Fiscal Year 1994 were public safety and culture and recreation. Public safety expenditures (fire services) comprised approximately 35 percent of total expenditures in Fiscal Year 1994. Culture and recreation expenditures were the second most important expenditure category at 26 percent of all expenditures. Culture and recreation includes expenses for parks, libraries, swimming pool, fairs, and ball fields.

Revenues less expenditures were $93,098 in Fiscal Year 1994. Debt service was $66,788. Current expense was $603,012, and the fund balance as a percentage of current expense was 67 percent (Tonopah, 1994).

Pahrump—The unincorporated town of Pahrump has a town board form of government. The largest community in Nye County, the town provides for general government, public safety, public works, health, and culture and recreation services for residents within its area.

The two most significant revenue sources in Fiscal Year 1994 for Pahrump were taxes and intergovernmental revenues. In Fiscal Year 1994, taxes were approximately 49 percent of total revenues. Tax revenues have two components: property tax and room tax. The property tax rate for 1993 was $2.8830 per $1,000 for an assessed value of $225,896,898 (Nye County, 1994). The town levies room taxes. Amounts collected for the Fiscal Year 1994 were $72,288 or 14 percent of all taxes. Intergovernmental revenues comprised approximately 37 percent of total revenues. Intergovernmental revenues involve a motor vehicle privilege tax, relief tax, county and state grants, and gas tax.

In Fiscal Year 1994, the two largest expenditure categories for Pahrump were general government and culture and recreation. General government expenditures, consisting of administration, building and grounds, town board, community center, and advisory planning, were approximately 41 percent of total expenditures in this year. Culture and recreation, the second largest expenditure category, was 16 percent of total expenditures. It included television, recreation, parks, and arena and fair activities.

Revenues less expenditures were $98,285 in Fiscal Year 1994. Debt service was $90,014. Current expense was $711,674, and the fund balance as a percentage of current expense was 80 percent (Pahrump, 1994).

Amargosa Valley—The town of Amargosa Valley is located on U.S. Highway 95, approximately 145 km (90 mi) northwest of Las Vegas. Its northern edge is adjacent to the NTS. The town encompasses some 1,243 km^2 (480 mi^2) and is about half the size of the state of Rhode Island. Its economy is based primarily on farming, the NTS, and several small- and medium-sized mines. Amargosa Valley has no professional government management or administrative staff. It is governed and funded by the Nye County Board of Commissioners. The County Commissioners set the annual budget for the town and enact ordinances and policies on the recommendation of the five-member Amargosa Valley Citizens' Advisory Council. The town provides a range of services, including a community center, library, parks and recreation, fire protection and ambulance, and a senior center.

Amargosa Valley financial and budgetary programs are administered by Nye County and are reflected in the Nye County finance section. Construction of the Amargosa Valley Community Center, library, and sheriff's substation/fire station was financed by general obligation bonds. The original amount of the bond issue was $735,000, which was reflected in increased capital outlay in Fiscal Years 1987 to 1988. The 1987 delinquency rate for ad valorem taxes was approximately 17 percent, and it is expected that Nye County will have to provide additional support to the town in the coming fiscal years (Blankenship, 1995).

Nye County School District—Nye County School District boundaries are contiguous with those of Nye County. The school district is governed by a seven-member Board of School Trustees, who are elected to serve four-year terms.

The key revenue sources for the district are state and local sources. Local sources are monies generated mostly from ad valorem taxes, school support taxes, and franchise taxes. These revenues were approximately 53 percent of total revenues in Fiscal Year 1994.

State sources are revenues generated by the state of Nevada and received by the district based on a formula. The formula includes a standard amount per student, plus special educational funding. These revenues were 44 percent of total revenues in Fiscal Year 1994.

The two major expenditures for the district were regular programs and operations and maintenance. The regular programs category includes expenditures such as instruction, support, and transportation for all regular elementary and secondary students. Regular programs comprise 39 percent of all expenditures. Operations and maintenance costs are the second most significant expenditure for the district, comprising 11 percent of total expenditures in Fiscal Year 1994. This expense includes salaries, benefits, purchased services, supplies, and property.

In Fiscal Year 1994, revenues less expenditures for the Nye County School District were a negative $1,097,295. Debt service was $4,020,145. Current expense was $18,840,821, and the fund balance as a percentage of current expense was 27 percent (Nye County School District, 1993 and 1994).

PUBLIC SERVICES—The key public services examined in this analysis are public education, police and fire protection, and health care. Providers of these services in the region of influence are public school districts, police and fire departments, and hospitals and clinics. Existing conditions for each major public service focus on those providers that are geographically close to the sites and/or maintain the closest relations to the sites. The level of general public service is determined by student-to-teacher ratios at primary and secondary public schools and by the ratio of employees (sworn officers, professional fire-fighters, and health care personnel) to serviced population.

The Superfund Amendments and Reauthorization Act of 1986 requires state and local jurisdiction, within the United States, to plan for and have the capability to respond to incidents involving all hazardous materials including waste that reside in or pass through their jurisdiction. This process is implemented through the Local Emergency Planning Committee and the State Emergency Response Commission. As part of this program local communities and counties are required to implement an Emergency Response Plan. These plans define chain-of-command, notification procedures, and evacuation procedures for each community.

For the past 15 years, the DOE has provided training to responders in Nevada through the First-On-Scene Program. The environment safety and health training will continue to be made available to state regulators, educators, the public, and agencies (firefighters, law enforcement, and emergency, medical personnel) within Nevada. Training courses for environmental safety and health, transportation, radioactive materials management, environmental restoration, and classes that meet or exceed federally mandated training requirements for personnel involved with the generation or disposal of radioactive or hazardous waste can be provided by the DOE/NV. Courses conducted associated with transportation activities include: first-on-scene responder for law enforcement, firefighters, and emergency medical personnel.

PUBLIC EDUCATION—The University of Nevada, Las Vegas, was officially established in 1957. More than 120 graduate and undergraduate programs are offered to a student body of 19,500. The university has on-campus research facilities, including the Desert Biology Research Center, Center for Business and Economic Research, Nuclear Waste Transportation Research Center, and Parent/Family Wellness Center. The Desert Research Institute, a separate division of the University and Community College System of Nevada, was founded in 1959 as an international center for environmental research. The University of Nevada Medical School trains medical students and resident physicians at the University Medical Center, where the school is located (Las Vegas Review-Journal, 1994). The Harry Reid Center is an environmental studies organization located on campus and operated by the university.

Under Nevada law, a single public school district serves each county and is responsible for educating students from kindergarten through grade twelve. The following discussion highlights the Clark County and Nye County school districts in terms of numbers of students and teachers and the student-to-teacher ratio.

American Indian Education—Under federal and Tribal Law, American Indian children can be educated in tribally controlled and federally certified schools located on Indian reservations. Federal funds are available through the Indian Education Act for the education of Indian children. Compensation from the federal government is provided to any school district who has entered into a cooperative agreement with Federally Recognized Tribes whether it be public, private, or an Indian controlled school.

Clark County School District—Approximately 62 percent of Nevada's total public school enrollment is in Clark County. The Clark County School District, with a 1993 to 1994 enrollment of 145,327 students, is the largest district in the state and the eleventh largest school district in the nation. A total of 7,928 full-time equivalent licensed teachers were employed by the school district. These figures result in a student-to-teacher ratio of 18.33:1 for the district. The district has 184 schools, including 127 elementary schools, 27 middle schools, 24 senior high schools, and 6 special schools (State of Nevada, 1995a).

With the continued rapid growth of Clark County, a 10-year, $600,000,000 school building program was approved by voters in 1988. In Fiscal Year 1990, 2 new schools opened as a result of the bond election, followed by 13 more in Fiscal Year 1991. As Fiscal Year 1992 began, 18 new schools opened. Eight schools were opened for use during Fiscal Year 1993, 13 opened in Fiscal Year 1994, and 3 new schools will open in Fiscal Year 1995, completing the 1988 bond program. Depending on the amount of additional monies passed by voters, it is estimated that between 25 and 38 new schools will be built in the immediate future (Clark County School District, 1994a).

Nye County School District—Of the 17 school districts in Nevada, the Nye County School District ranks as the eighth largest. There are 15 schools in the district: 9 elementary, 1 junior high, 1 junior high/high school, and 4 high schools (State of Nevada, 1995a). Some 239 full-time equivalent licensed teachers were employed by the school district in the 1993 to 1994 school year, and the district had a 1993 to 1994 enrollment of 3,918 students. Using these numbers, the student-to-teacher ratio for the Nye County School District was 16.39:1 (State of Nevada, 1995a).

American Indian Tribally Operated Schools in Nye County—In Nye County there is one tribally controlled elementary school. It is operated by the Duckwater Shoshone Tribe. In 1995 the school had 32 students enrolled from preschool to 8th grade, who were taught by three full-time certified teachers; these included two certified elementary teachers, two teaching assistants, one preschool teacher, and one teacher under the Chapter 1 Program. Using these numbers the student-to-teacher ratio was 10.66:1 (Duckwater Shoshone Tribe, 1996).

A tribally operated headstart program is located on the Moapa Paiute Indian reservation. The program is open to all eligible preschool students, both Indian students and non-Indian students from nearby communities. This program is funded through the Inter-tribal Council of Nevada, who operate headstart sites elsewhere in the state of Nevada. Indian students also attend non-Indian public schools.

POLICE PROTECTION—Police protection in the region of influence is provided by the Las Vegas Metropolitan Police Department, the North Las Vegas Police Department, and the Nye County Sheriff's Office with stations at Tonopah, Pahrump, Beatty, Mercury, and Amargosa Valley. Each provides law enforcement services in conjunction with other law enforcement agencies, including the Nevada Highway Patrol.

No universal standards can be employed to determine proper patrol size considering the duties the patrol force is expected to perform, such as responding to calls for service, conducting preventive patrol, and performing miscellaneous administrative tasks. The amount of time that should be devoted to each of these three broad areas is largely a policy decision that is made locally, based on experience. Once an acceptable patrol staffing level has been determined, it is necessary to devise a plan that will provide for the most efficient use of officers' time and the most productive geographic distribution (ICMA, 1982). The following discussion describes sworn officer or deputy levels of service per 1,000 population, the number of vehicles, and the number and capacity of holding facilities.

Las Vegas Metropolitan Police Department—To reduce the duplication of services, effective July 1, 1973, the Clark County Sheriff's Department and the Las Vegas Police Department were deactivated, and the Las Vegas Metropolitan Police Department was activated to take their place. The new department is headed by the elected sheriff of the county. In addition to patrolling the city of Las Vegas, the department provides service for rural areas of the county (Keller, 1995).

The department maintains 1,274 sworn personnel for a level of service of 2.26 per 1,000 people. Training personnel include 13 sworn officers and 10 civilian employees. In addition, there are 18 sworn and 5 civilian crime prevention specialists, which include community relations, crime prevention, and Drug Abuse Resistance Education officers. Some 821 vehicles, including 4-wheel vehicles, motorcycles, and search and rescue vehicles, are used by the department. The holding facility capacity for the Clark County Detention Center is 1,650 and the Las Vegas Detention Center, operated by the city of Las Vegas, is 600 (U.S. Bureau of the Census, 1994; Reed, 1995).

North Las Vegas Police Department—The North Las Vegas Police Department has one station that has 132 commissioned police officers. There are about 1.8 officers per 1,000 North Las Vegas residents. The city also has one detention center that presently (July 1995) houses 100 prisoners; the detention center is approximately 50 percent filled. This low occupancy rate is due to the planning of this facility to accommodate the projected prisoners for the year 2000.

Nye County Sheriff's Office—The Nye County Sheriff's Office, whose main office is located in Tonopah, serves the entire county and supports substations located in Pahrump, Mercury, Amargosa Valley, Beatty, Smoky Valley, and Gabbs. There are 104 sworn officers and deputy personnel, 2 Drug Abuse Resistance Education/crime prevention officers, and 1 assistant sheriff in charge of training in Nye County. Approximately 25 to 30 training instructors are on the force. The sheriff's office has a fleet of 78 vehicles, including 4 search and rescue vehicles.

Fourteen sworn officers and deputy personnel work in the main office in Tonopah, operating at a level of service of 3.67 per 1,000 people. The station also has 13 jailers. Staff also includes one Drug Abuse Resistance Education/crime prevention officer. The substation has 23 vehicles, 4 of which are search and rescue. Currently, there is one holding facility with a holding capacity of 18. This will change to 48 when the new jail is opened (Willen, 1995).

Pahrump Sheriff's Substation—The Pahrump substation maintains an administrative staff of one undersheriff, one area commander, and one Drug Abuse Resistance Education officer. The investigations section has two detectives. The substation employs ten deputies and three sergeants for patrol duties. The detention facility staff includes eight sworn detention deputies and a sergeant. In addition, the Pahrump substation employs two animal control officers. With a total of 28 sworn officers, the level of service is 1.85 per 1,000 people. Of the 26 vehicles used by the substation, 2 are motorcycles and 2 are trucks. The detention center at Pahrump has a total holding capacity of 37 (Redmond, 1995; Richards, 1995).

Beatty Sheriff's Substation—The Beatty substation has five sworn officers and operates at a level of service of 2.59 sworn deputies per 1,000 people. The substation uses seven vehicles. It has one holding facility with four cells and a capacity of eight people for up to 72 hours. However, detainees are often transported to Pahrump because its holding facility capacity is larger. A new building is being added to the Tonopah substation. When this facility is completed, detainees will be transported there (Sullivan, W., 1995).

Amargosa Valley Substation—Law enforcement services in Amargosa Valley are provided by the Amargosa Valley substation of the Nye County Sheriff's Department. The substation provides services to a 1,683-km^2 (650-mi^2) area, but patrols are sporadic because of the low number of sheriff's deputies. The level of service is 2.01 sheriff's deputies per 1,000 people. In addition, the great distances the sheriff's deputies must cover affect response times and wear out patrol cars at a rapid rate. Staff includes two deputies, one part-time mechanic, and three dispatchers. The substation transports prisoners to the holding facility in Beatty, and most bookings are performed at the Beatty substations (Sullivan, W., 1995).

FIRE PROTECTION—Fire protection for the region of influence is provided by the Clark County Fire Department, Las Vegas Fire Department, North Las Vegas Fire Department, and several volunteer fire departments in Nye County (including Tonopah, Pahrump, Beatty, and Amargosa Valley).

In evaluating the adequacy of fire protection levels in any given area, major consideration must be given to a fire department's ability to handle efficiently any reasonably anticipated workload. This requires an evaluation of the possibility of several simultaneous working fires, weather factors that might contribute to the spread of fire, the delay in response or the possibility of slow operation at the scene, and other demographic or geographic conditions that might affect the frequency of fire occurrence and the response time of initial firefighting units (NFPA, 1986). The following is a description of the current number of fire stations, levels of service per 1,000 people, number of firefighters, and types of equipment.

Clark County Fire Department—The Clark County Fire Department is divided in two sections: urban and rural. The urban fire stations are located in areas that are not cities and do not have their own fire departments. The rural fire stations are manned by volunteer firefighters and are discussed in the volunteer fire subsections of this section.

The urban area Clark County Fire Department operates out of 15 stations. With 422 uniformed personnel (1 chief, 2 deputy chiefs, 4 assistant chiefs, 8 battalion chiefs, 77 captains, 100 engineers, and 230 firefighters), the department provides a level of service of 1.04 firefighters per 1,000 people. The 1995 urban population outside incorporated cities in Clark County was assumed to be 39 percent of the entire Clark County population. This reflects the 1990 ratio to the county of the populations of Sunrise Manor, Spring Valley, Whitney (formerly East Las Vegas), Winchester/ Paradise, and Enterprise (U.S. Bureau of the Census, 1994; Vinson, 1995).

The Clark County station units include 15 engines, 8 rescue vehicles, 6 ladder trucks, 2 hose wagons, 1 mobile air unit, 3 battalion chief vehicles, 1 water tender, 1 heavy-rescue vehicle, and 1 hazardous materials vehicle. In reserve are three rescue vehicles and three engines. Reserve vehicles permit the repair of first-line equipment without reducing fire ground forces and provide additional firefighting units during major emergencies. Planned acquisition of station units include a heavy-rescue chase vehicle and a hazardous-materials chase vehicle (King, 1995).

Las Vegas Fire Department—The Las Vegas Fire Department currently has 10 fire stations, but 3 more are anticipated to be built by the year 2000. The department has 303 firefighters, including 1 fire chief, 3 deputy chiefs, 1 assistant fire chief, 6 battalion chiefs, 54 captains, 52 firefighter/paramedics, 58 engineers, and 128 firefighters. This staffing leads to a level of service of 0.84 firefighters per 1,000 people. In addition, the department has 9 training staff and 20 fire prevention staff. The department's equipment consists of 1 air resource vehicle (compressor for air tanks), 11 engines/ pumpers, 4 ladder trucks, 1 hazardous materials vehicle, 6 paramedic trucks, 3 reserve engines, 2 reserve ladder trucks, 3 reserve rescue trucks, and 1 communications unit (Lawson, 1995).

City of North Las Vegas Fire Department—The city of North Las Vegas Fire Department maintains three stations; one additional station was recently built. The total number of firefighters is 84, which results in a level of service of 1.15 for every 1,000 people. In addition, the department has 16 paramedics, 2 training personnel, and 4 fire prevention personnel. Equipment consists of four engine/pumpers, one ladder truck, two reserve engines, two rescue vehicles, and seven automobiles (Marchand, 1995).

Volunteer Fire Departments—There is no Nye County fire department. Because the county population is scattered and small, each area's volunteer fire department responds to fire-related calls. Volunteer fire departments are private, nonprofit corporations. The following discussion outlines the volunteer fire departments in Tonopah, Pahrump, Beatty, and Amargosa Valley.

Tonopah Volunteer Fire Department—The Tonopah Volunteer Fire Department operates out of one station with 27 firefighters, including 1 chief, 1 assistant chief (both of whom receive salaries), and 25 volunteer firefighters. This staffing results in a level of service of 7.09 per 1,000 people. Equipment includes 2 pumpers/engines, 1 mini-pumper, and one 100-ft aerial ladder truck. In reserve are one pumper and one 1942 vintage pumper, which is used as a hose tender (Jamison, 1995).

Pahrump Valley Volunteer Fire Department—The Pahrump Valley Volunteer Fire Department maintains a staff of 30 volunteer firefighters, resulting in a level of service of 1.98 firefighters per 1,000 people. The department employs a paid administrative assistant. Ten of the firefighters are emergency medical technicians. The department has three stations, and equipment consists of one pumper, two attack trucks, one utility truck, three engines, three water tenders, and one heavy-rescue truck (Duga, 1995).

Beatty Volunteer Fire Department and Ambulance Service—The Beatty Volunteer Fire Department has one fire station with no current plans for additional stations. The number of firefighters includes 28 (27 volunteers and 1 paid) for a level of service of 14.51 firefighters per 1,000 people. In addition, the department has five training personnel and five fire-prevention personnel. Equipment includes two pumpers and one crew cab, which is used mainly for automobile rescue (Sullivan, B., 1995).

Amargosa Valley Volunteer Fire Department—The Amargosa Valley Volunteer Fire Department has a force of about 123 volunteers, leading to a level of service of 23.12 per 1,000 people. Only the fire chief is a paid employee. The department charges for fire services to persons not living in Amargosa Valley. The service area encompasses 1,463 km^2 (565 mi^2). The fire department maintains two fire facilities. Station One is located in the town, and Station Two is located near the California border. Station One has a quick-attack truck, a pumper truck, a tanker truck, and a van that is used to transport extrication equipment. Station Two has two pumper trucks. The department has formal mutual-aid agreements with the State Bureau of Fish and Game and the U.S. Bureau of Land Management and responds to calls at Shoshone, California. The department has no equipment, such as hazardous material suits, for hazardous material response. If a hazardous material accident were to occur, the department would wait for assistance from outside sources (Blankenship, 1995).

HEALTH CARE—In Clark County, 1,418 medical doctors and approximately 5,000 registered nurses are registered to practice, resulting in a health care level of service of 1.37 medical doctors and 4.84 registered nurses per 1,000 people. The corresponding level of service for Nye County is 0.34 medical doctors and 1.53 registered nurses per 1,000 people, both of which are inadequate service levels (Table 4-14).

Health care in the region of influence includes 8 full-service hospitals, 2 medical clinics, and 3 special service hospitals located in Clark and Nye counties, with a combined bed capacity of 2,531 beds, or 2.75 beds per 1,000 people (Table 4-15). These facilities provide a wide array of medical services, including physical examinations; treatment of occupational and non-occupational illnesses; emergency, intensive, and cardiac care; coronary care; internal medicine; X-ray and laboratory; infertility; obstetrics and gynecology; neonatal intensive care; inpatient and outpatient surgery; pharmaceuticals; optometry; dental; respiratory therapy; and skilled nursing and long-term care. Services provided by the three special service hospitals include psychiatric, chemical dependency, and mental health treatment. In addition, the Clark County Health District provides public health clinics and visiting nurse services and coordinates the emergency medical services system. There are 3 public health centers, 20 immunization and child health satellite clinics, and a hospice program providing 24-hour care to terminally ill patients (Las Vegas Review-Journal, 1994).

The Tonopah Hospital District has been operating at a loss and will be taken over by the Nye County Board of Commissioners. Pahrump will open an urgent care facility. Health care clinics in Beatty and Amargosa Valley are operated by the Central Nevada Rural Health Consortium. Health care service is generally not readily available to Nye County residents.

The Central Nevada Rural Health Consortium is a quasi-governmental agency that was organized by Nye, Lincoln, Washoe, and Eureka counties to provide health care services to communities in rural Nevada that are not large enough to support private sector health care. The consortium is under contract with Nye County to provide physician's assistant supervision, support services, and equipment to rural areas. One of the clinics it supports is the Amargosa Valley Medical Clinic, which emphasizes family practice but also provides minor emergency service, X-ray service, minor laboratory work, and pharmacy services. Physician's assistants, who are staffed from Beatty, refer serious cases to hospitals and special care facilities in Las Vegas (Blankenship, 1995).

4.1.4 Geology and Soils

All DOE administrative units discussed in this EIS, including the NTS, NAFR Complex, and Tonopah Test Range, lie within the northern Basin and Range Physiographic Province. Because these units have similar settings, they are described together as a

Table 4-14. Health care personnel in the region of influence (1995)

Job Classification	Clark County	Nye County	Level of Service* Clark County	Level of Service* Nye County
Medical Doctors	1,418	9	1.37	0.34
Registered Nurses	5,000	40	4.84	1.53

* Per 1,000 people.

Source: Lyons and Towler, 1995.

Table 4-15. Primary medical facilities serving the region of influence (1995)

Facilities	Location	Number of Licensed Beds
Clark County		
Charter Behavioral Hospital	Las Vegas	84
Desert Springs Hospital	Las Vegas	225
Horizon Hospital	Las Vegas	28
Columbia Sunrise Hospital	Las Vegas	688
Lake Mead Hospital	North Las Vegas	195
Las Vegas Federal Medical Center	Las Vegas	129
Monte Vista Hospital	Las Vegas	80
University Medical Center	Las Vegas	560
Valley Hospital	Las Vegas	416
Women's Hospital	Las Vegas	82
Nye County		
Dr. Russell Joy Medical Clinic	Tonopah	N/A*
NTS Medical Center	NTS	N/A
Nye County Regional Medical Center	Tonopah	44

* Not applicable.

Sources: DOE/NV, 1993; Las Vegas Review-Journal, 1994.

single region. However, the greatest emphasis is placed on the NTS. Discussions of specific administrative units are also included in separate subsections when information at a local scale increases understanding and assists in the evaluation of impacts.

Detailed investigations of the geology of the NTS have been in progress since 1951, shortly after the test site was established. The geologic studies were expanded in the 1950s and early 1960s as underground testing became the established mode for testing nuclear explosives. Since then, many regional and site studies have been conducted that have included detailed geologic mapping, sitewide geophysical surveys, exploratory drilling and testing, and detailed geotechnical studies. As a result of these many investigations, comprehensive databases are available on virtually every aspect of the geologic conditions on the NTS and surrounding areas. As noted in the *Final Environmental Impact Statement Nevada Test Site, Nye County, Nevada*

(ERDA, 1977), the NTS is probably the geologically best known large area within the United States.

4.1.4.1 Physiography. The NTS and surrounding areas are in the southern part of the Great Basin, the northern-most subprovince of the Basin and Range Physiographic Province (Figure 4-18). The basin- and range-province is generally characterized by more or less regularly spaced, generally north-south trending mountain ranges separated by alluvial basins that were formed by faulting. The Great Basin subprovince is an internally draining basin; i.e., precipitation that falls over the basin has no outlet to the Pacific Ocean.

The topography of the eastern and southern NTS and the entire Tonopah Test Range are typical of the Great Basin, with numerous north-south trending mountain ranges and intervening alluvial basins. In the northwestern portion of the NTS, the physiography is dominated by the volcanic highlands of the Pahute and Rainier Mesas.

The relief of the NTS is considerable, ranging from less than 1,000 m (3,280 ft) above sea level in Frenchman Flat and Jackass Flats to about 2,339 m (7,675 ft) on Rainier Mesa and about 2,199 m (7,216 ft) on Pahute Mesa. Figure 4-19 shows the general topographic expression of the region. In general, the slopes of the upland surfaces are steep and dissected, and the slopes in the lowland areas are more gentle and less eroded.

There are three primary valleys on the NTS: Yucca Flat, Frenchman Flat, and Jackass Flats. Both Yucca and Frenchman Flat are topographically closed, with playas in the lowest portions of each basin. Jackass Flats is topographically open with drainage via the Fortymile Wash off the NTS.

The topography of the NTS has been altered by historic DOE actions, particularly underground nuclear testing. The principal effect of testing has been the creation of numerous craters in Yucca Flat basin and a lesser number of craters on Pahute and Rainier Mesas. Shallow detonations were also performed during Project Plowshare to determine the potential uses of nuclear devices for large-scale excavation. Lesser alterations of the natural topography of the NTS and adjacent areas have occurred as a result of road building, sand and gravel mining, underground mining prior to the creation of the NTS, and the construction of waste disposal areas, flood controls, and drainage improvements.

4.1.4.2 Geology. The geology of the NTS consists of a thick section (more than 10,597 m [34,768 ft]) of Paleozoic and older sedimentary rocks, locally intrusive Cretaceous granitic rocks, a variable assemblage of Miocene volcanic rocks, and locally thick deposits of postvolcanic sands and gravels that fill the present day valleys (Frizzell and Shulters, 1990). Figure 4-20 is a generalized geologic map of the NTS. More detailed stratigraphic information is available from recently updated maps of the NTS (Frizzell and Shulters, 1990) and Pahute Mesa (Minor et al., 1993). Figure 4-21 shows a generalized stratigraphic column for the area in the vicinity of the NTS.

The tectonic history of the region is very complex, and major structural events have left their imprint on the stratigraphy of the area. This region of the western United States was a stable continental margin until Late Devonian time, when uplift west and north of the NTS resulted in the erosion and deposition of thick Mississippian sandstones in a foreland basin (Poole and Sandberg, 1991). Compressional deformation during the Sevier orogeny produced regional thrusts, folds, and wrench faults that fundamentally rearranged the positions of the Paleozoic and older sedimentary rocks (Armstrong, 1968). The Sevier orogenic zone may have been extended with normal faulting prior to late Mesozoic time and the intrusion of granitic rocks (Hodges and Walker, 1992; Cole et al., 1993).

Following erosion throughout most of the Early Tertiary Period, the area in and around the NTS began to pull apart along low-angle normal faults and strike-slip faults associated with the formative stages of the modern basin-and-range structural province (Guth, 1981; Hamilton, 1988; Wernicke et al., 1988; Cole et al., 1989). Eruptions of the southwest Nevada volcanic field occurred in the Middle Tertiary Period (Warren et al., 1989; Sawyer et al., 1990). Successive eruptions produced no less than seven large and partially overlapping calderas,

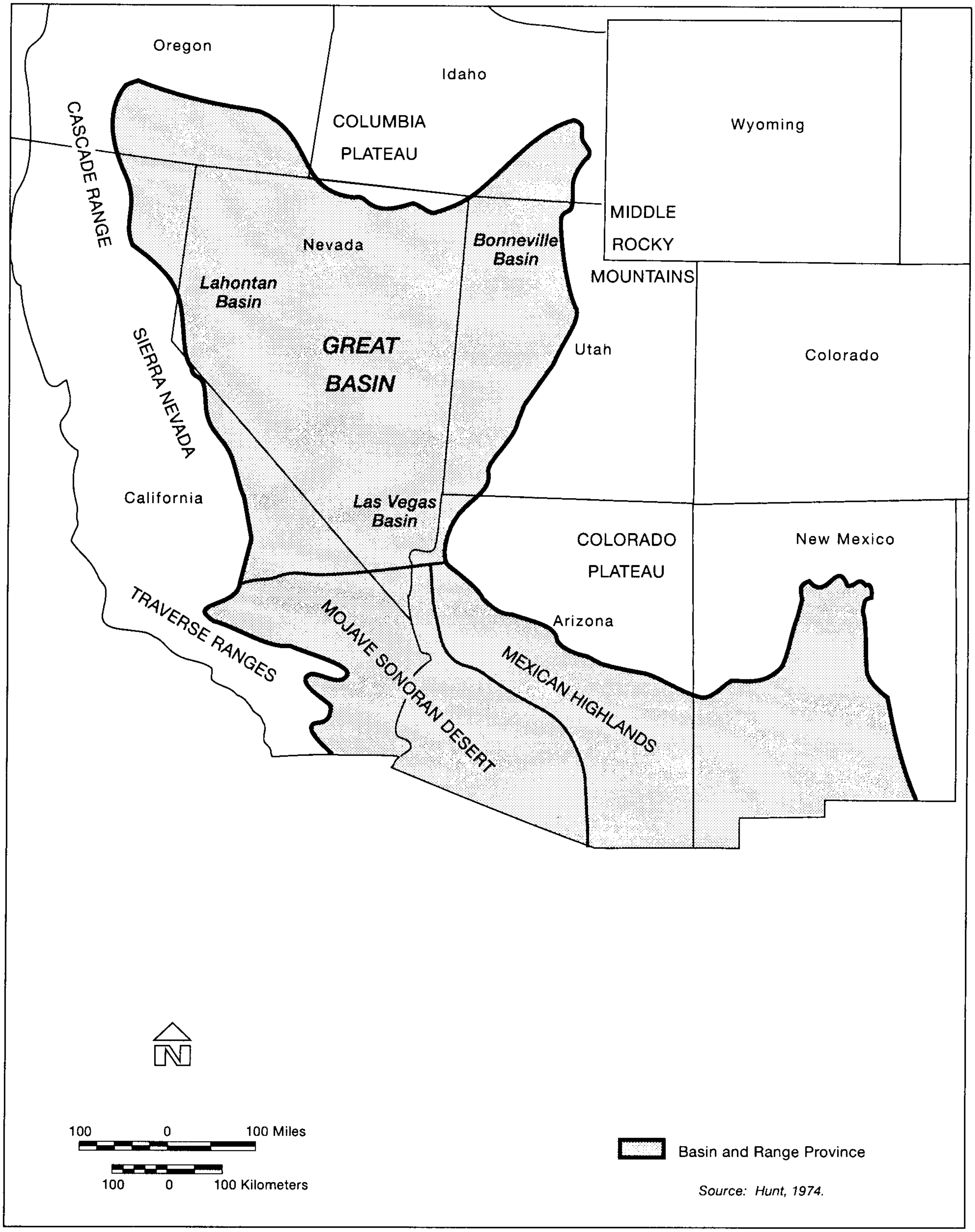


Figure 4-18. Basin and Range Physiographic Province

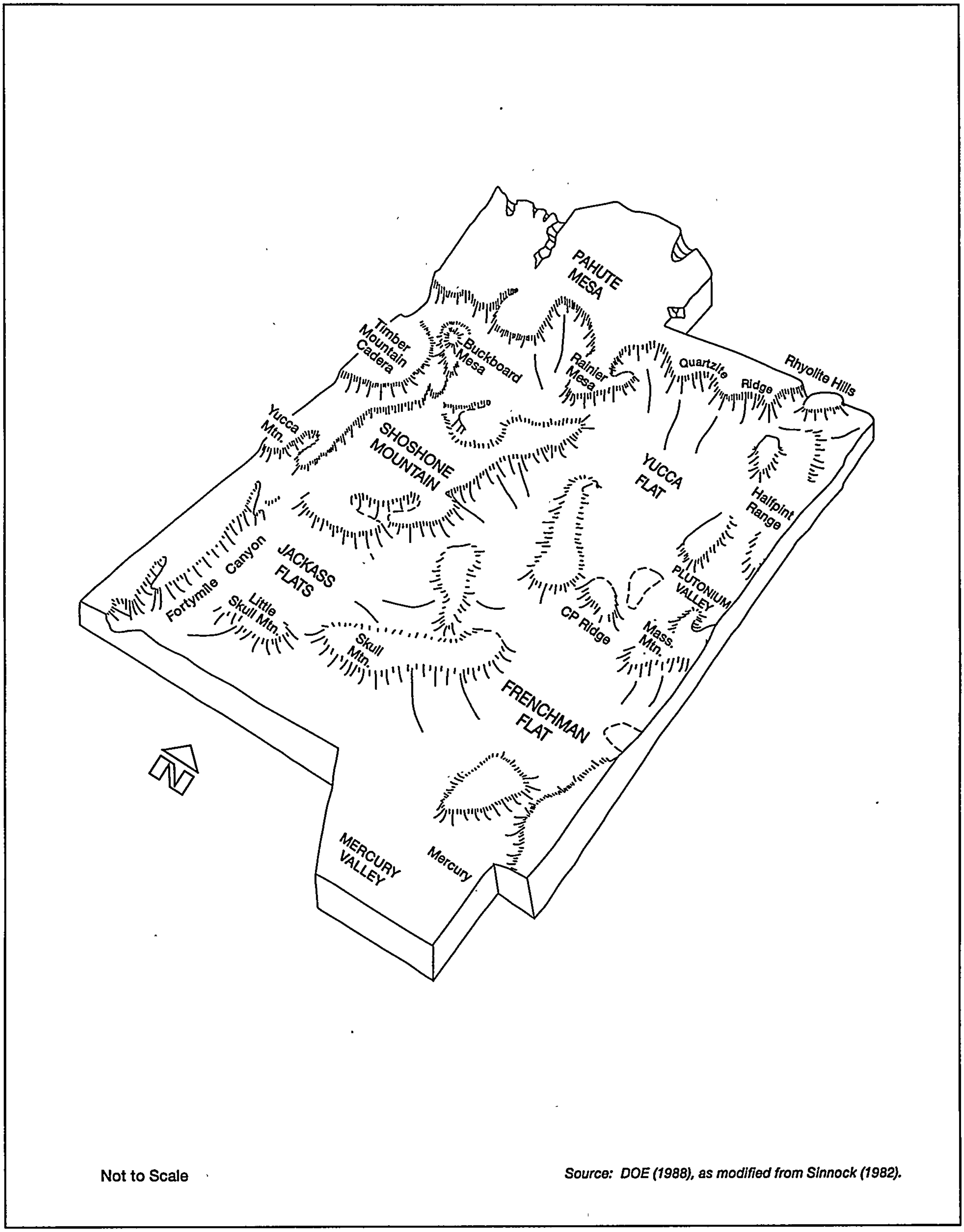


Figure 4-19. Topography of the NTS

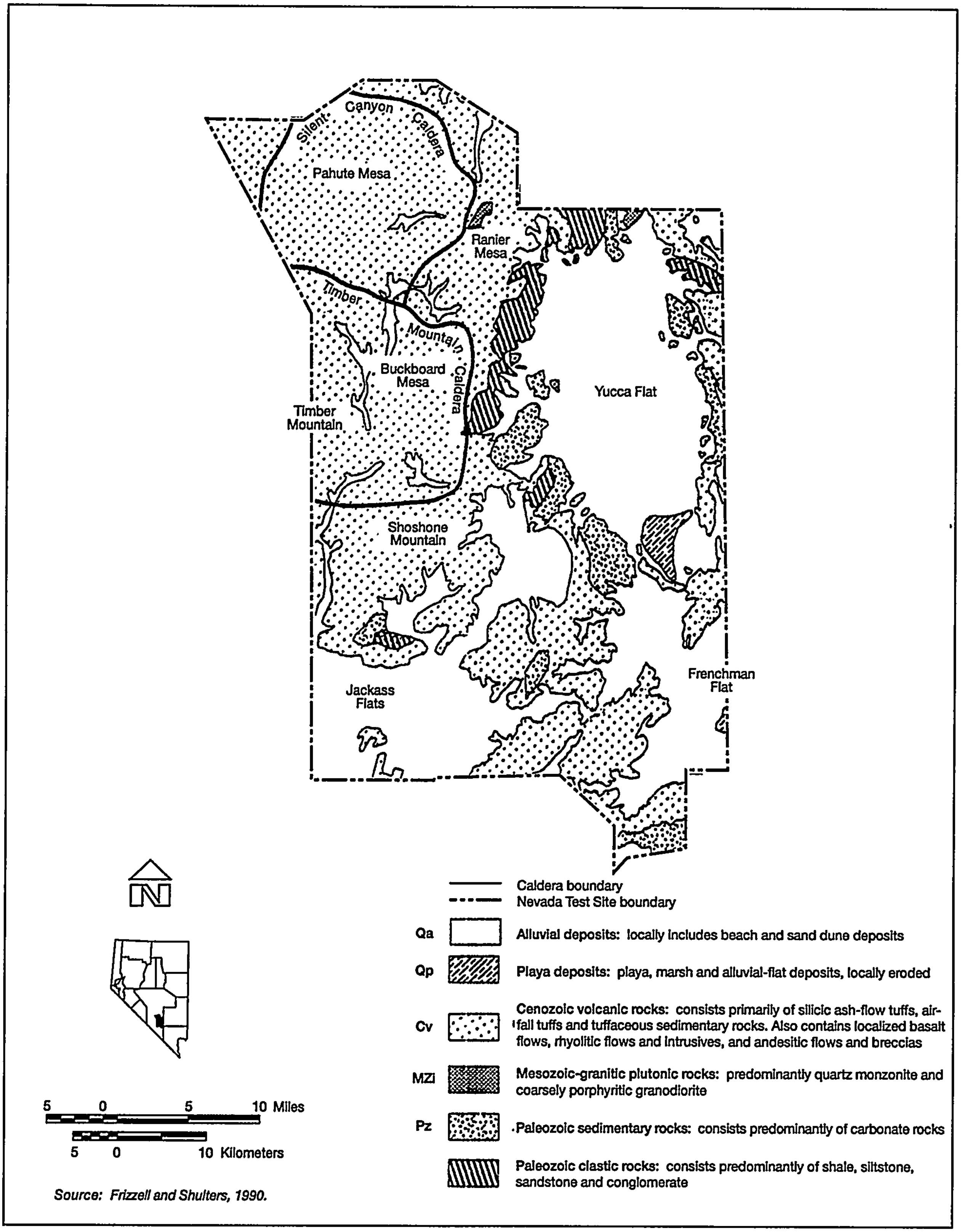
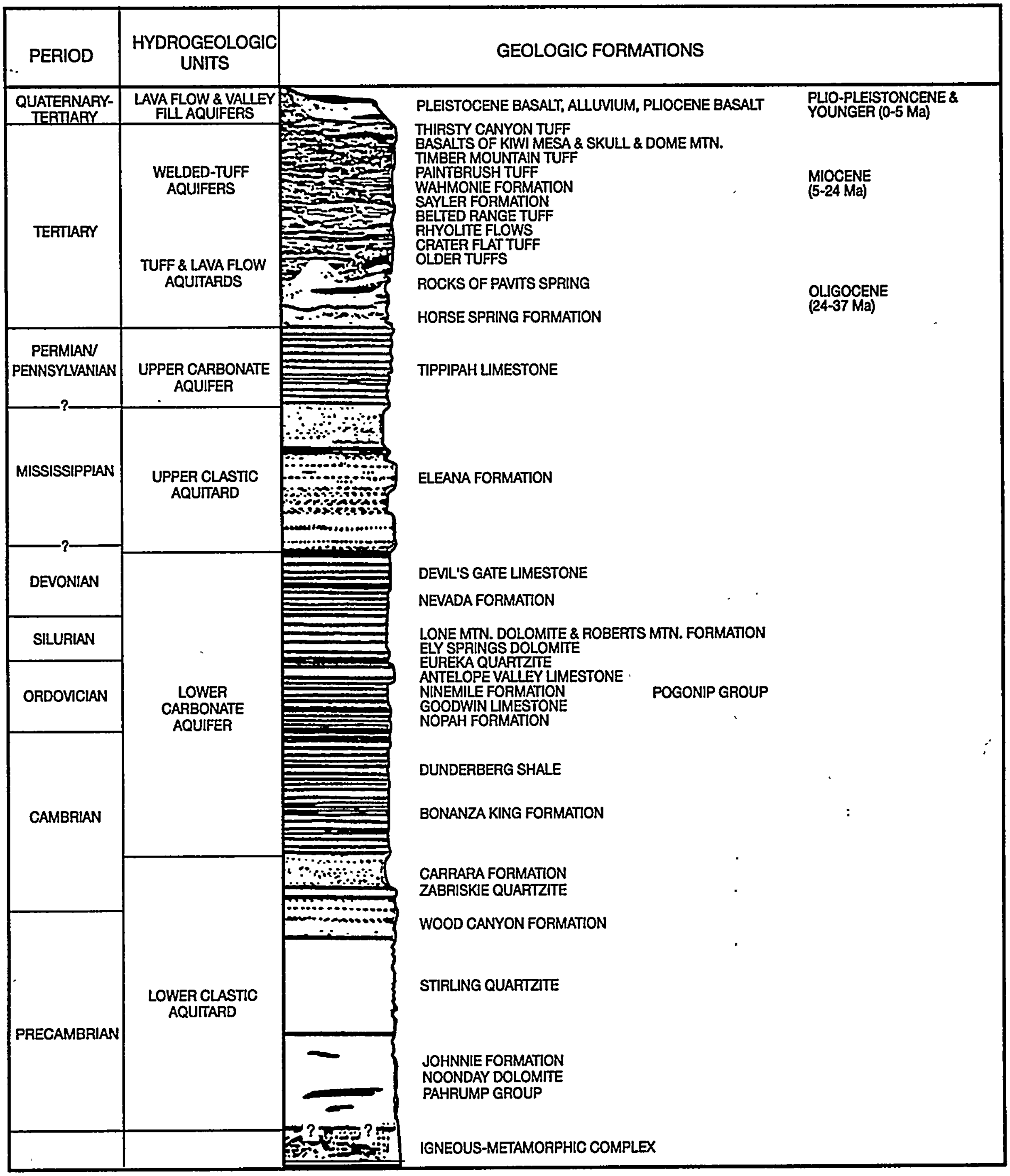


Figure 4-20. Generalized geologic map of the NTS



Source: DOE, 1988.

No vertical scale inferred

Figure 4-21. Generalized stratigraphic column which were filled with lava flows and blanketed by vast deposits of tuff.

Cenozoic crustal extension formed normal faults, continued during and after volcanic activity, and caused further tilting and lateral translation of major upper crystal blocks. Modern alluvial basins have progressively filled with as much as 1,200 m (3,936 ft) of coarse gravels and sands and localized deposits of playa silt and clay. Tectonic extension, wrench movement, and seismic activity continue to the present day.

YUCCA FLAT AND FRENCHMAN FLAT—Yucca Flat and Frenchman Flat, where nuclear testing occurred, are intermontane basins typical of basin-and-range structure. The alluvium- and tuff-filled valleys are rimmed mainly by Precambrian and Paleozoic sedimentary rocks and Cenozoic volcanic rocks.

In the lowland areas of these basins, the consolidated rock units are overlain with alluvium. On the alluvial fans, the alluvium comprises interbedded gravel, sand, and silt with varying degrees of cementation. These coarse-grained deposits grade to the predominantly clay deposits under the playa areas. Limited areas of wind-blown sands and silts are also present in portions of the lowland areas.

Mesozoic intrusive rocks are located at the north-northeast edge of the Yucca Flat weapons test basin. Precambrian and Paleozoic rocks are regionally extensive and occur under the basins as basement rocks.

The lowermost 2,999 m (9,840 ft) of the pre-Tertiary section consists of Late Precambrian to Middle Cambrian quartzites and siltstones. These clastics are overlain by 4,599 m (15,088 ft) of Cambrian through Devonian dolomite, interbedded limestone, and thin, but persistent, shale and quartzite layers. Pennsylvanian limestone depositionally overlies the Eleana formation along the western edge of the basins. The second assemblage consists of heterogeneous carbonate rocks that lie structurally above the Eleana formation as a result of thrust faulting of low-angle normal faulting (Cole et al. 1989). A few drill holes at the NTS have penetrated these "isolated" carbonate rocks overlying the Eleana formation. Thrust faults have repeated sections of the Paleozoic and Precambrian rocks, and low-angle gravity faulting has created isolated blocks of the Paleozoic rocks out of stratigraphic order. Today, most prominent structures are related to basin-and-range extensional faulting that is younger than the volcanic rocks. In the Yucca Flat weapons test basin, fault strikes are mostly north-south; in Frenchman Flat, structure strikes are mostly west-southwest.

Outflow sheets of tuffs from the volcanic centers west of the basins occurred during the Tertiary Period and were emplaced on the irregular paleotopographic surface of the basins. The youngest sediments of the valleys are sand and gravel, derived from the volcanic and sedimentary rocks in the surrounding highlands. Tests at both locations have been detonated primarily in alluvium or in the volcanic rocks. A few larger tests were detonated in the underlying carbonate rocks beneath the northern Yucca Flat weapons test basin during the early years of the testing program, and three small tests were detonated in granite just north of the Yucca Flat weapons test basin at the Climax stock (OTA, 1989). Testing near or below the water table was common in both the Yucca Flat weapons test basin and Frenchman Flat test area.

PAHUTE MESA AND RAINIER MESA—The southwestern Nevada volcanic field, of which Pahute Mesa is part, includes a broad volcanic plateau underlain by tuffs and lavas from the Timber Mountain-Oasis Valley caldera complex and the Silent Canyon and Black Mountain calderas north of Timber Mountain (Byers et al., 1989). This Miocene, rhyolitic, eruptive center produced an overlapping complex of fault-controlled calderas in the general area of Timber Mountain and Pahute Mesa and laterally extensive tabular outflow sheets of welded tuff on Rainier Mesa. The Timber Mountain caldera is listed as a National Natural Landmark by the U.S. Park Service. Recent work indicates that as many as six calderas may be present in the Pahute Mesa area and that the calderas may be ellipsoids bounded by faults related to basin-and-range structure rather than circular collapse structures (Ferguson et al., 1994).

Stratigraphic units represent caldera-forming, caldera-filling, and caldera-burying emplacements, depending on their location relative to their originating and successive eruptions (Ferguson et al, 1994).

All underground tests within Pahute Mesa, as well as Rainier Mesa, have been detonated within volcanic rocks.

OTHER TESTING AREAS—The DOE has also conducted limited nuclear tests in areas beyond the four major testing areas already discussed. The limited testing areas include Buckboard Mesa, Dome Mountain, Shoshone Mountain, and the Climax stock.

The area of testing in Buckboard Mesa is located in the east-central portion of Timber Mountain, and the Dome Mountain testing area is located along the southern flanks of this caldera. These two sites exhibit the general geologic conditions of the caldera complex, that is, a thick sequence of volcanic rocks, including welded and ash-flow tuffs; volcanic-derived sediments, including sandstone and conglomerate; and basalts. The radial fracturing and faulting typical of a caldera are present at both of these sites.

Shoshone Mountain is located beyond the Timber Mountain caldera, but the volcanic rocks derived from this volcanic center predominate at this site, as well. The predominant rocks include the Ammonia Tanks and Tonopah Spring tuffs and ash-flow tuffs. There are also exposures of clastic sediments and carbonate rocks of Paleozoic age, including the Tippipah Limestone and the Eleana formation, on the northwest flanks of the Shoshone Mountain testing area. At this site, the northeast to southwest striking normal faults typical of many portions of the Basin and Range Province are predominant.

The Climax stock, located along the northern flank of Yucca Flat, was used for testing and experimentation. The stock is a granitic (quartz monzonites and granodiorite) intrusion of the Late Cretaceous age. The Climax stock occurs at the intersection of two geologic structures, the Tippinip fault and the Halfpint anticline, and intrudes Paleozoic sediments.

Many of the valleys have playas that may hold shallow water after seasonal storms. Playa sediments are bedded sand, silt, or clay and may include salts. Other sediments in the region carried and deposited by wind are typically sand and silt. These aeolian sediments generally are from nearby playas or dry river beds, but can be from afar. These deposits are often retransported by streams. However, surfaces of relatively stable deposits in the valleys generally have a thin veneer of wind-deposited silt.

SUBSURFACE RADIOLOGIC SOURCES—As discussed in the *Final Environmental Impact Statement, Nevada Test Site, Nye County, Nevada* (ERDA, 1977), underground nuclear testing has resulted in unavoidable adverse impacts to land resources that render the resources unusable for most purposes. Underground nuclear tests were begun in June 1957, and through 1992 there were approximately 800 underground tests conducted at the NTS with yields ranging from zero to 1,000 kilotons (kt). Underground testing, for the purposes of discussion, can be divided into three broad categories: shallow borehole tests, deep vertical tests, and tunnel tests. In this section, the current condition of the subsurface geologic resources, as they have been affected by historic activities, is presented.

Shallow borehole tests were conducted between 1960 and 1968. Some of these tests were safety-related, others were conducted as part of Project Plowshare to determine whether nuclear detonations could be used as a method for excavation. The shallow tests resulted in the development of some large ejection craters, most notably the Sedan Crater in the northern end of the Yucca Flat testing area. Sedan, a 104-kt nuclear device detonated 194 m (635 ft) underground, displaced about 1.2×10^7 tons of earth and created a crater 390 m (1,280 ft) in diameter and 98 m (320 ft) deep. McArthur (1991) estimates that the remaining inventory of surficial radioactivity at the Sedan Crater is 344 Ci. The total estimate for all releases from shallow borehole tests to the surficial soil horizon at the NTS is 2,000 Ci.

Deep vertical underground nuclear tests have been completed in Frenchman Flat, Yucca Flat, Pahute

Mesa, Rainier Mesa, Shoshone Mountain, Buckboard Mesa, and Dome Mountain. The tunnel complex at Rainier Mesa has been extensively used for special experiments and tests that require access to materials and monitoring equipment left near the point of detonation. Figure 4-22 shows the locations of the underground tests. The historic tests have left their mark on the NTS both in terms of physical disruption and a large subsurface inventory of remaining radioactive isotopes.

The major impacts of an underground nuclear test on the physical environment are ground motion, disruption of the geologic media, surface subsidence, and contamination of the subsurface geologic media and surficial soils. Ground motion is a temporary phenomenon that, with the exception of rockfalls and minor land displacements, has not resulted in permanent effects on the NTS. The cratering, the disruption of underground geologic media, and the release of radioactivity into the environment have been the most significant impacts to the physical environment as a result of historic testing operations at the NTS. The physical impacts of vertical underground tests can perhaps be best described through a discussion of the events that occur after a nuclear detonation.

Figure 4-23 shows the sequence of events after an underground detonation. Within tens of milliseconds following detonation, the nuclear device and surrounding rock are vaporized, creating a "bubble" of high pressure steam and gas. An underground spherical cavity is formed by the pressure of this gas bubble and the explosive momentum that is imparted to the host rock. As the cavity continues to expand, the pressure decreases and, usually within a few tenths of a second after detonation, equalizes with the pressure from the overlying rock. At this point, the cavity has reached its greatest dimensions. Concurrent with this pressure decrease, the shock wave from the detonation travels outward, crushing and fracturing the rock in the near-test environment.

As the hot gases cool, the molten rock begins to collect and solidify on the cavity sidewalls and in a puddle at the bottom of the cavity. When the gas pressure declines to the point where it can no longer support the overlying rock and soil, the cavity may collapse, forming a chimney upward from the cavity. The collapse occurs as the overlying rock breaks into rubble and falls into the cavity void. This process continues until either the cavity completely fills with rubble, the chimney reaches a level where the strength of the rock can support the overburden, or, as usually happens, the chimney reaches land surface. When the chimney reaches the surface, the ground sinks, forming a saucer-like subsidence crater. The crater usually forms within a few hours after the detonation.

Historic deep vertical underground testing has resulted in the formation of hundreds of craters at the NTS, leaving Yucca Flat with a "pockmarked" appearance that is even visible on satellite images of the area. The craters generally range in diameter from 61 to 610 m (200 to 2,000 ft) and range in depth from a few meters to 60 m (a few feet to 200 ft) depending on the depth of emplacement and the explosive energy yield. The development of craters has been the principal consequence of nuclear testing on the terrain of the NTS and was one of the unavoidable adverse impacts identified in the *Final Environmental Impact Statement, Nevada Test Site, Nye County, Nevada* (ERDA, 1977) (see Plate 7, entitled Aerial View of the Many Craters Within Yucca Flat, of the *Framework for the Resource Management Plan* [Volume 2]).

In addition to the cavity, chimney, and subsidence crater, pressure ridges and small displacement faults may occur at the surface. The surface fracturing and faulting are the result of the sudden uplift of the earth at the time of detonation and the collapse during the formation of the chimney and crater. Another permanent consequence of testing has been vertical displacement along existing faults, particularly along Yucca Fault and Carpetbagger Fault in Yucca Flat. Vertical displacement of as much as 2 m (8 ft) has occurred along portions of the Carpetbagger Fault. Cratering has occurred on Pahute Mesa but, because of the greater competency of the rocks in that area and the depths of most tests, cratering in this test area has been infrequent. Fracturing has occurred on the top of Rainier Mesa as a result of the loss of strength in the rocks in that area.

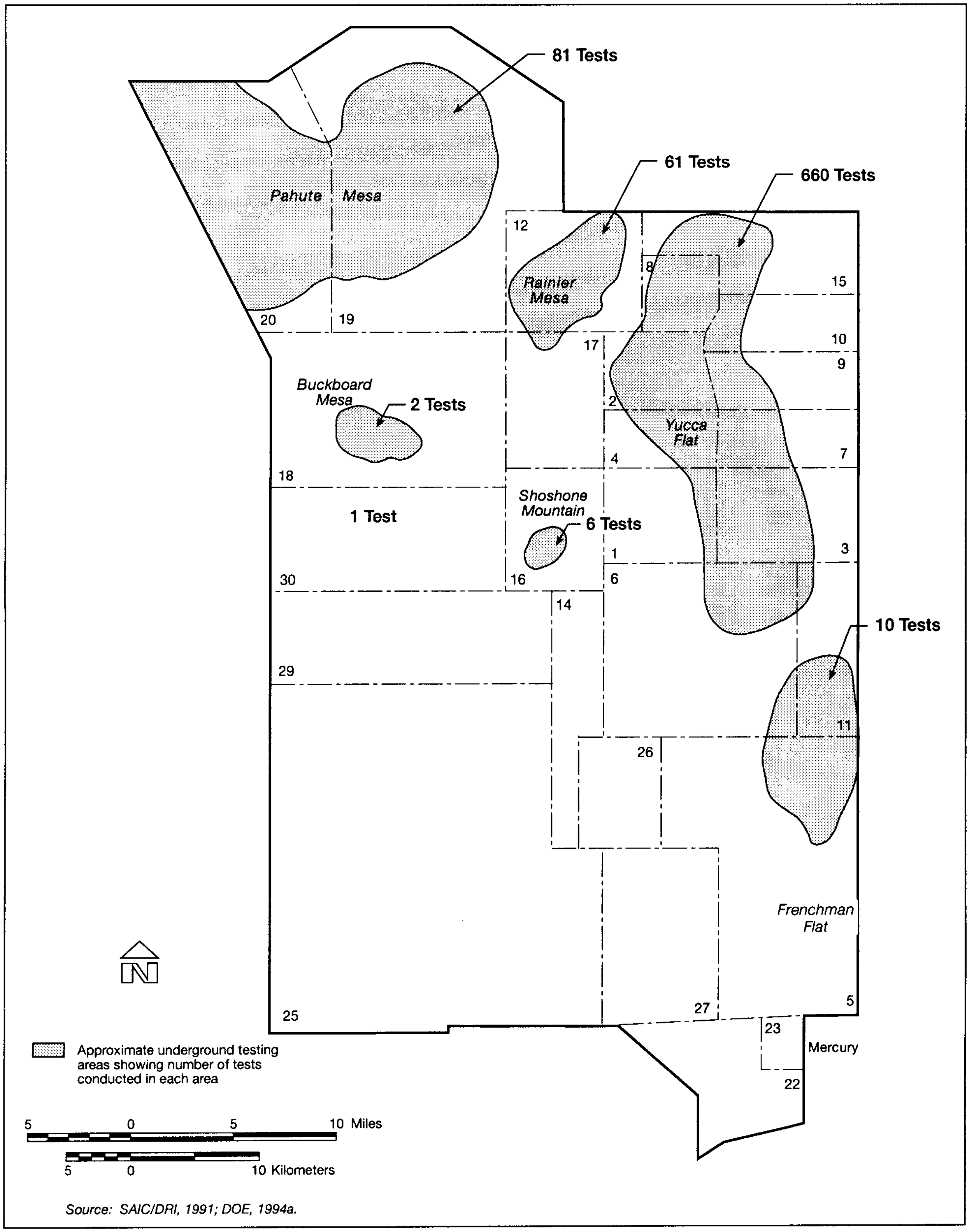


Figure 4-22. Location of underground testing areas and number of tests on the NTS

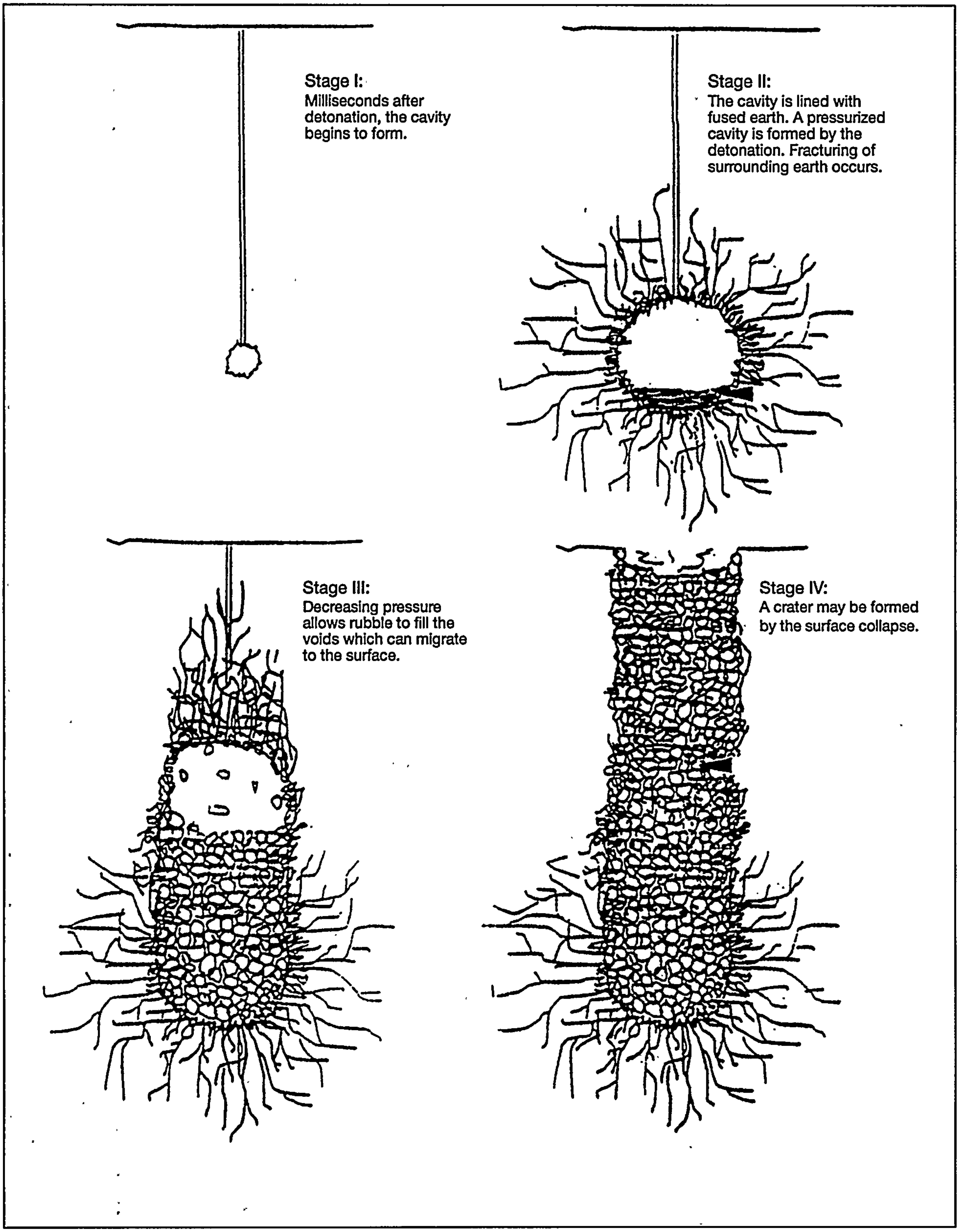


Figure 4-23. Formation of an underground nuclear explosive test cavity, rubble chimney, and surface subsidence crater

Although nuclear tests may have long-term physical consequences on the physical environment, effects of the tests are not synergistic. The sum of the effects of multiple tests does not produce unexpected consequences. Site selection factors that are essential to ensuring both containment and the integrity of test data have also ensured that failures within the test areas have not and would not occur. Appendix A describes the siting factors in greater detail.

The fracturing of the rock in the near-test environment may have resulted in some alteration of the natural permeability of the rocks underlying portions of the NTS. The shock wave and compressive forces from the tests can, on one hand, increase the permeability by creating more fractures near the test while, on the other hand, decrease the permeability by opening and closing fractures at greater distances from the test. According to the Office of Technology Assessment (OTA, 1989), post-test measurements of rock samples taken from tunnel complexes generally show that the properties of the host rock are unchanged at a greater distance than 3 cavity radii from the point of detonation. At this distance and beyond, no fracturing occurs from the detonation, but the preexisting fractures are opened as the shock wave propagates through the host rock and are closed after the shock wave is past. In some instances, the closing of the fractures may have reduced the fracture aperture and may have resulted in some permanent reduction in the gross permeability of the rock mass.

Another consequence of past underground testing has been the formation of pockets of radioactive contamination surrounding each underground test. The total amount of radioactivity released into the underground environment during a test is called the radionuclide source term. The source term includes numerous isotopes that are both short- and long-lived. For the example used for atmospheric testing of a 1-kt nuclear weapon, an initial release of 41 billion curies decays to about 10 million curies in just 12 hours. According to information presented in Borg et al. (1976), the quantity of radioactivity remaining from a 1-kt underground detonation 180 days after detonation is about 45,000 Ci (including 18,570 Ci of tritium).

It should be noted that there is considerable uncertainty concerning these estimates. For example, Borg et al. (1976) indicate that the actual tritium activity after 180 days (expressed in this EIS on a per-kiloton-basis) could range from 5,570 to 55,770 Ci.

The radionuclide inventories that have been referred to are an order of magnitude estimate to illustrate the dominance of short-lived radionuclides soon after a nuclear detonation and the effect of radioactive decay in reducing that inventory. More precise estimates of the radionuclide inventory for geologic media are discussed in the following text. Estimates of the remaining inventory that may be available for transport via groundwater and soil contamination are presented in the sections of the NTS EIS that concern hydrology and soils.

Declassification of the summed inventory (by radionuclide) that remains in, or within 98 m (321 ft) of, the water table has allowed an updated, unclassified estimate of the total radionuclide inventory remaining in the subsurface as a result of underground testing at the NTS. The estimate was based upon two key references: Borg et al. (1976) and a Los Alamos National Laboratory memorandum from T. Benjamin to M. Pankrantz (Benjamin, 1995). This memorandum, which in turn, was based upon Goishi et al. (1995), listed the remaining radionuclide inventory in, or within, 100 m (328 ft) of the water table (as of January 1994) for Los Alamos National Laboratory-only fission products as well as Los Alamos National Laboratory and Lawrence Livermore National Laboratory unfissioned fissile materials, neutron-activated radionuclides, and tritium.

Because the fission products table provided by Los Alamos National Laboratory addressed just the Los Alamos National Laboratory events, it was necessary to first project the radionuclide inventory for all tests. This adjustment was based upon the percentage of Los Alamos National Laboratory tests relative to all tests, and it resulted in the summaries presented in Section 4.1.5.2.

This estimate represents the source term exclusively for events that were detonated within 100 m (328 ft) of the water table; therefore, a further adjustment was needed to estimate the remaining inventory from tests conducted above this level. To estimate this value, the number of announced tests and the distribution of tests in proximity to the water table (as published by Bryant and Fabryka-Martin [1991]) was used. Their work indicates that 38 percent of the tests were conducted under or within 75 m (246 ft) of the water table; thus, the total hydrologic source term for the NTS, as defined previously, represents 38 percent of the total inventory. It is noted that the number of announced tests published by these authors has since been updated, but it was assumed that the relative proportion of shallow and deep events does not vary much from the information presented in their report. Based upon these relative percentages, the total inventory from all tests was estimated to be 3.0×10^8 Ci.

There is some uncertainty regarding this estimate including: the uncertainties in the estimation techniques used by Goioshi et al. (1995), in the actual proportions of Los Alamos National Laboratory tests and water table tests, and in the assumption that the inventories per test are similar for tests in or near the water table as compared to those above the water table. Nonetheless, the estimate serves as a useful reference until declassification efforts allow the release of a more refined estimate. Insofar as the intent of this estimate is to provide a basis for comparison with the remaining inventories which can be measured (e.g., surficial soils, waste disposal units, greater confinement disposal), the estimate is considered appropriate.

GEOLOGIC HAZARDS—Many natural hazards could impact facilities at the NTS, the NAFR Complex, and the Tonopah Test Range (Guzowski and Newman, 1993). Most of these hazards can be discounted on the basis of being physically unreasonable. Six natural hazards occur at a scale that could impact large areas. These include seismicity, volcanism, and four geotechnical hazards: soil instability, slope instability, ground instability, and flooding. Each of these is discussed below, except flooding, which is discussed in Section 4.1.5.1, Surface Hydrology.

SEISMICITY—Ground-motion studies have played a large role in the weapons testing program. Sandia National Laboratories has developed a program for recording surface and subsurface motions resulting from underground nuclear explosions (Vortman, 1979; Vortman and Long, 1982a and b). There are several factors that influence the level and duration of ground motion from underground explosions, including (1) yield of the device; (2) ground-coupling at the source of the explosion, which is a function of depth of the device, local geology, and stratigraphy; (3) geological complexity along the transmission path; and (4) the topography and geology at the location receiving ground motion. There is always some variation or unknown associated with estimating these factors, but because of the long history of conducting weapon tests, the effects are reasonably predictable.

Seismic activity in the region has recently been characterized (Vortman, 1991). This analysis was based on 11,988 seismic events that occurred within 193 km (120 mi) of the NTS since 1868. Of these events, 8,161 were natural, and 3,827 were human-induced. The actual number of seismic events may be larger because emplacement of instruments capable of detecting low-magnitude events is relatively recent. Naturally occurring seismic events are associated with extensional tectonic activity characteristic of the province (Sinnock, 1982; Vortman, 1991).

Three major fault zones in the region may be currently active: Mine Mountain, Cane Spring, and Rock Valley (Figure 4-24). Small earthquakes recently occurred at or near the Cane Spring Fault zone and the Rock Valley Fault zone, although no surface displacement was associated with either of these earthquakes (Carr, 1974). A fault near Little Skull Mountain in the southwest part of the NTS was the site of a 5.6 magnitude earthquake in 1992. This is the largest earthquake recorded within the boundaries of the NTS and may have resulted from the magnitude 7.5 earthquake near Landers, California, which occurred less than 24 hours earlier. Although there was no surface rupture, the Little Skull Mountain earthquake was the first to cause significant damage to facilities on the NTS (Anderson et al., 1993). These facilities, however, were built prior to the more stringent building codes presently followed on the NTS. The earthquake caused an estimated $40,000 in damage to the Field Operations Center, a two-story concrete-block structure located in Area 25 and used by the DOE for studies at Yucca Mountain (Anderson et al., 1993).

Additionally, the Yucca Fault in Yucca Flat weapons test basin (Figure 4-24) has been active in the recent geologic past (Sinnock, 1982; Rogers et al., 1987). This fault displaces surface alluvium by as much as 18 m (60 ft). Displacement of this young surface alluvium indicates that movement on Yucca Fault has occurred within the last few thousand to tens of thousands of years; subsurface displacement along this fault is 213 m (700 ft). The Carpetbagger Fault lies west of the Yucca Fault within Yucca Flat weapons test basin (Figure 4-24). In the subsurface, this fault shows about 610 m (2,000 ft) of displacement in the past 7.5×10^6 years (Sinnock, 1982).

Human-induced historic seismic events recorded since 1868 include those resulting from (1) filling Lake Mead, (2) high-explosive tests, (3) underground nuclear-explosive tests, (4) postnuclear explosion cavity collapses, or (5) after shocks from nuclear explosions (Vortman, 1991). Seismic waves from nuclear explosions are believed to relieve tectonic stress, as manifested by earthquakes deeper than 3 km (1.2 mi) (Rogers et al., 1987), aftershocks, and reactivation of nearby faults in the areas of nuclear-device testing (Rogers et al., 1991). Studies of nuclear-explosive tests show that these events can generate vertical and horizontal displacements on nearby existing faults. As much as 102 cm (40 in.) of vertical displacement and 15 cm (6 in.) of horizontal displacement have been observed (Rogers et al., 1991). Parts of both the Yucca Fault and the Carpetbagger Fault have been reactivated from nearby testing of nuclear devices (Frizzell and Shulters, 1990).

The NTS and the eastern parts of the NAFR Complex and Tonopah Test Range are within Seismic Zone 2B, as defined in the Uniform Building Code (ICBO, 1991) (Figure 4-25). The western parts of the NAFR Complex and the Tonopah Test Range are within Seismic Zone 3. Zone 2B is defined as an area with moderate damage potential, and Zone 3 is an area with major damage potential. Current design practices require facilities to be built to Seismic Zone 4 standards.

The *Final Environmental Impact Statement, Nevada Test Site, Nye County, Nevada* (ERDA, 1977) reported that only architectural damage has been sustained in the local communities for tests greater than 100 kt. Since the Threshold Test Ban Treaty, only a few reports of damage to local communities occur each year, and these are of a very minor nature. Beyond about 48 km (30 mi), structures would have to be higher than several stories tall before they would be affected. The closest location where structures of that height are located is Las Vegas. A smaller number of similar complaints have been recorded from people in Las Vegas high-rise structures.

Seismic activity may also have some impacts on groundwater flow. Water level fluctuations have been observed in southern Nevada that may be attributed to major earthquakes in southern California. These fluctuations are typically short-lived, with water levels rapidly returning to their pre-quake levels. Seismic activity can also fracture the rock aquifers, thereby increasing the transmissive properties of the aquifers and the rate at which groundwater flows through them.

VOLCANISM—Several late Cenozoic, silicic caldera complexes occur in an eastward-trending belt between 37 degrees and 38 degrees north latitude (Stewart, 1980). A part of this belt, which includes the mesas of the NTS and part of the northwestern NAFR Complex and the Tonopah Test Range, has been termed the southwestern Nevada volcanic field (Byers et al., 1989) (Figure 4-26). The Stonewall Caldera is the youngest (7.5×10^6 years) major silicic center in the area. Silicic volcanism is characterized by large-volume explosive eruptions.

A transition from predominantly silicic volcanism to predominantly basaltic volcanism, characterized by low-volume mild eruptions, was initiated approximately 1.0×10^8 years ago (Christiansen and Lipman, 1972). Since 7.5×10^6 years ago, only scattered, short-duration volcanic activity occurred

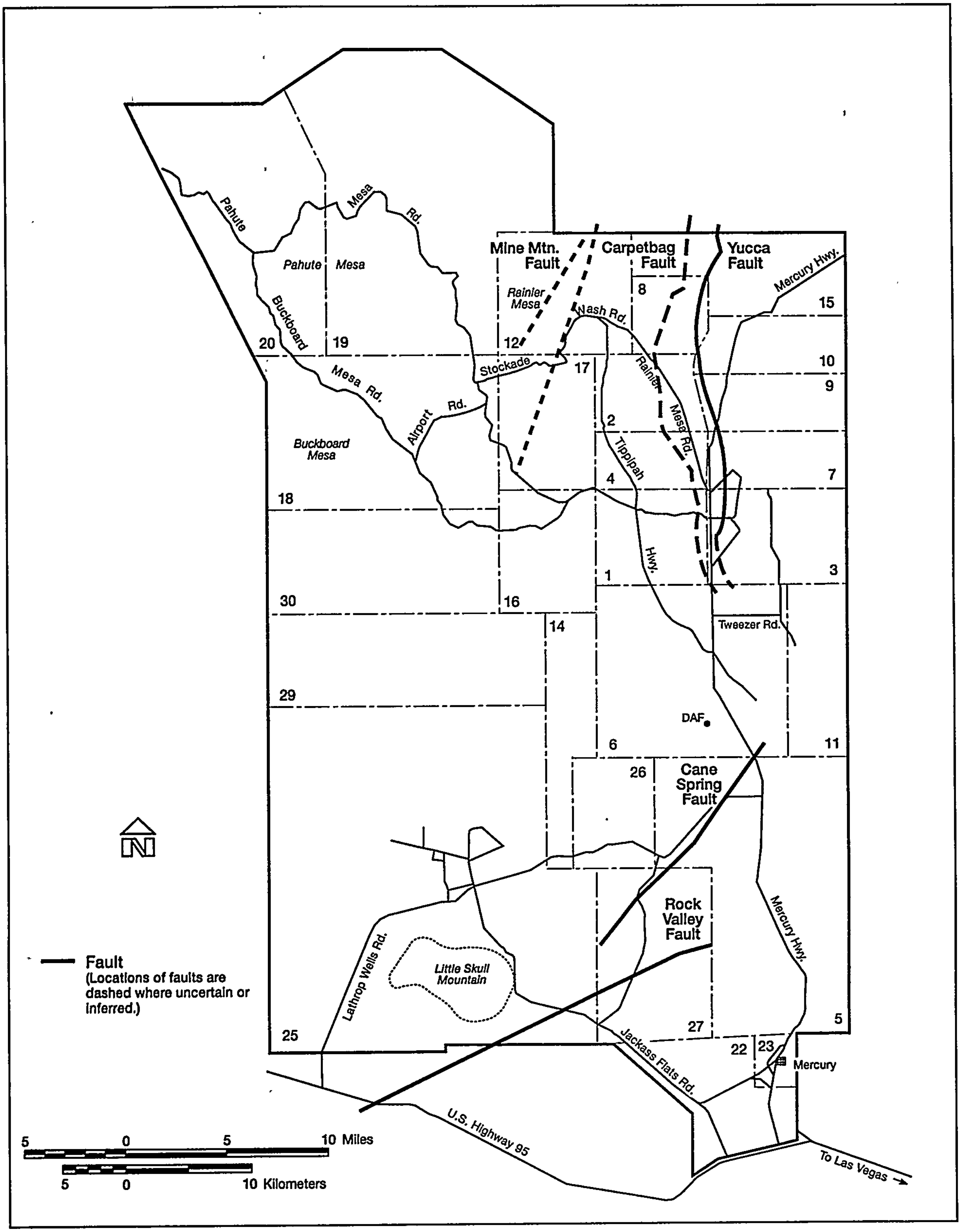


Figure 4-24. NTS fault map

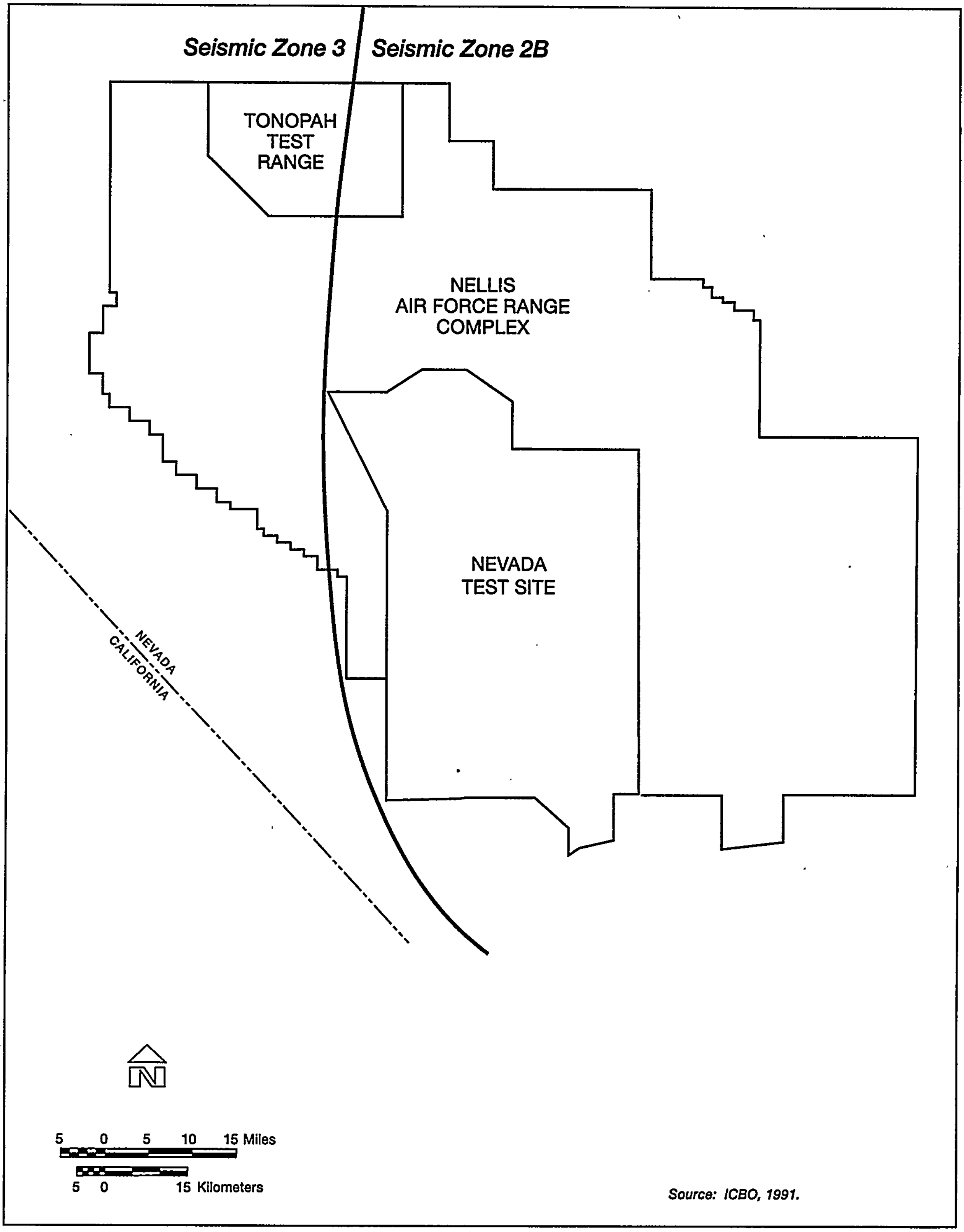


Figure 4-25. Seismic zones in the NTS area

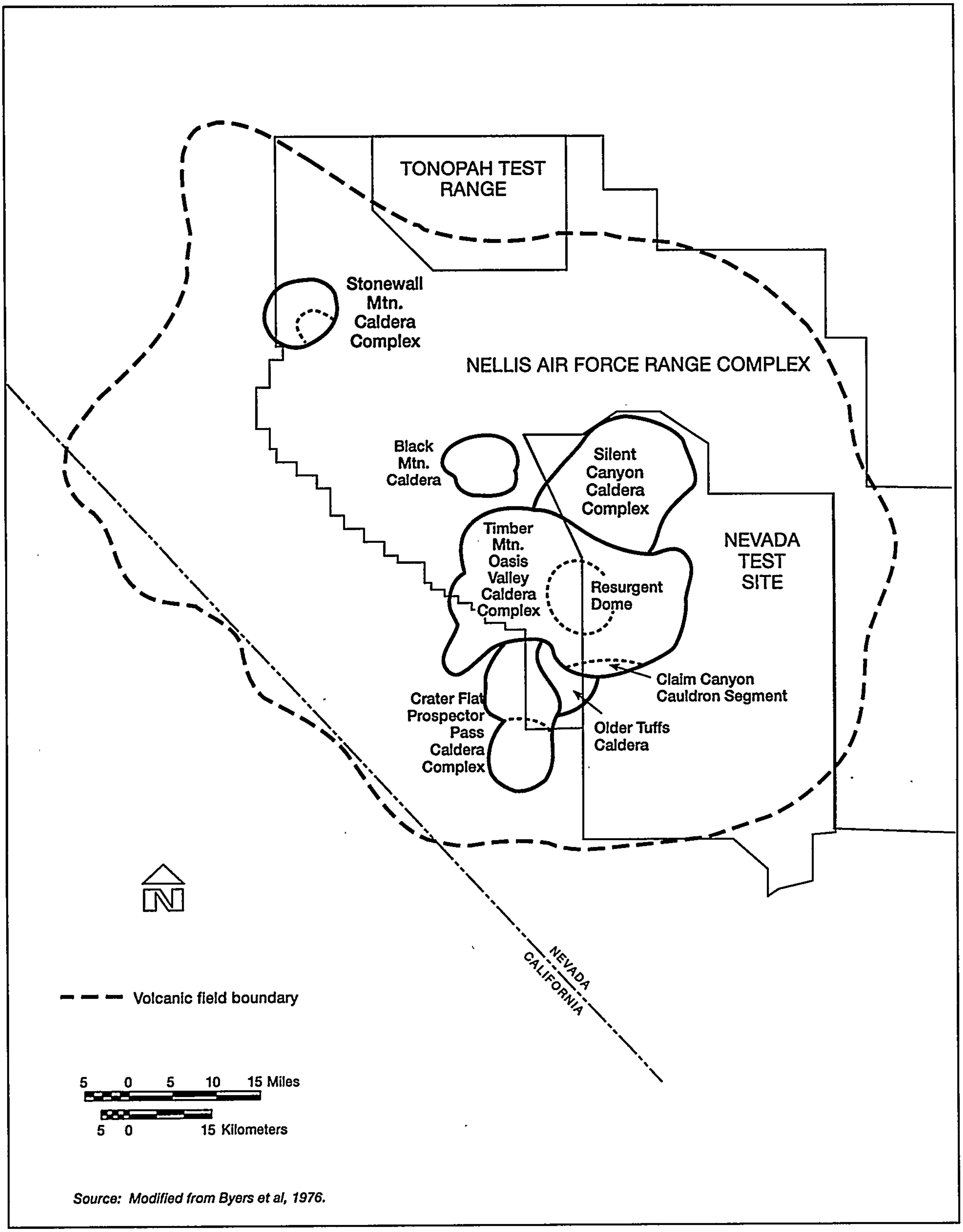


Figure 4-26. Southwestern Nevada volcanic field

in Nevada. The volcanic rocks are primarily basaltic cinder cones and lava flows (Stewart, 1980; Sawyer et al., 1990). The nearest examples of Quaternary volcanic cones and lava flows are located in Crater Flat, west of the NTS (Crowe, 1993).

Based on analysis of previous basaltic volcanism in the NTS region, there is no evidence of either an increase in the volcanic rate or the development of a large-volume volcanic field (Crowe et al., 1986).

GEOTECHNICAL HAZARDS—Geotechnical hazards are those that present an inherent direct risk to structures. Such hazards relevant to the region fall under the headings of slope stability, soil stability, and ground stability. Although this section primarily discusses hazards to engineering, areas that are particularly stable for certain activities are also noted.

Slope Stability—Within the region, no natural factors have been reported as affecting engineering aspects of slope stability. External factors that have or could affect slope stability in the region include load and fracturing and ground motion associated with nuclear explosions. Although not reported as problematic, caution is warranted for certain activities (e.g., construction and drilling) on or near slopes in or near areas of previous nuclear testing. On the NTS, particular caution is warranted on or near slopes that have been tunneled for nuclear testing. Site-specific evaluation of slope stability is necessary for specific activities.

Soil Stability—Soils in arid environments are typically rich in montmorillonite. The structure of montmorillonite is conducive to swelling or contraction as water is added or removed. Although not reported as problematic in the region, site-specific evaluation for expandable clay would be necessary for specific activities because soils in the region have not been mapped extensively.

Ground Stability—Certain soil-forming processes enhance ground stability: development of a pavement and accumulation of calcium carbonate, which are often coincident. Ground with these attributes, notwithstanding absence of factors that would result in instability, may be preferred for certain activities (e.g., waste management and foundations). In general, ground that has not been reworked by surface flow of water is more likely to have these attributes. Site-specific evaluation for pavement development, calcium carbonate accumulation, and the absence of detrimental soil conditions would be necessary for certain activities.

Ground will tend to be less stable if it:

- is composed of readily weathered and/or fractured rocks
- contains void space
- lacks vegetation
- is subjected to:

  - surface flow of water
  - freezing and thawing
  - wind
  - ground motion
  - heaving pumping of groundwater.

Although not reported as problematic, site-specific evaluation or regional evaluation for these factors would be necessary for certain activities.

Certain areas where nuclear devices have been tested may be less stable than other areas (Figure 4-22). On the NTS, not all rubble chimneys resulting from tests have reached the surface; these areas are considered to be unstable (Figure 4-23). Such areas are not appropriate for other types of use because of their instability; these areas are fenced and controlled. Areas in the region where testing of nuclear devices may be resumed certainly have to take into account ground motion associated with that testing. Evaluations of the suitability of areas for testing indicate that areas that have been used in the past are those most suited for testing (Houser, 1968).

GEOLOGIC RESOURCES—Geologic resources in the region are discussed under the headings of economic minerals, aggregate, hydrocarbons, and geothermal resources. The impact that past activities have had on geological resources is also discussed.

ECONOMIC MINERALS—Economic minerals are discussed under the headings of precious metals, base metals, ferroalloy metals, and industrial minerals. Important mineral commodities in the NTS region include gold, silver, copper, lead, zinc, tungsten, and uranium (Myhrer, 1990). Mining districts are shown in Figure 4-27. Should the region be opened for public access, areas of previous mining could become important for the collection of mineral specimens.

Precious Metals—Significant gold and silver deposits may be present east of Goldfield in the northwestern NAFR Complex. Silver may be present in the Oak Spring District at the north end of Yucca Flat and west of Area 13; a significant amount of silver has been taken from the Groom mine in this area (BLM, 1979). A potentially economic mineral deposit may remain in the Wahmonie District.

The NTS has been closed to commercial mineral development since the 1940s (SAIC/DRI, 1991). Reactivation of many other gold districts in the region, in response to current gold prices and modern extraction technologies, suggests that the potential for precious metal deposits in the NTS region should be considered moderate to high (SAIC/DRI, 1991).

Base Metals—Copper, lead, zinc, and mercury are known to be present within the region. Economic quantities of copper, lead, and zinc have been recovered from the Groom mine (Humphrey, 1945; Quade and Tingley, 1983; SAIC/DRI, 1991).

Ferroalloy Metals—On the basis of commercial tungsten mining operations in the Oak Spring District during the late 1950s and early 1960s, the NTS region is considered to have moderate potential for the occurrence of tungsten skarn deposits or polymetallic replacement deposits (SAIC/DRI, 1991). Molybdenum is also associated with these deposits (BLM, 1979). Iron (magnetite) is present in the region; however, the resource potential is considered to be low (SAIC/DRI, 1991).

Industrial Minerals—Uranium resources may be present in the northwestern part of the NAFR Complex (BLM, 1979). Zeolitized rocks underlie most of the volcanic rocks and the alluvial basins in the NTS region. The widespread occurrence of zeolite deposits in the region suggests a low to moderate potential for development. Barite is known to occur in the region in veins associated with quartz and mercury, antimony, and lead mineralization. Barite veins at the NTS are small and impure and do not represent a potential barite resource. Fluorite is also present in the region. Little is known about the occurrence of fluorite, and its resource potential is assumed to be low to moderate (SAIC/DRI, 1991).

AGGREGATE—Most of the alluvial valleys in the region have aggregate resources at least along the flanks of adjacent mountains. The quantity and quality of these resources are likely sufficient to meet future demand. These resources do not have any unique value over aggregate occurring in other areas throughout southern Nevada.

HYDROCARBON RESOURCES—Grow et al. (1994) indicated that on the basis of rock type and thermal maturity, the northeastern and southern parts of the NTS and NAFR Complex have the potential for oil and gas, and the southern part of the NTS and the southeastern part of the NAFR Complex have the potential for gas. Thermal maturity acceptable for oil, however, is just within the range of acceptability. Values for both total organic carbon and hydrogen index is regionally continuous; potential source rocks are low. Further, late Tertiary extensional faulting in the region has likely disrupted any seals that are required for hydrocarbon accumulation. Based on these findings, the potential for hydrocarbon resources in the region is considered to be low. Previous investigators have also concluded low potential for hydrocarbon resources in the region based on various parameters (Harris et al., 1980) and on reported shows of surface and subsurface hydrocarbons (Garside et al., 1988). Figure 4-28 shows the relative potential for oil and gas resources in the region. No occurrences of oil and gas, coal, tar sand, or oil shale in the region have been reported.

GEOTHERMAL RESOURCES—Hot springs are common in the province (Fiero, 1986). However, if water temperatures near Yucca Mountain are

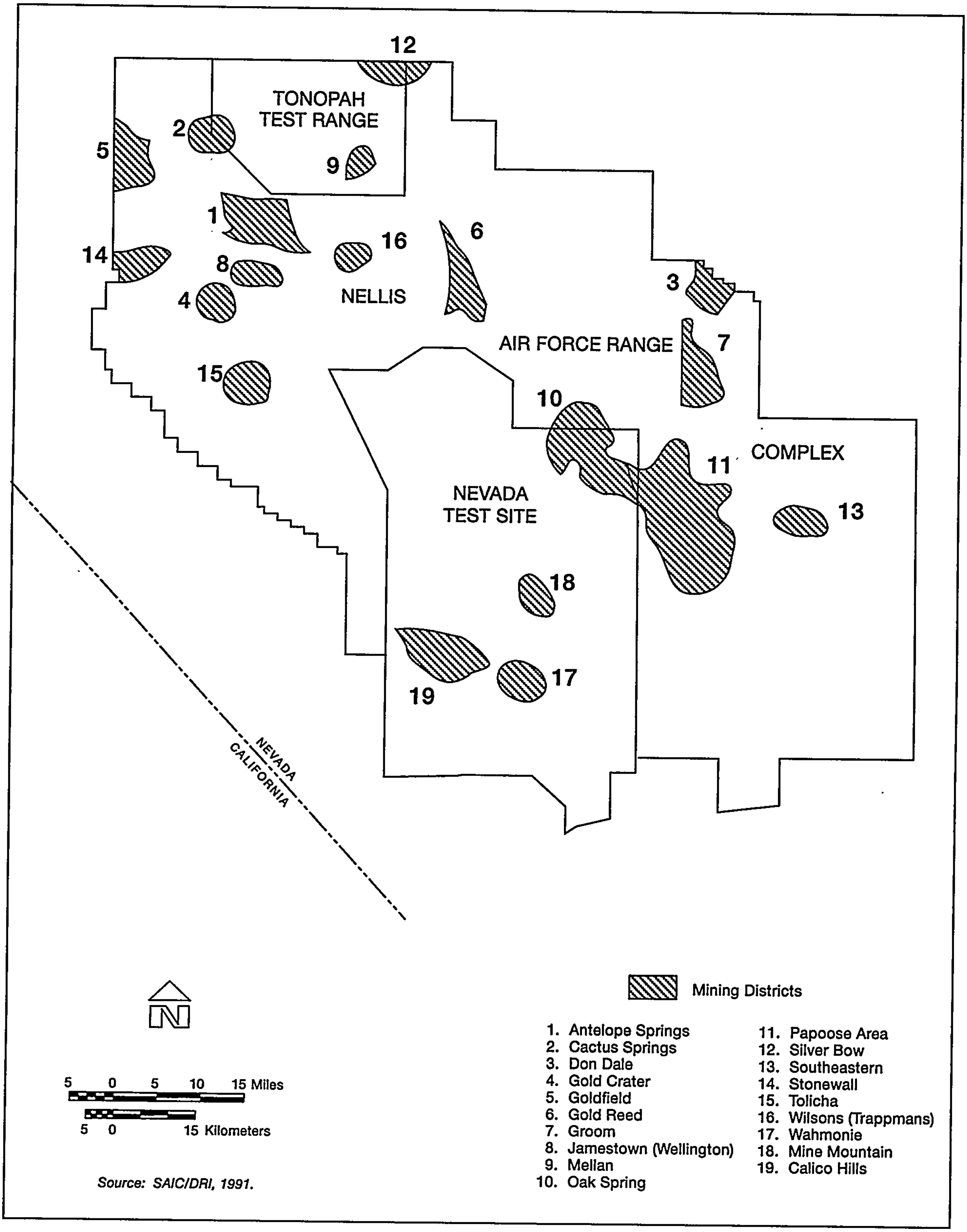


Figure 4-27. Mining districts located in the NTS, Tonopah Test Range, and NAFR Complex

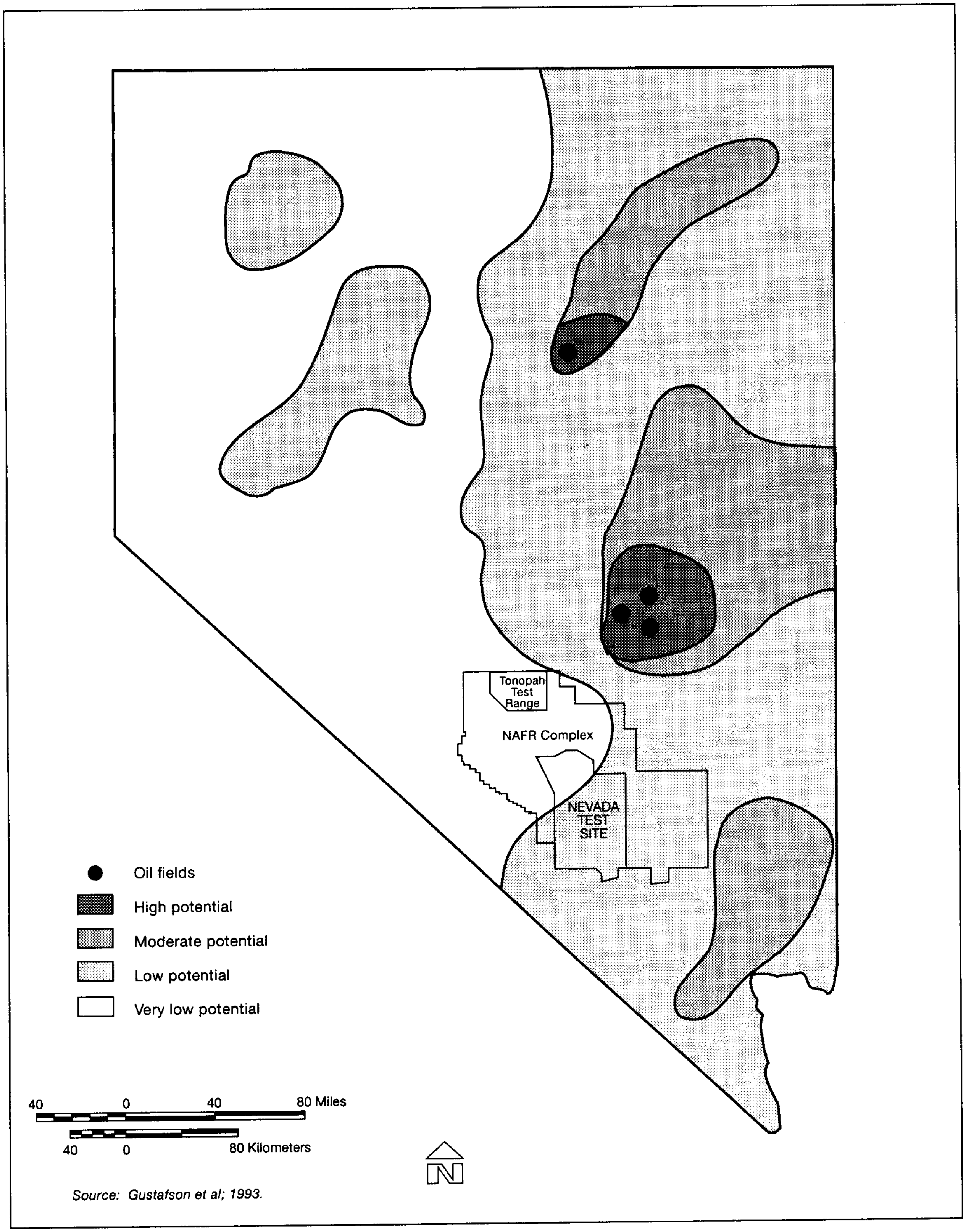


Figure 4-28. Nevada petroleum potential

representative (50 to 60 °C [120 to 140 °F]), water temperatures in the region may be insufficient for commercial power development. Current technology requires reservoir temperatures of at least 180 °C (356 °F) for commercial power generation (DOE, 1988).

A preliminary assessment of the geothermal potential of the NTS by the Harry Reid Center for Environmental Studies and Professional Analysis Incorporated (1994) found that there was very good potential for the development of a moderate temperature geothermal resource. This resource potential was judged to be suitable for the development of a binary geothermal power plant.

The North Las Vegas Facility, which is located in North Las Vegas in Clark County, is located within Seismic Zone 2. The soils on the North Las Vegas Facility range from stiff to very stiff silty and sandy clay and clay with interbedded medium-dense clayey and silty sand. The soils at the North Las Vegas Facility are considered acceptable for standard construction techniques.

4.1.4.3 ***Soils.*** Soil survey work has been limited on the NTS and surrounding areas to relatively small areas of local interest. Areas of local interest include specific facilities such as some large structures and waste disposal sites. In these cases, soil investigations are primarily limited to the characterization of specific geotechnical parameters. In some instances, the results of these investigations are published in form documents, e.g. Ho et al (1986) discusses the suitability of natural soils for foundations for surface facilities at Yucca Mountain. Often, information from these investigations has not been published and appears in various permit applications and DOE files. A great deal of research has been conducted, however, into the movement of contaminants through the soils of the NTS and the definition of areas where soils have been contaminated.

In general, the soils of the NTS are similar to those of surrounding areas and include aridisols and entisols. The degree of soils development reflects their age, and the soils types and textures reflect their origin. Entisols generally form on steep mountain slopes where erosion is active. The aridisols are older and form on more stable fans and terraces.

Soil loss through wind and water erosion is a common occurrence throughout the NTS and surrounding areas. Portions of some watersheds probably exhibit higher erosion rates, but the erosion conditions and susceptibility of soils on the NTS have not been defined.

There are limited areas of soils that can be irrigated on the NTS according to the Nevada map prepared by the Division of Water Resources (State of Nevada, 1973), and they occur only in the lower elevations of the Yucca Flat weapons test basin, Frenchman Flat, and Jackass Flats. Elsewhere on the NTS, the soils are generally very limited in both thickness and areal extent.

In the Yucca Flat weapons test basin, the soils include those soils that can be irrigated with moderate limitations and with moderately low available water-holding capacity and stony, cobbly soils. In Frenchman Flat, the soil classes present have severe limitations with low available water-holding capacities and soil subject to flooding. The soils that can be irrigated in Jackass Flats have very severe limitations, coarse textures, and very low available water-holding capacities.

According to Romney et al. (1973), the soils of the southern NTS reflect the mixed alluvial sediments upon which they form. Soils are generally young in profile development and show only weak evidence of leaching. In general, soils texture is gradational from coarse-grained soils near the mountain fronts to fine-grained soils in the playa areas of the Yucca Flat weapons test basin and Frenchman Flat. Most soils are underlain by a hardpan of caliche. Soil salinity generally increases dramatically in the direction of the playa areas, with the highest level of soluble salts having accumulated in the deeper soil profile horizons in Frenchman Flat.

The soils on portions of the NTS have been contaminated during the conduct of various testing and ancillary operations. The largest areas of surficial contamination are in the Yucca Flat weapons test basin, Frenchman Flat, Plutonium Valley, and in scattered locations in the western and northwestern parts of the facility. A discussion of radiological contamination in the soil can be found in the following section. A comprehensive investigation is underway to determine the risks associated with this soil contamination. Actions will be taken as part of the Environmental Restoration Program to reduce these risks, as appropriate.

RADIOLOGICAL SOURCES IN SOIL—The historical impacts on soils as a result of past Defense Program actions have been considerable and, in some instances, these impacts are considered significant. Lesser impacts include excavation of soils for roads and structures, alteration in nature drainages and erosion regimes, and the contamination of soils. This section describes the baseline soils conditions at the NTS, the NAFR Complex, and the Tonopah Test Range, as documented previously in the *Final Environmental Impact Statement, Nevada Test Site, Nye County, Nevada* (ERDA, 1977).

Atmospheric Testing—Aboveground nuclear weapons tests were initiated on January 27, 1951, with the detonation of a 1-kt air-dropped weapon over Frenchman Flat, and a total of 100 tests were conducted prior to the signing of the Limited Test Ban Treaty in August 1963. Atmospheric testing included weapons that were dropped by planes, those detonated from towers constructed to heights of 30 to 213 m (100 to 700 ft), tests conducted on land surface, and tests where the weapon was lofted using helium-filled balloons 137 to 457 m (450 to 1,500 ft) above the ground.

Depending on the proximity of the explosion to the ground surface and the size of the yield, surface disturbances from atmospheric testing vary widely. The greatest surficial disturbances typically occurred when an air-dropped weapon penetrated the ground surface to a shallow depth (about 15 m [50 ft]) before detonation. According to information presented by Glasstone (1962), such a test with a yield of 100 kt would result in a crater about 36 m (120 ft) deep and about 219 m (720 ft) in diameter.

Radioactivity from atmospheric tests was dispersed by three primary mechanisms: throwout, base surge, and fallout. Throwout occurs at detonation when the fireball propels large volumes of rock and soil upward. Base surge refers to the settling and outward movement of the throwout. Fallout is the portion of material that does not settle, but rises and merges with the radioactive weapons residues. These materials subsequently descend to earth over the next few hours or more as fallout. The extent and distribution of contamination from an atmospheric test was quite variable depending on the height of detonation, the yield and type of device, the nature of the ground surface, the mass of inert material surrounding the device, and weather conditions at the time of, and following, the test (DOE, 1988). Glasstone (1962) documented the chronology of a shallow penetration air-dropped test. Typical isotopes formed during the historic atmospheric testing included strontium, cesium, barium, tritium, and iodine. Of these, strontium-90 and cesium-137 are of the most concern because of their longer half-lives of 28 and 29 years, respectively.

The vast majority of radioactivity released during atmospheric testing decayed very quickly after each test was conducted. For example, for a 1-kt atmospheric test, the initial release after 1 minute is about 4.1×10^{10} Ci. This activity is reduced to 1.0×10^{7} Ci just 12 hours after the detonation. If the activity remaining after 12 hours is used as the basis for estimates, then about 6.0×10^{10} Ci were released during atmospheric testing between 1951 and 1963 at the NTS (OTA, 1989).

Many of the fission products released during the detonations were dispersed into the atmosphere, and much of the residual radioactivity has decayed in the more than 30 years since the last atmospheric test. Nonetheless, some of the longer-lived radionuclides remain in the soil and physical structures. The primary radioactive isotopes that remain on the NTS from historic atmospheric testing include americium, plutonium, cobalt, cesium, strontium, and europium. According to the Desert Research Institute (1988), the remaining radioactivity in NTS soils within 1,829 to 3,048 m (6,000 to 10,000 ft) of the Able test (a 1-kt airdrop) totaled almost 15 Ci. Based on the most recent estimates for Frenchman Lake (McArthur, 1991), about 20 Ci of radioactivity remain in this area. Most, if not all, of this remaining activity can be attributed to historic atmospheric testing. Residual contamination from atmospheric testing may also be present in Yucca Flat in Areas 1, 2, 3, 4, 7, 8, 9, and 10 of the NTS and in Buckboard Mesa in Area 18. However, because of the number of underground tests that were conducted in these areas, it is not possible to discriminate what residuals are remaining from atmospheric tests. Contamination remaining from the atmospheric tests in these areas is included within the inventory for shallow borehole tests, discussed in Section 4.1.4.2, Geology.

Safety Tests—Portions of the NTS, the NAFR Complex, and the Tonopah Test Range were used between 1954 and 1963 for chemical explosion tests of plutonium-bearing materials. Because of the similarities in the types of tests conducted and the consequences of those tests, the NAFR Complex and the Tonopah Test Range are included within this discussion and are not repeated in the discussion of the affected environment for those facilities.

The safety tests, or subcritical events, were conducted to evaluate the safety of nuclear weapons in accident scenarios. Two series, the GMX Project and Project 56, were conducted on the NTS in Areas 5 and 11, respectively. The GMX Project Site was used for 24 specific equation of state studies or experiments fissile materials. Project 56 was comprised of four discrete surface safety tests. Project 57 consisted of a single test and was conducted on the NAFR Complex in Area 13; the Double Tracks Test was conducted in the northern-most part of the NAFR Complex. An environmental assessment analyzing the potential environmental effects of four remediation alternatives was completed for the Double Tracks Site in April, 1996 (DOE, 1996). During preliminary characterization at the site, several pieces of highly radioactively contaminated metal were located, retrieved, and placed in a drum at the site. Between 998 and 1, 588 g (2.2 and 3.5 lbs) of plutonium were spread during the test. The recent work has shown that contamination of 200 pCi/g or higher, affects approximately 2.5 acres. Three safety tests conducted as part of the Clean Slate experiments were performed on the Tonopah Test Range. Figure 4-29 shows the locations of events conducted on the NTS and the NAFR Complex and Figure 4-30 shows the approximate areas of plutonium contamination exceeding 10 pCi/g.

The safety tests used mixtures of plutonium and uranium that were subjected to detonations of conventional explosives. Concurrent with and after these detonations, extensive studies were conducted to understand the dispersal and transport of these isotopes in the environment, including uptake by plants and animals. These studies were documented in a benchmark series of papers by the Nevada Applied Ecology Group, a panel of scientists chartered by the DOE to investigate the effects of testing at the NTS.

The immediate effects of the tests included the dispersal of plutonium and uranium over significant areas. To determine the area impacted by these tests, inventories were conducted by the Nevada Applied Ecology Group. These inventories were later augmented by extensive field-sampling efforts conducted under the Radionuclide Inventory and Distribution Program. These studies resulted in the definition of affected areas. Figures 4-30 through 4-37 show the limits of the affected areas and the distribution of radioactivity within those areas.

The total areas that were contaminated and the remaining inventory of radionuclides are summarized by McArthur and Mead (1989) and (McArthur, 1991) for areas on the NTS and in the *Final Environmental Impact Statement, Nevada Test Site, Nye County, Nevada* (ERDA, 1977) for the off-site locations. The GMX Project ion Area 5 resulted in the contamination of about 240 acres, with estimates of the total remaining inventory ranging from 1.7 to 2.5 Ci.

The Project 56 tests resulted in the contamination of about 2,200 acres, with estimates of the remaining inventory ranging from 34 to 39 Ci. On the NAFR Complex, the two disturbed areas total slightly under 1,000 acres, with an estimated remaining inventory of about 50 Ci. On the Tonopah Test Range, almost 670 acres were contaminated, with an estimated remaining inventory of about 65 Ci. The ranges in values given are all approximations and reflect the limitations in field sampling of large areas, detection equipment, and laboratory analyses.

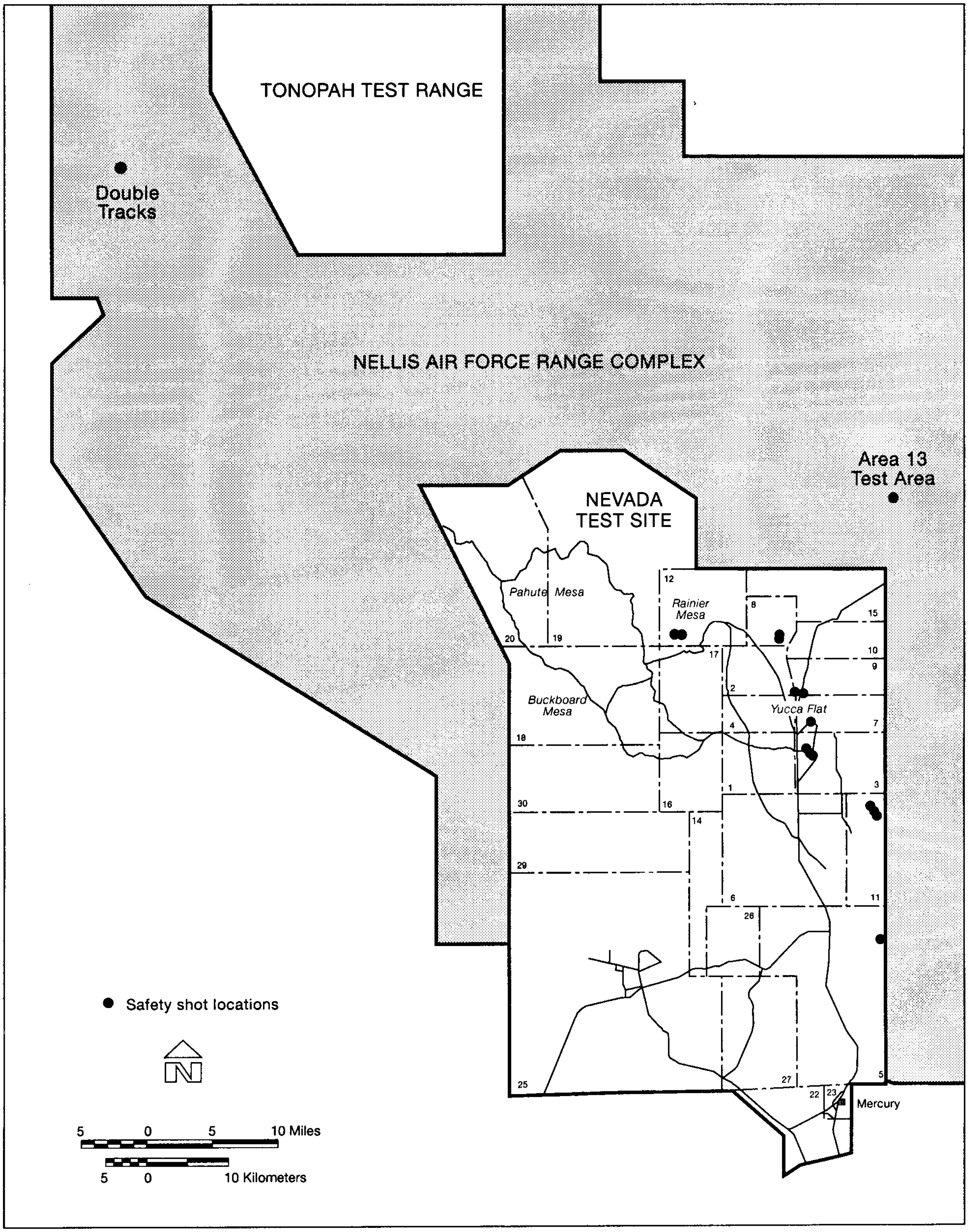


Figure 4-29. Locations of safety tests on the NTS and NAFR Complex

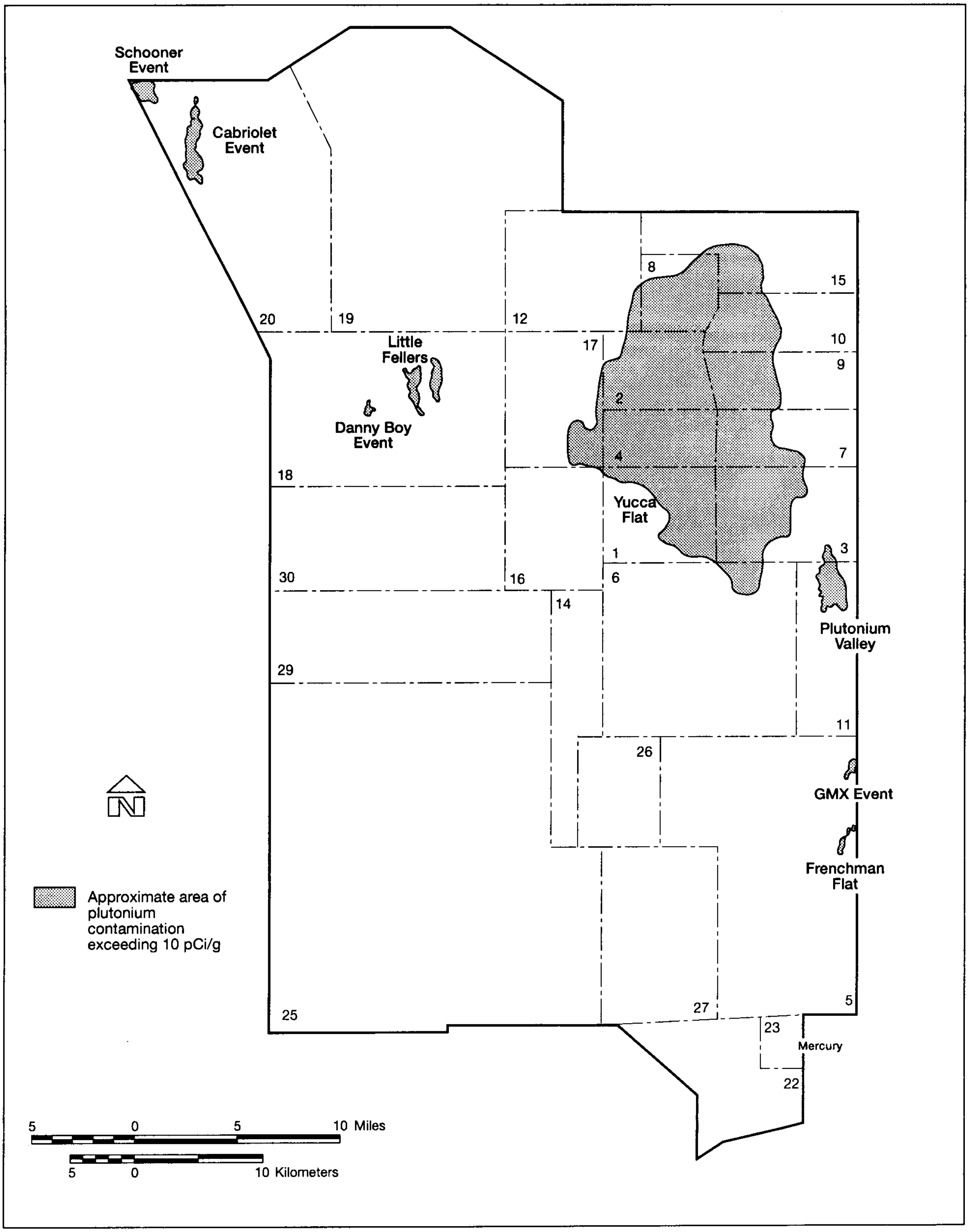
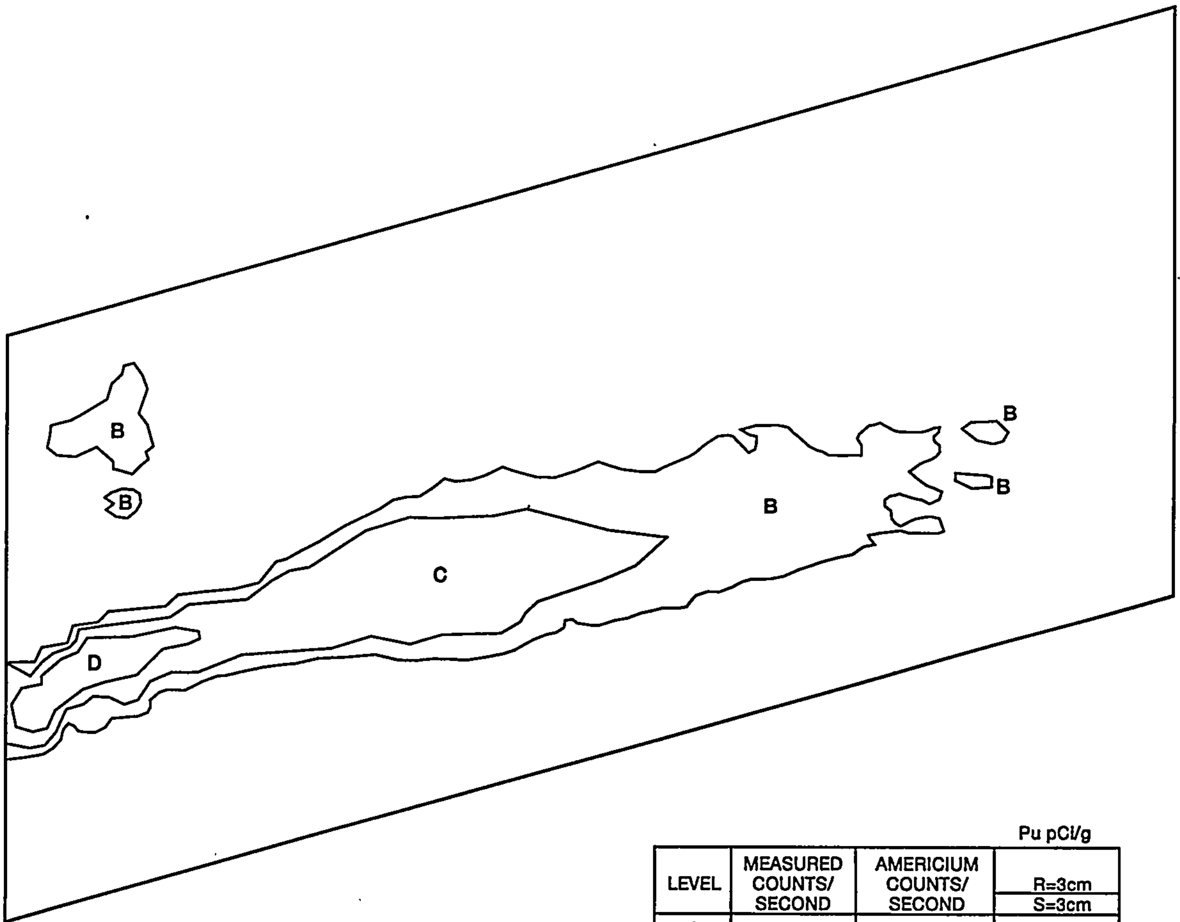


Figure 4-30. Approximate area of plutonium contamination exceeding 10 pCi/g on the NTS



Pu pCi/g

LEVEL	MEASURED COUNTS/ SECOND	AMERICIUM COUNTS/ SECOND	R=3cm / S=3cm
A	0-55	0-92	0-36
B	55-170	92-283	36-111
C	170-550	283-917	111-360
D	550-1700	917-2833	360-1112

R = Relaxation depth (cm)
S = Soil sample depth (cm)

N

0 8,000 16,000 Feet
0 2,500 5,000 Meters

Note: Data obtained from EG&G aerial flyover 100 ft aboveground; data area preliminary.

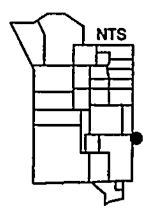


Figure 4-31. Approximate area of plutonium contamination plume east of Smallboy site

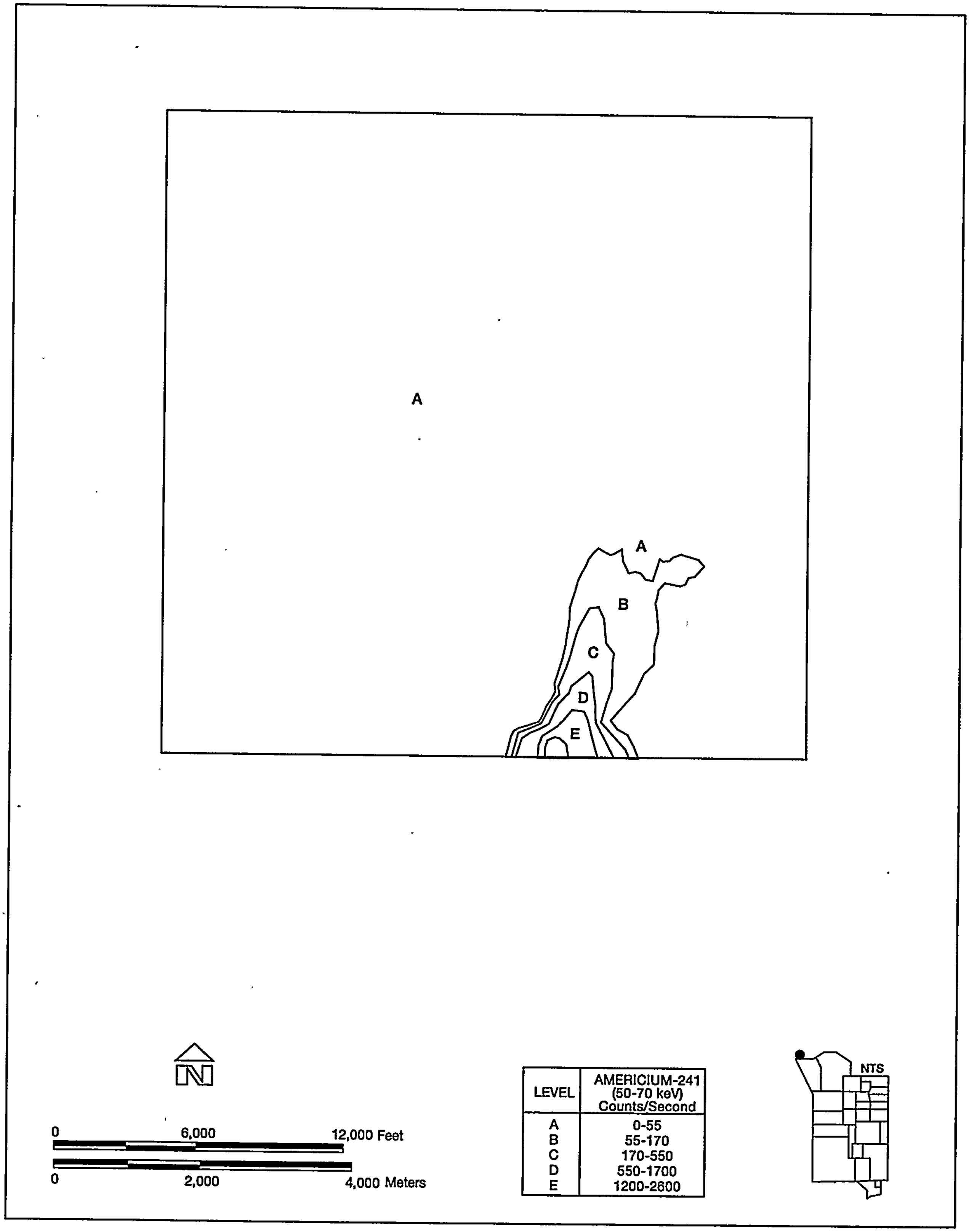


Figure 4-32. Approximate area of plutonium contamination plume north of Schooner site

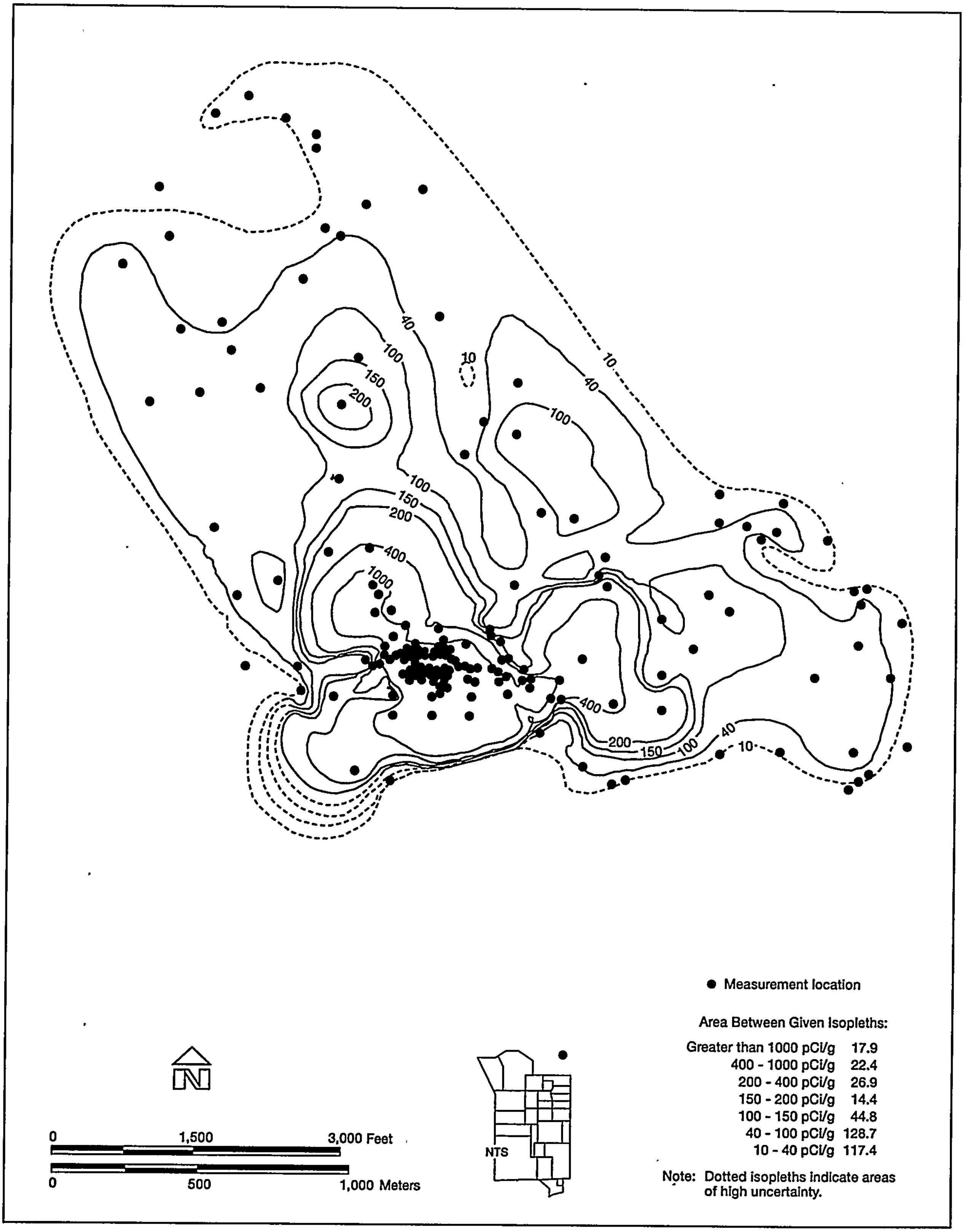


Figure 4-33. Approximate area of plutonium contamination, Area 13

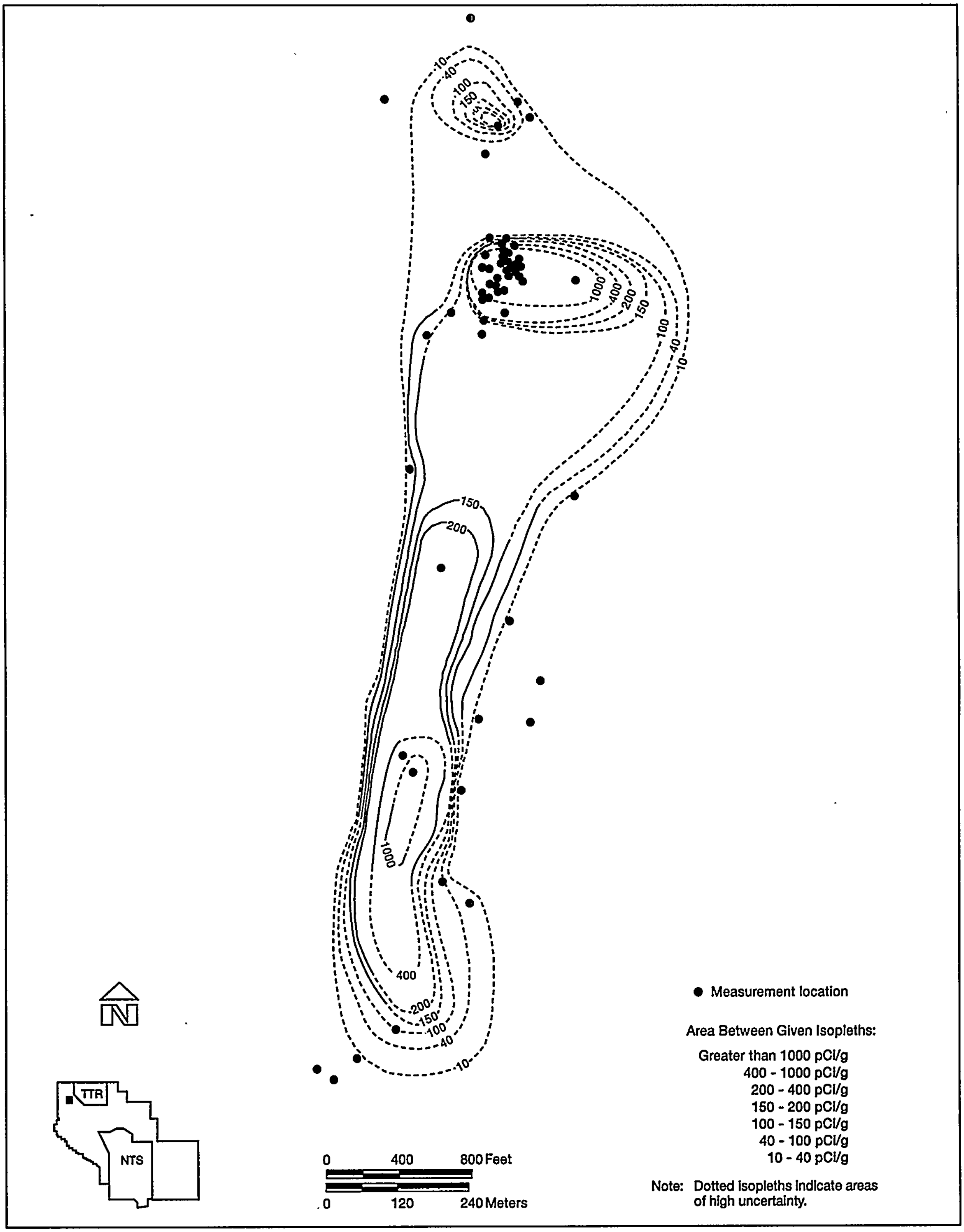
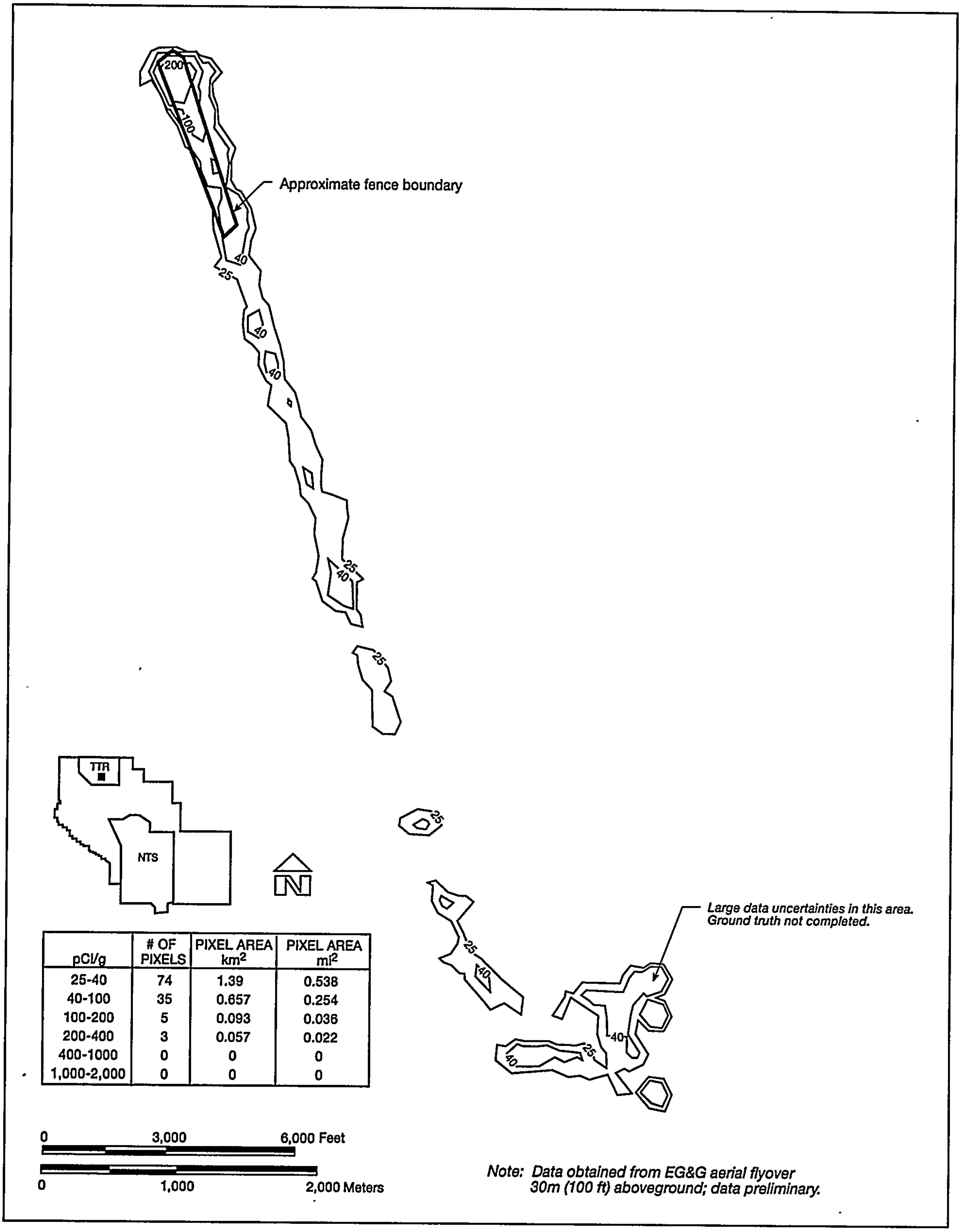
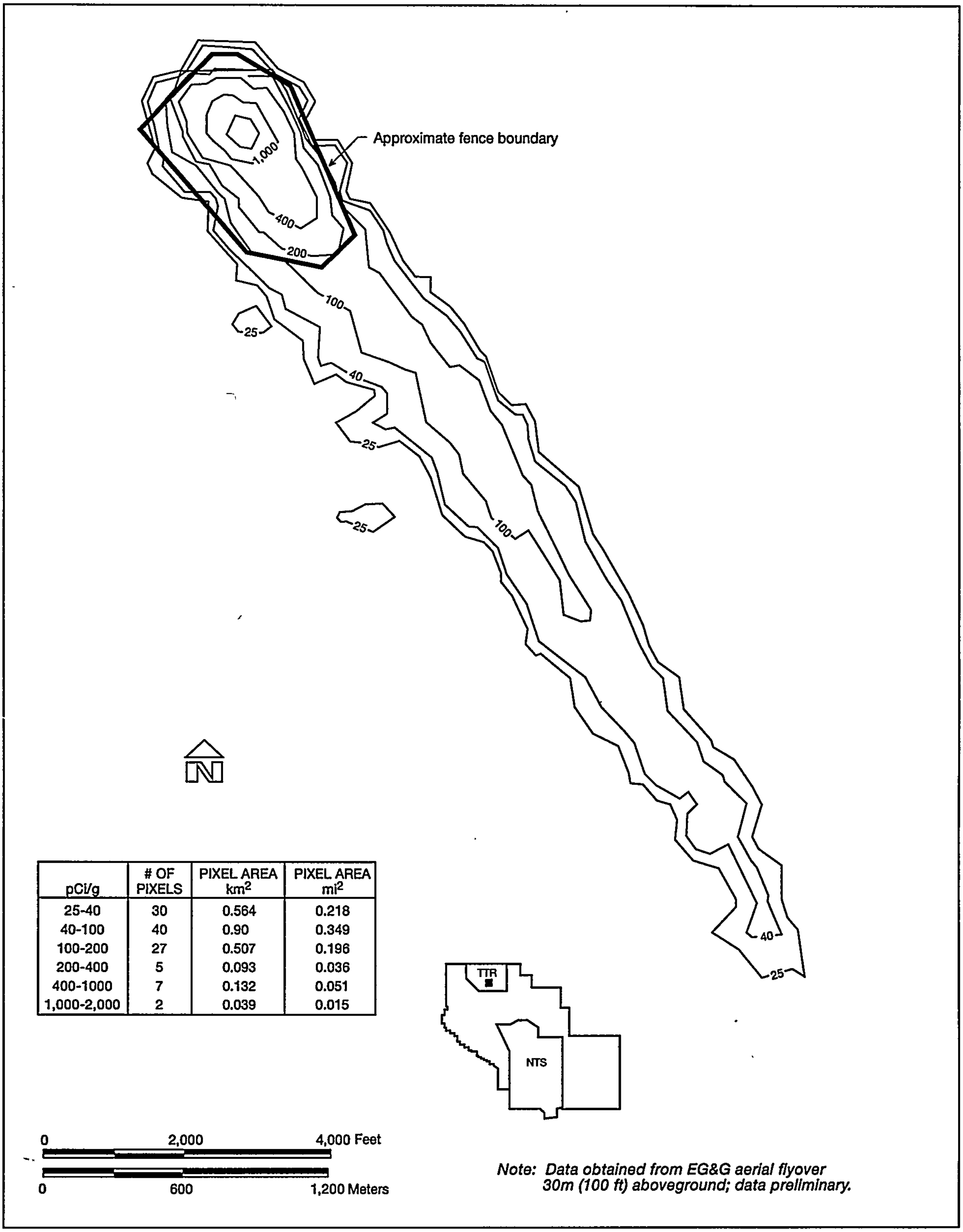


Figure 4-34. Approximate area of plutonium contamination, Double Tracks Test



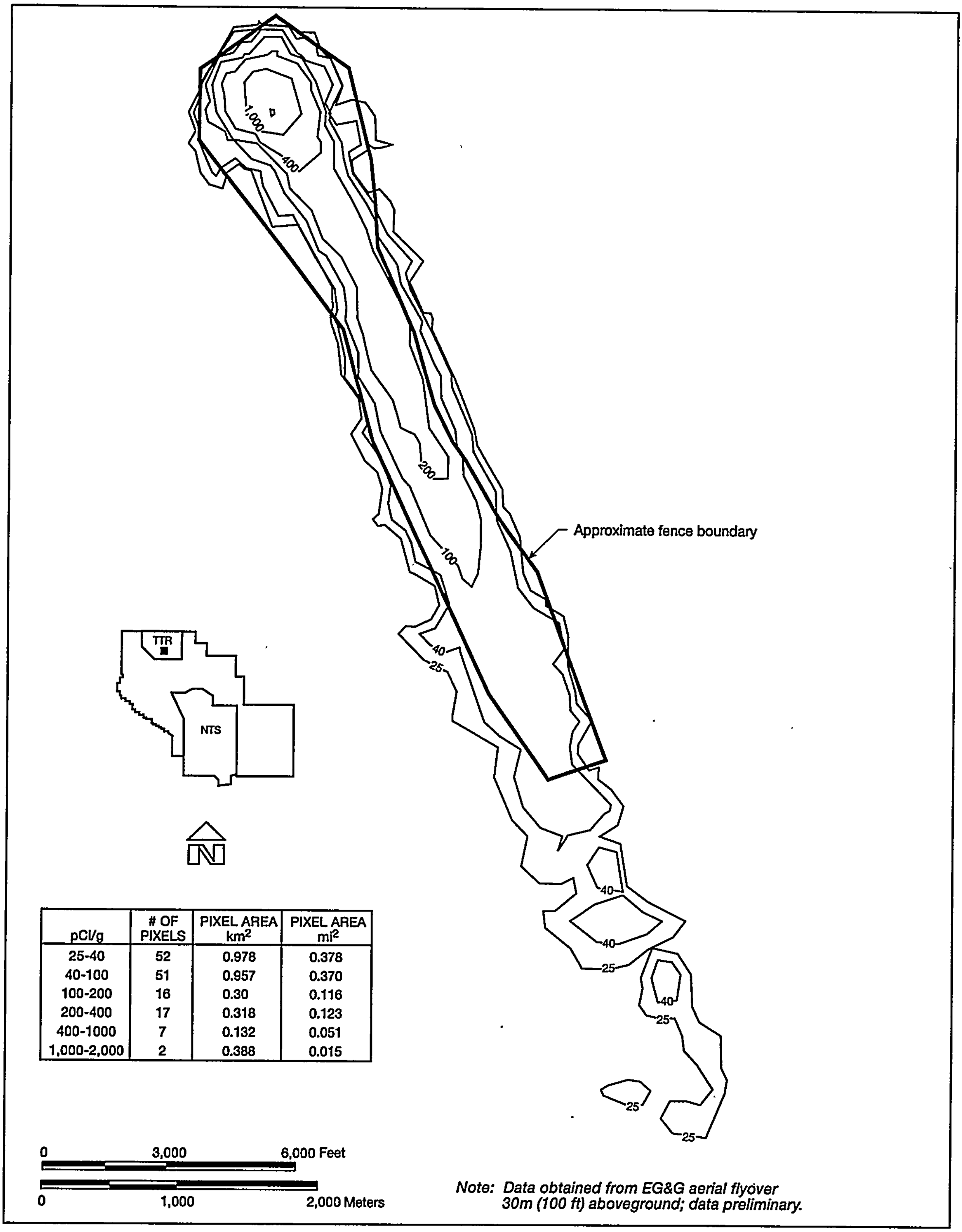
pCi/g	# OF PIXELS	PIXEL AREA km^2	PIXEL AREA mi^2
25-40	74	1.39	0.538
40-100	35	0.657	0.254
100-200	5	0.093	0.036
200-400	3	0.057	0.022
400-1000	0	0	0
1,000-2,000	0	0	0

Figure 4-35. Approximate area of plutonium contamination at the Tonopah Test Range, Clean Slate 1 site



pCi/g	# OF PIXELS	PIXEL AREA km^2	PIXEL AREA mi^2
25-40	30	0.564	0.218
40-100	40	0.90	0.349
100-200	27	0.507	0.196
200-400	5	0.093	0.036
400-1000	7	0.132	0.051
1,000-2,000	2	0.039	0.015

Figure 4-36. Approximate area of plutonium contamination at the Tonopah Test Range, Clean Slate 2 site



pCi/g	# OF PIXELS	PIXEL AREA km²	PIXEL AREA mi²
25-40	52	0.978	0.378
40-100	51	0.957	0.370
100-200	16	0.30	0.116
200-400	17	0.318	0.123
400-1000	7	0.132	0.051
1,000-2,000	2	0.388	0.015

Figure 4-37. Approximate area of plutonium contamination at the Tonopah Test Range, Clean Slate 3 site

At both on- and off-site locations, the primary isotopes are plutonium, uranium, and americium, with lesser amounts of cesium, strontium, and europium. These long-lived radionuclides remain today in the surficial soils in the vicinity of the test areas and are available to be transported by wind and uptake by plants and animals. Extensive research into the mobility of the isotopes has found that wind can transport the contaminants and concentrate them in mounds around desert shrubs, and water can cause plutonium to migrate deeper into the soils with time. The isotopes are now relatively immobile unless the soils are disturbed.

The uptake of plutonium by plants can vary widely, with large intakes as a result of plutonium dust settling on the leaves of a plant, while the quantity of uptake is almost negligible for movement from the soil via the plant's root system. In total, the inventory of plutonium in plants is small compared to the inventory in soils. In a comprehensive study of a contaminated area in Area 13 of the NAFR Complex, 44 Ci of plutonium were estimated to be in the soils while only 0.000264 Ci were estimated to have entered the foliage. Research has indicated that this trend may be as accurate for americium, however, which is much more easily taken into the root systems of plants. Similarly, the radioactivity levels in animals has been found to vary widely depending on the species, their habitats, and time spent in the contaminated area.

One of the actions being evaluated in this EIS is the characterization and remediation of the contaminated soils on the NTS, the NAFR Complex, and the Tonopah Test Range. Over the past two decades, the DOE has conducted many different types of surveys and research projects concerning these soils. A long-term data baseline has been established, the areas of contamination have been delineated, air monitoring and radiological surveying continue for key indicator parameters (plutonium, noble gases, and tritiated water vapor), and an extensive research and development project has evaluated alternative methods for cleaning up the soils. The final disposition of the remaining isotope inventory in these soils will be determined as part of the Soils Corrective Active Unit of the Environmental Restoration Program.

<u>Nuclear Rocket and Related Tests</u>—A number of activities were conducted at the Nuclear Rocket Development Station in Areas 25 and 28. From 1959 through 1973, the area was used for a series of open-air nuclear reactor, nuclear engine, and nuclear furnace tests and for the High Energy Neutron Reactions Experiment. Equipment and facilities remain from some of these activities, and there are some limited areas of contaminated soils. The total estimated inventory of isotopes remaining in the soils in this area of the NTS has been estimated to be about 1 Ci (McArthur, 1991). The primary soil contaminants in this area are isotopes of strontium, cesium, cobalt, and europium. The disposition of this contamination will be addressed as part of the Soils Corrective Action Unit under the Environmental Restoration Program.

4.1.5 Hydrology

Discussion of hydrology is divided into surface hydrology and groundwater. Surface hydrology is discussed in terms of hydrographic basins, whereas groundwater is discussed in terms of hydrogeologic basins. A hydrographic basin is the area drained by a stream system and bounded by topographic divides (Bates and Jackson, 1987). A hydrogeologic basin is groundwater flow from source areas located either in the bounding mountain ranges or upgradient basins toward discharge areas where groundwater is lost to evapotranspiration, discharge to the surface water regime, or flows underground into downgradient basins. The two types of basins are not necessarily coincident, but the distribution of surface water certainly has an effect on the distribution of groundwater.

The hydrologic conditions of the NTS have been extensively studied, and a very large database is available concerning the surface water and groundwater regimes. In fact, the hydrology of the NTS has probably received more scientific scrutiny than any other area in Nevada. However, the database for areas beyond the test site boundaries is not as extensive because of the lack of activities and wells over much of the region. The off-site database has been expanded in recent years through a number of regional studies conducted by the U.S. Geological Survey, the Desert Research

Institute, and other research organizations. Further, these organizations are continuing to expand the scope of their studies on the NTS as well, thereby addressing uncertainties both on and off the site.

No surface water features are located at the North Las Vegas Facility. The North Las Vegas Facility is located in the Las Vegas Valley, which is in a desert region between sharp, rugged mountain ranges. The lowest point of the alluvial fan is the Las Vegas Wash, which drains an area of 2,280 km^2 (880 mi^2) toward Lake Mead. Storm water from the North Las Vegas Facility is discharged into local flood control system.

4.1.5.1 Surface Hydrology. The Great Basin, a hydrographic basin in which no surface water leaves except by evaporation and which includes much of Nevada, is part of the Basin and Range Physiographic Province (Stewart, 1980). The NTS, the Tonopah Test Range, and all but the southern corner of the NAFR Complex, are within the Great Basin (Figure 4-38). Similarity of the physical environment throughout the region allows general discussion of surface water of the NTS, the NAFR Complex, and the Tonopah Test Range. This general discussion of all the areas is centered on the NTS and, unless otherwise specified, referred to simply as "the region."

Discussion of specific areas are included where significant differences exist or where information at a local scale increases understanding and assists in the evaluation of impacts. Consistent with the Great Basin, hydrographic basins of the region have internal drainage controlled by topography (Figure 4-39). Streams in the region are ephemeral. Runoff results from snowmelt and from precipitation during storms that occur most commonly in winter and occasionally in fall and spring, and during localized thunderstorms that occur primarily in the summer (DOE, 1988). Much of the runoff quickly infiltrates into rock fractures or into the dry soils, some is carried down alluvial fans in arroyos, and some drains onto playas where it may stand for weeks as a lake (DOE, 1986). These playas emphasize a perennial water deficit that has characterized Nevada at least in historic times (French et al., 1984).

Floods on alluvial fans and playas in the region are most likely to have an impact on DOE facilities or activities. The discussion below gives definitions and mechanisms. The potential exists for sheet flow and channelized flow through arroyos to cause localized flooding throughout the NTS. However, because of the size of the NTS, no comprehensive floodplain analysis has been conducted in the NTS region to delineate the 100- and 500-year floodplains (see Tables 4-16 and 4-17). A rise in the surface elevation of any standing water on a playa creates a potential flood hazard.

Playas in the Yucca Flat weapons test basin and Frenchman Flat in the northeastern and eastern parts of the NTS, respectively, collect and dissipate runoff from their respective hydrographic basins (Figure 4-39). Control Point and News Knob arroyos (informal names), and Gap Wash, Red Canyon Wash, Tongue Wash, and the Aqueduct arroyos in the Yucca Flat weapons test basin pose a potential flood hazard to existing facilities. Control Point and News Knob arroyos have been assessed for flood hazard (Miller et al., 1994c).

Arroyos in Frenchman Flat that pose a potential flood hazard to existing facilities are Barren Wash, Scarp Canyon, Nye Canyon, and Cane Spring. The first three of these arroyos have also been assessed for flood hazard (Schmeltzer et al., 1993a and b; Miller et al., 1994a and b). Ground-surface disturbance and craters associated with underground nuclear tests have rerouted parts of natural drainage paths in areas of nuclear device testing. Some craters have captured nearby drainage, and headward erosion of drainage channels is occurring. However, this is considered to be negligible. In some areas of the NTS, the natural drainage system has been all but obliterated by the craters. The western half and southernmost part of the NTS have arroyos that carry runoff beyond the NTS boundaries during intense storms (Figure 4-39). Fortymile Canyon, the largest of these arroyos, originates on Pahute Mesa and intersects the Amargosa arroyo in the Amargosa Desert about 32 km (20 mi) southwest of the NTS. The Amargosa arroyo continues to Death Valley, California (ERDA, 1977).

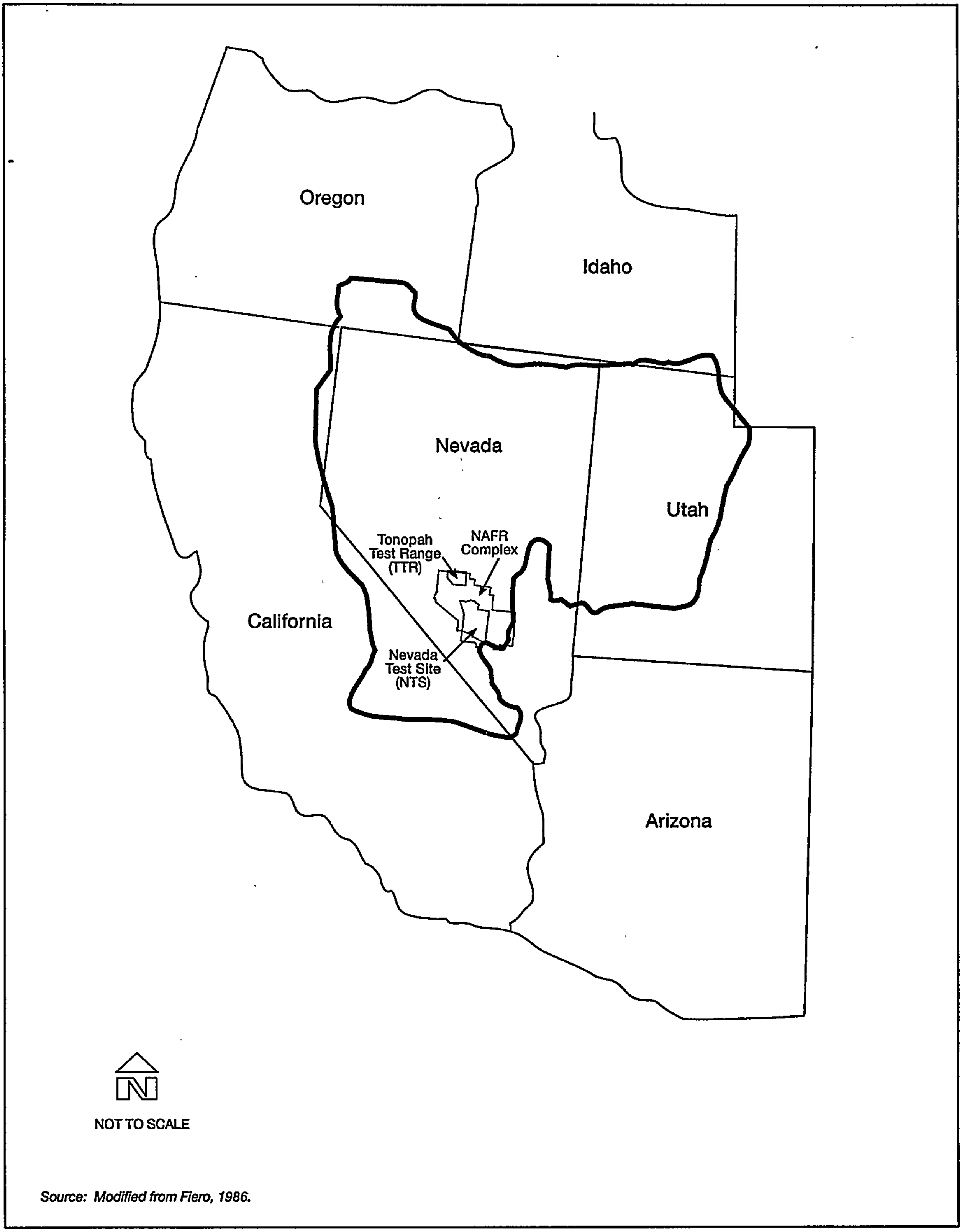


Figure 4-38. Great Basin

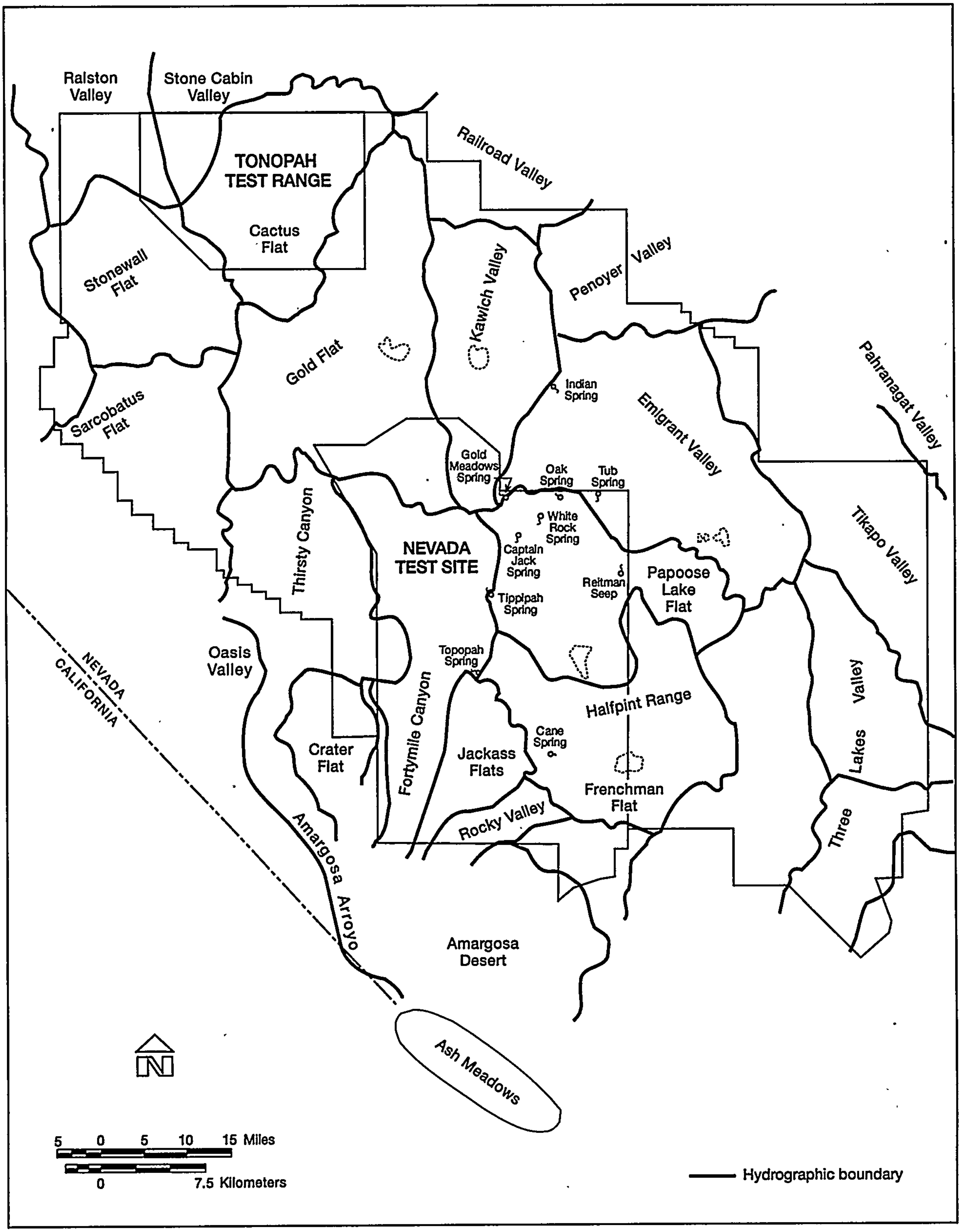


Figure 4-39. Hydrographic basins of the NTS, NAFR Complex, and Tonopah Test Range area

Table 4-16. Flood regulations relevant to waste management and other facilities on the NTS and NAFR Complex

Flood Regulations	Title
DOE Order 6430.1A	General Design Criteria
DOE-STD-1020-94	Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities
Executive Order 11988	Floodplain Management
Executive Order 11990	Protection of Wetlands
44 CFR Part 9	Floodplain Management and Protection of Wetlands
44 CFR Part 65	Identification and Mapping of Special Hazard Areas
10 CFR Part 1022	Compliance with Floodplain/Wetlands Environmental Review Requirements
40 CFR Part 264.18	Hazardous Waste Management Unit - Location Standards
40 CFR Part 264.193	Containment and Detection of Releases
40 CFR Part 270.14	Contents of Part B: General Requirements
NAC 444.8456	Location of Stationary Facility for Treatment, Incineration or Disposal of Hazardous Waste

Table 4-17. Applicable flood events and other information regarding regulations listed in Table 4-16

Regulations	25-yr, 6-hr	25-yr, 24-hr	100-yr, 6-hr	500-yr	PMP	Sediment Transport	Notes
DOE Order 6430.1A	X		X	X	X	X Also implied	References: EO 11988, EO 11990, 10 CFR Part 1022, UCRL 115910
DOE-STD-1020-94					X	X	
Executive Order 11988			X				
Executive Order 11990							Wetlands
44 CFR Part 9			X	X		Implied by references to other regulations	
44 CFR Part 65			X	X		X	Also FEMA Design Criteria Chapter 10
10 CFR Part 1022			X	X			
40 CFR Part 264.18			X				
40 CFR Part 264.193		X					
40 CFR Part 270.14			X			Requirement for flood hazard delineation map and consideration of other "special flooding"	

Areas prone to flooding surround Fortymile Wash, a major tributary of Fortymile Canyon. Tonopah Wash, which runs southwesterly across Jackass Flats from Jackass Divide in the south-central part of the NTS, is a major tributary to the Amargosa arroyo. Fortymile Canyon and Jackass Flats hydrographic basins pose a flood hazard to off-site areas (SAIC/DRI, 1991). Rock Valley arroyo trends westward from the southernmost part of the NTS to Ash Meadows in the east-central part of the Amargosa Desert (ERDA, 1977). Arroyos trending southward from Red Mountain pose a potential flood hazard to sewage lagoons that service Mercury.

Playas in Papoose Valley and Emigrant Valley on the NAFR Complex, northeast of the NTS, collect and dissipate runoff from these hydrographic basins. Arroyos originating in the Belted Range and Chalk Mountains cross Area 13 and trend to Groom playa in Emigrant Valley (DRI, 1988). Playas in Kawich Valley and Gold Flat, on the NAFR Complex north of the NTS, collect and dissipate runoff from the northern part of Pahute Mesa (ERDA, 1977).

Five hydrographic basins are within the boundaries of the Tonopah Test Range: most of Cactus Flat and parts of Stone Cabin Valley, Ralston Valley, Stonewall Flat, and Gold Flat (Figure 4-39). Playas in these hydrographic basins collect and dissipate runoff from these basins. Arroyos originating in the Cactus Range, Goldfield Hills, and Stonewall Mountain trend through Range 71.

SPRINGS AND IMPOUNDMENTS—Throughout the region, springs are the only sources of perennial surface water. These are restricted to some short reaches of the Amargosa arroyo and pools at some large springs (Figure 4-40). Most water discharged from springs travels only a short distance from the source before evaporating or infiltrating into the ground (DOE, 1986).

Discharges from springs, seeps, and marsh areas in the western hydrographic basins in the region range between less than one and several thousand gallons per minute; typically, discharges are several tens to several hundreds of gallons per minute in the larger springs. The largest discharge is at Crystal Pool in Ash Meadows (DOE, 1988). According to information provided by the U.S. Department of the Interior Texas, Nevares, and Travertine Springs in Death Valley (located downgradient of the NTS) provide a potable water supply for park visitors and a privately owned resort that includes restaurants, motels, hotels, and a golf course. Moore (1961) provides data on discharges from springs on the NTS and vicinity. The largest three of the nine springs listed, Indian, White Rock, and Cane Springs, discharge greater than 1 gal/min; all others discharge less than 1 gal/min. Prior to any actions that may result in discharges to these limited surface water occurrences, reviews will be made to ensure compliance with appropriate Executive orders and federal and state environmental laws and regulations.

A small lake, locally known as Crystal Reservoir, with a storage capacity of 2.3×10^6 m^3 (1,860 acre-feet [ac-ft]) is present in the Ash Meadows part of the Amargosa hydrographic basin (Figure 4-40). Water for the reservoir is supplied by a concrete flume from Crystal Pool (Giampaoli, 1986). The reservoir was recently drained and cleaned by the U.S. Fish and Wildlife Service.

Many impoundments have been constructed on the NTS for operations there. The impoundments on the NTS do not support any vegetation stands that qualify as wetlands. Any actions that could affect these impoundments will receive the same type of review for regulatory compliance as that discussed above for the spring discharge areas.

SURFACE WATER CHARACTERISTICS—Little data on characteristics of water in the region have been collected because all streams in the region are ephemeral, and only a few springs have been sampled. Moore (1961) presented results on chemical and radiological analyses for eight springs on the NTS (Table 4-18). Tabulated data suggest that concentrations of chemical and radiological constituents are within naturally occurring ranges.

As part of the DOE NTS Monitoring Program, potable water from groundwater wells, spring water, well reservoirs, waste disposal ponds, and sewage lagoons are routinely sampled for radiological substances in accordance with federal, state, and local regulations (DOE/NV, 1994a).

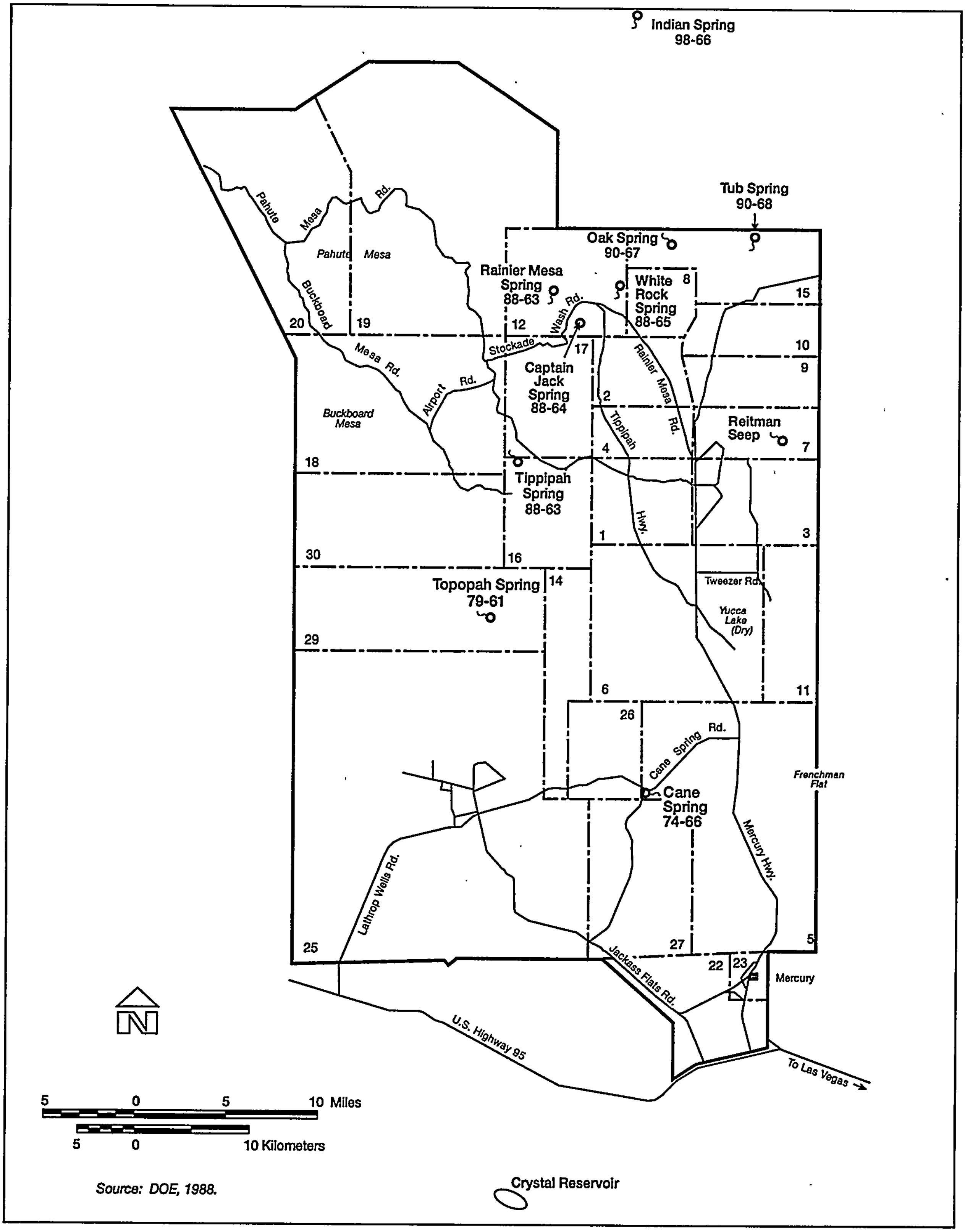


Figure 4-40. Location of springs on the NTS

Table 4-18. Chemical and radiochemical analyses of water from springs on the NTS

Spring No.	Date of Collection	°F	pH	Specific Conductance in Microohms at 25 °C	SiO_2[a]	Al[a]	Fe[a]	Mn[a]	Ca[a]	Mg[a]	Sr[a]	Na[a]	K[a]	HCO_3[a]	CO_3[a]	SO_4[a]	Cl[a]	F[a]	NO_3[a]	PO_4[a]	Total Dissolved Solids (ppm)[b]	Hardness (as $CaCo_3$)		Percent Sodium
																						Total	Noncarbonate	
74-66	9/19/57	66	7.9	425	64	.0	0.10	0.00[c]	32.0	9.2	0.0	37	7.8	163	0	28	20.0	0.5	19.0	0.25	298	118	0	399
74-66	3/24/58	64	8.0	403	63	.0	.00	.00	30.0	9.2	<.1	36	7.6	152	0	30	19.0	.7	18.0	.00	288	113	0	399
79-61	9/17/57	70	6.9	291	71	.2	.08	.00	20.0	3.9	.0	19	18.0	147	0	11	6.0	.7	.1	10	222	66	0	322
79-61	3/25/58	53	6.9	114	50	.3	.44	.00	7.2	1.0	<.1	14	6.4	48	0	15	3.0	.3	2.0	.9	123	22	0	50
83-63	9/17/57	53	7.7	207	53	.6	.31	.00	4.8	.1	.0	40	3.0	88	0	16	7.2	.2	4.6	.45	172	12	0	84
83-63	3/24/58	54	7.4	192	50	.0	.23	.00	4.8	.0	<.1	37	3.2	81	0	19	6.0	.3	4.2	.40	164	12	0	83
88-63	9/18/57	61	8.3	346	65	.2	.04	.00[c]	7.2	1.0	.2	66	4.0	158	2	18	14.0	.6	.6	2.2	256	22	0	84
88-64	5/1/59	56	6.9	188	43	.6	.95	.00[c]	3.2	.0	<.2	47	2.2	95	0	25	4.0	.4	.0	1.2	172	8	0	90
89-65	4/5/57	56	6.9	215	80	1.1	.62	.00	4.8	.0	.0	39	5.4	72	0	23	11.0	.4	4.9	.50	204	12	0	82
89-65	9/18/57	59	7.1	222	52	.1	.03	.00	4.0	.2	.0	42	5.4	78	0	29	8.0	.4	4.8	.65	184	11	0	84
89-65	3/21/58	48	7.2	197	119	.8	.44	.40[c]	6.4	.0	<.1	35	7.4	66	0	32	6.0	.6	4.8	.45	243	16	0	75
89-65	5/19/59	67	8.8	219	48	.7	.30	.00	4.8	.0	<.2	39	4.0	50	13	23	9.0	.6	1.9	.55	167	12	0	83
90-67	4/28/58	55	7.5	241	57	.1	.00	.00[c]	18.0	4.9	<.1	22	6.4	116	0	14	9.0	.3	.0	.10	189	65	0	40
90-68	4/30/59	52	7.1	260	64	.1	.13	.00	16.0	3.9	<.2	31	4.0	118	0	14	11.0	.4	.0	.21	202	56	0	52
98-66	5/1/58	50	7.2	358	61	.1	.08	.00	42.0	7.8	<.2	17	4.8	148	0	36	12.0	.4	.0	.00	254	137	16	211

[a] SiO_2=silica; Al=aluminum; Fe=iron; Mn=manganese; Ca=calcium; Mg=magnesium; Sr=strontium; Na=sodium; K=potassium; HCO_3=bicarbonate; CO_3=carbonate; SO_4=sulfate; Cl=chloride; F=fluoride; NO_3=nitrate; PO_4=phosphate

[b] Dissolved constituents given in parts per million

[c] In solution at time of analysis.

There is no known human consumption of surface water on the NTS. In fact, no public water supplies are drawn from springs in Amargosa Valley, which is located downgradient from the NTS along the primary pathway for surface water flow. The closest surface water supply that is used for public consumption is Lake Mead, which supplies a large portion of the water demand of metropolitan Las Vegas. Water availability and weather permitting, grab samples from open reservoirs, springs, containment ponds, and sewage lagoons are collected monthly. Analyses for gamma emitters, gross beta, and tritium are conducted monthly; analyses for plutonium-238, -239, and -240 are conducted quarterly; and analysis for strontium-90 is conducted annually.

The annual average for each radionuclide analyzed in surface waters is presented in Table 4-19, along with results from analysis of tunnel seepage. The annual averages for open reservoirs and natural springs are compared to the Derived Concentration Guides for ingested water. Gamma results for all sample locations indicated that radionuclide levels were consistently below the detection limit except for samples from the containment ponds. The containment ponds were constructed to catch contaminated runoff from the tunnel complexes. With the exception of containment ponds, no annual average concentration in surface waters was found to be statistically different from any other at the 5-percent significance level. The analytical results from the Area 12 containment ponds showed measurable quantities of radioactivity (DOE, 1993).

Open reservoirs have been established at various locations on the NTS for industrial uses. The annual average gross beta concentrations were compared to the Derived Concentration Guide for ingested water, listed in DOE Order 5400.5, even though there was no known consumption of these waters. The appropriate data are shown in Table 4-20 (DOE, 1993).

Of the nine natural springs found on the NTS, seven are consistently sampled. The other two springs, Tub Spring and Gold Meadows, are sampled when the discharge is large enough to allow sampling, which is infrequent. These springs are a source of drinking water for wild animals on the NTS. The annual average gross beta results for each spring are shown in Table 4-21 and compared to the strontium-90 Derived Concentration Guide for drinking water; however, the water is not used for human consumption. The highest result was for Reitman Seep, which was still below the Derived Concentration Guide (DOE, 1993). Spring discharge samples have also been analyzed for specific radionuclides (tritium, three isotopes of plutonium, and strontium). The average annual concentrations for these radionuclides are also below the Derived Concentration Guides based upon 4 millirem (mrem) effective dose equivalent for drinking water. Tritium averages were low in 1994, below 1.0 picocuries per liter (pCi/L), when eight of the springs were sampled (DOE, 1994b).

Nine of eleven sites related to containment ponds are sampled monthly: five ponds containing impounded waters from the tunnels, three liquid effluents discharged from the tunnels, and a contaminated laundry pond. All active containment ponds are fenced and are posted with radiological warning signs to prevent human access. These ponds are not fenced or flagged so as to prevent access by wildlife and migrating birds and are north of the range of the desert tortoise. The annual average of gross beta analyses from each sampling location is listed in Table 4-22 and compared to the Derived Concentration Guide for ingested water; however, the water is not used for drinking by humans (DOE, 1993).

Since the closing of the Area 6 Decontamination Facility Pond on November 8, 1992, wastewater has been discharged into holding tanks. Because the water and soil in the former pond are contaminated, grab water samples are collected from the pond monthly when possible (DOE, 1993).

As in the past, samples from the Areas 6, 12, and 23 sewage lagoons were collected quarterly during 1993. During the month of November, sampling was expanded to include all sewage lagoons that are in use, which amounted to an increase of six lagoons located in Areas 6, 12, 22, and 23. Each of the lagoons is part of a closed system used for evaporative treatment of sanitary waste. There was no known contact by the working population during the year. The annual gross-beta-concentration

Table 4-19. Radioactivity in NTS surface waters

(Annual average concentrations in units of picocurie per liter)							
Source of Water	Number of Locations	Gross β	Tritium	^{238}Pu	$^{239+240}$Pu	^{90}Sr[a]	% of DCG[b] Range
Open Reservoirs	15	5.7	-33[c]	0.0011	0.20	0.13	0.069 to 24
Natural Springs	7	9.3	5.4	0.03	0.46	0.24	0.007 to 33
Containment Ponds							
T Tunnel	3	260.0	3.1×10^7	0.028	0.81	ND[c]	([d])
N Tunnel	3	5.3	2.2×10^5	0.00076	0.047	NA[e]	([d])
E Tunnel	2	83	1.7×10^8	0.62	53	5.3	([d])
Decon Facility	1	53	1100	0.0	0.14	NA[e]	([d])
Sewage Lagoons	3	24	67	0.0011	0.0082	0.13	([d])

[a] Strontium-90 values are for one sample
[b] Derived Concentration Guide is based on value for drinking water (4 mrem effective dose equivalent)
[c] Below detection limit
[d] Not a potable water source
[e] Not analyzed.

Source: DOE/NV, 1994a.

Table 4-20. NTS open reservoir gross beta analysis results

		Gross Beta Concentration (picocurie per liter)				
Location	Number of Samples	Maximum	Minimum	Arithmetic Mean	Standard Deviation	Mean as %DCG*
Area 2, Mud Plant Reservoir	12	9.7	1.4	3.8	2.1	9.5
Area 2, Well 2 Reservoir	12	12.0	4.0	6.4	2.2	16.0
Area 3, Mud Plant Reservoir	12	18.0	2.8	11.0	3.5	28.0
Area 3, Reservoir	12	12.0	0.1	8.2	3.2	21.0
Area 5, UE-5c Reservoir	11	8.9	5.2	7.0	1.2	18.0
Area 5, Well 5b Reservoir	11	15.0	4.8	9.4	3.2	24.0
Area 6, Well 3 Reservoir	2	12.0	9.1	10.0	1.9	25.0
Area 6, Well C1 Reservoir	12	19.0	0.5	9.1	4.9	23.0
Area 18, Camp 17 Reservoir	11	8.7	2.8	4.2	1.6	11.0
Area 18, Well 8 Reservoir	3	6.1	3.8	5.1	1.2	13.0
Area 19, UE-19c Reservoir	10	12.0	1.4	3.4	3.0	8.5
Area 20, Well 20a Reservoir	7	12.0	1.1	4.3	3.6	11.0
Area 23, Swimming Pool	12	6.3	3.2	4.4	1.1	11.0
Area 25, Well J-11 Reservoir	12	6.5	3.7	5.2	0.9	13.0
Area 25, Well J-12 Reservoir	12	9.5	4.8	6.5	1.6	16.0

* Derived Concentration Guide based on strontium-90 value for drinking water (4 mrem effective dose equivalent).

Source: DOE/NV, 1994a.

Table 4-21. NTS natural spring gross beta analysis results, 1993

Location	Number of Samples	Gross Beta Concentration (picocurie per liter)				
		Maximum	Minimum	Arithmetic Mean	Standard Deviation	Mean as %DCG[a]
Area 5, Cane Spring	12	24.0	2.0	9.3	6.3	23
Area 7, Reitmann Seep	12	100.0	19.0	36.0	23.0	90
Area 12, Captain Jack	8	18.0	5.0	9.1	4.1	23
Area 12, Gold Meadows	5	23.0	8.1	14.0	7.5	35
Area 12, White Rock Spring	12	1.3	7.0	9.9	1.9	25
Area 16, Tippipah Spring	12	7.3	3.2	4.6	1.1	12
Area 29, Tonopah Spring	10	8.4	4.2	5.7	1.5	14

[a] Derived Concentration Guide based on strontium-90 value for drinking water (4 mrem effective dose equivalent).

Source: DOE/NV, 1994a.

Table 4-22. NTS containment pond gross beta analysis results

Location	Number of Samples	Gross Beta Concentration (picocurie per liter)				
		Maximum	Minimum	Arithmetic Mean	Standard Deviation	Mean as %DCG[a]
Area 6, Decontamination Pond	7	83.0	33.0	53.0	20.0	130.0
Area 12, E Tunnel Seepage	12	170.0	51.0	84.0	34.0	210.0
Area 12, E Tunnel Pond No. 1	10	130.0	53.0	82.0	29.0	210.0
Area 12, N Tunnel Seepage	5	22.0	-1.4[b]	6.8	9.2	17.0
Area 12, N Tunnel Pond No. 1[c]	(c)	(c)	(c)	(c)	(c)	(c)
Area 12, N Tunnel Pond No. 2	2	7.7	-4.3	1.7	8.5	4.3
Area 12, N Tunnel Pond No. 3	3	20.0	6.1	15.0	7.7	3.8
Area 12, T Tunnel Seepage	6	360.0	-3.9[b]	19.0	160.0	48.0
Area 12, T Tunnel Pond No. 1[c]	(c)	(c)	(c)	(c)	(c)	(c)
Area 12, T Tunnel Pond No. 2	4	310.0	170.0	260.0	58.0	650.0
Area 12, T Tunnel Pond No. 3	4	330.0	180.0	270.0	69.0	680.0

[a] Derived Concentration Guide based on strontium-90 value for drinking water (4 mrem effective dose equivalent)
[b] Below detection limit
[c] Pond dry.

Source: DOE/NV, 1994a.

averages for the three lagoons ranged between 2.0 and 3.1 pCi/L. The data for the new lagoons were similar. No radioactivity was detected above the minimum detectable concentrations for tritium and plutonium-238. Levels of strontium-90 slightly above the minimum detectable concentrations were detected in samples collected at the Area 6 Device Assembly Facility sewage lagoon, the Area 6 sewage lagoon, and the Area 12 sewage lagoon. Levels of plutonium-239 and -240 were also detected slightly above the minimum detectable concentration in two samples collected from the Area 6 sewage lagoon. No event-related radioactivity was detected by gamma spectrometry analyses (DOE, 1993).

All water discharges at the NTS are regulated by the state of Nevada. The NTS maintains compliance with required permits. Water-pollution control permits issued by the State are required for industrial and domestic wastewater discharges (DOE/NV, 1993). Discharge and monitoring requirements imposed by the State serve to prevent degradation of the surface waters (and groundwater) on the NTS.

*4.1.5.2 **Groundwater.*** Although the groundwater resources of the region are large, their physical availability is quite variable. All potentially affected areas are located within the Death Valley flow system. The Death Valley flow system is composed of 30 individual hydrographic basins and 41,440 km^2 (16,000 mi^2) of the Great Basin (Harrill et al., 1988). This flow system originates primarily from the infiltration of precipitation over mountainous areas and flows toward the regional groundwater depression at Death Valley or smaller depressions in Sarcobatus Flats, Oasis Valley, Ash Meadows, and the Amargosa Desert.

The groundwater within the eastern portion of the NTS and within Area 13 of the NAFR Complex flows toward the Ash Meadows discharge area. In most of the western portion of the NTS, it flows toward the Alkali Flat-Furnace Creek discharge area. In the western part of the Tonopah Test Range and the extreme northwest tip of the NTS, it flows toward the Oasis Valley and the Sarcobatus discharge areas and on to Death Valley.

Table 4-23 lists the hydrographic basins that include portions of the NTS, the perennial yields of these basins, DOE's water supply wells, and DOE's peak demand rates for water in each of the basins. The perennial yield is an estimate of the quantity of groundwater that can be withdrawn from a basin on an annual basis without depleting the reservoir (Scott et al., 1971). The perennial yield values are estimates used by the Nevada State Engineer for planning purposes and may be significantly greater if recharge is greater than current estimates. The perennial yield values could also be smaller if one-half of the underflow between some basins is not considered a part of the perennial yield of specific basins, e.g., Frenchman Flat. Such considerations reflect the uncertainties involved in developing the estimates presented in the published literature. As shown in Table 4-23, the peak demand associated with historic NTS actions has been a small fraction of the available perennial yield in Gold Flat, Kawich Valley, Frenchman Flat, Mercury Valley, and Fortymile Canyon. Only in Yucca Flat have the DOE groundwater withdrawals exceeded the published perennial yield. The peak demand of 1,124,935 m^3 (912 acre-feet) in 1989 exceeded the perennial yield of 431,719 m^3 (350 acre-feet) by a factor of 2.6. Historic data indicate that annual water withdrawals have exceeded the perennial yield of Yucca Flat since 1962, but only in 1967, 1969, and 1989 were more than 863,437 m^3 (700 acre-feet) withdrawn.

The effects of the DOE's water withdrawals have included the lowering of water levels in the vicinity of water supply wells and some localized changes in groundwater flow directions. Estimates of the drawdown in the vicinity of NTS water supply wells have been made by the U.S. Geology Survey (Young, 1972; Thordarson, 1983). In general, the effects of pumping NTS water supply wells is concentrated within a distance of a few thousand feet of the operating wells. As part of their Wellhead Protection Program for the NTS, the DOE recently completed capture zone models for each water supply well and mapped the area of influence for each well. These models used a very conservative approach that assumed that each well was run continuously for a period of ten years. The results of these analyses indicate that for each well, the area of influence is restricted, and only at

Table 4-23. Perennial yields and peak historic water demands for the 10 hydrographic basins on the NTS

Basin	Estimated Perennial Yield		DOE Water Supply Wells	Peak DOE Historic Water Demand		
	m³/yr	acre-feet/year		m³	acre-feet	yr
Gold Flat	2.3×10^6	1,900	1	4.3×10^5	345	1989
Kawich Valley	2.7×10^6	2,200	1	5.2×10^5	425	1989
Emigrant Valley	3.1×10^6	2,500	None	No Demand		
Yucca Flat	4.3×10^5	350	8	1.0×10^6	912	1989
Frenchman Flat	1.9×10^7	16,000	3	6.5×10^5	530	1962
Mercury Valley	9.8×10^6	8,000	1	5.3×10^5	428	1992
Rock Valley	9.8×10^6	8,000	None	No Demand		
Fortymile Canyon	9.4×10^6	7,600	3	4.2×10^5	340	1988
Oasis Valley	2.5×10^6	2,000	None	No Demand		
Amargosa Valley	2.9×10^7	24,000	None	No Demand		

Army Well 1 does the capture zone extend beyond the NTS boundaries. No impacts on springs or biological resources are anticipated as a result of the operation of these wells. The extent and magnitude of water-level declines in the vicinity of these supply wells is not considered a significant impact in Gold Flat, Kawich Valley, Frenchman Flat, Mercury Valley, and Fortymile Canyon.

Because the extraction rates in Yucca Flat exceed the perennial yield of the basin, the impacts of the water supply wells could be more significant and require special consideration. The capture of groundwater in excess of the perennial yield could have removed water from storage or decreased the downgradient subsurface discharge to Frenchman Flat or both. Long-term water-level data for three wells in Yucca Flat are presented in Clary et al. (1995) and show variable results. Water levels in Well UE-2ce have been affected by underground tests and declined about 24 m (80 ft) between 1977 and 1984, while water levels in Well UE-5n rose about 0.3 m (1 ft). At Well UE-2ce, water levels rose almost 8 m (25 ft) between 1984 and 1994. Records for Well TW-7 have been affected by underground nuclear detonations and show an overall trend of rising water levels between 1957 and 1980 and declining water levels from 1980 to 1994.

HYDROGEOLOGIC UNITS—The NTS and surrounding regions are hydrogeologically complex. Three principal hydrogeologic systems—valley-fill alluvium, Tertiary volcanic rocks (tuffs and lava flows), and Proterozoic and Paleozoic sedimentary rocks—have undergone several periods of extensive faulting and deformation. As evidence of the complex hydrogeology, Winograd and Thordarson (1975) identified six major aquifers and four major aquitards in the region. The general relationship of hydrogeologic units in southern Nevada is listed in Table 4-24 and shown graphically on Figure 4-41a and 4-41b.

The hydrologic basement, referred to as the lower clastic confining unit, is comprised of approximately low-permeability Cambrian and older quartzite and metamorphic rocks. This

Table 4-24. Major hydrogeologic units of the Death Valley flow system

Hydrogeologic Units	Primary Rock Types	Age
valley-fill aquifer	alluvium, playa	Late Tertiary to Quaternary
volcanic: lava flow aquifers welded-tuff aquifers tuff-confining units	rhyolite lava flows welded ash-flow tuffs nonwelded, zeolitized ash-flow tuffs	Miocene
carbonates and clastic rocks: upper carbonate aquifer upper clastic confining unit lower carbonate aquifer lower clastic confining unit	limestone shales and siltstones limestones and dolostones quartzites and other metamorphics	Pennsylvanian Mississippian Cambrian to Devonian Cambrian and Eocambrian

Sources: Modified after Waddell et al., 1984.

confining unit is regionally overlain by the lower carbonate aquifer, which is comprised of 4,000 to 5,000 m (13,120 to 16,400 ft) of relatively thick permeable limestones and dolostones, with thinner less permeable siltstones, shales, and quartzites.

Because of the past geologic history of uplift and erosion and structural deformation, the lower carbonate aquifer is not present in all areas, and rarely is the entire thickness of the unit present under the NTS or adjacent areas. Regional intrabasin flow is dominated by groundwater movement within the lower carbonate aquifer. Locally at the NTS, the lower carbonate aquifer is overlain by the upper clastic confining unit, which consists of low-permeability rocks of the Eleana and Chainman formations. In addition, Pennsylvanian-age limestones (or the upper carbonate aquifer) overlie the upper clastic confining unit in limited areas of the NTS. Flow through the upper carbonate aquifer is discontinuous and, therefore, considered less significant than flow through the regional lower carbonate aquifer.

Groundwater flow on Pahute and Rainier Mesas is through thick sequences of Tertiary volcanic rock, originating from calderas of the southwest Nevada volcanic field. Thinner sequences of these volcanic rocks overlie the upper carbonate aquifer and clastic confining units within some areas of the Yucca and Frenchman Flats. Tertiary volcanic rocks consist of ash flows, lava flows, and air-fall tuffs. Local alteration of units (primarily by zeolitization) in older, deeper parts of the volcanic pile has resulted in lower transmissivities characteristic of the volcanic confining unit. Lava-flow aquifers (present near volcanic centers) are present in Jackass Flats, Pahute Mesa, Rainier Mesa, Timber Mountain, and associated proximal areas. Tuff aquifers within the volcanic aquifer hydrogeologic unit consist of ash-fall, welded, or bedded tuffs. Welded-tuff aquifers are present in the deepest parts of the Yucca Flat weapons test basin, Frenchman Flat, and Jackass Flats. Welded- and bedded-tuff aquifers are also present on the mesas, Timber Mountain, and associated proximal areas.

Tertiary- and Quaternary-age alluvium and playa lake deposits fill the intermontane valleys and locally overlie Tertiary and Paleozoic rocks. The valley-fill deposits comprise a sequence of gravel, sand, silt, and clay. The sediments vary widely,

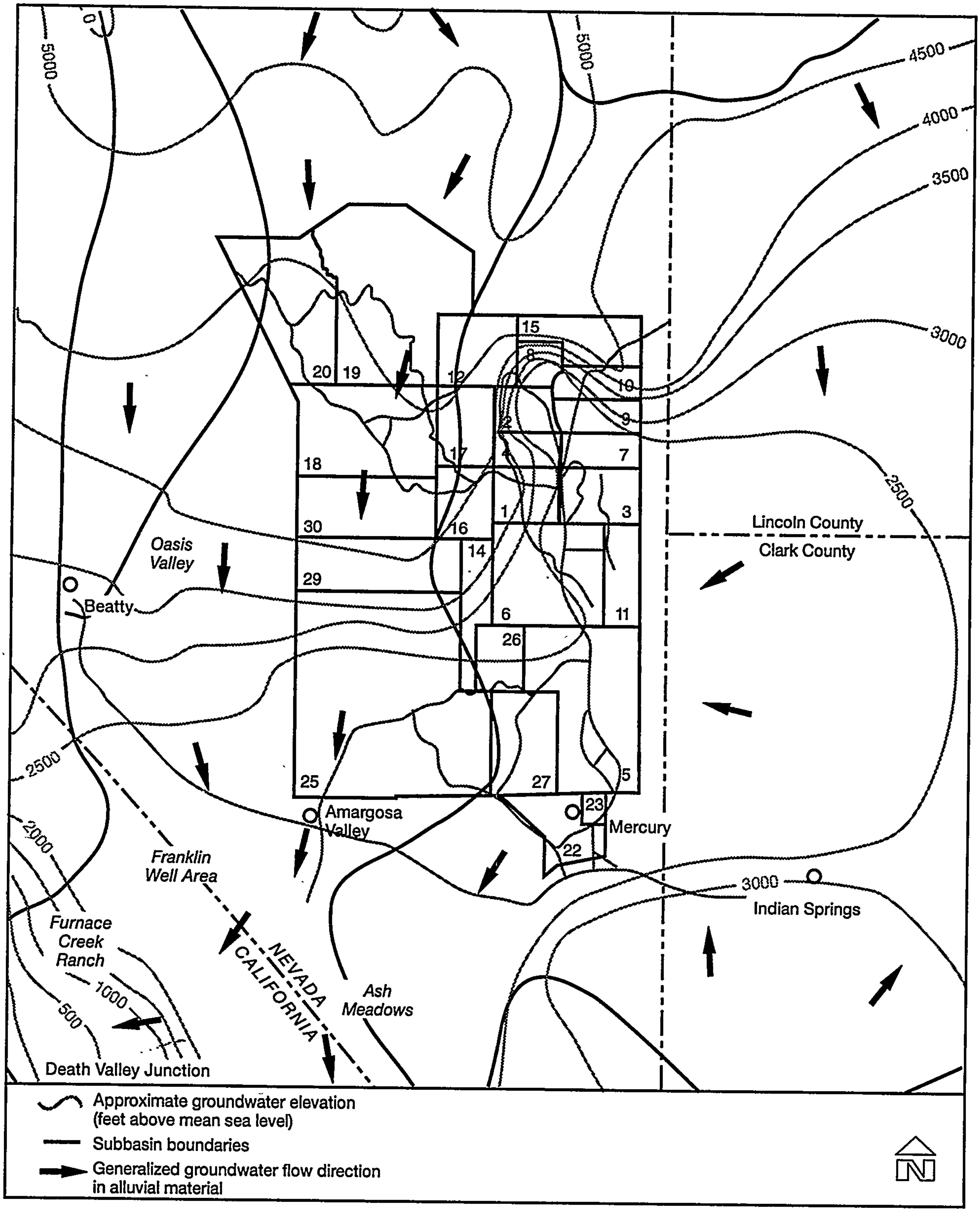


Figure 4-41a. Generalized potentiometric surface and groundwater flow directions

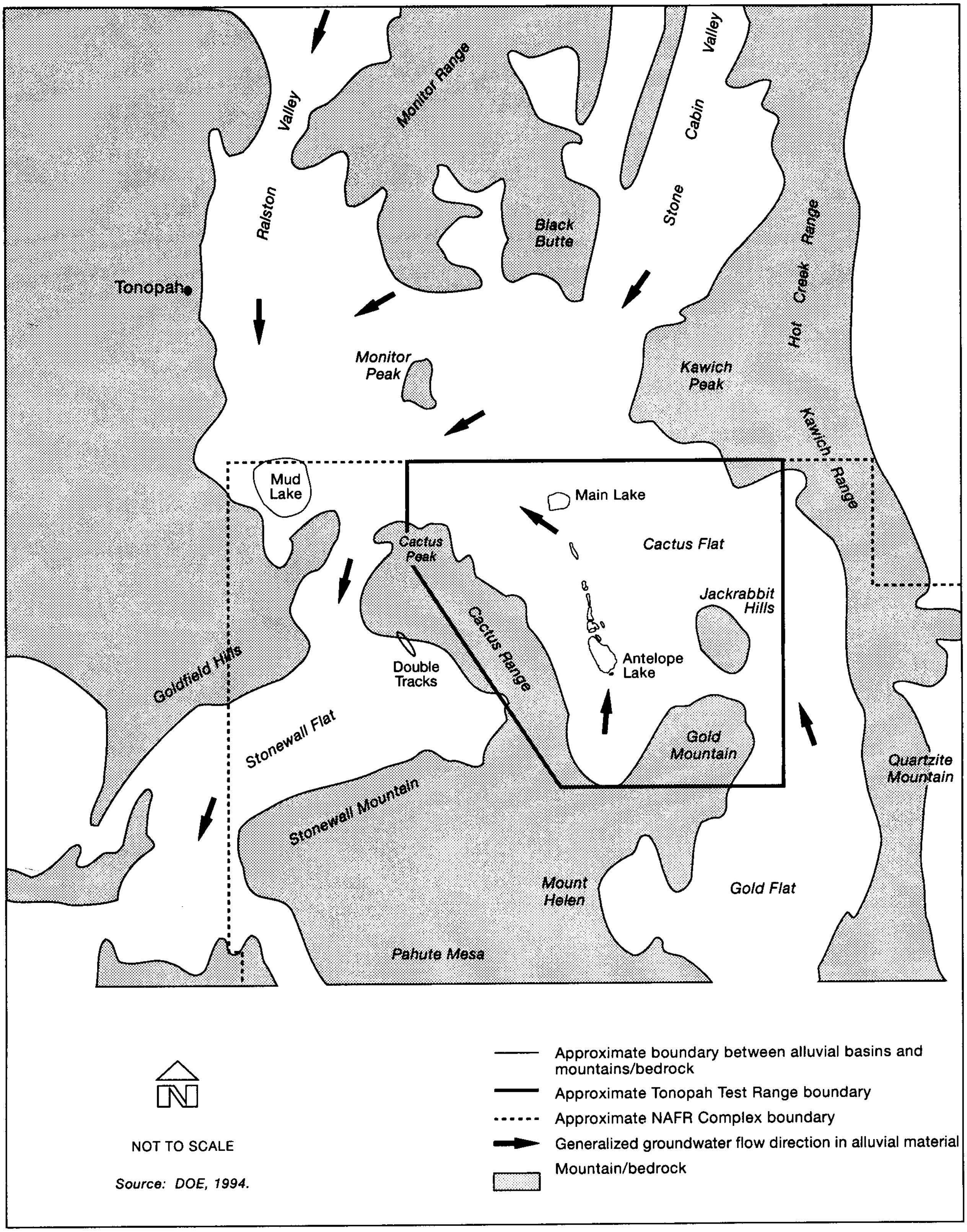


Figure 4-41b. Generalized alluvial material groundwater flow direction in the vicinity of the Tonopah Test Range

with clay predominating in the playa areas and in the gravels and sands under the alluvial fans. The permeability of these alluvial materials is quite variable with very low permeabilities associated with the fine-grained clays and silts, moderate permeabilities associated with poorly sorted mixtures and cemented or consolidated alluvium,and highest permeabilities occurring where the highest proportions of uncemented gravels and sands are located.

HYDROLOGIC/HYDRAULIC PROPERTIES—Transmissivity is defined as the rate at which groundwater flows through a unit width of an aquifer under a unit hydraulic gradient. Porosity is defined as the percentage of the volume of rock that is occupied by connected or isolated interstices (tiny open spaces). Estimated transmissivities and porosities for some of the principal hydrogeologic units are summarized in Table 4-25 (Winograd and Thordarson, 1975).

In general, water moves most rapidly through the fractured limestones and dolostones and less rapidly through valley-fill alluvium and fractured volcanic rocks; water moves most slowly through playa deposits, nonfractured volcanic rocks, quartzites, siltstones, and shales. In the limestones and dolostones, the relatively high transmissivities are associated primarily with fractures and dissolution features.

In the volcanic rocks, water movement occurs along bedding planes and cooling joints of lava-flow sheets and welded-flow units. In some locations, the overlying unaltered volcanic section is abundantly fractured and has retained its permeability. In the valley-fill deposits, transmissivity is dependent on the amount of clay and mineralization and on the degree of consolidation.

GROUNDWATER OCCURRENCE—Occurrences of groundwater are discussed in separate subsections for water levels and for groundwater flow and gradients.

Water Levels—The depth to the groundwater in wells at the NTS varies from about 79 m (260 ft) below land surface in the extreme northwest part of the NTS and about 160 m (525 ft) below land surface in portions of Frenchman Flat and Yucca Flat weapons test basin (Winograd and Thordarson, 1975) to more than 610 m (2,000 ft) under the upland portions of Pahute Mesa (Russell, 1994). Perched groundwater is known to occur in some parts of the NTS, mainly in the volcanic rocks of the Pahute Mesa area.

Groundwater Flow and Gradients—The present conceptual groundwater flow model for the Death Valley flow system is derived primarily from Winograd and Thordarson (1975) and updated by Waddell et al. (1984) and Laczniak et al. (1996). More recently, additional conceptual models of the system have been published by PAL Consultants (1995), Faunt (1994), and D'Agnese (1994). Groundwater flows generally south and southwest. The flow system extends from the water table to a depth that may exceed 1,494 m (4,900 ft) where the transmissivity of the rocks becomes much smaller (ERDA, 1977).

The rates of flow are quite variable, reflecting the types of aquifers present, the degree of fracturing and secondary dissolution of carbonate aquifers, and the hydraulic gradients that are present in a given area. In general, average flow rates over broad areas were estimated by Winograd and Thordarson (1975) to range from 2 to 201 meters per year (m/yr) (7 to 660 feet per year [ft/yr]), but rates can be much lower or much higher over short distances in certain geologic settings. Significant components of vertical groundwater flow are present in certain areas. For example, in the Frenchman Flat area, groundwater recharge derived from Indian Springs Valley on the east and the Yucca Flat weapons test basin on the north moves primarily downward into the underlying carbonate aquifers.

According to information provided by the U.S. Department of the Interior, flow rates may increase in the vicinity of Ash Meadows. The National Park Service is concerned that contaminant transport may be accelerated toward Devils Hole and Ash Meadows. Because contaminants that remain in the underground testing areas are almost exclusively contained in the alluvial and volcanic aquifers, they must first migrate out of these aquifers and into the carbonates. Therefore, DOE's efforts to model these contaminants has concentrated on the rate of transport between the aquifers, currently thought to be significantly slower than in the carbonates. The DOE will continue to participate in cooperative investigations with the National Park Service concerning environmentally sensitive areas downgradient of the NTS.

WATER BALANCE—Within the Death Valley flow system, recharge occurs as underflow from upgradient areas and from infiltration of precipitation primarily in the northern and eastern mountain ranges, while discharge occurs primarily in the southern and western low-lying valleys. Discharge locations are controlled by the presence of low-permeability materials that force groundwater to the land surface or by the lower elevations of Death Valley.

Recharge—The groundwater underlying the NTS and surrounding areas is derived from two sources: underflow from basins upgradient of the area and from recharge over the upland areas within the NTS boundaries.

Cumulative underflow from adjacent areas is significant (see Figure 4-41a). Harrill et al. (1988) estimated underflow of 3.9 x 10^7 m^3 /yr (32,000 acre-feet/year) discharge from Indian Springs Valley westward into Frenchman Flat.

Table 4-25. Summary of hydraulic properties of major hydrogeologic units

Hydrogeologic Unit	Approximate Range of Transmissivities: m^2 per day	Approximate Range of Transmissivities: ft^2 per day	Approximate Range of Porosities (%)
Limestones and dolostones	0.11 to 10,996	1.2 to 118,360	1 to 12
Tuff confining units	0.0016 to 180	0.017 to 1,936	20 to 48
Lava flow aquifers	0.00021 to 5.0	0.002 to 54	32 to 45
Tuff aquifer (welded)	0.00024 to 2,299	0.0025 to 24,748	7 to 36
Tuff aquifer (bedded)	Not Available	Not Available	20 to 53
Valley-fill aquifer	0.0019 to 340	0.02 to 3,658	10 to 54

They estimated that the underflow of 6.2×10^6 m^3/yr (5,000 acre-feet/year) and 1.2×10^6 m^3/yr (1,000 acre-feet/year) is derived from Kawich Valley and Gold Flat, respectively. estimated that small to moderate volumes of water (0.1 to 7.4×10^6 m^3/yr [80 to 6,000 acre-feet/year]) may enter the carbonate aquifer in the Ash Meadows groundwater basin by underflow from the northeast. Thus, the total underflow onto the NTS is at least 4.7×10^7 m^3/yr (38,000 acre-feet/year), based on Harrill et al. (1988), and could be as high as 5.4×10^7 m^3/yr (44,000 acre-feet/year) if the inflow suggested by Winograd and Thordarson (1975) is considered.

Upland recharge occurs predominately by slow percolation of surface water through the unsaturated zone that overlies the water table. Most of this recharge is restricted to higher elevations where precipitation is greatest and along upland canyons and alluvial fans adjacent to upland areas. Recharge from upland areas of the NTS is far more limited, about 4.2×10^6 m^3/yr (3,400 acre-feet/year), one-tenth of that derived from underflow. Most of the recharge originates over the upland areas of Pahute Mesa, Timber Mountain, and the Belted Range.

Discharge—Most of the natural annual discharge from the Death Valley flow system is transpired by plants or evaporated from soil and playas in the Amargosa Desert and Death Valley. This discharge is estimated to be about 2.1×10^7 m^3/yr (17,000 acre-feet/year) from the Ash Meadows area and about 1.1×10^7 m^3/yr (9,000 acre-feet/year) from the Alkali Flat-Furnace Creek Ranch area (Rush, 1970). Less than 1×10^6 m^3/yr (a few hundred acre feet/year) may continue southward through alluvium of the Amargosa arroyos, and as much as 6.2×10^6 m^3/yr (5,000 acre-feet/year) yearly may flow westward from the Amargosa Desert to springs in Death Valley (ERDA, 1977).

Discharge at Ash Meadows and Oasis Valley is structurally controlled; the presence of low-permeability rocks retards regional flow. This geologic setting creates high water levels that result in local spring discharge and evapotranspiration. However, some water may flow into the Alkali Flat-Furnace Creek Ranch area and discharges at springs near Furnace Creek Ranch (Winograd and Thordarson, 1975).

Within the NTS, groundwater discharge is much smaller and is limited to a few springs in the upland areas and several wells. The springs discharge waters from perched zones in the upland areas. Discharge from the springs is small; three springs discharge between 8 and 30 liters per minute (L/min) (2 and 8 gal/min), while the rest discharge less than 4 L/min (1 gal/min) (DOE, 1988). The springs are important sources of water for wildlife, but they are too small to be of use as a water supply source. The chemistry of these springs is summarized in Tables 4-18, 4-19, and 4-21 in the surface hydrology section (4.1.5.1). Well pumping varies from year to year and ranges between 1.2 and 2.5 million m^3/yr (1,000 and 2,000 acre-feet/year) (Russell, 1994).

Discharge to springs and wells is small compared to the natural discharge of groundwater from the NTS through subsurface flow to Rock Valley and the Amargosa Desert, which totals an estimated 5.2×10^7 m^3/yr (42,000 acre-feet/year) (Harrill et al., 1988).

GROUNDWATER QUALITY—Groundwater quality within aquifers on the NTS is generally acceptable for drinking water and industrial and agricultural uses. According to EPA guidelines for groundwater classification, all hydrologic units that supply drinking water to the NTS are classified as Class II groundwater (Chapman, 1994). Class II refers to groundwater that is either currently being used as a source of drinking water or that could be a source of drinking water.

Recent updates in the interpretation of chemical analyses of groundwater collected at and near the NTS are discussed in Chapman and Lyles (1993). Table 4-26 presents a summary of water chemistry data for selected wells and compares the results to

Table 4-26. Summary of 1993 water chemistry data for select wells on the NTS

Well Name	Calcium (mg/L)[a]	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Nitrate (mg/L)	Sulfate (mg/L)	Alkalinity (mg/L)	Hardness[b] (mg/L)	pH (unitless)	Sp. Cond.[c] (μS/cm)[d]	TDS[e] (mg/L)
Army Well 1	44	22	5	39	261	0	15	1.07	1.9	55	214	201	7.96	542	312
Well 5b	8	2	11	93	161	10	23	0.85	2.7	58	148	28	8.6	496	338
Well 5c	2	1	7	134	278	24	10	1.04	1.5	33	264	9	8.93	572	396
Well 4	24	8	5	48	149	7	12	0.8	6.8	42	134	93	8.26	401	288
Well 4a	22	6	6	55	159	5	9	0.81	NA	35	138	80	8.22	385	283
Well C	74	29	14	125	576	0	33	1.09	1.6	66	472	304	7.38	1,070	639
Well C1	73	28	13	121	578	0	34	1.14	0.6	66	474	298	7.47	1,070	639
Well 8	8	1	3	30	71	5	7	0.81	1.3	14	66	24	8.28	196	149
UE-16d	79	24	7	30	356	0	11	0.56	0.6	58	292	296	7.89	645	401
J-12	15	2	5	41	120	0	8	1.8	2	25	98	46	8.15	277	209
J-13	12	2	5	44	124	0	7	2.26	2.2	18	102	38	7.97	280	209
EPA[f] DWS	NS[g]	NS	NS	NS	NS	NS	250	2.0	10.0	250	NS	NS	6.5 to 8.5	NS	500

NOTE: The following elements are present in trace quantities below Safe Drinking Water Act limits: arsenic, boron, chromium, iron, manganese, selenium, silver, barium, cadmium, copper, lead, mercury, silica, and zinc.

NA=not applicable.

[a] Milligrams per liter = parts per million
[b] Hardness is expressed as calcium carbonate
[c] Specific conductivity
[d] Microsiemen per centimeter
[e] Total dissolved solids
[f] EPA Drinking Water Standards
[g] No standard exists.

Source: REECo, 1991.

the EPA Drinking Water Standards. Water chemistry varied from a sodium-potassium-bicarbonate type to a calcium-magnesium-carbonate type, depending on the mineralogical composition of the aquifer source.

Wells producing from the mesas (predominantly the volcanic aquifer system) yielded water containing between 150 and 200 milligrams per liter (mg/L) (parts per million [ppm]) of total dissolved solids. Ash Meadows groundwater produced higher values of total dissolved solids, ranging from 275 to 460 mg/L (275 to 460 ppm). Water from Wells C and C1 in the southern part of the Yucca Flat weapons test basin (Figure 4-42) had about 650 mg/L (650 ppm) of total dissolved solids that slightly exceed the primary recommended limit of 500 mg/L (500 ppm), but falls within the secondary limit of 1,000 mg/L (1,000 ppm) of total dissolved solids (EPA, 1992). Additionally, Wells 5B and 5C had pH values of 8.6 and 8.9, respectively, which slightly exceed the primary EPA drinking water standard for pH of 8.5. One well on the NTS produces water with fluoride concentrations that equal or exceed guidelines for continuous use (ERDA, 1977). Periodic groundwater monitoring for volatile organic compounds is performed at the NTS. Results from groundwater monitoring indicate that, except for one occurrence in 1992, no volatile organic compounds are present. In 1992, one volatile organic compound, 1,1,1,-trichloroethane, was detected in a sample collected from Area 6 Well 4a at a concentration of 2.1 μg/L (2.1 parts per billion), which was well below the drinking water standard of 200 mg/L (200 parts per million) Annual Site Environmental Report, 1991, (DOE/NV, 1992b). At that time, Well 4a had been recently developed and had not yet been connected to a distribution system. Samples for analysis from Well 4a were taken in May 1992. These analyses did not indicate the presence of volatile organic compounds, Annual Site Environmental Report, 1992, (DOE, 1993). Trends from recent analysis indicate no further presence of volatile organic compounds is expected to be detected in potable water wells (Annual Site Environmental Reports for years, (DOE/NV, 1992b, 1993, 1994a, and 1995b).

Much of what is known about radiologic sources in the groundwater and contaminant migration is derived from studies conducted by the Hydrologic Resources Management Program, and the Environmental Restoration Program. Monitoring programs are discussed in a later section and general findings of the other programs are discussed below.

RADIOLOGIC SOURCES IN GROUNDWATER—With respect to the current disposition of radioactivity at the NTS, it is important to note the difference between the total radionuclide source term and the hydrologic source term. The total radionuclide source term is considered as the total activity from all underground tests that were conducted beneath the water table or within 101 m (330 ft) of the top of the water table. Table 4-27 summarizes the isotopes and their remaining activities as of January 1, 1994. The total remaining inventory under, or within 101 m (330 ft) of, the water table is estimated to be 1.1 x 10^8 Ci (Benjamin, 1995). Of this quantity, an estimated 7.7 x 10^7 Ci is isolated on Pahute Mesa, and an estimated 3.5 x 10^7 Ci is isolated at the other testing areas, predominantly Yucca Flat and Frenchman Flat. These activities represent the remaining isotopes that could be available to the groundwater regime. There is considerable uncertainty concerning the actual quantity of this radioactivity that can enter the groundwater regime-- that is, the hydrologic source term. Most investigators have concluded that much of the radioactivity, exclusive of tritium, released during an underground detonation remains in the melt glass in the original cavity, especially the refractory isotope species, while the more volatile nuclides tend to condense on the chimney rubble. Refractory species include plutonium, rare earth elements, zirconium, and alkaline earth elements; the volatile species include alkali metals, ruthenium, uranium, antimony, tellurium, and iodine. The most mobile isotopes are the gaseous species, including argon, krypton, and xenon, which tend to rise through the chimney and may ultimately seep out to the surface.

The mechanisms by which radionuclides can enter the groundwater include leaching from the melt glass and condensation in the cavity and chimney; injection into fractures outside the cavity during the

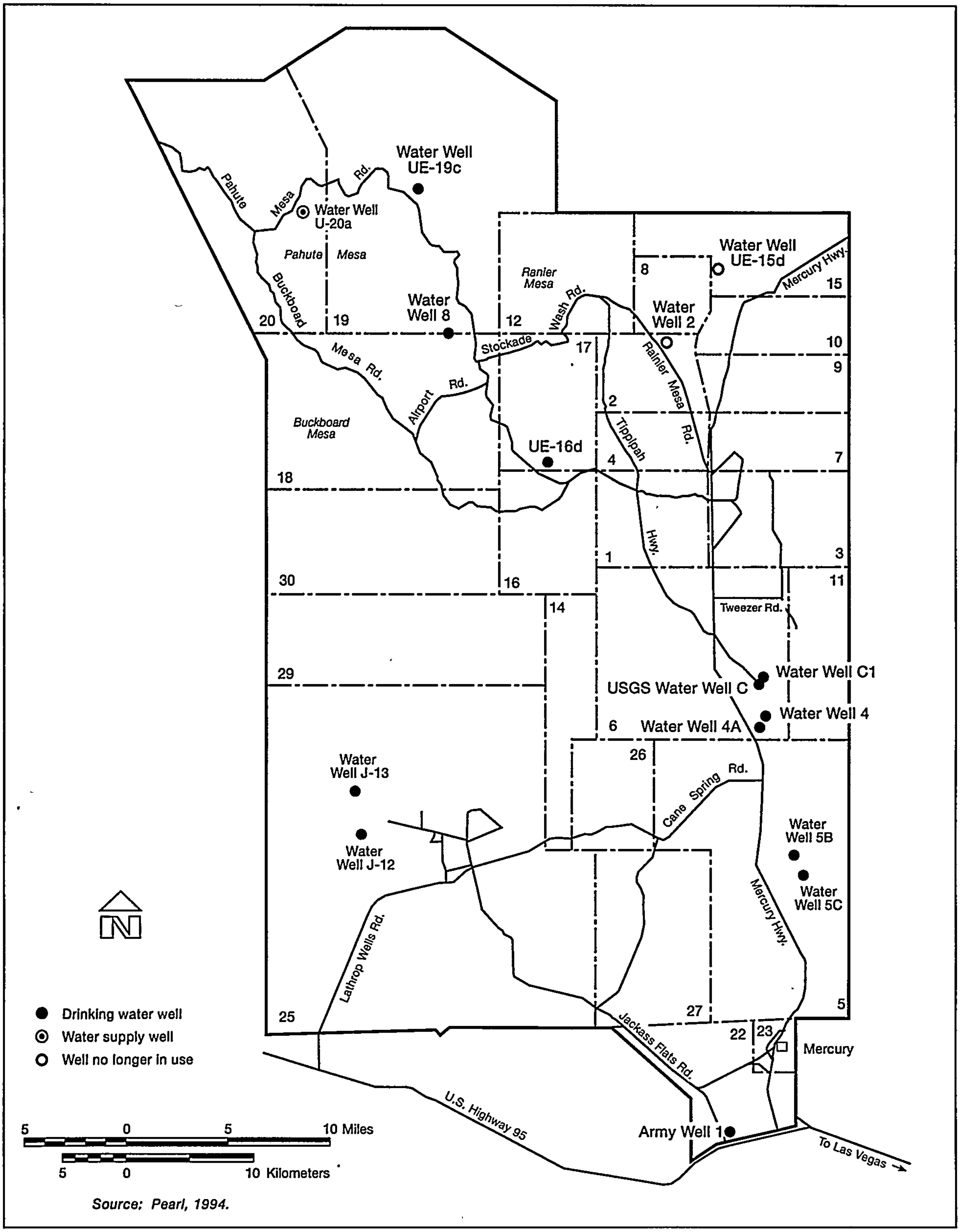


Figure 4-42. Groundwater quality sampling locations on the NTS

Table 4-27. Remaining isotope inventory under or within 100 m (330 ft) of the water table (Page 1 of 2)

Isotope	Curie Not On Pahute Mesa	Curie On Pahute Mesa
Hydrogen-3	3.07×10^{7}	6.99×10^{7}
Carbon-14	8.60×10^{2}	5.55×10^{2}
Aluminum-26	4.17×10^{-2}	8.94×10^{-3}
Chlorine-36	2.27×10^{2}	2.14×10^{2}
Argon-39	9.61×10^{2}	1.85×10^{3}
Krypton-40	2.47×10^{2}	4.69×10^{2}
Calcium-41	1.70×10^{3}	1.64×10^{3}
Nickel-59	4.23×10^{1}	3.99×10^{1}
Nickel-63	5.14×10^{3}	4.21×10^{3}
Krypton-85*	6.88×10^{4}	1.49×10^{5}
Krypton-85	5.40×10^{4}	9.54×10^{4}
Strontium-90	7.26×10^{5}	1.19×10^{6}
Strontium-90	8.93×10^{5}	1.84×10^{6}
Zirconium-93	2.63×10^{1}	4.17×10^{1}
Zirconium-93	3.11×10^{1}	6.17×10^{1}
Niobium-93m	6.35×10^{3}	7.59×10^{3}
Niobium-94 a	8.26×10^{-3}	1.44×10^{-2}
Niobium-94g	1.95×10^{2}	1.73×10^{2}
Technetium-99	1.90×10^{2}	3.07×10^{2}
Technetium-99	2.23×10^{2}	4.32×10^{2}
Palladium-107	1.01	1.67
Palladium-107g	9.70×10^{-1}	1.57
Cadmium-113	6.17×10^{2}	1.38×10^{3}
Cadmium-113m	4.83×10^{2}	1.16×10^{3}
Tin-121*	2.42×10^{3}	5.14×10^{3}
Tin-121m	1.95×10^{3}	4.31×10^{3}
Tin-126	2.88×10^{1}	6.02×10^{1}
Tin-126	2.35×10^{1}	4.92×10^{1}
Iodine-129*	6.51×10^{-1}	1.29
Iodine-129	5.50×10^{-1}	9.45×10^{-1}
Cesium-135	2.32×10^{1}	4.47×10^{1}
Cesium-135g	2.00×10^{1}	3.17×10^{1}
Cesium-137*	1.09×10^{6}	2.15×10^{6}
Cesium-137	9.15×10^{5}	1.51×10^{6}
Samarium-151*	3.69×10^{4}	6.90×10^{4}
Samarium-151	3.23×10^{4}	5.71×10^{4}
Europium-150	8.86×10^{1}	1.11×10^{3}
Europium-152*	8.03×10^{-2}	1.90×10^{-1}
Europium-152	6.40×10^{4}	3.29×10^{4}
Europium-154	4.84×10^{4}	1.55×10^{4}
Holmium-166*	1.22×10^{-2}	1.88×10^{-2}
Holmium-166m	5.06×10^{1}	4.48×10^{1}
Thorium-232 Device	4.01×10^{-4}	5.84×10^{-2}
Thorium-232 Soil	1.77×10^{1}	3.38×10^{1}
Uranium-232	3.65×10^{2}	2.55×10^{2}
Uranium-233	1.50×10^{2}	1.71×10^{2}

Table 4-27. Remaining isotope inventory under or within 100 m (330 ft) of the water table (Page 2 of 2)

Isotope	Curie Not On Pahute Mesa	Curie On Pahute Mesa
Uranium-234 Device	1.41×10^2	1.23×10^2
Uranium-234 Soil	8.85	1.67×10^1
Uranium-235 Device	3.79	1.66
Uranium-235 Soil	4.15×10^{-1}	7.94×10^{-1}
Uranium-236	3.42	4.73
Uranium-238 Device	7.00	2.19
Uranium-238 Soil	8.83	1.67×10^1
Neptunium-237	1.10×10^1	3.65×10^1
Plutonium-238	1.18×10^4	7.16×10^3
Plutonium-239	2.88×10^4	1.93×10^4
Plutonium-240	7.42×10^3	6.20×10^3
Plutonium-241	1.03×10^5	9.00×10^4
Plutonium-242	4.52	3.36
Americium-241	6.83×10^3	4.67×10^3
Americium-243	3.42	1.79×10^{-1}
Curium-244	2.35×10^3	2.97×10^3
Total Activity	3.27×10^7	7.30×10^7
Total Fission Products	2.09×10^6	4.21×10^6
Total Source Term	3.48×10^7	7.72×10^7
NTS Grand Total	1.12×10^8	

* Fission products.

first milliseconds after the test; and interactions between gaseous species and the groundwater.

The leaching of radionuclides from the rubble is probably an important pathway for tests that were conducted under the water table or in or under perched aquifers. Once detonation has occurred, the groundwater within the cavity area is vaporized and some portion of this vapor is forced by the shock wave out of the cavity and into the surrounding host rock. With time, groundwater gradually flows back into the cavity and chimney and comes into direct contact with the radionuclides that have condensed onto the chimney rubble. Depending on the solubility of the radionuclides, the groundwater dissolves the residues until chemical equilibrium has been achieved. Once dissolved, the radionuclides are available for migration through groundwater flow.

Leaching of radionuclides from the melt glass and cavity rubble probably has occurred to some degree. According to Borg et al. (1976), past studies have asserted that (1) less than 1 percent of the radionuclides in the melt glass near the bottom of the chimney will be sorted onto the chimney rubble and (2) most of the tritium will be mixed with the water in the chimney and cavity at times for about 1 year, and some tritium may be trapped in the melt glass. The leaching of radionuclides from the melt glass probably occurs over extended periods of time with the leachate available for transport through groundwater flow. The release of radionuclides through the leaching pathway continues to be an area of active research and, with time, a better understanding of the true hydrologic source term could be had.

Fracture injection provides the final pathway for the introduction of radionuclides into the hydrogeologic regime. Water vapor discharged from the cavity immediately following the detonation is seismically pumped into the fractures that are formed by the test and through other fractures that are opened by the shock wave. As discussed previously, the area over which this phenomenon occurs is believed to be about 3 cavity radii from the cavity. Thus, for a cavity with a diameter of 610 m (2,000 ft), the injection of radionuclides into rock fractures is expected to occur outward to a distance of 914 m (3,000 ft) from the cavity. Following the achievement of equilibrium conditions, radionuclides that have been injected into fractures under the water table are available for transport through groundwater flow.

As noted in the preceding discussion, tritium is one of the most mobile of the radionuclides present in the subsurface environment surrounding an underground nuclear test. It is also present at higher concentrations than other radionuclides for a period of 100 to 200 years following a test, and is generally believed to be present principally as part of a free water molecule rather than being bound in the puddle glass that contains the large majority of the radionuclides remaining after a test. Tritium is known to migrate when induced by nearby pumping, while many other radionuclides remain in or near the cavity (Bryant, 1992). Therefore, tritium represents the radionuclide of greatest concern to users of groundwater for at least the next 100 years because of its mobility and high concentration. It is for these reasons that, in assessing the impacts from the groundwater pathway, tritium is the radionuclide used in the modeling processes discussed in later chapters of the EIS. Other radionuclides either do not move as rapidly and are not a consequence in the assessments, or are of much lower concentrations.

About a dozen instances of migration of radionuclides other than tritium have been documented (Nimz and Thompson, 1992). The largest distance of migration does not exceed 500 meters (1,640 ft). Migration of tritium is more difficult to interpret, but is thought to have migrated no more than several kilometers.

As noted by Borg et al. (1976), the analysis of water samples for specific isotopes at random sites on the NTS is complicated and "it is possible that only relative or quantitative conclusions could ever be made from such data. Such conclusions, nonetheless, may be important." In recent years, the drilling of new characterization wells and the retrofitting of existing boreholes and wells by the Environmental Restoration Program have provided valuable new data that are now being integrated into the overall database so that new evaluations can be made. These studies and planned future studies covered by this EIS will help to reduce the current levels of uncertainty concerning both the mechanisms and consequences of radionuclide transport via groundwater flow at the NTS. The other pathway by which radionuclides are known to have migrated from the cavity and chimney is the air pathway.

While radionuclides that remain in the environment are of the most significance, there are also other materials that are used in testing that may be available for groundwater transport. Table 4-28 lists the materials that are introduced into the subsurface as part of the actual testing and during post-detonation drillback operations. The nonradioactive species include numerous metals, organic compounds, and drilling products. Following the detonation, most of the metals are either vaporized or undergo neutron activation and are accounted for in the radionuclide inventory. The fate of the organic compounds and drilling fluids is not fully understood. No estimates are available concerning the total quantity of these materials that may still remain in the subsurface at the NTS.

From a regional perspective, the distribution of the radionuclide source term can be determined by the location of underground tests. In other words, a traditional "plume map" can be approximated by the map of underground tests on Plate 2, Volume 2. Only one of those tests, Corduroy, in Yucca Flat, was conducted in the carbonate aquifer. The remainder were conducted in the alluvial or volcanic aquifers. Within the areas of testing significant quantities of clean water remain because of the limited migration of radionuclides in the groundwater.

<u>WATER SUPPLY</u>—There are physical, environmental, legal, and administrative limitations on the availability of the water resources from the NTS and surrounding regions for development of water supplies.

The physical limitations are due to the water-yielding properties of the aquifers present. In

Table 4-28. Materials used in underground nuclear testing

Fuels, Detectors, Tracers	Rack and Canister Materials	Organic Compounds	Drilling and Stemming Materials
Americium[a]	Aluminum	Alcohol	Bentonite
Curium[a]	Arsenic	Anionic Polyacrylamide	Cement
Neptunium	Barite	Coal-Tar Epoxy	Gel
Plutonium	Beryllium[a]	Complex Fluorescing Compounds[b]	Gravel
Tritium	Boron	Galacto-Mannans $(C_6H_{10}O_5)_n$	Modified Starch
Uranium	Cadmium	Laser Dyes[c]	Neoprene®
Lithium	Chrome Lignosulfate	Liquid Anionic Polyelectrolyte	Polyethylene
Yttrium[a]	Chromium	Paraformaldehyde	Pregelatinized Starch
Zirconium[a]	Copper	Phenolic	Sand
Thulium	Gold	Polystyrene	Sepiolite
Lutetium[a]	Iron	Polyvinyl Chloride	Soda Ash
	Lead[d]	Two-Part Epoxy	Sodium Montmorillonite
	Lithium		Surfactant TF Foamer
	Magnetite[e]		Teflon™
	Nickel[a]		
	Osmium		
	Potassium Chloride		
	Sodium Hydroxide		
	Tantalum		
	Thallium		
	Tungsten		
	Zinc[a]		

[a] Less than 100 grams (3 ounces) typically used
[b] Fluorescing compounds and laser dyes used in some detector packages may contain potentially hazardous organic constituents
[c] Contains theophylline, ethylenediamine, carbonic acid disodium salt
[d] Extensive quantities of lead (57.2 metric tonnes) are typically used as shielding material for device canisters and racks
[e] Magnetite is naturally occurring Fe_3O_4 containing thorium and other heavy rare earths.

Source: Bryant and Fabrika-Martin, 1991.

general, well yields are poorest in volcanic rocks of Pahute Mesa and in the fine-grained playa sediments of Emigrant Valley and Cactus, Yucca, and Frenchman Flats.

Well yields are moderate to high in the fractured volcanic rocks of the southwest part of the NTS, in the fractured carbonate rocks that underlie the eastern part of the facility, and from the alluvium where adequate saturated thicknesses are present. The production capacities of the existing watersupply wells range from about 644 to 2,650 L/min (170 to 700 gal/min) with a total capacity of about 11,356 L/min (3,000 gal/min) or about 6.0 x 10^6 m^3/yr (4,840 acre-feet/year).

Beyond the physical availability of the water, there are water chemistry limitations that render portions of the NTS unsuitable for groundwater development. As discussed in the previous section, more than 230 nuclear tests have been conducted below or in close proximity to the water table (Bryant and Fabrika-Martin, 1991). These tests have resulted in contamination of the near test environment with radionuclides (Borg et al., 1976), and localized contamination of groundwater has occurred as a result of some tests (Nimz and Thompson, 1992). Because of these underground tests, much of Yucca Flat, portions of Frenchman Flat, and portions of Pahute Mesa may require restrictions to additional groundwater development.

There are sensitive environments downgradient of the NTS, including Death Valley, Devils Hole, and the wetland environment at Ash Meadows. A number of federal and state laws prohibit the development of water supplies that would adversely impact these environments (Dudley and Larson, 1976).

As part of their groundwater investigations being conducted through the Environmental Restoration Program, the DOE is developing regional groundwater flow and tritium transport models that include the NTS and the Ash Meadows area. These models will be of use in evaluating the effects of past DOE actions and future DOE groundwater withdrawals on the NTS. The DOE is also working with the National Park Service in evaluating observed water level fluctuations at Devils Hole.

Water-resource use in support of the primary missions of the NTS is not subject to state water appropriation laws. The NTS, under the Federal Reserve Water Rights doctrine, is entitled to withdraw the quantity of water necessary to support the NTS missions. Water used for other actions that are determined to be outside the mission will require the appropriation of the water in accordance with Nevada's water law. Presently, the water resources of the Alkali Flat-Furnace Creek Ranch basin are fully appropriated, and it may not be legally possible to develop or use water in the western part of the NTS for purposes beyond the missions of the facility. Unappropriated groundwater is available in the Ash Meadows basin and is subject to the rights of the senior water rights holders.

Administrative limitations on the groundwater resources are primarily related to ongoing tests and activities. Extensive site characterization activities are in progress by both the Environmental Restoration Program and Yucca Mountain Projects, and experiments are being conducted by the Hydrologic Resources Management Program.

A considerable quantity of groundwater is in storage in the sediments and rocks underlying the NTS and surrounding regions. An estimated 2.7 x 10^9 m^3 (2.2 x 10^6 acre-feet) of groundwater are held in storage in the upper 30 m (100 ft) of the saturated zone in the Yucca Flat basin, Frenchman Flat, Mercury and Rock Valleys, and Fortymile Canyon (Scott et al., 1971). With certain limitations, this groundwater is an available resource for development of water supplies at the NTS. Well water is produced from the upper carbonate, volcanic tuff, and valley-fill aquifers.

<u>WATER USE</u>—Historically, domestic, industrial, and construction water supplies were provided by 15 water wells dispersed across the NTS, as shown in Figure 4-5. In the past several years as nuclear testing activities declined and the demand for water decreased accordingly, the total number of water wells supporting NTS operations has decreased to 12; a list of active water wells on the NTS is given in Table 4-29. Drinking water on the NTS is currently provided by 11 wells and is supplemented by bottled water in remote areas. Construction and fire-control water are supplied by other wells in addition to the potable water supply wells. Springs and seeps are not used for water-supply purposes.

Groundwater is used by small communities and scattered population areas. The communities of Indian Springs and Beatty used approximately 8.0 x 10^5 m^3 (660 acre feet) and 5.0 x 10^5 m^3 (390 acre feet) of groundwater, respectively, for potable, industrial/commercial, and agricultural purposes in 1992 (Wood, 1994). The Saint Joe Bullfrog Mine, located west of Beatty, used approximately 2.0 x 10^6 m^3 (1,640 acre feet) of groundwater in 1992 for potable and operation supply needs. In scattered population areas, groundwater usage was estimated for 1992 by areas as follows: Amargosa Valley, 8.0 x 10^6 m^3 (6,500 acre feet); Pahranagat Valley, 6.3 x 10^6 m^3 (5,100 acre feet); Penoyer Valley, 1.5 x 10^7 m^3 (12,300 acre feet); and Three Lakes Valley, 4.0 x 10^5 m^3 (350 acre feet) (Wood, 1994). Near Ash Meadows, groundwater usage is limited because of impacts on water levels in Devils Hole. The Devils Hole pupfish, an endangered species, relies on maintenance of the existing water level provided by spring flow for its continued existence (Dudley and Larson, 1976) (Section 4.1.6, Biological Resources). In addition, the U.S. Supreme Court has ruled that maintenance of water levels in Devils Hole has precedence over water uses for other purposes in the area. A study for the Las Vegas Valley Water District (Avon and Durbin, 1994) found no statistical correlation between water usage on the NTS and water levels in Devils Hole.

Preliminary groundwater modeling was performed as part of this EIS, and additional, detailed modeling is underway. As part of the groundwater investigations being conducted through the

Table 4-29. Summary of 1993 water well and discharge information for the NTS

Well Name	Aquifer	Depth		Static Water Level (depth)		Pump Setting (depth)		Yield		[a]Annual Pumpage (Mm^3 [b])	Annual Pumpage ac-ft
		m	ft	m	ft	m	ft	m /min	yd³/min		
Army Well 1	Carbonate	593.14	1,945	210.31	690	289.86	951	2.01	2.6	0.4178	338.7
Well 5c	Alluvial	361.80	1,187	211.23	693	238.96	784	1.23	1.6	0.2393	194
Well 5b	Alluvial	274.32	900	208.48	684			1.02	1.3	0.1126	91.31
Well 4	Volcanic	450.80	1,479	286.82	941	387.40	1,271	2.46	3.2	0.2856	231.51
Well 4a	Volcanic									0.4172	338.22
Well C	Carbonate	518.46	1,701	470.61	1,544	473.35	1,553	1.02	1.3	0.2390	193.78
Well C1	Carbonate	520.29	1,707	471.83	1,594	484.94	1,591	1.06	1.4	0.0357	28.95
Well 8	Volcanic	1,673.35	5,490	327.05	1,073	374.29	1,228	1.51	1.9	0.1185	96.11
UE-16D	Carbonate	914.40	3,000	230.12	755	330.10	1,083	0.73	.94	0.1813	146.95
J-12	Volcanic	347.17	1,139	225.25	739	250.55	822	3.09	4.0	0.0945	76.64
J-13	Volcanic	1,063.14	3,487	283.16	929	350.82	1,151	2.57	3.4	0.1584	128.38
UE-5c[c]	Alluvial									0.0278	22.52
UE-19c[d]	Volcanic									0.0269	21.79
U-20a[c]	Volcanic									0.1058	85.80
									Total Usage	2.4606	1994.66

[a] Well yields calculated from controlled pump tests are typically within one order of magnitude of driller's estimates
[b] Million cubic meters
[c] Construction water well
[d] No longer in use.

Environmental Restoration Program, the DOE is developing regional groundwater flow and tritium transport models that include the NTS and these environmentally sensitive areas. These models will be of use in evaluating the effects of past DOE actions and future DOE groundwater withdrawals on the NTS. The results of these models are not yet available, but they will be available for future National Environmental Policy Act reviews prior to the construction of projects that are expected to result in significant adverse impacts. The DOE is also working with the National Park Service in evaluating observed water level fluctuations at Devils Hole.

The National Park Service continues to implement projects, collect data, support research, and conduct studies to investigate the probable cause of the decline of the Devils Hole pool level.

MONITORING PROGRAMS—On-site water wells and select off-site wells are monitored in accordance with the Safe Drinking Water Act and the Nevada Administrative Code regulations (REECo, 1991). Concurrently, the DOE monitors on-site wells and select off-site wells for specific radionuclides (not related to Safe Drinking Water Act requirements) (DOE/NV, 1993). Additionally, the state of Nevada performs independent monitoring. Analytical results for all monitoring activities are published in Annual Site Environmental Reports.

The following is a brief description of the six existing NTS groundwater monitoring programs:

- Environmental Surveillance Program - Radiological and nonradiological monitoring for Safe Drinking Water Act and DOE Order 5400.1 compliance
- U. S. Geological Survey Water-Level Monitoring Program - Monitoring for DOE Order 5400.1 compliance
- EPA Long-Term Hydrologic Monitoring Program - Radiological monitoring of nonwater supply wells and DOE Order 5400.1 compliance
- Radioactive Waste Management Site Assessment Program - Monitoring for Areas 3 and 5 Resource Conservation Recovery Act Part B permit
- Underground Test Area Corrective Action Unit Monitoring Program - Monitoring of far-field and near-field wells for specific groundwater quality parameters
- Hydrologic Resources Management Program - Monitoring in support of the investigation of the effects of underground testing on the hydrogeology, hydrochemistry, and radiochemistry of the NTS.

Under the Hydrologic Resources Management Program, the DOE has sponsored research by the Desert Research Institute, the U.S. Geological Survey, and the National Laboratories to help understand the groundwater flow directions and velocities and the mechanisms of radionuclide migration. Research under this program has included the development of chemical and isotopic models, a detailed evaluation of the hydrology of Yucca Flat, recharge and runoff studies, exploratory drilling and aquifer testing, shot-specific investigations, and radionuclide distribution studies.

As discussed previously, evidence for the transport of radionuclides produced by underground nuclear testing is scarce. The approximate areas of underground contamination, including the groundwater and vadose zones, have been estimated. Most available information is derived from borings drilled in support of underground testing rather than for investigating radionuclide transport. Nimz and Thompson (1992) summarized data collected as part of the Hydrology and Radionuclide Migration Program, the program's predecessors, and other agencies. Five cases were documented in borings as evidence of prompt injection of radionuclides into rock surrounding nearby cavities (a mechanism that does not involve transport in groundwater).

Nimz and Thompson (1992) reported five cases where radionuclide transport occurred in groundwater, and recent drilling for the Environmental Restoration Program has detected three more. However, one of the cases involved pumping for over 16 years to induce migration. Present studies are aimed at determining the nature and extent of the migration of contaminants. Other data suggest that U.S. Geological Survey Water Well A, UE-15d Water Well, and Test Well B Exploration Hole have produced low activities of approximately 100 to 150 pCi/L (Lyles, 1993), but levels have since dropped significantly.

The DOE sponsors several monitoring efforts by NTS contractors, the U.S. Geological Survey, and the EPA on and around the NTS. The objectives of the monitoring include detection of radionuclide migration from underground nuclear tests, assurance of the water supply network on the NTS, compliance with waste disposal permits, determination of aquifer characteristics, and research into the mechanisms of radionuclide migration. The types of monitoring currently underway include the following:

Water Supply—Water supply wells on the NTS are monitored in accordance with the Safe Drinking Water Act and the Nevada Administrative Code regulations (REECo, 1991) by the DOE and, independently, the state of Nevada. In addition, off-site municipal and private water supply wells are monitored as a courtesy to assure that no radionuclides related to underground testing are present.

Ambient Water Quality—Approximately 30 monitoring wells and 10 springs are sampled on and around the NTS to detect the presence of radionuclides. These wells serve to establish the quality of water in and around the NTS. No test-related contamination has been detected offsite, and contamination onsite is limited to the extent described above.

Radioactive Waste Management—Three groundwater monitoring wells are located at the Area 5 Radioactive Waste Management Site as part of the Resource Conservation and Recovery Act compliance requirements. No contamination has been detected.

Characterization and Research—Approximately 50 wells are presently in use to characterize groundwater conditions regionally or near underground nuclear tests. These wells are part of the Underground Test Area project and the Hydrologic Resources Management Program. Some are monitored on a regular basis, and many of these wells may be incorporated into the long-term monitoring network in the future.

Water Level—Approximately 70 wells are monitored to determine the level of the groundwater surface on and around the NTS. This information is used to help determine the effects of water usage on water quantity, for groundwater flow modeling, and to predict the occurrence of water in new wells and emplacement holes.

4.1.6 Biological Resources

The NTS is located along the transition zone between the Mojave Desert and Great Basin (Beatley, 1975, 1976). As a result, this site has a diverse and complex mosaic of plant and animal communities representative of both deserts, as well as some communities common only in the transition zone between these deserts. This transition zone extends to the east and west far beyond the boundaries of the NTS. Thus, the range of almost all species found on the NTS also extends far beyond the site, and there are few rare or endemic species found there (Table 4-30 and Appendix E).

Elevation is the most obvious factor affecting the distribution of plant and animal communities on the NTS and surrounding areas. Elevations increase from south to north, from a low of 819 m (2,688 ft) in Jackass Flats to a high of 2,341 m (7,679 ft) on Rainier Mesa (O'Farrell and Emery, 1976). Climate differences associated with this increase in elevation cause a change from Mojave Desert communities in the south to Great Basin communities in the north (Beatley, 1975).

The diversity of biological communities in this region is also influenced by topography. The valleys in the southern and western parts of the NTS (e.g., Jackass Flats, Rock Valley, and Mercury Valley) have drainage outlets. In contrast, the two large valleys on the eastern side of the NTS (Frenchman Flat and the Yucca Flat weapons test basin) and Emigrant Valley to the northeast (where Area 13 is located), are closed basins. The lack of

Table 4-30. Species listed as endangered, threatened, or candidates under the Endangered Species Act that may be found in the areas addressed under the NTS, Tonopah Test Range, Central Nevada Test Area, Project Shoal Area, Dry Lake Valley, Eldorado Valley, and Coyote Spring Valley[a]

	NTS[b]	TTR[c]	CNTA	PSA	DLV	EV	CSV
Endangered							
falcon, peregrine[d]	✓	✓	✓	✓			
Threatened							
tortoise, desert[e]	✓				✓		✓
eagle, bald[d]	✓	✓	✓	✓			✓
Candidates - Category 1[f]							
milkvetch, Beatley[g]	✓						
Candidates - Category 2[h]							
Plants							
Eggvetch, Clokey's	✓						
Cholla, Blue Diamond	✓						
Birds							
Plover, mountain	✓						

[a] Compiled from the following sources: Bradley and Moor, 1975; Beatley, 1976, 1977a,b; O'Farrell and Emery, 1976; Rhoads and Williams, 1977; Rhoads et al., 1978, 1979a,b; Castetter and Hill, 1979; Clark County, 1990; Medica, 1990; Medica et al., 1990; Mendoza, 1995; 50 CFR Part 17, 1993; DOI, 1992; Cooper, 1993; EG&G/EM, 1993a, b, and c, in prep; Harlow, 1994a; NAC, 1994.
[b] Includes Area 13
[c] Tonopah Test Range includes Double Tracks test area
[d] Animal species listed by the State of Nevada as endangered
[e] Animal species listed by the State of Nevada as threatened
[f] Taxa for which the U.S. Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened
[g] Plant species listed by the state of Nevada as "threatened with extinction" and "fully protected"
[h] Taxa that may warrant listing, but for which substantial biological information to support a proposal is lacking.

surface water drainage and cold air drainage out of these closed basins has created soil conditions, temperatures, and biotic communities that differ from those found at similar elevations in the open basins (Beatley, 1975 and 1976).

The North Las Vegas Facility is in the Southern Basin and Range Ecoregion. It was built on cleared, previously disturbed land that is now mostly covered by buildings, pavement, or landscaping. Exceptions include about 11 acres of undeveloped land at the western end of the North Las Vegas Facility (the designated area for proposed new construction associated with the National Ignition Facility), an open area, and a stormwater detention basin. No original undisturbed native vegetation remains on the site.

Few wildlife species exist at the North Las Vegas Facility because it is located in an urbanized area and contains little vegetation. The only species that exists are those adapted to urban habitats which may include small mammals such as house mouse (*Mus musculus*) and Norway rat (*Rattus norvegicus*); and ubiquitous bird species such as American robin (*Turdus migratorius*), European starling (*Sturnus vulgaris*), house finch (*Carpodacus mexicanus*), house sparrow (*Passer domesticus*), and rock dove (*Columba livia*).

FLORA—The following descriptions of vegetation are taken from Beatley (1976) and O'Farrell and Emery (1976), unless otherwise stated. The flora of the NTS has been studied extensively; over 700 plant taxa in at least 67 families have been found. One-third of these plant taxa are in three families: *Asteraceae* (sunflowers), *Poaceae* (grasses), and *Polygonaceae* (buckwheats). The scientific names of all plants mentioned in this section are presented in Appendix E.

Mojave Desert plant communities are found at elevations below approximately 1,219 m (4,000 ft) on the alluvial fans and valley bottoms of Jackass Flats, Rock Valley, and Mercury Valley, and on the alluvial fans of Frenchman Flat. Creosote bush is the visually dominant shrub, and it is associated with a variety of other shrubs, depending on soil type and elevation. Shadscale is codominant with creosote bush on most alluvial fans where desert pavement is well defined. On deep, loose soil, such as exists on southern Jackass Flats and northeastern Frenchman Flat, creosote bush is codominant with white bursage and is associated with species such as winterfat and Indian ricegrass. Range ratany, Nevada ephedra, and Fremont indigo bush are common in both communities. At roughly 1,067 to 1,219 m (3,500 to 4,000 ft) along the northern and eastern slopes of Jackass Flats and the western half of Frenchman Flat, creosote bush grows with hopsage and wolfberry.

Two plant communities are unique to the transition between the Mojave Desert and Great Basin Desert. The first is best developed at elevations from 1,219 to 1,524 m (4,000 to 5,000 ft) on alluvial fans and valley bottoms in the middle third of the NTS. The dominant shrub in this community is blackbrush, which occurs in mixed stands with creosote bush on the northern alluvial fans of Jackass and Frenchman Flats below about 1,372 m (4,500 ft). At higher elevations (e.g., in the bottom of Tonopah and Mid Valleys and on the western slopes of the Yucca Flat weapons test basin), blackbrush occurs in large, nearly monotypic stands. The second unique transition community occurs in the bottom of the enclosed Frenchman and Yucca Flat weapons test basins, where the trapped winter air is too cold for typical Mojave Desert plants (Beatley, 1974 and 1975). The most abundant shrubs in these areas are hopsage and three species of wolfberry. Winterfat also is common in silty soils. Shadscale, four-winged saltbush, and horsebrush also can be found in certain regions of enclosed basins. Little or no vegetation grows on the playas in these basins.

Plant communities typical of the desert that lie in the Great Basin occur at elevations generally above 1,524 m (5,000 ft) in the northern third of the NTS and in Area 13. Most of the basin floor is covered with shadscale, and winterfat is also common. On deep, loose soils at middle elevations (1,372 to 1,686 m [4,500 to 5,500 ft]), the plant community is dominated by four-winged saltbush. Sagebrush begins to appear at 1,524 m (5,000 ft) and is the dominant plant on large parts of Pahute Mesa and Rainier Mesa, as well as elsewhere in the northwest part of the NTS. Big sagebrush is the most abundant shrub on sites with deep soils in this area, and black sagebrush is most abundant on the shallow soils of slopes and uplands. Pinyon pine and Utah juniper are codominant with sagebrush above 1,829 m (6,000 ft), and form an open shrub-woodland.

Sites on the NTS with vegetation or soil modified by nuclear test activities, construction, or other disturbances usually have plant communities that are different from adjacent undisturbed areas. Some of the species that colonize disturbed areas (e.g., cheesebush and punctate rabbitbrush) are native plants that usually occur in washes. However, most species found on disturbed sites are ephemeral, introduced plants such as red brome, cheatgrass, Russian thistle, and red-stemmed filaree (Hunter, 1992a). Natural succession of disturbed areas on the NTS is generally a slow process. Studies of natural succession in the Mojave Desert have shown that several decades, or even centuries, may be required to establish similar plant cover and productivity (Webb and Wilshire, 1980; Angerer et al., 1994). Because of the increased and more consistent precipitation, succession rates in the Great Basin Desert are generally much quicker than those in the Mojave Desert. Active revegetation of sites can greatly enhance secondary succession. Studies have been conducted on the NTS and other sites in the arid southwestern United States to assess and improve revegetation techniques for arid environments (Wallace, 1980; EG&G/EM, 1995b; Schaller and Sutton, 1978; Allen, 1988). Variables that have been determined to be important in revegetation success are: adequate moisture during seed germination and establishment; favorable soil conditions including depth, texture, fertility, and reduced compaction; and species adapted or native to the site. Reclamation trials at Yucca Mountain and at NTS and Tonopah Test Range sites have shown that revegetation of disturbed areas is practical and that equivalent density and cover of vegetation can be accomplished much quicker (3-10 years) than through natural succession (EG&G/EM, 1995b).

Soils on the NTS and Area 13 that were contaminated during safety shots and are to be cleaned as part of the Soils Media Corrective Action Unit of the Environmental Restoration Program were only slightly disturbed. Therefore, the biological communities on those sites are generally similar to adjacent, undisturbed sites (Moor and Bradley, 1974; Rhoads, 1974; Hunter, 1994a).

The only biological communities on and around the NTS that are not widespread are those associated with springs or other permanent sources of water. There are at least 10 springs and 23 manmade impoundments on the NTS (Greger and Romney, 1994b). Most natural springs are on the mesas and mountains in the northern part of the NTS (Figure 4-40); most reservoirs are scattered through the valley bottom to the east and south. There are no springs in the valley bottom areas. Groundwater under the NTS flows primarily to the south and west and discharges from springs in Ash Meadows, Oasis Valley, and Death Valley (see Section 4.1.5, Hydrology). Most of the springs at the NTS support wetland (hydrophytic) vegetation, such as cattail, sedges, and rushes which likely constitute wetlands as defined by the U.S. Army Corps of Engineers pursuant to Section 4.04 of the Clean Water Act. Because there have been no plans to negatively affect these water sources, studies to characterize them and determine their potential as "jurisdictional wetlands" were deferred until the summer of 1996.

FAUNA—Over 1,000 species of arthropods have been identified on the NTS, but this probably represents a small fraction of the arthropod species present (O'Farrell and Emery, 1976). About 80 percent of these species are insects; ants, termites, and darkling beetles are the most common insect taxa.

Vertebrate species have been studied much more thoroughly. Approximately 279 vertebrate species have been observed on the NTS, including 54 species of mammals, 190 species of birds, 33 species of reptiles, and 2 species of introduced fishes (O'Farrell and Emery, 1976; Castetter and Hill, 1979; Medica, 1990; Medica et al., 1990; EG&G/EM, 1993c). Eighty-six percent of the bird species on the NTS are transients (O'Farrell and Emery, 1976). The scientific names of all animals in this section are presented in Appendix E.

Many of the predators and scavengers in this region are everywhere throughout the area. These include coyotes, bobcats, common ravens, red-tailed hawks, loggerhead shrikes, speckled rattlesnakes, and gopher snakes. Other common species are the long-tailed pocket mouse, desert woodrat, white-tailed antelope squirrel, black-tailed jackrabbit, black-throated sparrow, horned lark, Say's phoebe, western kingbird, side-blotched lizard, and desert horned lizard.

Many animal species on the NTS are common only in the Mojave Desert habitats to the south or the Great Basin Desert habitats to the north. Typical Mojave Desert species found on the NTS include kit fox, Merriam's kangaroo rat, desert tortoise, chuckwalla, western shovelnose snake, and sidewinder snake. Typical Great Basin species in this region include cliff chipmunk, Great Basin pocket mouse, mule deer, northern flicker, scrub jay, Brewer's sparrow, western fence lizard, and striped whipsnake. About 60 wild horses live on the northern part of the NTS, usually on or near Rainier Mesa (Greger, 1994).

Some animal species on the NTS are typically found only in restricted habitats. Desert kangaroo rats are associated with loose, sandy soils at lower elevations. Dark kangaroo mice are restricted to fine, gravel-like soils at higher elevations. Chuckwallas occur primarily in rocky outcrops. Desert night lizards are usually found in stands of yuccas. Many of the birds on the NTS, including almost all of the waterfowl and shorebirds, use the playas in Frenchman and Yucca Flat weapons test basin, artificial ponds at springs, and sewage lagoons during their migration and/or during winter (Hayward et al., 1963). Bats often seek food over these water sources. Wild horses occur in the northern half of the NTS and their distribution may be related to the location of man-made ponds. Camp 17 pond, in the northwest corner of Area 18, and Well 2 pond, in the northeast corner of Area 2, are heavily used by horses. During field surveys conducted in the summer and fall of 1995, a total of 52 horses were observed, and an estimated 35 horses appeared to consistently use the Camp 17 pond and 17 horses consistently used the Well 2 pond (EG&G/EM, 1995a). Deer most likely use these ponds as well.

As described in Section 4.1.5.1, surface runoff periodically ponds on the playas in Yucca and Frenchman flats. The length of time that water remains on playas, and the extent to which playas are used by migratory shorebirds are not routinely monitored. However, water has been observed on the playas for periods of days to months following rainstorms. Occasionally, migratory shorebirds have been observed if the playas have water on them during the spring or fall migratory season. If radionuclides and other contaminants were in these ephemeral ponds, migratory birds could be exposed to them. Because of the episodic nature, the short duration of ponding on playas, and the relatively small numbers of birds that visit during the migratory seasons, the hypothetical exposures would be infrequent and brief.

Several species of State-designated game animals occur in this region, including 1,500 to 2,000 mule deer (Giles and Cooper, 1985) and an unknown number of mountain lions, desert and Nuttall's cottontails, chukar, Gambel's quail, mourning dove, and several species of waterfowl. Bighorn sheep and pronghorns inhabit surrounding areas and may on occasion stray onto the NTS (O'Farrell and Emery, 1976). Bobcats and kit foxes are the only State-designated fur-bearing animals on the NTS. Bighorn sheep are hunted on the NAFR Complex. No other hunting or trapping is allowed on the NTS or the NAFR Complex.

ENDANGERED AND THREATENED SPECIES—Only one animal species listed as endangered, the peregrine falcon, has been reported on the NTS. The bald eagle (down-listed in 1995 from an endangered to a threatened species) has also been reported on the NTS. Both of these birds are rare migrants in this region and have been sighted on the NTS only once (Castetter and Hill, 1979; Greger and Romney, 1994a). The state of Nevada lists these two species as endangered (Table 4-30).

The only other animal species found on the NTS which is listed by the U.S. Fish and Wildlife Service as threatened is the Mojave Desert population of the desert tortoise. The state of Nevada classifies the desert tortoise as a threatened species. Desert tortoises are found throughout the Mojave Desert plant communities in the southern half of the NTS (Figure 4-43). The abundance of tortoises on the NTS is low to very low relative to other areas within the range of this species (EG&G/EM, 1991; U.S. Fish and Wildlife Service, 1992; Rautenstrauch et al., 1994). The NTS contains less than 1 percent of the total desert tortoise habitat of the Mojave Desert population. Desert tortoises are not found on Area 13.

No plants that have been listed as threatened or endangered are known to occur on the NTS (50 CFR Part 17.11 and 17.12; Mendoza, 1995a).

There are three species (one animal and two plants) which are candidates for listing under the Endangered Species Act (61 FR 7596) and which are known to occur or may occur on the NTS. The U.S. Fish and Wildlife Service published the latest list of candidate plants and animals on February 28, 1996. Prior to this, 12 animal and 12 plant species found on the NTS or Area 13 were classified as candidates (Mendoza, 1995a). The updated Notice of Review has removed 11 of the 12 animals and all of the 12 plants from candidate status. Therefore, the following discussion of candidate species differs from that in the Draft NTS EIS issued in January 1996.

The mountain plover is the only candidate animal which is known to occur onsite. It is an uncommon migrant through the area.

Two candidate plants may occur on the NTS. Clokey's egg-vetch was recently discovered in the Belted Range of the NAFR Complex, just north of the NTS (Knight and Smith, 1996). It was found along the margins of a pinyon-juniper community near Indian Spring. This plant may occur in a

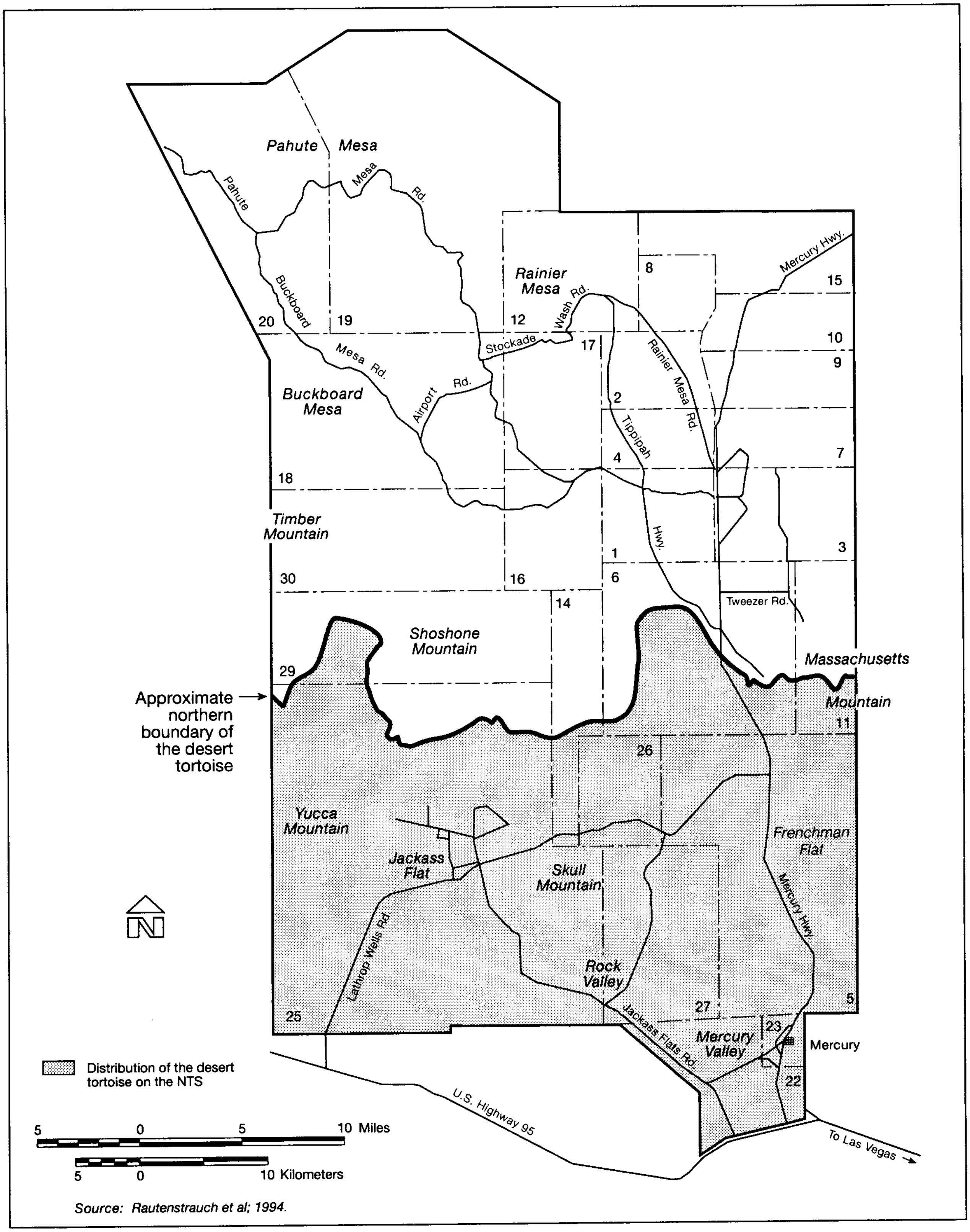


Figure 4-43. Approximate distribution of the desert tortoise on the NTS

similar habitat in the Belted Range which extends onto the NTS.

The Blue Diamond cholla.may possibly have been collected on the NTS in the western Spotted Range below Mercury Ridge in Area 23. It was identified as another cholla species when first collected in 1967, and taxonomic verification of this NTS specimen is being pursued.

There also are a number of other endangered, threatened, or candidate species associated with the springs off the NTS that may be affected by NTS activities. For example, the endangered Devils Hole pupfish is endemic to the spring at Devils Hole National Monument, 27 km (17 mi) south of the NTS. At Ash Meadows National Wildlife Refuge, located 32 km (20 mi) south of the NTS, there are one endangered and six threatened plants, four endangered fishes, and one threatened invertebrate (U.S. Fish and Wildlife Service, 1994). In addition, the candidate species Amargosa toad and Oasis Valley speckled dace are found in wetlands in the Oasis Valley.

The North Las Vegas Facility is located within urban Las Vegas on previously disturbed land within a fenced site. It is not expected that any threatened, endangered, or rare species exist. No designated critical habitats for federal-listed species exist at the North Las Vegas Facility. The facility is within the range of the federal-listed desert tortoises; however, urbanized areas of Clark County are not considered tortoise habitat. No desert tortoises were found during an off-site survey of undeveloped land located near the western boundary of the North Las Vegas Facility.

OTHER SPECIES OF CONCERN—Some other species of concern which are known to occur or may occur on the NTS or Area 13 include the spotted bat (classified by the state of Nevada as threatened), the banded gila monster (classified as State-protected), over 20 state-protected birds (predominately hawks and owls), and one plant, Beatley milkvetch designated as "fully protected" by the State). Three of these State-protected animal species, the spotted bat, western burrowing owl, the white-faced ibis, and the Beatley milkvetch had been classified as Category 2 candidates for listing under the Endangered Species Act. The Beatley milkvetch had been classified as a Category 1 candidate. All were recently removed from candidate status (61 FR 7596). These species are known to occur on the NTS. Vocalizations of the spotted bat were recorded on Pahute Mesa in 1992 (EG&G/EM, 1993c). Burrowing owls are common and are permanent residents throughout the NTS but the white- faced ibis is an uncommon migrant (Hayward et al, 1963).

No documented sightings or specimens of banded gila monsters have been made on the NTS.

EFFECTS FROM PAST RADIOLOGICAL AND PROJECT ACTIVITIES—A number of studies were conducted to document the types and extent of disturbances to the biological resources that may have resulted from projects. Although much of the focus was on determining the fate and effects of radionuclides, especially transuranics (Dunaway and White, 1974; Gilbert et al., 1988; Howard and Fuller, 1987; Howard et al., 1985; O'Farrell and Emery, 1976; White and Dunaway, 1975, 1976, 1977, 1978; White et al., 1977a.,b.), long-term impacts due to nuclear tests and nonradiological causes were also investigated (Hunter, 1992b, 1994b, c, d, 1995).

In areas where atmospheric tests, safety tests, or cratering experiments were conducted, there were measurable changes in the species composition and abundance of plants and animals. Immediately following some tests that deposited fallout containing beta-emitters, shrubs that were more radiosensitive, such as sagebrush, were killed and a grass disclimax was established. The projects also involved nonradiological physical and mechanical disturbances that altered the characteristics of the soils, and usually resulted in the removal of the shrubs which are a key component of the structure and functioning of these desert ecosystems. The ecological changes observed were similar to effects associated with other human activities that disturb desert habitats, and few could be attributed solely to radiological impacts.

A herd of cattle was allowed to graze the northwestern part of the NTS for 25 years (Smith and Black, 1984). Periodically, tissues of cattle, deer, and bighorn sheep were analyzed for concentrations of radionuclides. Results of this program suggested that since 1956 no significant amounts of biologically available radionuclides were contributed by activities on the NTS. Except for periods immediately following the deposition of close-in fallout, tissue concentrations of cesium-137 and strontium-90 reflected the deposition of worldwide fallout. Concentrations of tritium were within the ranges present in the general environment, except in tissues of animals that had access to point sources of tritium such as the Sedan Crater or the containment ponds in Area 12.

Hypothetical dose commitments for daily ingestion of NTS beef over varying lengths of time were less than 2 percent of the Federal Radiation Council or the International Commission on Radiological Protection guidelines. Both the calving rate of the herd, which exceeded 85 percent annually, and the 180-day weaning weight, usually greater that 18 kg (400 lbs), were above average. Routine necropsy and histopathological examinations revealed no harmful health effects that could be attributed to ionizing radiation in herbivores maintained for a lifetime on the NTS.

Concentrations of radionuclides in soils, plants, and animals in the vicinity of some past tests were above general background levels. Concentrations usually decreased by factors of 10 between soils-plants and plants-animals. Chromosomal aberrations were observed in cells of spiny sagebrush collected from Area 11, but the yields may not have been greater than what would be observed in the population naturally, and whether they were valuable or detrimental to the population was undetermined. Depressed levels of circulating lymphocytes and total leukocyte counts were found in kangaroo rats collected in areas comtaminated with plutonium, but they were considered to be physiologically inconsequential. Gross pathological changes in native mammals appeared to be minimal and nonspecific. Reproduction in and recruitment to mammalian populations inhabiting contaminated areas was largely responding to changes in the food supply of winter annual plants, not to levels of radiation.

The long-term consequences of past DOE activities were studied at past ground zero locations above which atmospheric tests were conducted, within subsidence craters formed following underground tests, in burned areas, on compacted drill pads and scrapes, and along roadsides. One of the major findings was that ecological impacts resulting from DOE programs on the NTS did not differ in type or magnitude from those resulting from other human activities that disturb desert ecosystems. Changes in the vegetation resulted from changes in patterns and amounts of precipitation. Changes in the species composition of vertebrates appeared to be linked to the structure of the vegetation associations, and changes in abundance were in response to altered food supplies which were linked to vegetation.

Changes to the structure and function of ecosystems were restricted to the immediate vicinity of project sites, and few long-term effects could be attributed to radiological impacts. Concentrations of radionuclides did not produce genetic or cytological abnormalities that appeared to be detrimental to species or populations either in the short- or long-term. Restoration of disturbed sites will likely follow the routes and rates of succession observed in comparable, manipulated desert ecosystems.

In spite of the extensive environmental and monitoring programs conducted since the 1950s, impacts of nonradiological contaminants on wildlife are unknown. Drill sites established for the Environmental Restoration Program include plastic-lined ponds to collect and evaporate fluids. In 1994, remains of seven birds were found in one of three ponds that contained water (Greger, 1995). Although the causes of death could not be determined, and no chemical analyses of the water were performed, a hypothesis was proposed that birds may have been trapped in the steep sumps because detergents used during drilling may have removed protective oils, which caused hypothermia, which in turn inhibited flight.

There are 18 known populations of Beatley milkvetch, 14 on the NTS and 4 on the NAFR Complex, 3.5 to 8 km (2.2 to 5 mi) west of the NTS (Blomquist et al., 1992). These 18 populations cover areas ranging in size from 700 m^2 (837 yds^2) to 120 acres and are restricted to isolated sites typically located on volcanic soils in the pinyon-juniper-sagebrush vegetation association at elevations between 1,850 m and 2,271 m (6,070 to 7,450 ft).

4.1.7 Air Quality and Climate

Air quality in a given location is described as the concentration of various pollutants in the atmosphere. Air quality is determined by the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, and the prevailing meteorological conditions. This section describes existing air quality conditions. Topics discussed include climatology, meteorology, and ambient air quality at the NTS and Area 13.

CLIMATOLOGY AND METEOROLOGY—The climate at the NTS and Area 13 is characterized by limited precipitation, low humidity, and large diurnal temperature ranges. The lower elevations are characterized by hot summers and mild winters, which are typical of other Great Basin areas. As elevation increases, precipitation increases and temperatures decrease (DOE, 1986).

Annual precipitation at higher NTS elevations is about 23 cm (9 in.), which includes snow accumulations. The lower elevations receive approximately 15 cm (6 in.) of precipitation annually, with occasional snow accumulations lasting only a few days (Quiring, 1968).

Precipitation in the summer falls in isolated showers, which cause large variations among local precipitation amounts. Summer precipitation occurs mainly in July and August when intense heating of the ground beneath moist air masses triggers thunderstorm development and associated lightning. A tropical storm occasionally will move northeastward from the coast of Mexico, bringing heavy precipitation during September and October (DOE, 1995f).

Elevation influences temperatures on the NTS. At an elevation of 2,000 m (6,560 ft) on Pahute Mesa, the average daily maximum and minimum temperatures are 4 °C to -2 °C (40 °F to 28 °F) in January and 27 °C to 17 °C (80 °F to 62 °F) in July. In the Yucca Flat weapons test basin at an elevation of 1,195 m (3,920 ft), the average daily maximum and minimum temperatures are 11 °C to -6 °C (51 °F to 21 °F) in January, and 36 °C to 14 °C (96 °F to 57 °F) in July. Elevation at Mercury is 1,314 m (4,310 ft), and the extreme temperatures are 21 °C to -11 °C (69 °F to 12 °F) in January and 43 °C to 15 °C (109 °F to 59 °F) in July (DOE, 1995f).

The annual average temperature in the NTS area is 19 °C (66 °F) (NOAA, 1991). Monthly average temperatures range from 7 °C (44 °F) in January to 32 °C (90 °F) in July. Relative humidity readings (taken four times per day) range from 11 percent in June to 55 percent in January and December (DOE/NV, 1995f).

Average annual wind speeds and direction vary with location (Figure 4-44). At higher elevations on Pahute Mesa, the average annual wind speed is 16 kph (10 mph). The prevailing wind direction during the winter months is north-northeasterly, and during the summer months winds are southerly.

In the Yucca Flat weapons test basin, the average annual wind speed is 11 kph (7 mph). The prevailing wind direction during the winter months is north-northwesterly, and during the summer months is south-southwesterly. At Mercury, the average annual wind speed is 13 kph (8 mph), with northwesterly prevailing winds during the winter months, and southwesterly prevailing winds during the summer months. Figure 4-45 shows the annual wind direction frequencies and mean wind speeds for 1990 at Desert Rock, the U.S. Geological Survey, and National Oceanographic and Atmospheric Administration Air Resources Laboratories near Mercury. The wind speeds were measured from a height of 10 m (33 ft) above the ground.

Wind speeds in excess of 97 kph (60 mph), with gusts up to 172 kph (107 mph), may be expected to occur once every 100 years (Quiring, 1968). Additional severe weather in the region includes occasional thunderstorms, lighting, tornados, and sandstorms. Severe thunderstorms may produce high precipitation that continues for approximately one hour and may create a potential for flash flooding (Bowen and Egami, 1983). Few tornados

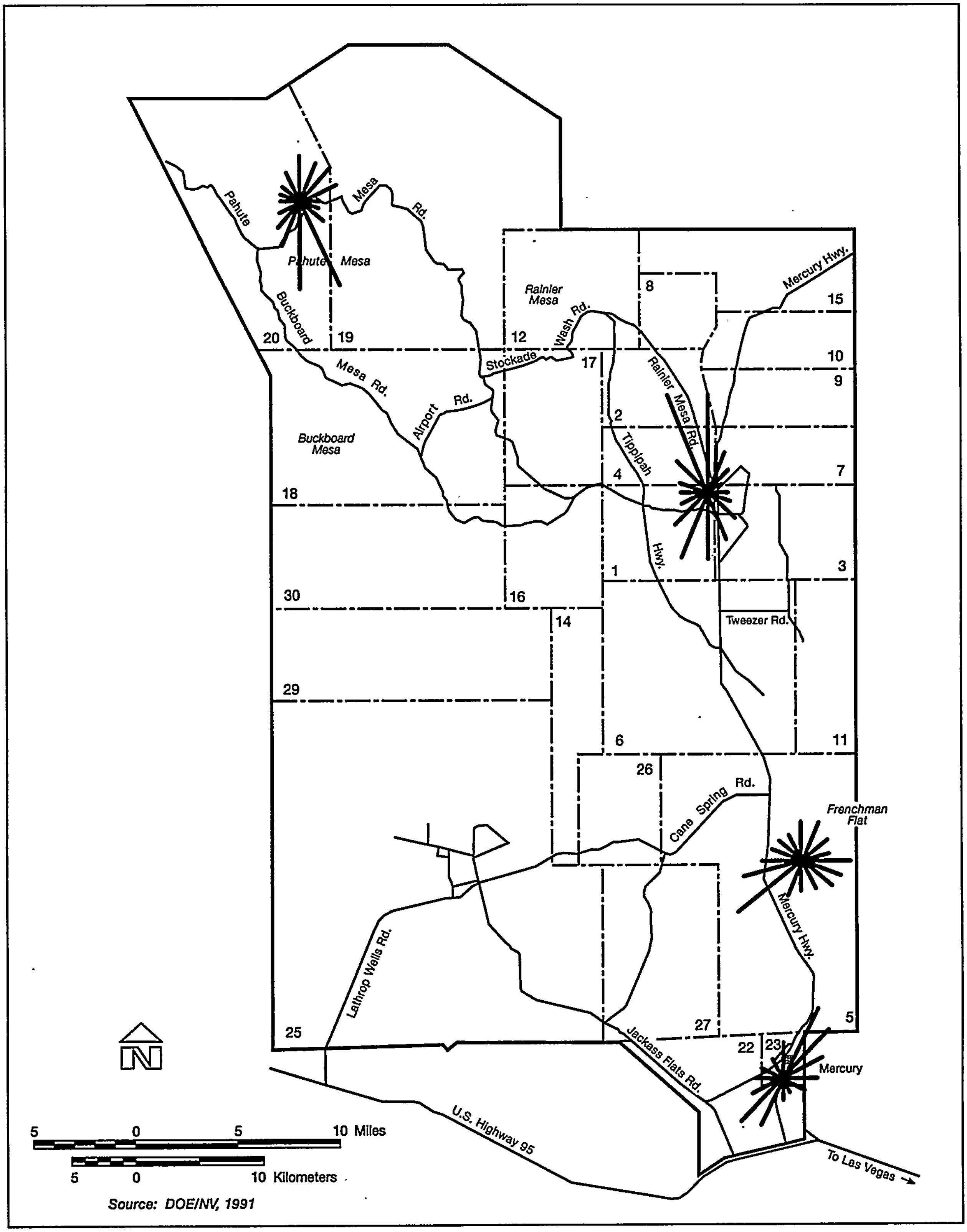
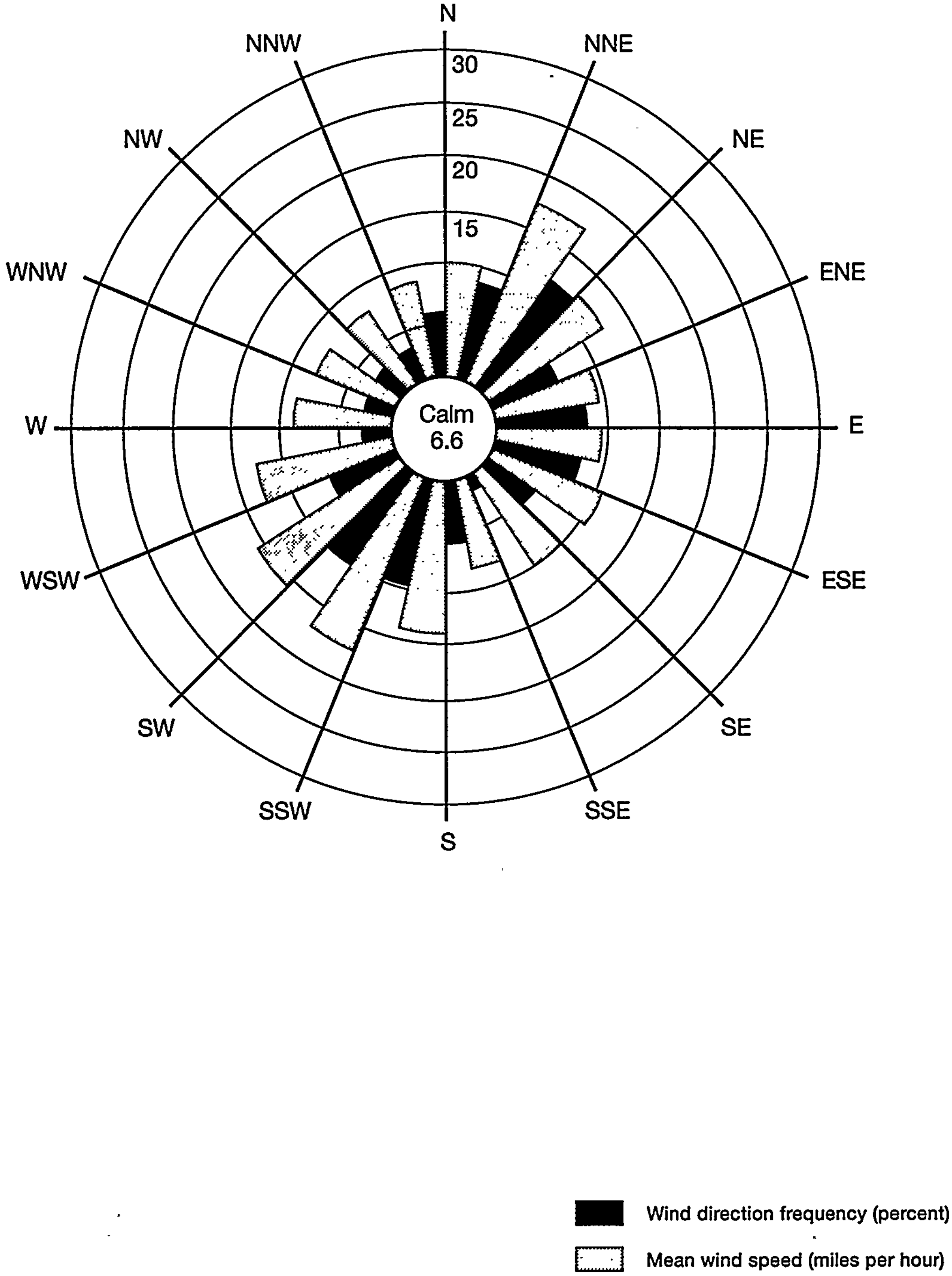


Figure 4-44. 10m (33ft) wind roses for NTS in 1990



Source: Engineering Science, 1990.

Figure 4-45. Wind direction frequencies and mean wind speed near Mercury, Nevada have been observed in the region and are not considered a significant event. The estimated probability of a tornado striking a point at the NTS is extremely low (3 in 10 million years) (Ramsdell and Andrews, 1986).

AMBIENT AIR QUALITY—The NTS is located in the Nevada Intrastate Air Quality Control Region 147. The region has been designated as attainment with respect to the National Ambient Air Quality Standards (40 CFR Part 81.329). The nearest nonattainment area is the Las Vegas area, located 105 km (65 mi) southeast of the NTS. The Las Vegas Valley Hydrographic Area 212, located in Clark County, is classified as moderate nonattainment for carbon monoxide and serious nonattainment for fugitive dust (PM_{10}). The remaining portion of Clark County is designated as unclassifiable/attainment for these pollutants (40 CFR Part 81.329).

An area is designated by the EPA as being in attainment for a pollutant if ambient concentrations of that pollutant are below the National Ambient Air Quality Standards, and nonattainment if violations of the National Ambient Air Quality Standards occur. In areas where insufficient data are available to determine attainment status, designations are listed as unclassified. Unclassified areas are treated as attainment areas for regulatory purposes. The applicable National Ambient Air Quality Standards and Nevada State Ambient Air Quality Standards are presented in Table 4-31.

Prevention of Significant Deterioration is a regulation incorporated in the Clean Air Act that limits increases of pollutants in clean air areas (attainment areas) to certain increments even though ambient air quality standards are being met. The Prevention of Significant Deterioration Program is implemented in large part through the use of increments and area classifications. The Clean Air Act area classification scheme for Prevention of Significant Deterioration establishes three classes of geographic areas and applies increments of different stringency to each class. Air quality impacts, in combination with other Prevention of Significant Deterioration-permitted sources in the area, must not exceed the maximum allowable incremental increases presented in Table 4-32. Facilities planning construction or modifications of a facility that is located in an attainment area may be subject to Prevention of Significant Deterioration regulations if classified as a "major" source or "major" modification. A new source is major if it is one of 28 listed sources and has the potential to emit more than 100 tons per year of a regulated pollutant or more than 250 tons per year of a regulated pollutant, regardless of its source type. A modification is major if it will occur at an existing major source and will cause emission increases of regulated pollutants above "significant" emission rate levels defined in the regulations. Major sources must first obtain a Prevention of Significant Deterioration permit for either a new facility or modifications from the state where the facility is located (40 CFR Part 52.21).

The nearest Prevention of Significant Deterioration Class I areas to the NTS are the Grand Canyon National Park, 208 km (130 mi) to the southeast, and the Sequoia National Park, 169 km (105 mi) to the southwest (DOE, 1995f). The NTS has no sources subject to Prevention of Significant Deterioration requirements.

Ambient air quality at the NTS is not currently monitored for criteria pollutants or hazardous air pollutants, with the exception of radionuclides. Elevated levels of ozone or particulate matter may occasionally occur because of pollutants transported into the area or because of local sources of fugitive particulates (Bowen and Egami, 1983). Ambient concentrations of other criteria pollutants (sulfur dioxide, nitrogen oxides, carbon monoxide, and lead) are probably low because there are no large sources of these pollutants nearby. The nearest significant source of pollutants is the Las Vegas area (DOE, 1995f). Ambient air quality data for the NTS is summarized in Table 4-33. These measurements were recorded during the period from August 15, through September 15, 1990. Monitoring stations were located in Area 23 at Building 525; Area 6 at Building 170; and Area 12 at the sanitation department office trailer. Based on the data collected during this study (Engineering Science, 1990), the NTS is well within all applicable federal and state ambient air quality standards.

Table 4-31. Ambient air quality standards

		Nevada Standards[a]	National Standards[b]	
Pollutant	**Averaging Time**	**Concentration**	**Primary[c,d]**	**Secondary[c,e]**
Ozone	1 hour	235 μg/m^3 [f] (0.12 ppm) [g]	235 μg/m^3 (0.12 ppm)	Same as primary
Ozone-Lake Tahoe Basin, #90	1 hour	195 μg/m^3 (0.10 ppm)	None	None
Carbon monoxide less than 5,000 ft above mean sea level	8 hours	10,000 μg/m^3 (9.0 ppm)	10 mg/m^3 (9.0 ppm)	Same as primary
At or greater than 5,000 ft above mean sea level		6,870 μg/m^3 (6.0 ppm)		
Carbon monoxide at any elevation	1 hour	40,000 μg/m^3 (35 ppm)	40 mg/m^3 (35 ppm)	
Nitrogen dioxide	Annual arithmetic mean	100 μg/m^3 (0.05 ppm)	100 μg/m^3 (0.05 ppm)	Same as primary
Sulfur dioxide	Annual arithmetic mean	80 μg/m^3 (0.03 ppm)	80 μg/m^3 (0.03 ppm)	Same as primary
	24 hours	365 μg/m^3 (0.14 ppm)	365 μg/m^3 (0.14 ppm)	
	3 hours	1,300 μg/m^3 (0.5 ppm)	None	1,300 μg/m^3 (0.50 ppm)
(Suspended) particulate matter as PM_{10}	Annual (geometric) arithmetic mean	(75) 50 μg/m^3	(75) 50 μg/m^3	Same as primary
	24 hours	150 μg/m^3	(260) 150 μg/m^3	(150 μg/m^3)
Lead (Pb)	Quarterly arithmetic mean	1.5 μg/m^3	1.5 μg/m^3	Same as primary
Visibility [h]	Observation	In sufficient amount to reduce the prevailing visibility to less than 30 mi when humidity is less than 70 percent	There is no national standard for visibility	There is no national standard for visibility
Hydrogen sulfide[i]	1 hour	112 μg/m^3 (0.08 ppm)	There is no national standard for visibility	There is no national standard for visibility

[a] These standards must not be exceeded in areas where the general public has access
[b] These standards, other than for ozone and those based on annual averages, must not be exceeded more than once per year. The ozone standard is attained when the expected number of days per calendar year with a maximum hourly average concentration above the standard is equal to or less than one
[c] Concentration is expressed first in units in which it was adopted and is based on a reference temperature of 25 °C and a reference pressure of 760 millimeter (mm) of mercury. All measurements of air quality must be corrected to a reference temperature of 25 °C and a reference pressure of 760 mm of mercury (1,013.2 millibars); parts per million (ppm) in this table refers to ppm by volume or micromoles of pollutant per mole of gas
[d] National primary standards are the levels of air quality necessary, with an adequate margin of safety, to protect the public health
[e] National secondary standards are the levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant
[f] Micrograms per cubic meter
[g] Parts per million by volume or micromoles per mole of gas
[h] For the purposes of this section, prevailing visibility means the greatest visibility that is attained or surpassed around at least half the horizon circle, but not necessarily in continuous sectors
[i] The ambient air quality standard for hydrogen sulfide does not include naturally occurring background concentrations.

NOTE: All values are corrected to reference conditions. These standards of quality for ambient air are minimum goals, and it is the intent of the State Environmental Commission in this section to protect the existing quality of Nevada's air to the extent that it is economically and technically feasible. (Environmental Commission Air Quality Reg. §§ 12.1-12.1.6, eff. 11/7/75; A and renumbered as §12.1, 12/4/76; A 12/15/77; 8/28/79; §§ 12.2-12.4, eff. 11/7/75; § 12.5, eff. 12/4/76; A 8/28/79) (NAC A 10/19/83; 9/5/84; 12/26/91.)

Source: NAC, 1995.

Table 4-32. Maximum allowable pollutant concentration increases under Prevention of Significant Deterioration regulations

Pollutant	Averaging Time	Maximum Allowable Increment ($\mu g/m^3$)[a]		
		Class I	Class II	Class III
Particulate matter (PM_{10})	Annual	4.0	17.0	34.0
	24 hours	8.0	30.0	60.0
Sulfur dioxide (SO_2)	Annual	2.0	20.0	40.0
	24 hours	5.0	91.0	182.0
	3 hours	25.0	512.0	700.0
Nitrogen oxides (NO_x)	Annual	2.5	25.0	50.0

[a] Microgram per cubic meter.

Source: 40 CFR Part 52.21, 1995.

Table 4-33. Ambient air quality data for the NTS, 1990

Monitoring Station	Time Period	Ambient Concentration ($\mu g/m^3$)[a]									
		Sulfur Dioxide			Carbon Monoxide		Nitrogen Oxides	Particulate Matter[b]		Lead	Ozone
		Annual	Max. 24-Hour	Max. 3-Hour	Max. 8-Hour	Max. 1-Hour	Annual	Annual	Max. 24-Hour	Max. Calendar Quarter	Max. 1-Hour
Area 23	8/15/90 to 9/15/90	(c)	39.3	65.4	1,374	1,374	(c)	(c)	78.3	(c)	(c)
Area 6	8/15/90 to 9/15/90	(c)	0	0	1,145	1,947	(c)	(c)	20.2	(c)	(c)
Area 12	8/15/90 to 9/15/90	(c)	15.7	52.4	2,290	2,748	(c)	(c)	45.4	(c)	(c)

[a] Migrograms per cubic meter
[b] Particulate matter less than 10 microns in diameter
[c] Not measured.

Source: Engineering Science, 1990.

The criteria air pollutants emitted at the NTS include particulates from construction, aggregate production, and surface disturbances, and fugitive dust from vehicles traveling on unpaved roads; various pollutants from fuel-burning equipment, incineration, and open burning; and volatile organics from fuel storage facilities (DOE, 1995f). A summary of emission estimates for sources at the NTS is presented in Table 4-34. Emissions of hazardous air pollutants from current NTS sources are below regulatory requirements (DOE, 1995f).

RADIOLOGICAL AIR QUALITY—The DOE maintains an extensive network of air sampling stations for radiological parameters, such as particulates, tritium, noble gases, and reactive gases. Past activities at the NTS have resulted primarily in radioactive effluents from underground weapons testing. Some radioactivity detected by on-site air monitoring stations is attributed to the resuspension of soils contaminated from past aboveground nuclear weapons testing (1951 to 1962).Monitoring of airborne particulate matter, noble gases, and tritiated water vapor on the NTS in 1993 indicated on-site levels that were consistent with background concentrations (Table 4-35). The external exposure monitoring network indicated a stable level of gamma radiation levels from year to year. Airborne releases of radioactivity have occurred from past aboveground weapons testing, but in recent years no radioactivity from operations at the NTS has been detected at off-site monitoring stations.

During 1993, the radiation dose to the maximum exposed individual was estimated to be 0.004 mrem at Indian Springs (DOE, 1994b), which is well below the EPA standard of 10 mrem per year. This effective dose equivalent was based on calculations using the CAP88 air dose assessment model (an air dispersion model developed by the EPA to predict effective doses). This computer code uses site-specific radionuclide emission data, on-site meteorological data, and dose conversion factors to predict the effective dose equivalent.

Historically, releases have occasionally occurred to the ground surface and atmosphere as a result of underground testing. There have been five categories of releases: (1) venting that occurred when containment failed and there was a rapid, massive release; (2) seeps that occurred when containment failed and there was a small, slow release shortly after the test; (3) late-time seeps that released gases to the surface a few days or weeks after the test; (4) controlled tunnel purging to allow recovery of equipment and data; and (5) operational releases that are small and occur when core or gas samples are collected. According to the Office of Technology Assessment (OTA, 1989), prior to 1971, a total of 2.5×10^7 curies were released from underground tests at the NTS. After a 1971 Atomic Energy Commission review (following a 6.7×10^6 Ci release from the Baneberry test), new containment procedures were implemented. From 1971 through 1988, 54,000 Ci were released, and of this amount 11,000 Ci were unintentionally released through containment failure. Seeps continue to emit radioactive gases from the underground testing areas. The DOE maintains an extensive network of monitoring stations on the at NTS and at off-site locations to monitor extensive network of monitoring stations on the at NTS and at off-site locations to monitor conditions. The results of this monitoring measure the concentrations of gross beta, plutonium, noble gases, and tritiated water vapor in air rather than the total inventory of radionuclides.

In 1990, the average concentrations never approached the Derived Concentration Guides for inhalation for samples collected either on or off the NTS. The results of monitoring in 1990 found xenon, a key noble gas indicator, was detected only for a short period after underground tests.

The total inventory of 1990 releases to the atmosphere from underground tests through seepage of gaseous radionuclides is estimated at about 66 Ci. Of this quantity, some was related to ventilation of tunnels where tests were conducted. The 1990 monitoring of the G Tunnel Complex indicated that ventilation resulted in a release of 28 Ci of airborne tritium into the atmosphere.

No nuclear tests were performed at the NTS in 1993; therefore, the radiological monitoring consisted primarily of routine air sampling throughout the NTS. In 1993, samples of air exhausted through the ventilation duct at the P Tunnel portal (used for underground testing in

Table 4-34. NTS source emission inventory, 1993

Pollutant	Source	Emission Rate (lbs/hour)
Particulate matter (PM_{10})	Area 12 boiler	2.8
	Area 23 boiler	3.6
	Area 23 boiler	2.8
	Area 23 incinerator	0.75
	Area 6 boiler	2.9
	Area 1 rotary dryer	7.1
Sulfur dioxide (SO_2)	Area 12 boiler	2.8
	Area 23 boiler	3.1
	Area 23 boiler	2.8
	Area 23 incinerator	3.0
	Area 6 boiler	2.5

Source: NDCNR, 1988a, b, c, 1989a, b, and 1990.

Table 4-35. NTS radioactive emissions – 1993, airborne effluent releases

	Curies		
Facility Name	**Tritium**	**Krypton-85**	**Plutonium**
Area 3	NA*	NA	1.0×10^{-3}
Area 5, Radioactive Waste Management Site	2.9×10^{-1}	NA	NA
Area 9, Bunker	NA	NA	7.5×10^{-4}
Area 12, Containment Ponds	7.4×10^{2}	NA	NA
Area 12, P Tunnel Portal	3.7	NA	NA
Areas 19 and 20, Pahute Mesa	NA	1.6×10^{2}	NA
Total	$\mathbf{7.08 \times 10^{2}}$	$\mathbf{1.6 \times 10^{2}}$	$\mathbf{1.8 \times 10^{-3}}$

* Not applicable.

Source: DOE/NV, 1994b.

horizontal mines) indicated emissions of 3.7 Ci of gaseous radioactivity in the form of tritiated water vapor due to seepage within the tunnel from nuclear tests performed in previous years. Air samples collected around the Area 5 Radioactive Waste Management Site indicated trace amounts of tritium at the boundary and no measurable activity away from the area. Air samples collected in Area 3 and at the Area 9 bunker indicated levels of plutonium-239 and -240 above background. Measured krypton-85 levels on Pahute Mesa were approximately 1 pCi/m³ higher than the NTS average because of atmospheric pumping from past nuclear events.

Using the data from the highest annual average concentration, replacing the diffuse source with an equivalent point source, and using the CAP88 Systems Laboratory, Las Vegas has an extensive air monitoring network throughout central and southern Nevada and the southern portion of Utah and California for a total of 27 monitoring sites. The EPA's off-site air monitoring network air concentration data indicated doses far below those modeled with the CAP88-PC model. The gamma exposure rates are measured weekly throughout the year at these sites. The CAP 88-PC model estimated a dose of 0.004 mem to a hypothetical maximum exposed individual. The actual data from the EPA's air monitoring network indicated that the air concentration would have to be 14 times higher than measured values to achieve the modeled dose. Table 4-36 summarizes the annual contributions to the effective dose equivalent in 1993 due to operations at the NTS as estimated by the CAP88-PC computer model.

4.1.8 Noise

Noise is defined as sound that is undesirable because it interferes with speech communication and hearing, is intense enough to damage hearing, or is otherwise annoying. The characteristics of sound include parameters such as amplitude, frequency, and duration. The decibel (dB), a logarithmic unit that accounts for the large variations in amplitude, is the accepted standard unit measurement of sound.

When measuring sound to determine its effects on the human population, A-weighted sound levels (dBA) are typically used to account for the response of the human ear (ANSI/ASME, 1983). Human responses to sounds are lowest at low and high frequency levels and greatest in the middle frequency range. A-weighted sound levels represent adjustments to sound levels that are made according to the frequency content of the sound. Examples of typical sound levels are shown in Figure 4-46.

Noise levels often change with time; therefore, to compare levels over different time periods, several descriptors were developed that take into account this time-varying nature. These descriptors are used to assess and correlate the various effects of noise on man, including land-use compatibility, sleep and speech interference, annoyance, hearing loss, and startle effects.

The day-night average sound level was developed to evaluate the total community noise environment. The day-night average sound level is the average dBA during a 24-hour period with 10 dB added to nighttime levels (between 10 p.m. and 7 a.m.). This adjustment is added to account for the increased sensitivity to nighttime noise events. The day-night average sound level was endorsed by the EPA and is mandated by the U.S. Department of Housing and Urban Development, the Federal Aviation Administration, and the DoD for land-use assessments.

The day-night average sound level is sometimes supplemented with another noise level measurement, primarily the equivalent sound level. The equivalent sound level is the dBA level of a steady-state sound that has the same dBA sound energy as that contained in the time-varying sound being measured over a specific time period. The major noise sources at the NTS include equipment and machines (e.g., cooling towers, transformers, engines, pumps, boilers, steam vents, paging systems, construction and material-handling equipment, and vehicles), blasting and explosives testing, and aircraft operations. No NTS environmental noise survey data are available. At the NTS boundary, away from most facilities, noise from most sources is barely distinguishable above background noise levels.

The acoustic environment in areas adjacent to the NTS can be classified as either uninhabited desert or small rural communities. In the uninhabited desert, the major sources of noise are natural physical phenomena such as wind, rain, and wildlife activities, and an occasional airplane. The wind is the predominant noise source. Desert noise levels as a function of wind have been measured at an upper limit of 22 dBA for a still desert and 38 dBA for a windy desert (Brattstrom and Bondello, 1983).

A background sound level of 30 dBA is a reasonable estimate. This is consistent with other estimates of sound levels for rural areas. The rural

Table 4-36. Summary of effective dose equivalents from NTS operations during 1993

	Maximum EDE[a] at NTS Boundary[b]	Maximum EDE to an Individual[c]	Collective EDE to Population Within 80 kilometers of the NTS Sources
Dose	4.8×10^{-3} mrem	$3.8 \pm 0.57 \times 10^{-3}$ mrem	1.2×10^{-2} person-rem
Risk of Cancer[d]	1.728×10^{-7} latent cancer fatalities		
Location	Site boundary 58 km (36 mi) SSE of NTS Area 12	Indian Springs, 80 km (50 mi) SSE of NTS Area 12	21,750 people within 80 km (50 mi) of NTS sources
NESHAP[e] Standard	10 mrem per year	10 mrem per year	NA[f]
Percentage of NESHAP	0.05	0.04	NA[f]
Background	97 mrem	97 mrem	1,747 person-rem
Risk of cancer (from background)[d]	3.492×10^{-3} latent cancer fatalities		
Percentage of Background	5.0×10^{-3}	4.0×10^{-3}	6.9×10^{-4}

[a] Effective dose equivalent
[b] The maximum boundary dose is to a hypothetical individual who remains in the open continuously during the year at the NTS boundary located 60 km 37 ml) south-southeast from the Area 12 tunnel ponds
[c] The maximum individual dose is to a person outside the NTS boundary at a residence where the highest dose rate occurs as calculated by CAP88 (Version 1.0) using NTS effluents listed in Table 5.1 of the 1993 Annual Site Environmental Report document (DOE/NV, 1994a) and assuming all tritiated water input to the Area 12 containment ponds was evaporated
[d] Assume individual exposed to dose per year for lifetime (72 years)
[e] National Emission Standards for Hazardous Air Pollutants
[f] Not applicable.

Source: DOE/NV, 1994a.

communities day-night average sound level has been estimated in the range of 35 to 50 dB (EPA, 1974). A background sound level of 50 dB is a reasonable estimate for Mercury.

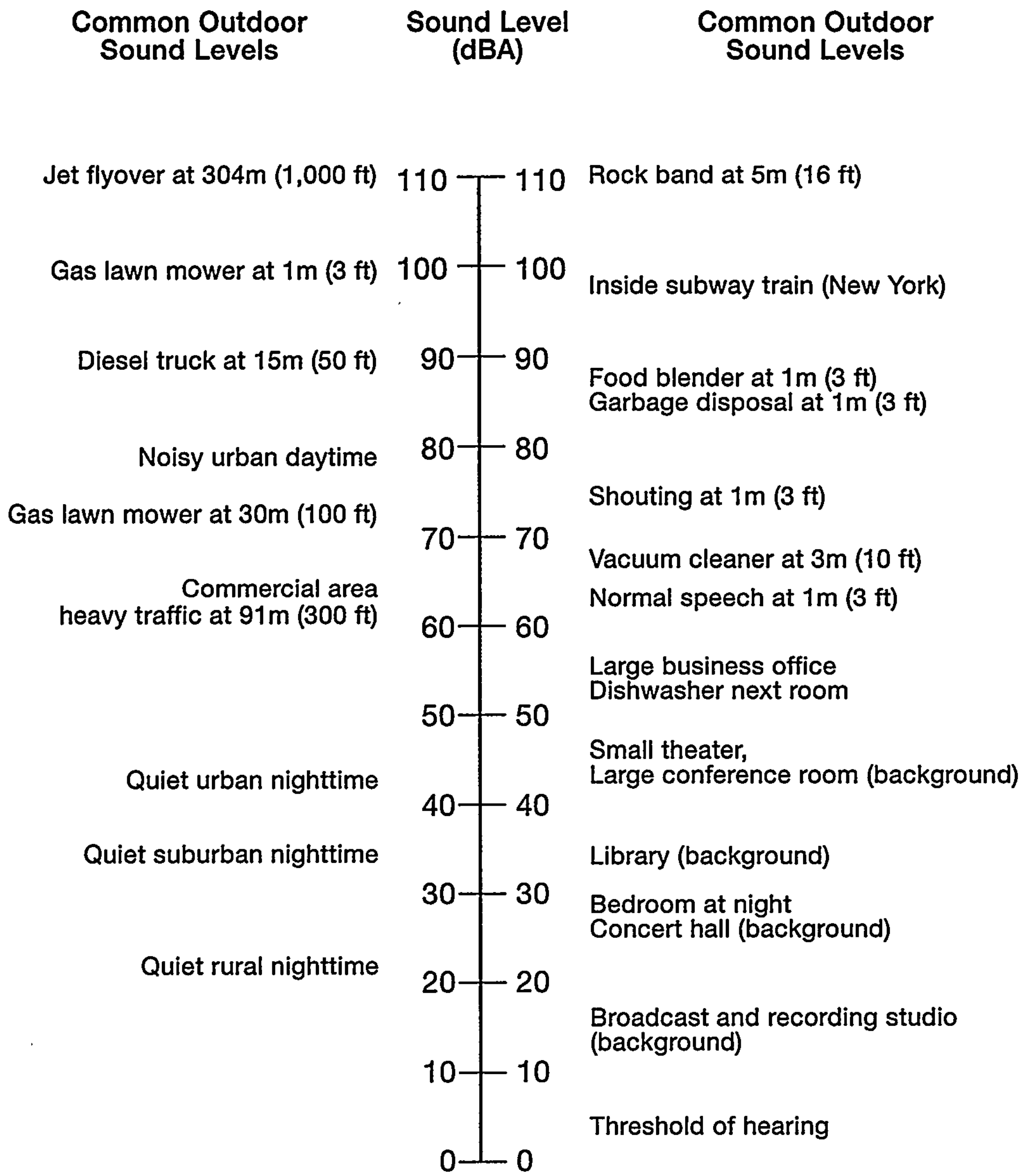
Except for the prohibition of nuisance noise, neither the state of Nevada nor local governments have established specific numerical environmental noise standards.

At the North Las Vegas Facility, noise background levels are those that would be expected in an urbanized industrial area.

4.1.9 Visual Resources

Visual resources include the natural and man-made physical features that give a particular landscape its character and value as an environmental factor. The feature categories that form the overall impression a viewer receives of an area include landform, vegetation, water, color, adjacent scenery, scarcity, and man-made (cultural) modification (BLM, 1980).

Criteria used in the analysis of visual resources for this EIS include scenic quality, visual sensitivity, and distance and/or visibility zones from key public viewpoints.



Source: Modified from U.S. Department of Transportation, 1980

Figure 4-46. Comparative A-weighted sound levels

There are three scenic quality classes. Class A includes areas that combine the most outstanding characteristics of each physical feature category. Class B includes areas in which there is a combination of some outstanding characteristics and some that are fairly common. Class C includes areas in which the characteristics are fairly common to the region. Visual sensitivity for this analysis was based solely on the volume of travel on public highways because these roads are the only key public viewpoints from which the study areas are seen. Study areas that are visible from highways with 3,000 or more average annual daily traffic were average daily traffic were assigned a medium sensitivity level. Study areas that are visible from highways with annual average daily traffic below 1,000 were assigned a low sensitivity level.

Visual quality and sensitivity may be magnified or diminished by the distance and/or visibility of the landscape from key view points (BLM, 1980). The landscape scene can be divided into three basic distance zones: foreground, 0 to 0.8 km (0.5 mi); middleground, 0.8 km (0.5 mi) to 8 km (5 mi); and background/seldom seen, 8 km (5 mi) to infinity. Seldom-seen views also include those portions of the landscape that cannot be seen from a key viewpoint because the viewer's line of sight is blocked by terrain, vegetation, or some other physical feature.

The NTS is located in a transition area between the Mojave Desert and the Great Basin. Vegetation ranges from grasses and creosote bush in the lower elevations to juniper, pinyon pine, and sagebrush in elevations above 1,524 m (5,000 ft). The topography of the NTS consists of a series of mountain ranges arranged in a north-south orientation separated by broad valleys. A portion of the site is characterized by the presence of numerous subsidence craters resulting from past nuclear testing. Scenic views related to geologic features are numerous within this region. The southwestern Nevada volcanic field, which includes portions of the NTS, is recognized by researchers to be a classic example of a nested, multicaldera volcanic field. The scenic quality of the NTS ranges from Class B to Class C. The areas of the NTS visible from U.S. Highway 95 are common to the region. Therefore, they have been designated as Class C.

The area surrounding the NTS consists of unpopulated to sparsely populated desert and rural lands. Because the NTS is surrounded to the east, north, and west by the NAFR Complex and to the south by lands controlled by the U.S. Bureau of Land Management, the main public views into the interior of the NTS are from U.S. Highway 95. Because the southern boundary of the NTS is surrounded by various mountain ranges, including the Spector Range, Striped Hills, Red Mountain, and the Spotted Range, views from U.S. Highway 95 are limited to Mercury Valley and some portions of the southwestern sector of NTS which can be seen from Amargosa Valley. Traffic on U.S. Highway 95 at the Mercury exit is approximately 3,600 vehicles per day (NDOT,1993a). Therefore, portions of the NTS visible from this area would have a high sensitivity level.

The North Las Vegas Facility occupies approximately 80 acres in the city of North Las Vegas, Nevada. The area can be described as an urbanized industrial area, and visual resources are typical for such an area.

4.1.10 Cultural Resources

The following sections describe the cultural resources of the NTS and North Las Vegas Facilities. Resources are described in two ways. First, archeological resources are described in accordance with the provisions of the National Historic Preservation Act of 1966 and the Archaeological Resources Protection Act of 1979, as these acts are implemented through consultations and the programmatic agreement between the SHPO and the DOE/NV. The second description of resources, which begins at the unnumbered section entitled "Sites of American Indian Significance," describes cultural resources from the American Indian cultural perspective, as provided by the American Indian Writers Subgroup of the Consolidated Group of Tribes and Organizations. This section is in italics.

Archaeological research indicates that important cultural resources exist at the NTS. These resources range from sites associated with the earliest prehistoric people in the New World to structures associated with the development of nuclear testing. At the time of contact with the Euroamericans in the mid-1800s, the area was occupied or used by the Southern Paiute, Western Shoshone (Steward, 1938), and Owens Valley Paiute (Stoffle and Evans, 1988). Historic contexts commonly employed on the NTS are the Paleoindian, Early, Middle and Late Archaic, Shoshonean and Historic periods. The latter has been subdivided into contexts concerned with mining, ranching, transportation and communication, nuclear testing and research, and American Indians. Those sites dating to the Cold War era and associated with nuclear testing and development are considered of particular relevance because they occur at only a few locations across the United States.

Current knowledge of the NTS cultural resources is the result of over 20 years of surveys and data recovery, most conducted prior to NTS activities. In addition to preactivity surveys and studies, in 1990 the DOE entered into a Programmatic Agreement with the SHPO and the Advisory Council for Historic Preservation, which implemented the Long-Range Study Plan for Negating Potential Adverse Effects to Historic Properties on Pahute and Rainier Mesas. This is a comprehensive program that examines in depth an 11-percent geographic sample of the cultural resources on the two mesas. As a result of these programs 4.68 percent of the NTS (40,491 acres) has been surveyed for cultural resources. The Long-Range Study Plan and other programs have produced a large archaeological database that is the foundation for the information presented in this document. Some sites, particularly mining, ranching, and nuclear testing sites, are known but have yet to be studied and recorded. At least 600 buildings, structures and objects dating to the Cold War era have been identified on the NTS, but these have not been systematically recorded or evaluated for significance. The sites included here are those that have been systematically recorded. Determinations of eligibility for the cultural resources have been made through consultations between the DOE and the SHPO. However, many of the older sites have not been evaluated for National Register of Historic Places eligibility. In many cases, the site records do not indicate any National Register of Historic Places recommendations. Based on current knowledge, all areas of the NTS have the potential to contain archaeological sites that are considered significant because they meet the criteria of eligibility for the National Register of Historic Places. As a result, the boundaries of the NTS mark the area of potential effect for cultural resources. The following section documents previous work conducted on the NTS and North Las Vegas Facilities, and evaluates the sites according to types and eligibility for listing on the National Register of Historic Places.

<u>RECORDED CULTURAL RESOURCES</u>—Over 1,700 archaeological sites have been identified on the NTS. The terminology used here to define site types is derived from the Desert Research Institute's Branch Technical Procedures Manual (DRI, 1990). Site types are grouped into prehistoric and historic categories. Prehistoric sites include temporary camps, extractive localities, processing localities, localities, caches, and stations. One other prehistoric site type is the residential base. Historic site types include mining sites, ranching sites, and transportation and communication sites. Other historic types are those related to nuclear testing and research.

Temporary camps are defined as occasional operational centers for prehistoric task groups or population groups. These sites were the hub of resource collection activities where processing, manufacturing, maintenance, and living activities were likely to take place. Consequently, the inventory of artifacts and features at these sites often reflects a number of different activities. The diversity of these assemblages makes them useful when characterizing prehistoric occupations. Extractive localities are resource procurement areas, such as quarries, water catchment basins, hunting blinds, and plant resource extraction locations. Processing localities are areas where resources, such as stone tools, plants, and animals, are processed. Localities are places where these types of activities took place, but lack sufficient information to discern which activity is represented. These sites are marked by low artifact diversity when compared to temporary camps. Caches are temporary places used for storing either resources or artifacts. Stations are locations where special purpose task groups gather to exchange information about game movement, routes of travel, and ritual activities. Stations include rock cairns marking travel routes, isolated rock art, geoglyphs, observation points, and overlooks. A residential base is a location of extended occupation for prehistoric people. Historic sites are grouped according to major themes commonly encountered in the DOE project areas. These allow some characterization of an extremely variable resource. The major themes within which historic sites are grouped include mining, ranching, and transportation and communication. Other historic contexts are nuclear testing and research, and American Indian activities.

Documents that provide further information used to assess resources found on the NTS include Pippin (1984, 1986, 1992), Reno and Pippin (1985), and Worman (1969). The characteristics and significance of these resources are summarized in this EIS in terms of eligibility for the National Register of Historic Places. The data are presented according to hydrographic boundaries (State of Nevada Engineer's Office, 1974). These boundaries provide a useful way to organize the data in a comparable manner to other studies presented in this document. Those sites recorded as a result of DOE activities, including the Yucca Mountain Site Characterization Project, are considered in the following sections. (Figure 4-47 and Table 4-37).

Mercury Valley—This basin is bounded by the Spotted Range and the Specter Range (State of Nevada Engineer's Office, 1974). Twenty-one archeological reconnaissance surveys have been conducted within that portion of Mercury Valley that lies within the NTS. Approximately 214 acres were surveyed for cultural resources. Only four sites have been recorded as a result of these surveys. Of these, three are classified as localities, and one is a historic site. None of these sites is considered eligible for listing on the National Register of Historic Places.

Rock Valley—This basin is bounded by the Specter Range to the south and the Skull Mountains to the north (State of Nevada Engineer's Office, 1974). Most of the Rock Valley hydrographic basin lies within NTS boundaries. Nine archaeological reconnaissance surveys have been conducted within Rock Valley. Approximately 432 acres have been surveyed for cultural resources. Seventeen sites have been recorded as a result of these studies. One of the sites is an extractive locality, 15 are localities, and 1 is a temporary camp. Three of these sites have been determined eligible for listing on the National Register of Historic Places.

Fortymile Canyon-Jackass Flats—Jackass Flats is bounded by the Skull Mountains to the south and the Shoshone Mountains to the north (State of Nevada Engineer's Office, 1974). Almost the entire basin, with the exception of the extreme western edge and the southwest corner, lies within NTS boundaries. One hundred fifty-six archaeological reconnaissance surveys have been conducted within the Fortymile Canyon-Jackass Flats basin. Approximately 12,177 acres have been surveyed for cultural resources. The Fortymile Canyon-Jackass Flats area has a very high density of recorded sites. This density is partially a reflection of the intensity of archaeological survey which has occurred in the area. There have been 371 cultural resources sites recorded as a result of these surveys. This total includes 35 temporary camps, 15 extractive localities, 59 processing localities, 236 localities, 7 caches, 1 station, 1 residential base, 8 historic sites, and 9 untyped sites. Currently, 106 of these sites are eligible for listing on the National Register of Historic Places.

Buckboard Mesa—This hydrographic area includes Buckboard Mesa and part of Pahute Mesa. The entire hydrographic basin is within NTS boundaries. It is bounded by the Shoshone Mountains and the Eleana Range on its eastern boundary (State of Nevada Engineer's Office, 1974). Fifty-one archaeological reconnaissance surveys have been conducted within that portion of Buckboard Mesa that lies within the NTS. Approximately 4,190 acres have been surveyed for cultural resources. The Buckboard Mesa area has a very high density of recorded sites. This density may be a reflection of the intensity of archaeological survey which has occurred in the area. To date, 470 sites have been recorded in the Buckboard Mesa hydrographic region. This total includes

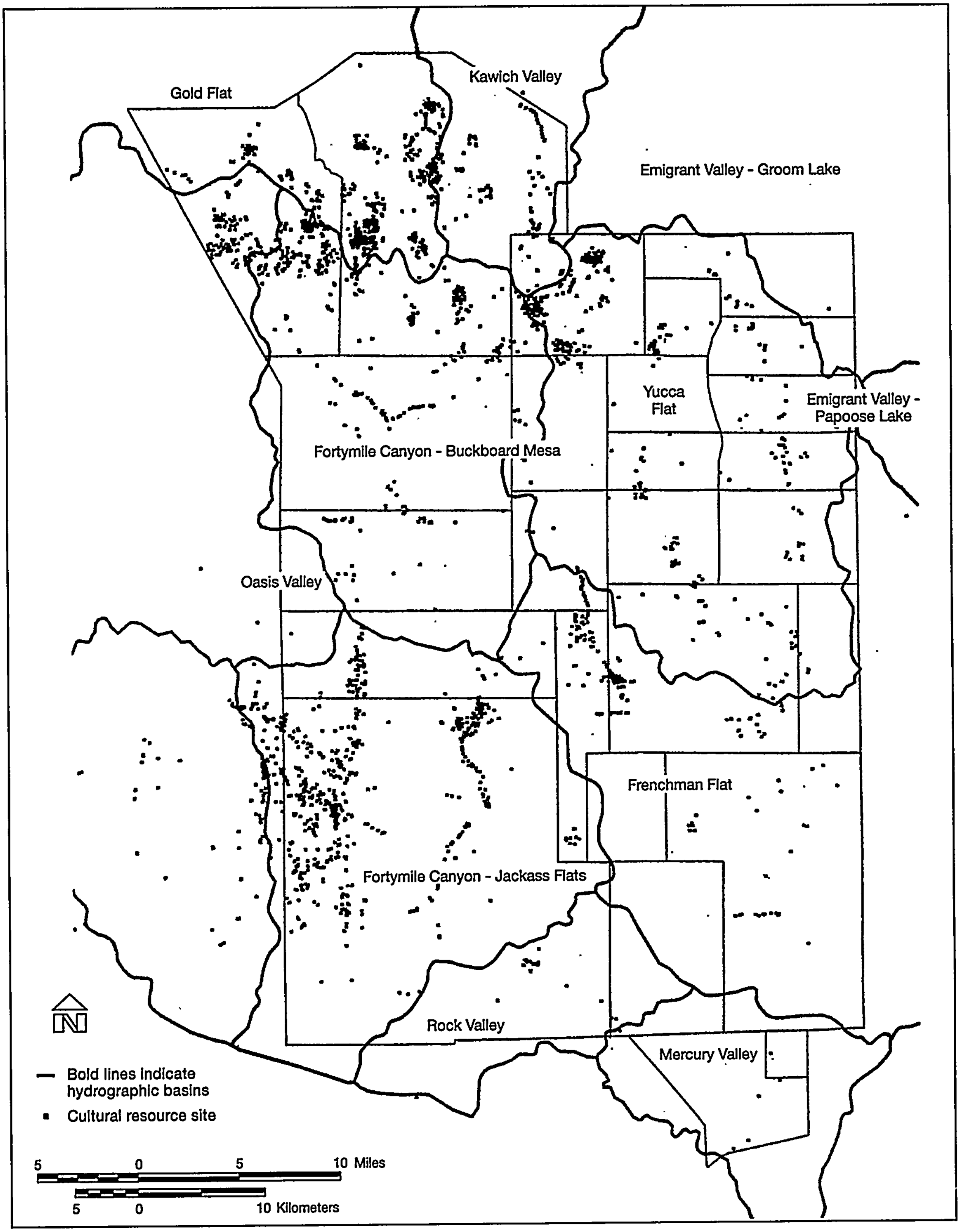


Figure 4-47. Recorded cultural resources on the NTS

Table 4-37. Types of sites found within the hydrographic basins of the NTS

	Prehistoric Site Types							Historic Site Types		Untyped Sites	NR Eligible
Basin	RB	TC	EL	PL	LO	CA	STA	HI	NT	UT	NR
Mercury Valley	0	0	0	0	3	0	0	1	0	0	0
Rock Valley	0	1	1	0	15	0	0	0	0	0	3
Fortymile Canyon & Jackass Flats	1	35	15	59	236	7	1	8	0	9	106
Buckboard Mesa	0	103	6	94	203	5	1	3	0	54	327
Oasis Valley	0	14	1	20	82	0	0	0	0	2	49
Gold Flat	0	25	1	96	124	10	0	2	0	1	169
Kawich Valley	0	9	0	25	37	0	0	2	0	8	58
Emigrant Valley & Groom Lake Valley	0	0	0	0	5	0	0	0	0	0	0
Yucca Flat	4	54	10	34	126	56	0	38	5	13	130
Frenchman Flat	1	2	2	38	52	0	0	2	2	0	49
Totals	**6**	**243**	**36**	**366**	**883**	**78**	**2**	**56**	**7**	**87**	
Total NTS Sites										**1,764**	**891**

Site type codes: RB=residential base; TC=temporary camp; EL=extractive locality; PL=processing locality; LO=locality; CA=cache; STA=station; HI=historic; NT=nuclear testing; UT=untyped; NR=National Register.

103 temporary camps, 6 extractive localities, 94 processing localities, 203 localities, 5 caches, 1 station, 3 historic ranching sites, and 54 untyped sites. Currently, 327 of these sites have been determined eligible for listing on the National Register of Historic Places. The large number of localities recorded in the Buckboard Mesa region suggest that this region was highly used by mobile groups during their annual round. These kinds of sites can often provide important information about the technological orientation of prehistoric people.

Oasis Valley—Only the eastern portion of this basin is within the NTS boundaries. This region includes parts of Pahute Mesa. Twenty-nine archaeological reconnaissance surveys have been conducted within that portion of Oasis Valley that lies within the NTS. Approximately 3,445 acres have been surveyed for cultural resources. To date, 119 cultural resources sites have been recorded in the part of the Oasis Valley hydrographic basin that is within NTS boundaries. This total includes 14 temporary camps, 1 extractive locality, 20 processing localities, 82 localities, and 2 untyped sites. While many of the smaller localities are not eligible for listing on the National Register of Historic Places, 49 of the sites are eligible for listing on the National Register of Historic Places.

Gold Flat—The southern part of this basin is within the NTS and includes part of Pahute Mesa. A wide range of site types can be found in the area. Forty-eight archaeological reconnaissance surveys have been conducted within that portion of Gold Flat Valley that lies within the NTS. Approximately 6,140 acres have been surveyed for cultural resources. Currently, 259 sites have been recorded as a result of these surveys. This total includes 25 temporary camps, 1 extractive locality, 96 processing localities, 124 localities, 10 caches, 2 historic sites, and 1 untyped site. To date, 169 of these sites are eligible for listing on the National Register of Historic Places.

Kawich Valley—Only the southern part of this hydrographic basin is within the boundaries of the NTS and includes a portion of Pahute Mesa. Twenty-one archaeological reconnaissance surveys have been conducted within that portion of Kawich Valley that lies within the NTS. Approximately 2,635 acres have been surveyed for cultural resources. There are 81 sites that have been recorded as a result of these surveys. This total includes 9 temporary camps, 25 processing localities, 37 localities, 2 historic sites, and 8 untyped sites. To date, 58 sites are eligible for listing on the National Register of Historic Places (see Table 4-37).

Emigrant Valley-Groom Lake Valley—Only a small portion of this basin is within the NTS boundaries. This basin includes part of the Belted Range and part of Groom Lake Valley (State of Nevada Engineer's Office, 1974). Two archaeological reconnaissance surveys have been conducted within that portion of Emigrant Valley and Groom Lake Valley that falls within the NTS. Approximately 60 acres have been surveyed for cultural resources. Five localities have been identified within NTS boundaries. None of these localities has been found to be eligible for listing on the National Register of Historic Places. This small sample of sites is not necessarily representative of the hydrographic basin as a whole.

Yucca Flat Weapons Test Basin—The Yucca Flat basin area is bounded by the Eleana Hills to the west and the Halfpint Range to the east. Several isolated mountains form the southern boundary of the Yucca Flat basin (State of Nevada Engineer's Office, 1974). Most of the basin lies within NTS boundaries. One hundred twenty-two archaeological reconnaissance surveys have been conducted within the Yucca Flat hydrographic basin. Approximately 7,785 acres have been surveyed for cultural resources. This region is rich in cultural resources and includes sites from virtually all categories. There have been 340 sites recorded in the Yucca Flat weapons test basin hydrographic basin. This total includes 54 temporary camps, 10 extractive localities, 34 processing localities, 126 localities, 56 caches, 4 residential bases, 38 historic sites, 5 nuclear testing sites, and 13 untyped sites. Historic structures associated with nuclear testing are common here, but most have not been recorded and evaluated. To date, 130 sites in the Yucca Flat hydrographic basin are eligible for listing on the National Register of Historic Places. One site, Sedan Crater, is listed on the National Register of Historic Places.

Frenchman Flat—This area is bounded by the Spotted Range on the east; Mine Mountain/ Massachusetts Mountain on the north; the Shoshone Mountains, Lookout Peak, and Skull Mountains on the west, and the Ranger Mountains on the south (State of Nevada Engineer's Office, 1974). Only the western half of this hydrologic basin is within the NTS boundaries. Forty-two archaeological reconnaissance surveys have been conducted within Frenchman Flat hydrologic basin. Approximately 3,305 acres have been surveyed for cultural resources. There are 99 archaeological sites recorded as a result of these surveys. Of these, 2 are temporary camps, 2 are extractive localities, 38 are processing localities, 52 are localities, 1 is a residential base, 2 are historic sites, and 2 are related to nuclear testing and research. Forty-nine of the sites have been determined eligible for listing on the National Register of Historic Places. Historic structures relating to the development of nuclear weapons may also be eligible for listing on the National Register of Historic Places as a historic district.

SITES OF AMERICAN INDIAN SIGNIFICANCE—The Consolidated Group of Tribes and Organizations has had a long-standing relationship with the DOE since 1987. The group is comprised of 17 tribes and organizations, representing the Southern Paiutes, Western Shoshones, and the Owens Valley Paiutes. Each of these groups has substantiated cultural and historic ties to the NTS and the surrounding areas. The Consolidated Group of Tribes and Organizations has been instrumental in providing guidance by actively participating in the DOE's American Indian Religious Freedom Act Compliance Program, the Native American Graves Protection and Repatriation Act activities, the American Indian Monitoring Program, and the Yucca Mountain Site Characterization Project.

Numerous sites have been identified within the NTS boundaries that are important to American Indian people. Some of these sites have been identified through visits to the area by tribal representatives during American Indian Religious Freedom Act consultations.

These visits are summarized in Stoffle et al. (1990a) and Stoffle et al. (1994b). Any project that may impact sites of American Indian significance will include consultations with American Indian tribes and other potentially affected cultural groups before activities are initiated.

With respect to North Las Vegas, a historic site (Kyle Ranch) is located less than 1.6 km (1 mi) southwest of the proposed National Ignition Facility location; however, no archaeological remains (prehistoric or historic) are likely to be present because of the heavy past disturbance of the surface and near-surface sediment. No historic structures exist at the proposed National Ignition Facility location, nor have any American Indian cultural resources been identified at the North Las Vegas Facility in the course of past consultation with potentially affected tribal organizations.

The following information pertaining to cultural resources on the NTS is provided by the American Indian Writers Subgroup of the Consolidated Group of Tribes and Organizations.

<u>AMERICAN INDIAN CULTURAL RESOURCES</u>—*The CGTO knows, based upon its collective knowledge of Indian culture and past American Indian studies, that American Indian people view cultural resources as being integrated. Thus, certain systematic studies of a variety of American Indian cultural resources must be conducted before the cultural significance of a place, area, or region can be fully assessed. Although some of these studies have been conducted on the NTS and nearby lands, many studies still need to be completed. In some portions of the NTS, a number of American Indian studies have been conducted, while in other areas studies have not begun. A number of studies are currently planned.*

Indian people can fully assess the cultural significance of a place and its associated natural and cultural resources when all studies have been completed, and our governments and tribal organizations have reviewed the recorded thoughts of our elders and have officially supported these conclusions. American Indian studies focus on one topic at a time so that tribes and organizations can send experts in the subject being assessed. The following is a list of studies that are required for a complete American Indian assessment:

1. *Ethnoarchaeology*
   the interpretation of the physical artifacts produced by our Indian ancestors

2. *Ethnobotany*
   the identification and interpretation of the plants used by our Indian people

3. *Ethnozoology*
   the identification and interpretation of the animals used by Indian people

4. *Rock art*
   the identification and interpretation of traditional Indian paintings and rock peckings

5. *Traditional cultural properties*
   the identification and interpretation of places of central cultural importance to a people, called Traditional Cultural Properties; often Indian people refer to these as "power places"

6. *Ethnogeography*
   the identification and intrepretation of soil, rocks, water, and air
7. *Cultural landscapes*
   the identification and interpretation of spatial units that are culturally and geographically unique areas for Indian people.

When all of these subjects have been studied, then it is possible for Indian people to assess three critical issues: (1) what is the natural condition of this portion of our traditional lands? (2) how have DOE's ground-disturbing and monitoring activities altered and/or impacted American Indian cultural resources? and (3) what impacts will proposed alternatives have on either furthering existing changes in the natural environment or restoring our traditional lands to their natural condition? Indian people believe that the natural state of their traditional lands was what existed before 1492, when Indian people were fully responsible for the continued use and management of these lands.

The NTS and nearby lands were central to the Western Shoshone, Owens Valley Paiute, and Southern Paiute people (Figure 4-48). The lands were central in the lives

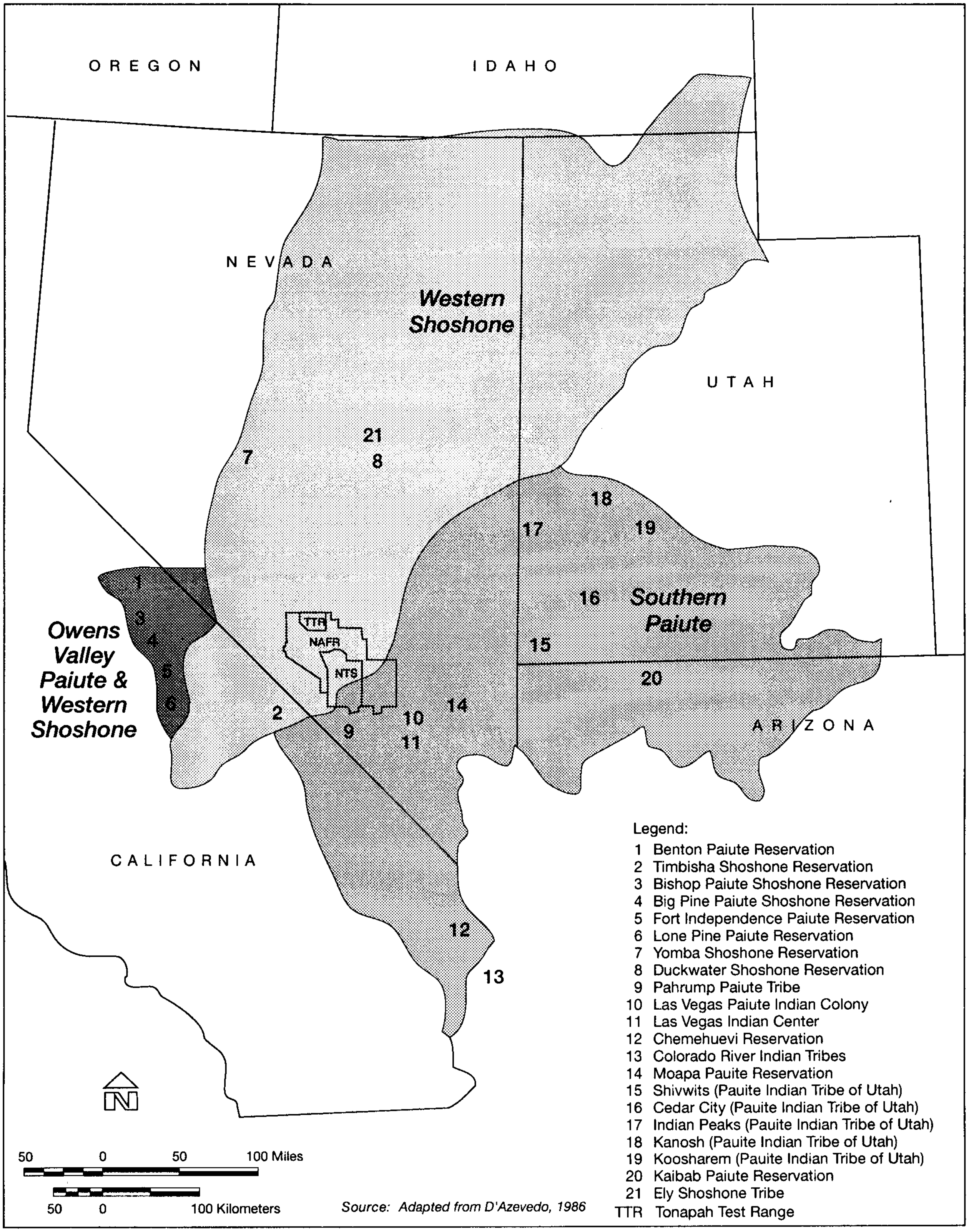


Figure 4-48. American Indian region of influence for the NTS EIS

of these people and so were mutually shared for religious ceremony, resource use, and social events (Stoffle et al., 1990a). When Europeans encroached on these lands, the numbers of Indian people, their relations with one another, and the condition of their traditional lands began to change. European diseases killed many Indian people, European animals replaced Indian animals and disrupted fields of natural plants, Europeans were guided to and then assumed control over Indian minerals, and Europeans took Indian agricultural areas. The withdrawal of Nevada lands for the use of the War Department as an aerial bombing and gunnery range in 1942 (Executive Orders No. 8578 of October 1940, and No. 9019 of January 12, 1942) and later the final land withdrawal of February 12, 1952 (Public Law Order 805), for use by the Atomic Energy Commission, continued the process of Euroamerican encroachment on these Indian lands. Pollution and destruction followed in the form of bombs and atomic testing, thus causing some places to become unusable again for Indian people. On the other hand, many places were protected by this land withdrawal because pothunters were kept from stealing artifacts from rock shelters and European animals were kept from grazing on Indian plants. The forced removal of Indian people from the NTS lands was combined with their involuntary registration and removal to distant reservations in the early 1940s. Indian people were thus removed from lands that had been central in their lives for thousands of years.

Despite the pollution and destruction of some cultural resources and the physical separation from the NTS and neighboring lands, the Indian people continue to value and recognize the central role of these lands in their continued survival. Recognizing this continuity in traditional ties between the NTS and Indian people, in 1985 the DOE began long-term research involving the inventory and evaluation of American Indian cultural resources in the area. This research was designed to comply with the American Indian Religious Freedom Act, which specifically reaffirms the First Amendment of the United States Constitution's rights of American Indian people to have access to lands and resources essential in the conduct of their traditional religion. These rights are exercised not only in tribal lands but beyond the boundaries of a reservation (Stoffle et al., 1994b).To reinforce their cultural affiliation rights and to prevent the loss of ancestral ties to the NTS, 17 Tribes and Organizations have aligned themselves together to form the CGTO. This group is formed by officially appointed representatives who are responsible for representing their respective tribal concerns and perspectives. The CGTO has established a long-standing relationship with the DOE. The primary focus of the group has been the protection of cultural resources. The DOE and the CGTO have participated in cultural resource management projects, including the Yucca Mountain Project (Stoffle 1987; Stoffle et al., 1988a; 1989a; 1990a), and the Underground Weapons Testing Project (Stoffle et al., 1994b). These studies are used in this report, along with the collective knowledge of the CGTO, as the basis of the comments in this NTS EIS.

The cultural resource management projects sponsored by the DOE have been extremely useful for expanding the inventory of American Indian cultural resources beyond the identification of archaeological remains and historic properties. To date, 107 plant and more than 20 animal species present on the NTS have been identified by Indian elders as part of their traditional resources. These plant and animal species are discussed in the following sections (see Table 4-38, Traditional-Use Plants and Table 4-39, Traditional-Use Animals).

<u>Mercury Valley</u>—The CGTO knows that the Mercury Valley hydrographic area contains a wide range of important cultural resources, including plants, animals, and archaeology sites. This knowledge comes from frequent visits by the CGTO members to this area. Observed plants in this valley include Indian ricegrass (Oryzopsis hymenoides), prince's plume (Stanleya pinnata), yucca (Yucca Baccata), and sacred datura (Datura meteloides). These plants represent sources of food, fiber, and medicine. Some important animal resources are rabbit, turtle, coyote, and chuckwalla. These and other Indian cultural resources found in Mercury Valley were and continue to be critical in the lives and culture of Indian peoples. No systematic American Indian studies have been conducted in Mercury Valley; therefore, at this time, it is not possible to completely assess the cultural significance of this area.

<u>Rock Valley</u>—The CGTO knows that the Rock Valley hydrographic area contains a wide range of important cultural resources, including plants, animals, archaeology sites, and minerals. One formal American Indian plant study involving elder Indian plant experts was conducted in Rock Valley as part of the Yucca

Table 4-38. American Indian traditional-use plants present in the NTS area
(Page 1 of 4)

Scientific Name	Common Name	GC[a] UTTR[b]	YM[c]	PM[d]/RM[e]
Ambrosia dumosa	*White bursage*	X		
Amelanchier utahensis	*serviceberry*		X	
Amsinckia tesselata	*fiddleneck*		X	
Anemopsis californica	*yerba mansa*		X	
Arabis pulchra	*wild mustard*		X	
Artemisia ludoviciana	*sagebrush, wormwood*	X	X	
Artemisia nova	*black sagebrush*	X		X
Artemisia tridentata	*big sagebrush*		X	X
Atriplex canescens	*four-winged saltbush*	X		
Atriplex confertifolia	*shadscale*		X	
Brodiaea pulchella	*desert hyacinth*		X	
Calochortus bruneaunis	*sego lily*			X
Calochortus flexuosus	*mariposa lily*		X	
Carex spp.	*sedge*	X		
Castilleja chromosa	*Indian paintbrush*		X	
Castilleja martinii	*narrowleaf paintbrush*			X
Ceratoides lanata	*winterfat*			X
Chenopodium fremontii	*Fremont goosefoot*			X
Chrysothamnus nauseosus	*rabbitbrush*	X	X	X
Cirsium mohavense	*desert thistle*		X	
Coleogyne ramosissima	*black brush*		X	
Coryphantha vivipara var. desertii	*fishhook cactus*	X	X	
Coryphantha vivipara var. rosea	*foxtail cactus*			X
Datura meteloides	*jimsonweed*	X	X	
Descurainia pinnata	*tansy mustard*		X	
Distichlis spicata	*salt grass*		X	
Echinocactus polycephalus	*cotton-top cactus*		X	
Echinocereus englemannii	*hedge hog cactus*	X	X	
Eleocharis palustris	*spikerush*			X

Table 4-38. American Indian traditional-use plants present in the NTS area (Page 2 of 4)

Scientific Name	Common Name	GC[a] UTTR[b]	YM[c]	PM[d]/RM[e]
Elymus elymoides	*squirrel tail*			X
Encelia virginensis var.actonii	*brittlebush*		X	
Ephedra nevadensis	*Indian tea*	X	X	X
Ephedra viridis	*Indian tea*		X	X
Eriastrum eremicum	*desert eriastrum*			X
Eriogonum inflatum	*desert trumpet*		X	
Erodium cicutarium	*herringbill*			X
Euphorbia albomarginata	*rattlesnake weed*		X	X
Geastrum spp.	*earthstar*		X	
Gilia inconspicua	*gilia*			X
Grayia spinosa	*spiny hop sage*			X
Gutierrezia microcephala	*matchweed*	X	X	
Juncus mexicanus	*wire grass*		X	
Juniperus osteosperma	*juniper, cedar*	X	X	X
Krameria parvifolia	*range ratany*		X	
Larrea tridentata	*creosote bush, greasewood*	X	X	
Lewisia rediviva	*bitter root*			X
Lycium andersonii	*wolfberry*	X	X	
Lichen	*lichen*		X	X
Lycium pallidum	*wolfberry*		X	
Menodora spinescens	*spiny menodora*		X	
Mentzelia albicaulis	*desert corsage*		X	X
Mirabilis multiflora	*four o'clock*	X		X
Nicotiana attenuata	*coyote tobacco*			X
Nicotiana trigonophylla	*Indian tobacco*	X	X	
Opuntia basilaris	*beavertail cactus*	X	X	
Opuntia echinocarpa	*golden cholla cactus*		X	
Opuntia erinacea	*Mojave prickly pear*	X	X	
Opuntia polycantha	*grizzly bear cactus*			X

Table 4-38. American Indian traditional-use plants present in the NTS area
(Page 3 of 4)

Scientific Name	Common Name	GC[a] UTTR[b]	YM[c]	PM[d]/RM[e]
Orobanche corymbosa	*broomrape, wild asparagus*			X
Oryzopsis (Stipa) hymenoides	*Indian ricegrass*	X	X	X
Penstemon floridus	*Panamint beard tongue*			X
Penstemon pahutensis	*Pahute beard tongue*			X
Peraphyllum ramosissimum	*squawapple*		X	
Phragmites australis	*cane, reed*	X	X	
Pinus monophylla	*pinyon pine*		X	X
Prosopis glandulosa	*mesquite*	X	X	
Prosopis pubescens	*screwbean*		X	
Psorothamnus polydenius	*dotted dalea*		X	
Purshia glandulosa	*buckbrush*		X	
Purshia mexicana	*cliffrose*			X
Purshia tridentata	*buckbrush*			X
Quercus gambelii	*scrub oak*		X	X
Rhus aromatica	*skunkbush, sumac*			X
Rhus trilobata var. anisophylla	*squawbush*		X	
Rhus trilobata var. simplicifolia	*squaw bush*	X	X	
Ribes cereum	*white squaw currant*			X
Ribes velutinum	*desert gooseberry*			X
Rosa woodsii	*woods rose*			X
Rumex crispus	*curly dock, wild rhubarb*		X	
Salix exigua	*willow*	X	X	
Salix gooddingii	*black willow*	X	X	
Salsola iberica	*Russian thistle*	X		X
Salvia columbariae	*chia sage*		X	
Salvia dorrii	*purple sage, Indian tobacco*	X	X	
Sarcobatus vermiculatus	*greasewood*	X		
Sisymbrium altissimum	*tumbling mustard*			X
Sphaeralcea ambigua	*globe mallow*	X	X	X

Table 4-38. American Indian traditional-use plants present in the NTS area
(Page 4 of 4)

Scientific Name	Common Name	GC/[a] UTTR[b]	YM[c]	PM[d]/RM[e]
Stanleya pinnata	*Prince's Plume*	X	X	X
Stephanomeria sp. spinosa	*spiny wire lettuce, gum bush*		X	X
Stipa speciosa	*bunchgrass*		X	
Streptanthella longirostris	*wild mustard*		X	
Streptanthus cordatus	*wild mustard*		X	
Suaeda torreyana	*seepweed*		X	
Symphoricarpos longiflorus	*snowberry*		X	
Symphoricarpos spp.	*snowberry*			
Tessaria sericeae	*arrowweed*	X	X	
Thamnosma montana	*turpentine bush*	X	X	
Thelypodium integrifolium	*wild cabbage*		X	
Typha domingensis	*cattail*		X	
Typha latifolia	*cattail*	X	X	
Veronica anagallis-aquatica	*speedwell*		X	
Vitis arizonica	*wild grape*	X	X	
Xylorhiza tortifolia	*desert aster*		X	
Yucca baccata	*banana yucca*	X	X	X
Yucca brevifolia	*Joshua tree*		X	
Yucca spp.	*yucca*		X	
Yucca schidigera	*Mojave yucca, Spanish bayonet*		X	

[a] Colorado River Corridor
[b] Utah Test and Training Range
[c] Yucca Mountain
[d] Pahute Mesa
[e] Rainier Mesa.

NOTE: American Indian traditional-use plants present in the NTS area are identified in the project reports entitled American Indian Plant Resources in the Yucca Mountain Area, Nevada (Stoffle et al., 1994b) and American Indian Cultural Resources on Pahute and Rainier Mesas, NTS. This table includes traditional-use plants identified in the Colorado River Corridor Study and in the Utah Test and Training Range Study that are also present at the NTS.

Table 4-39. American Indian traditional-use animals present at the NTS

Scientific Name	Common Name
Alectoris chukar	*chukar*
Ammospermophilus leucurus	*white-tailed antelope squirrel*
Amphispiza bilienata	*black-throated sparrow*
Aquila chrysaetos	*golden eagle*
Buteo jamaicensis	*red-tailed hawk*
Callipepla gambelii	*Gambel's quail*
Canis latrans	*coyote*
Cicadidae spp.	*cicada*
Cnemidophorus tigris	*western whiptail lizard*
Canis latrans	*coyote*
Colaptes auratus	*northern flicker*
Crotalus spp.	*rattlesnake*
Eutamias dorsalis	*cliff chipmunk*
Felis concolor	*mountain lion*
Felis rufus	*bobcat*
Formicidae formicinae	*mound-building ant (red and black ant)*
Gopherus agassizii	*desert tortoise*
Haliaeetus leucocephalus	*bald eagle*
Odocoileus hemionus	*mule deer*
Ovis canadensis	*bighorn sheep*
Sauromalus obesus	*chuckwalla*
Spizella breweri	*Brewer's sparrow*
Stagmomantis spp.	*praying mantis*
Sylvilagus spp.	*cottontail*
Vulpes velox	*kit fox*
Zenaida macroura	*mourning dove*

NOTE: American Indian traditional-use animals are identified in the project report entitled American Indian Cultural Resources on Pahute and Rainier Mesas, NTS (Stoffle et al., 1994b). This table presents only a partial list of traditional-use animals present at the NTS. To date, no systematic or extensive animal studies have been conducted at the NTS.

Mountain Project. A total of 32 medicine and food plants in upper Rock Valley were identified as part of the Yucca Mountain Project ethnobotany study (Stoffle et al., 1989b).

Another 10 traditional-use plants were identified at the northeast base of Little Skull Mountain near the divide between Rock Valley and Jackass Flats (Stoffle et al., 1988a). Some of the important animals in the valley include rabbit, turtle, coyote, and whiptail lizard, which were used for food, ceremony, and eye surgery.

Systematic American Indian studies of animals and archaeology have not been conducted in Rock Valley; therefore, a complete assessment of the cultural significance of this area is not possible at this time.

Fortymile Canyon-Jackass Flats—The CGTO knows that the Fortymile Canyon and Jackass Flats hydrographic area contains a wide range of important cultural resources, including plants, animals, archaeology sites, minerals, and power places. Three formal plant studies were conducted in this area as part of the Yucca Mountain Project, which identified 13 traditional-use plants (Stoffle et al., 1988a). Fifteen formal ethnoarchaeological studies were conducted in this area as part of the Yucca Mountain Project, which identified numerous archaeological resources in this area, dating as early as Clovis (10,000 years ago) (Stoffle et al., 1989a). Also present in this area are important minerals, which were extracted by Indian people to make tools and other stone artifacts. Traditional quarry sites and localities are associated with these mineral resources. At least one power place, known to be associated with Indian ceremonies, is located in this area. Fortymile Canyon is well known among Indian people who continue to use either its traditional Shoshone name Dogowya Hunumpi (Snake Wash) or the Owens Valley name Towahonupi (Snake Canyon) to describe it. The canyon was a significant crossroads where numerous traditional Indian trails from distant places like Owens Valley, Death Valley, and the Avawatz Mountains came together (Stoffle et al., 1989a). While many American Indian studies have been conducted in this area, other cultural resources have not been systematically studied. Other needed studies include rock art (which is called in Southern Paiute tumpituxwinap or literally "storied rocks" [Stoffle et al., 1995]), power places, and animals.

Buckboard Mesa—The CGTO knows that the Buckboard Mesa hydrological area contains a wide range of important cultural resources including plants, animals, archaeology sites, minerals, and power places. Two ethnoarchaeology site visits have been conducted in this area. One study was focused on a power rock and a series of petroglyph panels located at the southern end of Buckboard Mesa (Stoffle et al., 1994b), and the second study included a visit to rock shelters containing obsidian nodules, artifacts, and Indian rock paintings. To the north of Buckboard Mesa is an extensive area of obsidian nodules that were significant in many ways to Indian people. Scrugham Peak, a volcanic cone, was preliminarily identified by Indian people as a place of traditional power and ceremony. A full cultural assessment of this place and its role in the Buckboard Mesa area awaits systematic American Indian Traditional Cultural Property studies. While some American Indian studies have been conducted in this area, only a few archaeology sites have been assessed. There have been no systematic studies of plants, animals, and Traditional Cultural Properties.

Oasis Valley—The CGTO knows that the Oasis Valley hydrographic area is a part of the agricultural core area of a much larger Indian district called Ogwe'pi *by the Indian people who used this farming, gathering, and medicine area. The cultural significance of the* Ogwe'pi *District is well-established by document research (Stoffle et al., 1989a), one plant area study, and one archaeology study area (Stoffle et al., 1994b) and by interviews conducted during the 1930s. According to Indian people interviewed in the 1930s (Steward, 1938), the* Ogwe'pi *District contained agricultural lands next to springs and streams in Oasis Valley itself, while the uplands formed by nearby mountains contributed pine nuts and deer to the diet of the Indian people (Stoffle et al., 1990b). The* Ogwe'pi *District was an important place for Indian trade and ceremonialism. Mineral hot springs were used by Indian people for curing, thus further increasing the cultural importance of the Oasis Valley core area. During much of the historic period, Indian people continued to live in Oasis Valley and use the surrounding uplands of the* Ogwe'pi *District. Much of the Oasis Valley hydrological basin has not been systematically studied by American Indian people. Therefore, at this time, it is not possible to fully assess the cultural significance of all places in the Oasis Valley.*

Gold Flat—The CGTO knows that the Gold Flat hydrographic area contains a wide range of important cultural resources including plants, archaeology sites, and power places. This conclusion is based on American Indian studies conducted along the central and northern portions of Pahute Mesa. These studies identified 42 species of Indian plants found in this area (Stoffle et al., 1994b). American Indian archaeological studies in this area document the presence of living areas, food and tool processing areas, burial sites, and power places. Initial animal studies indicate the presence of culturally significant species, such as hawks and eagles. At this time, it is not possible to make a full cultural assessment of this hydrological area because only the Pahute Mesa has been studied, and additional studies are planned to assess rock art and traditional cultural properties.

Kawich Valley—The CGTO knows that the Kawich Valley hydrological area contains a wide range of important Indian cultural resources, including plants, animals, archaeology sites, and places of both power and ceremony. This knowledge comes from a series of systematic American Indian studies on Pahute Mesa regarding plants and animals and by selected observations by individual Indian people. A total of 42 plants were identified from 6 plant locations, 36 of which are still used today (Stoffle et al., 1994b). Interviews with Indian experts about animals indicated a number of culturally significant species, including hawks and eagles, and a unique species of ant valued as both food and medicine. Archaeological studies at sites indicate the presence of living areas and places where food and plants were processed (Stoffle et al., 1994b). Kawich Valley contains an important trail used within the current memory of Indian people. Members of the Kawich family visited this area and recounted family memories of Kawich Valley and the use of the Pahute Mesa. Individual Indian people identified places in Gold Meadows where places of power and ceremony traditionally occurred, but no systematic interviews on this issue have been conducted. The CGTO has recommended that the Gold Meadows area be set aside for special protection and use by Indian people because of the concentration and variety of Indian cultural resources it contains (see Appendix G containing EIS-American Indian Meeting Report April, 1995). The cultural significance of the entire Kawich Valley hydrological area cannot be assessed at this time because studies have been limited to Pahute Mesa and because both Traditional Cultural Property and animal studies are planned for the area.

Emigrant Valley—The CGTO knows that the Emigrant Valley hydrological area contains a wide variety of important cultural resources, including plants, animals, and archaeology sites, because it is next to Gold Meadows and Rainier Mesa areas (Stoffle et al., 1994b). Indian people have requested access to this area but have not been permitted to either visit or conduct systematic interviews here; therefore, all current information about this area derives from recorded and unrecorded Indian oral history. It is known that an Indian man who received the Anglo name Panamint Joe Stuart was from the Belted Range, which is the western boundary of the Emigrant Valley (Steward, 1938). Steward's Indian interviews conducted in the 1930s indicated that in the late 1800s there were 15 known locations of Indian camps in the Belted Range (Steward, 1938). Steward's interviews revealed that the Indian people of these Belted Range villages associated with the Indian people in the Kawich Range to the east and the Beatty people to the southwest. These data support the tentative conclusion of the CGTO that the two valleys have similar levels of cultural significance. No systematic Indian studies have been conducted in Emigrant Valley, so a complete cultural assessment is not possible at this time.

Yucca Flat weapons test basin—The CGTO knows that the Yucca Flat weapons test basin hydrological area contains a wide variety of culturally important Indian resources including plants, animals, archaeology sites, rock paintings, and ceremonial areas. Systematic American Indian studies have been conducted along the southern rim and base of Rainier Mesa, in the Eleana Range, on the northeastern flank of Shoshone Mountain, and along the western edge of Yucca Flat weapons test basin itself. Plant studies indicate that 2 species are located in the more arid lowlands, 13 species at Tippipah Spring, 21 species at Captain Jack Spring, 11 species at White Rock Spring, and 4 species on the mesa rim (Stoffle et al., 1988a). The few interviews with Indian people about animals observed in this area do indicate that many significant animals are present, including mountain lion, deer, and hawks. The area is archaeologically complex with major camps located at permanent springs and food and tool processing places scattered throughout the area. All the springs in this area were permanent Indian camps. White Rock Spring, Toshatimbibah, *had a major settlement called* Tunava *in the late 1880s and was a central place for interethnic gatherings. Indian people came to these ceremonies from distant communities. These ceremonies included major annual rabbit drives and dances that lasted up to a month (Steward, 1938). This spring was the home of a regional chief whose name was* Wangagwana *(Steward, 1938). The White Rock Spring was occupied by Indian people until the 1930s and used until the mid-1950s after the NTS was officially withdrawn from public use. The cultural significance of the western portion of this hydrological area is well established; however, no studies have been conducted in the central, eastern, and southern portions of this area. Because additional American Indian studies are planned and some areas have not been studied, a full cultural assessment of this area is not possible at this time.*

Frenchman Flat—The CGTO knows that the Frenchman Flat hydrological area contains a wide variety of plants, animals, and archaeology sites of cultural importance to Indian people. Systematic studies of both plants and archaeology sites have been conducted in the west-central portion of this area. A total of 20 plant species were identified at 2 plant study locations, with 2 species identified on a flat area near the eastern flank of Mt. Sayler and another 18 species identified at Cane Spring (Stoffle et al., 1988a). A complete cultural assessment of this area is not possible at this time because past studies were geographically and topically restricted.

CULTURAL RESOURCES, AREA 13—Area 13 lies in the southern Great Basin, an area with a prehistory that may span the past 10,000 years or more. Properties ranging from the early prehistoric period to historic mining and ranching sites are found in the region. Archaeological research in the vicinity of Area 13 has been extremely limited. This limitation makes characterization of the cultural resources extremely difficult. Archaeological reconnaissance in the area includes a survey of three soil test units (Beck, 1993) in Emigrant Valley, a Class II cultural resources reconnaissance of the entire Groom Range (Reno and Pippin, 1986), and Class II survey of the Nellis Air Force Bombing and Gunnery Range (Bergin et al.,1979). Because these surveys only sampled this large area, it is likely that additional undiscovered resources occur within the project area.

At the time of contact with Euroamericans in the mid-1800s, the area was used by bands of Western Shoshone people centered around the Belted and Kawich Mountain Ranges (Steward, 1938) and by Southern Paiutes centered in the Pahranagat Valley (Fowler and Fowler, 1971). The project area lies adjacent to the boundary between these two groups. Ethnographic studies have focused on the central areas within these two districts, thus little is known about the interaction of these groups along the frontier of their tribal boundaries. Therefore, this region is important archaeologically.

An area of potential effect for the cultural resources in the Area 13 region is based on research performed in the area for three proposed test units for soil treatability studies. The site is on the NAFR Complex within the Emigrant Valley, adjacent to the northeast corner of the NTS. Emigrant Valley is bounded by the Halfpint Range to the south and southwest, the Belted Range to the northwest, and the Groom Range to the northeast (State of Nevada Engineer's Office, 1974).

RECORDED CULTURAL RESOURCES—Few sites have been recorded directly within the area of potential effect for Area 13. Five sites, one temporary camp, and four processing localities (Brooks et al., 1978) have been identified in the general vicinity. In the same year, the University of Nevada, Las Vegas recorded four more processing localities (Jenkins, 1978). As part of the Nellis Air Force Base Bombing and Gunnery Range survey, two of the previously mentioned sites were relocated, and two more processing localities were found. Other surveys for roads and fencelines identified more sites. Three are temporary camps, three are extractive localities, seven are processing localities, and one is a mining area (Clerico, 1978; Steinberg, 1980; Bunch, 1984).

The most extensive cultural resource reconnaissance work in the project area was conducted by the Desert Research Institute as part of a 6 percent sample survey of the Groom Range (Reno and Pippin, 1986). A total of 160 sites were recorded during this survey, including 30 temporary camps, 17 extractive localities, 63 processing localities, and 53 localities. This sample provides a background against which predictive models may be generated. Similar types of sites may be expected in Area 13, although frequencies may be quite different. Many of these sites have been recommended as eligible for listing on the National Register of Historic Places.

SITES OF AMERICAN INDIAN SIGNIFICANCE—The CGTO knows that Area 13 contains significant cultural resources, including plants, animals, archaeology sites, and places of historic value to Indian people. This is known from Indian interviews conducted in the 1930s (Steward, 1938) and recent plant, animal, and archeology studies conducted south of this area in comparable environments (Stoffle et al., 1990a; Stoffle et al., 1994b). These studies document long-term and extensive involvement of Indian people in these traditional lands. These were among the last areas lived in before Indian people were forced out of the area to live on more distant Indian reservations. As a result of oral history, Indian people know there are various types of cultural resources located in this study area, but *cannot provide site-specific information about these areas at this time. No Indian people officially representing the CGTO have visited Area 13 or any other portion of the NAFR Complex, although such interviews have been requested and one initial meeting with a NAFR Complex archaeologist has occurred. Therefore, it is not possible to fully assess the cultural significance of Area 13 at this time.*

4.1.11 Occupational and Public Health and Safety/Radiation

The health and safety of site workers and the general public is discussed in this section. In addition, a brief discussion of the NTS health and safety program is presented.

OVERVIEW—The potential for activities at the NTS to impact the health and safety of the general public is minimized by a combination of the remote location of the NTS, the sparse population surrounding it, and a comprehensive program of administrative and design controls.

Visitors to the NTS, including individuals and tour groups, are subject to essentially the same safety and health requirements as workers. Safety briefings are provided as appropriate (e.g., tunnel entry), personal protective equipment is provided when necessary, and radiation dosimeters may be issued along with badges as part of the visitor-control process. Visitors may request radiation dosimeters even though none might be required in the areas visited. Secondary access control is provided when necessary for safety or security reasons. Access to areas of the NTS where working conditions require special hazard controls (e.g., the Radioactive Waste Management Sites) is restricted through the use of signs, fences, or barricades.

The health and safety of NTS workers is protected by adherence to the requirements of federal and state law, DOE orders, and the plans and procedures of each organization performing work on the NTS. A program of self-assessment for compliance with these requirements is conducted by each of the Maintenance and Operations contractors and by the DOE. In addition, workers are protected from the specific hazards associated with their jobs by training, monitoring the workplace environment, using personal protective equipment, and using administrative controls to limit their exposures to radioactive or chemical pollutants. Worker access to areas of the NTS that present working conditions requiring special hazard control is restricted through the use of signs, barriers, and fences, as appropriate.

CRITERIA—All work at the NTS is performed according to the safety and health requirements of the Occupational Safety and Health Administration as codified in Title 29 CFR Parts 1910 and 1926. The DOE orders also provide direction for worker safety and health programs (see Appendix C).

To integrate the activities of a number of contractors and NTS users and to avoid discontinuities in the health and safety program, the NTS is operated under the standard operating procedures of the NTS Operations. The relevant procedures include the following NTS standard operating procedures:

- 5401 Environment, Safety, and Health Coordination Responsibilities (DOE, 1990)
- 5402 Radiological Safety (DOE, 1995b)
- 5409 Management of Hazardous Materials and Hazardous Wastes (DOE, 1993)
- 5410 Industrial Hygiene (DOE, 1995c)
- 5411 Nuclear Criticality Safety (DOE, 1995d)
- 5412 Explosive Safety (DOE, 1995e)
- 5415 Safety and Fire Responsibilities (DOE, 1991).

Procedures relevant to specific aspects of the nuclear testing program are also part of the standard operating procedures of the NTS Operations.

INSTITUTIONAL SAFETY PROGRAMS—The NTS supports the following on-site safety services provided by the Maintenance and Operations contractor and available to all users:

- Fire department

- Occupational medicine department
- Radiological safety services, including a radioactive material control to ensure that material leaving the NTS is not contaminated
- Industrial hygiene services.

Workers at the North Las Vegas Facility may be exposed to other hazards in the workplace. Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. Workers are also protected by strict adherence to federal standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in facility processes, ensures that these standards are not exceeded. The North Las Vegas Facility stores and uses few hazardous materials in amounts greater than the threshold planning quantities that require reporting under federal regulations.

RADIOLOGICAL HEALTH—The *Nevada Test Site Annual Site Environmental Report-1993* (Annual Site Environmental Report) (DOE/NV, 1994a) provides ambient exposure levels at numerous locations on the NTS. The Annual Site Environmental Report contains detailed information regarding ongoing radiological monitoring at the NTS and also provides some information regarding safety shots conducted on the NAFR Complex (Area 13).

Radiation exposure levels of the NTS indicate that during 1993, exposure rates varied on the NTS from 90 to 4,300 milliroentgen (mR)/yr. A group of locations that were not, to the best available knowledge, influenced by radiological contamination served as control areas for the NTS and on parts of the NAFR Complex and Tonopah Test Range. The average exposure rate from all of these control areas was 0.36 mR/day or 131 mR/yr. A complete listing of all of the exposure measurements can be found in Volume 2 of the Annual Site Environmental Report.

The North Las Vegas Facility provides calibration services using specialized radiation fields for a variety of instrument test packages in support of the DOE/NV operations. Based on operating data for the year 1993, workers at the North Las Vegas Facility received an average radiation dose of 82 millirem per year, and the maximally exposed worker received a dose of 440 millirem. The worker population received a collective dose of 0.57 roentgen equivalent man (rem) which would result in a risk of 2.3×10^{-4} of a single fatal cancer in the worker population. These doses are in addition to natural background radiation which would contribute about 300 millirem per year to each individual and a collective dose of about 2.1 rem to the worker population (based on seven monitored workers).

RADIOLOGICAL EFFLUENTS—Radiological effluent in the form of air emissions and liquid discharges is released as a routine part of operations on the NTS. Radioactivity in liquid discharges released to on-site waste treatment or disposal systems (containment ponds) is monitored to assess the efficacy of treatment and control and to provide a quantitative and qualitative annual summary of released radioactivity. Air emissions are monitored for source characterization and operational safety, as well as for environmental surveillance purposes.

Environmental surveillance on the 3,496-km^2 (1,350-mi^2) NTS is designed to cover the entire area, with emphasis on areas of past nuclear testing and present operational activities. In 1994, there were 54 samplers collected for air particulate and reactive gases, 19 samplers collected for tritiated water vapor in atmospheric moisture, and 10 samplers collected for air for analysis of noble gas content. Grab samples were collected frequently from springs, water supply wells, open reservoirs, containment ponds, and sewage lagoons. Thermoluminescent dosimeters were placed at 201 locations on the NTS.

Data from these networks are summarized as annual averages for each monitored location. Locations with concentrations above the NTS average are assumed to reflect on-site emissions. These emissions arise from diffuse (areal) sources and from particular operational activities (e.g., radioactivity buried in the low-level waste site).

Approximately 2,700 air samples were analyzed by gamma spectroscopy. All isotopes detected by gamma spectroscopy were naturally occurring in the environment (potassium-40, beryllium-7, and members of the uranium and thorium series), except for fixed instances where very low levels of cesium-137 were detected. A slightly higher average was found in samples in certain areas, but that level was calculated to be only 0.01 percent of the Derived Air Concentration Guide for exposure to the public.

Surface water sampling was conducted quarterly at 12 well reservoirs, 8 springs, 1 containment pond, and 9 sewage lagoons. A grab sample was taken from each of these surface water sites for analysis of gross beta, tritium, gamma-emitters, and plutonium isotopes. Strontium-90 was analyzed once per year for each location. Water samples from the springs, reservoirs, and lagoons contained background levels of gross beta, tritium, plutonium, and strontium. Samples collected from the containment pond contained detectable levels of radioactivity, as would be expected. Water from on-site supply wells and distribution systems was sampled and analyzed for radionuclides. The supply-well average gross beta activity was 2 percent of the Derived Concentration Guide; gross alpha was 40 percent of the drinking water standard; strontium-90 was measured at about 1 percent of the Derived Concentration Guide; and plutonium-239, -240, and -238 were all below detectable levels.

External gamma radiation exposure data from the on-site thermoluminescent dosimeter network indicated that gamma exposure rates recorded during 1994 were statistically lower than the data collected in 1993. Recorded exposure rates on the NTS ranged from 54 mrem/yr in Mercury to 3,679 mrem/yr for a radioactive material storage area in Area 5. The 1994 sitewide average for boundary and control stations of 111 mrem/yr was about 23 percent lower than 1993.

RADIOLOGICAL CONTAMINATION—As discussed in previous sections, radiation-contaminated areas on the NTS, the NAFR Complex, and the Tonopah Test Range primarily resulted from safety tests that began in 1951 and continued through the early 1960s. Nuclear explosive tests conducted through the 1950s were predominantly atmospheric tests. These tests involved the detonation of a nuclear explosive device placed on the ground surface, on a steel tower, suspended from tethered balloons, or dropped from an aircraft. Several of the tests were non-nuclear; i.e., safety tests, involving destruction of a nuclear device with non-nuclear explosives. Since 1962, nearly all tests have been conducted in sealed vertical shafts drilled into the valley floor of Yucca Flat weapons test basin and the top of Pahute Mesa, or in horizontal tunnels mined into the face of Rainier Mesa. Other nuclear testing over the history of the NTS has included the BREN Tower and the nuclear ramjet experiment conducted in Area 26 by Lawrence Livermore National Laboratory. Waste disposal facilities for radioactive and mixed waste are located at Areas 3 and 5.

The *Contaminated Areas Report* published by Reynolds Electrical and Engineering Co. Inc. (1992) provides a complete listing and maps of all the identified radiation-contaminated areas on the NTS. This report also includes the contaminated areas that are found on the Tonopah Test Range and the NAFR Complex. Areas are considered contaminated if the radiation level is above background levels. A total of 235 contaminated areas exist on the NTS, the Tonopah Test Range, and the NAFR Complex. These areas are either posted and/or fenced, depending on their level of contamination. There are 135 km^2 (52 mi^2) of posted areas and 13 km^2 (5 mi^2) of fenced areas. Most of the contaminated areas on the NTS are a direct result of weapons tests. These areas include craters, mud pits, cellars, and muck piles. In addition to those areas, there are a number of other contaminated locations associated with tunneling and the tests conducted within tunnels. The bulk of the contaminated areas associated with tunnels are located in Area 12 and include such areas as contaminated muck piles, tunnel ponds, and holding areas for contaminated items exiting the tunnels.

Buildings used for the safe handling of spent nuclear rods and for nuclear rocket development from reactors are also listed as contaminated areas. These buildings, located in Area 25, include maintenance, assembly, and disassembly facilities and test cells. Other contaminated areas include a few core testing laboratories and the EPA Farm site in Area 15. Storage sites for radioactive material and wastes and for other miscellaneous sites make up the remainder of contaminated areas on the NTS. The current radionuclide content in most of the contaminated areas is fission products (predominately cesium-137) that have not totally decayed. Plutonium-239 is the other primary radionuclide appearing on the NTS.

ECOLOGICAL STUDIES—Studies conducted under programs sponsored by the DOE/NV included monitoring the plants and animals on the NTS to assess changes over time in their ecological conditions and to provide information needed to document NTS compliance with environmental laws, regulations, and orders (Hunter, 1992b, 1994b,c, 1995). The monitoring effort has been arranged into three interrelated phases of work: (1) a series of five undisturbed study plots in test-impacted ecosystems that are monitored at 1- to 5-year intervals to establish natural baseline conditions; (2) a series of study plots in representative disturbed areas that are monitored at 3- to 5-year intervals to determine impacts of disturbance, document site recovery, and investigate natural recovery processes; and (3) observations of birds and large mammals throughout the NTS.

In 1994, during the seventh full year of flora and fauna monitoring, surveys were conducted at numerous sites for perennial and ephemeral plants, mammals, and reptiles. Many of these sites included paired disturbed and undisturbed plots. Three baseline sites were monitored, and perennial and ephemeral plants were measured at all of them. Sites in disturbed areas are monitored on a 3-year cycle. Baseline measurements were also made near the Device Assembly Facility in Frenchman Flat (Woodward et al., 1995).

Monitoring of wild horses continued for the fifth consecutive year. All horses, including foals, were individually identified. Field observations were also made of raptors, mule deer, and raven in appropriate habitats throughout the NTS. Desert tortoises in the Rock Valley study enclosures were monitored in the spring and fall, and free-roaming tortoises were marked and measured when encountered by chance.

GROUNDWATER PROTECTION—The DOE/NV instituted a long-term Hydrological Monitoring Program in 1972 to be operated by the EPA under an interagency agreement. In 1994, groundwater was monitored on and off the NTS and at five sites in other states to detect the presence of any radioactivity that may be related to nuclear testing activities. No radioactivity was detected above background levels in the groundwater sampling network surrounding the NTS. Low levels of tritium, in the form of tritiated water vapor, were detected in on-site wells, as has occurred previously. None of the levels exceeded 33 percent of the National Primary Drinking Water Regulation level.

Monitoring and surveillance on and around the NTS by DOE contractors and NTS user organizations during 1994 indicated that operations on the NTS were conducted in compliance with applicable federal and DOE regulations and guidelines. All discharges of radioactive liquids remained on site in containment ponds, and there was no indication of potential migration of radioactivity to the off -site area through groundwater. Surveillance around the NTS indicated that airborne radioactivity from diffusion, evaporation of effluent, or resuspension was not detectable off site, and no measurable net exposure to members of the off-site population was detected through the off-site dosimetry program.

OFF-SITE ENVIRONMENTAL SURVEILLANCE—The off-site radiological monitoring program has been conducted around the NTS since 1992 by the EPA's Environmental Monitoring Systems Laboratory, Las Vegas, under an interagency agreement with the DOE. Prior to 1972, monitoring was performed by the U.S. Public Health Service. The objectives of the Off-Site Environmental Surveillance Program are to assure nearby residents of the safety of the air and water, to provide a long-term environmental baseline, and to detect contamination from DOE activities, if present." This program consists of several extensive environmental sampling, radiation detection, and dosimetry networks.

For the first three quarters of 1994, the Air Surveillance Network was made up of 30 continuously operating sampling locations surrounding the NTS, and 77 standby stations (operated 1 week each quarter) in all states west of the Mississippi River. The 30 Air Surveillance Network stations included 18 located at Community Radiation Monitoring Program stations described below. During 1994, no airborne radioactivity related to current activities at the NTS was detected on samples from the Air Surveillance Network.

The Noble Gas and Tritium Surveillance Network initially consisted of 21 off-site noble gas samplers (8 on standby) and 21 tritium-in-air samplers (7 on standby) located outside the NTS, in associated and exclusion areas, and in Nevada, California, and Utah. During 1994, no radioactivity that could be related to NTS activities was detected at these sampling stations.

The Milk Surveillance Network consisted of 24 sampling locations within 244 km (186 mi) of the NTS and 115 standby Milk Surveillance Network locations throughout the major milk sheds west of the Mississippi River. The levels of analytes in both milk networks have decreased over time since reaching a maximum in 1964. The results from these networks are consistent with previous data.

Other foods were analyzed regularly; most of this food was meat from domestic or game animals collected on and around the NTS. The strontium-90 levels in samples of animal bone remained very low, as did plutonium-239 and -240 in both bone and liver samples. Beets and apples from several off-site locations contained normal potassium-40 activity. Small amounts of plutonium-239, -240, and -238 were found on a few samples.

In 1994, external exposure was monitored by a network of 127 thermoluminescent dosimeters and 27 pressurized ion chambers. The ion chamber network in the communities surrounding the NTS indicated that background exposures, ranging from 73 to 164 mrem/yr, were consistent with previous data and well within the range of background data in other areas of the United States.

Sampling of Long-Term Hydrological Monitoring Program wells and surface waters around the NTS showed only background radionuclide concentrations. The program also included groundwater and surface-water monitoring at locations in Colorado, Mississippi, New Mexico, Alaska, and Nevada where underground tests were conducted.

A network of 18 Community Radiation Monitoring Program stations is operated by local residents. Each station was an integral part of the Air Surveillance, the Noble Gas and Tritium Surveillance, and the Thermoluminescent Dosimeter networks. In addition, the stations are equipped with a pressurized ion chamber connected to a gamma-rate recorder. Samples and data from these Community Radiation Monitoring Program stations were analyzed and reported by Environmental Monitoring Systems Laboratory, Las Vegas, and interpreted and reported by the Desert Research Institute, University of Nevada system. All measurements for 1994 were consistent with previous years and were within the normal background range for the United States.

No radioactivity attributable to current NTS operations was detected by any of the off-site monitoring networks. However, based on the NTS releases reported, atmospheric dispersion model calculations indicated that the maximum potential effective dose equivalent to an off-site individual would have been 0.0038 rem, and the dose to the population within 80 km (50 mi) of the emission sites would have been 0.012 person-rem. The hypothetical person receiving this dose would also have been exposed to 97.0 rem from natural background radiation.

In North Las Vegas, radiation doses to the public as a result of routine operations at the North Las Vegas Facility are too low for measurement. Two very small atmospheric releases of radioactivity occurred in 1995. Calculated doses to the public from these releases are estimated to be a fraction of one millirem and are well within regulatory limit of 10 millirem/year for the airborne pathway. These calculated doses are in addition to natural background radiation of about 300 millirem per year per person.

<u>American Indian Perceived Risks</u>—Indian people believe that various perceived risks are present and occur as a result of DOE activities. Although there are no Indian words for terms such as radiation *in the Indian language, early ethnographic studies supported by the DOE, documented a traditional view of radioactivity which centers on the perception by Indian elders of radiation being produced by an* angry rock *(Stoffle, et al., 1989a). Briefly this view is as follows:*

> *Rocks have power. It is recognized that some rocks have more or different power than others. Breaking a rock or removing if from its place without fully explaining these actions not only releases*

the power inherent in the rock, but also angers the rock.

Rocks can also be self-willing, inasmuch as they can reveal themselves to people and act on people. Crystals, for example have a self-willing, animate power and will reveal themselves to a person whom they desire to be with. If this person picks them up, the person will have great luck. The luck, however, is taken away from others and eventually people will come to recognize this fact and single out the excessively lucky person as having used some nonhuman power at the expense of his or her people...Usually the person takes the crystal back to where it had revealed itself and returns it with an explanation of why it was being returned.

Radioactivity was interpreted as being the angry action of a powerful rock that had been quarried without its permission and had its power used for purposes it did not agree to. Now the remains of the rock (radioactive waste) is angry and it is taking its anger out on things around it. Plants, animals, people, water, and even the air itself can be hurt or even killed by the radiation from the angry rock. Indian people express the belief that past radiation releases have contaminated plants and animals traditionally used for foods and medicines. Spiritual people believe that they can see and feel radiation; it has unique colors. This is why they cannot eat nor collect some plants, animals, and minerals in some areas. It is now impossible for Indian people to go to certain places, do certain ceremonies, and eat certain foods because radiation from the angry rock has been released.

<u>Air: Living and Dead</u>—Indian people express the belief that the air is alive. There are different kinds of air with different names in Indian language. The Creator puts life into the air which is shared by all living things. When a child is born, they pull in the air to begin their life. The mother watches carefully to make sure that the first breath is natural and that there is no obstruction in the throat. It is believed that if the day of birth is a windy day, it is a good day and the child will have a good life. According to one elder:

> *The seasons - like winter, spring, summer, and fall - they're all important when a child comes into the world because their spirit is tied in with the harvest, or hunt, they say that it gets kinda like into their blood and they become hunters or farmers.*

You can listen to the wind; the wind talks to you. Things happen in nature. Our people had weather watchers, who are kinds of people who will know when crops and things should be done. They watch the different elements in nature and pray to ask the winds to come and talk about these things. Sometimes you ask the north wind to come down and cool the weather. The north wind is asked to blow away the footsteps of the people who have passed on to the afterlife. That kind of wind helps people; it is positive. The wind also brings you songs and messages. Sometimes the messages are about healing people, a sign that the sickness is gone now from the person, or that it's coming to get that sickness to take it away, or it's coming to bring you the strength that you need to deal with the illness.

But air can be destroyed by radiation that has been released by the angry rock, thus causing pockets of dead air. There is only so much alive air which surrounds the world. If you kill the living air, it's gone forever and cannot be restored. Dead air lacks the spirituality and life necessary to support other life forms. Airplanes crash when they hit dead air. One member of the CGTO compared this Indian view of killing air with what happens when a jet flies through the air and consumes all the oxygen, producing a condition where another jet cannot fly through the air. The atomic blast consumes the oxygen like the jet, killing the air. While this comparison of the western science view of dead air from burning seems close to the Indian perspective, the latter has a "life force" component that makes killing air more significant than just consuming its natural components.

Some Indian people who were present during the aboveground atomic blasts, believe that the *sickness they have today came from the radiation. To some of those people the effects of the radiation were in addition to what happened when the air itself was killed. Some elders today say, that even when the plants survive the effects of radiation, the dead air killed them or made them lose their power, their spiritual power to heal things.*

Blast Radiation—The aboveground atomic detonations were witnessed by many Indian people. Today these Indian eyewitness accounts are told with retrospective assessment of the risks that were involved by being close to the blasts and from using the natural resources in the area. Indian people continued to regularly enter the NTS to hunt and collect long after the atomic testing began. Today, the eyewitnesses are elders talking about when they were younger in the 1950s. A few of these accounts are provided in order to explain to non-Indian people the Indian perception of risk derived from these experiences.

A Western Shoshone woman, who still lives near the NTS, recounted her memories of being a young woman during the blasts. According to her:

> *After the bombs (aboveground atomic explosions), my people (Shoshone people) would kill the animals in the area and find something wrong with them. They would kill a deer, but when the hide was skinned off it would just pull apart. When they saw the mushrooms going up (atomic bomb blasts), they knew something was bad. The people (my family and others) were in the mountains picking pine nuts when one of the blasts went off; it felt like an earthquake. I was there, about 8,000 feet. The little animals ran away. The old people looked up into the swaying trees and asked what would happen to those little (bird) nests up there. We Indian people do not go up in the trees, so we will not disturb the birds.*
>
> *After some of the blasts occurred, the old people told us not to pick the pine nuts off the ground, so after that time we took the green cones from the trees. This made fewer pine nuts available to us. Lots of animals seemed different after the blasts. The migrating birds did not come through after that. The rabbits, of which we were eating a lot at that time, were not right. We developed a way to test them for sores. Many rabbits we could not even skin properly, the skin would just fall apart. The chuckwallas and tortoises disappeared, like the migrating birds. The old people told us that the plants are not maturing properly, so the tortoises and chuckwallas are dying. Both the Indian women and the Indian cattle lost their unborn children (through miscarriage) at this time.*
>
> *Many of the essential plants were affected by the blasts, either directly or because the rain would not come. Those old basket makers would say the willows were really brittle after that, they were hard and would not split easily. Even the greasewood became bad too - it is related to the tortoises and the playas (dry lakes) - the Shoshone songs sing about the tortoises and the greasewood together. The old ones would say that when the plants go away, it (what we need to live) will not be there for us anymore. So, we will go away too. One elder is remembered as saying, "What will become of us?" You know they (the elders) would talk like that when they saw what was changing around them.*

A Southern Paiute man remembered his mother (who is still living) telling him stories of the atomic blasts and their effects on plants and animals. His mother would travel with her family to hunt and gather plants. They (old Paiutes) say that the deer would come down over the Bare Mountains and collapse. People would eat other deer that they had killed for themselves, but when they tried to make clothing out of the hides, the hides would fall apart. Plants in the area don't grow as big anymore and were not preferred because they lost some of their power as food and medicine.

A Southern Paiute woman recounted the story of one of her tribal elders who personally experienced *the blasts. This elder currently lives on the Colorado River Indian Reservation hundreds of miles to the south of the NTS, thus again reinforcing the need to talk with Indian people regardless of where they live today. (Name withheld) is a 78-year-old Chemehuevi woman who lived in this area when she was young. She was here when the blasting occurred and she remembers the white flashes. She has vivid recollections of seeing all of this and now that she is older, she has cancer and is real afraid. She feels good when she comes to the NTS as part of the CGTO studies, but she is real afraid of the rocks and the plants because of what has happened. She says that what happened to them, happened to her.*

Perceptions such as these are well-known among the Western Shoshone, Southern Paiute, and Owens Valley Paiute people of this region. These perceptions of risks from radiation are frightening, and remain an important part of our lives. We will always carry these thoughts with us. Today, people are afraid of many things and places in this whole area, but we still love to come out and see our land. We worry about more radiation being brought to this land.

If the DOE wants to better understand our feelings about the impact of radiation on our cultures, they should support a study of risks from radiation designed, conducted, and produced by the CGTO. At this time there has not been a systematic study of American Indians perceptions of risk. Therefore, it's not possible to provide action by action estimation of risk perception impacts. We believe it is a topic that urgently needs to be studied so that Indian people may better address the actual cultural impacts of proposed DOE actions. There have been recent workshops funded by the National Science Foundation to understand how to research the special issue of culturally based risk perception among American Indian communities, and at least one can be more fully understood by research that deeply involves the people being considered. To understand our view of radiation is to begin to understand why we responded in certain ways to past, present, and future DOE activities.

4.1.12 Environmental Justice.

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of federal programs, policies, and activities on minority populations and low-income populations.

This section presents a summary of the demographic analysis prepared to analyze the potential impacts to low-income and minority populations affected by the programs discussed in this EIS. Demographic analysis is the first step in determining disproportionately high and adverse human health or environmental effects to low-income and minority populations. This analysis sets the stage for the impact analysis presented in Chapter 5. Demographic analysis includes defining the region of influence, census block groups, low-income populations, minority communities, and the thresholds for calculating a low-income or minority community census block group.

All program activities described in this EIS are located in Clark, Nye, or Lincoln counties. The region of influence for Environmental Justice includes these counties for this NTS EIS. The Consolidated Group of Tribes and Organizations has identified areas on the NTS and nearby lands as culturally important to the American Indian people. The American Indian region of influence for the NTS area is shown on Figure 4-48. Although many of the American Indian groups live outside Clark, Nye, and Lincoln counties, the American Indian people continue to value and recognize traditional ties to the NTS and surrounding area. In recognition of this tie, the DOE has established a relationship with the group. Specific aspects of the participation of the group in DOE cultural resource management projects are discussed in the Cultural Resources section.

Census block groups, which are clusters of blocks within the same census tracts, have been delineated for Clark, Nye, and Lincoln counties. Census block groups do not cross county or census tract boundaries, and generally contain between 250 and 550 housing units (U.S. Bureau of the Census, 1993).

For the purpose of analysis, low-income populations are individuals living within a census block group whose income is below the poverty level. Households are classified as being below the poverty level if their total family income or unrelated individual income is less than the poverty threshold specified for the applicable family size. For example, the weighted average threshold for a four-person family is $12,674 for the 1990 census. This reflects the different consumption requirements of families based on their size and composition (U.S. Bureau of the Census, 1994).

The U.S. Bureau of the Census identifies four racial classifications, including (1) white; (2) black; (3) American Indian, Eskimo, or Aleut; and (4) Asian or Pacific Islander. Hispanic is not considered a race by the U.S. Bureau of the Census; it is considered an origin. To determine the number of minorities for each census block group for the purpose of analysis, the white race category less whites of Hispanic origin were subtracted from the total census block group population (U.S. Bureau of the Census, 1994).

Within each census block group for each county, percentages were calculated of low-income and minority communities. The denominator used was the tricounty total 1990 population of 763,015. To determine whether a census block group percentage was meaningfully larger than other census block group percentages, thresholds (the average absolute deviation from the mean) for low-income and minority communities were determined. If a census block group percentage was larger than the threshold, it was considered a low-income or minority community census block group and was appropriately shaded. This methodology was chosen to avoid designating a large census block group as low-income or minority when its population is extremely low. For example, a 3,126-km^2 (1,207-mi^2) census block in Nye County had a population count of 51 in 1990. The total number of people under the poverty line was 23. With some methodologies, this entire large census block group would be designated a poverty area and would have been shaded.

Clark County is subdivided into 318 census block groups. Ninety-one of the census block groups are made up of low-income populations (Figure 4-49). The 57 census block groups that constitute minority communities are also illustrated.

Nye County is divided into 25 census block groups. One of these census block groups has low-income communities above the threshold level percentage, and none has minority communities. Lincoln County contains eight census block groups. No census block groups have low-income or minority communities above the threshold level percentage (Figure 4-50).

Using a Geographic Information System, the transportation routes discussed in Appendix I were layered over census block groups shown in Figures 4-49 and 4-50. The Geographic Information System indicated the total mileage of transportation routes and how many miles of these routes traveled through areas of minority and/or low income populations. Less than 2 percent of the routes in Clark County and 0.02 percent of the routes in Nye County travel through areas of low income or minority populations.

4.2 Tonopah Test Range

The Tonopah Test Range comprises 1,616 m^2 (624 mi^2) and has been used by the DOE since the early 1950s. The facility is surrounded on three sides by the NAFR Complex and to the north by the U.S. Bureau of Land Management's open range. The town of Tonopah is located 32 km (20 mi) northwest of the main gate of the Tonopah Test Range and is approximately 241 km (150 mi) northwest of Las Vegas.

Sandia National Laboratories has been the facility operator and site manager of the facility since it was established. The laboratory facilities support their mission in stockpile stewardship, as well as research and design of new weapons and weapon components. The facility offers a unique test bed for testing DOE and DoD weapons. The DOE in the early 1960s conducted several safety-related tests on nuclear weapons, resulting in surface soil contamination of three sites (Clean Slates I, II, and III) that have been managed appropriately since the program.

The existing environmental conditions of the Tonopah Test Range are described in this section.

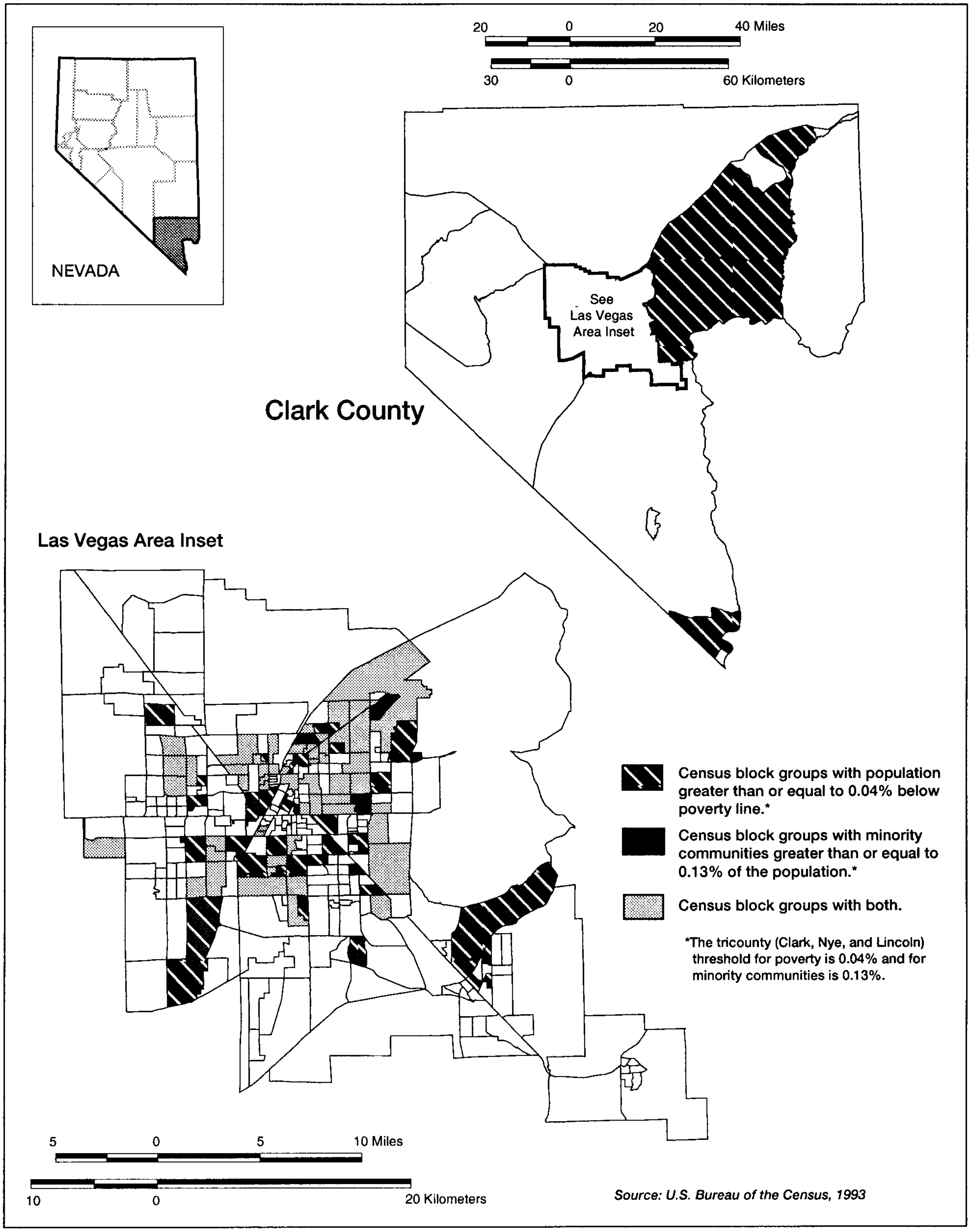


Figure 4-49. Clark County census block groups

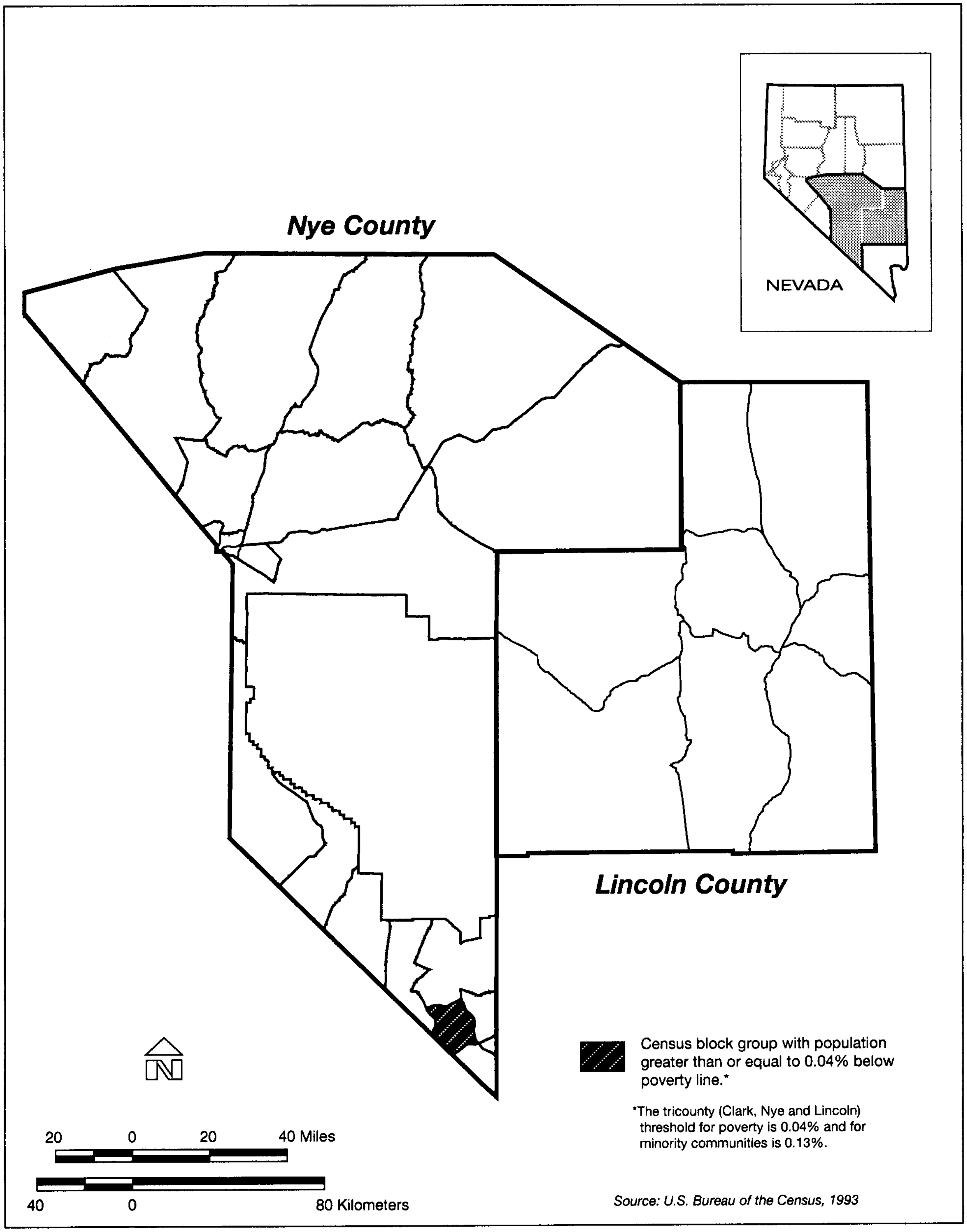


Figure 4-50. Nye and Lincoln counties census block groups

4.2.1 Land Use

Land resources are an important consideration for decisions regarding site use. The land-use analysis determines whether there is enough land available for the proposed facilities and required buffers and identifies conflicts between the proposed project and existing or projected on- and off-site land use. These analyses are necessary to determine whether public lands would be managed in a manner consistent with existing and projected land uses. To make decisions with respect to locating facilities at the Tonopah Test Range, the DOE must consider several issues, that is, the constraints and opportunities related to land resources. These include whether conflicts exist with the administrative framework and whether adequate resources are available and viable.

The known land-use constraints and opportunities at the Tonopah Test Range are outlined in this section. Land-use constraints include those features of the Tonopah Test Range, either natural or manmade, that preclude or limit the future activities that can be conducted in a specific location or area. Opportunities are the best and highest use of the land that can be accomplished within constraints.

Many of the constraints identified throughout Chapter 4 are those resulting from historic land uses, primarily from nuclear weapons safety tests and conventional weapons testing that resulted in radioactive contamination. Public Law 99-606, which consolidated the NAFR Complex under a single land withdrawal, authorizes the use of the withdrawn lands by other federal agencies for "defense-related" uses. For example, a Memorandum of Understanding between the DOE and the U.S. Air Force grants to the DOE the use of portions of the Tonopah Test Range. Consequently, many of the constraints on the DOE's use of land results from the fact that the Tonopah Test Range is used by many other federal agencies, including the U.S. Air Force, for test programs. Because of the nature of many historic and ongoing activities and their consequences, specifically the ongoing use of portions of the Tonopah Test Range by the U.S. Air Force and past DOE safety tests (see Section 4.1.4.3), land use will continue to be constrained in some areas of the Tonopah Test Range during the 10-year period covered by this EIS and likely well into the future. Based on more than 30 years of operations and the information collected, many of the consequences of past weapons testing and other activities are well understood and documented. For example, between the late 1960s through 1985, non-nuclear weapons testing was conducted at several locations on the Tonopah Test Range. Several of these tests resulted in the dispersion of depleted uranium, beryllium, and other hazardous materials. Some of these areas have been designated for no further use until remediation is complete. Many of the consequences described in this chapter were previously presented in the 1975 Environmental Assessment (ERDA, 1975) and in the EIS prepared by the DOE for U.S. Air Force operations in 1990. The information serves as a basis for evaluating the potential impacts of future actions.

The DOE and U.S. Air Force activities include the construction of remote, fully serviced facilities in the early 1980s to support the development of the F-117A fighter plane. This facility is now operated solely by the U.S. Air Force. Although the full impacts of this operation are not considered in this EIS, they will be fully analyzed during the preparation of the U.S. Air Force EIS for the 2001 land withdrawal.

Information for each affected resource is included in the specific resource discussions in this chapter. In addition, Section 4.2.2.3, Transportation of Materials and Waste, identifies the transportation of low-level waste from the Tonopah Test Range to the NTS.

4.2.1.1 Public Land Orders and Withdrawals. The Tonopah Test Range, which is part of the NAFR Complex encompasses 1,616 km² (624 mi²). The NAFR Complex has been closed to public entry since the 1940s when it was withdrawn for military use. Since 1956, the Tonopah Test Range has been managed by the DOE under a Memorandum of Understanding with the U.S. Air Force. A five-party agreement between the U.S. Air Force, the U.S. Bureau of Land Management, the U.S. Fish and Wildlife Service, Nevada Division of Wildlife, and the Energy Research and Development Administration (now the DOE) was instituted for the purpose of protecting, developing, and managing the natural resources, wildlife, vegetation, and watersheds on the NAFR Complex, the NTS, and the Tonopah Test Range. The U.S. Bureau of Land Management had previously developed a wild horse range for the protection of wild horses and burros over a portion of the area.

4.2.1.2 Land Use Designations. The eastern portion of the Tonopah Test Range is designated as part of the 394,000 acres Wild Horse Range that is located in the north-central portion of the NAFR Complex. The Nevada Wild Horse Range is managed by the U.S. Bureau of Land Management under a 1974 cooperative agreement in compliance with the Wild Horse and Burro Act of 1971. The goal of Public Law 92-195 is to protect wild horses from unauthorized actions, and require management of their habitat to achieve an ecological balance and a population of sound, healthy individuals.

With minor exception, the Tonopah Test Range is used by the DOE as a research, design, and testing ground for defense-related activities (Figure 4-51).

Area 3 of the Tonopah Test Range contains the majority of administrative and industrial facilities. Within this area is the fenced technical compound of Sandia National Laboratories. The facilities within the compound are administrative and research-related facilities.

Area 9 of the Tonopah Test Range contains all facilities that directly support the DOE weapons testing program. Rocket launchers, Davis gun support equipment, and weapon storage facilities are located in this area. Additionally, ground-to-air related tests are initiated from this facility.

Area 10 of the Tonopah Test Range is occupied by the U.S. Air Force Northern Remote Base. These facilities include the industrial area and housing area. These facilities and activities are not being evaluated in this EIS. U.S. Air Force activities associated with these facilities will be evaluated in the U. S. Air Force EIS for the 2001 land withdrawal.

The remaining land on the Tonopah Test Range is open and used for testing and military training programs. All uses of the Tonopah

Test Range are coordinated activities to ensure they are within scope of the land use of the area.

4.2.1.3 Site-Support Activities. Minor industrial and housing areas (Areas 10A and 10B, respectively) were developed by the U.S. Air Force within the Tonopah Test Range. Other facilities operated by Sandia National Laboratories in Areas 3 and 9 exist on a smaller scale.

FACILITIES—The Tonopah Test Range contains approximately 105 major buildings, providing a gross 15,004 m^2 (161,505 ft^2) of space. The Tonopah Test Range facilities also include approximately 90 smaller buildings, including towers and small sheds.

<u>SERVICES</u>—Services available at the Tonopah Test Range include law enforcement and security, fire protection, and health care.

<u>Law Enforcement and Security</u>—Law enforcement for the Tonopah Test Range is provided by Nye County Sheriff's Department. Security on the site is provided by Advanced Security, Inc.

<u>Fire Protection</u>—Fire protection services on the Tonopah Test Range are provided by Sandia National Laboratories and the U.S. Air Force.

<u>Health Care</u>—A medic serves the Tonopah Test Range medical needs. If serious care is required, the patient is either transferred to the town of Tonopah or airlifted to Las Vegas, depending on the medical needs.

<u>UTILITIES</u>—Utilities at the Tonopah Test Range include water systems, wastewater systems, and electrical systems.

<u>Water Systems</u>—A number of water wells have been drilled on or near the Tonopah Test Range to supply water to the facility (Figure 4-52). Well 6 provides potable water to the Sandia National Laboratories facilities, while several other nonpotable wells service the Tonopah Test Range for construction and industrial activities. The water use for DOE operations is 64,345 m^3/yr (17 million gal/yr).

The U.S. Air Force has developed a water distribution system of six potable wells to service the industrial and housing areas. The estimated water usage by the U.S. Air Force is 9.5 x 10^5 m^3/yr (2.5 x 10^7 gal/yr). There is an impoundment on the southwestern portion

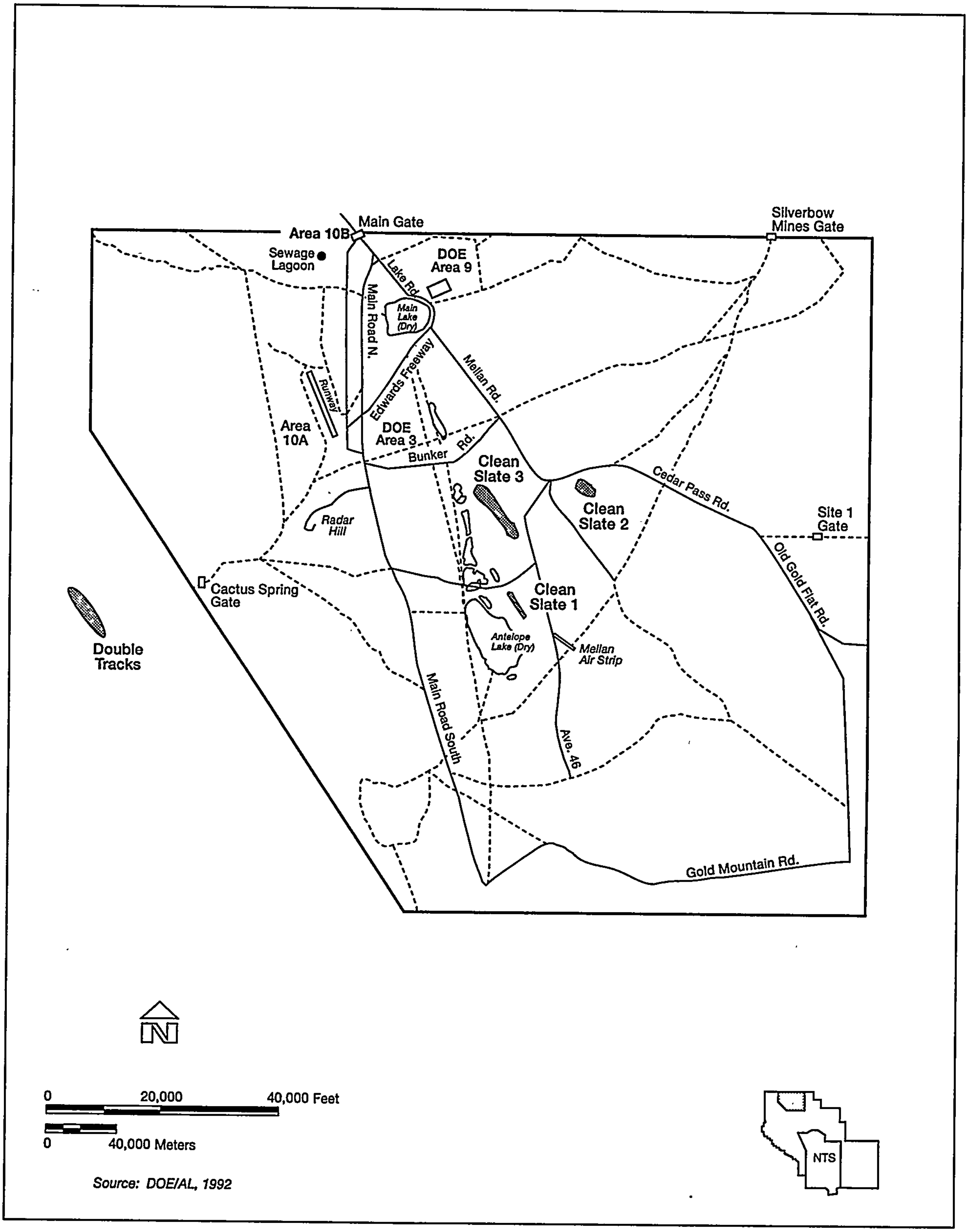


Figure 4-51. Tonopah Test Range detail

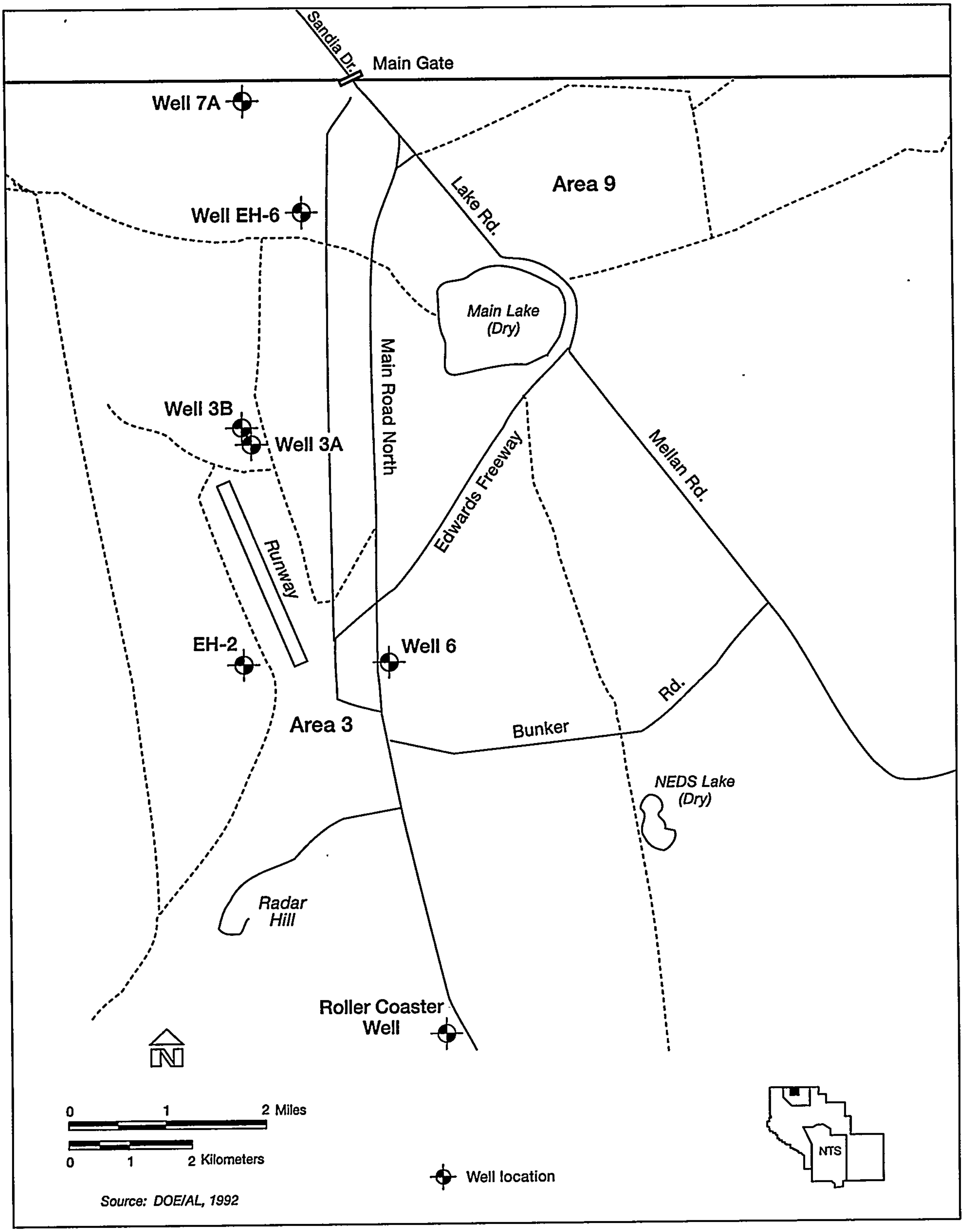


Figure 4-52. Domestic wells supporting the Tonopah Test Range

of the Tonopah Test Range that was used to store water during activities there. Other impoundments have been constructed by the DOE in the Tonopah Test Range area to provide water for the wild horse population.

Wastewater Systems—Sewage at the Tonopah Test Range is collected and pumped to the wastewater treatment unit located approximately 2.4 km (1.5 mi) southwest of the main gate. Effluent lines and three lift stations connect all DOE and U.S. Air Force facilities to the wastewater treatment unit. This treatment unit is designed to treat raw sewage in compliance with secondary treatment standards. Treatment is accomplished by an aerobic stabilization pond, followed by two parallel evaporation basins. The system allows for final disposal of the wastewater by evaporation and percolation.

Five septic tanks are still in use at remote locations on the Tonopah Test Range (DOE/AL, 1992). Their associated leachfields are used as the only means of treatment for septic tank wastes. These remote septic tanks are occasionally pumped into vacuum trucks and transported off site for ultimate disposition.

Electrical System—Power to DOE facilities at the Tonopah Test Range is supplied by the Sierra Pacific Power Company. Sierra Pacific has two supply lines to the Tonopah Test Range: one is 120 kV, and a backup line is 60 kV. Sierra Pacific transformers step the voltage down to 13.8 kV for the DOE distribution system. The remaining power line supplies the U.S. Air Force facilities. All remote operations are supplied with electrical power by portable generators.

COMMUNICATIONS—Communications at the Tonopah Test Range are supported by a regional system. The Tonopah Test Range telecommunication system employs digital telephone switching, fiber-optic transmission, microwave, two-way radio, voice privacy, data transmission systems, general-and-special-purpose data communications, and teleconferencing services.

The Tonopah Test Range also has a ground-to-air communication system that supports all air-to-ground testing programs. The VHF and UHF communication capability is reliable within a radius of 322 km (200 mi) of the range, depending on the altitude, while high-frequency communication can be reliable for thousands of miles.

Other modes of communication at the Tonopah Test Range include automated data processing equipment, automated office support systems, and information systems. Computer systems encompass general purpose, stand-alone, data management, word processing, engineering, computer-aided drafting, and computer-aided manufacturing.

4.2.1.4 Airspace. The airspace over the Tonopah Test Range is restricted area R-4809. The airspace is managed by the DOE and designated for joint use by the DOE and U.S. Air Force. Civilian aircraft may gain permission to use the facility in case of in-flight critical emergencies. This area is authorized for supersonic activity above 1,762 m (2,500 ft) above ground level with prior authorization from the appropriate agencies. The area is restricted for live ordnance unless the conditions enforced by the DOE and the U.S. Air Force are met. Currently, flying operations over the Tonopah Test Range are characterized moderate to heavy. The range has a 3,048-m (10,000-ft) concrete runway which can accommodate aircraft rated up to and including heavy cargo aircraft. The runway is lighted and marked for nighttime operations.

4.2.1.5 Waste Management. The following section addresses solid, hazardous, and radioactive waste management at the Tonopah Test Range.

SOLID WASTE MANAGEMENT—Tonopah Test Range sanitary waste from DOE and U.S. Air Force operations are disposed of in a Class II solid waste landfill. The Tonopah Test Range landfill is located just east of the U.S. Air Force industrial area. The materials disposed of are characterized as rubbish, construction debris, and sanitary waste from food service areas. The sanitary landfill currently in operation consists of one active cell.

HAZARDOUS WASTE MANAGEMENT—The DOE hazardous waste management activities are defined as a small quantity generator and operate in compliance with the Resource Conservation and

Recovery Act under an EPA identification number. All hazardous waste generated at the Tonopah Test Range can be stored up to 180 days at the facilities storage area. All waste is then transported off site for ultimate disposition by a subcontractor.

RADIOACTIVE WASTE MANAGEMENT Current plans are to remediate the radioactively contaminated areas on the Tonopah Test Range through excavation and disposal of surface soils. Disposal volume estimates are based on the level of cleanup, but are expected to be large. The remediation waste generated from cleanup of the contaminated soils would be transported to the Area 3 Radioactive Waste Management Site for disposal.

4.2.2 Transportation

The following sections discuss baseline transportation activities at the Tonopah Test Range with respect to on-site traffic, off-site traffic, transportation of materials and waste, and other transportation.

4.2.2.1 On-Site Traffic. The Tonopah Test Range on-site transportation consists of 190 km (118 mi) of primary paved roads, 37 km (23 mi) of secondary paved roads, 182 km (113 mi) of primary compacted dirt roads and 63 km (39 mi) of secondary dirt roads. The two primary traveled paved roads on the Tonopah Test Range traverse north-south and east-west. These roads support the majority of the daily traffic, as well as traffic during operations. The dirt roads are used for secondary daily travel, but are primarily used during testing activities. A total 480 km (298 mi) of roads on the Tonopah Test Range are used on a regular basis.

The roadway system on the Tonopah Test Range is jointly maintained by the DOE and the U.S. Air Force. No personally owned vehicles are permitted on the site. Workers either drive government-supplied vehicles from the main entry of the Tonopah Test Range or ride government-supplied bus transportation to the work site. The majority of the on-site traffic is attributed to security support and facility operations. The average estimated mileage traveled on the Tonopah Test Range during 1994 was 2.5×10^6 km (1.6×10^6 mi), driven by 96 government vehicles.

4.2.2.2 Off-Site Traffic. The primary highway access to the main entry gate of the Tonopah Test Range is via U.S. Highway 6 to north-south alternate Road 504. U.S. Highway 6 links U.S. Highway 95 and U.S. Highway 93 and is an all-weather, two-lane paved roadway. U.S. Highway 6 in the vicinity of the Tonopah Test Range (near Warm Springs) carried less than 500 annual average daily traffic in 1993. Regional traffic conditions in Clark and Nye counties are presented in Section 4.1.2.2.

4.2.2.3 Transportation of Materials and Waste. All material and waste are taken off site for management at other facilities, including the NTS, or at commercial waste facilities. No radioactive or hazardous waste disposal activities are conducted at the Tonopah Test Range. The primary roads used for waste and material transportation are discussed in Section 4.2.2.2.

4.2.2.4 Other Transportation. Because of the remote location of the Tonopah Test Range, the majority of the workers are flown from Las Vegas to the Tonopah Test Range on a daily basis. The DOE uses a DeHavilland seven-commuter airplane to transport the workers. The plane is flown an average of four daily round trips per week and transports approximately 30 individuals daily. The plane is maintained at DOE facilities in Las Vegas and uses U.S. Air Force facilities on the Tonopah Test Range during operations.

The U.S. Air Force maintains an active base on the Tonopah Test Range. This facility is 929 m^2 (10,000 ft^2). The existing runway and navigation aids are open to the DOE and the U.S. Air Force on an as-needed basis. The facility is lighted for night operations. The adjacent airfield is used by the DOE in support of its mission at the Tonopah Test Range. This facility supports approximately 15 sorties per week for DOE operations. The remaining sorties are in support of the U.S. Air Force and other organizations at the Tonopah Test Range.

Mellan airstrip is located on the southern portion of the Tonopah Test Range. This airstrip supports DOE and U.S. Air Force training programs and is used sporadically. There are no support facilities associated with this airstrip.

4.2.3 Socioeconomics

The majority of DOE/NV workers, including those assigned to projects at the Tonopah Test Range, live in Clark or Nye counties (DOE, 1994b). An analysis of socioeconomic conditions in Clark and Nye counties is presented in Section 4.1.3.

4.2.4 Geology and Soils

Geology and soils at the Tonopah Test Range are addressed in this section. The discussion includes a description of physiography, geology, including geologic resources, and soils.

4.2.4.1 Physiography. The Tonopah Test Range is located in the lowland portions of Cactus Flat and Stonewall Flat. Cactus Flat is a topographically closed basin with a total area of 1,044 km^2 (403 mi^2). Stonewall Flat is topographically open and encompasses 987 km^2 (381 mi^2). The Kawich Range on the east and northeast of the Tonopah Test Range rises to elevations of 2,438 m (8,000 ft) to more than 2,743 m (9,000 ft). To the west in the Cactus Range, which separates the two basins, the maximum elevation is 2,281 m (7,482 ft). On the south, Cactus Flat is separated from Gold Flat by the volcanic hills around Gold Mountain (about 1,829 m [6,000 ft]) and a low topographic divide through the alluvium to the east. Stonewall Flat is bounded on the south by Stonewall Mountain, which has a maximum elevation of 2,522 m (8,275 ft). On the west, Stonewall Flat is bounded by the Goldfield Hills, which rise to an elevation of almost 2,134 m (7,000 ft). On the valley floors of both basins, the dominant features are a number of small playas and the many washes that drain the upland areas.

The general appearance of the range is of great bareness. The playas support no vegetation, while the lower slopes and mountains support brush, some Joshua trees, and juniper. Only above 2,134 m (7,000 ft) are limited woodlands present.

4.2.4.2 Geology. The general geologic conditions and mineral deposits of the Tonopah Test Range have been described by the Nevada Bureau of Mines and Geology. The general geology of the area is comprised of two major geologic units: volcanic rocks and alluvium. Intrusive igneous rocks and a few isolated outcroppings of Paleozoic sediments occur in the Cactus Range.

The total thickness of volcanic rocks outcropping in the Cactus and Kawich Ranges and underlying the valley-fill deposits has been estimated to be as much as 6,096 m (20,000 ft). The Tertiary volcanics are composed of a series of welded and nonwelded ash-flow tuffs and basalts, andesites, dacites, and rhyolites. The Kawich Range is a horst that is bounded on the east by normal faults. The northern part of the range (adjacent to the Tonopah Test Range) is primarily composed of Tertiary tuffs, lavas, and intrusions of Miocene tuff.

The Cactus Range is also a horst that is bounded by an elliptical ring of fractures that suggests a collapsed cauldron. Some of these fractured areas were subsequently intruded with stocks, sills, and dikes. The central part of the range comprises minor Paleozoic sediments, a small granite mass, and a thick sequence of widespread Tertiary volcanic rocks. The hills to the south of Mellan comprise a series of lava ridges separated by valleys of tuff. The hills are capped with rubble formed from weathering and breccias in the lava piles, and breccias formed by the structural deformation (faulting and tilting) of the lava ridges.

The total thickness of alluvium is unknown. Exploratory drilling in Cactus Flat indicates that the thickness exceeds 305 m (1,000 ft). The alluvium is primarily coarse- to medium-grained and is derived from the volcanic rocks of the highlands. Volcanic ash is present in the alluvial deposits.

The Walker Lane shear zone is a major northwest to southeast trending regional structural element that transects the Tonopah Test Range. The Walker Lane is a transcurrent fault zone that extends several hundred miles through western Nevada, merging to the southwest with the Las Vegas shear zone. Numerous volcanic centers are located within or immediately east of the Walker Lane, including the Goldfield, Cactus Range, Stonewall Mountain, and Mount Helen centers. Volcanic calderas are absent over the test range but are present immediately to the east, south, and west on the NAFR Complex.

The geologic hazards present at the Tonopah Test Range are similar to those described for the NTS and include seismicity, volcanism, and geotechnical hazards. These hazards are discussed in Section 4.1.4.2 for the region comprising both the NTS and the Tonopah Test Range.

GEOLOGIC RESOURCES—The geologic resources of the Tonopah Test Range include metals, industrial minerals, and aggregate. The Tonopah Test Range has been the site of historic mining at the Silver Bow, Antelope Springs, Cactus Springs, Wilsons, and Mellan mining districts. The Tonopah Test Range is also adjacent to a number of other mining districts, most notably the Goldfield, Gold Crater, Golden Arrow, Stonewall, Gold Reed, and Jamestown districts. Appreciable quantities of silver and gold have been produced from the Silver Bow district. The Antelope Springs district produced silver and minor amounts of gold. The Cactus Springs district produced small quantities of silver, and there are reports of turquoise, gold, and copper in the area. The Wilsons district produced small quantities of gold and silver in the early 1900s. Minor production of gold and silver came from the Mellan district. Of these areas, only the Silver Bow district is classified as having high potential for locatable minerals.

Immediately to the east of the Goldfield district in the area between the Tonopah Test Range and Goldfield, there is moderate to high potential for the occurrence of quartz-alunite gold deposits. Although gold, silver, and lead have been produced from the Gold Crater and Stonewall districts, production from these areas had ceased by the mid-1930s, and the remaining potential for mineral resources is low.

No geothermal resources have been identified, and the potential for oil and gas resources is considered low. There are no reported occurrences of coal, tar sands, or oil shale on the Tonopah Test Range or adjacent areas on the NAFR Complex. Similarly, no economic deposits of industrial minerals have been identified. Although no uranium deposits have been identified, there are speculative resources of uranium. Tertiary volcanic rocks and tuffaceous sedimentary rocks of silicic compositions occur on the Tonopah Test Range and the NAFR Complex. Other uranium host environments are located elsewhere in the Great Basin.

The aggregate resources of the Tonopah Test Range are considerable. Sand and gravel deposits are present, and the quality and quantity of these resources are likely to be sufficient to meet future demands for construction, roads, and other uses. The aggregate resources do not have any unique value compared to other areas throughout southern Nevada.

4.2.4.3 Soils. The following soils information was extracted from the *Soil Inventory of Tonopah Management Environmental Impact Area* report prepared by Earth Environmental Consultants, Inc. for the U.S. Bureau of Land Management (Cox et al., 1977).

The Tonopah Test Range is situated in the Basin and Range physiography between the elevations of 1,676 and 2,377 m (5,500 and 7,800 ft). Approximately 15 percent of the soil survey is comprised of mountainous terrain with the remaining portion consisting of alluvial fans, ephemeral washes, valley floors, and dry lake beds. The soil parent material consists of a variety of igneous and sedimentary rock with rhyolitic tuffs and ignimbrite being the most common rock.

Strongly cemented silica pans (i.e., duripans), formed primarily from igneous sources, are the most common feature on most bejadas. These pans usually occur near the surface. In general, soil depth (i.e., depth to restrictive layer) increases from the topslope/shoulder slope of the alluvial fan, downslope to the footslope/toeslope. Indurated hardpans and cemented layers can range from a few inches to several feet in thickness.

The 1977 soil inventory was conducted as a third order survey and mapped to the soil series level. Soil mapping units were derived from field descriptions and delineated on aerial photographs at a scale of 1:31,680 with the exception of Ione, which was delineated on a 1:63,360 photograph. The minimum size of the soil mapping units is

10 acre. A quality assurance procedure, called a field correlation, was conducted by the Soil Conservation Service, U.S. Department of Agriculture, State Soil Scientist.

Soil Mapping Units consist of consociations, associations, complexes, and miscellaneous areas on the landscape such as rock outcrops, areas with excessive stone, or very steep eroded slopes. The following three out of 10 Soil Orders are found in the survey area:

- Mollisols--soils that contain a horizon rich in bases
- Aridisols--dry soils with low organic matter
- Entisols--young soils with little or no development of soil horizons.

The soils of the Tonopah Test Range and adjacent areas can be separated into four general categories based primarily upon the following physiographic position:

- Valley bottoms and dry lake beds (i.e. playas)
- Upper erosional portion of the alluvial fans
- Mountains and hills.

The valley bottom and dry lake bed soils occur in the central portions of both Cactus and Stonewall Flats. These very deep, poorly drained saline and alkali, fine-textured soils occur on slopes generally less than 1 percent. These low-lying areas are usually points of groundwater discharge. Therefore, depth to groundwater is usually fairly shallow and is manifested by discharging springs or plants that indicate in shallow water table (i.e., usually within 15 m [50 ft] below ground surface). These plants are called phreatophytes with greasewood being the most common in the area. There is periodic flooding from runoff and the shrink-swell potential is generally high due to the abundance of smectitic clays. This can present problems with most construction projects. The corrosion hazard for steel and concrete is high due to the high concentrations of salts. Soil families include:

- Typic Salorthids (e.g., Saltair soil series)
- Typic Haplaquolls (e.g., Hutton soil series).

The lower, depositional portion of the alluvial fan consists of deep to very deep, well-drained, very coarse (coarse sand) to medium-textured (very fine sandy loam/loam) gravelly soils that occur on slopes ranging from gently sloping(2 to 4 percent) to strongly sloping (8 to 15 percent) slopes. The coarser-textured, very gravelly to extremely gravelly soils are located in the ephemeral washes (i.e., arroyos) and are subject to periodic flash floods.

The soils on the actual dissected alluvial fan are generally moderate-textured, gravelly soils that are often covered with desert pavement. Soil families include:

- Typic Torriorthents (e.g., Fang and Cliffdown soil series)
- Typic Camborthids (e.g., Alcorn and Dun Glen soil series)
- Typic Calciorthids (e.g., Puddle).

The upper, erosional portion of the alluvial fan consists of older, very shallow (less than 25 cm [10 in.] thick) to moderately deep (between 51 and 102 cm [20 and 40 in.] in thickness) moderate to well drained, very coarse (coarse sand) to medium textured (very fine sandy loam/loam) gravelly to extremely stony soils. Some soils contain an old, well developed, fine textured (i.e., high in clay) subsoil called an argillic horizon. The presence of a duripan is common and is usually found between 38 and 76 cm (15 and 30 in.) below the ground surface, however, in some areas may be exposed at the surface. Slopes range from moderately sloping (4 to 8 percent) to moderately steep (15 to 30 percent). Soil families include:

- Xerollic Durorthids (e.g., Ursine soil series)
- Xerollic Durargids (e.g., Ratto, Olson, Indian Creek, and Deer Lodge soil series).

The upland mountains and hills consist of rock outcrops, areas with excessive stone, or very steep eroded slopes that generally contain a thin mantle of alluvial or colluvial soils usually less than 25 cm (10 in.). These soils can range in texture from coarse to fine, gravelly to extremely stony, and are dependent upon primarily age and parent material for textural composition. Slopes generally range from moderately steep (15 to 30 percent slopes) to extremely steep (>75 percent). These soils usually have a severe erosion hazard because of their slopes and runoff is generally rapid.

The historic use of the Tonopah Test Range has created certain site-specific restrictions for some surface soils. The clean slates sites included an open detonation on a concrete pad, and detonation in igloo-like structures with varying amounts of earth-cover to simulate accidents in open storage and weapons magazines. Depleted uranium and plutonium were used as a tracer in these Clean Slate tests. The areas that were contaminated with radioactivity from the tests (Figures 4-35 through 4-37) and associated decontamination areas and disposal sites are the subject of Environmental Restoration Program activities that will resolve their ultimate disposition. Until the appropriate investigations have been completed and remedial decisions are made, the soils in these areas are not suitable for use and have been fenced and posted. These sites were studied in the late 1970s by the Nevada Applied Ecology Group. One objective of the studies was to estimate the amount and distribution of plutonium in the soil.

Samples were primarily collected from the top 5 cm (2 in.) of the soil profile. A few profile samples were collected to a depth of 25 cm (10 in.). In almost all profiles, plutonium was detected in the 25 cm (10 in.) increment. Deeper profiles from Clean Slate 1 and 3 showed plutonium at less than 1 pCi/g at a depth of 32.5 cm (12.8 in.) (Essington, 1987).

Estimated areas of plutonium concentrations in soils range from less than 1 acre at greater than 400 pCi/g, through 6 acres at greater than 200 pCi/g, and 81 acres at greater than 40 pCi/g. Clean Slate 2 has 17 acres at greater than 400 pCi/g, 26 acres at greater than 200 pCi/g, and 170 acres at greater than 40 pCi/g. Clean Slate 3 has 17 acres at greater than 400 pCi/g, 49 acre at greater than 200 pCi/g, and 180 acres at 740 pCi/g (DOE/NV, 1995c).

Because of the similarities in the types of tests conducted and the consequences of those tests, additional discussion of the affected soils can be found in Section 4.1.4.3, NTS soils.

4.2.5 Hydrology

Surface water and groundwater at the Tonopah Test Range are addressed in this section.

4.2.5.1 Surface Hydrology. Hydrographic basins of the Tonopah Test Range are shown in Figure 4-53. Cactus Flat is a closed basin; runoff from the Cactus Range and Kawich Range drains to a series of small, north-trending playas in the lowlands along the axis of the valley. Stonewall Flat is open, with a small quantity of surface water discharged to Lida Valley. The runoff over the two basins has not been gauged, but has been estimated at 1.5×10^6 m^3/yr (1,200 acre-feet/year) for Cactus Flat and 4.9×10^5 m^3/yr (400 acre-feet/year) for Stonewall Flat. No perennial streams exist in any of the basins on the Tonopah Test Range. The many washes that drain the upland areas occasionally convey ephemeral flow that ponds on the playa areas.

4.2.5.2 Groundwater. The Tonopah Test Range encompasses portions of five hydrographic basins that comprise portions of two regional groundwater flow systems (Figure 4-39). Past DOE operations have been concentrated in two areas: in the lowland portions of Cactus Flat and in Stonewall Flat. Groundwater that originates as precipitation over the Kawich Range flows west and then southwest under the Tonopah Test Range, ultimately discharging in Death Valley as springs and evapotranspiration. Some groundwater may flow northwest off the Tonopah Test Range and into the Southern Marshes flow system, with discharge at Mud Lake, Alkali Flat, and Clayton Valley. The generalized directions of regional groundwater flow are shown in Figure 4-39.

The depth to groundwater under Cactus Flat ranges from about 27 m (90 ft) to about 137 m (450 ft) below land surface. Groundwater is derived from

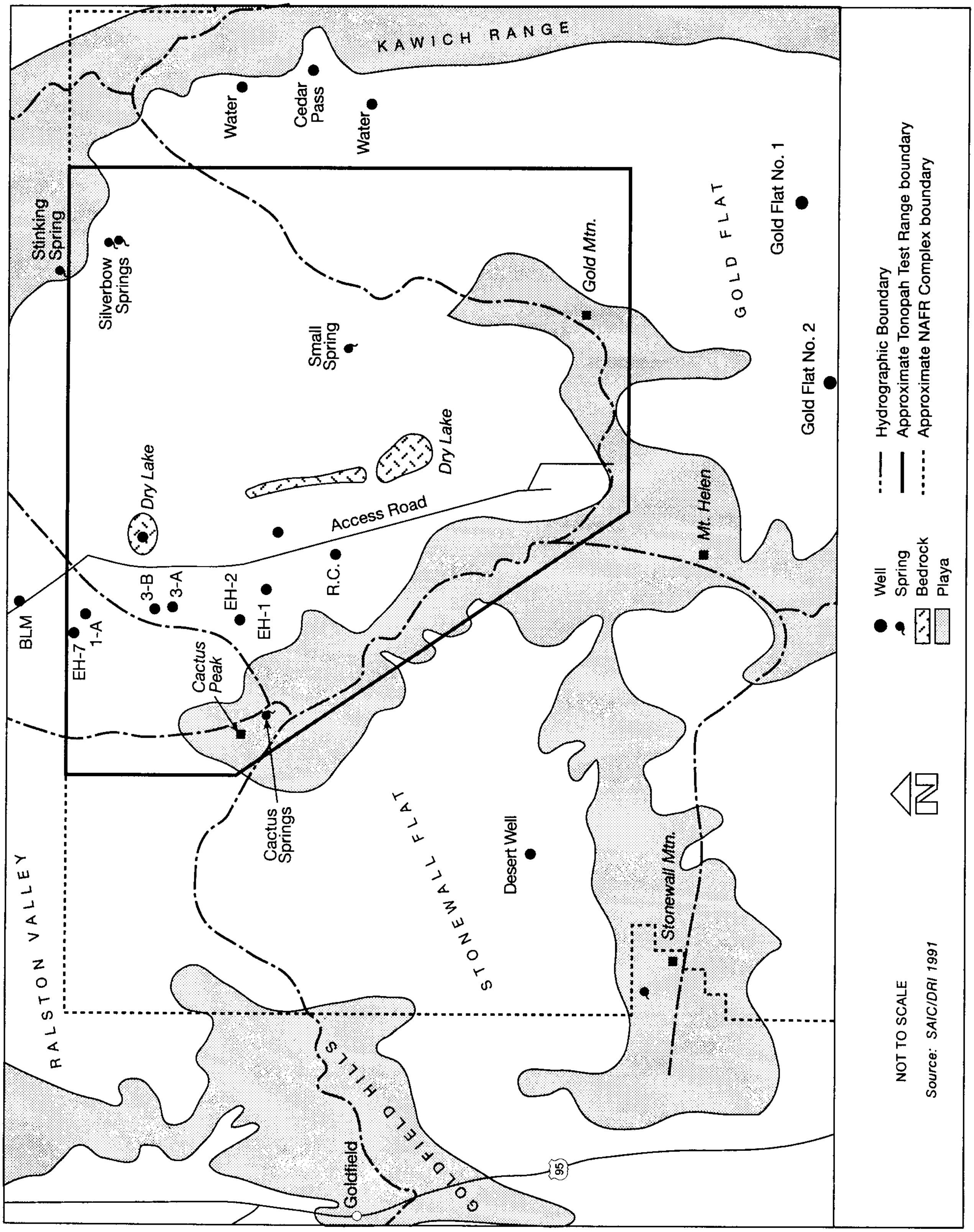


Figure 4-53. Hydrographic basins and water resource features at Tonopah Test Range.

precipitation over the upland areas; there is no subsurface recharge from neighboring basins. The total recharge has been estimated at only 7.4×10^5 m^3/yr (600 acre-feet/year). Groundwater discharge, totaling only a little more than 1.2×10^6 m^3/yr (1,000 acre-feet/year), is through subsurface underflow to the southwest into Stonewall Flat and Gold Flat. No groundwater is discharged to evapotranspiration by phreatophytes.

The groundwater under Stonewall Flat ranges in depth from about 31 m (100 ft) to more than 84 m (275 ft) below land surface. Groundwater is derived from recharge over the upland areas (only about 1.2×10^5 m^3/yr [100 acre-feet/year]) and an unknown quantity of subsurface inflow from Cactus Flat. An estimated 2.5×10^5 m^3/yr (200 acre-feet/year) is discharged through underflow to Lida Valley. No groundwater is discharged to evapotranspiration in Stonewall Flat.

Several springs are located in the north Kawich Range and along the eastern flanks of the Cactus Range. Four spring areas have been mapped within the boundaries of the Tonopah Test Range: Silver Bow Springs on the flank of the Kawich Range, Small Spring near Mellan on the valley floor, and Cactus Spring and Antelope Springs near the base of the Cactus Range. Stinking Spring is located immediately to the north of the Tonopah Test Range, and Rose Spring is located about 10 km (6 mi) to the east, in the Cedar Pass area. There are no mapped springs within the Tonopah Test Range portions of Stonewall Flat or the NAFR Complex. Willow Springs is located about 2 km (1 mi) to the west of the NAFR Complex in the Goldfield Hills. Gauging data are very limited for these springs, and water chemistry data are lacking. A single 1963 discharge measurement of 15 L/min (4 gal/min) was reported for a spring located near the mapped location for Cactus Spring.

The quality of water on the Tonopah Test Range is generally good and is suitable for domestic purposes, livestock, wild horse, and wildlife use. There are a number of areas where the groundwater may have been impaired by past activities at the facility. The nuclear safety tests conducted at the Clean Slates sites on the Tonopah Test Range have resulted in surface soil contamination. Although groundwater contamination has not been detected at these sites, there is the potential for downward migration of some contaminants into the water table. Other potential sources of groundwater contamination include french drains, septic tanks and leachfields, underground storage tanks, landfills, and sewage lagoons.

There are about 1.5×10^7 m^3/yr (12,500 acre-feet/year) of water rights in the five hydrographic basins associated with the Tonopah Test Range. Almost 4.9×10^6 m^3/yr (4,000 acre-feet/year) of this total are surface water rights; the remainder (about 1.0×10^7 m^3/yr [8,500 acre-feet]) represents groundwater rights. Currently, defense-related federal water rights total 2.2×10^6 m^3/yr (1,775 acre-feet/year), of which only 1.8×10^5 m^3/yr (148 acre-feet) are surface water rights. Table 4-40 lists the water rights status for each of the basins that encompass portions of the Tonopah Test Range. Federal water rights are limited to two basins, Cactus Flat and Stone Cabin Valley. Both basins are over appropriated; i.e., the appropriations exceed the perennial yield in each basin. It is unlikely that additional water rights can be obtained in the area without groundwater mining (the removal of groundwater from storage).

Groundwater on the Tonopah Test Range has been used for domestic, industrial, and construction purposes. Groundwater is pumped from a number of wells, depending on the location of range activities and the total demand for water. Records identifying historic pumping are not available; water use in 1988 was 4.7×10^5 m^3/yr (380 acre-feet), and this value is probably representative of long-term use. About 80 percent 2.9×10^5 m^3/yr (240 acre-feet/year) of the domestic water is pumped from a U.S. Bureau of Land Management well located north of the Tonopah Test Range on public land in Stone Cabin Valley. The remaining 20 percent of domestic water and water for construction and industry is withdrawn from wells located in Cactus Flat (about 1.2×10^5 m^3/yr [100 acre-feet/year]) and Gold Flat (about 4.9×10^4 m^3/yr [40 acre-feet/year]).

All water supply wells installed at the Tonopah Test Range were completed in the alluvium. Well yields range from approximately 23 to 606 L/min (6 to

160 gal/min). These yields are based on water-supply well-construction completion records prepared by the driller.

4.2.6 Biological Resources

The following description of vegetation was taken from EG&G Energy Measurements (1995) unless otherwise stated. The scientific names of plants and animals mentioned in this section are given in Section 2.6 of Appendix E, Biological Resources.

The Tonopah Test Range is within the Great Basin desert. The lowest elevation on the Tonopah Test Range is approximately 1,600 m (5,250 ft); the highest elevation is approximately 2,301 m (7,550 ft).

The dominant flora of the valley bottoms on the Tonopah Test Range include shadscale, budsage, winterfat, and galleta grass. Less common plant species are horsebrush, greasewood, desert globemallow, and desert prince's plume. Big sagebrush occurs in wash bottoms near the playa lakes. On the bajadas above the valley floor, shadscale, budsage, winterfat, and Indian ricegrass are dominant. At higher elevations, greasewood, wolfberry, hopsage, and desert prince's plume are common. Pinyon-juniper woodlands occur at the highest elevations.

Animal species on the Tonopah Test Range include all species found in the Great Basin desert on the NTS. Some of the most common animal species include side-blotched lizards, desert-horned lizards, horned larks, chisel-toothed kangaroo rats, little pocket mice, and wild horses (Bradley and Moor, 1975). State-designated game animals that occur on the Tonopah Test Range include mule deer, bighorn sheep, pronghorn, mountain lions, desert and Nuttall's cottontails, chukar, and mourning dove.

Vegetation samples were collected on the Tonopah Test Range in 1973 (Romney, 1975) and again in 1990 and 1991 (EG&G/EM, 1993d). Recent plutonium levels in samples of vegetation ranged from 4.0 x 10^{-5} to 3.9 x 10^{-2} nCi/g dry vegetation, and have not changed substantially over the past 25 years. Many studies in arid and semiarid environments (Francis, 1973; Price, 1973; Romney, 1977; Hanson, 1975; and Hakonson, 1975) have shown that most of the plutonium remains in the soil and is not readily transported. Very little of the contamination is incorporated into the biological components of the ecosystem in similar arid areas (Hakonson and Nyhan, 1980). Plutonium contamination of vegetation at the Tonopah Test Range and the NTS is concentrated mainly on the surface of vegetation and is generally not taken up by the roots and concentrated internally. Small mammals have been collected from the Tonopah Test Range for plutonium contamination analyses in 1974-1975 (Bradley and Moor, 1975) and from other contaminated sites off and on the NTS (Gilbert et al., 1988). From these studies, the following general conclusions can be made: very low levels of contamination (from undetectable levels to a few hundred femtocuries [10^{-15} Ci] per gm) were found in animals; desert rodents (which represent the primary consumer trophic level) have very low plutonium levels; most of the radioactivity in rodents is associated with the pelt and gastrointestinal tract and not internal organs or carcasses; and the plutonium contamination does not appear to concentrate up the food chain.

No current federal threatened, endangered, or candidate plant or animal species are known to occur on the Tonopah Test Range, although bald eagles and peregrine falcons may be rare migrants.

The U.S. Fish and Wildlife Service published the latest list of candidate plants and animals on February 28, 1996 (61 F.R. 7596). Prior to this, 10 animal and 5 plant species which were identified as potentially occurring on the Tonopah Test Range were classified as candidates (Mendoza, 1995b) and were addressed in the Draft NTS EIS (listed in Table 4-30). The updated Notice of Review has removed all of these species from candidate status. The western burrowing owl, a state-protected bird, is known to occur on this site.

4.2.7 Air Quality and Climate

This section describes the air quality conditions at the Tonopah Test Range. Climatology, meteorology, and ambient air quality are discussed.

<u>CLIMATOLOGY AND METEOROLOGY</u>—The climate is usually dry, but given to large diurnal and

seasonal changes in temperature. Clear, sunny days prevail, and the winds are light to moderate. Rainfall is 13 to 15 cm (5 to 6 in.) per year in the valley, primarily resulting from summer thunderstorms. Dust storms are common in the spring, and strong dust devils occur in the summer.

The average temperature at the Tonopah Test Range is about 10 °C (50 °F); maximum temperatures are over 38 °C (100 °F), and minimum temperatures are below -29 °C (-20 °F). The average relative humidity is approximately 40 percent. The average annual snowfall is 30 to 33 cm (12 to 13 in.) (Schaeffer, 1968). Surface wind directions are predominantly from the west-northwest to northwest in the winter and from south to southeast in the summer. Local terrain tends to shift southerly surface winds to a more southeasterly direction. Highest wind speeds occur in mid-afternoon in all seasons, but especially in the spring; highest wind speeds are also strongest for south winds overall. In April, the most frequent wind direction between 1 p.m. and 4 p.m. is from the south, with an average speed of approximately 25 kph (16 mph). The annual average speed for south winds is 16 kph (10 mph). Nighttime wind speeds average approximately 10 km (6 mph). There is little diurnal wind direction variability in summer and winter; however, in late spring and autumn, the diurnal cycle is typically northwest nighttime flow and south to southeast afternoon flow (Schaeffer, 1968).

AMBIENT AIR QUALITY—The Tonopah Test Range is located within Nevada Intrastate Air Quality Control Region 147. Although ambient pollutant concentrations have not been measured on the Tonopah Test Range, ambient air quality characteristics are similar to the NTS (see Section 4.1.7). Ambient pollutant concentrations on the Tonopah Test Range are below the Nevada and National Ambient Air Quality Standards (Table 4-31). The Air Quality Control Region is designated as unclassifiable/attainment for all criteria pollutants.

4.2.8 Noise

The acoustic environment around the Tonopah Test Range and the NAFR Complex can be classified as uninhabited desert or small rural communities. The primary source of noise on the Tonopah Test Range and the NAFR Complex is from the DOE and U.S. Air Force aircraft operations and ordnance testing. Because the public is prohibited from entering the Tonopah Test Range and the NAFR Complex, public exposure to these noise sources is limited to occasional sonic booms produced by supersonic overflights of military aircraft (SAIC/DRI, 1991).

4.2.9 Visual Resources

The landscape character of the Tonopah Test Range is similar to the higher elevation areas of the NTS. The Tonopah Test Range is visible only from an access road off U.S. Highway 6; therefore, visual sensitivity would be low.

4.2.10 Cultural Resources

The resources recorded at the Tonopah Test Range are limited to certain environmental areas, while the archaeological sites within other areas are virtually unknown. Recorded properties cluster within the categories of extractive localities, processing localities, and mining and ranching, but other types of sites are known. Projectile points found on the Tonopah Test Range suggest that the area has been used for the last 10,000 years. At the time of the first European explorations of the area, groups of Western Shoshone people occupied the area. The Kawich band used much of the Tonopah Test Range, while groups from the areas came to Cactus Flat to collect seeds and hunt Beatty and Belted Mountain antelope and rabbits (Steward, 1938).

Based on current knowledge of cultural resources on the Tonopah Test Range, all areas have the potential to contain significant historic properties. Thus, the current Tonopah Test Range boundaries are considered the area of potential effect for cultural resources. To date, 11,549 acres have been surveyed for cultural resources on the Tonopah Test Range. The following section summarizes previous work conducted on the Tonopah Test Range, evaluates the sites according to their types, and assesses their eligibility for listing on the National Register of Historic Places.

Table 4-40. Water rights status for hydrographic basins at the Tonopah Test Range

Hydrographic Basin Number and Name	Perennial Yield		Total Committed Groundwater Resources		Comments
	m^3/yr	ac-ft/yr	m^3/yr	ac-ft/yr	
Ralston Valley	7.4×10^6	6,000	2.4×10^6	1,917	Basin designated by Order 742, Notice of Curtailment by Order 752. No Tonopah Test Range water rights or use.
Stonewall Flat	1.2×10^5	100	1.4×10^4	12	No Tonopah Test Range water rights or use.
Gold Flat	2.3×10^6	1,900	1.2×10^5	95	Estimated Tonopah Test Range water use in 1988 was 49,339 m^3 (40 ac-ft).
Cactus Flat	3.7×10^5	300	7.6×10^5	619	Estimated Tonopah Test Range water use in 1988 was 197,357 m^3 (160 ac-ft).
Stone Cabin Valley	2.5×10^6	2,000	2.5×10^6	2,033	Basin designated by Order 720. Estimated Tonopah Test Range water use in 1998 was 296,036 m^3 (240 ac-ft).

Sources: Buqo, 1996a.

RECORDED CULTURAL RESOURCES—Large reconnaissance surveys and overviews completed at the Tonopah Test Range include the Seafarer Project (Ferraro et al., 1975), the Mt. Diablo Baseline Survey (Brooks et al., 1976), and the NAFR Complex surveys (Ellis, 1979; Bergin and Roske, 1978; Bergin et al.,1979; Crownover, 1981). Numerous smaller reconnaissance surveys have been completed by the Desert Research Institute including those compiled for the development of a U.S. Air Force base supporting the F-117A on the Tonopah Test Range (DOE, 1988). Figure 4-53 shows the hydrographic basins, and Table 4-41 lists the types of sites found.

Gold Flat—Most of this hydrographic basin lies south of the Tonopah Test Range on the NAFR Complex. The portion that is within the Tonopah Test Range is divided from Cactus Flat at the Breen Creek drainage. Seven archaeological reconnaissance surveys have been conducted within that portion of Gold Flat that lies within the Tonopah Test Range. Approximately 950 acres were surveyed for cultural resources. Forty-four cultural resources sites have been recorded as a result of these surveys. Of this total, 4 are temporary camps, 31 are localities, and 9 are historic sites associated with mining or ranching. Forty sites have been recommended as eligible for the National Register of Historic Places.

Stonewall Flat—Most of Stonewall Flat lies outside of the Tonopah Test Range on the NAFR Complex. Only the extreme eastern portion lies inside the Tonopah Test Range boundaries. Stonewall Flat is differentiated from Cactus Flat by the Cactus Range. Only one archaeological survey has been conducted within the small portion of Stonewall Flat that lies within the Tonopah Test Range. Approximately 215 acres were surveyed for cultural resources. Thirteen sites have been recorded as a result of this survey. Other sites have been recorded in the portion of Stonewall Flat that falls within U.S. Air Force jurisdiction. Of the sites recorded,

Table 4-41. Types of sites found within the hydrographic basins of the Tonopah Test Range

Basin	Prehistoric Site Types							Historic Sites	NR Eligible
	RB	TC	EL	PL	LO	CA	STA	HI	NR
Gold Flat	0	4	0	0	31	0	0	9	40
Stonewall Flat	0	0	0	0	3	0	1	9	13
Ralston Valley	0	2	0	0	36	0	0	2	38
Cactus Flat	0	19	0	2	89	0	0	17	68
Stone Cabin Valley	0	3	0	6	87	0	0	3	63
Totals	**0**	**28**	**0**	**8**	**246**	**0**	**1**	**40**	**Total NR**
Total Tonopah Test Range Sites								**323**	**222**

Site type codes: RB=residential base; TC=temporary camp; EL=extractive locality; PL=processing locality; LO=locality; CA=cache; STA=station; HI=historic; NR=National Register of Historic Places.

three are localities, one is a station, and nine are historic mining and ranching sites. All of these sites have been recommended as eligible for the National Register of Historic Places.

Ralston Valley—The extreme southeastern corner of the Ralston Valley lies within the Tonopah Test Range boundaries. This drainage is divided from the Stone Cabin Valley drainage by the Monitor Hills. Only one archaeological survey has been conducted within the small portion of Ralston Valley that lies within the Tonopah Test Range. Approximately 170 acres were surveyed for cultural resources. Forty sites have been recorded as a result of this survey. Of these, 2 are temporary camps, 36 are localities, and 2 are historic. To date, 38 sites within the Ralston Valley hydrographic basin have been recommended as eligible for the National Register of Historic Places.

Cactus Flat—Most of the Cactus Flat hydrographic basin lies within the boundaries of the Tonopah Test Range. The basin is bounded by the Cactus Range, the Kawich Range, Gold Mountain, and the Breen Creek drainage. The Cactus Flat region has the highest density of archaeological sites recorded on the Tonopah Test Range. This may be a reflection of the intensity of survey that has occurred in this basin. Forty-eight archaeological surveys have been conducted within the Cactus Flat hydrographic basin and 9,795 acres have been examined. To date, 68 sites have been recommended as eligible for the National Register of Historic Places.

Stone Cabin Valley—The extreme southern portion of Stone Cabin Valley extends into the northern part of the Tonopah Test Range. It is bounded by the Monitor Hills and the Kawich Range. Six archaeological reconnaissance surveys have been conducted within that portion of Stone Cabin Valley that lies within the Tonopah Test Range. Approximately 420 acres were surveyed for cultural resources. A total of 105 sites have been recorded as a result of these surveys. This total includes 3 temporary camps, 6 processing localities, 87 localities, and 3 historic sites. To date, 63 sites have been recommended as eligible for the National Register of Historic Places.

SITES OF AMERICAN INDIAN SIGNIFICANCE—The CGTO knows that the

Tonopah Test Range contains significant cultural resources, including plants, animals, archaeology sites, and places of historic value to Indian people. This is known from Indian interviews conducted in the 1930s (Steward, 1938) and recent plant, animal and archeology studies conducted south of this area in comparable environments (Stoffle et al., 1990a; Stoffle et al., 1994b). These studies document long-term and extensive involvement of Indian people in these traditional lands. These were among the last areas lived in before Indian people were forced out of the area to live on more distant Indian reservations. As a result of oral history, Indian people know there are various types of cultural resources located in this study area, but cannot provide site-specific information at this time. No Indian people officially representing the CGTO have visited the Tonopah Test Range or any other portion of the NAFR Complex, although such interviews have been requested and one initial meeting with a NAFR Complex archaeologist has occurred. Therefore, it is not possible to fully assess the cultural significance of the Tonopah Test Range at this time.

4.2.11 Occupational and Public Health and Safety Radiation

The DOE's commitments to quality management of the Tonopah Test Range worker safety and health as well as environmental resources is evident by the establishment of many offices and departments to oversee environmental, safety and health issues.

OVERVIEW - The potential for activities at the Tonopah Test Range to impact the health and safety of the general public is minimized by a combination of the remote location of the Tonopah Test Range, the sparse population surrounding it, and a comprehensive program of administrative and design controls. Visitors to the Tonopah Test Range are subject to essentially the same safety and health requirements as the workers. Safety briefings are provided as appropriate, personal protective equipment is provided when necessary, and radiation dosimeters are issued to long-term visitors. Secondary access control is provided, when necessary, for safety and or security reasons. Operations with higher-than-normal hazards are fenced or barricaded. The health and safety of the Tonopah Test Range workers is protected by adherence to the requirements of federal and state law, DOE orders, and plans and procedures of each organization performing work on the range. A program of self-assessment of compliance with these requirements is conducted by the Sandia National Laboratories, support contractors, and the DOE. Workers are further protected from specific hazards associated with their jobs by training, monitoring the workplace environment, using personal protective equipment, and using administrative controls to limit their exposures to chemical or radioactive materials.

All DOE activities on the Tonopah Test Range are in compliance with all environmental and other requirements established by federal, state, and local agencies. The main environmental compliance activities included the operation of a less than 90-day storage area for hazardous waste, minimal cleanup activities associated with the Environmental Restoration Program, and compliance sampling for the public water distribution system as required by the Safe Drinking Water Act.

RADIOLOGICAL ENVIRONMENT - Radiological effluent in the form of air emissions are released into the environment as a routine part of operations at the Tonopah Test Range. These emissions are monitored for source characterization and operational safety, as well as for environmental surveillance purposes.

The environmental surveillance of the Tonopah Test Range is focused on the three safety test areas that include approximately 670 acres. Environmental surveillance activities conducted by the DOE and the EPA include air, water, and soil sampling at various locations on the Tonopah Test Range and surrounding areas. The data from these efforts are summarized as annual averages for each monitoring location.

CRITERIA - All work at the Tonopah Test Range is performed in accordance with the safety and health requirements of the Occupational Safety and Health Administration as codified in Title 29 CFR Parts 1910 and 1926. In addition, the following DOE orders provide direction for worker safety and health programs:

- 5480.7A Fire Protection
- 5480.8A Contractor Occupational Medical Program
- 5480.9A Construction Project Safety and Health Management
- 5480.10 Contractor Industrial Hygiene Program
- 5480.13A Aviation Safety
- 5480.16A Firearms Safety
- 5480.1B Environmental Safety and Health Programs for Workers
- 5480.23 Nuclear Safety Analysis Reports
- 5480.28 Natural Phenomena Hazards Mitigation
- N441.1 Radiological Protection for DOE Activities.

INSTITUTIONAL SAFETY PROGRAMS - The Tonopah Test Range supports the following on-site safety services provided by Sandia National Laboratories and other support contractors:

- Fire support services
- Occupational medicine services (limited critical care patients are transported into the town of Tonopah)
- Radiological safety services, including a radioactive material control program to assure that materials leaving the Tonopah Test Range are not contaminated
- Industrial hygiene services.

The above services can be expanded to meet the requirements of the Tonopah Test Range from Sandia National Laboratories' main facility in Albuquerque, New Mexico.

4.2.12 Environmental Justice

Existing demographic conditions for Environmental Justice are discussed in Section 4.1.12. This discussion includes conditions for the Tonopah Test Range region of influence.

4.3 Project Shoal Area

Project Shoal Area was a joint effort of the DoD and the Atomic Energy Commission to study the effects of different geological media (e.g., granite) on seismic waves produced by underground nuclear shots and to determine whether seismic waves produced from underground nuclear testing could be differentiated from natural earthquakes (DOE, 1988). The Project Shoal Area was selected as a potential site in 1961, and preparations for the test began in late 1962. The Project Shoal Area was a nuclear device with an estimated yield of 12.5 kt at 367 m (1,205 ft) belowground surface on October 26, 1963. The shot produced a rubble-filled chimney 52 m (170 ft) in diameter and 140 m (460 ft) high (Gardner and Nork, 1970).

Deactivation of the site began almost immediately after the test, with all surface equipment removed by January 31, 1964. The shaft was covered by a permanent concrete slab, and all exploratory boreholes leading to the cavity were permanently sealed. A preliminary site assessment, conducted by the Desert Research Institute in 1988, resulted in a Hazard Ranking System score of 3.52. This score does not meet the minimum score required for placement on the National Priorities List under Superfund.

Management recommendations listed in the report included groundwater monitoring of nearby wells and further investigations to quantify the nature and extent of potential contaminants (DOE, 1988).

Because the activities at the Project Shoal Area are restricted to environmental restoration actions, the alternatives do not have the potential to impact waste management, transportation, or socioeconomics at the Project Shoal Area. Therefore, the development of a detailed baseline for these issues is not warranted. A brief explanation for this decision follows:

- Waste Management—No waste management facilities exist at the Project Shoal Area. Any waste generated during the course of Environmental Restoration Program activities would be transported either to the NTS or a permitted hazardous waste facility

- Transportation—The Project Shoal Area is crossed by numerous roads used for accessing surrounding public lands. Access to the site during Environmental Restoration Program activities would generate only a minor amount of traffic on local roads. Transportation of investigation-derived waste and remediation-generated waste is discussed in Section 4.1.2.3

- Socioeconomics—No new facilities are proposed to be located at the Project Shoal Area. Only environmental restoration activities are planned at this location. Environmental restoration activities would be short-term and would require relatively few personnel (less than 10 at any given time).

4.3.1 Land Use

The Project Shoal Area is a 10.4 km^2 (4 mi^2) area located at an elevation of 1,585 m (5,200 ft) in the northern part of the Sand Springs Mountain Range. It is located 48 km (30 mi) southeast of Fallon, Nevada (Figure 4-54). The closest human population is represented by a private ranching operation 8 km (5 mi) to the west. The site is surrounded by unimproved rangeland covered with sparse, low vegetation.

4.3.1.1 Public Land Orders and Withdrawals. The Project Shoal Area was withdrawn in 1962 for the proposed Project Shoal Area test by Public Land Orders 2771 and 2834. This site consists of 2,560 acres. (SAIC/DRI, 1991).

4.3.1.2 Land-Use Designations. Characterization and testing activities began at the Project Shoal Area in late 1962. Upon completion of operations on October 28, 1963, site deactivation was initiated (AEC, 1970). All vehicles and equipment were returned to the NTS, including communications equipment, technical instruments, and radiation monitoring instruments. Roads and concrete pads remained on the site. After wire, cable, poles, and lumber were salvaged, the lease of facilities in Fallon was terminated, and site decommissioning was deemed completed on January 31, 1964. Control or prevention of entry into the subsurface in the area continues to be a necessity for security purposes and is defined as the exclusion zone. The exclusion zone lies between a depth of 55 m (180 ft) and 518 m (1,700 ft) below surface ground zero and 1,006 m (3,300 ft) laterally between those depths (AEC, 1970). Access to the land surface of the withdrawal area is currently uncontrolled. The site is bounded on all sides by public land. North and south of the Project Shoal Area, land is used for grazing.

The Navy has applied for a withdrawal which surrounds and overlaps the DOE withdrawal at the Project Shoal Area site. The DOE's present plan is to characterize and complete any required remediation so that the surface can be available for unrestricted public use. Access to the deep subsurface would remain excluded. Continued access by the DOE for monitoring of the subsurface would be long term.

The preliminary Hazard Ranking System score (EPA's ranking system for Superfund cleanup determination) for the Project Shoal Area is a low score based primarily on the assumption of a low probability for the migration of radionuclides, and there are no human drinking water receptors in the vicinity of the Project Shoal Area. The nearest population center is the town of Fallon, Nevada, located 45 km (28 mi) northwest of the site, although evidence of past ranching activities can be found closer to the site.

4.3.1.3 Site-Support Activities. This section provides a brief discussion of site-support activities at the Project Shoal Area.

<u>FACILITIES</u>—There are no existing facilities at the Project Shoal Area.

<u>SERVICES</u>—Services discussed for the Project Shoal Area include law enforcement and security, fire protection, and health care.

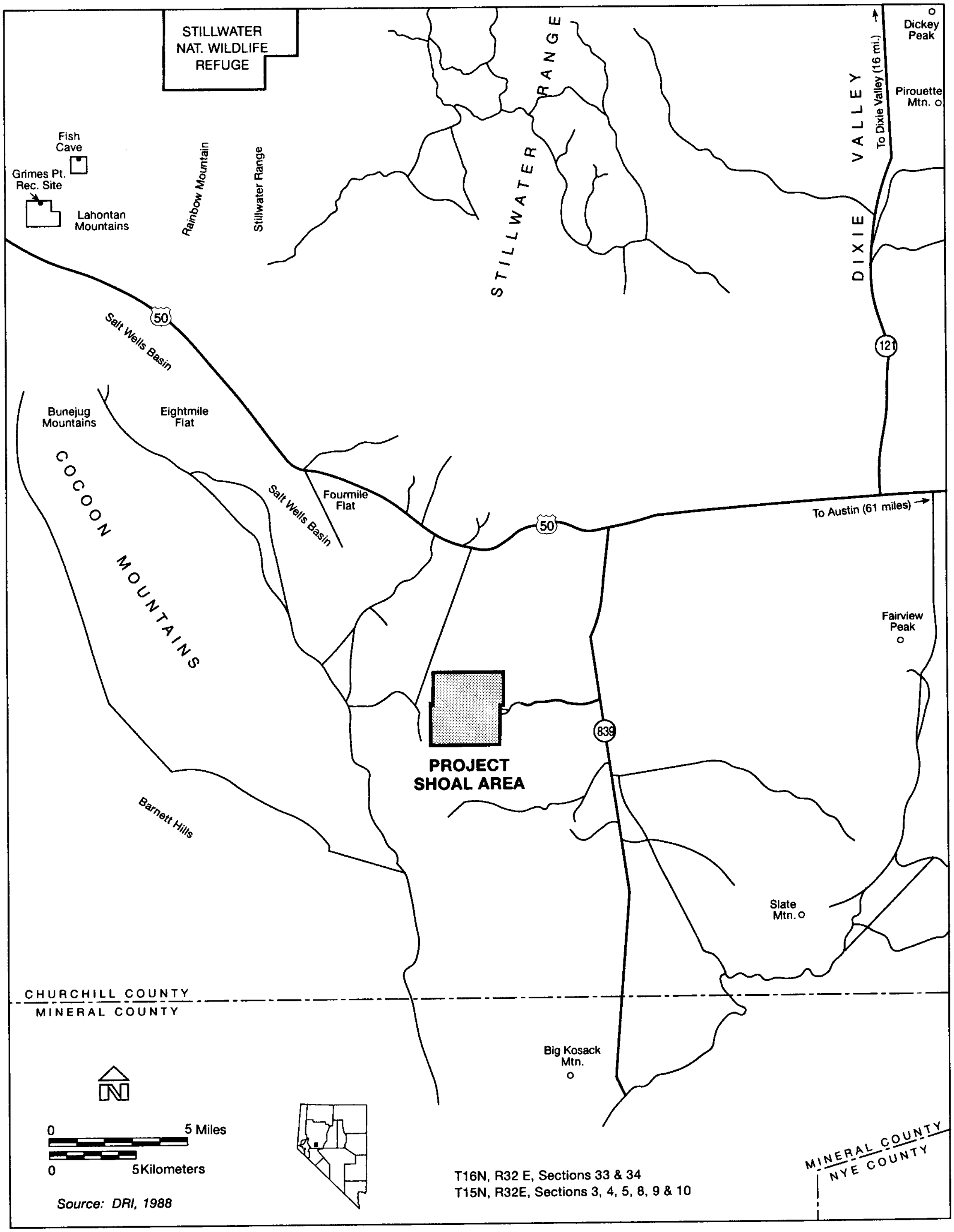


Figure 4-54. Project Shoal Area and surrounding area

Law Enforcement and Security—No security is provided at the Project Shoal Area. Law enforcement is provided by the Churchill County Sheriff's Department.

Fire Protection—Fire protection for the Project Shoal Area is provided by the U.S. Bureau of Land Management.

Health Care—No health care facilities currently exist at the Project Shoal Area.

UTILITIES—No utilities currently exist at the Project Shoal Area.

COMMUNICATIONS—No communication systems currently exist at the site.

4.3.1.4 Airspace. The airspace over the Project Shoal Area is part of the Fallon Range Training Complex located in restricted area R-4812. This area encompasses 453 km^2 (175 mi^2) of public land (see Figure 4-55). This restricted area is a joint-use area, and civilian aircraft are able to fly in the area when it is not being used for military training activities (SAIC/DRI, 1991).

4.3.2 Transportation

No public roads currently exist on the Project Shoal Area. Access to the site during environmental restoration activities would generate only a minor amount of traffic on local access roads and the immediate regional highway (U.S. Highway 50), which are currently underused. In 1993, the average daily traffic on U.S. Highway 50 near the site was 1,340 vehicles (NDOT, 1993a). This traffic volume is far below the capacity of U.S. Highway 50 at this location, which ranges from 10,000 to 20,000 vehicles.

4.3.3 Socioeconomics

The majority of DOE/NV workers, including those assigned to projects at the Project Shoal Area, live in Clark or Nye counties (DOE, 1994b). An analysis of socioeconomic conditions in Clark and Nye counties is presented in Section 4.1.3.

4.3.4 Geology and Soils

Physiography, geology, and soils are addressed in this section. Also discussed are seismic issues.

4.3.4.1 Physiography. The Project Shoal Area is within the Basin and Range Physiographic Province. Section 4.1.4.1 contains a description of this physiographic province. The area immediately surrounding the site is a high, gently rolling plateau, falling steeply away to valleys on the east and west (AEC, 1970).

The Project Shoal Area is located on Gote Flat in the northern portion of the Sand Springs Range. The range is a low, north-south-trending formation approximately 32 km (20 mi) long and 5 to 8 km (3 to 5 mi) wide. Total relief between the range and valley is 503 m (1,650 ft) (AEC, 1970). The range is bordered on the east and west by the similarly trending alluvial valleys of Fairview Valley and Fourmile Flat, respectively. Large faults are presumed to separate the range from the valleys to the east and west (AEC, 1963). Steeply dipping faults, joints, and shear zones with northwest and northeast orientations are prevalent in the range (AEC, 1970).

4.3.4.2 Geology. Sand Springs Range is composed chiefly of Cretaceous granitic rocks, bordered on both the north and south by Mesozoic metamorphic rocks. Tertiary and Quaternary alluvial and aeolian (wind-blown) deposits occupy the valleys (AEC, 1970). Locally, both the granitic and metamorphic rocks are overlain by Tertiary and Quaternary volcanic rocks, and the surface ground zero area is overlain by Quaternary alluvium. Numerous dikes composed of aplite-pegmatite, andesite, and rhyolite intrude the granite. The Project Shoal Area test was detonated in the Cretaceous granite.

There are 18 mines within 84 km (52 mi) of the Project Shoal Area surface ground zero. Two inactive tungsten mines are within 6 km (4 mi) of the site. The closest marginally active mine is a gold mine 8 km (5 mi) north of the site (AEC, 1970).

The area surrounding the Project Shoal Area is seismically active, and future earthquakes could cause rearrangement of the rubble in the test

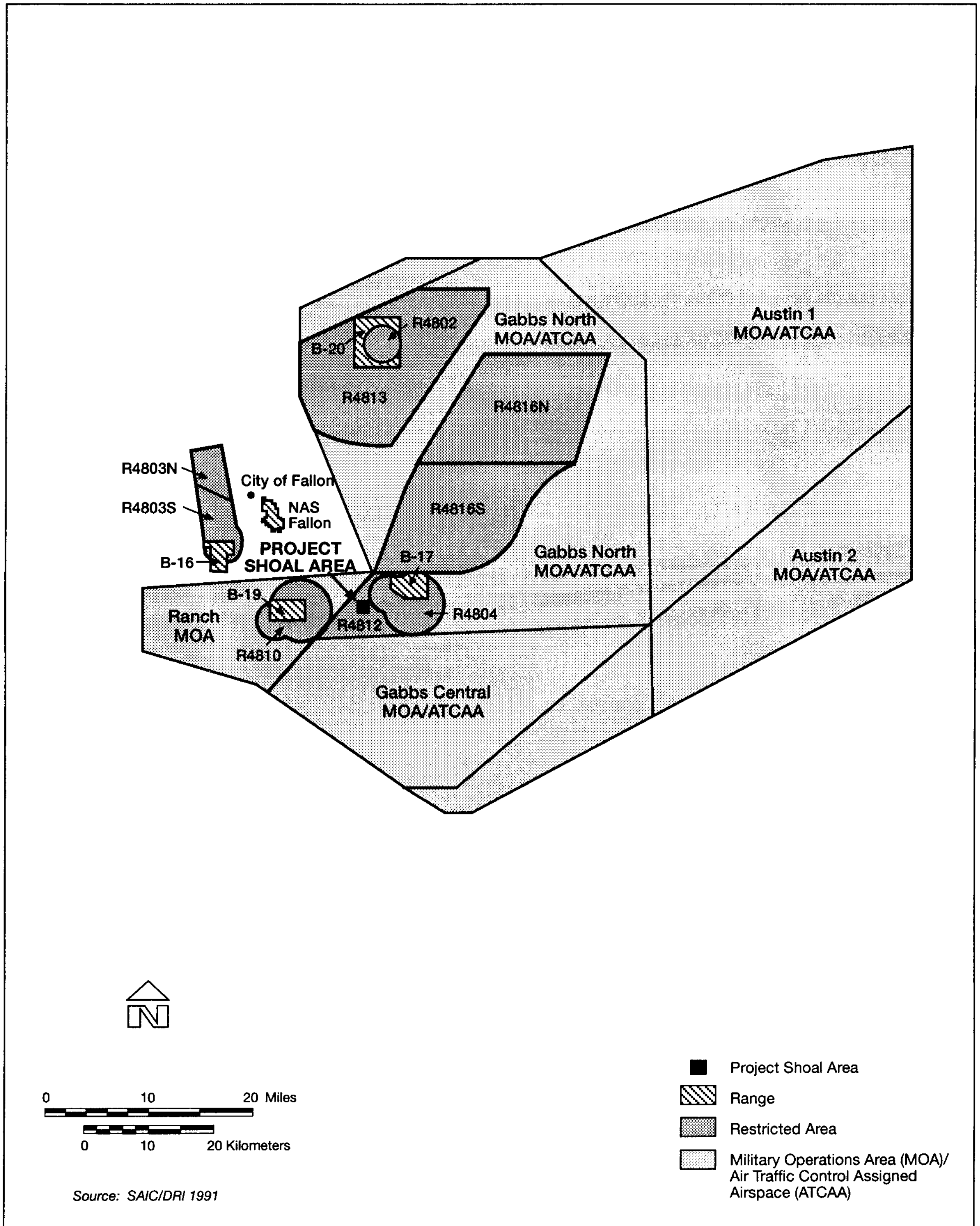


Figure 4-55. Project Shoal Area airspace

chimney and further collapse of the ceiling. However, with more than 244 m (800 ft) of granite between the top of the chimney and the land surface, a complete collapse of the chimney resulting in release of radioactivity to the surface is unlikely (DRI, 1988).

4.3.4.3 Soils. Soil at the Project Shoal Area consists of the Chill series, a gravelly, sandy loam with the soil surface covered by approximately 10 percent fine pebbles. The Chill series consists of very shallow and shallow well-drained soils, formed in residuum of granitic bedrock on low hills (Dahl, 1994).

4.3.5 Hydrology

This section addresses surface water and groundwater conditions at the Project Shoal Area. A discussion of wells in the vicinity is also presented in this section.

4.3.5.1 Surface Hydrology. The Project Shoal Area is within the Great Basin (AEC, 1970). There are no permanent bodies of water in the Project Shoal Area (DRI, 1988), only ephemeral streams fed by seasonal snow and rain. The ephemeral nature of the streams makes water monitoring difficult; consequently, there are no surface-water quality data. Ephemeral streams originating in the higher elevations of Aplite Ridge flow in an easterly direction across the site. The only springs in the area are the Bucky O'Neil Flowing Well, located 7.2 km (4.5 mi) northwest of surface ground zero on the edge of Fourmile Flat; and the Smith-James Spring, located 8 km (5 mi) southeast of surface ground zero on the edge of Fairview Valley.

4.3.5.2 Groundwater. The mountain range around the Project Shoal Area is a regional groundwater recharge area, with regional discharge occurring both in the Fourmile and Eightmile Flats area to the west of the range, and in the Humboldt Salt Marsh in Dixie Valley to the northeast of the range (Figure 4-56). The University of Nevada (1965) analyzed hydrologic data in the Project Shoal Area and concluded that a groundwater divide may exist northwest of the event and that the main component of lateral movement of groundwater near ground zero is southeast toward Fairview Valley. (Cohen and Everett, 1963) and (Glancy and Katzer, 1975) also identify a groundwater divide just west of the Project Shoal area, apparently based on a topographic divide. Though the hydraulic data suggest flow to the east from the site, hydrochemical parameters suggest flow to the west (University of Nevada, 1965), and available data are not sufficient to rule out either the east or west pathway.

At the Project Shoal Area, groundwater occurs within fractured granite. Hydraulic tests conducted at the time of the Project Shoal Area test showed that there was a range of conditions in the granite, depending on fracture geometry relative to the wells, but that overall the transmissive capacity was low. This transmission capacity is expected to be less than 2.5 m^2/day (200 gal/day/ft) (University of Nevada, 1965). In general, groundwater occurs about 290 m (951 ft) belowground surface in the immediate vicinity of the test, although a few high-altitude springs discharging from perched zones in the granite can be found to the south. In the adjacent valleys, groundwater occurs in alluvial material eroded from the highlands, and hydraulic testing indicated much higher transmissivities. These are on the order of 62 m^2/day (5,000 gal/day/ft) to 944 m^2/day (76,000 gal/day/ft) (University of Nevada, 1965). Granitic bedrock is relatively near the surface beneath a veneer of alluvium west of the Sand Springs Range. Farther to the west, and in Fairview Valley to the east, bedrock occurs at greater depths and is not penetrated by wells. Discharge of water originating in the Sand Springs Range occurs at springs and by evapotranspiration along the edge of the salt pan in Fourmile Flat. Data from a well completed in the alluvium between the range and the salt pan suggest that a counterflow of dense, saline water may be moving back toward the range from the playa, driven by buoyancy forces, with fresh water moving from the Sand Springs Range being confined to a thin lens at the top of the saturated zone (Chapman et al., 1995). The alluvium is much thicker in Fairview Valley, and the groundwater occurs in at least three separate aquifers separated by clay aquitards. No discharge to the surface occurs in Fairview Valley; rather, groundwater moves northward to discharge areas in Dixie Valley. The Long-Term Hydrologic Monitoring Program

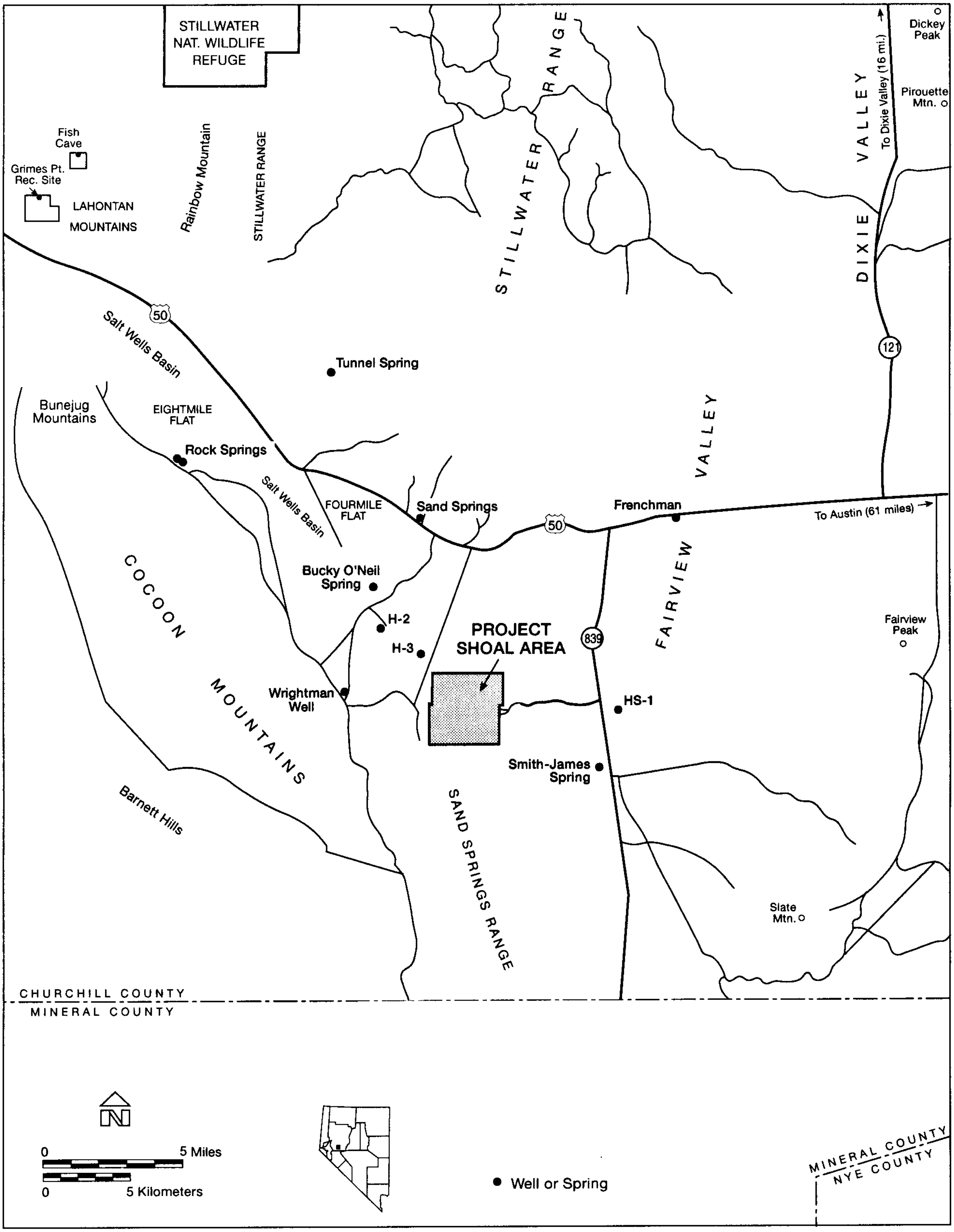


Figure 4-56. Location of wells and springs in the Project Shoal Area

samples one spring in the Sand Springs Range and five wells in the adjacent valleys. No contamination related to the Project Shoal Area test has been detected in these samples. The Environmental Restoration Program will evaluate the need for additional hydrology studies and expanded monitoring at the Project Shoal Area.

Six water wells exist within 4 miles of the site: one domestic water supply well, one livestock well, and four U.S. Bureau of Land Management exploratory wells. The only wells in the Sand Springs Range itself are associated with mining operations to the south of the Project Shoal Area. Groundwater is used in both of the adjacent valleys for stock watering, primarily on a seasonal basis. Groundwater quality is poor in the Fourmile Flat basin because of high dissolved solids, with better quality water found in Fairview Valley. Although there is a well at an apparently abandoned homestead in Fourmile Flat (Wightman Well), and there is a well at the location of a former store (known as Frenchman Station) in Fairview Valley, groundwater in the area is not currently used for private domestic supply. The perennial yield of Fairview Valley has been estimated at 16,741 m^3 (500 acre-feet) (Cohen and Everett, 1963). The yield of the Fourmile Flat area is unknown; it was grouped with a large area of the Carson Desert for the resource appraisal, but estimates of groundwater discharge exceeded estimates of groundwater recharge for the region (Glancy and Katzer, 1975).

4.3.6 Biological Resources

The scientific names of plants and animals mentioned in this section are given in Section 2.0 of Appendix E, Biological Resources. The Project Shoal Area is within the Great Basin desert. The vegetation surrounding the site varies with elevation and topography. Salt Wells Basin is located about 10 km (6 mi) northwest of the Project Shoal Area in Fourmile Flat and lies at an elevation of about 1,201 m (3,940 ft). This basin has a dry, saline lake bed vegetated only by saltgrass where sufficient moisture is available. Sand dunes are located along the northeast edge of the lake bed and extend along its eastern edge. The northern end of these dunes have no vegetation, but the southern extension contains sparse stands of greasewood, glandular indigo bush, four-winged saltbush, and shadscale. Several springs and wells occur around the lake bed and dunes. Sedges, rushes, and desert saltgrass are common where seep areas and overflow from the wells sustain small oases of vegetation.

Between the lakebed and the Sand Springs Range are shallow-sloped foothills dominated by the shrubs greasewood, shadscale, rabbitbrush, horsebrush, and glandular indigo bush. Steep, rocky slopes occur along a narrow zone between the shallow-sloped foothills and Gote Flat. These steep slopes are dominated by Nevada ephedra, rabbitbrush, horsebrush, big sagebrush, and snowberry. The highest elevations at this site, 1,500 to 1,800 m (4,920 to 5,910 ft), are dominated by big sagebrush.

It is likely that few animal species use the dry lake bed. Animal species occupying the surrounding habitats are probably widespread and similar to those described for the Tonopah Test Range and the Great Basin desert portions of the NTS. Chukar is the only common game species in the area (BLM, 1983).

No current federally threatened, endangered, or candidate plant or animal species are known to occur at the Project Shoal Area, although bald eagles and peregrine falcons may be rare migrants. The U.S. Fish and Wildlife Service published the latest list of candidate plants and animals on February 28, 1996 (61 F.R. 7596). Prior to this, 10 vertebrate species, 4 invertebrate species, and 2 plant species that were identified as potentially occurring at this site were classified as candidates (Mendoza, 1995b) and were addressed (Table 4-30). The updated Notice of Review has removed all but one of these species from candidate status. The mountain plover, which may be an uncommon migrant in the area, remains a candidate bird species. The western burrowing owl, one of over 20 State-protected bird species, is likely to occur on site.

4.3.7 Air Quality and Climate

This section includes a description of air quality conditions at the Project Shoal Area, including climatology, meteorology, and ambient air quality.

CLIMATOLOGY AND METEOROLOGY—Meteorological measurements are not available for the Project Shoal Area. Based on Nevada climatological maps of temperature and precipitation (Ruffner, 1980), temperatures would be 2 to 3 °C (4 to 5 °F) cooler than those on the Tonopah Test Range (see Section 4.2.7). Mean annual precipitation is estimated to be about 20 cm (8 in.). Wind patterns are similar to those that occur on the Tonopah Test Range.

AMBIENT AIR QUALITY—The Project Shoal Area is located in Nevada Intrastate Air Quality Control Region 147. There are no air-quality monitoring stations in the region. Because there are no significant sources of pollutant emissions in the region, the air quality is most likely good. Air Quality Control Region 147 is designated as unclassifiable/attainment for all criteria pollutants.

4.3.8 Noise

The acoustic environment around the Project Shoal Area can be classified as uninhabited desert or small rural communities. Noise measurements have not been made at the Project Shoal Area. The major sources of noise would be associated with prevailing meteorological conditions, such as wind, or would result from sonic booms produced by supersonic overflights of military aircraft. Training ranges used by the Naval Air Station, Fallon, are located several miles from the Project Shoal Area. These training ranges are used for gunnery, explosive ordnance, and bombing practice activities. C-weighted (L_{dn}) resulting from these range activities are less than 65 dB at the Project Shoal Area (SAIC/DRI, 1991). Noise from traffic on U.S. Highway 50, which is 6 km (4 mi) to the north, has negligible effect on the Project Shoal Area.

4.3.9 Visual Resources

The landscape character of the Project Shoal Area is typical of the Great Basin. Regional topography consists of mountain ranges arranged in a north-south orientation, separated by broad valleys. The landscape at the Project Shoal Area is common to the region. Therefore, scenic qualities have been designated Class C. State Route 839, which is 3 km (2 mi) east of the site, has an average daily traffic of 160 vehicles (NDOT, 1993a). Therefore, the sensitivity level would be low.

4.3.10 Cultural Resources

The Project Shoal Area lies in the western Great Basin, an area with a prehistory that may span the past 10,000 years or more. Properties ranging from the early prehistoric period to historic mining and ranching sites are known. Historical contexts are summarized in (Hardesty, 1982) and in (Bard et al. 1981). At the time of contact with Euroamericans in the mid-1800s, the area was used by the *Toedokado* band of the Northern Paiute (Stewart, 1939). Their territory centered around camps on the edge of the Carson Sink, northwest of the project area. Detailed information about the Northern Paiute can be found in (Stewart, 1939), (Bard et al., 1981) and (Fowler and Liljeblad, 1986).

The Project Shoal Area consists of three separate land areas with a total area of approximately 2,560 acres (SAIC/DRI, 1991). An area of potential effect for the cultural resources at the Project Shoal Area is based on research performed in the area for environmental restoration at the site. Environmental Restoration Program activities involve sampling wells and springs within 16 km (10 mi) of ground zero. Based on that sampling strategy, an area of potential effect was created and a stratified, random sample survey of the area of potential effect was conducted to characterize the cultural resources of the area.

RECORDED CULTURAL RESOURCES—Eleven archaeological sites have been recorded within the area of potential effect. Of the 11 sites, 1 is an extractive locality, 4 are processing localities, 1 is a station, and 5 are historic sites. Five sites have been recommended as eligible for listing on the National Register of Historic Places. Consultation with the SHPO regarding eligibility of these sites is not concluded.

SITES OF AMERICAN INDIAN SIGNIFICANCE—This study area is not within the traditional lands of the American Indian people represented by the CGTO. It is recommended by the CGTO that the DOE EIS team directly contact American Indian tribes and *organizations having traditional lands in the Project Shoal Area. The following tribes were suggested: Fallon Paiute, Walker River Paiute, Pyramid Lake, and Lovelock Paiute Tribe.*

NOTE: The DOE/NV provided notification, as recommended by the Consolidated Group of Tribes and Organizations.

4.3.11 Occupational and Public Health and Safety and Radiation

Approximately 3×10^{11} Ci of radioactivity existed 1 minute after detonation of the Project Shoal Area test (Glasstone and Dolan, 1977). This amount of radioactivity was reduced by a factor of more than 2,000 during the first day after detonation. Virtually all radioactivity associated with the detonation is assumed to be confined to the puddle-glass mixture at the bottom of the shot cavity chimney. There is no evidence of venting of particulate matter during or after the explosion. Groundwater in the vicinity of the detonation is assumed to be contaminated with tritium. Historical groundwater monitoring in the vicinity of the Project Shoal Area has been performed by the EPA as part of the Long-Term Hydrologic Monitoring Program. Monitoring results demonstrate that the tritium concentration is below the EPA limit for drinking water (EPA, 1992).

Low groundwater velocities indicate that migration of radionuclides to the nearest water supply well would take 750 years (DRI, 1988). Calculations indicate that tritium would decay to negligible levels long before reaching potential receptors (DRI, 1988).

Minor levels of radioactivity were released and reached the surface during drilling and sampling operations subsequent to the detonation. The releases consisted of gases and vapors that were safely channeled into filters and traps. Historical records indicate that the radioactive material was slightly contaminated with short-lived radioisotopes of iodine and xenon. The radioactive material was placed in the post-shot mud pit and covered with several feet of uncontaminated earth. These isotopes have since decayed to negligible concentrations below detectable levels. A recent radiological survey of the surface showed no radiation levels above natural background (DRI, 1988).

4.3.12 Environmental Justice

Existing demographic conditions for Environmental Justice are discussed in Section 4.1.12.

4.4 Central Nevada Test Area

The existing environmental conditions of the Central Nevada Test Area are described in this section.

The Environmental Restoration Program activities at the Central Nevada Test Area would not have the potential to impact waste management, transportation, socioeconomics, or occupational health and safety. Therefore, development of a detailed baseline for these issues is not warranted. A brief explanation as to why these issues are not described is as follows:

- Waste Management—No waste management facilities exist at the Central Nevada Test Area. Any waste generated during the course of Environmental Restoration Program activities would be transported to either the NTS or a permitted hazardous waste facility.
- Transportation—No public roads currently exist at the Central Nevada Test Area. Access to the site during Environmental Restoration Program activities would only generate a minor amount of traffic on local roads. Transportation of investigation-derived and remediation-generated waste is discussed in Section 4.1.2.3.
- Socioeconomics—No new facilities will be located at the Central Nevada Test Area.
- Occupational Health and Safety—Any environmental restoration activities occurring at the Central Nevada Test Area would be required to comply with applicable DOE orders and directives concerning occupational health and safety as described in Section 4.1.11.

4.4.1 Land Use

The closest permanent habitation to the Central Nevada Test Area is the Hot Creek Ranch, located 16 km (10 mi) southwest of surface ground zero. The nearest population center is the town of Tonopah, located 97 km (60 mi) southwest of surface ground zero.

The Central Nevada Test Area is located in the north-central part of Hot Creek Valley, a remote desert area in south-central Nevada, 97 km (60 mi) northeast of Tonopah, in Nye County, Nevada, and 52 km (32 mi) northeast of Warm Springs, Nevada (Figure 4-57). A portion of this area is also within the Toiyabe National Forest. The Central Nevada Test Area was obtained by the Atomic Energy Commission for the purpose of developing potential alternative sites for nuclear testing activities. Several emplacement holes were drilled in anticipation of future events; however, Project Faultless was the only nuclear test conducted at the Central Nevada Test Area. The event was conducted on January 19, 1968, at a depth of 975 m (3,200 ft), and had a yield of approximately 1 megaton (DOE, 1994a).

4.4.1.1 Public Land Orders and Withdrawals. The Central Nevada Test Area consists of two non-contiguous areas that were withdrawn by Public Land Order 4338; 640 acres for the Project Faultless detonation, and Public Land Order 4748 (1,920 acres) for a total of 2,560 acres. (SAIC/DRI, 1991). Although surface is not controlled, subsurface access is restricted by the DOE.

4.4.1.2 Land Use Designations. Site-support activities, such as movable trailer modules for use as offices, dining facilities and dormitories, tanks, power lines, underground cables, and an airstrip existed only temporarily at the Central Nevada Test Area during preparation, testing, and demobilization. Demobilization activities began in 1973, when all facilities except the Base Camp, Control Point, Noname Hill, and the airstrip were removed. Numerous drillholes used for subsurface soil and groundwater sampling were plugged; however, four wells have been left open for hydrologic monitoring on the site (DRI, 1988). Aside from this long-term hydrologic monitoring site, land use is confined to cattle grazing and recreation.

4.4.1.3 Site-Support Activities. Site-support at the Central Nevada Test Area is described in this section.

FACILITIES—There are no existing facilities at the Central Nevada Test Area.

SERVICES—Services described at the Central Nevada Test Area are law enforcement and security, fire protection, and health care.

Law Enforcement and Security—No security is provided at the Central Nevada Test Area. Law enforcement is provided by the Nye County Sheriff's Department.

Fire Protection—Fire protection for the Central Nevada Test Area is provided by the U.S. Bureau of Land Management.

Health Care—No health care facilities currently exist at the Central Nevada Test Area.

UTILITIES—The Central Nevada Test Area does not contain utility systems.

COMMUNICATIONS—No communication systems are currently located at the site.

4.4.1.4 Airspace. The Central Nevada Test Area is not located beneath any special-use airspace used for DOE or defense-related purposes.

4.4.2 Transportation

No public roads currently exist on the Central Nevada Test Area. Access to the site during environmental restoration activities would generate only a minor amount of traffic on local roads and the immediate regional highway (U.S. Highway 6), which are currently under-used. In 1993, U.S. Highway 6 near Warm Springs carried an average of 145 to 210 vehicles per day. This traffic volume is far below the two-way vehicle capacity of U.S. Highway 6 at this location, which is approximately 1,700 vehicles per hour.

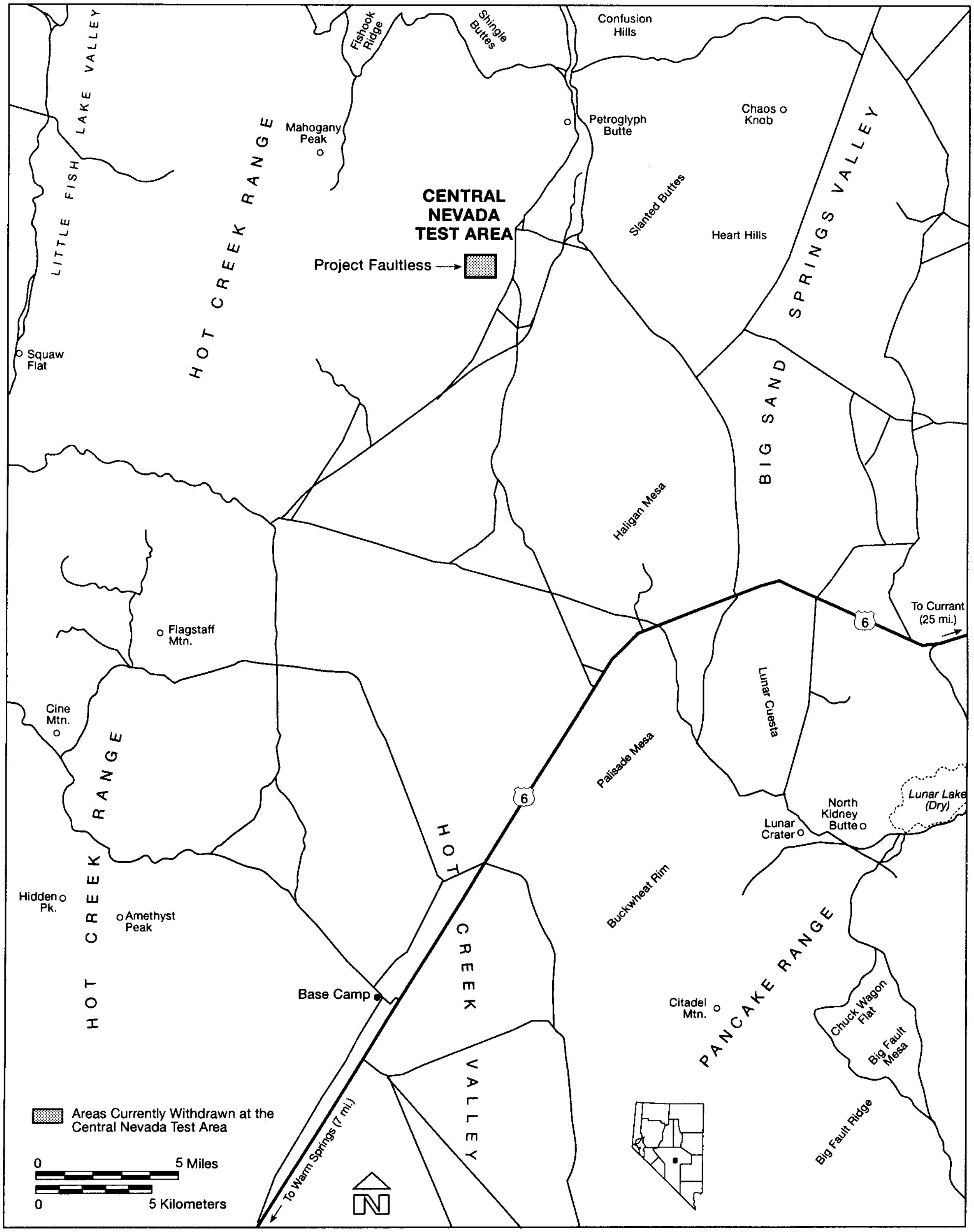


Figure 4-57. Central Nevada Test Area and surrounding area

4.4.3 Socioeconomics

The majority of DOE/NV workers, including those assigned to projects at the Central Nevada Test Area, live in Clark or Nye counties (DOE, 1994b). An analysis of socioeconomic conditions in Clark and Nye counties is presented in Section 4.1.3.

4.4.4 Geology and Soils

Physiography, geology, and soils are addressed in this section for the Central Nevada Test Area.

4.4.4.1 Physiography. The Hot Creek Valley is within the Basin and Range Physiographic Province. See Section 4.1.4.1 for a description of this province. The valley is about 113 km (70 mi) long on its north-south axis and varies in width from 16 to 32 km (10 to 20 mi). The Project Faultless site is in the north-central portion of the valley (AEC, 1973b). The Hot Creek Range lies immediately to the west and rises to an elevation that is 1,219 m (4,000 ft) above the site.

4.4.4.2 Geology. The mountains immediately west of the site are composed of volcanic rocks interlayered with sedimentary units (Stewart and Carlson, 1978). The thick alluvial fill of Hot Creek Valley displays little evidence of the structural framework or stratigraphy of the valley; therefore, the primary source of subsurface geologic data is the several exploratory holes that were drilled in the area. The Project Faultless emplacement hole (UC-1) penetrated alluvium from the surface to a depth of 732 m (2,400 ft). The alluvium is underlain by tuffaceous sediments and zeolitized tuff from 732 to 998 m (2,400 to 3,275 ft), which includes the total depth of the hole. The geologic media at the shot point consisted of tuffaceous sediments and zeolitized nonwelded tuffs (DRI, 1988).

The Project Faultless test, detonated in the saturated zone, created a large cavity. The estimated radioactivity at one minute after shot time was 3×10^{13} Ci. The event resulted in numerous surface fractures up to 2,743 m (9,000 ft) in length, with vertical displacement up to 5 m (15 ft) and horizontal offset up to 1 m (3 ft). The explosion resulted in the formation of an irregularly-shaped subsidence block of approximately 372 m^2 (4,000 ft^2), bounded by local faults in the surface ground zero area (DRI, 1988).

Although Hot Creek Valley has historically been the site of significant mineral production, most deposits have been fully developed and mining activity is now limited to a few small operations. According to (Kleinhampl and Ziony, 1984), historic production has included antimony, barite, gold, lead, silver, turquoise, uranium, and zinc. Most of this production came from two mining districts, the Morey District from 1866 to 1953 and the Danville District from 1866 to 1950.

Because of the proximity of Hot Creek Valley to the largest producing oil fields in Nevada (in Railroad Valley), there has been limited interest in oil and gas exploration. According to (Garside et al. 1988) and (Hess and Davis, 1995), only two oil wells have been drilled in Hot Creek Valley. The Hot Creek Federal No. 24-13 well was drilled in 1981 to a total depth of 3,361 m (11,028 ft). Although this well exhibited numerous gas shows below a depth of 2,710 m (8,890 ft), no oil was found, and no production came from the well. The other well, Warm Springs Federal No. 10-14, was drilled in 1981 to a total depth of 2,798 m (9,180 ft) with no reported shows of either gas or oil.

4.4.4.3 Soils. Soils most likely encountered at the Central Nevada Test Area range from rock outcrops and stony-cobbly alluvial fans to fine-loamy, and sometimes calcareous, soils (Cox et al., 1977). These are also referred to as Xerollic Durargids, Xerollic Durarthids, and Typic Durargids.

4.4.5 Hydrology

This section contains the discussion of surface water and groundwater conditions at the Central Nevada Test Area. A discussion of wells in the vicinity is also presented in this section.

4.4.5.1 Surface Hydrology. The Central Nevada Test Area, located in Hot Creek Valley, is within the Great Basin hydrographic region. This region is characterized by the alluvium-covered topographically closed valleys and elongated north-south trending mountain ranges typical of the Basin and Range Physiographic Province. Hot Creek Valley is bordered by the Hot Creek Range on the west and the Pancake Range on the east. The topography of the region controls the surface water drainage (DOE/NV 1992), with the higher elevations receiving more precipitation than the lower elevations. Perennial surface waters are limited to low-discharge springs that travel a short distance before evaporating or infiltrating back into the ground (DOE, 1986). The Hot Creek Range hosts numerous springs that flow away from the site. The nearest spring to the site is 5 km (3 mi) away. No perennial streams cross the Central Nevada Test Area, and there are no permanent surface water bodies. Morey Canyon and South Canyon are prominent ephemeral streams that pass through the Central Nevada Test Area to Moore's Station Wash, 2 km (1 mi) east of the site. Owing to the intermittent flows in these streams, there are no surface-water quality data from streams that cross the Central Nevada Test Area.

4.4.5.2 Groundwater. The hydrogeology of Hot Creek Valley is controlled in part by the basin-and-range topography. The valley is a long graben (an elongated depressed block of crust bounded by faults on its long sides) containing a sequence of Quaternary and Tertiary alluvial fill (up to 1,200 m [3,936 ft]) underlain by Tertiary volcanic rocks. The bounding ranges on either side of the valley contain Paleozoic carbonates overlain by Tertiary age volcanics (Thordarson, 1987). Boreholes close to the site penetrate approximately 610 m (2,001 ft) of alluvium underlain by tuffaceous sediments and volcanic rocks.

The watertable in Hot Creek Valley generally occurs within the alluvium, and groundwater flow is believed to follow the general direction of surface flow (Rush and Everett, 1966; Fiero, 1986). The depth to groundwater in wells drilled at the Central Nevada Test Area ranged from 66 to 168 m (215 to 551 ft) below land surface at the time of drilling in 1967. Recharge occurs in the higher mountain range to the west (Hot Creek Range), with groundwater flowing toward the east-central part of the valley (Figure 4-58). Discharge is by evaporation in low portions of the valley (the area around Twin Springs Ranch), with a minor amount of subsurface flow out of Hot Creek Valley to Railroad Valley (Rush and Everett, 1966). Little information is available on water flow in the bedrock aquifers of the valley. Differences in hydraulic head, water chemistry, and temperature suggest that the alluvium and volcanics are distinct water-bearing zones (Dinwiddie and Schroder, 1971). Head values in the upper 340 m (1,115 ft) of the section indicate that groundwater movement is generally south to southeast. Head values measured in units 1,500 to 2,100 m (4,920 to 6,888 ft) below land surface reveal that the deep component of the flow system moves northeast and east to Railroad Valley. Evaluation of vertical head gradients indicates a potential for downward flow in the north end of the valley (in the immediate test area), while an upward potential for flow exists over the southern part of the valley. Dinwiddie and Schroder (1971) concluded that vertical movement is slow relative to lateral flow, based on the anisotropy of hydraulic properties.

The Project Faultless test occurred in the tuffaceous sediment section, but the resultant cavity extended into the overlying alluvium. The pre-event water-table level was predicted to be reached between the years of 1993 and 2018 (Thordarson, 1987), with recent measurements indicating the level is still depressed by about 50 m (164 ft), but rising at a rate of approximately 8 m/yr (25 ft/yr) (Chapman et al., 1994). Although radionuclide transport from the chimney was not expected until the pre-event water level was reached, logging in the post-shot hole at the site has revealed horizons of water outflow, which, if representative of conditions outside the chimney, suggests that transport could already be occurring (Chapman et al., 1994). The Long-Term Hydrologic Monitoring Program includes sampling of five wells and one spring in Hot Creek Valley. No contamination related to the Project Faultless test has been detected in samples from those wells.

Private wells in Hot Creek Valley are believed to be completed in the upper part of the alluvium section. They are used for domestic, farming, and stock-watering purposes. The perennial yield of Hot Creek Valley is estimated at 7 x 10^6 m^3 (5,500 acre-feet) (Rush and Everett, 1966). Some springs in the area have elevated temperatures and chemical characteristics that indicate they could be discharge points for deeper, regional flow systems. The

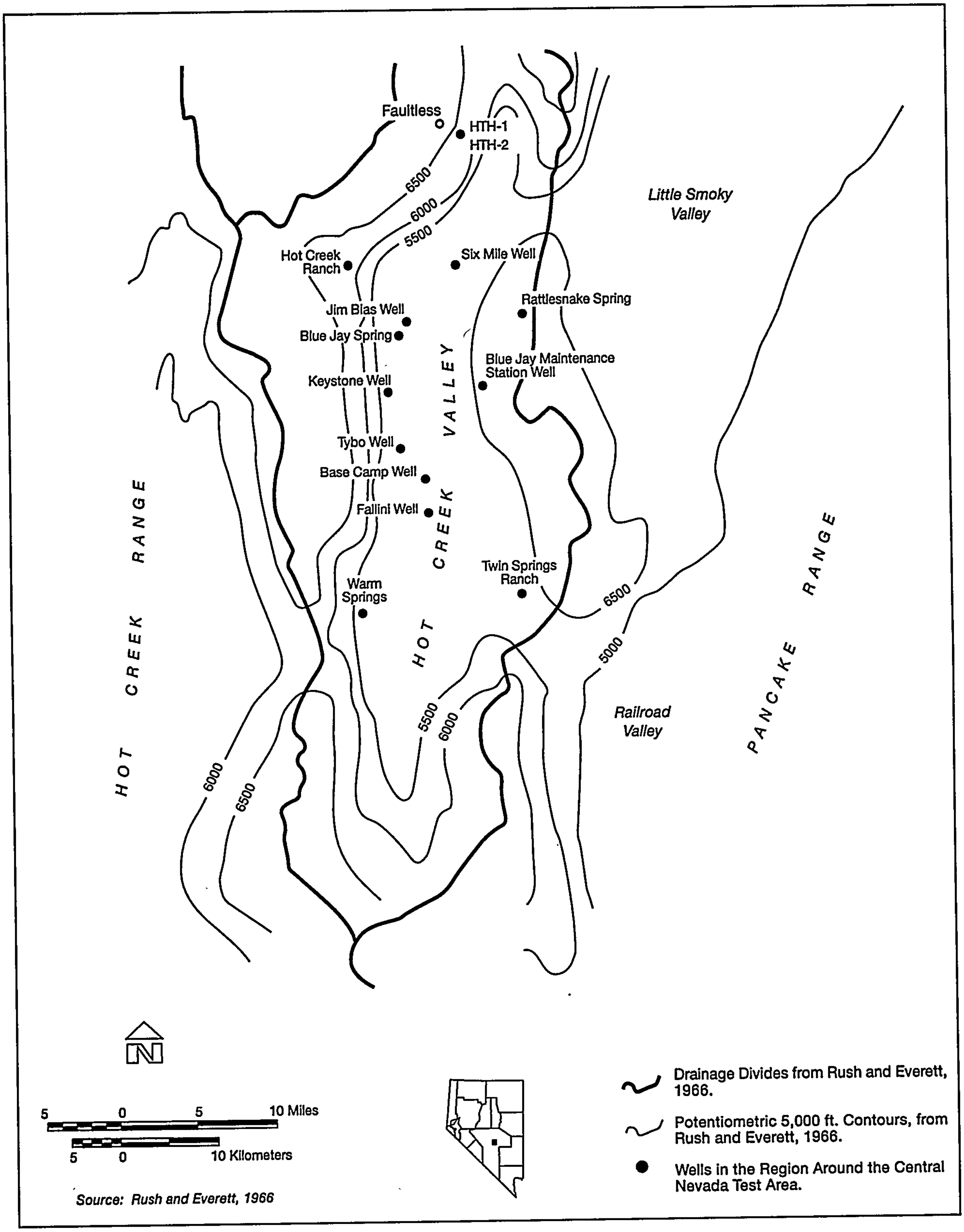


Figure 4-58. Hydrogeologic features of the Central Nevada Test Area

sparse data indicate that groundwater quality is generally good, although salinity increases in the natural discharge area near Twin Springs Ranch (Rush and Everett, 1966).

4.4.6 Biological Resources

The scientific names of plants and animals mentioned in this section are given in Section 2.0 of Appendix E, Biological Resources. The Central Nevada Test Area is at an elevation of about 1,861m (6,104 ft). This site and the rest of Hot Creek Valley has vegetation typical of the Great Basin region. The valley bottom is dominated by big sagebrush, with scattered rabbitbrush and Indian ricegrass. At the slightly higher elevations in the big sagebrush, with scattered rabbitbrush and Indian ricegrass. At the slightly higher elevations in the foothills surrounding the valley, sagebrush, pinyon pine, and juniper form an open woodland (EG&G/EM, 1993a). The most common plants found at the springs and wells in this valley and the surrounding mountains are sedges, rushes, and desert saltgrass. Disturbed sites in the valley are dominated by exotic weeds, such as halogeton, goosefoot, Russian thistle, and tansy mustard.

Animal species are probably similar to those found on the Tonopah Test Range. Mule deer are year-round inhabitants (BLM, 1993), and wild horses, pronghorn, and mourning dove are known to use springs in the area (EG&G/EM, 1993a).

No current federally threatened, endangered, or candidate plant or animal species are known to occur on the Central Nevada Test Area, although bald eagles and peregrine falcons may be rare migrants. The U.S. Fish and Wildlife Service published the latest list of candidate plants and animals on February 28, 1996 (61 FR 7596). Prior to this, 10 vertebrate species, 1 invertebrate species, and 5 plant species that were identified as potentially occurring at this site were classified as candidates (Mendoza, 1995b) and were addressed (Table 4-30). The updated Notice of Review has removed all of these species from candidate status. The western burrowing owl, 1 of over 20 state-protected birds, may occur at this site.

Five Category 2 candidate plant species may occur in the vicinity of the test area (Cooper, 1993; EG&G/EM, 1993a). None of these species was found within the test area during a survey in 1993 (EG&G/EM, 1993a); however, sanicle biscuitroot was found just south of the site. Sanicle biscuitroot is not endemic to this site and may be found throughout the southern half of Nevada, and in scattered populations in California (Blomquist, et al., 1995).

4.4.7 Air Quality and Climate

This section includes description of air quality conditions at the Central Nevada Test Area, including climatology, meteorology, and ambient air quality.

CLIMATOLOGY AND METEOROLOGY—Meteorological measurements are not available at this site. However, based on climatological maps of temperature and precipitation (Ruffner, 1980), temperatures would be 1 to 2 °C (2 to 4 °F) cooler than those on the Tonopah Test Range (Section 4.2.7). Mean annual precipitation is estimated to be about 20 cm (8 in.). Wind speed and direction characteristics are similar to those that occur on the Tonopah Test Range.

AMBIENT AIR QUALITY—The Central Nevada Test Area is located within Nevada Intrastate Air Quality Control Region. Ambient air quality has not been monitored for criteria pollutants at the Central Nevada Test Area. However, because of the lack of significant pollutant emission sources, the air quality is good. Air Quality Control Region 147 is designated unclassifiable/attainment for all criteria pollutants.

4.4.8 Noise

The acoustic environment of the Central Nevada Test Area and surrounding areas can be classified as uninhabited desert or small rural communities. Noise measurements have not been taken at the Central Nevada Test Area. The major sources of noise would be associated with prevailing meteorological conditions, such as wind. Traffic on U.S. Highway 6, which is 11 km (7 mi) to the southeast, would not have a significant acoustic impact at the Central Nevada Test Area. The only projects anticipated for the Central Nevada Test Area are Environmental Restoration Program projects that would not create loud noises nor would they be affected by loud noises.

4.4.9 Visual Resources

The landscape character of the Central Nevada Test Area is typical of the Great Basin. Regional topography consists of mountain ranges arranged in a north-south orientation, separated by broad valleys. Because this site is located at the east base of the Hot Creek Range, scenic quality has been designated Class B. U.S. Highway 6, 19 km (12 mi) to the southeast, is the closest public highway. It has an average daily traffic of about 200 vehicles. Therefore, the sensitivity level would be low.

4.4.10 Cultural Resources

Archaeological research in the Central Nevada Test Area, and particularly in Hot Creek Valley, has documented the presence of significant cultural resources. Archaeological sites ranging from the early prehistoric period to historic mining and ranching sites are known. These sites have been identified, located, and evaluated by a variety of cultural resources surveys and excavations. A large gap exists in the archaeological database as the research conducted for the Project Faultless project was never incorporated in the statewide inventory. A large collection of between 20,000 and 30,000 artifacts, field notes, photographs, and other records on file at the University of Nevada, Las Vegas, indicates there are over 100 sites within the Central Nevada Test Area that have never been properly recorded (Edwards and Johnson, 1994).

Small bands of Western Shoshone people lived in the project area vicinity. Villages were located at Hot Springs and Twin Springs, while family camps were situated along Hot Creek and Tybo Creek (Steward, 1938 [Figure 4-48]). These groups harvested pine nuts in the southern part of the Hot Creek and Kawich Ranges. They often joined Kawich Mountain people for antelope and rabbit drives in Hot Creek Valley and the Kawich Mountains (Steward, 1938).

The Central Nevada Test Area includes three withdrawn areas of land totaling approximately 2,560 acres (SAIC/DRI 1988). Environmental restoration activities in the region of ground zero of the Project Faultless event have included sampling wells and springs up to 40 km (25 mi) from ground zero. Anticipated Environmental Restoration Program activities will include construction of wells. Thus, an area of potential effect for environmental restoration activities was created, and an overview of all recorded cultural resources and cultural resource surveys was performed.

RECORDED CULTURAL RESOURCES-Twenty-six cultural resource reconnaissance projects have been conducted in the area of potential effect. These projects and other recording projects have yielded just over 100 sites. Among the prehistoric cultural resources are two rock art sites, called stations. One of them, is called Moore's Station in (McLane, 1993:28) because of its proximity to that site. The other site is located in a rock shelter on Palisade Mesa. Prehistoric sites range from as few as four artifacts to extensive concentrations of artifacts and features. An additional site includes three large hearths and abundant flakes, flake tools, and groundstone. Most of the prehistoric sites that have been recorded in the area are smaller sites. The larger, more complex sites have a limited distribution and are in close proximity to water sources. A site found near Rattlesnake Springs includes groundstone and projectile points. Other sites in the area contain hearths and grayware pottery. Among the historic cultural resources are Moore's Station, Hobble Spring, Sixmile Well, a historic site, and Hot Creek Ranch. The latter has an additional site number assigned to the cemetery. Other historic sites in the area include the charcoal kilns located in Fourmile and Sixmile Canyons and the towns of Tybo and Morey (BLM, 1993). The charcoal kilns at Tybo are listed on the National Register of Historical Places. While the information contained in the U.S. Bureau of Land Management site files· suggests that many of the other sites are eligible for the National Register of Historical Places, recommendations have not been made for most of them.

SITES OF AMERICAN INDIAN SIGNIFICANCE—The CGTO knows that there are a variety of cultural *resources contained at the Central Nevada Test Area. Information about this area comes from previous ethnographic research (Steward, 1938) and recent archaeology reports (Edwards and Johnson, 1994). The area contains a number of cultural resources of special interest to the CGTO, including hot springs, cold springs, petroglyph panels, and more than 100 archaeology sites. Earlier archaeology research conducted by the University of Nevada, Las Vegas, collected between 20,000 to 30,000 artifacts. The simple fact that so many artifacts were recovered from this small area indicated the long-term involvement of American Indian people with this site. The CGTO has requested the opportunity to visit the area as part of this EIS in order to more fully understand its cultural significance. Until this site visit occurs, it is impossible to more fully assess the cultural significance of this area.*

4.4.11 Occupational and Public Health and Safety and Radiation

Radioactivity was contained during the Project Faultless test and subsequent drilling and sampling activities (DRI, 1988). A surface radiological survey conducted prior to demobilization of the Central Nevada Test Area detected no radioactivity (AEC, 1973c). A post-shot reentry hole (UC-1-P-2SR) drilled into the chimney serves as a standpipe for measuring water levels and allows samples to be taken of the water entering the chimney. The detonation caused water levels to immediately drop to 646 m (2,120 ft) (Thordarson, 1987). Water levels were observed to fluctuate over time; however, levels did not begin to rise continuously until September 1974 (ERDA, 1977).

Long-term hydrologic monitoring, conducted annually by the EPA, continues at the Project Faultless site. Numerous drillholes were established prior to the shot detonation to measure the effects on localized hydrology (Figure 4-58). Many of these holes were subsequently plugged and abandoned. Two hydrologic test holes, HTH-1 and HTH-2, were left open for monitoring, and Well UC-1-P-2SR remains open to allow sampling from above the shot cavity (DRI, 1988). Four wells and two springs are monitored for tritium on a yearly basis. Two wells, HTH-1 and HTH-2, are used as sampling points and are presumably located downgradient and within 1,494 m (4,900 ft) of the test site. An additional abandoned postdetonation hole (UC-1-P-1S) is periodically monitored (Chapman et al., 1994). In concert with multiple, ongoing groundwater monitoring programs, samples are analyzed for tritium, gross alpha, and gross beta radiation from one or more of the following sites: drill hole UC-1-P-2SR, drill hole HTH-1, HTH-2, Hot Creek Ranch domestic water supply well, 6-Mile Well, Blue Jay Springs, and Blue Jay Maintenance Station Well (DRI, 1988).

Tritium had not been detected in concentrations above background outside the chimney well until recently. Tritium (214 pCi/L) was detected in a water sample obtained from HTH-1 at 236 m (774 ft) in July 1992. The source of the tritium remains unresolved. The detection of tritium in HTH-1 could be the result of an earlier migrating pulse, recent surface recharge, or possibly inadvertent cross-contamination of the well (Chapman et al., 1994). Tritium concentrations in water samples taken from the reentry hole in 1976 varied with the depth of the sample. Results of the analysis ranged from a maximum value of 9.2×10^8 pCi/L at a depth of 789 m (2,590 ft), or 186 m (610 ft) above the detonation point, to a low of 2,200 pCi/L at 576 m (1,189 ft), or 399 m (1,310 ft) above the detonation point. Estimates made in 1977 indicated that radionuclides would not be expected to migrate away from the cavity region until water levels reached predetonation hydraulic equilibrium, estimated to be after 1997, based on average cavity fill rates (ERDA, 1977).

The preliminary Hazard Ranking System score (EPA's ranking system for Superfund cleanup determination) for the Central Nevada Test Area is a low score of 3.54. This score is based primarily on the assumption of a low probability for the migration of radionuclides and that there are no human drinking water receptors in the vicinity of the Central Nevada Test Area (DRI, 1988). Recent field studies by the Desert Research Institute have revealed a more complicated hydrologic system than previously thought (Chapman et al., 1994). As a result, flow away from the cavity may have begun sooner than anticipated and the existing monitoring wells may not be ideally located to intercept potential contaminant plumes.

The Central Nevada Test Area is currently being investigated as part of the DOE's Environmental Restoration Program. The DOE will evaluate the site in consultation with the state regulatory authority to determine what investigations may be required and what responses may be appropriate.

4.4.12 Environmental Justice

Existing demographic conditions for Environmental Justice are discussed in Section 4.1.12. This discussion includes conditions for the Central Nevada Test Area.

4.5 Eldorado Valley

The Eldorado Valley is southwest of Boulder City, Nevada. U.S. Highway 95 to Searchlight, Nevada, transects the valley in a north-south direction. The U.S. Bureau of Land Management patented 107,412 acres of Eldorado Valley to the state of Nevada, at which time this land was transferred to the city of Boulder City. Boulder City has designated 6,000 acres of this land for a Solar Enterprise Zone facility (DOE/NV, 1994b). This zone is excluded from a conservation easement within these transferred lands that is managed for the conservation, protection, restoration, and enhancement of the desert tortoise and its habitat. The DOE would enter into a partnership agreement with the solar industry, Nevada stakeholders, and university systems to develop the solar-generating facilities.

4.5.1 Land Use

Land in Eldorado Valley is used for a limited number of activities as discussed in the following Land-Use Designations section. Also discussed in this section are the site-support activities related to Eldorado Valley.

4.5.1.1 Public Land Orders and Withdrawals. This section is not applicable to Eldorado Valley.

4.5.1.2 Land-Use Designations. Land use in Eldorado Valley is limited primarily to grazing, light industry, and recreational use, including a raceway and windsurfing. Active grazing permits have been issued by the U.S. Bureau of Land Management for the Ireteba Peaks, McCullough Mountains, and Hidden Valley allotments. The Iretaba Peaks and McCullough Mountains allotments have historically provided forage for almost 2,300 animal unit months. The McCullough Mountains allotment is operated by the Nature Conservancy. There is some limited light industry in the northwestern-most part of the basin. The playa area is used for recreation, especially land sailing, and a raceway is situated near the southern end of the playa.

4.5.1.3 Site- Support Activities. Site support in the Eldorado Valley includes three power substations and transmission lines and two natural gas pipe lines.

<u>FACILITIES</u>—No facilities currently exist at the proposed location of a Solar Enterprise Zone facility in Eldorado Valley.

<u>UTILITIES</u>—Two existing 500-kV substations and a third substation under construction are within a few miles of the proposed Solar Enterprise Zone facility in Eldorado Valley: Southern California Edison's Eldorado Substation, Los Angeles Department of Water and Power's McCullough Substation, and the Marketplace Switching Station. When the Marketplace Switching Station is completed, these substations will connect the transmission systems of California, southern Nevada, and Arizona (DOE/NV, 1994b).

Two major Southwest Gas natural gas pipe lines transect Eldorado Valley. One pipe line is immediately adjacent to U.S. Highway 95, and the other pipe line is approximately 2 km (1 mi) west of the highway. Depending on where the proposed Solar Enterprise Zone facility is sited, the pipe lines could be immediately adjacent or up to 10 km (6 mi) away. Both pipe lines are main supply lines for the Las Vegas area and consequently are insufficient to support the Solar Enterprise Zone facility during winter months. An additional 51-cm (20 in) pipe line from an existing main line would be necessary; the nearest main gas pipe line is an

El Paso Gas pipe line south of Laughlin, Nevada, 110 km (68 mi) away (DOE/NV, 1994b).

SERVICES—Services discussed for Eldorado Valley include law enforcement and security, fire protection, and health care.

Law Enforcement and Security—Eldorado Valley is not secured or restricted. Law enforcement is provided by the Clark County Sheriff's Department.

Fire Protection—Fire protection for Eldorado Valley is provided by the U.S. Bureau of Land Management.

Health Care—For health care, first aid stations would be located near field activities, if required.

4.5.1.4 Airspace. Eldorado Valley is located underneath the southeastern portion of the Las Vegas Class B airspace that begins at 2,438 m (8,000 ft) mean sea level. All aircraft operating in this area must be under positive control of Las Vegas Approach Control (see Section 4.1.1.4).

4.5.2 Transportation

This section presents existing transportation at Eldorado Valley. Transportation is discussed with respect to on-site traffic, off-site traffic, transportation of materials and waste, and other transportation.

4.5.2.1 On-Site Traffic. This section is not applicable for Eldorado Valley.

4.5.2.2 Off-Site Traffic. U.S. Highway 95 runs north-south through Eldorado Valley and is a single lane in each direction. At the northern end of the valley, U.S. Highway 95 intersects U.S. Highway 93 approximately half the distance between Boulder City, Nevada and Henderson, Nevada. U.S. Highway 93/95 continues northwestward through Henderson and through Las Vegas where it intersects Interstate 15. At the southern end of the valley at Searchlight, Nevada, U.S. Route 95 intersects east-west trending State Route 164, also a single lane in both directions. State Route 164 intersects Interstate 15, 52 km (32 mi) west of Searchlight. U.S. Route 95 continues south of Searchlight for 30.6 km (19 mi), where it intersects State Route 163, and continues an additional 39 km (24 mi) south where it intersects U.S. Highway 40 at Needles, California. From U.S. Highway 95, State Highway 163 continues 34 km (21 mi) to Laughlin, Nevada, where it continues east through Arizona to Kingman as State Route 68. In 1993, U.S. Route 95 just south of Boulder City had an average annual daily traffic of 6,600 vehicles and operated at a level of service B.

4.5.2.3 Transportation of Materials and Waste. Transportation of waste and materials at a Solar Enterprise Zone facility location is not expected. Therefore, this section is not applicable.

4.5.2.4 Other Transportation. Air or rail transportation of workers or materials to Eldorado Valley has not been proposed; therefore, these facilities have not been examined in detail. The nearest rail line to the Eldorado Valley site is the Union Pacific line in Boulder City, which connects Boulder City with Las Vegas. No rail spur exists on a Solar Enterprise Zone facility site. Airfield facilities do not exist on the site. The nearest airfield is in Boulder City. Traffic information in the vicinity of a Solar Enterprise Zone facility in Eldorado Valley is presented in Section 4.5.2.2, Off-Site Traffic.

4.5.3 Socioeconomics

Eldorado Valley is located within Clark County, and this county's existing socioeconomic conditions are addressed and characterized in Section 4.1.3.

4.5.4 Geology and Soils

Physiography, geology, and soils are addressed in this section. Also briefly discussed are seismic activities and geologic resources.

4.5.4.1 Physiography. Eldorado Valley is a topographically closed basin of 1,373 km² (530 mi²) (see Figure 4-59). Elevations range from about 2,152 m (7,060 ft) on the west at McCullough Mountain to 521 m (1,708 ft) at the playa in the north-central part of the valley. On the east, the Eldorado Mountains rise to elevations only slightly

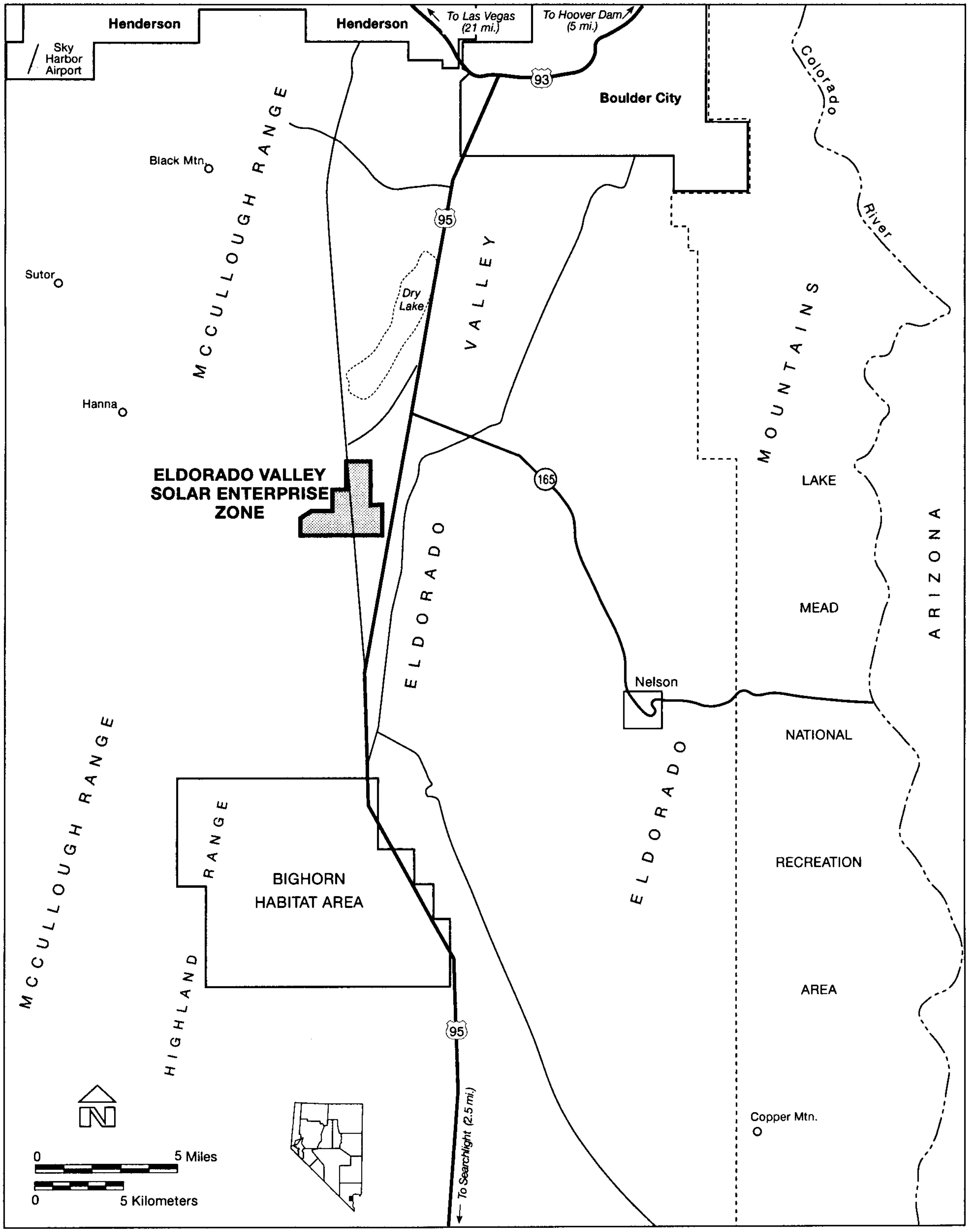


Figure 4-59. Eldorado Valley and surrounding area

above 1,524 m (5,000 ft). On the south, Eldorado Valley is separated from Paiute Valley by the Highland Range and unnamed highlands of the Searchlight district. On the north, Eldorado Valley is bounded by the Black Hills and the River Mountains. On the valley floor, the dominant feature is the playa in the north-central part of the basin and the numerous washes that drain the upland areas.

4.5.4.2 Geology. The general geologic conditions and mineral deposits of Eldorado Valley have been detailed by the Nevada Bureau of Mines and Geology (Longwell, et al., 1965). The general geology of Eldorado Valley includes a number of geologic units. The rocks and valley-fill deposits may be categorized into five types: (1) alluvial deposits, (2) older gravels, (3) volcanics, (4) granite, and (5) metamorphics.

Alluvial deposits occur in the valley-floor area and include interbedded sequences of gravel, sand, silt, and clay. These deposits are generally unconsolidated, but may be cemented in the vicinity of fault zones or where mineralized water is present. A test well near the playa penetrated more than 305 m (1,000 ft) of alluvium. Older gravels of Late Tertiary to Early Quaternary age crop out near the Searchlight area. These deposits are generally weakly consolidated, but include well-lithified fanglomerates, conglomerates, and arkoses.

Volcanic rocks of Quaternary, Tertiary, and Cretaceous ages crop out in the mountain masses of the northern half of the McCullough Range, the entire Highland Range, and in the northeastern Eldorado Mountains. Where present, the volcanic rocks reach thicknesses of 610 m (2,000 ft) to 1,219 m (4,000 ft) in some areas. These rocks include a number of discrete geologic units, including andesite, rhyolite, diorite, and tuff.

Granitic rocks of Tertiary and Precambrian age (including granites, quartz monzonites, and porphyritic granites) occur in the central and southern Eldorado Mountains. Granitic rocks of Tertiary and Precambrian age probably also form the basement complex under most of the valley. The thickness of granite is not known, but probably exceeds 1,524 m (5,000 ft). Metamorphic rocks comprising schists and gneisses of Precambrian age and metavolcanics of possible Precambrian age occur throughout the southern half of the McCullough Range. The thickness of these rocks is generally less than 610 m (2,000 ft).

The major geologic structures in Eldorado Valley include normal faults in the McCullough Range and Eldorado Mountains and in the Highland Springs Anticline in the northwest Highland Range. The major recognized faults include the McClanahan Fault in the McCullough Range and the Jeep Pass, Hidden Valley, Eldorado, and Welcome faults in the Eldorado Range.

GEOLOGIC RESOURCES—Potential mineral resources in Eldorado Valley include fluid minerals (oil, gas, and geothermal resources), nonenergy leasable minerals (primarily sodium and potassium compounds), salable minerals (common sand, gravel, and rock), and locatable minerals (metallic and nonmetallic mineral deposits). The U.S. Bureau of Land Management (BLM, 1992) has defined the level of potential for development of these mineral types.

The potential for geothermal is low and, although the oil and gas potential has been categorized by the U.S. Bureau of Land Management as moderate, there is only one oil lease within the valley. This area is located in the Railroad Pass area in the northernmost part of the basin. No oil or gas exploratory wells have been drilled in the basin.

The U.S. Bureau of Land Management (BLM, 1992) has categorized the sodium and potassium potential of Eldorado Valley as moderate in the north-central part of the basin and low elsewhere. Much of the area in the vicinity of the Eldorado playa has a high potential for salable minerals, primarily sand and gravel, with the rest of the areas of alluvium classified as having moderate potential. In the consolidated rock areas of the Eldorado Mountains and McCullough Range, the potential for salable minerals is low. The potential for locatable mineral resources is low over much of the valley. The potential for locatable resources is moderate in the McCullough Range and northern Highland Range, and high in the Eldorado Mountains and southern Highland Range.

Eldorado Valley contains portions of three mining districts: the Searchlight District, the Eldorado Canyon District, and the Alunite (Railroad Pass) District. Although production has been limited since the early 1950s, interest in these areas continues. The Searchlight District has been the most active, having produced millions of dollars worth of gold, silver, copper, and lead since 1897. Mining in the Eldorado District, located in and around Nelson, was initiated in 1857, and has since produced millions of dollars worth of gold, silver, copper, lead, and zinc. The Alunite District is located about five miles east of Boulder City and historically has produced minor amounts of gold, silver, and lead. Alunite is also present in the district, but has not been successfully developed. Because of the presence of these mining districts, hundreds of mining claims have been filed within Eldorado Valley. The Nevada Department of Transportation maintains about 10 material site rights-of-way in the valley, and there is 1 community pit.

4.5.4.3 Soils. The soils in Eldorado Valley are very deep, medium-textured saline and alkaline soils in the lowland areas; shallow, gravelly coarse-textured soils over the alluvial fans; and discontinuous, rocky gravelly coarse-textured soils in the mountain areas (BLM, 1992).

The soils in Eldorado Valley are susceptible to erosion by wind and water. The potential for erosion is generally slight except where the soils have been disturbed or along the banks of washes. There is also the potential for localized landslides on the steep slopes of the upland areas. The erosion susceptibility of the soils in Eldorado Valley ranges from low to moderate (BLM, 1992). Most of the erosion condition ranges from slight to moderate, but two areas of critical erosion condition have been identified within the basin.

4.5.5 Hydrology

Discussion of hydrology is divided into surface water and groundwater. Water supply in the vicinity is also discussed.

4.5.5.1 Surface Hydrology. The surface water resources of Eldorado Valley are very limited. Although not known, the annual runoff within the basin has been estimated at less than 1.0×10^5 m^3/yr (100 acre-feet/year) (Scott et al., 1971). Surface water runoff is very infrequent, occurring as ephemeral flow in the streambeds and, even less often, as ponded water on the playa in the north-central part of the basin. Surface water runs from the Boulder City Sewage Treatment Plant to the playa area. Flooding characteristics are probably similar to those in adjacent basins; i.e., shallow flash flooding over large areas.

4.5.5.2 Groundwater. Eldorado Valley is situated within the Las Vegas Flow System, a subsystem of the regional Colorado Flow System (Harrill et al., 1988). Groundwater that originates as precipitation over areas of higher elevation generally flows toward the axis of the basin and then north into Las Vegas Valley or eastward into the Colorado River Valley. (Harrill et al; 1988) indicate that an estimated 1.2 million m^3/yr (1,000 acre-feet/year) discharge into the Colorado River Valley.

Groundwater under Eldorado Valley occurs at depths ranging from about 84 to 98 m (275 to 320 ft) below land surface in the north-central part of the basin (Buqo and Giampaoli, 1988). The depth to water may be greater under the higher portions of the alluvial aprons that bound the valley floor. The groundwater is derived from two sources: recharge over the basin is 1.0×10^6 m^3/yr (1,100 acre-feet/year) and subsurface inflow from Hidden Valley (Rush and Huxel, 1966). The recharge derived from flow from Hidden Valley is believed to be minor; i.e., less than 370,050 m^3/yr (300 acre-feet/year) (Rush and Huxel, 1966).

Although there are a number of springs in the upland areas of Eldorado Valley, the combined discharge rate of these springs is small. The more significant springs include McCullough and Ora Hanna Springs in the McCullough Range; Cow Spring in the Highland Range; and Tule, Bridge, and Forlorn Horse Springs in the Eldorado Mountains. These springs provide an important source of water and habitat for wildlife. Eldorado Valley is a designated groundwater basin. The committed groundwater resources of 3.0×10^6 m^3/yr (2,390 acre-feet/year) are more than 4 times the perennial yield of 6.0 x 10^5 m^3/yr (500 acre-feet/year). Mining is by far the largest water user in the basin with total water rights of 3.0 x 10^6 m^3 (2,400 acre-feet). Small quantities of water (a total of only 3.0 x 10^4 m^3 or 24 acre-feet) have been appropriated for municipal, quasimunicipal, stock watering, and industrial use (Buqo, 1996). As of October 1994, there were two additional water right applications for 7.0 x 10^5 m^3/yr (540 acre-feet/year).

Water supplies in Eldorado Valley can be augmented through the importation of water from Boulder City. According to information presented by the Nevada Solar Enterprise Zone task force work group, Boulder City has the capability to provide 1.0 x 10^6 m^3/yr (1,000 acre-feet/year) to 3.0 x 10^6 m^3/yr (3,000 acre-feet/year) of treated effluent or irrigation water to meet water demands in Eldorado Valley.

WATER QUALITY—Groundwater in Eldorado Valley is predominantly a sodium-bicarbonate type with high concentrations of total dissolved solids and a medium to high salinity hazard (Rush and Huxel, 1966). Historic analyses of the groundwater from wells in Eldorado Valley indicate that concentrations of total dissolved solids, sulfate, and chloride exceed drinking water standards in some areas. Although data are generally lacking for metals and other trace constituents for the area, the presence of historic mining districts suggests that these constituents may be present in the groundwater in the vicinity of former mining areas. Iron, lead, manganese, mercury, and nitrate have been detected in groundwater at levels exceeding their respective maximum contaminant levels in the Searchlight area, according to information on file with the Clark County Department of Health Services (Buqo and Giampaoli, 1988).

4.5.6 Biological Resources

The scientific names of plants and animals mentioned in this section are given in Chapter 2 of Appendix E, Biological Resources. The Eldorado Valley is within the Mojave Desert. Creosote bush and white bursage are the dominant shrub species within the Solar Enterprise Zone. Dry washes in this area often have stands of catclaw acacia. To the north of this area, on the fine-textured saline or alkaline soils close to the playa, four-wing saltbush, shadscale, green ephedra, seep weed, and bud sage are the dominant plants (BLM, 1992).

Common animal species are similar to those described for the Mojave Desert habitats on the NTS. This site is not habitat for mule deer or bighorn sheep (BLM, 1992), although these species do occur in some of the surrounding mountain ranges.

The threatened desert tortoise is the only threatened or endangered species that occurs at this site (U.S. Fish and Wildlife Service, 1994). The density of desert tortoises in the area was estimated at 8 per km^2 (20 per mi^2). This site occurs immediately adjacent to the Paiute-Eldorado Critical Habitat Unit for the desert tortoise (U.S. Fish and Wildlife Service, 1994). The site is not a critical habitat for the desert tortoise (U.S. Fish and Wildlife Service, 1994). The Paiute-Eldorado Critical Habitat Unit lies immediately east and south of the site. The site was excluded by Boulder City from a conservation easement granted to Clark County for the conservation, protection, restoration, and enhancement of the desert tortoise. This easement (85,617 acres) surrounds lands designated for a Solar Enterprise Zone facility. No current candidate plant or animal species (61 FR 7596) are known to occur within the Eldorado Valley site. The banded gila monster, a state-protected species, may occur in this area (BLM, 1992).

No plant species are known to occur within the Eldorado Valley site that have been listed as threatened, endangered, or candidate under the Endangered Species Act or by the state of Nevada (16 U.S.C. 1531, 1973; BLM, 1992; 58 FR 188, 1993; NAC, 1994).

4.5.7 Air Quality and Climate

This section includes a description of the air quality conditions at Eldorado Valley, including climatology, meteorology, and ambient air quality.

CLIMATOLOGY AND METEOROLOGY—Although there are no weather stations in Eldorado Valley, the climate can be represented on the basis of stations in Boulder City and Searchlight. In general, Eldorado Valley exhibits the low humidity and low annual precipitation characteristic of the climate of Clark County. The warmest month is July, when the mean monthly maximum temperature is 40 °C (104 °F), and January is the coolest month with a mean monthly minimum of 0.5 °C (33 °F). The average monthly wind speed ranges from 11 kph (7 mph) in December to 18 kph (11 mph) in April and June. Diurnal variation in wind is common, reflecting the differential heating of the ground.

AMBIENT AIR QUALITY—Eldorado Valley is located within Nevada Intrastate Air Quality Control Region 147, which is designated unclassifiable/ attainment for all criteria pollutants. The closest Class I Prevention of Significant Deterioration area is Grand Canyon National Park, approximately 90 km (56 mi) east of Eldorado Valley. Because Eldorado Valley is largely undeveloped, there are few emission sources in the area. Typical sources include mining and milling operations; off-road vehicle, railroad, and aircraft traffic; and fugitive dust.

The closest nonattainment area to the Eldorado Valley is the Las Vegas Valley, which is a nonattainment area for PM_{10} particulates and carbon dioxide and borderline nonattainment for ozone. Eldorado Valley borders the Las Vegas Valley Air Quality Nonattainment Area on the west and north.

4.5.8 Noise

The acoustic environment of Eldorado Valley can be classified as uninhabited desert or small rural communities (Section 4.1.8). Noise measurements have not been made at the Eldorado Valley Solar Enterprise Zone facility site. The major sources of noise would be associated with prevailing meteorological conditions, such as wind. Traffic on U.S. Highway 95, which transects Eldorado Valley just east of the site, also generates noise.

4.5.9 Visual Resources

The landscape character of Eldorado Valley is typical of the Great Basin. Regional topography consists of mountain ranges arranged in a north-south orientation, separated by broad valleys. The existing viewscape includes two Bureau of Land Management Wilderness Study Areas located in the McCullough Range and one in the Eldorado Mountains, U.S. Highway 95, portions of Boulder City, power transmission lines, gravel quarries, and electrical substations. The Bureau of Land Management Wilderness Study Areas are 8 km (5 mi) from the proposed site. The landscape at Eldorado Valley is common to the region, and because of the amount of cultural modifications, the scenic quality has been designated as Class C. U.S. Highway 95 has an average daily traffic of 5,000 to 7,000 vehicles (NDOT, 1993a). Therefore, Eldorado Valley would have a high sensitivity level.

4.5.10 Cultural Resources

Eldorado Valley lies in southern Nevada, an area with a prehistory that may span the past 10,000 years or more. Properties ranging from the early prehistoric period to historic mining and ranching sites are known.

Groups of Southern Paiute and Mohave people lived within or used parts of the project area at the time of first European contact. The Colorado River defines the southern boundary of Southern Paiute territory where it formed the core of Mojave territory (Stoffle and Dobyns, 1982). Southern Paiute groups foraged widely for wild plant foods throughout southern Nevada and also practiced horticulture at select oases in the Las Vegas Valley and on the Virgin and Colorado Rivers. The Chemehuevi, a closely related group, took over much of Mohave Indian traits, including floodplain agriculture, and routinely cooperated with the Mohave in raids against enemies, such as the Cocopa and Halchidhoma. However, the Chemehuevi were occasionally at war with the Mohave themselves (Kelly and Fowler, 1986). The Mohave focused on floodplain agriculture, but also utilized wild plant and animal foods and fish.

Geographically, Eldorado Valley extends from Boulder City to Searchlight. The region of influence includes areas south of Boulder City adjacent to U.S. Highway 95 near the junction with State Route 60. A 2,000-acre zone is proposed for a parabolic trough generating station, while existing natural gas pipe line corridors would be used to bring an additional gas supply to the generating station.

RECORDED CULTURAL RESOURCES—Most of the cultural resources that have been recorded in the previously defined area have resulted from Transmission Line and Powerline Surveys (Dames and Moore, 1985; Rafferty, 1991). Prehistoric sites have been recorded around the perimeter of Eldorado Dry Lake. Two temporary camps have been recorded. One of the sites first recorded by (M.J. Rogers, 1939) includes numerous lithic artifacts and groundstone. Testing conducted in 1990 indicated that only surface deposits occur and that the integrity of the site had been compromised owing to hydraulic action (Dames and Moore, 1985). Both sites were recommended as ineligible for the National Register of Historic Places. Other sites date to the historic period. Most are isolated occurrences of cans, which may have been left behind by prospectors or the Hoover Dam construction workers passing through the area.

*SITES OF AMERICAN INDIAN SIGNIFICANCE—The CGTO knows that the Eldorado Valley study area contains a wide variety of cultural resources, including plants, animals, and archaeology sites. This knowledge derives from previous American Indian cultural resource studies of the area conducted during the Harry Allen-Warner Valley (Bean and Vane, 1979) and Intermountain Power Project (Stoffle and Dobyns, 1982; Stoffle et al., 1983) studies of American Indian concerns along various proposed power line routes, and the Ivanpah Generating Station study (Bean and Vane, 1982) conducted in a neighboring valley. Identified Indian plants include creosote (*Larrea tridentata*), desert trumpet (*Erigonum inflatum*), and Indian tea (*Nevada ephedra*). American Indian animals include bighorn sheep (*Ovis canadensis*), desert tortoise (*Gopherus agassizii*), and speckled rattlesnake (*Croatalus mitchellii*). The valley is associated with Indian funeral songs associated with the Cry Ceremonial. There are both spiritual and physical Indian trails associated with this valley. Eldorado Valley trails were used by Pahrump and Las Vegas Paiutes to travel to places along the Colorado River, especially Cottonwood Island. Traditional Indian trails are a significant American Indian cultural resource because they were both physical and spiritual paths (Laird, 1976). The Ivanpah Generating Study concluded that the McCullough Mountains (which define the western edge of Eldorado Valley) are of much concern to American Indian people, both Southern Paiute and Mohave. According to the Ivanpah study, these American Indian people have trails, sacred sites, plants, and animals of cultural importance in the McCullough Mountains, the associated Eldorado Valley, and in the Eldorado Mountains (Bean and Vane, 1982). A 1975 study of the Navajo-McCullough transmission line right-of-way further indicates the presence of traditional-use plants, early Pinto Series-style projectile points, numerous lithic scatters, and grinding stone fragments that "are related to the seed gathering activities possibly of the later Paiute peoples" (Brooks et al., 1975). Previous studies have been geographically limited to a few places within Eldorado Valley or in neighboring areas, so a complete cultural assessment of the Eldorado Valley is not possible without visiting other portions of the valley with American Indian people.*

4.5.11 Occupational and Public Health and Safety

The Eldorado Valley site proposed for siting a Solar Enterprise Zone facility is currently undeveloped desert. Baseline health and safety considerations associated with the environment include the potential for heat stroke and exhaustion (primarily during summer months), dehydration, and poisonous spider and snake bites. Other physical hazards include tripping or stumbling hazards associated with the desert terrain.

4.5.12 Environmental Justice

Existing demographic conditions for Environmental Justice are discussed in Section 4.1.12. This discussion includes conditions for Eldorado Valley.

4.6 Dry Lake Valley

The Dry Lake Valley site is near the Apex industrial area, several miles northeast of the intersection of U.S. Highway 93 and Interstate 15. The Nevada Power Company has identified 3,600 acres for development of a Solar Enterprise Zone facility.

The DOE would enter into a partnership agreement with the solar industry, Nevada stakeholders, and university systems to develop the solar-generating facilities. The area is bounded on the southwest by development in the Apex industrial area and on the southeast by Interstate 15 and the Dry Lake Range, which runs parallel to the highway.

4.6.1 Land Use

Land in Dry Lake Valley is used for a limited number of activities as discussed in the following Land Use Designations section. Also discussed in this section is the infrastructure related to Dry Lake Valley.

4.6.1.1 Public Land Orders and Withdrawals. This section is not applicable to Dry Lake Valley.

4.6.1.2 Land-Use Designations. Land use in Dry Lake Valley is limited to three types: industrial, municipal waste disposal, and land-use management by federal agencies. Industrial land use is limited to the Apex area immediately south of the proposed Solar Enterprise Zone facility site. Current industrial tenants at Apex include Kerr-McGee Chemical Corp., Chemstar Inc., and Georgia Pacific Corp. Silver State Disposal operates a waste landfill and waste processing facilities in the southern part of the basin east of Interstate 15.

4.6.1.3 Site-Support Activities. Site support in or adjacent to the Dry Lake Valley includes a power substation, a power tie, a phase shifter and autotransformer, and transmission lines; a natural gas pipe line ; a landfill; and a fiber-optic line (DOE/NV, 1994b).

SERVICES—Services discussed for Dry Lake Valley include law enforcement and security, fire protection, and health care.

Law Enforcement and Security—Dry Lake Valley is not secured or restricted. Law enforcement is provided by the Clark County Sheriff's Department.

Fire Protection—Fire protection for Dry Lake Valley is provided by the U.S. Bureau of Land Management.

Health Care—First aid stations would be located near field activities, if required.

UTILITIES—At the Dry Lake Valley site, located adjacent to the alternative Solar Enterprise Zone location, Nevada Power Company owns and operates a 345/230-kV substation, a 345-kV tie with Pacific Corp, a phase shifter, and a 345/230-kV autotransformer. A 230-kV line is also present that delivers power to the internal transmission system of Nevada Power Company. Nevada Power Company is currently constructing two power plants at the Dry Lake Valley site that will provide a total of 144 megaWatts (MW) and has plans for two additional plants that would provide an additional 144 MW. The current transmission capacity could accommodate 305 MW of solar-generated power; however, after the additional power plants are completed, the Dry Lake Valley system will be able to accommodate only 25 MW of additional power derived from alternate sources. This can only be achieved by investing in the construction of a generator bay. Transmission capacity greater than 25 MW would require additional transmission facilities. Up to 140 MW of solar power could be generated with the addition of a 48 km (30 mi) long, 230-kV circuit from the Dry Lake Valley to the Northwest substation, plus additional substation equipment. With either scenario, the total transmission capacity is relatively low because of plans for constructing gas combustion turbines at the site. Should this construction not occur, the transmission capacity would be greater.

Four natural gas pipe line s are within 187 km (116 mi) of the Dry Lake Valley: Transwestern Gas, 187 km (116 mi); El Paso Gas, 75 km (109 mi); Southwest Gas, 24 km (15 mi); and Kern River Gas, 2 km (1 mi). Nevada Power Company anticipates tapping the nearby Kern River pipe line to supply the new gas turbines at the site. However, results of studies related to land, water, and electric transmission capacity must be evaluated before determining whether this apparently readily available gas supply can be used. If so, it is assumed that all necessary natural gas infrastructure required for solar support would be in place.

4.6.1.4 Airspace. Dry Lake Valley is located east of the NAFR Complex underneath the northern portion of the Las Vegas Class B airspace that begins at 2,438 m (8,000 ft) mean sea level. All aircraft operating in this area must be under positive control of Nellis Approach Control (see Section 4.1.1.4).

4.6.2 Transportation

Transportation at Dry Lake Valley is discussed with respect to on-site traffic, off-site traffic, transportation of materials and waste, and other transportation.

4.6.2.1 On-Site Traffic. This section is not applicable to the Dry Lake Valley.

4.6.2.2 Off-Site Traffic. Interstate 15, a four-lane, divided freeway, is the major regional access to the Dry Lake Valley site. In 1993, Interstate 15 had an average annual daily traffic of 11,550 vehicles and operated at a level of service A. U.S. Highway 93 runs north and south from the intersection of southwest-northeast-trending Interstate 15. Las Vegas, Nevada, is 35 km (22 mi) southwest of this intersection, and Glendale, Nevada, is 42 km (26 mi) northeast of this intersection. At Glendale, State Highway 168 trends northwest for 39 km (24 mi) and connects with U.S. Highway 93.

4.6.2.3 Transportation of Materials and Waste. Transportation of waste and materials is not expected at the Solar Enterprise Zone facility site. Therefore, this section is not applicable to Dry Lake Valley.

4.6.2.4 Other Transportation. Air or rail transportation of workers or materials to the Dry Lake Valley has not been proposed; therefore, these facilities have not been examined in detail. The nearest rail line to the Dry Lake Valley site is the Union Pacific line that parallels Interstate 15 just east of the site. No rail spur exists on the Solar Enterprise Zone facility site. Airfield facilities do not exist on the site. The nearest airport is the North Las Vegas Air Terminal. Traffic information in the vicinity of the Dry Lake Valley Solar Enterprise Zone facility location is discussed in Section 4.6.2.2, Off-Site Traffic.

4.6.3 Socioeconomics

There are no residences in the Dry Lake Valley. Current land use, exclusive of federal land management, is for industrial purposes, such as manufacturing and municipal waste disposal. The valley is located in Clark County, Nevada, and general existing socioeconomic conditions are presented in Section 4.1.3.

4.6.4 Geology and Soils

The physiography, geology, and soil conditions in Dry Lake Valley are discussed in this section.

4.6.4.1 Physiography. The Dry Lake Valley is a topographically closed basin comprised of about 414 km^2 (160 mi^2) (Figure 4-60). Elevations within the basin range from about 1,219 m (4,000 ft) on the west in the Arrow Canyon Range, to about 601 m (1,970 ft) at Dry Lake Playa. The Dry Lake Range on the southeast rises to an elevation of only about 1,036 m (3,400 ft). On the south, the Dry Lake Valley is separated from the Las Vegas Valley by a narrow topographic divide. A somewhat broader divide on the north and northeast separates Dry Lake Valley from the California Wash. On the valley floor, the major features are the many washes that drain the bounding upland areas and the playa in the central part of the valley.

4.6.4.2 Geology. The general geologic conditions and mineral deposits of the Dry Lake Valley have been described by the Nevada Bureau of Mines and Geology (Longwell et al., 1965). The general geology of the valley comprises three major geologic units: alluvium, Tertiary valley-fill deposits, and Paleozoic carbonate rocks. The alluvium occurs over the valley floor and comprises interbedded gravels, sand, silt, and clay. The total thickness of alluvium is about 305 m (1,000 ft).

The Tertiary valley-fill deposits include the Muddy Creek Formation, which was deposited over a large area of Clark County. These deposits are found in the area between the Dry Lake Valley and the California Wash and probably occur under the entire valley floor area. The Muddy Creek Formation is comprised of a sequence of interbedded fine-grained and coarse-grained

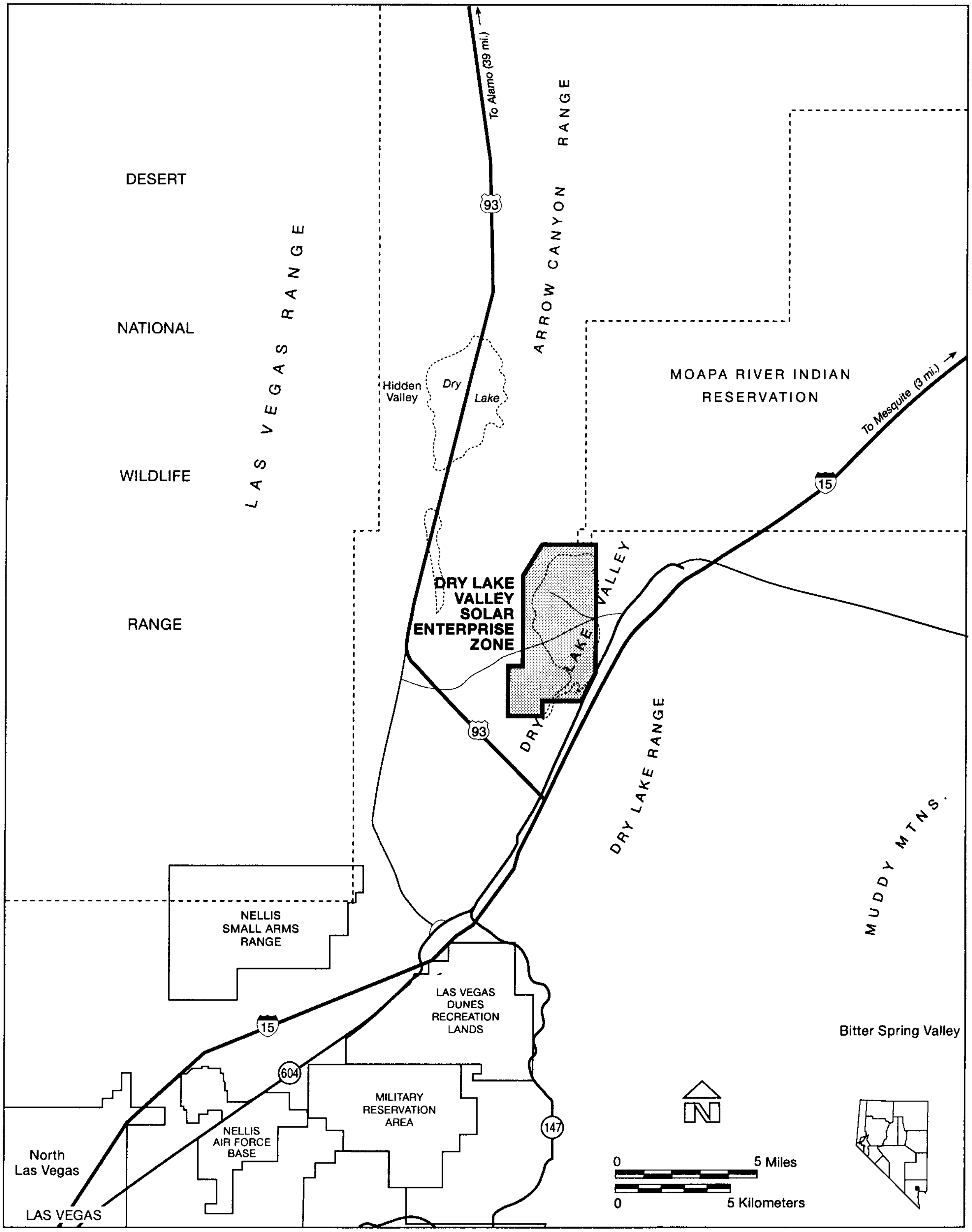


Figure 4-60. Dry Lake Valley and surrounding area

sediments, including claystone, siltstone, and minor sandstone. Gypsum is common in the more fine-grained deposits, and a conglomerate is common along the margins of the depositional basin. The thickness of the Muddy Creek Formation in the Dry Lake Valley is not known, but is probably at least several hundred feet in most areas.

The Paleozoic rocks of the Arrow Canyon Range and Dry Lake Range comprise a thick sequence of limestone, dolomites, and quartzite. In the Arrow Canyon Range, this sequence includes, in descending order, the Birdspring Formation, Monte Cristo Limestone, Sultan Limestone, Lone Mountain Dolomite, the Ely Springs Dolomite, the Eureka Quartzite, and the Pogonip Group. These rocks outcrop in the mountainous areas and probably underlie the Muddy Creek Formation at depth under the valley floor area. The total thickness of Paleozoic rocks in the area is unknown, but is probably several thousand feet.

Two major geologic structures predominate in the Dry Lake Valley; the Arrow Canyon syncline and the Dry Lake Thrust Fault. The Arrow Canyon syncline is a structural trough that is believed to underlie the south-central part of the basin and occurs along the eastern Arrow Canyon Range in the northern part of the basin. On the eastern part of the basin, in the Dry Lake Range, the Ordovician Pogonip Group has been thrust over the uppermost Paleozoic (Kaibab, Toroweap, Coconino, and Birdspring formations).

GEOLOGIC RESOURCES—Potential mineral resources in the Dry Lake Valley include fluid minerals (oil, gas, and geothermal resources), non-energy leasable minerals (primarily sodium and potassium compounds), salable minerals (common sand, gravel, and rock), and locatable minerals (metallic and nonmetallic mineral deposits). The U.S. Bureau of Land Management (BLM, 1992) has defined the level of potential for development of these mineral types.

The potential for geothermal resources is low, and although the oil and gas potential has been categorized by the U.S. Bureau of Land Management as moderate, there are only two areas with oil leases within the valley. One area is located in the central Arrow Canyon Range and includes about 8 km^2 (3 mi^2) of Dry Lake and Hidden Valleys. The second area encompasses about 10 km^2 (4 mi^2) east of the Union Pacific Railroad's Dry Lake siding. Two oil and gas exploratory wells have been drilled in the Dry Lake Valley (United Petroleum Corporation No. 1 Apex, and Pozil, Johnson, and Krug No. 1 Apex), but no production has been reported from the basin. The U.S. Bureau of Land Management (BLM, 1992) has categorized the sodium and potassium potential of the Dry Lake Valley as low. Much of the area in the vicinity of the Dry Lake playa has a high potential for salable minerals, primarily silica sand and gravel, with the rest of the areas of alluvium classified as having moderate potential. In the consolidated rock areas of the Arrow Canyon and Dry Lake Ranges, the potential for salable minerals is low. The potential for locatable mineral resources is low over much of the valley; only in the Arrow Canyon Range and in portions of the Dry Lake Range is the potential classified as moderate.

Although hundreds of mining claims have been filed within the Dry Lake Valley, the historic mining production has been limited to the production of limestone and dolomite. Chemstar, Inc., has been actively mining and processing limestone in the Apex area for more than 40 years. No metallic mineral deposits have been developed in the valley. The Nevada Department of Transportation maintains several material site rights-of-way in the valley.

4.6.4.3 Soils. The soils in the Dry Lake Valley are typical desert soils (entisols and aridisols). The soils of the area have been categorized into four series (Nevada Power Company, 1975). The Rockland-St. Thomas series occurs on the foothills and mountains with slopes of 15 to 50 percent and includes rock and cobbly loam. These soils are generally well drained and have a moderately rapid permeability. The Colorock-Tonopah series occurs at an elevation of 396 (1,300 ft) to 914 m (3,000 ft) in areas with slopes of 2 to 8 percent. Colorock soils are gravelly to a depth of 0.3 m (1 ft) and have an underlying hardpan. The gravelly material has a moderate permeability but, because of the presence of shallow hardpan, has a low water capacity. The Tonopah soils, comprising sandy loam and gravelly loam, have high permeability and rapid drainage. Bard-Tonopah soils occur in areas of 2 to 8 percent slope between 457 m (1,500 ft) to 914 m (3,000 ft) in elevation. These soils are stony or sandy loams that exhibit moderate permeabilities and low water capacity. Bard soils are gravelly, sandy loams and gravelly sands with a hardpan occurring at a depth of 0.3 to 0.6 m (1 to 2 ft). The permeability of the Bard soils is moderate, and the water capacity is low.

The soils in the Dry Lake Valley are susceptible to erosion by wind and water (BLM, 1992). The potential for erosion is generally slight, except where the soils have been disturbed or along the banks of washes. There is also the potential for localized landslides on the steep slopes of the upland areas.

The U.S. Bureau of Land Management (BLM, 1992) indicates that the erosion susceptibility of the soils in the Dry Lake Valley is moderate to high in the northern part of the basin and low to moderate in the southern portion of the basin. The erosion condition ranges from slight to moderate.

4.6.5 Hydrology

Discussion of hydrology is divided into surface water and groundwater. Water supply in the vicinity is also discussed.

4.6.5.1 Surface Hydrology. Surface water resources in the Dry Lake Valley are meager, occurring only as ephemeral flow in the streambeds that drain the upland areas or in temporary ponding of runoff in the playa. There are no gaging stations in the Dry Lake Valley; total runoff has been estimated at 3.7 x 10^{-1} m^3/yr (300 acre-feet/year) (Scott et al., 1971). Heavy runoff events may result in short-duration flows along reaches of washes in the basin; however, most rainfall probably infiltrates and is transpired by vegetation or evaporated from the soil.

Flooding is probably a recurrent problem over most of the valley floor area in the Dry Lake Valley. Runoff estimates made by the Clark County Regional Flood Control District for the Apex area indicate that a rainfall event with a 0.01 recurrence interval will result in shallow (less than 0.3 m [1 ft]) flooding over extensive areas (Nevada Power Company, 1975). Such floods typically occur as flash floods wherein the depth of the water in the alluvial channels can exceed bankful conditions and result in sheet-flow over large areas of the alluvial fans that bound the playa.

The Alkali Flat Dry Lake in the Dry Lake Valley is roughly bisected by some of the land that could be used for a Solar Enterprise Zone facility. In this area, more frequent floods of longer duration are to be expected. Ponding in some areas of the dry lake may be present for periods of several months or more.

4.6.5.2 Groundwater. The Dry Lake Valley is situated within the California Wash Flow System, a subsystem of the regional Colorado River Flow System (Harrill et al., 1988). Groundwater that originates as precipitation over the upland areas of the valley discharges out of the regional flow system near Overton, Nevada, about 29 km (18 mi) to the east, ultimately reaching the Colorado River through a complicated pathway of groundwater and surface water flow including the Muddy River and Lake Mead.

Groundwater under the Dry Lake Valley occurs at depths ranging from about 70 m (230 ft) to 87 m (285 ft) (unpublished U.S. Geological Survey data). Groundwater is derived from two sources: recharge over the basin is 5.0 x 10^5 m^3 per year (400 acre-feet/year), and subsurface inflow on the west from Hidden Valley is 5.0 x 10^5 m^3 per year (400 acre-feet/year) (Rush, 1968). Groundwater is discharged via subsurface outflow to the California Wash at a rate of about 1.0 x 10^6 m^3 per year (800 acre-feet/year), according to (Rush, 1968).

There are no springs in the Dry Lake Valley. Groundwater is the only available water resource. There are currently only six water supply wells in the Dry Lake Valley. Well yields within the basin are low, ranging from about 76 to 303 L/min (20 to 80 gal/min). According to information on file with the Nevada Division of Water Resources, the committed groundwater resources of 1.0 x 10^6 m^3 /yr (930 acre-feet/year) are more than double the perennial yield of 5.0 x 10^5 m^3/yr (400 acre-feet/year). Current groundwater rights within the basin include

4.0×10^5 m³ (308 acre-feet) for mining, 3.8×10^5 m³ (308 acre-feet) for commercial use, 2.0×10^5 m³ (168 acre-feet) for industrial use, 1.0×10^5 m³ (75 acre-feet) for municipal and quasi-municipal, and 6.3×10^4 m³ (51 acre-feet) for other uses. As of October 1994, there were 16 applications for water rights in the Dry Lake Valley totaling 1.1×10^6 m³/yr (21,155 acre-feet/year).

A master plan has been established for the Apex area in southern-most Dry Lake Valley (Clark County, 1990a). A 21,000-acre industrial-use park is planned for the area with three tenants already operating. This master plan indicates that any water required for industrial purposes at the Apex site would have to be imported to the site. Further, the master plan recommends a policy that private wells be limited to low water-use industries that employ conservation measures.

According to information on file with the U.S. Geological Survey, the groundwater in the Dry Lake Valley is generally calcium-sodium-sulfate type with a total dissolved solids concentrations ranging from 700 to 1,000 mg/L (700 to 1,000 ppm), exceeding the primary drinking water standard of 500 mg/L (500 ppm). Sulfate concentrations, reported for three wells in the basin, range from 360 to 380 mg/L (360 to 380 ppm), about 40 percent more than the primary drinking water standard of 250 mg/L (250 ppm).

4.6.6 Biological Resources

The scientific names of plants and animals mentioned in this section are given in Chapter 2 of Appendix E, Biological Resources. The plant communities in the Dry Lake Valley are typical of those found in deep, sandy soils throughout this part of the Mojave Desert. The visually dominant plants are creosote bush and white bursage. Other common species include range ratany and Nevada ephedra. Areas around the playa are dominated by saltbush. Blackbrush becomes the dominant shrub on the slopes of the Las Vegas Range (Clark County, 1990a).

Animal species in the Dry Lake Valley are similar to those described for the Mojave Desert habitats of the NTS. Bighorn sheep inhabit the surrounding mountains.

The desert tortoise is the only threatened or endangered species in this area. Densities of tortoises are generally low, though some patches with higher densities may occur (Clark County, 1990a). No current candidate plant or animal species are known to occur in the Dry Lake Valley. The U.S. Fish and Wildlife Service published the latest list of candidate plants and animals on February 28, 1996 (61 FR 7596). Prior to this, six species of mammals, two species of birds, two species of reptiles, and four plant species that were identified as potentially occurring at this site were classified as candidates (Clark County, 1990a; 59 FR 219) and were addressed (Table 4-30). The updated Notice of Review has removed all of these species from candidate status. Two of these former candidates are designated as State-protected and are likely to occur in the area: the western burrowing owl and the banded gila monster (Clark County, 1990a).

The Geyer milkvetch and the golden bear poppy are two plant species that may occur at the site. These plants are designated by the state of Nevada as threatened with extinction and are classified as "fully protected." Geyer milkvetch was found in nearby areas, but has not been found within the site boundary. Three Category 2 candidate plants have been found at this site. A fourth Category 2 plant, Geyer milkvetch, was found in nearby areas, but has not been found within the site boundary.

4.6.7 Air Quality and Climate

This section includes a description of the air quality conditions at the Dry Lake Valley, including climatology, meteorology, and ambient air quality.

CLIMATOLOGY AND METEOROLOGY—Although there are no weather stations in the Dry Lake Valley, National Oceanic and Atmospheric Administration data on the climate of the area are available for stations located in the Valley of Fire, Logandale, and North Las Vegas. In general, the climate of the valley exhibits the low humidity and low annual precipitation characteristics of the climate of Clark County. The warmest month is

July, when the mean monthly maximum temperature is 40 °C (104 °F), and January is the coolest month with a mean monthly minimum of 0.5 °C (33 °F). The average monthly wind speed ranges from 12 kph (7 mph) in December to 18 kph (11 mph) in April and June. Diurnal variation in wind is common, reflecting the differential heating of the ground.

AMBIENT AIR QUALITY—The Dry Lake Valley, although in Clark County, is located outside of the Las Vegas Valley Nonattainment Area (see Section 4.1.7). This part of Clark County is designated unclassifiable/attainment for all criteria pollutants. Dry Lake Valley borders the nonattainment area on the north. The closest Class I Prevention of Significant Deterioration area is Grand Canyon National Park, 100 km (63 mi) southeast of the Dry Lake Valley. Because the Dry Lake Valley is largely undeveloped, there are few emission sources in the area. Typical sources include mining and manufacturing operations at the southern end of the basin; on-road and off-road vehicle, railroad, and aircraft traffic; and fugitive dust.

Background air quality data for Dry Lake Valley are summarized in Table 4-42. These background data are for the Kerr-McGee plant and the Georgia-Pacific gypsum board production facility in the Apex industrial area. No violations of ambient air quality standards have been reported for the pollutants monitored. Emissions from individual industrial developments should be evaluated on the basis of the emission rates, the size of the facility, seasonal variations in process emissions, and source-specific atmospheric dispersion characteristics.

4.6.8 Noise

The acoustic environment of the Dry Lake Valley can be classified as uninhabited desert or small rural communities (Section 4.1.8). However, several noise producers are adjacent to or within the 3,600-acre site. The major sources of noise would be associated with traffic on Interstate 15; which forms part of the eastern border of the site, the Union Pacific Railroad, which parallels Interstate 15, and the Apex industrial area, southeast of the site. On the site, the Nevada Power Company owns and operates an electrical substation, a phase shifter and an autotransformer, and has plans to construct four additional power plants. Meteorological conditions, such as wind, generate noise at the site.

4.6.9 Visual Resources

The landscape character of the Dry Lake Valley is typical of the Great Basin. Regional topography consists of mountain ranges arranged in a north-south orientation, separated by broad valleys. In addition to the natural surroundings, the existing viewscape includes an industrial area, U.S. Highway 93, Interstate 15, a railroad, power plant, and power transmission lines. The landscape at the Dry Lake Valley is common to the region, and because of the amount of cultural modification, the scenic quality has been designated as Class C. The average daily traffic on Interstate 15 is 12,000 to 13,000 vehicles (NDOT, 1993a). Therefore, the Dry Lake Valley would have a high visual sensitivity.

4.6.10 Cultural Resources

The Dry Lake Valley lies in southern Nevada, an area with a history that may span the past 10,000 years or more. Properties ranging from the early prehistoric period to historic transportation, mining, and ranching are known.

When Europeans first entered the area around the Dry Lake Valley, they encountered groups of Southern Paiute people. Groups that are likely to have used resources found in the project area include the Moapa, Tule Springs, and Las Vegas bands (Steward, 1938; Stoffle and Dobyns, 1982).

Geographically, the Dry Lake Valley extends from Apex to well within the Moapa River Indian Reservation. The area proposed for solar power development is within the Apex industrial area northwest of Interstate 15. It encompasses approximately 3,600 acres.

Table 4-42. Background air quality data for the Dry Lake Valley

				Average Period
Nitrogen Oxide[a] (μg/m)				Annual
1. Kerr-McGee				0.017
2. Bonneville-Nevada's Georgia Pacific Site				1.620
	Total			1.640
	Standard			25.000
	Available			23.360
Sulfur Dioxide[b] (μg/m)		3-hour	24-hour	Annual
1. Kerr-McGee		0.010	0.004	0.001
2. Great Star		100.100	30.500	5.000
	Total	100.100	30.500	5.000
	Standard	512.000	91.000	20.000
	Available	411.900	60.500	15.000
Total Suspended Particulate (μg/m)			24-hour	Annual
1. Kerr-McGee			0.125	0.001
2. United Rock and Great Star			4.600	1.480
3. Avena			0.900	0.300
4. Georgia Pacific			2.800	0.900
5. Bonneville-Nevada			0.800	0.080
	Total		9.200	2.800
	Standard		37.000	19.000
	Available		27.800	16.200

[a] United Rock and Avena emit no nitrogen oxides from stationary sources; Great Star, and Georgia Pacific were approved prior to February 8, 1988

[b] No sulfur dioxide impact from United Rock, Avena, Georgia Pacific, Bonneville-Nevada.

Source: Clark County, 1990a.

RECORDED CULTURAL RESOURCES—Eight sites have been recorded directly within the project area boundaries. Most of these are associated with the shoreline of the Dry Lake Valley. Two processing localities were recorded as part of the Overthurst Project (Bergin et al., 1980). Two other sites were recorded as part of the Kern River Gas Pipeline Survey (Kelly et al., 1990). One site is a locality with a relatively high percentage of stone tools.

Data recovery was conducted at this site and included surface collections and limited excavation of portions of the site. Another site is untyped and includes two flakes and several pieces of burned bone. There is also a temporary camp with rock circles, Southern Paiute grayware pottery, and numerous pieces of lithic fragments. Two other sites were recorded as part of a transmission line survey (Rafferty and Blair, 1986). Both of these were located along the Dry Lake Valley shoreline and both contained burned or fire-cracked rock concentrations. Several of the sites previously described have been recommended as eligible for the National Register of Historic Places. These sites may provide information about late prehistoric use of shoreline environments. A historic site that traverses The Dry Lake Valley is the Mormon Road, which is listed on the National Register of Historic Places. This route, originally part of the Spanish Trail, connected the Las Vegas Valley with cities in Utah and California. Use of the Mormon Road mainly postdates 1848 (Paher, 1971). Portions of the Old Spanish Trail/Mormon Road remain intact and have been recorded as significant historic archaeological sites (Myhrer et al.,1990).

SITES OF AMERICAN INDIAN SIGNIFICANCE—The CGTO knows that the Dry Lake Valley area contains a wide range of important cultural resources. This knowledge derives from previous American Indian cultural resource studies of the area conducted during the Harry Allen-Warner Valley (Bean and Vane, 1979) and the Intermountain Power Project (Stoffle and Dobyns, 1982; Stoffle et al., 1983) studies of Indian concerns along various proposed power line routes. These power line study areas were located in the bottom and along the eastern edge of the Dry Lake Valley. During these studies, elders identified a wide range of plants, animals, and archaeological sites within this valley. A 1982 mail survey of American Indian people indicated an "Intensity of Concern" score of 2.5 on a 4.0 scale (Stoffle and Dobyns, 1982). A 1983 on-site visit to the Dry Lake area indicated numerous rock shelters that American Indian people considered very significant and the presence of 10 American Indian plants (Stoffle et al., 1983). The cultural assessment of the Navajo-McCullough right-of-way indicated the presence of eight plants identified elsewhere as American Indian plants, numerous archaeological sites, and artifact scatters in the Dry Lake Valley (Brooks et al., 1975). Previous studies have been geographically limited, so a complete cultural assessment of the Dry Lake Valley is not possible without visiting other portions of the valley.

4.6.11 Occupational and Public Health and Safety

The Dry Lake Valley site proposed for siting a Solar Enterprise Zone facility is currently undeveloped desert. Baseline health and safety considerations associated with the environment include potential for heat stroke and exhaustion (primarily during summer months), dehydration, and poisonous spider and snake bites. Other physical hazards include tripping or stumbling hazards associated with the desert terrain.

4.6.12 Environmental Justice

Existing demographic conditions for Environmental Justice are discussed in Section 4.1.12. This discussion includes conditions for the Dry Lake Valley.

4.7 Coyote Spring Valley

Information concerning the physical characteristics of the Coyote Spring Valley (Figure 4-61) is available from a number of sources. The Clark County Department of Comprehensive Planning and the U.S. Bureau of Land Management have compiled data on the soils and their erosion potential, biota, and habitat. The Nevada Bureau of Mines and Geology has published information on the geology and mineral resources of the valley, and the U.S. Geological Survey has published maps of the area and maintains databases on the water resources. The Nevada Division of Water Resources maintains a database on water resource use and availability and wells within the basin. The state of Nevada has information on air and water quality. The National Oceanographic and Atmospheric Administration keeps comprehensive climate records for numerous National Weather Service Observing Sites in southern Nevada, including sites that are close to the Coyote Spring Valley.

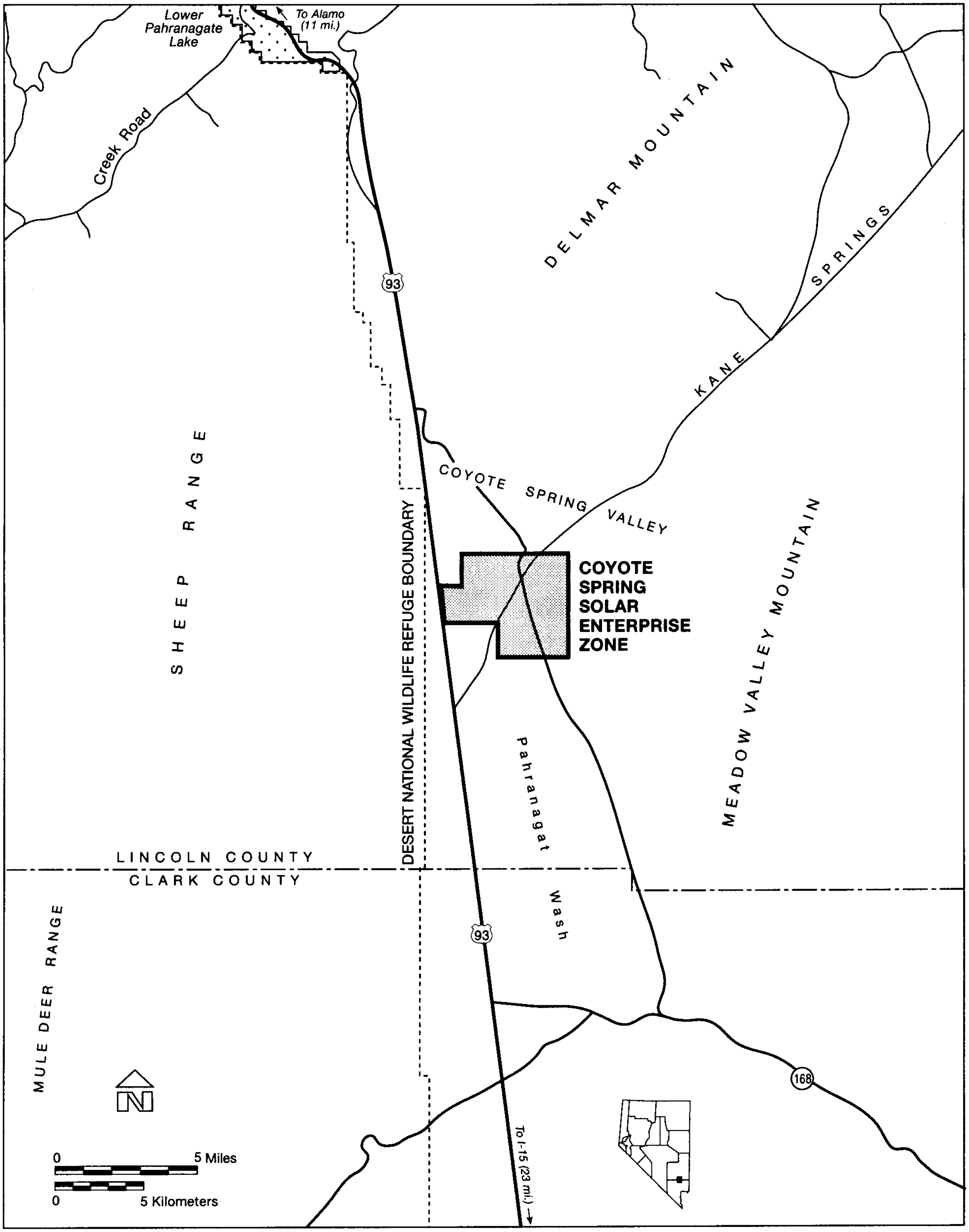


Figure 4-61. Coyote Spring Valley and surrounding area

4.7.1 Land Use

The Coyote Spring Valley includes privately owned land and land administered by the U.S. Bureau of Land Management and the U.S. Fish and Wildlife Service. Most of the area located west of U. S. Highway 93 is within the Desert National Wildlife Range. Land in the Coyote Spring Valley is used for a limited number of activities as discussed in the following Land-Use Designations section. Also discussed in this section is the infrastructure related to the Coyote Spring Valley.

4.7.1.1 Public Land Orders and Withdrawals. This section is not applicable to the Coyote Spring Valley.

4.7.1.2 Land-Use Designations. Appreciable areas of the Coyote Spring Valley have been designated by the U.S. Bureau of Land Management for special management (BLM, 1992). The U.S. Bureau of Land Management has designated a portion of east-central Coyote Spring Valley as part of the Arrow Canyon Special Recreation Management Area (BLM, 1993). This area will be managed for semiprivate recreation opportunities and the protection of cultural resources. The area between the wildlife range and U.S. Highway 93 includes portions of three Wilderness Study Areas: NV050-201, NV050-216, and NV050-217. Wilderness Study Area NV050-17 is located in northern-most Coyote Spring Valley and includes the southern Delamar Mountains.

Wilderness Study Area NV050-156 is located on the east side of the valley and encompasses most of the Meadow Valley Mountains. Wilderness Study Area NV050-215 also occurs along the east side of the basin and includes the northern portions of the Arrow Canyon Range.

The largest block of privately owned land is the Aerojet Project Area, located east of U.S. Highway 93 between the Rainbow Canyon Road on the north and U.S. Highway 168 on the south. A portion of this land was sold by Aerojet to the Wylie Corporation.

The Aerojet Project Area has been classified into four land-use types: (1) the project area of 2,760 acres; (2) a buffer area of 11,240 acres of low-density tortoise habitat; (3) a 17,885-acre conservation reserve of moderate to high tortoise density; and (4) a 10,735-acre power line corridor (Aerojet General, 1987). These areas are all located east of U.S. Highway 93, north of U.S. Highway 168, and west of the Arrow Canyon Range.

The U.S. Bureau of Land Management has also proposed a utility corridor through portions of the Coyote Spring Valley. This corridor, to be 805 m (2,640 ft) wide, would be located east of the centerline of U.S. Highway 93 from the south end of the Aerojet designated corridor. This corridor would cross the Arrow Canyon Range and into the Dry Lake Valley area substations.

Two small areas of privately owned land are located on the west side of U.S. Highway 93: the old Butler Ranch which has been abandoned, and a silica sand mining operation. These two tracts contain only about 80 acres.

4.7.1.3 Site-Support Activities. The site support of the Coyote Spring Valley is limited to two transmission lines. There are no existing facilities for water, sewage or waste disposal, or communications.

SERVICES—Services discussed for the Coyote Spring Valley include law enforcement and security, fire protection, and health care.

Law Enforcement and Security—The Coyote Spring Valley is not a secured or restricted area. Law enforcement is provided by the Lincoln County Sheriff's Department.

Fire Protection—Fire protection is provided by the U.S. Bureau of Land Management.

Health Care—No health care services are currently available on the site.

UTILITIES—One transmission line roughly parallels U.S. Highway 93 and extends the entire length of the valley. The other transmission line is located 3 to 5 km (2 to 3 mi) south of U.S. Highway 168 and extends as far west as U.S. Highway 93.

4.7.1.4 Airspace. Airspace overlying almost all of the Coyote Spring Valley is the Sally Corridor portion of the Desert Military Operating Areas. Sally Corridor is used primarily as the transition route between Nellis Air Force Base and the NAFR Complex (see Figure 4-8).

4.7.2 Transportation

This section addresses on-site traffic, off-site traffic, transportation of materials and waste, and other transportation for the Coyote Spring Valley.

4.7.2.1 On-Site Traffic. This section is not applicable to the Coyote Spring Valley.

4.7.2.2 Off-Site Traffic. U.S. Highway 93, a two-lane, two-way rural highway, is the major regional access to the Coyote Spring Valley site. In 1993, U.S. Highway 93 had an average annual daily traffic of 1,210 vehicles and operated at a level of service B. U.S. Highway 168 provides access from the central part of the basin to the Muddy Springs Area and Moapa Valley to the east. Access via unpaved roads is also limited to two main routes, the Rainbow Canyon Road on the north and the Desert Wildlife Range Road on the west. There is no rail access to the Coyote Spring Valley.

4.7.2.3 Transportation of Materials and Waste. This section is not applicable to the Coyote Spring Valley.

4.7.2.4 Other Transportation. Air or rail transportation of workers or materials to the Coyote Spring Valley has not been proposed; therefore, these facilities have not been examined in detail.

4.7.3 Socioeconomics

The Coyote Spring Valley is located in Lincoln County. What follows is a discussion of general socioeconomic conditions in Lincoln County. The county's land area is 2.7 x 10^4 km^2 (10,635 mi^2). The total civilian labor force in 1991 was 2,068; 4.5 percent or 94 civilians were unemployed. Some 6.8 percent were employed in agriculture; 1.7 percent in manufacturing; 18.7 percent in wholesale and retail trade; 2.0 percent in finance, insurance, and real estate; 5.0 percent in health services; and the largest sector, 16.0 percent in public administration. Total personal income for the county was $62.0 million, a 103.3-percent change from 1980 personal income.

The 1992 population for Lincoln County was 3,739. It grew by 0.2 percent (less than 1 percent) between 1980 and 1992. Housing stock in the county totaled 1,800 with a vacancy rate of 26.4 percent. The number of houses increased by 6.8 percent between 1980 and 1990. The construction of four homes was authorized by building permits between 1990 and 1992.

Of the total students in Lincoln County (1,066), 97.7 percent are enrolled in public elementary or high school. From 1986 to 1987, general revenue for the county was $7.2 million. Intergovernmental revenue was $5.6 million, and taxes accounted for $0.9 million, 95.8 percent of which was property taxes. Direct general expenditures were 7.6 million, a 21.5-percent change from 1982 to 1987.

4.7.4 Geology and Soils

Physiography, geology, and soils are addressed in this section. Also briefly discussed are seismic activities and geologic resources.

4.7.4.1 Physiography. The Coyote Spring Valley is a topographically open basin comprised of about 1,702 km^2 (657 mi^2). Elevations within the basin range from about 3,018 m (9,900 ft) on the west in the Sheep Range to about 650 m (2,134 ft) at the outlet for the valley along the Pahranagat Wash. The Arrow Canyon Range on the southeast rises to an elevation of only about 1,586 m (5,203 ft). On the southwest, the Coyote Spring Valley is separated from the Las Vegas Valley by the Las Vegas Range, with a maximum elevation of about 1,503 m (4,931 ft). On the valley floor, the major features are the many washes that drain the bounding upland areas and the broad alluvial fans and the Pahranagat Wash, an incised ephemeral stream. Badland topography occurs where the Muddy Creek Formation is exposed in the east-central part of the basin.

4.7.4.2 Geology. The general geologic conditions and mineral deposits of the Coyote Spring Valley have been detailed by the Nevada Bureau of Mines and Geology (Longwell et al., 1965). The general geology of the valley comprises four major geologic units: alluvium, Tertiary valley-fill deposits, Tertiary volcanics, and Paleozoic carbonate rocks. The alluvium occurs over the valley floor and comprises interbedded gravels, sand, silt, and clay. The maximum thickness of alluvium is not known, but thicknesses of 183 to 260 m (600 to 850 ft) have been penetrated by U.S. Geological Survey and U.S. Air Force test wells.

The Tertiary valley-fill deposits include the Muddy Creek Formation, which was deposited over a large area of Clark County. These deposits outcrop to the east of the Pahranagat Wash in the east-central part of the basin. The Muddy Creek Formation comprises a sequence of interbedded fine-grained and coarse-grained sediments, including claystone, siltstone, and minor sandstone. Gypsum is common in the more fine-grained deposits, and a conglomerate is common along the margins of the depositional basin. The thickness of the Muddy Creek Formation in the Coyote Spring Valley is not known, but is probably at least several hundred feet in most areas. The Tertiary volcanic rocks outcrop in the northern part of the Coyote Spring Valley and include tuffs and other volcanoclastic deposits with an unknown total thickness.

The Paleozoic rocks of the Arrow Canyon, Sheep, and Las Vegas Ranges comprise a thick sequence of limestone, dolomites, and quartzite that include, in descending order, the Birdspring Formation, Monte Cristo Limestone, Sultan Limestone, Lone Mountain Dolomite, the Ely Springs Dolomite, the Eureka Quartzite, the Pogonip Group, middle and lower Cambrian Limestones and Dolomites, and the Chisolm and Pioche Shale. These rocks outcrop in the mountainous areas and probably underlie the Muddy Creek Formation at depth under the valley floor area.

A number of major geologic structures occur in the Coyote Spring Valley. The Arrow Canyon syncline is a structural trough that occurs along the eastern Arrow Canyon Range in the northern part of the basin. On the western part of the basin, in the Sheep Range, the lower clastic aquitard (formed by the Cambrian clastics) has been thrust over younger Paleozoic rocks. The other predominant structural features are an east-west trending lineament through the Muddy Springs area, which may be related to the Pahranagat Shear System, and a northeast-southwest trending lineament that extends from northeast the Coyote Spring Valley through Kane Spring Valley.

MINERAL RESOURCES—Potential mineral resources in the Coyote Spring Valley include fluid minerals (oil, gas, and geothermal resources), non-energy leasable minerals (primarily sodium and potassium compounds), salable minerals (common sand, gravel, and rock), and locatable minerals (nonmetallic mineral deposits) (BLM, 1992). Maps presented for the other off-site Solar Enterprise Zone facility alternative locations that show the resource potential are not available for the Coyote Spring Valley.

Metallic mineral deposits are absent in the Coyote Spring Valley. The only known mineral deposits include a bentonitic clay deposit and sand and gravel. There are numerous placer claims within the basin. Oil and gas resources are considered speculative. The Nevada Department of Transportation has three material site rights-of-way within the basin. The geothermal resources are moderate. The U.S. Bureau of Land Management has categorized the sodium and potassium potential of the Coyote Spring Valley as moderate.

4.7.4.3 Soils. The soils in the Coyote Spring Valley are typical desert soils (Entisols and Aridisols). The soils of the area have been categorized into seven soil types (Aerojet General, 1987). The Arizo soils form on alluvial fans with 2 to 8 percent slopes and are deep, excessively drained gravelly and cobbly sand. The permeability is very rapid, and the available water capacity is very low. The Badland soil unit forms on the Muddy Creek Formation and is stratified sand, silt, and clay with gypsum and calcium carbonate. The Badland soils are severely eroded and are unsuitable for development because of slope and erosion limitations.

The Colorock-Tonopah Association forms on 2 to 8 percent slopes on alluvial fans and are gravelly sands or very gravelly loams. The Colorock soils are shallow loam over a caliche layer about 1 m (2 ft) thick and have a moderately rapid permeability and a very low available water capacity. The Tonopah soils are excessively drained and deep. The permeability is rapid, and the available water capacity is low.

The Glendale fine sand is limited to floodplains and terraces with 0 to 2 percent slope. The Glendale grades downward from a fine sand to brown clay loam, silty loam, and very fine sandy loam. The permeability is very low, and the available water capacity is high. The Glendale loam occurs in similar areas, but is well drained and has a moderately slow permeability and high available water capacity.

The Rockland-St. Thomas Association occurs on very steep slopes in the foothills and mountain sides. The Rockland is in areas of limestone exposures. The St. Thomas soils are cobbly loam that is well drained with a moderately rapid permeability and very low available water capacity. The Weiser cobbly sandy loam is a deep and well-drained soil that forms on steeper (15 to 30 percent slope) alluvial fans. The permeability is moderately rapid, and the available water capacity is low to very low.

SOIL EROSION—The soils in the Coyote Spring Valley are susceptible to erosion by wind and water. The potential for erosion is generally slight except where the soils have been disturbed or along the banks of washes. There is also the potential for localized landslides on the steep slopes of the upland areas.

The soils that are most susceptible to erosion include the Badland soil and the Glendale fine sand (Aerojet General, 1987). The Badland soil has a very high water-erosion hazard, and headward erosion occurs extensively in this unit. The Glendale fine sand is very susceptible to wind erosion. The erosion hazard for the Arizo soils is slight; the erosion hazard for the other soils types present is moderate.

4.7.5 Hydrology

Discussions of hydrology are divided into surface water and groundwater. Water supply in the vicinity is also discussed.

4.7.5.1 Surface Hydrology. There are no perennial surface water bodies or streams in the Coyote Spring Valley (Eakin, 1964). The surface water resources are meager, occurring only as ephemeral flow in the streambeds that drain the upland areas or in temporary ponding of runoff in the playa. Surface water flows into the basin on the north via the Pahranagat Wash (shown as White River or Muddy River on some maps). Because of the presence of surface water reservoirs in southern Pahranagat Valley, little if any runoff enters the Coyote Spring Valley from the north. To the northeast, the Kane Springs Wash discharges very infrequently to the Coyote Spring Valley.

Surface water discharges from the Coyote Spring Valley into the upper Muddy Springs area through the Pahranagat Wash. Although there are no gaging stations within the basin, the U.S. Geological Survey does maintain a gaging station in the Pahranagat Wash in Arrow Canyon, just east of the basin boundary. Flow in the wash occurs very infrequently, usually for only a few days during the winter and late summer months. In some years of record, no flow occurred at all at this gaging station. For the 5 year period of record, the average annual runoff is 668,547 m^3/yr (542 acre-feet/year). The peak instantaneous discharge rate of 95 m^3/sec (3,350 ft^3/sec) occurred on September 6, 1991.

Flooding is probably a recurrent problem over most of the valley floor area in the Coyote Spring Valley. Severe flash floods do occur infrequently in both the Pahranagat Wash and Kane Spring Wash. Such floods typically occur when the tributary alluvial channels exceed bankful conditions, resulting in sheet flow over large areas on the alluvial fans that drain to the Pahranagat Wash.

*4.7.5.2 **Groundwater.*** The Coyote Spring Valley is situated within the White River Flow System, a subsystem of the regional Colorado Flow System (Harrill et al., 1988). Groundwater that originates as precipitation over the upland areas of the valley discharges out of the regional flow system near Overton, 29 km (18 mi) to the east, ultimately reaching the Colorado River through a complicated pathway of groundwater and surface water flow.

Groundwater under the Coyote Spring Valley occurs at depths ranging from only 3 m (10 ft) below land surface in a perched aquifer in the vicinity of the Coyote Spring and the old Butler

Ranch to about 107 to 183m (350 to 600 ft) below land surface for the water table aquifer throughout the valley floor area (Buqo et al., 1992). Groundwater is derived from two sources: recharge over the basin (estimated at about 2.5×10^6 m^3/yr [2,000 acre-feet/year]) and subsurface inflow on the north from the Pahranagat Valley (about 4.3×10^7 m^3/yr [35,000 acre-feet/year]). Groundwater is discharged via subsurface outflow to the Muddy Springs area and is appreciable, estimated to be at least 4.6 x 104 m^3/yr (37,000 acre-feet/year).

There are a number of springs in the Coyote Spring Valley (Eakin, 1964). The springs are situated primarily on the eastern slopes of the Sheep Range. Of the nine springs that have been identified, discharge data are only available for two, Coyote and Mormon Well Springs. Published estimates of discharge for both of these springs is less than 4 L/min (1 gal/min); however, some seasonal variations may occur with higher discharge rates in the late spring and reduced discharges during the summer and fall. As of 1992, there were 15 surface water rights totaling only 50,573 m^3/yr (41 acre-feet/year) for springs in the basin.

Because of the limited spring discharge and the irregular nature of surface water discharge, the only reliable water resource is groundwater. There is currently only one operating water supply well in the Coyote Spring Valley. Well yields within the basin are quite variable, depending on the aquifer that is used as a water source. In general, well yields from the alluvial aquifer are quite low, approximately a few hundreds of liters (a few tens of gallons per minute), owing to the limited saturated thickness of alluvium that is present over much of the basin. In contrast, exploratory water wells drilled into the underlying regional carbonate aquifer by the U.S. Air Force were found to be quite productive, with one well capable of producing more than 11,356 L/min (3,000 gal/min).

Because of the tremendous water production potential of the regional carbonate aquifer, there has been considerable interest in developing water supplies in the Coyote Spring Valley in support of defense, municipal, and industrial applications. As of 1994, there were no groundwater rights appropriated within the basin (Buqo, 1996b). However, there are many senior applications for groundwater appropriations in the basin. In 1983, Nevada Power Company applied for 1.6 m^3/sec (55.0 ft^3sec). In 1985, Aerojet applied for 0.17 m^3/sec (6 ft^3/sec), and, later in that year, Nevada Power Company submitted applications for an additional 1.4 m^3/sec (50 ft^3/sec). In 1986, Aerojet filed 13 additional applications, bringing its total request to 747.97 m^3/sec (26,414 ft^3/sec). In 1988, a single application for 0.44 m^3/sec (15.46 ft^3/sec) was filed for ore processing and, in 1989, the Las Vegas Valley Water District filed five applications totaling 1.1 m^3/sec (38 ft^3/sec). None of these applications have been acted on, and there is considerable uncertainty regarding the potential for obtaining approval of new applications for groundwater to support a Solar Enterprise Zone facility.

WATER QUALITY—According to information published by the Las Vegas Valley Water District (Buqo et al., 1992), the groundwater in the Coyote Spring Valley is generally a calcium-sodium-sulfate type with a total dissolved solids concentrations ranging from 700 to 1,000 mg/L (700 to 1,000 ppm), exceeding the Primary Drinking Water standard of 500 mg/L (500 ppm). Samples of water from the alluvium have been found to have concentrations of iron and manganese that exceed drinking water standards, and elevated concentrations of fluoride have been reported for wells completed in the carbonate aquifer.

4.7.6 Biological Resources

Extensive inventories and assessments of the biological resources of the Coyote Spring Valley have been performed as part of the U.S. Air Force's MX Missile studies and as part of the Aerojet land withdrawal. Detailed information on the biological resources of the basin can be found in (Aerojet General, 1987), and is summarized in the following discussion. The scientific name of plants and animals mentioned in this section is given in Section E.2.6, of Appendix E, Biological Resources. If the Coyote Spring Valley is selected as the most reasonable alternative location, updated surveys would be conducted in support of a Solar Enterprise Zone-specific environmental document.

The plant communities of the Coyote Spring Valley are typical of those found in this part of the Mojave Desert. The dominant plants include creosote bush and white bursage. Mojave yucca, beaver tail cactus, and spiny menodora are subdominant on the bajada areas; shadscale, prince's plume, and wolfberry are subdominant over badland areas; desert willow and cheesebush are subdominant in wash areas. There are no known federally listed threatened, endangered, or candidate plant species within the area designated for consideration as a Solar Enterprise Zone facility.

The desert tortoise is the only threatened or endangered animal species in the Coyote Spring Valley. The Coyote Spring Valley is within critical habitat for this species. The U.S. Bureau of Land Management has designated a large area of the basin as an Area of Critical Environmental Concern to provide for management of the desert tortoise population in accordance with the U.S. Fish and Wildlife Recovery Plan for the desert tortoise (Mojave Population). The tortoise density of the Coyote Spring Valley ranges from 65 to 194 per km^2 (25 to 75 per mi^2) with a total population of almost 18,000, according to the U.S. Bureau of Land Management. Detailed investigations by Garcia et al., 1982 indicate that the population in the vicinity of the proposed Solar Enterprise Zone facility location ranges from 26 to 233 per km^2 (10 to 90 per mi^2). Because of the relatively high density of tortoises and the pristine habitat conditions, the Coyote Spring Valley is considered one of the most valuable tortoise habitats in Nevada (Aerojet General, 1987).

The desert bighorn sheep is a trophy big game species that has been classified as a sensitive species for management purposes by the U.S. Bureau of Land Management and Nevada Department of Wildlife. Bighorn sheep inhabit all of the mountain ranges surrounding the Coyote Spring Valley, and five intermountain migration routes have been identified. One route is 16 km (10 mi) northeast of a Solar Enterprise Zone facility site between the Delamar Mountains and northern Meadow Valley Mountains, and another route is located 10 km (6 mi) to the southeast between the Arrow Canyon Range and the southern Meadow Valley Mountains.

Although undocumented and unsighted within the Coyote Spring Valley, the banded gila monster, a State-protected reptile, may be present. This animal has been reported in the Maynard Lake area immediately north of the Coyote Spring Valley and to the east in the Moapa Valley. The most suitable gila monster habitat in the vicinity of the alternative Solar Enterprise Zone location is in the rocky areas of Pahranagat Wash and adjacent arroyos. If present within the Coyote Spring Valley, the density of this species is expected to be quite low.

4.7.7 Air Quality and Climate

This section includes a description of the air quality conditions at the Coyote Spring Valley, including climatology, meteorology, and ambient air quality.

CLIMATOLOGY AND METEOROLOGY—Although there are no weather stations in the Coyote Spring Valley, National Oceanic and Atmospheric Administration data on the climate of the area are available for stations located in the Valley of Fire, Logandale, and North Las Vegas. In general, the climate of the valley exhibits the low humidity and low annual precipitation characteristic of the climate of Clark County. The warmest month is July, when the mean monthly maximum temperature is 40 °C (104 °F); January is the coolest month, with a mean monthly minimum of 0°C (32 °F). The average monthly wind speed ranges from 11 kph (7 mph) in December to 18 kph (11 mph) in April and June. Diurnal variation in wind is common, reflecting the differential heating of the ground.

AMBIENT AIR QUALITY—The Coyote Spring Valley is located within Nevada Intrastate Air Quality Control Region 147, which is designated unclassifiable/attainment for all criteria pollutants. The closest Class I Prevention of Significant Deterioration area is the Grand Canyon National Park, approximately 121 km (75 mi) southeast of the Coyote Spring Valley. Because the Coyote Spring Valley is largely undeveloped, there are few emission sources in the area. Typical sources include a silica sand mining operation in the north-central part of the basin; on-road and off-road vehicle, railroad, and aircraft traffic; and fugitive dust.

4.7.8 Noise

The acoustic environment of the Coyote Spring Valley can be classified as uninhabited desert or small rural communities (Section 4.1.8). Noise measurements have not been made at the Coyote Spring Valley Solar Enterprise Zone site. Natural sources include wind and thunder. The major sources of noise would be associated with prevailing meteorological conditions, such as wind.

4.7.9 Visual Resources

The landscape character of the Coyote Spring Valley is typical of the Great Basin with extensive views of linear mountain ranges and valleys arranged in a north-south orientation. The valley is surrounded to the southwest and west by the Las Vegas and Sheep Ranges, Delamar Mountains to the north, Meadow Valley Mountains to the east, and Arrow Canyon Range to the south. The steep and rugged mountain slopes give way in the valley to gently sloping surfaces dissected by arroyos and washes. The visual quality of the area ranges from Class B to Class C. Because of the surrounding vista, the visual quality of the site has been designated Class B.

The proposed Solar Enterprise Zone facility in the Coyote Spring Valley is visible to the east from U.S. Highway 93. State Route 168 is 19 km (12 mi) south of the proposed site. The site would be visible from BLM Wilderness Study Areas located in the Delamar Mountains, Meadow Valley Mountains, and along the west side of U.S. Highway 93. The BLM Wilderness Study Areas range from 2 km (1 mi) to 8 km (5 mi) from the site. There are two utility corridors that roughly parallel these two routes. An abandoned ranch is located in the northern portion of the valley, and there is an active silica sand mining operation located adjacent to this ranch. The Kane Spring Wash cuts from east to west in the north part of the site.

4.7.10 Cultural Resources

The Coyote Spring Valley lies in southern Nevada, an area with a prehistory that may span the past 10,000 years or more. Properties ranging from the early prehistoric period to historic mining and ranching sites are known. A summary of cultural resources and associated impacts are described in (Aerojet General, 1987).

*SITES OF AMERICAN INDIAN SIGNIFICANCE—Coyote Spring is an area on the west flank of the Meadow Valley Mountains. The CGTO knows that this site contains a wide variety of American Indian cultural resources. The site was studied by American Indian people during the Intermountain Power Project (Stoffle and Dobyns, 1982). Nine Indian-use plants were identified during that on-site visit, including desert willow (*Chilopsis linearis*), prince's plume (*Stanleya pinnata*), and wolfberry (*Lycium andersonii*) (Stoffle and Dobyns 1982). The large desert tortoise was observed at this location. The area contains portions of an original Indian trail-wagon road from the Moapa Valley to Pahranagat Valley. Archaeological survey of the Intermountain Power Project corridor revealed 9 sites and 20 scattered finds (Tucker et al., 1982). Known American Indian cultural resources exist in the Coyote Spring area, but it is impossible to fully understand the potential impacts to cultural resources without additional systematic on-site resource studies by American Indian people.*

4.7.11 Occupational and Public Health and Safety

The Coyote Spring Valley location proposed for siting a Solar Enterprise Zone facility is currently undeveloped desert. Baseline health and safety considerations associated with the environment include potential for heat stroke and exhaustion (primarily during summer months), dehydration, and poisonous spider and snake bites. Other physical hazards include tripping or stumbling hazards associated with the desert terrain.

4.7.12 Environmental Justice

Existing demographic conditions for Environmental Justice are discussed in Section 4.1.12. This discussion includes conditions for the Coyote Spring Valley.

4.8 References

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Chapter 5

ENVIRONMENTAL CONSEQUENCES

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ENVIRONMENTAL CONSEQUENCES

This chapter provides the scientific and analytical base for the comparison of the alternatives. The discussion addresses the potential direct and indirect effects of each of the alternatives. In addition, this chapter contains discussions of unavoidable adverse effects, the relationship of short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and irreversible and irretrievable commitments of resources that would be involved in implementing an alternative.

Four alternatives are analyzed in this Environmental Impact Statement (EIS): Alternative 1 (Continue Current Operations), Alternative 2 (Discontinue Operations), Alternative 3 (Expanded Use), and Alternative 4 (Alternate Use of Withdrawn Lands). Twelve environmental resources and/or environmental resource elements are analyzed for each alternative. These are as follows:

- Land Use (includes land-use designations, site-support activities, and airspace)
- Transportation (includes on-site traffic, off-site traffic, transportation of materials and waste, and other transportation)
- Socioeconomics
- Geology and Soils
- Hydrology (surface hydrology and groundwater)
- Biological Resources
- Air Quality (includes radiological air quality)
- Noise
- Visual Resources
- Cultural Resources/American Indian
- Occupational and Public Health and Safety
- Environmental Justice.

Five programs are analyzed for each of the environmental resources and resource elements. These include the Defense Program, the Waste Management Program, the Environmental Restoration Program, the Nondefense Research and Development Program, and the Work for Others Program. In addition, site-support activities are analyzed for each of the environmental resources and resource elements.

Each program identified within an alternative was evaluated separately to identify its potential environmental impact. By evaluating each program separately, the U.S. Department of Energy (DOE) will be able to identify specific mitigation measures that may be necessary to alleviate the severity of impacts.

This EIS identifies the impacts of past, current, and potential programs of the U.S. Department of Energy, Nevada Operations Office (DOE/NV). Proposed programs are included in one or more of the four alternatives and fall into three basic levels: (1) current activities, (2) planned projects, and (3) proposed projects. Current activities are those that are presently part of the normal operations of the Nevada Test Site (NTS), the Tonopah Test Range, portions of the Nellis Air Force Range (NAFR) Complex, and other areas considered in this EIS, such as the Area 5 Radioactive Waste Management Site. Planned projects are those that are within the five-year planning cycle and are likely to be implemented, such as the Solar Enterprise Zone facility. Proposed projects are not currently considered within the five-year planning window, but have undergone sufficient conceptual development to allow a reasonable assessment. The most reliable data are clearly derived from ongoing activities. Planned projects would present slightly less reliable data. Data for proposed projects would be the least defined, but were determined to be essential to a full and open evaluation and disclosure of the potential effects of the alternatives. To provide an adequate analysis, conservative assumptions and parameter values were used to evaluate potential impacts of the less-defined activities.

Implementation of any of the alternatives could result in a permanent commitment of resources such as groundwater, soil, biota, minerals, surface area, and subsurface geology and would represent an irreversible and irretrievable commitment of such resources. In addition to the National Environmental Policy Act requirement to identify the irreversible and irretrievable commitments of resources, it is also the intent of the DOE to identify these same resources within the meaning of the Comprehensive Environmental Response, Compensation, and Liability Act, Section 107(f)(1). Though the NTS is not listed on the National Priorities List established by the U.S. Environmental Protection Agency (EPA), the requirement exists to address the natural resource damage liability as discussed in Section 107.

The impact analysis for this NTS EIS is based on the best data currently available. This EIS will serve as a baseline document for the preparation of subsequent, tiered National Environmental Policy Act documents that may be required prior to implementation of future specific projects.

5.1 Alternative 1 - Continue Current Operations (No Action)

Alternative 1, Continue Current Operations, is defined as Defense, Waste Management, Environmental Restoration, Nondefense Research and Development, and Work for Others. These programs would continue in the same manner and degree as they have within the past three to five years. This alternative includes programs at the NTS, the NAFR Complex, the Tonopah Test Range, the Project Shoal Area, and the Central Nevada Test Area. A more detailed description of the program projects and activities is presented in Appendix A.

Defense Program. Defense Program operations would continue under the conditions of the ongoing moratorium and the negotiations of the Comprehensive Test Ban Treaty. Stockpile stewardship and nuclear emergency response would continue to be the two main categories of activities included in the Defense Program operations under Alternative 1. Stockpile stewardship includes a program of activities to maintain confidence in the safety, reliability, and performance of the nation's nuclear weapons. Stockpile stewardship activities include nuclear test readiness, one or more underground nuclear weapons tests, if directed by the President, and hydrodynamic tests and dynamic experiments. The DOE cannot speculate on how many tests the President might direct the DOE to conduct in the unlikely event that the United States decides to renew underground nuclear testing. However, the DOE believes that this number is likely to be small and that the total environmental impact of any additional testing would be only a fraction of the impacts caused by the approximately 800 underground tests conducted prior to 1992 and documented in Chapter 4. This chapter describes the impacts each additional test would have and demonstrates that a limited testing program would result in only a few isolated areas of impact. Nuclear emergency response would continue to be composed of the Nuclear Emergency Search Team, the Federal Radiological Monitoring and Assessment Center, the Aerial Measuring System, the Accident Response Group, the Radiological Assistance Program, and the DOE/NV Internal Emergency Management Program.

Waste Management Program. The primary mission of the NTS Waste Management Program would be to continue to serve as a transuranic storage and low-level and mixed waste disposal and storage facility in support of the DOE/NV. The NTS would continue to provide disposal capability for approved waste generated on the NTS, as well as for approved off-site waste generators. The NTS will continue to implement the Waste Minimization/ Pollution Prevention Program as described in Appendix C.6. Waste management activities at the NTS would continue to be conducted in four primary areas: Areas 3, 5, 6, and 11.

The Area 3 Radioactive Waste Management Site would continue to serve the NTS and approved off-site generators as a bulk, low-level waste disposal facility. Under Alternative 1, it is anticipated that two additional cells/craters and no additional support facilities would be opened. Two disposal units in Area 3 would be closed under this alternative.

Although the Area 5 Radioactive Waste Management Site would continue to serve the NTS as a low-level and mixed waste disposal site, existing capacity would not meet the disposal needs of low-level waste expected to be generated under Alternative 1. Greater confinement disposal technology would continue to be pursued for disposal of high-specific activity waste. The pit used for disposal of mixed waste has sufficient capacity to meet the expected amount generated under this alternative. Therefore, the mixed waste disposal capacity would not be expanded. No sanitary landfill construction or disposal activities would occur in Area 5 under Alternative 1. The Transuranic Waste Storage Unit and the Hazardous Waste Storage Unit would continue to be used to store waste.

Waste management operations in Area 6 under Alternative 1 would include continued storage of polychlorinated biphenyl (PCB) waste, operation of the hydrocarbon landfill, and treatment of low-level waste at the Liquid Waste Treatment System Facility.

The Area 11 Explosive Ordnance Disposal Unit is a thermal treatment unit. Explosive ordnance wastes would continue to be detonated at the Explosive Ordnance Disposal Unit under Alternative 1.

Environmental Restoration Program. The goal of the Environmental Restoration Program is to remediate contaminated sites while complying with applicable environmental regulations and statutes and protecting the public and workers' health and safety. The Environmental Restoration Program projects that would continue under Alternative 1 are the Underground Test Area Corrective Action Unit, Soils Media Corrective Action Unit, Industrial Sites Units, decontamination and decommissioning facilities, Defense Nuclear Agency sites, Tonopah Test Range, Project Shoal Area, and Central Nevada Test Area.

Nondefense Research and Development Program. The DOE has historically supported a variety of research and development activities at the NTS in cooperation with universities, industries, and other federal agencies. Activities that would continue under Alternative 1 include development of a variety of alternative energy resources, a spill test facility, alternative-fueled vehicles and fueling station, development of an Environmental Management and Technology Development Program, and an Environmental Research Park.

Work for Others Program. The Work for Others Program would continue to be hosted by the DOE and includes the shared use of certain NTS and Tonopah Test Range facilities and resources with other federal agencies (such as the U.S. Department of Defense [DoD]) for various military training exercises and research and development projects. Activities included in the Work for Others Program under Alternative 1 are treaty verification, nonproliferation, counter-proliferation research and development, conventional weapons demilitarization, and defense-related research and development.

Activities at the NTS and NTS support facilities throughout Nevada are and would be affected by implementation of current and future international arms control treaties. Treaties currently in effect or under negotiation that are included as part of the treaty verification activities under Alternative 1 are the Threshold Test Ban Treaty, the Peaceful Nuclear Explosion Treaty, the Chemical Weapons Convention, and the Open Skies Treaty.

Nonproliferation is defined as the use of a full range of political, economic, and military tools to prevent the spread of weapons of mass destruction or missiles, diplomatically reverse the spread, or protect the United States interest against an opponent armed with these weapons, should that prove necessary. Under Alternative 1, the NTS and Tonopah Test Range would continue to provide critical support for the United States nonproliferation goals and objectives, particularly in the areas of research and technology development.

Counterproliferation refers to DoD efforts to combat the international proliferation of weapons of mass destruction. As with nonproliferation, these efforts would continue to include the full range of political, economic, and military tools available. However, because facilities for developing, producing, and storing weapons of mass destruction would likely be located below ground, a considerable amount of counterproliferation research and development would involve the detection, monitoring, and neutralization of buried targets. Under Alternative 1, the NTS would continue current counterproliferation activities and could become the center for a national counterproliferation program.

Conventional weapons demilitarization activities would continue to include demonstration projects for the disposal or destruction of solid rocket motors and other nonnuclear energetic materials at the NTS.

Defense-related research and development activities under Alternative 1 would include tests and training exercises employing weaponry, such as small arms, artillery, guns, aircraft, armored vehicles, demolitions, rockets, bazookas, and air-dropped armaments, as well as a variety of electronic, imagery, and sensory technologies.

5.1.1 NTS

The following sections describe the potential effects the five programs and the site-support activities could have on the resources at the NTS.

5.1.1.1 Land Use. The land-use analysis includes an assessment of the availability of land; potential disturbance of prime, unique, and other important features or habitat; and compatibility with land-use plans and policies. The baseline for each site and its immediate vicinity was established based on the interpretation of aerial photographs, land-use plans and policies, maps, and other sources available through local, state, and federal agencies and through information in the DOE files. Changes to land-use resource areas associated with the alternatives are compared to baseline land use discussed in Chapter 4, and the potential impacts on these areas are assessed. No impacts to surrounding land uses have been identified under this alternative.

The NTS has been committed to weapons testing since the 1950s, and some of its land areas have undergone changes that are considered to be permanent and irreversible. As stated in the *Final Environmental Impact Statement, Nevada Test Site, Nye County, Nevada* (ERDA, 1977),

> "...the addition of new underground pockets of radioactivity and the formation of subsidence craters in the test areas of the NTS will deny use of those sites for other nontest-related purposes. As a result of the test program, it will be necessary to subject those areas to rigorous control of access and limited use for an indefinite time. Such an evaluation of land-use impacts is largely qualitative and is supported by the quantitative impact analysis presented in other resource sections."

Defense Program. The entire NTS is designated as a Defense Program site. Defense Program projects, research and development, testing, and experimentation under this alternative are assumed to continue at levels equivalent to the past 3 to 5 years. Therefore, no new impacts to land use are expected. Defense Program activities are consistent with current site and land-use designation definitions. Land-use designation restrictions preclude activities that are inconsistent with current land uses.

The analysis performed for this EIS is for the conduct of one nuclear test. The impacts to the environment from the conduct of multiple tests (a series) are assumed to be incrementally additive. For example, the impacts of conducting two tests would be twice the impact of conducting a single test.

Waste Management Program. Under Alternative 1, ongoing Waste Management Program activities at the NTS would continue at current levels and are consistent with current site- and land-use designation definitions. Therefore, no new impacts to land use are expected.

Environmental Restoration Program. Under Alternative 1, the Environmental Restoration Program would continue at current levels. Therefore, no adverse impacts to land use are anticipated. After existing facilities are decontaminated, they could be used for other purposes. Removal of plutonium-contaminated soils would provide additional areas that could be used for new facility construction.

Nondefense Research and Development Program. Under Alternative 1, the DOE would continue to support ongoing program operations, but no new initiatives would be pursued. Thus, no new impacts to land use are expected.

Work for Others Program. Under Alternative 1, the DOE would continue to host projects and activities of other federal agencies (e.g., the DoD) at activity levels not exceeding those of the past 3 to 5 years. Activities are consistent with the site- and land-use designation definitions for the areas. No new impacts to land use are expected.

5.1.1.1.1 Site-Support Activities— Site-support activities are discussed in the following sections as an NTS resource that is affected by the implementation of the alternatives. The changes to the site-support activities are estimated based on changes in activities from baseline levels. Four subsections of site support are evaluated, including facilities, services, utilities, and on-site communications.

FACILITIES—Under Alternative 1, facilities would be maintained at approximately the current level. Facilities that are currently not in use would remain inactive, but be maintained to the extent possible so that they might be used at a later time.

SERVICES—Support services, such as law enforcement and security, fire protection, and health care, would remain at approximately the current level under this alternative.

UTILITIES—Water, wastewater, and electrical systems would be maintained to ensure they are defect free. Utilities currently not in use would be shut down and stabilized to the extent possible so that they might be restarted and used at a later time.

ON-SITE COMMUNICATION—Communication systems under Alternative 1 would be maintained at approximately the current capacity. Radio, telephone, and video communication systems would receive routine maintenance as deficiencies are identified. The internal and the United States mail systems would continue to operate.

5.1.1.1.2 Airspace—The effects of continued activities and aircraft operations under Alternative 1 would have a minimal effect on the NTS and NAFR Complex airspace. DOE operations (including Desert Rock Airport activities) may increase by approximately 2 percent each year and military operations may increase slightly under the Defense Program and Work for Others Program. As a result, internal NAFR Complex airspace boundaries may be modified to better accommodate range operations and facilitate movement of air traffic through the NAFR Complex. However, no significant modification to the external NTS and NAFR Complex airspace boundaries is anticipated.

The inherent constraints of the existing NTS and NAFR Complex restricted airspace would continue to require that nonparticipating civil and military aircraft be routed around the NTS and NAFR Complex, as necessary, contingent upon joint-use status, operations in progress, and air traffic considerations. The current level of air traffic control and radar/radio/navigational aid services would likely be maintained or improved under normal upgrade programs.

The possible effect on civilian aviation is keyed primarily to constraints that defense-related airspace might place on routes of flight. General aviation would continue to be diverted around the NTS and NAFR Complex. However, the current level of air traffic control and navigational aid services, as well as the same airspace structures, would most likely be maintained under this alternative. Based on the past trend and on improvements in communication, it would not appear that this alternative would cause a major change in civilian air traffic.

Under Alternative 1, the only activities that would affect airspace would be defense related. Therefore, only Defense and Work for Others Programs will be discussed and evaluated. However, with all programs, occasional flights of helicopters and fixed-wing aircraft carrying supplies and personnel are anticipated.

Defense Program. Activities at the NTS would continue at the levels of the past 3 to 5 years. No new programs or initiatives would be pursued. Activities would likely include an increase in air traffic of approximately 2 percent per year for the next 3 to 5 years.

Work for Others Program. With the Work for Others Program, the continuation of the use of the NTS airspace for various training exercises and associated defense activities is anticipated. However, no commercial air passenger, general aviation, or air cargo activities would occur except for occasional DOE-related cargo and personnel operations or for emergency operations.

Airspace requirements under Alternative 1 would be the same as those currently in effect with the Nellis Air Force Base Air Traffic Control Facility, assuming full air traffic control in the NTS and surrounding area. The continuation of operation at the NTS under the Work for Others Program would not result in changed airspace or additional air traffic impacts.

*5.1.1.2 **Transportation***. The following sections contain the discussion of the environmental impacts related to transportation activities as defined under Alternative 1. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.1.1.2.1 On-Site Traffic—The majority of NTS employees commute to the site by bus and work 4 days per week. Currently there are 54 buses serving the Las Vegas area, and 5 buses that serve the town of Pahrump, located approximately 72 km (45 mi) south of the NTS on State Route 160. These buses have dedicated routes to the following locations on the NTS: Mercury (23 routes), Area 25 (12 routes), Control Point in Area 6 (8 routes), Area 6 operations (8 routes), Area 12 operations (1 route), Area 3 Radioactive Waste Management Site (2 routes), and 1 mail route. There is a limited number of shuttle buses for on-site trips. The average number of daily trips attributable to the commuter buses would be 120 trips per day on roads within the NTS. All buses enter the site through the main gate on Mercury Highway, except for two buses from Pahrump. These buses use Gate 510 on Lathrop Wells Road (Thomas, 1995).

Traffic generated within the NTS as a result of the land use, projects, and activities associated with Alternative 1 is estimated to be 3,370 trips per day. Table 5.1-1 shows the baseline average daily trip generation for each of the programs.

Table 5.1-2 summarizes the average daily traffic volume for the key roadways on the NTS under Alternative 1. The portion of the average daily traffic volume that would be attributable to each program is also provided. All key on-site roadways have capacities exceeding 2,000 vehicles per hour for both directions combined (Transportation Research Board, 1994). A comparison of capacity to volumes assigned to each segment on Table 5.1-2 shows that no roadway would experience significant traffic congestion under Alternative 1. The segment of roadway with the highest volume would be the section of Mercury Highway from Mercury to Road 5-01, with an average daily volume of 1,215 vehicles per day.

Defense Program. Traffic generated on the roads within the NTS as a result of projects and activities associated with the Defense Program is estimated to be 635 average daily trips under Alternative 1. No adverse effects on traffic-flow would occur as a result of the Defense Program.

Waste Management Program. Traffic generated on the roads within the NTS as a result of projects and activities associated with the Waste Management Program is estimated to be 145 average daily trips under Alternative 1. The Radioactive Waste Management Sites in Areas 3 and 5 would continue to receive and dispose of low-level waste from approved waste generators within the DOE complex. The Area 5 Radioactive Waste Management Site would also continue to make mixed waste disposal capability available to NTS generators. Acceptance of waste quantities would continue at levels consistent with past activity (Shott el al., 1995). Inbound shipments from off-site generators are estimated to be approximately 6,800 in the next 10 years for an average of

Table 5.1-1. Average on-site daily trip generation (one-way trips) by program, Alternative 1

Program	Trips per Day
Defense	635
Waste Management	145
Environmental Restoration	390
Nondefense Research and Development	180
Work for Others	140
Site-Support Activities	1,880
Total	**3,370**

3 shipments per day. The number of waste shipments generated on the NTS is expected to be 11,615 in the next 10 years for an average of 6 shipments per day. The majority of the low-level waste would be shipped to the Radioactive Waste Management Site in Area 5. Access to this site would be provided by the Radioactive Waste Management Site access road from Mercury Highway to Road 5-01. No adverse effects on traffic flow would occur as a result of the Waste Management Program.

Environmental Restoration Program. Traffic generated on the roads within the NTS as a result of projects and activities associated with the Environmental Restoration Program is estimated to be 390 average daily trips under Alternative 1. No adverse effects on traffic flow would occur as a result of the Environmental Restoration Program.

Nondefense Research and Development Program. Traffic generated on the roads within the NTS as a result of projects and activities associated with the Nondefense Research and Development Program is estimated to be 180 average daily trips under Alternative 1. No adverse effects on traffic flow would occur as a result of the Nondefense Research and Development Program.

Work for Others Program. Traffic generated on the roads within the NTS as a result of projects and activities associated with the Work for Others Program is estimated to be 140 average daily trips under Alternative 1. No adverse effects on traffic flow would occur as a result of the Work for Others Program.

Site-Support Activities. Traffic generated on the roads within the NTS as a result of activities associated with site-support activities is estimated to be 1,880 average daily trips under Alternative 1. No adverse effects on traffic flow would occur as a result of site-support activities.

5.1.1.2.2 Off-Site Traffic—Alternative 1 effects on roadway traffic were assessed by estimating the number of trips generated by each program-related activity and considered employees, visitors, residents, and service and delivery vehicles associated with construction and operations. These trips were then assigned to key roadway segments.

Traffic impacts were determined based on level of service changes for each of the key roads analyzed. The major traffic generators at the site under Alternative 1 would be the construction and operation employees (totaling 2,947 employees on site in 1996 through 2005) and their activities. Table 5.1-3 shows a summary of average daily vehicle trips generated by each program activity for the years 1996, 2000, and 2005. Distribution among programs is assumed to remain approximately the same as the current trip distribution. The projected peak-hour traffic on key roads and the

Table 5.1-2. Average daily traffic volumes (one-way trips) on key NTS roadway segments, Alternative 1

Roadway	Segment	Average Daily Traffic Volume						
		Defense	Waste Management	Environmental Restoration	Nondefense Research and Development	Work for Others	Site-Support Activities	Total
	North							
Buckboard Mesa Rd	Pahute Mesa Rd. to Airport Rd.	65	0	30	0	0	0	**95**
Mercury Hwy.	Tippipah Hwy. to Rainier Mesa Rd.	125	30	90	0	0	0	**245**
Pahute Mesa Rd.	Mercury Hwy. to Stockade Wash Rd.	125	0	60	0	0	0	**185**
Pahute Mesa Rd.	Stockade Wash Rd. to Buckboard Mesa Rd.	65	0	30	0	0	0	**95**
Rainier Mesa Rd.	Mercury Hwy. to Tippipah Hwy.	125	0	30	0	0	0	**155**
Tippipah Hwy.	Mercury Hwy. to Pahute Mesa Rd.	255	0	120	0	0	0	**375**
Tippipah Hwy.	Pahute Mesa Rd. to Rainier Mesa Rd.	0	0	30	0	0	0	**30**
	South							
Cane Spring Rd.	Lathrop Wells Rd. to Mercury Hwy.	0	0	30	70	30	0	**130**
Jackass Flats Rd.	Mercury Hwy. to Lathrop Wells Rd.	0	0	90	90	70	0	**250**
Lathrop Wells Rd.	U.S. Hwy. 95 to Jackass Flats Rd.	0	0	30	20	40	0	**90**
Mercury Hwy.	Mercury Hwy. to Road 5-01	510	145	270	70	30	100	**1,125**
Mercury Hwy.	Road 5-01 to Cane Spring Rd.	510	35	240	70	30	100	**985**
Mercury Hwy.	Cane Spring Rd. to Tippipah Hwy.	510	35	240	0	0	100	**885**
Road 5-01	Mercury Hwy. to Area 5 RWMS	0	95	30	0	0	0	**125**
Road 5-07	Mercury Hwy. to Area 5 RWMS	0	15	0	0	0	0	**15**

NOTE: RWMS = Radioactive Waste Management Site.

Table 5.1-3. Average off-site daily vehicle trip generation, Alternative 1

Program	1996	2000	2005
Defense	330	330	330
Waste Management	60	60	60
Environmental Restoration	90	90	90
Nondefense Research and Development	40	40	40
Work for Others	80	80	80
Site-Support Activities	880	880	880
Total	**1,480**	**1,480**	**1,480**

NOTE: All values are rounded to the nearest 10. Daily trips shown are defined as one-way vehicle trips or vehicle trip ends.

Source: AASHTO, 1990.

associated level of service that would result under Alternative 1 for 1996, 2000, and 2005 is shown on Table 5.1-4. These include the average daily vehicle trip generation, by program, listed in Table 5.1-3.

Based on American Association of State Highway Transportation Officials standards, level of service B is appropriate for freeways and arterials and rural highways (level or rolling terrain). Level of service C is appropriate for rural (mountainous), urban, and suburban highways. For local roads, level of service D is appropriate in all terrain (AASHTO, 1990). By 2005, all key roads in the immediate vicinity of the site (U.S. Highway 95; the Mercury interchange ramps; and the access highway to the site, State Route 433) would continue to operate at level of service C or better, which is acceptable according to American Association of State Highway Transportation Officials standards. However, key roads within metropolitan Las Vegas (segments of Interstate 15, U.S. Highway 95, and U.S. Highway 93) already operate at levels of service ranging from A to F, and by 2000, they would all deteriorate to an unacceptable level of service F. These conditions would prevail even without Alternative 1 because of cumulative traffic growth (recreational, regional, and commuter traffic). U.S. Highway 93 at Hoover Dam already operates at an unacceptable level of service F, and its level of service would continue to deteriorate further with or without Alternative 1 activities because of its geometry (steep grades and narrow curves) and partially because of its moderate traffic volume and truck traffic. All other key roadways would generally continue to operate at a level of service C or better throughout the period of analysis.

The off-site conditions described above would occur with or without Alternative 1 and with or without any single program activity. The following sections address the contribution of each program activity to traffic impacts.

Defense Program. The major Defense Program traffic generators in 2005 under Alternative 1 would be the approximately 660 on-site employees, generating approximately 330 vehicle trips on a typical weekday in 2005. Except for site-support, defense-related activities would have the highest number of daily vehicle trips (22 percent of the total) and the most traffic impacts.

Waste Management Program. The major traffic generators in 2005 under Alternative 1 would be the 112 on-site employees associated with the Waste Management Program, generating approximately 60 vehicle trips on a typical weekday in 2005. The Waste Management Program-related activities would contribute 4 percent of the total number of daily vehicle trips.

Table 5.1-4. Peak-hour traffic volumes and level of service on key roads, Alternative 1

Roadway Segments	Capacity VPH[a]	1996 DDHV[b]	1996 LOS[c]	2000 DDHV	2000 LOS	2005 DDHV	2005 LOS
Regional							
I-15 @ California/Nevada state line	6,800	2,980	E	3,749	F	4,711	F
I-15 north of Sahara Avenue interchange	10,200	7,321	F	9,015	F	11,133	F
I-15 north of the Downtown Expressway interchange	10,200	4,430	E	5,573	F	7,002	F
I-15 just north of the 'D' and Washington interchange	10,200	4,067	D	5,116	F	6,428	F
I-15 north of the Cheyenne interchange	6,800	1,902	C	2,689	D	3,672	F
I-15 south of the Lamb Blvd. interchange	6,800	652	A	852	A	1,103	B
I-15 north of West Mesquite interchange (Nevada/Utah state line)	6,800	636	A	887	A	1,200	B
I-80 east of Apex interchange (California/Nevada state line)	6,800	1,756	C	2,007	C	2,321	C
I-80 east of the West Wendover interchange (Nevada/Utah state line)	6,800	327	A	412	A	517	A
Local							
U.S. Hwy. 95 south of Jones Blvd. interchange (North Las Vegas Terminal)	10,200	7,325	F	9,215	F	11,578	F
U.S. Hwy. 95 north of Sunset Road interchange (East Las Vegas)	6,800	2,594	D	3,263	F	4,100	F
Tonopah Hwy. 599 east of the U.S. Hwy. 95/Rancho Road interchange	6,800	1,208	B	1,972	C	2,926	E
U.S. Hwy. 95 south of 157 north of Las Vegas	6,800	843	A	989	A	1,173	B
U.S. Hwy. 95 just east of Mercury interchange	6,800	358	A	385	A	419	A
U.S. Hwy. 95 interchange at Mercury							
Southbound off-ramp	1,300	37	B	37	B	37	B
Southbound on-ramp	1,300	242	B	242	B	242	B
Northbound off-ramp	1,300	242	B	242	B	242	B
Northbound on-ramp	1,300	37	B	37	B	37	B
SR[d] 433, 0.32 km (0.2 mi) north of the Mercury interchange (access to NTS)	2,200	291	C	291	C	291	C
U.S. Hwy. 95, 6.1 km (3.8 mi) north of Mercury interchange	2,200	283	C	323	C	374	C
U.S. Hwy. 95 @ Amargosa Valley to Beatty	2,000	62	A	69	A	78	A
U.S. Hwy. 95 north of Beatty	2,000	174	B	194	B	218	C
SR[d] 160 south of U.S. Hwy. 95	2,000	74	A	91	A	112	B
U.S. Hwy. 93 south of the Nevada/Arizona state line at Hoover Dam	1,500	820	F	987	F	1,196	F
U.S. Hwy. 93 east of westbound off-ramp of Railroad Pass interchange	6,840	2,700	E	3,250	F	3,936	F
U.S. Hwy. 93 north of I-15/U.S. Hwy. 93 interchange	2,000	134	B	168	B	211	B
U.S. Hwy. 93 south of SR 375 junction near Crystal Springs	2,000	133	B	160	B	194	B
U.S. Hwy. 93 west of SR 375 junction near Crystal Springs	2,000	47	A	55	A	65	A
SR 375 west of U.S. Hwy. 93 junction at Crystal Springs	1,500	31	A	34	A	37	A
SR 375 east of Warm Springs	1,500	14	A	15	A	16	A
U.S. Hwy. 6 east of Warm Springs at SR 375 junction	1,700	16	A	17	A	18	A
U.S. Hwy. 6 west of Warm Springs at SR 375 junction	1,700	21	A	23	A	25	A
U.S. Hwy. 6 east of Tonopah, west of SR 376	1,700	99	B	90	A	80	A

[a] Vehicles per hour
[b] Directional design hourly volume (one direction)
[c] Level of service
[d] SR=State Route.

Environmental Restoration Program. The major traffic generators in 2005 under Alternative 1 would be the 174 on-site employees associated with the Environmental Restoration Program, generating approximately 90 vehicle trips on a typical weekday in 2005. The Environmental Restoration Program-related activities would contribute approximately 6 percent to the total number of daily vehicle trips.

Nondefense Research and Development Program. The major traffic generators in 2005 under Alternative 1 would be the 86 on-site employees associated with the Nondefense Research and Development Program, generating approximately 40 vehicle trips on a typical weekday in 2005. The Nondefense Research and Development Program activities would contribute slightly less than 3 percent to the total number of daily vehicle trips.

Work for Others Program. The major traffic generators in 2005 under Alternative 1 would be the 157 on-site employees associated with the Work for Others Program, generating approximately 50 vehicle trips on a typical weekday in 2005. These activities would generate approximately 5 percent of the number of daily vehicle trips.

Site-Support Activities. Site-support activities are anticipated to generate 880 vehicle trips on a typical weekday in 2005. These trips account for operations activities related to roads, utilities, communication, and other site support. Under Alternative 1, these activities would contribute to approximately 60 percent of the total number of daily trips in 2005.

5.1.1.2.3 Transportation of Materials and Waste—The expected waste volumes and numbers of shipments for Alternative 1 are identified on Table 5.1-5. Table 5.1-5 reflects a 10-year average estimate of low-level waste volumes and shipments by generator sites for Alternative 1. The yearly average for low-level waste, ignoring NTS generated low-level waste, is approximately 700 shipments/year. Low-level waste, mixed waste, and some defense programs nuclear material would be transported under this alternative. The specific routes analyzed and their lengths are provided in Appendix I.

Defense Program. The Defense Program requires the shipment of special nuclear materials and weapons components in a safe-secure trailer. Information regarding the total number of radioactive materials shipments generated by the Defense Program is classified for reasons of national security. In addition, with the current weapons testing moratorium in place, it is uncertain at this time how many tests and what types of tests would be performed, in the event the moratorium is lifted. Under Alternative 1, a total of 140 shipments of nuclear test devices to the NTS would occur. The risk associated with Defense Programs transportation is low. The risk of radiation induced latent cancer fatality in the exposed population is 4×10^{-5}; the risk of health effects due to vehicle emissions (nonradiological risk) is 1.85×10^{-4}. The risk of a vehicle-related traffic fatality is 6×10^{-4}. The accident-initiated radiological risk of latent cancer fatality is 8×10^{-11}.

The only on-site risk is from the 32 to 40 km (20 to 25 mi) of roadway that the safe-secure trailer would travel. A group of flammable-liquid storage tanks, protected by dikes, is located near Mercury, about 31 m (100 ft) off the roadway. A transportation accident having serious consequences along this route is estimated to have a probability of less than or equal to 1 in 1,000,000.

Waste Management and Environmental Restoration Programs. Under Alternative 1, a waste volume of 350,500 cubic meters (m^3) (458,437 cubic yards [yd^3]) would be expected, of which 350,000 m^3 (457,783 yd^3) is low-level waste. Additionally, 200,000 m^3 (261,590 yd^3) of the waste would be from off-site generators. This volume of waste represents approximately 7,200 shipments for the 10-year period evaluated.

For the transportation risk analysis, health risk was estimated in terms of vehicle-related fatalities and cargo-related deaths and illness, such as latent cancer fatalities, from highway transportation of DOE-generated low-level and mixed waste. The results are given in Table 5.1-6. Traffic injuries and fatalities would be the most dominant risk, followed by the risk of radiation-induced cancer, which would be dominated by incident-free transportation.

The nonradiological accident risk along the entire route for the 10-year duration of the program is an estimated 2 vehicle-related fatalities and 27 injuries. It is estimated that 0.002 latent cancer fatalities would be induced over 10 years as a result of exposure to radiation. Inside the borders of Nevada, the risk of a traffic-related fatality is estimated to be 0.02 in 10 years, and 1 traffic-related injury is expected in 10 years. The risk of a latent cancer fatality inside Nevada during 10 years is 6×10^{-4} ($6 \times 10^{-4} = 0.0006$). The consequence and probability of the maximum foreseeable accidents were calculated based on the total number of low-level radioactive waste shipments to the NTS. The most severe consequence from a low-level waste accident would be 8.08×10^{-3} latent cancer fatalities and 1.04×10^{-3} radiation detriments. The maximum probability of occurrence of this accident is 2.25×10^{-3}. There is no off-site mixed waste received at the NTS under Alternative 1.

On-site risks include those from the transport of NTS-generated waste, as well as those from the on-site transportation of wastes generated off site. As with off-site transportation, the risk is dominated by vehicle-related fatalities and injuries; the cargo-related risks are very small.

Table 5.1-5. Low-level volumes and shipments by generator site[a], Alternative 1

Generator Site		Waste Type	10-year Volume (m^3)[b]	10-year Volume (yd^3)[c]	Number of Shipments[d]
Aberdeen Proving Ground		LLW[e]	790	1,033	21
Energy Technology Engineering Center		LLW	614	803	6
Fernald Environmental Management Project		LLW	84,177	110,099	2,213
Lawrence Livermore National Laboratory		LLW	1,928	2,522	51
Inhalation Toxicology Research Institute		LLW	344	450	9
Mound		LLW	60,027	78,512	1,578
Nevada Test Site	(WM)[f]	LLW	500	654	20
	(ER)[g]	LLW	115,000	150,414	8,800
Oak Ridge National Laboratory		LLW	26,607	34,801	699
Pantex Plant		LLW	769	1,006	20
RMI Extrusion Plant		LLW	5,528	7,230	146
Rocky Flats Environmental Technology Site		LLW	14,000	18,311	2,000
Tonopah to NTS		LLW	35,191	46,028	2,707
Sandia National Laboratories, CA		LLW	219	286	6
Sandia National Laboratories, NM		LLW	3,600	4,709	9
Total[h]			**349,294**	**456,858**	**18,285**

[a] All volumes are derived from the 1994 Integrated Data Base and the Waste Management Programmatic EIS inventory projections
[b] Cubic meter
[c] Cubic yard
[d] Assumes an average of 12 containers per shipment
[e] LLW = Low-level waste
[f] Waste Management Program operations
[g] Environmental Restoration Program operations
[h] Includes internally generated waste for WM and ER.

Source: 1994 Integrated Data Base (DOE, 1995a) and the Waste Management Programmatic EIS (DOE, 1995b).

Table 5.1-6. Transportation risks, Alternative 1

	Transportation Risks	Transportation Risks Inside Nevada	On-site Transportation Risks for Off-site Shipments	On-site Transportation Risks from NTS-generated Waste (One-way trips)
TRAFFIC				
Fatalities	2.04±0.01	0.0229±0.0002	3×10^{-2}	6×10^{-2}
Injuries	26.6±0.2	1.1±0.1	3×10^{-1}	7×10^{-1}
RADIATION CANCER[a]				
Incident Free[b]	0.002±0.0005	$(6\pm2) \times 10^{-4}$	3×10^{-3}	1×10^{-7}
Average Exposed Individual[c]	$(8.2\pm) \times 10^{-8}$	$(7.8\pm2.6) \times 10^{-9}$	8×10^{-8}	1×10^{-10}
Maximally Exposed Individual[d]	$(1.1\pm0.4) \times 10^{-6}$	$(1.6\pm0.7) \times 10^{-7}$	9×10^{-8}	3×10^{-9}
RADIATION DETRIMENT[e]				
Incident Free	$(1.8\pm0.4) \times 10^{-3}$	$(4.6\pm1.4) \times 10^{-4}$	0.002	1×10^{-7}
Average Exposed Individual	$(6\pm2) \times 10^{-8}$	$(6.0\pm2.2) \times 10^{-9}$	6×10^{-8}	8×10^{-11}
Maximally Exposed Individual	$(9\pm3) \times 10^{-7}$	$(1.3\pm0.5) \times 10^{-7}$	7×10^{-8}	2×10^{-9}
EARLY RADIATION FATALITIES[f]				
Average Exposed Individual	$(6.8\pm1.8) \times 10^{-7}$	$(6.5\pm2.1) \times 10^{-8}$	7×10^{-7}	9×10^{-10}
Maximally Exposed Individual	$(9.1\pm3.1) \times 10^{-6}$	$(1.3\pm0.5) \times 10^{-6}$	7×10^{-7}	2×10^{-8}
EARLY RADIATION INJURIES[g]				
Average Exposed Individual	$(1.4\pm0.4) \times 10^{-6}$	$(1.4\pm0.5) \times 10^{-7}$	1×10^{-6}	2×10^{-9}
Maximally Exposed Individual	$(1.9\pm0.7) \times 10^{-5}$	$(2.8\pm1.2) \times 10^{-6}$	1×10^{-6}	4×10^{-8}
CHEMICAL CANCER[h]				
Average Exposed Individual	$(9\pm3) \times 10^{-6}$	$(2.4\pm1.1) \times 10^{-6}$	3×10^{-7}	NA[i]
Maximally Exposed Individual	$(2.2\pm0.7) \times 10^{-4}$	$(6.2\pm2.7) \times 10^{-5}$	8×10^{-6}	NA
HAZARD INDEX[j]				
Average Exposed Individual	$(8\pm3) \times 10^{-4}$	$(2.3\pm1.2) \times 10^{-4}$	3×10^{-5}	NA
Maximally Exposed Individual	$(2.1\pm0.9) \times 10^{-2}$	$(5.8\pm3.1) \times 10^{-3}$	7×10^{-4}	NA

[a] The number of latent fatal cancers is expected because of exposure to ionizing radiation. The cancer can develop, and death can occur many years after exposure
[b] Risk resulting from routine, normal day-to-day operations without accidents or other unexpected or unusual occurrences
[c] For accident risk assessment, inhalation exposure to radioactive or chemical materials is assumed to occur under neutral atmospheric conditions (Pasquill atmospheric stability Class D). This results in most-likely or average exposure
[d] For accident risk assessment, inhalation exposure to radioactive or chemical materials is assumed to occur under stable atmospheric conditions (Pasquill atmospheric stability Class F). This results in worst-case or maximum exposure
[e] The total number of health detriment cases because of exposure to ionizing radiation minus the number of latent fatal cancers. Health detriments include genetic damage and development of nonfatal cancer
[f] The number of fatalities expected to occur a relatively short time (a few days to a few months) after acute radiation exposure. Death occurs because of loss of bone marrow function and, at higher doses, gastrointestinal damage and acute inflammation of the lungs
[g] The number of injuries expected to occur a relatively short time (a few days to a few months) after acute radiation exposure
[h] The number of latent cancers expected because of exposure to a chemical carcinogen. Cancer can develop many years after exposure
[i] Not applicable
[j] The ratio between the daily intake of a noncarcinogenic toxic chemical and acceptable reference level. A hazard index less than one indicates that exposure would not result in adverse noncarcinogenic health effects.

Source: Appendix I.

5.1.1.3 Socioeconomics. This section discusses the potential socioeconomic effects associated with Alternative 1. The purpose of this section is to identify and analyze the major socioeconomic issues related to each possible future activity at the sites.

This analysis addresses the timing of effects associated with each alternative for future reuse and covers a period extending 10 fiscal years beyond 1996. Results are usually presented for each alternative for the benchmark years 1996, 2000, and 2005. Table 5.1-7 lists the economic activity projections for Clark and Nye Counties, and Table 5.1-8 lists total housing projections.

ECONOMIC ACTIVITY, POPULATION, AND HOUSING—The baseline for this alternative was established from the total employment projected for each of the sites at the end of Fiscal Year 1995. These proposed Fiscal Year 1995 employment estimates are believed to best reflect the staffing levels needed as a result of recent stockpile requirement reductions.

The region of influence for Clark and Nye counties was identified based on the distribution of residents for current DOE and contractor personnel working at the NTS, the NAFR Complex, and the Tonopah Test Range (DOE, 1994). The region of influence was determined to be the area in which approximately 97 percent of current DOE and contractor employees reside. It was estimated that future distribution of direct workers associated with the proposed alternatives would follow the same trend. For the purpose of this analysis, county data projections are accomplished separately. Because of the difference in size, economies, and contributions to the NTS, a misleading analysis would be produced if Clark and Nye Counties were analyzed as one aggregate area of impact. In other words, the effects might be different for each county.

Under Alternative 1, it was assumed that all sites would continue their current mission with the existing facilities that could comply with environmental, safety, and health requirements and current DOE guidance. It was estimated that a 6,576-person workforce would provide the necessary support to maintain current levels of operations. Figure 5.1-1 compares direct employment among all alternatives in 2005. With the 6,576-person workforce, it is estimated that direct payroll and purchases of goods and services would generate 12,516 secondary jobs (12,235 in Clark County and 281 in Nye County).

Table 5.1-7. Economic activity projections, Clark and Nye counties, 1996, 1997, 1998, 2000, and 2005, Alternative 1

	1996	1997	1998	2000	2005
Clark County					
Population	1,077,576	1,112,348	1,148,241	1,223,541	1,380,920
Total Jobs	507,538	523,916	540,822	576,288	650,413
Unemployment Rate	5.8%	5.8%	5.8%	5.8%	5.8%
Personal income ($1,000)	21,307	22,526	23,746	26,184	32,281
Nye County					
Population	27,407	28,918	30,511	33,966	38,516
Total Jobs	10,990	11,596	12,235	13,621	15,445
Unemployment Rate	5.2%	5.2%	5.2%	5.2%	5.2%
Personal Income ($1,000)	481	516	554	637	781

Table 5.1-8. Total housing projections for the region of influence, 1996, 1997, 1998, 2000, and 2005, Alternative 1

Location and Housing Characteristics*	1996	1997	1998	2000	2005
Clark County					
Housing Stock	456,751	471,504	486,733	518,684	585,414
Housing Demand	420,928	434,511	448,532	477,946	539,422
Available Vacancy Units	35,823	36,993	38,202	40,738	45,992
Available Vacancy Rate	7.8%	7.9%	7.9%	7.9%	7.9%
City of Las Vegas					
Housing Stock	159,125	164,264	169,570	180,701	203,949
Housing Demand	147,884	152,656	157,582	167,916	189,515
Available Vacancy Units	11,240	11,608	11,988	12,785	14,434
Available Vacancy Rate	7.1%	7.1%	7.1%	7.1%	7.1%
City of North Las Vegas					
Housing Stock	28,931	31,986	35,041	38,096	46,087
Housing Demand	27,226	30,102	32,980	43,363	31,495
Available Vacancy Units	1,705	1,884	2,061	2,724	1,989
Available Vacancy Rate	5.9%	5.9%	5.9%	5.9%	5.9%
Nye County					
Housing Stock	12,252	12,927	13,639	15,184	17,221
Housing Demand	10,272	10,838	11,435	12,730	14,435
Available Vacancy Units	1,980	2,089	2,204	2,454	2,786
Available Vacancy Rate	16.2%	16.2%	16.2%	16.2%	16.2%
Town of Tonopah					
Housing Stock	1,801	1,833	1,870	1,935	1,959
Housing Demand	1,485	1,509	1,535	1,586	1,606
Available Vacancy Units	316	324	335	348	353
Available Vacancy Rate	17.6%	17.7%	17.9%	18.0%	18.0%
Town of Pahrump					
Housing Stock	6,936	7,477	8,060	9,367	11,757
Housing Demand	6,130	6,609	7,125	8,283	10,396
Available Vacancy Units	806	868	1,935	1,084	1,360
Available Vacancy Rate	11.6%	11.6%	11.6%	11.6%	11.6%
Amargosa Valley					
Housing Stock	491	512	533	579	659
Housing Demand	403	420	438	475	542
Available Vacancy Units	88	91	95	103	117
Available Vacancy Rate	17.8%	17.8%	17.8%	17.9%	17.8%

* Housing stock is the total number of units; housing demand is the total number of occupied units.

Direct earning levels are estimated at $323 million annually, and secondary earnings are estimated at more than $339 million annually. Of these earnings, $300 million in direct earnings and $330 million in secondary earnings would remain in Clark County, and $23 million direct earnings and $9 million in secondary earnings would remain in Nye County.

For all programs, because there would be no change in economic activity under Alternative 1, the unemployment rate would not be affected and would remain at 5.8 percent. Because of a lack of change in employment, no changes in population are anticipated. The demand for housing would not change under this alternative, because no in- or out-migration would be triggered with this alternative.

Defense Program. Under Alternative 1, the Defense Program would account for 1,472 direct jobs and 2,802 secondary positions, for a total of 4,274 jobs.

Waste Management Program. The Waste Management Program would result in no change in total current employment. This program would remain at approximately 726 jobs, including 250 direct and 476 secondary positions.

Environmental Restoration Program. Under Alternative 1, total employment in this program would not change from current levels. This program would account for approximately 1,129 jobs, including 389 direct and 740 secondary positions.

Nondefense Research and Development Program. Under Alternative 1, the DOE would continue to support ongoing program operations, but no new initiatives would be pursued. Total employment in this program would remain at the same levels. This program would support approximately 555 jobs, including 191 direct and 364 secondary positions.

Work for Others Program. Total employment in this program would remain at current levels. This program would contribute approximately 1,016 jobs, including 350 direct and 666 secondary positions.

Site-Support Activities. Under Alternative 1, total employment in this program would remain at the same levels. This program would contribute approximately 11,392 jobs, including 3,924 direct and 7,468 secondary positions.

PUBLIC FINANCE—The fiscal effects of Alternative 1 are presented in this section. Table 5.1-9 outlines the projected financial summary for Fiscal Years 2000 and 2005 under Alternative 1. The fiscal impact of other alternatives can be determined by subtracting their totals from the Alternative 1 future baseline. The remaining fiscal impact would be the specific impact associated with that alternative.

Clark County. The expansion and improvement of the county infrastructure would continue to be the primary focus of Clark County fiscal efforts. In addition, Clark County has undertaken the implementation of a county facilities development program as discussed in Chapter 4.

Under Alternative 1, revenues for Clark County would increase because of increases in population, personal income, and total employment in the county. Assuming continued small increases in revenues and slightly larger initial increases in expenditures, Alternative 1 would result in revenues less expenditures of a negative $2,502,000 in Fiscal Year 2000. It is expected that Clark County would achieve a positive fiscal position by Fiscal Year 2001. In Fiscal Year 2005, revenues less expenditures are expected to be $37,041,000. The fund balance (or reserves) as a percentage of current expense is expected to be 247 percent in 2000 and 379 percent in 2005.

City of Las Vegas. Under Alternative 1, revenues over expenditures for Las Vegas are expected to become positive in Fiscal Year 1995 because of increases in population, personal income, and total employment in the city. Assuming continued increases in revenues and expenditures, Alternative 1 would result in revenues less

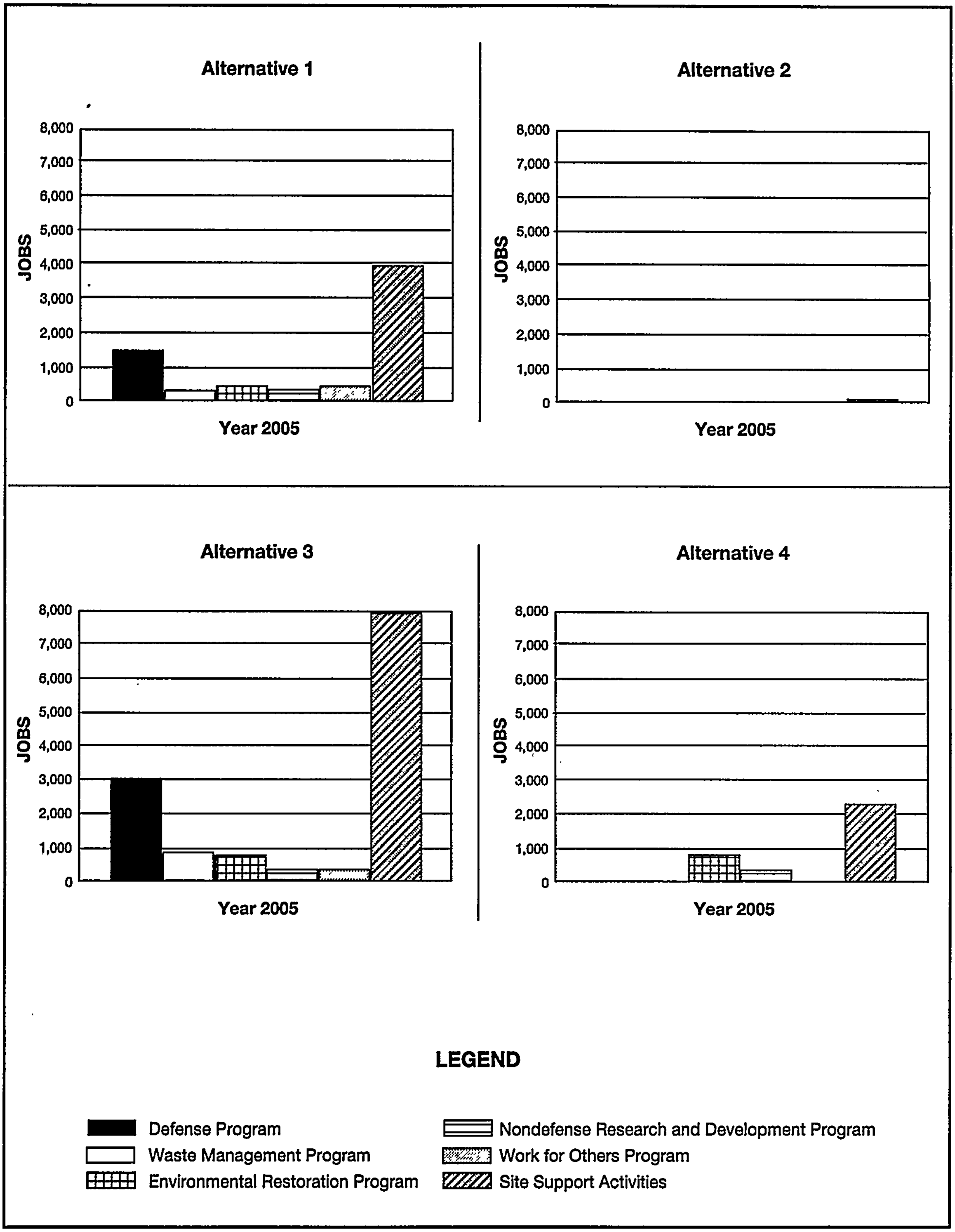

Figure 5.1-1. Total direct employment among all alternatives

Table 5.1-9. Projected financial summary for Fiscal Years 2000 and 2005, general, special revenues, debt service, and capital projects funds, Alternative 1

	Revenues Over Expenditures	Current Expense	Ending Fund Balance	Fund Balance as a Percentage of Current Expense
Fiscal Year 2000				
Clark County	($2,502,740)	$525,981,796	$1,301,552,190	247.45%
City of Las Vegas	$14,379,645	$196,970,437	$355,048,190	180.25%
City of North Las Vegas	($7,077,212)	$47,082,837	$29,965,484	63.64%
Clark County School District	($15,067,362)	$751,358,806	$124,171,528	16.53%
Nye County	$1,567,307	$25,905,977	$14,474,565	55.87%
Town of Tonopah	$78,617	$642,646	$823,356	128.12%
Town of Pahrump	$223,877	$944,592	$1,607,833	170.21%
Nye County School District	($1,402,124)	$26,698,631	($438,631)	-1.64%
Fiscal Year 2005				
Clark County	$37,041,321	$563,448,841	$2,136,031,692	379.10%
City of Las Vegas	$16,435,446	$210,832,569	$574,864,206	272.66%
City of North Las Vegas	($6,580,499)	$50,452,640	$47,652,957	94.45%
Clark County School District	($11,167,703)	$848,002,970	$190,429,375	22.46%
Nye County	$3,455,410	$27,922,658	$27,110,664	97.09%
Town of Tonopah	$75,381	$646,767	$1,206,175	186.49%
Town of Pahrump	$315,094	$1,094,844	$3,011,288	275.04%
Nye County School District	($135,592)	$30,272,304	$4,200,315	13.88%

expenditures of $14,380,000 in Fiscal Year 2000. It is predicted that Las Vegas would achieve an increasingly positive fiscal position and by Fiscal Year 2005, revenues over expenditures would be $16,435,000. The fund balance as a percentage of current expense is expected to be 180 percent in 2000 and 273 percent in 2005.

City of North Las Vegas. Expenditures for North Las Vegas are forecast to continue outpacing revenues under Alternative 1. Revenues over expenditures in Fiscal Year 2000 would be a negative $7,077,000 and a less negative $6,580,000 in Fiscal Year 2005, despite increases in population, personal income, and total employment in the city. Public safety and capital projects are anticipated to continue to be the largest expenditures. Taxes, which recently decreased (from $10,059,472 in Fiscal Year 1993 to $7,941,972 in Fiscal Year 1994), are expected to slowly grow to 1993 levels by Fiscal Year 2001. The fund balance as a percentage of current expense is expected to be 64 percent in Fiscal Year 2000 and 94 percent in Fiscal Year 2005.

Clark County School District. Under Alternative 1, revenues for the Clark County School District would expand because of increases in population and corresponding school enrollment. Regular program and undistributed expenditures would likely continue to increase at a slower rate. The school district is not predicted to achieve a positive fiscal position by Fiscal Year 2005. In Fiscal Year 2000, revenues less expenditures would be a negative $15,067,000 and in Fiscal Year 2005 a less negative $11,168,000. The fund balance as a percentage of current expense is expected to be 17 percent in Fiscal Year 2000 and 22 percent in Fiscal Year 2005.

Nye County. Under Alternative 1, revenues for Nye County would increase slightly because of small increases in population, personal income, and total employment in the county. Assuming continued small increases in expenditures as well, a positive fiscal position is expected to be reached in Fiscal Year 1996. Alternative 1 would result in revenues less expenditures of $1,567,000 in Fiscal Year 2000. In Fiscal Year 2005, revenues less expenditures would be $3,455,000. The fund balance as a percentage of current expense is expected to be 56 percent in Fiscal Year 2000 and 97 percent in Fiscal Year 2005.

Town of Tonopah. Revenues and expenditures for Tonopah would increase slightly because of small increases in population, personal income, and total employment in the county. Assuming continued small increases, Alternative 1 would result in revenues less expenditures of $79,000 in Fiscal Year 2000. In Fiscal Year 2005, revenues less expenditures would be $75,000. The fund balance as a percentage of current expense would be 128 percent in Fiscal Year 2000 and 186 percent in Fiscal Year 2005.

Town of Pahrump. Under Alternative 1, revenues for Pahrump would increase slightly because of small increases in population, personal income, and total employment in the county. Assuming continued small increases in revenues and slightly smaller initial increases in expenditures compared to Fiscal Year 1994, Alternative 1 would result in revenues less expenditures of $224,000 in Fiscal Year 2000. In Fiscal Year 2005, revenues less expenditures would be $315,000. The fund balance (or reserves) as a percentage of current expense is anticipated to be 170 percent in Fiscal Year 2000 and 275 percent in the Fiscal Year 2005.

Nye County School District. Under Alternative 1, revenues for Nye County School District would increase slightly because of small increases in population. Local sources would continue to generate the most revenue. Revenues less expenditures would be a negative $1,402,000 in Fiscal Year 2000 and a less negative $136,000 in Fiscal Year 2005. The fund balance as a percentage of current expense would be a negative 2 percent in Fiscal Year 2000 and 14 percent in Fiscal Year 2005.

PUBLIC SERVICES—The public service impacts of all other alternatives can be determined by subtracting total personnel required from the Alternative 1 future baseline. The addition or reduction in personnel required would be the specific impact associated with that alternative. Table 5.1-10 summarizes the levels of service that would be required for Alternative 1. In each case, the current levels of service are assumed to continue.

The Superfund Amendments and Reauthorization Act of 1986 requires state and local jurisdiction, within the United States, to plan for and have the capability to respond to incidents involving all hazardous materials, including waste, that reside in or pass through their jurisdiction. This process is implemented through the Local Emergency Planning Committee and the State Emergency Response Commission. As part of this program, local communities and counties are required to implement an Emergency Response Plan. These plans define chain-of-command, notification procedures, and evacuation procedures for each community.

For the past 15 years, the DOE has provided training to responders in Nevada through the First-On-Scene Program. The environmental safety and health training will continue to be made available to state regulators, educators, the public, and agencies (firefighters, law enforcement, and emergency, medical personnel) within Nevada. Training courses for environmental safety and health, transportation, radioactive materials management, environmental restoration, and classes that meet or exceed federally-mandated training requirements for personnel involved with the generation or disposal of radioactive or hazardous waste can be provided by the DOE/NV. Courses conducted associated with transportation activities include: first-on-scene responder for law enforcement, firefighters, and emergency medical personnel.

Public Education. A total of 7,928 full-time equivalent licensed teachers were employed by the Clark County School District in the 1993 to 1994 school year, resulting in a student-to-teacher ratio of 18 students to 1 teacher. To continue with this ratio, the Clark County School District would

Table 5.1-10. Projected levels of public service for Fiscal Years 1996, 2000, and 2005, Alternative 1

Jurisdiction	Level of Service *	1996	2000	2005
Clark County School District Teachers	18.33	8,665	9,839	11,105
Nye County School District Teachers	16.39	273	338	384
Las Vegas Metropolitan Police Department (Las Vegas and county rural areas)	2.27	1,330	1,510	1,705
North Las Vegas Police Department	1.75	142	161	182
Nye County Sheriff's Office (Tonopah)	3.67	14	15	15
Pahrump Sheriff's Substation	1.85	30	41	51
Beatty Sheriff's Substation	2.59	5	6	5
Amargosa Valley Sheriff's Substation	2.01	2	3	3
Clark County Fire Department (urbanized unincorporated areas)	1.04	440	500	564
Las Vegas Fire Department	0.84	316	359	406
North Las Vegas Fire Department	1.15	93	106	120
Tonopah Volunteer Fire Department	7.09	27	29	30
Pahrump Volunteer Fire Department	1.98	32	44	55
Beatty Volunteer Fire Department and Ambulance Service	14.51	29	31	28
Amargosa Valley Volunteer Fire Department	23.12	26	31	36
Clark County Medical Doctors	1.37	1,481	1,681	1,897
Clark County Registered Nurses	4.84	5,220	5,927	6,689
Nye County Medical Doctors	0.34	9	12	13
Nye County Registered Nurses	1.53	42	52	59

* Level of services is per 1,000 population. The number of school teachers is based on student-to-teacher ratios, and the number of students is based on a percentage of the population.

require 11,105 teachers by the school year 2004 to 2005. This is an increase of 40 percent over this period from 1993 to 1994 to 2004 to 2005. The student-to-teacher ratio for the Nye County School District was 16.39 students to 1 teacher in the school year 1994 to 1995. Projecting this ratio to the school year 2004 to 2005, a total of 384 additional teachers would be required. This additional increase is 61 percent above the 1994 to 1995 school year's full-time teaching staff.

Police Protection. Assuming the same levels of service in the future, requirements for sworn police and deputy protection in the year 2005 can be examined. The Las Vegas Metropolitan Police Department would require 1,705 sworn officers. The North Las Vegas Police Department would require 182 sworn officers. The Nye County Sheriff's Office in Tonopah would require 15 deputy sheriffs. The Pahrump Sheriff's Substation would require 51 deputy sheriffs, the Beatty Sheriff's Substation would require 5 deputy sheriffs, and the Amargosa Valley Sheriff's Substation would require 3 deputy sheriffs.

Fire Protection. The following discussion addresses firefighter personnel expected to be required in the year 2005 under Alternative 1. The Clark County Fire Department, which handles urban fires in the county, would be expected to require 564 firefighters. Some 406 firefighters would be required in the Las Vegas Fire Department in 2005. The North Las Vegas Fire Department would require 120 firefighters. The Tonopah, Pahrump, Beatty, and Amargosa Valley Volunteer Fire Departments would require 30, 55, 28, and 36 firefighters, respectively.

Health Care. The 1995 level of service for medical doctors and registered nurses was used to determine future needs based on population growth. In 2005, a total of 1,897 medical doctors and 6,689 registered nurses would be required in Clark County. In Nye County, 13 medical doctors and 59 registered nurses would be required. However, because of the present difficulty in obtaining medical services in Nye County, it is anticipated that this level of service would increase in the future.

AMERICAN INDIAN SOCIOECONOMICS— This section describes the American Indian concerns associated with implementing Alternative 1, as summarized by the Consolidated Group of Tribes and Organizations (CGTO).

Indian people prefer to live in their traditional homelands. One reason for this preference is that Indian people have special ties to their traditional lands and a unique relationship with each other. When Indian people receive employment near their reservations, they can remain on the reservation while commuting to work. This pattern of employment tends to have positive benefits for both the Indian community and tribal enterprises like housing. The reservation Indian community has the participation of the individual and his(her) financial contribution. The individual payment for housing is tied to income level, so the more a person earns with the job, the more they pay to the tribal housing office, thus making tribally sponsored housing more economically viable.

When employment opportunities decline on reservations, however, often times Indian families must move away from their reservations to seek employment. These situations have resulted in approximately one-half to two-thirds of the tribal members in the CGTO region of influence moving away from their reservations.

As Indian people move away from reservations due to employment opportunities, Indian culture is threatened because the number of families living on reservations declines. Tribal members who choose to relocate from their reservations impact reservation economies, school, housing, and emergency services. Both schools and economies are impacted because federal funding available to tribes is based on population statistics.

With local employment opportunities such as those offered by the NTS to neighboring tribes, prices of tribal housing rise because they are based on income. If a positive balance between increased income and increased cost of living in tribal reservations is achieved, then both individual members and the tribe benefit from employment opportunities. However, continued salary raises may tip the balance toward sharp increase in cost of living, making it unable for tribal members to continue living in the reservation.

Tribal housing programs become jeopardized if vacancies occur in tribal housing projects and cannot be reoccupied. If vacancies occur, tribal revenues and federal funding will be adversely impacted and will make it more difficult to expand housing programs in future years.

Additionally, vacant units require more maintenance. If tribal members are unavailable to occupy a tribal housing unit, then tribes make units available to non-Indians, and this too potentially impacts Indian culture. The increased presence of non-Indians on a reservation or in an Indian community reduces the privacy needed for the conduct of certain ceremonies and traditional practices. When non-Indian children are in constant interaction with Indian children, it creates a situation that potentially disrupts cultural learning opportunities that occur in everyday life.

Small rural reservations must have a sufficient number of people to generate an emergency response capability. The need for emergency services will decline as people move away from the reservation. Tribal members employed in these emergency service occupations may move away because of their marketable skills. Tribal revenues for administration, school, housing, and emergency services will be reduced accordingly, due to a decline in population size.

When Indian people move away from their reservations several dilemmas occur. Typically, Indian people experience a feeling of isolation from their tribe, culture, and family. When an Indian person relocates to an off-reservation area, the individual finds that there are fewer people of their tribe and culture around them. As a result, Indian people must decide on the appropriateness of practicing traditional ceremonies in the presence of non-Indian people. Indian people are continually torn between the decision to stay in the city or return to the reservation to participate in traditional ceremonies and interact with other tribal members. This dilemma occurs on a regular basis and potentially impacts the livelihood and cultural well-being of off-reservation employees *and their families. When off-reservation individuals choose to return to their homelands to participate in traditional ceremonies, they risk their jobs or disciplinary actions against their children who attend public schools due to excessive absenteeism.*

Should an emergency situation resulting from NTS-related activities, including the transportation of hazardous and radioactive waste occur, it could result in the closure of a major reservation road. Many of the Indian reservations within the region of influence are located in remote areas with limited access by standard and substandard roads. Were a major (only) road into a reservation to be closed, numerous adverse social and economic impacts could occur. For example, Indian students who have to travel an unusually high number of miles to or from school could realize delays. Delays also could occur for regular deliveries of necessary supplies for inventories needed by tribal enterprises and personal use. Purchases by patrons of tribal enterprises and emergency medical services enroute to or from the reservation could be dramatically impeded. Potential investors interested in expanding tribal enterprises and on-going considerations by tribal governments for future tribal developments may significantly diminish because of the perceived risks associated with NTS-related activities including the transportation of hazardous waste.

__Defense Program.__ Under Alternative 1, the Defense Program would produce a total of 4,274 jobs. It is expected that a percentage of these jobs would be filled by tribal members from reservations within the American Indian Region of Influence. Many of these Indian people will move away from their reservations to take these jobs causing the socioeconomic impacts discussed above. Increased employment can positively impact American Indian employees and their families; however, this off-reservation employment is expected to adversely impact the social structure and cultural activities on the reservation.

__Waste Management Program.__ Under Alternative 1, the Environmental Restoration Program would create approximately 1,129 jobs. Although this is approximately one-third the number of jobs created by the Defense Program, it is anticipated that a higher percentage of American Indians would be attracted to the Environmental Restoration jobs because they are more consistent with American Indian land preservation values. American Indians have special skills that may be especially critical to Environmental Restoration activities, and the CGTO has specifically asked that Indian people be involved in these programs. American Indians have asked to be involved when soil mediation actions remove contaminated soil, and afterwards, during habitat restoration.

Nondefense Research and Development Program. *Under Alternative 1, no new jobs would be created by the Nondefense Research and Development Program. Were existing research programs, especially the National Environmental Research Park Program, to integrate American Indians into the study designs, it is possible that a few more Indian people would be employed. These shifts in employment are expected to be minor, so no American Indian socioeconomic impacts are expected.*

Work for Others Program. *Under Alternative 1, no new jobs would be created by the Work for Others Program. No American Indian socio-economic impacts are expected.*

Site-Support Activities. *Under Alternative 1, no new jobs would be created by the site-support activities. No American Indian socioeconomic impacts are expected.*

5.1.1.4 Geology and Soils. The impacts to geology and soils resulting from the five programs and site-support activities are presented in this section.

Defense Program. Under Alternative 1, two scenarios for stockpile stewardship are considered. In the first scenario, a state of readiness to conduct nuclear tests is maintained, but no tests are conducted. No impacts to geologic and soil media result from readiness activities. In the second scenario, which the DOE believes to be highly unlikely, the President directs that one or more nuclear test be conducted. These stockpile tests would be conducted on Pahute Mesa and/or

Yucca Flat; because the type of test that would be conducted cannot be identified, the impacts associated with both types of potential tests are discussed.

Approximately 12 acres of surface geologic media are disturbed in each underground nuclear test in Yucca Flat. The surface area disturbed is three times this amount for each test on Pahute Mesa. Radioisotope contamination could extend up to five cavity radii from the point of detonation. Radii of cavities at the NTS range up to 49 meters (m) (160 feet [ft]), and rubble chimneys range up to 351 m (1,150 ft) high (Borg et al., 1976).

The formation of an underground cavity, a subsurface pocket of radioactivity, and a subsidence crater, as a result of underground testing under Alternative 1, represents an unavoidable and incremental impact on the geologic media in the vicinity of the planned tests. There are, however, already hundreds of such cavities and craters on the NTS where radioactivity has been released into the geologic media, as discussed in Chapter 4, Affected Environments. The impacts associated with conducting a single underground nuclear test also are described in Chapter 4 (Sections 4.1.4.2, 4.1.4.3, 4.1.5.1, 4.1.5.2, and 4.1.11), Affected Environments. The adverse impacts on geology and soils of one to a small number of nuclear tests are a small increment when viewed against existing baseline conditions. The analysis performed for this EIS is for the conduct of one nuclear test. The impacts to the environment from the conduct of multiple tests (a series) are assumed to be incrementally additive. For example, the impacts of conducting two tests would be twice the impact of conducting a single test.

Fault reactivation and associated seismicity induced by underground testing of nuclear devices are described in Section 4.1.4. Fault reactivation from testing of nuclear devices disturbs subsurface and surface geologic media, which is potentially significant in terms of resultant limitations on land use or resultant changes in surface and subsurface water movement. The yield or size of underground nuclear explosions is controlled by the Threshold Test Ban Treaty to a maximum high-explosive equivalent of 150 kilotons (kt). For the purposes of this evaluation, any future weapons testing is assumed to occur under this limitation. Currently, underground nuclear testing can be conducted in the Pahute Mesa and Yucca Flat areas. Because geologic structure may differ considerably among the testing areas, predicting the effects of tests prior to characterizing the geologic environment in the unused areas is uncertain. Nevertheless, the geographic areas for testing and the yield limits can be used to estimate ground-motion effects from future weapons tests.

Ground-motion hazards can result from the underground nuclear explosion and secondary seismic effects. Because of the rather complete recording of ground motions emanating from NTS activities, the effects of the weapons testing program are predictable, and damage effects have been documented.

Communities within 48 kilometers (km) (30 miles [mi]) of testing areas that could be most affected by ground motion from underground nuclear explosions are Beatty, Amargosa Valley, and Indian Springs. The closest potential testing area for these communities is 31 to 40 km (19 to 25 mi) away. Table 5.1-11 is a tabulation of peak horizontal ground-motions for 150-kt tests at 31 km (19 mi), using regressions developed by Long (1986). Peak ground acceleration, velocity, and displacement were computed at the 50th and 84th percentiles of the log-normal distributions given by Long (1986) for rock and alluvium recording geology at 31 km (19 mi) for a 150-kt test. Expected peak ground accelerations (*g*) are well below 0.05 *g*, which is the acceleration where slight damage might occur in typical buildings less than several stories in height.

Several Nye County mines are located in the testing vicinity, but all are at a distance greater than 40 km (25 mi) from the closest potential testing area. Because the distances from these mines to the underground nuclear explosions are approximately the same as, or greater than, the distances for communities, damage to structures in the mines is not expected. In investigations of earthquake effects to mines (Owen, 1981), there are very few reports of damage. Surveys of mines in the vicinity of the NTS by Owen and Scholl support these findings (ERDA, 1977).

Table 5.1-11. Predicted (50th and 84th percentiles) peak ground motions at localities 30 km (19 mi) from underground testing areas

Distance		Yield	Acceleration (g)*		Velocity				Displacement			
km	mi	kt	50%	84%	50%		84%		50%		84%	
					m/sec	ft/sec	m/sec	ft/sec	cm	in.	cm	in.
Rock												
31	19	150	0.012	0.029	0.009	0.03	0.020	0.07	0.23	0.09	0.51	0.20
Alluvium												
31	19	150	0.009	0.016	0.009	0.03	0.018	0.06	0.28	0.11	0.61	0.24

* Local acceleration due to gravity.

NOTE: All peak values reported are the largest of the radial and transverse components.

In addition to direct ground motion effects of underground nuclear explosions, there is also potential hazard from secondary seismic effects. Secondary effects are associated with co-seismic strain release attributed to the release of tectonic strain, aftershocks that can be associated with tectonic strain release, and events associated with the collapse of cavities created by the underground nuclear explosions. Beyond 4.8 to 9.7 km (3 to 6 mi) of even the largest underground nuclear explosion (greater than 1 megaton), there was no evidence of significant secondary seismic effects associated with the test. In no case has the magnitude of an aftershock been larger than the magnitude of the underground nuclear explosion (URS/John A. Blume and Associates, 1986).

Underground subcritical experiments would produce some physical effects on the geologic media. Approximately 2,314 m^3 (81,700 cubic feet [ft^3]) would be disturbed each year in association with the conduct of up to four experiments. Irreversible effects would include the deposition of radiological material within the cavity mined in the subsurface. Approximately 20 acres of surface geologic media are currently disturbed in association with the Lyner Complex, where these experiments would be conducted.

In addition to the direct effect of detonating nuclear and other devices on geologic media and processes, preparation for such tests also disturbs geologic media. Disturbances include any associated infrastructure, excavated tunnels, and an existing inventory of deep boreholes up to 4 m (12 ft) in diameter for detonation. of nuclear devices. Geologic media excavated in tunnels, boreholes, and burrow pits are considered to be permanently lost. Excavation of tunnels and testing conducted in those tunnels could potentially impact slope stability.

Withdrawal of the NTS would continue to exclude locatable minerals from exploration or appropriation. The presence of past production indicates a potential for future production using modern techniques. Thus, some potential impact regarding availability of these undefined resources exists. Industrial minerals and materials are widespread throughout Nevada. The unavailability of these minerals and materials from the NTS has had little effect on Nevada's mining, manufacturing, and construction industries and would probably have little effect in the future. Aggregate resources have been used in the past as part of Defense Program actions, and aggregate mining would continue under Alternative 1. The impacts of this mining are not considered significant with respect to the resource availability. The aggregate resources of the region are immense, and the demand outside metropolitan Clark County is negligible.

The NTS is considered to have a low potential for geothermal, oil, and gas resources. No impact on these resources is anticipated as a result of Defense Program activities under Alternative 1.

The impacts of soils grading and excavation in support of testing under Alternative 1 are not considered significant. Testing locations in Yucca Flat require that 12 acres be disturbed, while locations on Pahute Mesa require almost 3 times that amount. Given that one or more tests would be conducted under Alternative 1 and that an inventory of prepared sites exists, the associated soil disturbance either already exists or would be minor if a new location(s) was prepared. There is the potential for minor soil contamination as a result of drill-back operations. In the event that such a release occurs and results in soil contamination, corrective actions would be initiated, as required under the appropriate environmental regulations and DOE orders. The soil removed would be lost for the long term.

The consequences of altering the natural drainages and erosion rates are not considered significant. Short-term increases in sediment loss might occur; however, because of the overall slight precipitation over the NTS, increased soil erosion would be limited in both time and extent. Activities associated with conventional high-explosive testing, surface dynamic experiments, and hydrodynamic tests are not anticipated to significantly disturb the surface geology. No significant change in surface topography and drainage paths are anticipated, and, thus, the impacts would be negligible. Construction activities associated with these activities are mitigated to minimize impacts.

Waste Management Program. Craters resulting from underground nuclear tests in Area 3 that meet certain criteria have been excavated to dispose of bulk low-level waste. In this process, the area between adjacent crater pairs is removed, and the floors are reshaped so waste containers can be stacked for disposal. The Area 3 Radioactive Waste Management Site covers approximately 128 acres. The craters that are, and would continue to be, used at the Area 3 Radioactive Waste Management Site represent the unavoidable adverse impacts that resulted from past underground nuclear tests. Use of the craters for waste disposal is a beneficial use of lands that have been significantly and unavoidably impacted by past actions.

The underground shot cavities beneath the subsidence craters and waste cells in the Area 3 Radioactive Waste Management Site are much deeper than active hydrologic surface processes (infiltration, redistribution, and evapotranspiration) operating beneath the waste unit from the ground surface to a depth of 31 m (100 ft). Current scientific models suggest that the chimney beneath the low-level waste unit does not enhance or promote vertical groundwater flow between the waste unit (subsidence crater) and the deep shot cavity. This conceptual model was confirmed by hydrologic data obtained in 1996 from the exploratory borehole completed beneath U-3bl. Water-potential data indicate that there is no groundwater movement from a 40-m to 96-m (131-ft to 315-ft) depth within the subsurface chimney (Van Cleave, 1996). Given the proximity of Area 5 to Area 3 (23 km [14 mi]) and the very similar hydrologic conditions, the defensible hydrogeologic conceptual model for Area 5 is being tested and validated for the Area 3 Radioactive Waste Management Site. The underground shot cavities beneath the subsidence craters and waste cells in the Area 3 Radioactive Waste Management Site are located in the unsaturated zone more than 101 m (330 ft) above the water table. This substantial separation between the shot cavities and the water table provides a further basis, albeit preliminary, to conclude that there is no vertical groundwater flow between the low-level waste unit and the water table. The Environmental Restoration Program will evaluate the potential for groundwater contamination from shot cavities located in the unsaturated zone.

The trenches, pits, and boreholes in Area 5 have been excavated to dispose of containerized low-level waste and mixed waste. The Area 5 Radioactive Waste Management Site covers approximately 732 acres surrounded by a fence. The waste disposal craters and excavations are anticipated to be closed with an engineered cap. The presence of a landfill is essentially a long-term commitment of the area.

Environmental Restoration Program. Environmental Restoration Program activities on the NTS and NAFR Complex are not anticipated to significantly impact geologic media. Safety tests, venting, drill-backs, and atmospheric tests in certain areas of the NTS and NAFR Complex have resulted in radioactive soil contamination, as described in Chapter 4. Various methods of cleanup of these areas have been proposed, including removal of contaminated soil media followed by revegetation. This method of cleanup could temporarily make the surface vulnerable to erosion by water or wind processes. Chemical stabilization followed by revegetation would provide longer-term stability. Reclamation will be based on the specific circumstances of the site and will be addressed in site-specific reclamation plans. Among the variables which will be considered are size of the area, future use, nature of soils, annual precipitation, slope aspect, and site location. The range of options includes natural revegetation, gravel armoring, chemical stabilization, seeding, planting, and irrigating. When highly intensive revegetation techniques are necessary, subsoils could be amended and irrigation could be used. Soils from areas used for staging and support sites could also be salvaged and replaced at the completion of activities. Some areas would be restored to full productivity, while others would be impaired for the long term. Industrial processes have resulted in various areas of chemical or hydrocarbon soil contamination. Remediation of these areas would result in closure in place or removal to an authorized facility. The soils involved would be lost for the long term.

Nondefense Research and Development Program. Projects conducted within the NTS Environmental Research Park are not anticipated to result in significant adverse impacts to geologic media. Tests conducted at the Spill Test Facility on Frenchman Playa in Area 5 do not pose a risk of significant adverse impact to geologic media at or near the facility (DOE/OFE, 1994).

Work for Others Program. Activities under the Work for Others Program, such as defense-related research, development projects, and military training exercises, could have an adverse impact on geologic media of the NTS and NAFR Complex. One potential impact would be soil contamination resulting from weapons firing tests on the NTS and NAFR Complex. Another would be alteration of natural drainage paths, resulting in potential preferential erosion of natural or fill deposits or deposition of sediments. Weapons-firing tests conducted on the NTS, primarily in Area 25, have contaminated relatively small areas of surface and near-surface geologic media. Lead and depleted uranium are the primary contaminants. Continued tests are assumed to have similar impacts as those in the past. Assuming that contaminants are long-lived, these media would be considered permanently lost either through closure in place or removal to a disposal facility. Removal of the contaminated media would make that surface temporarily vulnerable to erosion by water or wind processes.

Site-Support Activities. Infrastructure and grading associated with disposal of bulk waste in Area 3 and containerized waste in Area 5 have further disturbed nearby surface and near-surface unconsolidated deposits, including soils. Continued aggregate use on the NTS as a result of road and facility construction would result under Alternative 1. Aggregate excavated for site-support activities is considered to be permanently lost. Other geologic resources are not anticipated to be significantly impacted by site-support activities. Site-support structures (i.e., roads and buildings) could be removed, and the disturbed geologic media could be restored.

5.1.1.5 Hydrology. The environmental impacts to surface hydrology and groundwater are described in the sections that follow.

5.1.1.5.1 Surface Hydrology—The impacts to surface hydrology for the five programs and site-support activities are presented in this section. One potential impact from all the programs would be effects to mines (Owen, 1981), and there are very few reports of damage. Surveys of mines alteration of natural drainage paths, resulted in potential preferential erosion of natural or fill deposits, deposition of sediments, ponding of water, or inundation of infrastructure. There is little surface water present on the NTS or NAFR Complex. Surface waters on the NTS consist of small areas of seepage associated with springs, small ponds associated with production wells, tritium-contaminated ponds created by tunnel drainage, and ephemeral waters caused by convective summer thunderstorms and runoff during wet winters. No surface waters are used for water supply. The ephemeral waters exist in normally dry washes for short periods of time and on the surfaces of playas for periods of days to weeks. Water quality of the ephemeral waters is poor because of naturally high sediment loads and dissolved solids. Activities could have minor effects on drainage patterns and discharge rates because of surface disturbance, existing surficial contamination, and altered infiltration rates (see Sections 4.1.3 and 4.1.5). Change to sediment loads and dissolved solids because of project activities would be minor compared to the natural conditions. No significant change in surface water quality or quantity is anticipated, and, thus, the impacts would be negligible.

Defense Program. Ground-surface disturbance and craters associated with underground nuclear tests have rerouted parts of natural drainage paths in areas of underground nuclear testing. Some craters have captured nearby drainage, and headward erosion of drainage channels is occurring. However, this is considered to be negligible. In some areas of the NTS, the natural drainage system has been all but obliterated by the craters. As noted in the *Final Environmental Impact Statement, Nevada Test Site, Nye County, Nevada* (ERDA, 1977), the development of surface craters is an unavoidable adverse impact of underground nuclear testing.

Alteration of natural drainage in the areas of nuclear-device testing is considered to be irrevocable. Whether water entering these craters and subsequently infiltrating into the ground has other than a negligible effect on the unsaturated zone, or potentially the saturated zone, is unknown. However, water entering the unsaturated zones or the saturated zone would account for a negligible source component when compared to the overall baseline condition. The erosion would continue, and over extended periods of time could result in some alteration of the natural drainage system. However, the principal areas where cratering has occurred are in Frenchman Flat and Yucca Flat, which are both topographically closed basins, and no effects on drainage would occur beyond the limits of these basins.

The potential impacts of detonating additional underground nuclear device(s) on flow rates of springs on the NTS are assumed to be negligible. Springs on the NTS are located outside the testing areas or are generally upgradient.

The impacts associated with conducting a single underground nuclear test are described in Sections 4.1.4.2, 4.1.4.3, 4.1.5.1, 4.1.5.2, and 4.1.11. The adverse impacts on hydrology of a small number of additional nuclear tests are small when viewed against existing baseline conditions.

The analysis performed for this EIS is for the conduct of one nuclear test. The impacts to the environment from the conduct of multiple tests (a series) are assumed to be incrementally additive; that is, the impacts of conducting two tests would be twice the impact of conducting a single test.

Activities associated with conventional high-explosive testing, surface dynamic experiments, and hydrodynamic tests are not anticipated to contaminate the water table. No significant change in surface water quality or quantity is anticipated, and, thus, the impacts would be negligible. Construction activities associated with these activities are mitigated to minimize impacts.

Waste Management Program. Potential flood hazards on the NTS and portions of the NAFR Complex are presented in Section 4.1.5 of Chapter 4, Affected Environments. Siting of waste management facilities is a critical issue in terms of protecting the facilities from floods. Also important, however, is the impact on natural processes and media of siting such facilities in areas of potential flood hazard.

The Radioactive Waste Management Sites in Areas 3 and 5 and other waste disposal areas on the

NTS alter natural drainage paths. The craters that are, and would continue to be used, in the Area 3 Radioactive Waste Management Site resulted from underground nuclear tests. The craters have significantly altered the topography and have significantly impacted the surface drainage as discussed in Section 4.1.5. Emplacement of waste in the craters and subsequent engineered closure of the cells would return portions of the surface topography to a natural grade and help to restore drainage patterns. Similarly, engineered berms at the Area 5 Radioactive Waste Management Site constructed to prevent run-on to the site cause negligible impacts to the natural drainage of the area.

Environmental Restoration Program. Water produced from characterization and monitoring wells drilled as part of the Environmental Restoration Program can only be discharged to the surface if it is in compliance with requirements of the Clean Water Act. Because monitoring of the water would be performed and erosion would be reduced through channel protection, drilling activities would have no significant impact to drainage channels or to downstream springs or surface impoundments. Any accidental discharge of produced water that is contaminated with radionuclides or hazardous substances has the potential to contaminate surface and near-surface geologic media. However, present practice is to contain all discharged water in lined sumps until the water quality is determined.

As with Defense Program activities, the Environmental Restoration Program soil-disturbing activities might result in slight increases in sediment yield and some inorganic compounds in surface water. The only planned Environmental Restoration Program action that could result in significant adverse impacts is the cleanup of large areas of plutonium-contaminated soils on the NTS. Appropriate dust and drainage controls would be implemented to ensure that unacceptable levels of plutonium would not become available for transport via surface water flows. Because such controls would be implemented, the impacts of soil restoration actions on surface water quality would not be considered significant.

Other Environmental Restoration Program activities would not have significant impacts to surface waters on the NTS and NAFR Complex; therefore, the impact of environmental restoration actions on the quantity of surface water resources is not expected to be significant.

Nondefense Research and Development Program. The facilities for the Nondefense Research and Development Program have already been constructed, and no new soil-disturbing actions that might impact the surface water regime are included as part of Alternative 1. Tests conducted at the Spill Test Facility on Frenchman Playa in Area 5 do not pose a significant adverse impact to any surface water at or near the facility (DOE/OFE, 1994).

Work for Others Program. Surface-based testing under the Work for Others Program might have negligible impacts on the surface water regime. Slight alterations in runoff and minor contributions of inorganic compounds and increased sediment yield might occur. Any such impacts would likely be very short term and small scale. Because of the very limited surface water flows and the limited extent of disturbances, significant impacts on the surface-water regime are not anticipated.

Other activities of the Work for Others Program could have a significant impact on surface waters of the NTS and NAFR Complex. Whether these activities have a significant impact is dependent on the size and location of the activity, which are yet to be determined.

One potential impact would be contamination of surface waters resulting from weapons-firing tests on the NTS and NAFR Complex. Weapons-firing tests conducted on the NTS, primarily in Area 25, have contaminated relatively small areas of surface and near-surface geologic media. Lead and depleted uranium are the primary contaminants. Continued tests and military training activities are assumed to have similar impacts as in the past.

Site-Support Activities. As with the five programs discussed prior, a potential impact from the siting of support infrastructure in certain areas would be the alteration of natural drainage paths, resulting in potential preferential erosion of natural or fill deposits, deposition of sediments, ponding of water, or inundation of infrastructure.

Construction activities could result in some temporary impacts on surface water quality. Anticipated impacts include increases in sediment yield and perhaps in the loading of naturally occurring inorganic compounds (salts). Because of the very infrequent surface water flows, these impacts would likely be negligible and are not considered significant.

Road building associated with well drilling and soil remediation might disturb significant areas of soils. However, because of the very limited nature of surface water resources on the NTS and other DOE-administered lands in Nevada, the impact on surface water flows is expected to be minimal.

5.1.1.5.2 Groundwater—Impacts to groundwater from the five programs and site-support activities are presented in this section. In addition, because groundwater is an important resource in Nevada and the primary source of water for the NTS, the impacts to this resource are analyzed.

The consequences of Alternative 1 activities on the water resources of the NTS and adjacent areas include two broad types of effects: reductions in water resource availability and impacts on water quality. The DOE routinely withdraws groundwater at the NTS and other DOE-administered lands in Nevada. These groundwater withdrawals could result in localized impacts, including a lowering of water levels, changes in groundwater flow directions, and a reduction in the quantity of water available to other users. If large-scale groundwater withdrawals occur, the impacts could increase to include reductions in spring off-site discharge rates, water quality impairment, and reduced underflow to downgradient areas.

The potential for increased percolation of water downward through the chimney and into the groundwater system is another potential impact. However, water entering the unsaturated zones or the saturated zone would account for a negligible source component when compared to the overall baseline conditions. The Desert Research Institute (Tyler et al., 1986) has investigated the effects of craters on infiltration and soil moisture movement, and research is continuing in this area. This study was inconclusive; additional studies are planned during 1997.

Two key areas of environmental concern are located beyond the NTS boundaries to the south: Devils Hole National Monument and Ash Meadows. Devils Hole is a small pool in the limestone in the Amargosa Desert that is the habitat for the desert pupfish. This fish feeds and spawns in the shallow water on limestone ledges in the pool. An adequate water level must be maintained in the pool to provide for the continued success of this endangered species. The Ash Meadows area is a point of regional discharge for the carbonate aquifer system. An estimated 2.09 x 10^7 m^3/yr (17,000 acre-feet/year) discharges to the surface, creating an extensive area of spring pools, streams, and wetlands. These wetlands form a valuable habitat for a great diversity of unique species. While the results of past investigations have not found any impacts resulting from DOE operations on these key environmentally sensitive areas, additional evaluation would be performed using sophisticated numerical simulation methods to ensure the continued existence of the pupfish and the important habitat at Ash Meadows.

Another category of effects is the potential impact of a given activity on the quality of the water resources. The grading of soils and other construction actions could slightly alter the quantity and quality of runoff.

Defense Program. Historically, the total annual demand for water at the NTS since the early 1960s has varied considerably, ranging from about 1.0×10^6 m^3/yr (850 acre-feet) in 1963 to a peak of 4.2×10^6 m^3/yr (3,430 acre-feet) in 1989.

Long-term measurements of the water levels have demonstrated that historic water withdrawals have not resulted in significant impacts on water levels. It is considered unlikely that future Defense Program water withdrawals under Alternative 1 would result in significant impacts. Localized water-level declines and changes in flow direction would occur during periods of active pumping.

These effects would be limited and are thus considered to be unavoidable, but not significant, impacts.

As an unavoidable consequence of underground nuclear testing, the quality of the groundwater under some portions of the NTS has been impaired. If an underground nuclear test is conducted under or near the water table, additional impairment of water quality and further losses of groundwater resources could be expected. NTS standard operating procedures are designed to protect groundwaters from contamination by ensuring that no tests are conducted within two cavity radii (or a minimum of 100 m [328 ft]) of the groundwater table.

The effects of underground testing have been well-documented in Borg et al. (1976), and the hazardous materials associated with testing have been detailed by Bryant and Fabryka-Martin (1991). A detailed discussion of the effects of past underground testing on the groundwater is presented in Sections 4.1.5 and 4.1.11.

Yields, locations, and proximity to the water table of tests to be conducted under Alternative 1 have not been defined. Therefore, it is not possible to estimate the total potential releases to the groundwater. If tests are conducted in or near the water table, then significant releases of radionuclides and hazardous materials into the near test environment are to be expected. The estimated total release of fission and source-term radionuclides and activation products is 804,500 curies (Ci)/kt of explosive yield. Thus, the potential releases to the groundwater environment from testing of a single device far exceed releases from other actions to be included under Alternative 1. Tests conducted well above the water table would release significant quantities of radionuclides and hazardous materials into the unsaturated zone. Some downward migration of these contaminants may occur and may have the potential to contaminate the underlying groundwater.

The ancillary operations related to testing under Alternative 1 are primarily surface-based and have little potential for groundwater contamination. Minor quantities of drilling fluids or lost circulation materials might be introduced into the near-water-table environment during test hole drilling and post-shot drill-back operations. Any contamination that results from these activities would be considered inconsequential compared to the releases from the actual test.

The continuation of testing under Alternative 1 would have a significant impact on groundwater quality only if the testing is conducted in, or near, the water table. In this event, contamination of the near-test groundwater resources would occur. However, because of the conditions at the NTS (long travel paths, sorptive geologic media, slight hydraulic gradients, and the depths of the stockpiled holes), it is not considered likely that significant impacts would occur in areas downgradient of the underground testing locations.

Underground conventional high-explosive, hydrodynamic tests, and dynamic experiments would not affect the groundwater because such tests and experiments would be conducted well above the water table.

Waste Management Program. Water use in support of Waste Management Program actions under Alternative 1 would be minimal. The impact of withdrawing limited quantities of groundwater in support of the Waste Management Program would not result in significant impacts to groundwater availability.

The craters that are and would continue to be used at the Area 3 Radioactive Waste Management Site represent unavoidable adverse impacts that resulted from past underground nuclear tests. Use of the craters for waste disposal and subsequent capping with engineered covers would prevent the downward migration of precipitation into the waste.

The underground shot cavities beneath the subsidence craters and waste cells in the Area 3 Radioactive Waste Management Site are much deeper than active hydrologic surface processes (infiltration, redistribution, and evapotranspiration) operating beneath the waste unit from the ground surface to a depth of approximately 31 m (100 ft). Current scientific models suggest that the chimney beneath the low-level waste unit does not enhance or promote vertical groundwater flow between the waste unit (subsidence crater) and the deep shot cavity. This conceptual model was confirmed by hydrologic data obtained in 1996 from the exploratory borehole completed beneath U-3bl. Water potential data indicate that there is no groundwater movement from a 40-m to 96-m (131-ft to 315-ft) depth within the subsurface chimney (Van Cleave, 1996). Given the proximity of Area 5 to Area 3 (23 km [14 mi]) and the very similar hydrologic conditions, the defensible hydrogeologic conceptual model for Area 5 is being tested and validated for the Area 3 Radioactive Waste Management Site. The Environmental Restoration Program, will evaluate the potential for groundwater contamination from shot cavities located in the unsaturated zone (more than 101 m [330 ft] above the water table).

After 30 years of waste disposal operations, groundwater monitoring at the Area 5 Radioactive Waste Management Site has not detected any contamination. In addition, field studies conducted to support the Performance Assessment (Shott et al., 1995), which included monitoring of soil moisture and chloride ion concentrations, indicate that water falling on the surface (precipitation) does not reach the groundwater. These studies and the absence of contamination support the conclusion that no groundwater pathway exists beneath the Area 5 Radioactive Waste Management Site. Thus, no impact to groundwater from waste management operations at the Area 5 Radioactive Waste Management Site would occur during the timeframe covered by this EIS and long into the future. (See Volume 1: Appendix A, Section A.2; Chapter 2, Section 2.5.6; and Chapter 4, Section 4.1.5.2 for additional information.)

Environmental Restoration Program. Groundwater use during environmental restoration activities would be minimal and would be limited to that used in pad and road construction, dust control, drilling and testing of characterization wells, decontamination of sampling materials, and purging of wells prior to sampling. Annual water requirements for characterization have not been well defined, but are expected to be minimal.

According to information from the Underground Test Area Corrective Action Unit project, the greatest demand for nonpotable water for drilling a characterization well was 7,401 m^3 (6 acre-feet). The total water demand for this program would probably be less than 74,009 m^3/yr (60 acre-feet/year) between 1995 and 2005. Smaller quantities of water would be required to support decontamination and well sampling. Total demand for site characterization activities would probably be 123,348 m^3/yr (100 acre-feet/year), and no significant impact is expected from the withdrawal of such a small quantity of water.

Information concerning future remediation efforts is preliminary. Water demands projected for the decommissioning of some sites (e.g., the demolition of structures at Test Cell C) have been as high as 3,785 liters (L)/day (1,000 gallons [gal]/day) of potable water (or about 1,357 m^3/yr [1.1 acre-feet/year] over a two-year period). Long-term remediation requirements have not yet been determined. If it is assumed that remediation does not include any active groundwater controls, future requirements for monitoring and well-testing would be a few thousands of cubic meters per year (tens of acre-feet per year). If active groundwater controls were implemented (e.g., hydraulic barriers or extraction wells), future water demands could be several million cubic-meters per year (thousand acre-feet per year).

Nondefense Research and Development Program. The current water demand for the Spill Test Facility has not been determined, but is expected to be slight for fire control, safety, experiments, and potable and nonpotable water. Similarly, the Environmental Management and Technology Development Program has unquantified, but minimal, water demands. Some field measurements and testing might be included in the feasibility study of a Solar Enterprise Zone facility; however, any requirements would be negligible. In total, the water demands for the Nondefense Research and Development Program activities would probably be no more than 12,335 m^3/yr (10 acre-feet/year), and no significant impact would be related to this water use.

Work for Others Program. The water demand for the Work for Others Program has not been defined, but is expected to be minimal. The defense-related research and development activities would include the development of nonintrusive detection and imaging capabilities and surface-based testing. Small quantities of water (probably less than 1,234 m^3/yr [1 acre-feet/year]) may be required to support personnel. The withdrawal of this quantity of water is not significant.

Site-Support Activities. The DOE monitored water withdrawals at the NTS for the periods between 1951 through 1990 (see Chapter 4). These records serve as the basis for predicting the demand for water for the period 1996 through 2005. Under Alternative 1, water use is expected to remain relatively stable because the activities included within the alternative are the same as those that have been conducted previously at the NTS. For the purpose of evaluating the environmental consequences of testing, the water-use rate for 1989 was assumed to be representative for active testing conditions. Water use for 1993 was assumed to be representative of the water demand to support nuclear testing readiness.

Because the water required to support the NTS is derived exclusively from groundwater, there would be some level of impacts on groundwater resources. Because the effects of groundwater withdrawals vary depending on the location, geologic conditions, and withdrawal rates, a more detailed evaluation is required.

The localized water-level declines in areas adjacent to operating water supply wells is not considered a significant impact. The impacts of water-level declines would not be considered significant unless water levels decline in areas off site from the NTS or if the quantity of groundwater discharging from the NTS to downgradient areas would be diminished. The U.S. Geological Survey maintains a water-level monitoring network downgradient of the NTS. The water level in the Devils Hole well rose more than 1 m (3 ft) between the lowest recorded measurement in 1972 and the highest recorded measurement in 1993. Similarly, in the Point of Rocks south well, static water levels rose more than 22 m (72 ft) between the lowest recorded measurement in 1970 and 1994. These data and records for other monitoring wells in the region do not show any effects that might be attributed to water withdrawals on the NTS.

5.1.1.6 Biological Resources. Little or no previously undisturbed habitat would be cleared for the Defense, Waste Management, Nondefense Research and Development, and Work for Others Programs. About 9,800 acres of land would be cleared for the Environmental Restoration Program. Most of this land has been contaminated by radioactive or hazardous materials, and some of it has been disturbed previously. Much of that land would be stabilized and/or revegetated. Infrastructure development would result in the removal of approximately 18 acres of previously undisturbed habitat. Collectively, approximately 9,900 acres, part of which has been disturbed previously, would be disturbed by the DOE or DOE-sponsored organizations under Alternative 1. This represents approximately 1 percent of undisturbed habitat present at the NTS (Hunter and Medica, 1992). Military training exercises under the Work for Others Program might impact additional sizeable habitat blocks, but these exercises are not defined well enough to allow estimation of the potential extent of disturbances. No projects in Alternative 1 are large enough that they would likely lower the viability of populations of any species, including candidate species and economically or recreationally important species.

Because Alternative 1 does not include additional atmospheric, safety, or cratering tests, the concentrations of radionuclides that the flora and fauna are exposed to will not increase. Since few deleterious effects were observed in species or populations when such activities were conducted in the past, no additional impacts are anticipated.

The desert tortoise is the only threatened or endangered species commonly found on the NTS. Individual desert tortoises might be accidentally killed or injured during military training exercises. However, because surveys are conducted and tortoises are removed prior to soil-disturbing activities on the NTS, this is unlikely. From 1989 through 1994 on average, less than one tortoise was killed per year on roads on the NTS (DOE/NV, 1991, 1993, and 1994a). Because vehicular traffic patterns are expected to be similar or lower under Alternative 1 than they were during 1989 through 1994, a similar or lower number of tortoises probably would be killed under this alternative. Groundwater withdrawals under Alternative 1 would not likely affect water flow rates at springs on and around the area. Only military training exercises located at or near springs on the NTS or NAFR Complex could significantly impact the biota associated with these springs.

In a Draft Biological Opinion issued to the DOE/NV on May 21, 1996, the U.S. Fish and Wildlife Service determined that the level of effect described in the NTS EIS would not reduce appreciably the likelihood of survival and recovery of the Mojave Desert population of the desert tortoise in the wild or diminish the value of critical habitat both for survival and recovery of the desert tortoise because:

- The proposed programmatic area does not occur within any areas recommended for recovery of the desert tortoise or areas designated as critical habitat.
- Rehabilitation and revegetation of disturbed sites or payment of off-site mitigation fees will benefit conservation and recovery of the desert tortoise as directed under Section 7(a)(1) of the Act.
- The desert tortoise is a wide-ranging species occurring over a large area. The degree of threats to the species vary in different parts of the Mojave Desert, requiring implementation of management actions tailored to the needs of specific areas (Service, 1994). The loss of habitat associated with the proposed action translates to approximately 1 percent of the total habitat on the NTS. With proper management and conservation, important desert tortoise populations both inside and outside designated recovery areas, will remain viable.
- The NTS occurs within the northeastern Recovery Unit in Nye County, Nevada. Activities on the NTS should not result in a substantial loss of the tortoises within this Recovery Unit. The potential effects on desert tortoises as a result of implementation of the proposed programs by the DOE/NV, as described in the *Description of the Proposed Action,* represents a small impact to the Mojave population of the desert tortoise when total desert tortoise population numbers and geographical extent are considered.

Because there would be few significant impacts to population viability, rare species, or rare habitats in the region, Alternative 1 should have little negative impact on biodiversity or ecosystem functions in this area.

Defense Program. No new facilities would be needed for stockpile stewardship or emergency response activities, and transportation of hazardous or radioactive materials would not likely result in significant impacts on biological resources (Appendix I). Therefore, these projects would have no significant impact on biological resources.

Counterproliferation research and development activities involve detecting underground objects related to nuclear testing or eliminating such objects. Some activities would take place in buildings or, if outside, would involve nondestructive sampling. Thus, this part of the project is unlikely to impact biological resources. Other activities might include aboveground detonations near bunkers. Some activities involve developing technologies for the safe rendering of nuclear devices. This includes aboveground detonations of conventional high explosives at the Big Explosives Experimental Facility (see Appendix F). The detonations would take place on the 20 m x 20 m (66 ft x 66 ft) gravel firing pad constructed for high-explosive detonations. The facility site consists of 8 acres of graded and cleared land surrounding the bunkers and firing pad. It is unlikely that explosions would significantly impact surrounding habitat, affect the viability of plant or animal populations, or impact springs. This facility is north of the range of the desert tortoise (Rautenstrauch et al., 1994). Transportation to study sites would be infrequent; therefore, the impact of this program on biological resources would not be significantly increased.

Under Alternative 1, one or more nuclear tests could be conducted underground on Pahute Mesa or in Yucca Flat. Because the DOE has already prepared sufficient sites to handle numerous underground tests, no new impacts on biological resources would arise from maintaining readiness for these tests. A subsidence crater could be created by the underground test of the nuclear device. Because this crater would form in the area disturbed during site preparation for the test, no new loss of habitat would occur. Drilling sumps constructed as part of post-shot drilling operations could attract waterfowl and doves. Exposure to drilling fluid additives might increase these organisms' probability of drowning (Greger, 1995).

Additional releases of tritium into the aquifer from the underground nuclear test would not likely increase the impact to threatened and endangered species located at Devils Hole National Monument or Ash Meadows National Wildlife Refuge. The short half-life of tritium and the slow rate of water exchange between the nuclear test sites and groundwater and the resulting model studies indicate that tritium would not be detected off government-controlled lands (Borg et al., 1976; GeoTrans Inc., 1995). Hydrodynamic tests and dynamic experiments conducted at the existing Big Explosives Experimental Facility in Area 4 and at the Lyner Complex in Area 1 are not expected to impact biological resources. Conventional high-explosives testing is expected to occur in areas previously cleared of vegetation, so no new wildlife or plant habitat would be lost. No other significant impact to biological resources is expected.

The analysis performed for this EIS is for the conduct of one nuclear test. The impacts to the environment from the conduct of multiple tests (a series) are assumed to be incrementally additive; that is, the impacts of conducting two tests would be twice the impact of conducting a single test.

Waste Management Program. Activities at the Area 3 Radioactive Waste Management Site would disturb very little of the previously undisturbed areas and would not have a significant impact on habitat or population viability. Closure of the two disposal cells would result in a beneficial impact because these sites would be revegetated with native plants. Area 3 is north of the range of the desert tortoise; therefore, construction and operation would have no effect on this species. This program also would have no effect on other threatened and endangered species or springs and their associated biota.

Land disturbance at the Area 5 Radioactive Waste Management Site is too localized to impact viability of plant and animal populations. Construction activity would include one new trench and closure of several pits and trenches. Because these disturbed sites would be revegetated, this activity would have a positive impact on habitat. Effects on threatened or endangered species would be unlikely given that no tortoises or tortoise sign has been seen in this area (EG&G/EM, 1994), and other threatened and endangered species would be unlikely to use this area. No springs are near this site.

At the Area 6 Waste Management Site, PCBs are temporarily stored prior to being transported off site for disposal at EPA-permitted facilities. Because this waste would be stored in a developed area with no anticipated releases to the environment, this activity would have no biological impacts. Disposal activities at the hydrocarbon landfill in Area 6 are also not expected to impact biological resources.

In Area 11, explosive ordnance would be destroyed in an 8 m x 31 m (26 ft x 102 ft) detonation pit surrounded by an earthen pad. No new land would be disturbed. Detonations occur infrequently. They would not likely impact habitat use by animals in areas around this site, because desert tortoises are rare near this facility. A 40-acre area surrounding this facility was searched in 1991; no tortoise or tortoise sign was found. It is, therefore, unlikely that tortoises would be directly injured or killed by this project.

Environmental Restoration Program. Five projects in the Environmental Restoration Program would occur on the NTS or NAFR Complex under Alternative 1. None of the environmental restoration actions would have significant impacts on population viability or habitat of plants or animals. The impacted areas are small relative to the geographic areas inhabited by affected populations, and very little undisturbed habitat would be disturbed. About 50 acres would be cleared for the Underground Test Area Corrective Action Unit project; however, much of this land is already disturbed. Burrowing owls, candidate species of bats, and economically or recreationally important species like doves or waterfowl might be exposed to drilling mud contained in drill sumps. Drilling mud, although nontoxic, might contain polymers and surfactants that could coat birds or mammals that land in or drink from the sumps. This could increase their probability of drowning (Greger, 1995). Drilling also might result in production of some hazardous and radioactive wastes; these wastes would be transferred to waste management facilities for disposal. Transport of the removed material to approved disposal sites would not likely impact biological resources (Appendix I).

The second project, the Soils Media Corrective Action Unit activities, would involve the removal and transport of radioactively contaminated soils from 3,257 acres to approved disposal locations. The habitat would be destroyed during soil removal, but may be revegetated afterward. This area is adjacent to the playa and, thus, is not desert tortoise habitat (EG&G/EM, 1991). No candidate species of plants occur on those sites (Blomquist et al., 1995). These activities would not occur near springs nor require pumping of shallow groundwater; thus, the tortoises would not be affected.

The third project, the Industrial Site Unit activities, would disturb about 2,510 acres. Almost all of this land has been disturbed previously and is not wildlife habitat. It is unlikely that desert tortoises would be killed or injured during earthmoving. Surveys would be conducted, and all tortoises would be removed prior to those activities. Removal of hazardous or radioactive materials might have positive impacts on the survival of individuals of threatened or endangered species, such as desert tortoises. Transport of the removed material to approved disposal sites would not likely impact biological resources because workers follow stringent safety protocols (Appendix I). This project is unlikely to take place near springs; thus, springs should not be affected.

During the fourth project, Decontamination and Decommissioning, eight contaminated buildings or building complexes could be torn down and transferred to appropriate disposal areas. Transport of the contaminated material to approved disposal sites would not likely impact biological resources.

There are 100 Defense Nuclear Agency sites in Area 12 of the NTS that were contaminated with radioactive or hazardous waste. This project might continue operations to contain contaminant migration, characterize and remediate contaminated muck piles and ponds, and select and implement post-contamination remediation actions. About 50,971 m^3 (1.8×10^6 ft^3) of radioactive wastes would be removed from a 500-acre area. Therefore, a substantial amount of habitat would be destroyed, but might be revegetated. Revegetation could have a positive impact on habitat in highly disturbed areas because it would advance the successional process in these areas (Call and Roundy, 1991). Cleanup might also have negative impacts on habitat in areas where mature, undisturbed natural vegetation existed prior to cleanup. Transport of the removed material to approved disposal sites would not likely impact biological resources (Appendix I). This project would not take place near springs; thus, springs would not be impacted.

Nondefense Research and Development Program. All five activities within this program would be operational under Alternative 1. The first activity, the Alternative Energy Project, and the second activity, the Environmental Management and Technology Development Project, would be in planning or design stages and would not affect biological resources.

The third activity, the Alternative Fuels Demonstration Projects would not require destruction of habitat or have other negative impacts on biological resources. Over the long term, information from this project might have significant positive ramifications for biological resources because of potential influences on fossil fuel use.

The fourth activity, the National Environmental Research Park, would have no negative effect on habitat, population viability of plants or animals, threatened or endangered species, or springs. Over the long term, research into many of these topics might have positive impacts on biological resources because the findings could result in improved management of resources.

The fifth activity, the Spill Test Facility, is not expected to result in any significant impact to vegetation or wildlife. A monitoring program was established in 1981 to evaluate impacts from chemical spill tests at various distances downwind (northeast) from the Spill Test Facility. Results of monitoring vegetation, small mammals, kit foxes, lizards, and lagomorphs showed no measurable impacts on these biological resources except for leaf burns observed on vegetation growing in patches of disturbed soil on the playa (DOE/OFE, 1994). No adverse impacts are anticipated to occur at distances greater than 5 km (3 mi) downwind of the facility, near the western boundary of the Desert National Wildlife Range. Desert tortoises are very uncommon near this facility (EG&G/EM, 1991) and probably would not be affected. Chemicals would be dispersed by the time they reach areas where tortoises are known to occur. Information from this project could have positive impacts on biological resources to the degree that it contributes to a better understanding of how to contain and clean up hazardous spills.

Work for Others Program. The Work for Others Program consists of five projects. Treaty verification and nonproliferation projects would have no significant impacts on biological resources. The Conventional Weapons Demilitarization Project would have no expected impacts on biological resources. Defense-related research and development projects have the potential to negatively impact biological resources because of habitat disturbance, either through troop or vehicle movements, ordnance detonation, or fires (Schaeffer et al., 1990). If off-road military exercises occur within tortoise habitat, tortoises might be inadvertently killed. Defense-related research activities performed in the past were essentially benign, consisting primarily of nondestructive sampling and testing, such as infrared imaging. Based on these prior projects, no significant negative impacts are anticipated on biological resources from this activity.

Similarly, defense-related research activities involving hydrodynamic tests are likely to have little or no impact on surrounding habitat, the viability of plant or animal populations, or springs or other water sources. This is because the detonations would take place on the 20 m x 20 m (66 ft x 66 ft) gravel firing pad (constructed for high-explosive detonations) surrounded by 8 acres of graded and cleared land.

Site-Support Activities. The NTS and NAFR Complex are served by existing airfields and by paved and graded roads. Most people and material are transported to these sites via roads. Road maintenance would not significantly impact biological resources because it involves redisturbance of previously disturbed habitat. The southernmost 52 km (32 mi) of Mercury Highway would be repaved, disturbing approximately 6 acres of land for staging areas. In addition, 5 km (3 mi) of the Road 5-01 reconstruction would be completed. This road would run from Mercury Highway to just south of the Area 5 Radioactive Waste Management Site, and would remove approximately 18 acres of undisturbed habitat. The fiber-optic network would continue to be expanded when extensions are added from the two central hubs. Because surveys are conducted and tortoises are found and relocated out of harm's way prior to ground disturbances, it is unlikely that tortoises would be killed during this project. Construction would be unlikely to significantly impact other biological resources. Waterline, powerline, and natural gas line developments are not likely to be extensive.

5.1.1.7 Air Quality. The impacts to air quality resulting from the five programs and site-support activities are summarized in this section. The region of influence for this air quality analysis includes Nye and Clark Counties, Nevada. The emissions from stationary, mobile, and fugitive PM_{10} sources, which are shown in Tables 5.1-12 and 5.1-13, occur within and outside of the NTS. These emissions would be dispersed over the 3,496 square kilometer (km^2) (1,350 square mile [mi^2]) area of the NTS. At the boundaries of the NTS, ambient pollutant concentrations would be well below the ambient air quality standards. Since no substantial increases in air pollution emissions

Table 5.1-12 Summary of NTS construction emissions and mobile source emissions (on site and off site), tons per year, Alternative 1

Program	Construction	Mobile Sources								
		On Site			Off Site					
					Nye County			Clark County		
	Fugitive PM_{10}[a]	CO[b]	VOC[c]	NO_x[d]	CO	VOC	NO_x	CO	VOC	NO_x
Defense	Negligible	53.63	7.29	9.55	16.69	2.52	5.90	32.40	4.89	11.44
Waste Management	0.00	9.10	1.24	1.62	2.83	0.43	1.00	5.50	0.83	1.94
Environmental Restoration	220	14.13	1.92	2.52	4.40	0.66	1.55	8.53	1.29	3.01
Nondefense Research and Development	0.00	6.94	0.94	1.24	2.16	0.33	0.76	4.20	0.64	1.48
Work for Others	0.0	12.69	1.72	2.26	3.95	0.60	1.40	7.66	1.16	2.71
Site-Support Activities	NA[e]	142.93	19.42	25.45	44.49	6.72	15.71	86.36	13.05	30.49
Total	**220**	**239.42**	**32.53**	**42.64**	**74.52**	**11.26**	**26.32**	**144.65**	**21.86**	**51.07**

[a] PM_{10} = particulate matter with a diameter equal to or less than 10 micrometers
[b] CO = carbon monoxide
[c] VOC = volatile organic compounds
[d] NO_x = nitrogen oxides
[e] NA = not applicable

Table 5.1-13. Site-support activities stationary source emissions at the NTS and Nye County, tons per year, Alternative 1

Area	TSP[a]	SO_2[b]	NO_x[c]	HC[d]	CO[e]
Area 1	34.7	3.40	2.20	0.10	0.50
Area 2	87.3	0.0	0.0	0.0	0.0
Area 3	24.37	0.0	0.0	0.0	0.0
Area 6	11.7	2.90	4.10	0.0	0.0
Area 23	1.12	10.62	9.4	0.0	2.54
U.S. DOE Portable[f]	17.68	15.24	229.32	0.0	49.68
Fuel Storage Tanker	0.0	0.0	0.0	31.95	0.0
Total NTS	**176.87**	**32.16**	**245.02**	**32.05**	**52.72**
Total Nye County	**1,685.70**	**960.68**	**933.28**	[g]	**187.68**

[a] Total suspended particulates
[b] Sulfur dioxide
[c] Nitrogen oxides
[d] Hydrocarbons
[e] Carbon monoxide
[f] Compressors
[g] No data; state hydrocarbon emission inventory is not complete.

Source: Bureau of Air Quality, State of Nevada, 1995.

are expected at the NTS by 2005, Nye County would continue its present attainment designation for all criteria pollutants. The analysis performed for this EIS is for the conduct of one nuclear test. The impacts to the environment from the conduct of multiple tests (a series) are assumed to be incrementally additive; that is, the impacts of conducting two tests would be twice the impact of conducting a single test.

Mobile source emissions in Nye County (on-site and off-site) and Clark County are presented in Table 5.1-12. These emissions would be dispersed over a wide area and would not increase ambient pollutant concentrations in Nye County above ambient standards. Therefore, Nye County would continue to maintain its attainment designation for all criteria pollutants. The NTS contribution to mobile source emissions in Clark County would continue to be very small. The carbon monoxide, volatile organic compounds, and nitrogen dioxide pollutant emissions from NTS mobile sources in Clark County contribute 0.11, 0.10, and 0.41 percent, respectively, to the Clark County pollutant burden. The small contribution to the carbon monoxide burden in Clark County would not produce additional violations of the carbon monoxide ambient air quality standard.

GENERAL CONFORMITY DETERMINATION—The EPA published the General Conformity Rule (40 CFR Parts 6, 51, and 93) to implement Section 176 (c) of the Clean Air Act as amended in 1990. This section requires that federal actions conform to the appropriate State Implementation Plan. Conformity, as defined in the Clean Air Act, is conformity to the State Implementation Plan's purpose of eliminating or reducing the severity and number of violations of National Ambient Air Quality Standards and achieving expeditious attainment of such standards. A formal conformity determination is required for federal actions occurring in nonattainment areas when the total direct and indirect emissions of nonattainment pollutant (or their precursors) exceed specified annual de minimis (threshold) values. Because ozone (O_3) is a secondary pollutant, the conformity determination for ozone uses the precursor emissions of volatile organic compounds and nitrogen dioxide (NO_2) as surrogate pollutants. The de minimis thresholds are presented in Table 5.1-14.

The mobile-source emissions for Clark County shown in Table 5.1-12 are based on commuter traffic traveling on U.S. Highway 95 between Las Vegas and the NTS. Approximately 40 percent of this highway is located in the Las Vegas Valley nonattainment area for carbon monoxide and PM_{10}.

Thus, the annual emissions of carbon monoxide (CO) in the nonattainment area would be 57.9 tons.. This is well below the 100 ton per year de minimus shown for carbon monoxide in Table 5.1-14. Therefore, a general conformity analysis would not be required for this alternative.

RADIOLOGICAL AIR QUALITY—Air concentrations would have to be 14 times higher than the measured 1993 average concentrations to achieve the maximum CAP-88 air dose assessment modeled dose (see Section 4.1.7). Effluents from the five programs are estimated at concentration levels that would never approach or even begin to approach this amount; therefore, it is expected that impacts to the air quality by radioactive effluents would be minimal under Alternative 1. The analysis performed for this EIS is for the conduct of one nuclear test. The impacts to the environment from the conduct of multiple tests (a series) are assumed to be incrementally additive; that is, the impacts of conducting two tests would be twice the impact of conducting a single test.

5.1.1.8 Noise. Noise generated on the NTS does not propagate off site at audible levels. The closest sensitive receptors to the site boundary would be residences located 2 km (1.3 mi) to the south in the town of Amargosa Valley (Lathrop Wells). Therefore, NTS noise impacts under Alternative 1 would be a result of noise generated during the operation of construction equipment and from the transportation of personnel and materials to and from the site. The NTS total construction and operations workforce with this alternative would remain relatively constant through the 1996 to 2005 period.

Railroad and aircraft noise were considered. However, there are no railroads serving the NTS; therefore, a railroad noise impact analysis was not required. Based on composite noise contours developed by the U.S. Air Force in 1994 for subsonic and supersonic flight operations over the Nellis Air Force Range Complex (U.S. Air Force, 1994), the day-night average sound level (L_{dn}) in the NTS portion of the complex resulting from aircraft operations would be less than 50 decibels (dB). Flight operations at supersonic speeds are not authorized over the NTS (SAIC/DRI, 1991), and subsonic operations are not normally scheduled over

Table 5.1-14. De minimis thresholds in nonattainment areas

Criteria Pollutant	Degree of Nonattainment	Tons/Year
Ozone (VOCs and NO_2)	Serious	50
	Severe	25
	Extreme	10
	Other ozone nonattainment areas (outside of ozone transport region)	100
Volatile Organic Compounds (VOCs)	Marginal/moderate nonattainment (within ozone transport region)	50
NO_2	Marginal/moderate nonattainment (within ozone transport region)	100
Carbon monoxide (CO)	All	100
Particulate matter (PM_{10})	Moderate	100
	Serious	70
Sulfur/nitrogen dioxide (SO_2/NO_2)	All	100
Lead (Pb)	All	25

the eastern portion of restricted area R-4808, which includes most of the NTS (U.S. Air Force, 1994). Only periodic helicopter and small fixed-wing aircraft operations are conducted from Desert Rock Airport.

Defense Program. Transportation noise levels on the NTS would be minimal and would not produce any noise impacts off site, contributing less than 3 a-weighted sound level (dBA) to the overall traffic noise levels on U.S. Highway 95. Thus, noise impacts related to Defense Program activities would be considered minor and not significant. Noise levels associated with the conduct of multiple tests would be sporadic and transitory.

Waste Management Program. Waste Management Program activities under Alternative 1 would continue to include the disposal of low-level waste and mixed waste pits or trenches. The preparation of the disposal cells requires the use of some construction equipment. These construction activities would be intermittent. Noise levels would decrease with distance and would be barely distinguishable from background noise levels at the NTS boundary.

The delivery of waste to the site by large trucks would produce some on-site and off-site traffic noise. However, the number of vehicles would average only 10 to 15 per working day. This small number of vehicles would contribute only minor amounts of noise to the overall noise levels on U.S. Highway 95. Therefore, the noise levels produced by Waste Management Program activities under this alternative would produce only minor noise impacts, both on site and off site.

Environmental Restoration Program. Environmental Restoration Program activities would require the removal and disposal of contaminated soils and the drilling of characterization wells. The equipment required to perform these activities would generate noise at environmental restoration areas. The noise levels would decrease with distance. At the NTS boundary, the noise levels would be barely distinguishable from background noise levels. For example, the noise level 15 m (50 ft) from a drill rig would be about 90 dBA. At a distance of 1.6 km (1 mi), the noise level would be 50 dBA, and at a distance of 3.2 km (2 mi), the noise level would be about 44 dBA.

Removal of the contaminated material from the NTS by trucks would produce a minor contribution to on-site and off-site noise levels generated by traffic on U.S. Highway 95. Therefore, the noise levels produced by Environmental Restoration Program activities under this alternative would produce only minor noise impacts, both on site and off site.

Nondefense Research and Development Program. The only activity in the Nondefense Research and Development Program that would generate noise is the continued operation of a wind tunnel at the Spill Test Facility. The wind tunnel operation is infrequent, and local noise levels would decrease with distance. The noise from this source would be barely distinguishable from background noise levels at the NTS boundary. Transportation noises for the Nondefense Research and Development Program would be minor, both on site and off site. Therefore, noise impacts from these programs would be negligible.

Work for Others Program. Included in the Work for Others Program are activities that include periodic military training exercises. These exercises include the operation of fixed and rotary wing aircraft in the NTS airspace. Noise levels resulting from these operations would produce local noise levels of 80 to 90 dBA. However, these noise levels would decrease with distance. Because of the large size of the NTS, noise levels from these activities would be barely audible at the NTS boundaries. Noise impacts would be minor.

Site-Support Activities. Transportation noise levels on the NTS would be minimal and would not produce any on-site or off-site noise impacts.

5.1.1.9 Visual Resources. An analysis has been conducted to determine the effects of Alternative 1 on visual resources. Visual impacts were assessed on the potential of Alternative 1 to alter or conflict with the existing landscape character. An impact to visual resources would be considered adverse and potentially significant if the contrasts and sensitivity levels of the viewpoints were unacceptably high. Appendix A provides related information regarding proposed facilities and activities that would affect visual resources at the NTS. The only activities that could affect visual resources would be from the Environmental Restoration Program. The other programs would not create new ground disturbance.

The Environmental Restoration Program activities would be located in areas of scenic quality common to the region, and none would be visible from public viewpoints. Depending on pertinent reclamation factors, disturbed areas could be revegetated after remediation has been completed. Long-term impacts would be negligible. There would be some beneficial impacts to visual resources once vegetation is re-established.

5.1.1.10 Cultural Resources. There would be impacts to cultural resources as a result of ground-disturbing activities, building modifications, and change to setting through increased noise, lighting, and construction in previously undisturbed locations. Impacts to cultural resources could occur through underground testing, drilling, grading, fencing, explosives-producing subsidence craters; cleanup activities (contaminated soils, effluent ponds and inactive tanks), construction of buildings, water systems, lights, wells, upgrading power lines, natural gas lines, roads, and the decontamination of buildings. A total of 9,905 acres are expected to be disturbed, but impacts to significant cultural resources are unlikely. Continued visitation and vehicular traffic could lead to vandalism or artifact collecting that could indirectly affect recorded archaeological sites and archaeologically sensitive areas.

Although archaeological surveys have not been conducted in those areas, it is estimated that 67 sites could be impacted by projects associated with this alternative based on the results of archaeological surveys conducted in adjacent areas in 1994. The precise location and number of these resources are unknown until archaeological surveys are conducted. Surveys will be conducted prior to ground-disturbing activities, and impacts will be mitigated through the measures described in Chapter 7. At least eight structures will be decommissioned under Alternative 1. If these buildings are determined to be historically significant, they would be mitigated using measures described in Chapter 7.

Defense Program. Under Alternative 1, the DOE would maintain readiness to perform one nuclear test at the NTS. Although it is likely that this test would be performed in a disturbed area, the excavation and preparation of the test area, if in a previously undisturbed area, could adversely affect archaeological resources.

Some buildings in Area 4 may have historic significance related to the Cold War and nuclear development. Prior to any modification or destruction, these structures would be evaluated for their potential to provide historical information. No nuclear testing, stockpile management activities, or nuclear weapons storage projects are scheduled for Area 13 on the NAFR Complex. Therefore, these projects of the Defense Program would not impact cultural resources.

Waste Management Program. Under this alternative, the Area 3 Radioactive Waste Management Site facility would be sufficient to handle forecasted waste volumes for the next 10 years. With the same level of activity, this program would present no increased potential for impact on cultural resources.

At the Area 5 Radioactive Waste Management Site, existing facilities would be full before 10 years. It is estimated that one additional trench within the currently operated site would be needed.

No DOE waste management storage facilities are currently located within the NAFR Complex. All such facilities are located on the NTS, and any Waste Management Program activities pertaining to the NAFR Complex would involve removal of contaminated soils to the NTS. Therefore, the Waste Management Program would have no impact on cultural resources within the NAFR Complex.

Environmental Restoration Program. Environmental Restoration Program activities at the NTS would occur mainly on previously disturbed land. However, well construction, to monitor groundwater contamination, could impact cultural resources in undisturbed areas.

Under Alternative 1, eight structures will be decommissioned at the NTS. Two of these structures have been determined to be eligible for the National Register of Historic Places. These include the EPA Farm and the Junior Hot Cell facility. Data recovery at the Junior Hot Cell facility has been completed and the building has since been demolished. Other structures, as yet unevaluated, may be eligible. These structures will be evaluated and if eligible, they will be mitigated using the measures described in Chapter 7.

Few sites have been recorded directly within the area of potential effect for Area 13. However, much of the area has not been surveyed for cultural resources. Archaeological sites have been recorded in the general area, and indirect impacts to these sites could occur as a result of increased visitation to the site area.

Nondefense Research and Development Program. Most of the DOE's Nondefense Research and Development Program projects are located at the NTS. These projects are related to the development of solar generation facilities. If located in previously undisturbed areas, ground disturbance from construction could impact cultural resources. These programs would have no effect on the cultural resources found in the vicinity of the Area 13 site.

Work for Others Program. The DOE's Work for Others Program is focused on the NTS and would be located within existing facilities. Therefore, there would be no impact to significant cultural resources at the NTS. This program would have no effect on the cultural resources found in the vicinity of the Area 13 site.

Site-Support Activities. Site-support activities could impact cultural resources through ground disturbances associated with upgrading roads, utilities, power lines, and communication facilities.

<u>AMERICAN INDIAN CULTURAL RESOURCES</u>—*This section describes the American Indian concerns associated with implementing Alternative 1, as summarized by the CTGO.*

The CTGO knows that the actions considered in the NTS EIS potentially will affect American Indian cultural resources within an area roughly bounded by where these people live today in their traditional lands (Figure 4-47). The proposed NTS EIS actions will have cultural effects within this region of influence because of the cultural centrality of these lands to all three ethnic groups (Western Shoshone, Owens Valley Paiute, and Southern Paiutes). Within this region of influence, specific actions will have direct local impacts. Ultimately, however, any action that moves the NTS away from or back towards its natural state has influence on all the Indian people.

The CTGO recognizes that some of the actions proposed in the NTS EIS will have direct impacts on other Indian tribes and organizations. For example, the Project Shoal Area is located on the traditional lands of the Northern Paiute people. The Eldorado Valley actions potentially impact the Mohave people. The return of radioactive waste to the NTS has permitted and potentially will permit people like the Alaskan natives to have their lands restored to a natural state (see Project Chariot Report [DOE/NV, 1994b]). Therefore, the CTGO defines the American Indian region of influence map in an effort to focus on the cultural concerns of those people having traditional ties to the NTS itself, but, in so doing, does not intend to preclude the cultural concerns of other Indian ethnic groups.

<u>*Defense Program at the NTS*</u>*—Under Alternative 1, it is expected that American Indian cultural resources will be adversely impacted if further underground nuclear tests occur and if natural lands are scraped for construction. Access to culturally significant places will be reduced because Indian people's perception of health and spiritual risks will increase if additional testing, storage, disassembly, or disposal of nuclear and conventional weapons occurs.*

<u>*Waste Management Program at NTS*</u>*—Under Alternative 1, it is expected that American Indian cultural resources will continue to be adversely impacted because the waste has not been disposed of in a culturally appropriate manner. Access to culturally significant places on the NTS will be reduced because waste isolation facilities increase Indian people's perception of health and spiritual risks.*

Environmental Restoration Program at the NTS—Under Alternative 1, it is expected that American Indian cultural resources will be adversely impacted by the well monitoring program and the construction of access roads, but will be positively impacted by actions that return disturbed lands to their natural condition in a culturally appropriate manner and with the participation of Indian people.

Nondefense Research and Development Program at the NTS—Under Alternative 1, it is expected that American Indian cultural resources will be adversely impacted by increased visits by students and researchers who collect artifacts, visit sacred areas, and remove plants or animals. Cultural resources could be positively impacted if students and researchers receive proper guidance by Indian people regarding how to visit places and interact with the environment.

Work for Others Program at the NTS—Under Alternative 1, it is expected that American Indian cultural resources will be adversely impacted if the NTS continued to be a place where weapons are stored, disassembled, and disposed. These actions have and will continue to pollute these lands. The presence of conventional and nuclear weapons defines the NTS as a place of destruction, which promotes an image that is inappropriate as a place for peaceful relations between Indian ethnic groups.

American Indian cultural resources will continue to be adversely impacted by military training exercises and weapons tests.

Defense Program at Area 13—Under Alternative 1, it is expected that American Indian cultural resources will be adversely impacted if further nuclear safety tests occur and if natural lands are scraped for construction. In this alternative, however, there are no plans for additional tests at the Area 13 site on the NAFR Complex.

Waste Management Program at Area 13—Under Alternative 1, it is expected that American Indian cultural resources will not be impacted because there is no Waste Management Program at Area 13 on the NAFR Complex and none has been identified for this alternative.

Environmental Restoration Program at Area 13—Under Alternative 1, it is expected that American Indian cultural resources at Area 13 on the NAFR Complex will be adversely impacted if natural lands are scraped during environmental restoration. Access to culturally significant places will be increased if environmental restoration is successful, thus reducing Indian people's perception of health and spiritual risks associated with this area. Indian people wish to be involved in identifying environmental restoration methods and in the evaluation of restoration success.

Nondefense Research and Development Program at Area 13—Under Alternative 1, it is expected that American Indian cultural resources will be adversely impacted if Area 13 on the NAFR Complex continues to be a place where weapons are researched and developed. These actions have and will continue to pollute these lands. American Indian cultural resources will continue to be adversely impacted by military training exercises and weapons tests.

Work for Others Program at Area 13—Under Alternative 1, it is expected that American Indian cultural resources will be adversely impacted if Area 13 on the NAFR Complex continues to be a place where weapons are researched and developed. These actions have and will continue to pollute these lands. American Indian cultural resources will continue to be adversely impacted by military training exercises and weapons tests.

5.1.1.11 Occupational and Public Health and Safety. For workers at the NTS, occupational health and safety impacts could result from industrial safety hazards in the workplace (e.g., injuries or fatalities from construction and maintenance), controlled exposure to radiation or hazardous chemicals in the workplace, and accidental exposures to radiation or hazardous chemicals. Impacts to worker health could take the form of injuries or fatalities from industrial hazards and cancer fatalities, or other detrimental health effects from exposure to radiation or hazardous chemicals. Table 5.1-15 summarizes the occupational and public health and safety impacts for each NTS program area under Alternative 1.

Table 5.1-15. Health risks to workers and the public from program activities, NTS, Alternative 1

Program Area	Worker Health Risks						Public Health Risks			
	Occupational Safety Risks		Occupational Radiation Risks		Occupational Chemical Risks		Public Radiation Risks		Public Chemical Risks	
	Injuries	Fatalities	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers[c]	Chemical Hazard Index[d]	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers[c]	Chemical Hazard Index[d]
Defense (with nuclear testing)	6.8	0.012	0.032 (0.034)	0.012 (0.013)	e e	e e	4.0×10^{-6} (0.0054)	1.8×10^{-6} (0.0025)	e e	e e
Waste Management	153	2.9	0.020	0.0081	5.2×10^{-7}	0.48	5.1×10^{-5}	2.3×10^{-5}	2×10^{-5}	3.8×10^{-6}
Environmental Restoration	10	0.031	0.0085	0.0034	3.0×10^{-7}	0.14	2.3×10^{-10}	1.1×10^{-10}	6×10^{-6}	2.4×10^{-6}
Nondefense Research and Development	1.9	0.0033	0.0031	0.0013	3.2×10^{-6}	0.58	f	f	1.9×10^{-4}	1.5×10^{-4}
Work for Others	11	0.019	0.0055	0.0022	6.1×10^{-8}	4.4×10^{-3}	f	f	2.9×10^{-7}	1.9×10^{-8}
Site-Support Activities	19	0.033	0.046	0.018	e	e	f	f	e	e
Total (with nuclear testing)	**202**	**3**	**0.12 (0.15)**	**0.045 (0.058)**	**4.1×10^{-6}**	**0.58**	**5.5×10^{-5} (0.0055)**	**2.5×10^{-5} (0.0025)**	**2.3×10^{-4}**	**1.5×10^{-4}**

a. Number of radiation-induced latent cancer fatalities in the exposed population associated with the activities conducted over the 10-year period of analysis
b. Number of radiation-induced detrimental health effects (e.g., nonfatal cancers, genetic effects) in the exposed population associated with the activities conducted over the 10-year period of analysis
c. Number of chemical-induced cancers (fatal and nonfatal) in the exposed population associated with the activities conducted over the 10-year period of analysis
d. A hazard index of greater than one indicates that the non-cancer health effects could be life-threatening to individuals exposed for one hour or more
e. No reasonably foreseeable scenarios resulting in exposure to chemically hazardous materials have been identified
f. No reasonably foreseeable scenarios resulting in exposure to radiation have been identified.

The remote location of the NTS insulates impacts to the general public from NTS activities. To impact public health and safety, there must be a pathway or a transport mechanism to transmit the hazard to the public. For NTS activities, the principal pathways by which the public could be exposed to hazards are air, groundwater, and motorized transport. Potential impacts to the public from routine airborne emissions of radioactivity and priority pollutants are discussed in Section 5.1.1.7, Air Quality.

Transportation impacts are discussed in Section 5.1.1.2, Transportation. This section addresses potential impacts to public health and safety from subsurface contamination of groundwater and from accidental releases of radioactivity to the air. Unless otherwise noted, impacts presented in this section are the total impacts for the 10-year period evaluated in this EIS. Results are presented for each program area, although some program areas do not involve hazards from radiation or hazardous chemicals.

Defense Program. Based on occupational injury and fatality rates for construction and other industrial activities, the Defense Program at the NTS is expected to result in 3.7 injuries to workers during routine program activities and 3.1 injuries as a result of construction activities over the 10-year period evaluated in this EIS. During the same period, 0.0066 fatalities are expected from routine activities, and 0.0055 fatalities are expected to result from construction activities.

Based on previous NTS occupational radiation records, occupational exposure to radiation is estimated to result in a collective dose to NTS Defense Program workers of about 78 person-rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 0.031 latent cancer fatalities and 0.012 other detrimental health effects in the worker population. Risk of accidental exposure to workers increases the latent cancer fatality risk by 0.001. No Defense Program hazardous chemical accident resulting in measurable effects at the NTS has been identified.

The health and safety impact to the public from potential Defense Program accidents could result in about 4.0×10^{-6} latent cancer fatalities and 1.8×10^{-6} other detrimental health effects in the population. Should the DOE be directed by the President to conduct underground nuclear-yield testing under Alternative 1, potential accidents associated with venting of radionuclides following a test could result in a risk of about 0.0054 latent cancer fatalities and 0.0025 other detrimental health effects in the population.

Subsurface radioactivity from past underground nuclear weapons tests potentially provides an exposure pathway for both NTS workers and the public. Transport modeling of tritium-contaminated groundwater from underground test areas at Pahute Mesa and Yucca Flat was performed in support of this EIS (GeoTrans, 1995). An earlier screening study by Daniels et al. (1993) also evaluated tritium migration from Pahute Mesa to Oasis Valley. The modeling results showed that tritium concentrations in groundwater are never expected to reach concentrations that are above the EPA's maximum allowable tritium concentration in drinking water which is 20,000 picocurie per liter (pCi/L) at the boundaries of the NTS or NAFR Complex. To date, only low levels of tritium have been detected in any on-site wells.

Health effects impacts to the public from subsurface radioactivity have been estimated based on future predictions of tritium concentrations in well water, even though predicted concentrations are below current limits of detection. These impacts are not expected to occur within the 10-year time frame of this EIS. The maximally exposed public individual is estimated to have a lifetime probability of contracting a fatal cancer between 8×10^{-13} (about one in one trillion) and 1×10^{-5} (about one in 100,000). The public exposure scenario assumes that the individual consumes contaminated well water for 70 years centered around the time of peak tritium concentration in well water.

No health effects impacts to NTS workers from subsurface radioactivity are expected to occur during the 10-year time period evaluated in this EIS. Tritium is not detectable in on-site drinking water wells. Existing monitoring programs and controls preclude inadvertent consumption of contaminated well water by workers.

The maximum reasonably foreseeable radiological Defense Program accident at the NTS would be a non-nuclear explosion involving high explosives in an Area 27 nuclear weapons storage bunker, which has a probability of occurrence of 1 x 10^{-7} (1 in 10,000,000) per year. The following consequences are estimated if this accident occurs:

- Involved worker: fatally injured in the explosion
- Maximally exposed non-involved worker: 62,000 rem (2,700 rem in first year after exposure), acute radiation effects could result in fatality without immediate medical treatment
- Non-involved worker population at the nearest major facility area: 16,000 person-rem, 6.4 latent cancer fatalities, 2.6 other detrimental effects
- Maximally exposed off-site individual at the nearest point of public access: 34 rem, 3.4 x 10^{-2} chance of latent cancer fatality, 1.6 x 10^{-2} chance of other detrimental effects
- Population within 80 km (50 miles): 5,800 to 110,000 person-rem, 3 to 55 latent cancer fatalities, 1 to 25 other detrimental effects.

No Defense Program accident resulting in measurable chemically hazardous effects at the NTS has been identified.

Waste Management Program. Based on occupational injury and fatality rates for construction and other industrial activities, the Waste Management Program at the NTS is expected to result in 150 injuries to workers during routine program activities and 2.8 injuries as a result of construction activities over the 10-year period evaluated in this EIS. During the same period, 2.9 fatalities are expected from routine activities, and 0.005 fatalities are expected to result from construction activities.

Based on previous NTS occupational radiation records, occupational exposure to radiation is estimated to result in a collective dose to NTS Waste Management Program workers of about 11 person-rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 0.0043 latent cancer fatalities and 0.0017 other detrimental health effects in the worker population.

The risk of accidental exposure increases the latent cancer fatality risk by 0.016 and the detrimental health effect risk by 0.0064. The risk of a single cancer in the worker population as a result of accidental exposure to hazardous chemicals is estimated to be 5.2 x 10^{-7}. The risk of life-threatening noncarcinogenic effects to a single worker from Waste Management Program hazardous chemical accidents has a hazard index of 0.48. A hazard index less than 1.0 indicates that no life-threatening noncarcinogenic health effects would be expected to occur.

The health and safety impact to the public from potential Waste Management Program accidents could result in about 5.1 x 10^{-5} latent cancer fatalities and 2.3 x 10^{-5} other detrimental health effects in the population. Waste Management Program accidents involving hazardous chemicals could result in about 2.0 x 10^{-5} cancers in the population. No noncancer effects from chemical accidents would be expected to occur.

The maximum reasonably foreseeable Waste Management Program radiological accident at the NTS would be an airplane crash into the Area 5 transuranic waste storage unit, which has a probability of occurrence of 6 x 10^{-7} (1 in 1,700,000) per year. The following consequences are estimated if this accident occurs:

- Involved worker: fatally injured in the crash
- Maximally exposed non-involved worker: 3,500 rem (154 rem in first year after exposure), 1.0 chance of latent cancer fatality, 1.0 chance of other detrimental effects

- Non-involved worker population at the nearest major facility area: 99 person-rem, 0.04 chance of a single latent cancer fatality, 0.016 chance of other detrimental effects

- Maximally exposed off-site individual at the nearest point of public access: 3.5 rem, 1.8×10^{-3} chance of latent cancer fatality, 8.0×10^{-4} chance of other detrimental effects

- Population within 80 km (50 mi): 1,400 to 25,000 person-rem, 1 to 13 latent cancer fatalities, 0 to 6 other detrimental effects.

For Waste Management Programs hazardous chemical effects, the maximum reasonably foreseeable accident would be an airplane crash into the Area 5 hazardous waste storage unit, which has a probability of occurrence of 1×10^{-7} (1 in 10,000,000) per year. The following consequences are estimated if this accident occurs:

- Involved worker: fatally injured in the crash

- Maximally exposed non-involved worker: 6.6×10^{-2} chance of cancer, 340 noncancer hazard index for potentially life-threatening one-hour concentration

- Non-involved worker population at the nearest major facility area: 1.1×10^{-3} chance of a single cancer, 0.09 noncancer hazard index for potentially life-threatening one-hour concentration

- Maximally exposed off-site individual at the nearest point of public access: 2.4×10^{-5} chance of cancer, 0.013 noncancer hazard index for potentially life-threatening one-hour concentration

- Population within 80 km (50 mi): 0.027 to 0.10 chance of a single cancer, 0.005 to 0.01 noncancer hazard index for potentially life-threatening one-hour concentration.

The long-term effects of waste disposal operations are being evaluated as a part of the performance assessment process discussed in Appendix A, Section A.2; Chapter 2, Section 2.5.6; and Chapter 4, Section 4.1.5.2. As part of the performance assessment process, scenarios have been developed to evaluate the potential for public exposure to radionuclides from the disposed waste. Considered in these scenarios are the transport of radionuclides by air, surface water, groundwater, and human intrusion pathways. Preliminary results of the Area 5 Radioactive Waste Management Site Performance Assessment (Shott et al., 1995) indicate that the potential risk/exposure from waste disposal activities through the surface water and air pathways is not significant over thousands of years. Based on the results of field studies, the groundwater pathway is not considered a credible transport mechanism. The limiting scenario identified in the Area 5 performance assessment is the intruder scenario. The intruder scenario is postulated to occur thousands of years in the future, when areas previously used for waste disposal would be mined or farmed. The significant exposure results from a person living on the former waste disposal site consuming food and water (assumed to be contaminated) for a lifetime. The results of the very conservative approach to estimating exposure is then used to establish design, operation, closure, and waste acceptance criteria for the waste management facilities. The performance assessment is a continual process that is used to improve the design and operation of DOE waste management facilities.

Environmental Restoration Program. Based on occupational injury and fatality rates for construction and other industrial activities, the Environmental Restoration Program at the NTS is expected to result in 8 injuries to workers during routine program activities and 2.2 injuries as a result of construction activities over the 10-year period evaluated in this EIS. During the same period, 0.027 fatalities are expected from routine activities, and 0.004 fatalities are expected to result from construction activities.

Based on previous NTS occupational radiation records, occupational exposure to radiation is estimated to result in a collective dose to NTS Environmental Restoration Program workers of about 21 person-rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological

Protection (1991), this dose could result in about 0.0085 latent cancer fatalities and 0.0034 other detrimental health effects in the worker population. The risk of a single cancer in the worker population as a result of accidental exposure to hazardous chemicals is estimated to be 2.8 x 10^{-7}. The risk of life-threatening noncarcinogenic effects to a single worker from Environmental Restoration Program hazardous chemical accidents has a hazard index of 0.14.

The health and safety impact to the public from potential Environmental Restoration Program accidents could result in about 2.3 x 10^{-10} latent cancer fatalities and 1.1 x 10^{-10} other detrimental health effects in the population. Environmental Restoration Program accidents involving hazardous chemicals could result in about 1.6 x 10^{-5} cancers in the population. No noncancer effects to the public from chemical accidents would be expected to occur.

The maximum reasonably foreseeable Environmental Restoration Program radiological accident at the NTS would be an airplane crash into the Area 13 site, which has a probability of occurrence of 7 x 10^{-7} (1 in 1,400,000) per year. The following consequences are estimated if this accident occurs:

- Involved worker: fatally injured in the crash
- Maximally exposed non-involved worker: 0.0011 rem, 4.4 x 10^{-7} chance of latent cancer fatality, 1.8 x 10^{-7} chance of other detrimental effects
- Non-involved worker population at the nearest major facility area: 0.0055 person-rem, 2.2 x 10^{-6} chance of a single latent cancer fatality, 8.8 x 10^{-7} chance of other detrimental effects
- Maximally exposed off-site individual at the nearest point of public access: 0.0022 rem, 1.1 x 10^{-6} chance of latent cancer fatality, 5.1 x 10^{-7} chance of other detrimental effects
- Population within 80 km (50 mi): 0.04 to 0.71 person-rem, 2.1 x 10^{-5} to 3.6 x 10^{-4} chance of a single latent cancer fatality, 9.4 x 10^{-6} to 1.6 x 10^{-4} chance of other detrimental effects.

For Environmental Restoration Program hazardous chemical effects, the maximum reasonably foreseeable accident would be an airplane crash into a hypothetical environmental restoration site consisting of a composite of hazardous sites across the NTS, which has a probability of occurrence of 7 x 10^{-7} (1 in 1,400,000) per year. The following consequences are estimated if this accident occurs:

- Involved worker: fatally injured in the crash
- Maximally exposed non-involved worker: 0.008 chance of cancer, 45 noncancer hazard index for potentially life-threatening one-hour concentration
- Non-involved worker population at the nearest major facility area: 9.4 x 10^{-5} chance of a single cancer, 0.0097 noncancer hazard index for potentially life-threatening one-hour concentration
- Maximally exposed off-site individual at the nearest point of public access: 8.5 x 10^{-6} chance of cancer, 9.8 x 10^{-4} noncancer hazard index for potentially life-threatening one-hour concentration
- Population within 80 km (50 mi): 1.5 x 10^{-3} to 3.3 x 10^{-3} chance of a single cancer, 6.1 x 10^{-4} to 6.5 x 10^{-4} noncancer hazard index for potentially life-threatening one-hour concentration.

Nondefense Research and Development Program. Based on occupational injury and fatality rates for construction activities, the Nondefense Research and Development Program at the NTS is expected to result in 1.9 injuries and 0.0033 fatalities to workers during construction activities over the 10-year period evaluated in this EIS. During the same period, no injuries or fatalities are expected to result from routine program activities.

Based on previous NTS occupational radiation records, occupational exposure to radiation is estimated to result in a collective dose to NTS Nondefense Research and Development Program workers of about 8 person-rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 0.0031 latent cancer fatalities and 0.0012 other detrimental health effects in the worker population. No Nondefense Research and Development Program accident resulting in measurable radiological effects at the NTS has been identified.

The risk of a single cancer in the worker population as a result of accidental exposure to hazardous chemicals is estimated to be 3.2 x 10^{-6}. The risk of life-threatening noncarcinogenic effects to a single worker from Nondefense Research and Development hazardous chemical accidents has a hazard index of 0.58.

The health and safety impact to the public from potential Nondefense Research and Development Program accidents could result in about 1.9 x 10^{-4} cancers in the population. No hazardous chemical noncancer effects to the public from chemical accidents would be expected to occur.

For Nondefense Research and Development Program hazardous chemical effects, the maximum reasonably foreseeable accident would be an airplane crash into the tank farm at the Spill Test Facility, which has a probability of occurrence of 1 x 10^{-7} (1 in 10,000,000) per year. The following consequences are estimated if this accident occurs:

- Involved worker: fatally injured in crash
- Maximally exposed non-involved worker: 1.0 chance of cancer, 1,000 noncancer hazard index for potentially life-threatening one-hour concentration
- Non-involved worker population at the nearest major facility area: 0.054 chance of a single cancer, 0.80 noncancer hazard index for potentially life-threatening one-hour concentration
- Maximally exposed off-site individual at the nearest point of public access: 8.8 x 10^{-4} chance of cancer, 0.34 noncancer hazard index for potentially life-threatening one-hour concentration
- Population within 80 km (50 mi): 0 to 3 cancers, 0.01 to 0.19 noncancer hazard index for potentially life-threatening one-hour concentration.

Work for Others Program. Based on occupational injury and fatality rates for construction activities, the Work for Others Program at the NTS is expected to result in 11 injuries and 0.019 fatalities to workers during construction activities over the 10-year period evaluated in this EIS. During the same period, no injuries or fatalities are expected to result from routine program activities.

Based on previous NTS occupational radiation records, occupational exposure to radiation is estimated to result in a collective dose to NTS Work for Others Program workers of about 14 person-rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 0.0055 latent cancer fatalities and 0.0022 other detrimental health effects in the worker population. No Work for Others Program accident resulting in measurable radiological effects at the NTS has been identified. The risk of a single cancer in the worker population as a result of accidental exposure to hazardous chemicals is estimated to be 6.1 x 10^{-8}. The risk of life-threatening noncarcinogenic effects to a single worker from Work for Others Program hazardous chemical accidents has a hazard index of 0.004.

The health and safety impact to the public from potential Work for Others Program accidents could result in about 2.9 x 10^{-7} cancers in the population. No noncancer effects to the public from chemical accidents would be expected to occur.

For Work for Others Program hazardous chemical effects, the maximum reasonably foreseeable accident would be a heavy metal release as a result of an unplanned detonation of a test assembly at the Big Explosives Experimental Facility, which has a probability of occurrence of 1×10^{-2} (1 in 100) per year. The following consequences are estimated if this accident occurs:

- Involved worker: fatally injured in the explosion
- Maximally exposed non-involved worker: 1.8×10^{-4} chance of cancer, 0.044 noncancer hazard index for potentially life-threatening one-hour concentration
- Non-involved worker population at the nearest major facility area: 6.1×10^{-7} chance of a single cancer, 4.0×10^{-6} noncancer hazard index for potentially life-threatening one-hour concentration
- Maximally exposed off-site individual at the nearest point of public access: 1.4×10^{-9} chance of cancer, 1.9×10^{-7} noncancer hazard index for potentially life-threatening one-hour concentration
- Population within 80 km (50 mi): 2.9×10^{-6} to 1.3×10^{-7} chance of a single cancer, 1.9×10^{-7} noncancer hazard index for potentially life-threatening one-hour concentration.

Site-Support Activities. Site-support activities are distributed among the five major program areas. Site-support activities at the NTS are expected to result in 19 injuries and 0.033 fatalities as a result of construction activities during the 10-year period evaluated in this EIS. No injuries or fatalities are projected as a result of routine site-support activities. Occupational exposure to radiation is expected to result in a collective dose to NTS site-support workers of about 115 person-rem in 10 years. This dose could result in about 0.046 latent cancer fatalities and about 0.018 other detrimental health effects in the worker population.

Perceptions of radiation effects are discussed in Section 4.1.11 and are well known among the Western Shoshone, Southern Paiute, and Owens Valley Paiute people of this region. These perceptions of risks from radiation are frightening, and remain an important part of our lives. We will always carry these thoughts with us. Today, people are afraid of many things and places in this whole area, but we still love to come out and see our land. We worry about more radiation being brought to this land.

If the DOE wants to better understand our feelings about the impacts of radiation on our cultures, they should support a study of risks from radiation designed, conducted, and produced by the CGTO. At this time there has not been a systematic study of American Indians' perceptions of risks. Therefore, it is not possible to provide action by action estimation of risk perception impacts. We believe it is a topic that urgently needs to be studied so that Indian people may better address the actual cultural impacts of proposed DOE actions. There have been recent workshops funded by the National Science Foundation to understand how to research the special issue of culturally based risk perception among American Indian communities, and at least one major project has been funded. Although this is a relatively new topic of research, it is one that can be more fully understood by research that deeply involves the people being considered. To understand our view of radiation is to begin to understand why we responded in certain ways to past, present, and why we will continue to respond to future DOE activities.

5.1.1.12 Environmental Justice. Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of federal programs, policies, and activities on minority populations and low-income populations. Analysis of Environmental Justice is based on geographic distribution of low-income and minority populations in Clark, Nye, and Lincoln counties as described in Section 4.1.12.

Environmental Justice analysis involves two tiers of investigation. One is the determination of significant and adverse impacts as a result of the alternative. The other is an evaluation of whether a minority or low-income population is disproportionately affected by these significant and adverse impacts. If there are no significant and adverse impacts, there would be no significant, disproportionately high and adverse impacts experienced by minority and low-income populations.

To determine whether human health effects are adverse and disproportionately high, the following factors were considered:

- Whether the health effects, which may be measured in risks and rates, are significant, unacceptable, and above generally accepted norms. Adverse health effects may include bodily impairment, infirmity, illness, or death
- Whether the risk or rate of exposure by a minority population or low-income population to an environmental hazard is significant and appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population
- Whether health effects occur in a minority population or low-income population affected by total or multiple adverse exposures from environmental hazards.

To determine whether environmental effects are adverse and disproportionately high for low-income and minority communities, the following three factors were considered to the extent practicable:

- Whether there is an impact on the natural or physical environment that significantly and adversely affects a minority community or low-income community
- Whether environmental effects are significant and are having an adverse impact on minority population or low-income populations that appreciably exceeds or is likely to exceed appreciably those in the general population or other appropriate comparison group
- Whether the environmental effects occur in a minority population or low-income population affected by total or multiple adverse exposure from environmental hazards.

To identify the need for ensuring protection of populations with differential patterns of subsistence consumption of fish and wildlife, whenever practicable and appropriate, information of the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence was analyzed. Differential patterns of consumption of natural resources relates to subsistence and differential patterns of subsistence, and means differences in rates and/or patterns of fish, water, vegetation, and/or wildlife consumption among minority populations or low-income populations, as compared to the general population. Subsistence consumption of fish and wildlife means dependence by a minority population or low-income population or subgroup of such populations on indigenous fish, vegetation, and/or wildlife, as the principal portion of its diet (CEQ, 1995). No such populations have been identified in the region of influence.

The CGTO has identified impacts to American Indian groups as a result of Alternative 1. The Yomba Shoshone tribe, the Moapa Paiute tribe, the Las Vegas Paiute tribe, the Pahrump tribe, and the Las Vegas Indian Center are all part of the CGTO and are all located in Clark, Nye, or Lincoln counties. In addition, while not physically located in Clark, Nye, or Lincoln counties, other groups have traditional ties to the NTS and surrounding areas. All American Indian groups in the American Indian region of influence (Figure 4-48) would be equally affected. Figure 4-48 does not imply that groups located closer to the NTS are more concerned about impacts than groups that live farther away. Impacts include continued reduced access to culturally significant areas, the potential for unauthorized artifact collection, and the potential for culturally inappropriate environmental restoration techniques. These impacts would be perceived only by American Indian groups and would, therefore, be a disproportionately high impact on these groups.

No other significant adverse impacts as a result of this alternative were ascertained; therefore, there would be no disproportionately high and adverse impacts to other minority and low-income populations.

The CGTO knows that the actions considered in the NTS EIS potentially will disproportionately affect American Indian people. As discussed in Section 5.1.1.10, Cultural Resources, and Section 5.1.1.11, Occupational and Public Health and Safety, the American Indian impacts include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival especially access violations.

The effects of Alternative 1 on American Indian Environmental Justice issues are discussed below by program.

<u>Defense Program at the NTS</u>—Under Alternative 1, it is expected that all three American Indian Environmental Justice impacts would occur. Holy Land violations occur whenever a portion of traditional land and its resources are taken away from Indian people by contamination or surface disturbance. Perceived risks will occur when more radioactivity is brought to or created at the NTS. Cultural survival impacts will occur if defense activities reduce the present and future access of Indian people and their children to places where cultural transmission occurs. Because these impacts would be perceived only by American Indian people, an Environmental Justice impact would occur.

<u>Waste Management Program at the NTS</u>—Under Alternative 1, it is expected that all three American Indian Environmental Justice impacts would occur. Holy Land violations occur whenever a portion of traditional land and its resources are taken away from Indian people by contamination or surface disturbance. Perceived risks will occur when more radioactivity is brought to or created at the NTS. Cultural survival impacts will occur if waste management activities reduce the present and future access of Indian people and their children to places where cultural transmission occurs. Because these impacts would be perceived only by American Indian people, an Environmental Justice impact would occur.

<u>Environmental Restoration Program at the NTS</u>—Under Alternative 1, it is expected that all three American Indian Environmental Justice issues would occur. Holy Land violations can be reversed when a portion of traditional land and its resources are returned to the Indian people by eliminating contamination and restoring surface disturbance areas with traditional Indian plants and animals. Perceived risks potentially can be reduced when radioactivity is reduced by the physical and spiritual restoration of the NTS. Cultural survival impacts will reverse if environmental restoration activities increase the present and future access of Indian people and their children to places where cultural transmission occurs. Because these impacts would be perceived only by American Indian people, an Environmental Justice impact would occur.

<u>Nondefense Research and Development Program at the NTS</u>—Under Alternative 1, it is expected that all three Environmental Justice impacts would occur. Holy Land violations occur whenever a portion of traditional land and its resources are taken away from Indian people whether this occurs by contamination or use by students and researchers. Perceived risks will not increase unless more radioactivity is brought to or created at the NTS. Cultural survival impacts will occur if research and development activities reduce the present and future access of Indian people and their children to places where cultural transmission occurs. Because these impacts would be perceived only by American Indian people, an Environmental Justice impact would occur.

<u>Work for Others Program at the NTS</u>—Under Alternative 1, it is expected that all three Environmental Justice impacts would occur. Holy Land violations occur whenever a portion of traditional land and its resources are taken away from Indian people by contamination or surface disturbance. Perceived risks will occur when more radioactivity or hazardous waste is brought to or created at the NTS. Cultural survival impacts will occur if military training exercises and weapons tests reduce the present and future access of Indian people and their children to places where cultural transmission occurs. Because these impacts would be perceived only by American Indian people, an Environmental Justice impact would occur.

5.1.2 Tonopah Test Range

Under Alternative 1, the Defense, Environmental Restoration, and Work for Others Programs at the Tonopah Test Range would continue in the same manner and degree as they have within the past three to five years. The activities associated with Alternative 1 are summarized below. A more detailed description of the activities is presented in Appendix A.

Defense Program. Under Alternative 1, Tonopah Test Range activities associated with stockpile stewardship would continue. Impact, passive, and chemical testing would also continue.

Environmental Restoration Program. Environmental Restoration Program activities would continue at current rates.

Work for Others Program. Current Work for Others Program activities would continue at the Tonopah Test Range. Activities include treaty verification, nonproliferation projects, counter-proliferation projects, conventional weapons demilitarization, and defense research and development.

Site-Support Activities. Site-support activities under Alternative 1 would remain at the existing level of approximately 150 personnel. Routine maintenance would continue to be provided to keep existing equipment and utilities functional.

5.1.2.1 Land Use. The DOE land uses under Alternative 1 would continue in the same manner and degree as in the past. This would continue the restriction on all non-federal agency uses. As a consequence, few of the traditional multiple uses for this type of land would be permitted. Undeveloped areas would continue to function as wildlife and wild horse habitat, while the industrial areas would continue in that type of land use. Past aerial bombing and gunnery activities, which have resulted in ordnance contamination of land areas, may have made it impossible to certify that decontamination is complete. The Secretary of the Interior can either accept or decline relinquished lands on the NAFR Complex.

Defense Program. Defense Program activities would continue to take place in already disturbed test beds and training areas. All ordnance or hardware would continue to be recovered following use. No new areas would be altered as a result, and land-use options would remain the same.

Environmental Restoration Program. On the Tonopah Test Range, 3 nuclear device safety test sites and 43 known industrial sites are scheduled for characterization and remediation. Presently, the safety test sites are fenced and completely restricted from use. Remediation of the safety test sites would result in their having a lessened degree of restriction on land uses. Depending on the cleanup level agreed upon between the state of Nevada and the DOE, these sites would be available for a greater unrestricted variety of other land uses. For the industrial sites that are remediated, fewer or no restrictions on alternative land uses would occur, depending on whether closure in place or clean closure is selected as the remediation measure.

Work for Others Program. Work for Others Program activities would continue to take place in already disturbed test beds and training areas. Other, noncompatible uses would be precluded, but no long-term restrictions on future land-use options would result.

5.1.2.1.1 Site-Support Activities—Under Alternative 1, the facilities associated with support functions and services at the Tonopah Test Range would continue to be maintained and used at approximately the current level. Site-support services such as law enforcement and security, fire protection, and health care would continue to operate at existing levels. The water and electrical systems would remain; general maintenance and upgrades would occur as required to ensure safe operations. The wastewater systems would remain in service with only regular maintenance and minor improvements as required to ensure adequate services to the users at the Tonopah Test Range. All solid waste disposal activities would continue to operate at current levels. Hazardous and low-level waste would continue to be transported off site for disposal. Under Alternative 1, the communication systems at the Tonopah Test Range would remain operational and be maintained for all current administrative and testing operations.

5.1.2.1.2 Airspace—It is estimated that there would be an increase of DOE sorties at a rate of 2 percent per year. As a result, the estimated sorties flown by the DOE in 2000 would exceed 18,000 per year.

The effect on civil aviation is keyed primarily to constraints on routes of flights because of defense-related airspace. The Tonopah Test Range is landlocked within the NAFR Complex, and its airspace is controlled by the surrounding airspace restrictions. Civilian aviation flights are generally restricted from crossing the surrounding airspaces, thus occurrences within Tonopah Test Range airspace would have little potential to impact civilian flights. Under Alternative 1, an increase in flying time between some commercial airports would remain. However, under this alternative, the current level of air traffic control and navigational aid services, as well as airspace structure, would be maintained. Activities under Alternative 1 are not expected to cause an increased delay in civilian air traffic. No new impacts to airspace are anticipated from the continuation of current activities.

5.1.2.2 Transportation. The following sections contain the discussion of the environmental impacts related to transportation activities as defined under Alternative 1. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.1.2.2.1 On-Site Traffic—Under Alternative 1, on-site traffic levels would remain at approximately the current levels. Therefore, no impacts to on-site traffic would occur as a result of Defense, Environmental Restoration, or Work for Others Programs. Site-support activities would not result in impacts to on-site traffic under Alternative 1.

5.1.2.2.2 Off-Site Traffic—Under Alternative 1, off-site traffic levels would remain at approximately current levels.

Defense Program. Approximately 50 employees would travel to the Tonopah Test Range to support Defense Program activities under this alternative. The main regional access to the Tonopah Test Range would continue to be U.S. Highway 6, which is currently underused. Given the number of trips associated with the Tonopah Test Range Defense Program, U.S. Highway 6 would still have a level of service A. Therefore, no significant impacts would occur.

Environmental Restoration Program. Under Alternative 1, the Environmental Restoration Program at the Tonopah Test Range would generate only an occasional, and minor, amount of vehicular traffic (less than 100 vehicle trips per day) on the local access roads and on the immediate regional highway (U.S. Highway 6 near Tonopah). Therefore, under Alternative 1, there would be no traffic impacts on off-site roadways.

Work for Others Program. The Work for Others Program is anticipated to generate less than 100 vehicle trips per day on the local access roads and U.S. Highway 6 near Tonopah. The average daily traffic on U.S. Highway 6 is far below capacity at this location. Therefore, there would be no traffic impacts on off-site roadways.

Site-Support Activities. Site-support activities and personnel would not significantly impact off-site roadways.

5.1.2.2.3 Transportation of Materials and Waste—Under Alternative 1, all materials would be delivered to the Tonopah Test Range by commercial carrier, government contractor, government vehicles, or, in the case of special nuclear material, special courier or airlift. The Tonopah Test Range would not be used for disposal of waste. Therefore, all waste would be transported off site for disposal.

Defense Program. Defense Program activities would require the transportation of special nuclear materials and weapons components in safe-secure trailers. Based on the limited testing of components from ground to air at the Tonopah Test Range, the total number of shipments is estimated to be five per year. The average transportation mileage for all safe-secure trailer shipments to the Tonopah Test Range is 24,140 km/yr (15,000 mi/yr).

The DOE evaluated and reported the risks associated with transporting Defense Program materials in a Defense Program transportation risk assessment (see Appendix I). Conclusions from the risk assessment indicated that a transportation accident having serious consequences along many identified routes is estimated to have a probability of less than or equal to one in a million. Under Alternative 1, transportation of materials and waste would remain at the current level. Therefore, no new impacts are anticipated under this alternative.

Environmental Restoration Program. Required remediation levels for contaminated soils located at the Tonopah Test Range are uncertain. As a result, the number of waste shipments to be sent from the Tonopah Test Range to the NTS is uncertain.

Work for Others Program. Under Alternative 1, no significant impacts would occur as a result of the transportation of materials and waste with this program.

Site-Support Activities. Site-support activities would not require the transport of materials and waste. Therefore, no impacts would occur.

5.1.2.2.4 Other Transportation—Approximately half of the workforce at the Tonopah Test Range would continue to be transported to the site by airlift on a daily basis. Equipment and supplies would also continue to be transported to the site by airlift.

5.1.2.3 Socioeconomics. The socioeconomic analysis has been performed for the region of influence of Clark and Nye Counties, regardless of where employees work. Therefore, the place of employment would not change the effects in any of the socioeconomic issues. The analysis for this site is included in Section 5.1.1.3.

American Indian socioeconomic impacts due to fluctuations in DOE employment opportunities for tribal members from the CGTO region of influence are discussed in Section 5.1.1.3.

5.1.2.4 Geology and Soils. The impacts to geology and soils resulting from the three programs and site-support activities are presented in this section.

Defense Program. Defense Program activities at the Tonopah Test Range would have an adverse impact to geologic media by excavation of the surface for installation of infrastructure or test activities. These projects are anticipated to impact 0.9 acres.

Several Defense Program projects have the potential to disturb and contaminate surface and subsurface geologic media. These projects are anticipated to impact approximately 640 acres, with fuel-air explosive operations accounting for greater than 99 percent of the area. Should remediation of contaminated geologic media not be implemented, and assuming that contaminants are long-lived, these media would be considered permanently lost.

Environmental Restoration Program. Environmental Restoration Program activities to restore the 964 acres of contaminated soils would make the surface vulnerable to short-term erosion by water or wind processes. Chemical stabilization and eventual revegetation would reduce erosion potential of disturbed areas.

Work for Others Program. The Work for Others Program activities would result in the same impacts as discussed for the Defense Program.

Site-Support Activities. No impacts from site-support activities would occur under this alternative.

5.1.2.5 Hydrology. The environmental impacts to surface hydrology and groundwater are described in the sections that follow.

5.1.2.5.1 Surface Hydrology—Little surface water is present on the Tonopah Test Range. Surface waters consist of small areas of seepage associated with Cactus Spring, a small sump associated with the Roller Coaster production well, a U.S. Air Force well that provides a small surface water source for wild horses, and ephemeral waters caused by summer convection storms and runoff during wet winters. No surface waters are used for water supplies. The ephemeral waters exist in normally dry washes for short periods of time and on the surfaces of usually dry lakes for periods of days to weeks. Water quality of the ephemeral waters is poor because of naturally high sediment loads and dissolved solids. Activities could have minor effects on drainage patterns and discharge rates due to surface disturbance and altered infiltration rates. Change to sediment loads and dissolved solids due to project activities would be minor in comparison to the natural baselines. No significant change in water quality or quantity is anticipated, and, thus, the impacts are negligible.

Defense Program. Defense Program activities have some potential to impact the surface hydrologic environment at the Tonopah Test Range. The nature of the impact depends on the size and location of the activity.

One potential impact is contamination of the surface hydrologic environment resulting from weapons and burn tests. Some contaminants present in geologic media could be transferred to surface waters and transported downgradient to other soil areas.

Environmental Restoration Program. The restoration areas of the Tonopah Test Range that are contaminated with radionuclides from safety tests of nuclear weapons are all on the valley bottom and, in one case, a playa. Remediation would thus clean the lower and the terminal areas of the drainages. This would remove a source of potential contamination that ephemeral standing waters could pick up. Potential sources of surface water contamination would be removed during industrial site remediation.

Work for Others Program. Under Alternative 1, Work for Others Program activities are similar to Defense Program activities; therefore, the potential impacts to surface hydrology are similar.

Site-Support Activities. Under Alternative 1, site-support activities at the Tonopah Test Range are not expected to significantly impact surface waters.

5.1.2.5.2 Groundwater—Potential impacts to the groundwater from the programs and site-support activities are presented in this section.

Under Alternative 1, the potential impact on the water resources at the Tonopah Test Range include two broad types of effects: reduction in water resource availability and impact on water quality. The DOE routinely withdraws groundwater at the Tonopah Test Range that results in localized impacts, including a lowering of water levels, changes in groundwater flow direction, and reduction in quantity of water available to other users. If large-scale groundwater withdrawals occur, the impacts could increase to include reduction in spring discharge rates, water quality damage, and a reduction in underflow to downgradient areas.

Defense Program. Under Alternative 1, defense-related activities would be similar to those of the past three to five years. Therefore, no additional impacts are anticipated to the groundwater or water resources.

Environmental Restoration Program. Existing groundwater use by the Environmental Restoration Program would continue to be minimal and would be limited to that used for dust control, equipment decontamination, sanitation, and potable water for the workforce. Annual water requirements for characterization are expected to be minimal. Because of the limited demand for water, no significant adverse impacts on groundwater resources are anticipated as the results of Environmental Restoration Program activities at the Tonopah Test Range.

Work for Others Program. Under Alternative 1, adverse impacts to groundwater at the Tonopah Test Range would not occur.

Site-Support Activities. Under Alternative 1, site-support activities at the Tonopah Test Range are not expected to significantly impact the groundwater.

5.1.2.6 Biological Resources. Collectively, approximately 50 acres of undisturbed habitat would be disturbed by DOE or DOE-sponsored organizations under Alternative 1. No projects in Alternative 1 would be large enough that they would likely lower the viability of populations of any species. Therefore, it is unlikely that activities under Alternative 1 would influence biodiversity or ecosystem functions on or around the Tonopah Test Range.

Defense Program. There are 20 projects proposed for this site under this program. Eighteen of these projects involve testing of defense-related materials in previously disturbed areas. The projects are located in disturbed areas, and governing environmental protocols are followed. No biological impacts are likely to arise from these tests. Seismic verification tests would involve disturbance of up to 20 small 0.08-acre areas. Some of these areas may be in undisturbed habitats. No impacts are envisioned for biological resources given the small size of areas to be disturbed and the lack of threatened and endangered species in these areas. The final project, Hazardous Burn Tests, would involve digging four 9-m^2 (100-ft^2) pits, lining them with plastic, and burning defense-related material in the pits. These pits could be in undisturbed habitats. This project would also be performed in compliance with relevant environmental regulations and should have no impact on biological resources.

The Defense Program at the Tonopah Test Range involves a considerable amount of ground and air transportation. It is unlikely that this travel would significantly affect population viability of plants or animals, survival of individuals of threatened or endangered species, or springs and their associated habitats. No new infrastructure development is planned at the Tonopah Test Range for the Defense Program. Hazardous waste (5,614 kg [12,376 lb]) generated from these defense projects would be transported off site for disposal. No biological impacts are likely to occur from the transport of this hazardous material. No radioactive waste would be generated from Defense Program activities.

Environmental Restoration Program. This program would involve the removal and disposal of hazardous and radioactive materials from approximately 50 acres of undisturbed habitat, and the removal and disposal of ordnance scattered across approximately 1,000 acres. Cleanup would include characterization, remediation, and closure of sites. Disturbed sites would be revegetated as necessary. Disposal would involve transport of material to several sites both on and off the NTS.

Removal of ordnance would not result in long-term disturbance of habitat or the mortality of plants or animals. Removal of contaminants would have a beneficial, long-term impact on plant and animal populations found in or near contaminated sites. However, cleanup would also have a negative impact on habitat because areas must be completely or partially cleared of vegetation during this removal process. This impact would be less significant on previously disturbed sites because habitat in these areas was already disturbed before this project began.

This program would not negatively affect population viability because the disturbances are small relative to the geographic range of affected species. Candidate species, such as burrowing owls and some bats and economically or recreationally important species such as doves or waterfowl, might be exposed to drilling mud or surfactants in drill sumps constructed for monitoring wells. This could increase their chances of drowning. Transport of the removed material to approved disposal sites would not likely impact the biological resources because stringent safety protocols are followed.

Work for Others Program. The Work for Others Program activities under Alternative 1 are similar to activities associated with the Defense Program. The level of activity is expected to remain at current levels. Therefore, no impacts to biological resources are anticipated.

Site-Support Activities. No new infrastructure would be developed under Alternative 1. Therefore, no impacts to biological resources resulting from site-support activities are expected under this alternative.

5.1.2.7 Air Quality. The Tonopah Test Range is located in Nevada Intrastate Air Quality Control Region 147. Because there are no significant sources of pollutant emissions in the region, the air quality is good. The Air Quality Control Region is designated as unclassifiable/attainment for all criteria pollutants. Fugitive dust levels generated from construction activities were calculated. Other criteria pollutants were not considered because there are no active sources on the site. In addition, mobile source emissions were not calculated because of the minimal number of mobile sources.

Defense Program. Pollutant emissions would result from rocket artillery firing, as well as missile and explosives operations. These activities would be intermittent and produce only local emissions, which would be dispersed over the relatively large target area. Therefore, air quality impacts at the boundary and off site would be minor.

Environmental Restoration Program. About 80 acres would be disturbed during the Environmental Restoration Program activities. The average annual fugitive dust emission (PM_{10}) from Alternative 1 during Environmental Restoration Program activities would be about 2.4 tons. The total fugitive dust emissions generated from Environmental Restoration projects represents about less than 0.01 percent of the total fugitive dust (PM_{10}) generated in Nye County. Calculations assume that fugitive dust would be reduced by 50 percent as a result of watering the sites. Because activities would occur only on a short-term basis, long-term air quality impacts would not be expected.

Work for Others Program. At the Tonopah Test Range, the Work for Others Program would continue to include fuel air explosives operations. A fuel air explosive device can produce a detonation yield equivalent to several thousand pounds of high explosives. Fugitive dust, as well as gaseous pollutant emissions, would result from each explosives test. Local dust clouds would result, but they would be dispersed on site and would not produce high concentrations of dust off site. Therefore, air quality impacts would be minor.

5.1.2.8 Noise. Impacts to noise as a result of the Defense, Environmental Restoration, and Work for Others Programs are presented in this section. Site-support activities under Alternative 1 are not expected to generate significant noise on site or off site.

Defense Program. Heavy equipment operation during preparation and removal of equipment for mobile testing and construction of permanent testing facilities would result in noise levels of approximately 85 to 90 dBA near the equipment (15 m [50 ft]). The noise levels would decrease to 50 dBA at distances from 878 m to 1,524 m (2,800 ft to 5,000 ft). Periodic, short-term noise would occur as a result of artillery and explosives testing operations. However, the noise levels would decrease with distance. For example, a noise level of 90 dBA at 15 m (50 ft) decreases to 50 dBA at 2 km (1 mi) and to 44 dBA at 3 km (2 mi).

Environmental Restoration Program. Noise impacts would occur during site characterization (e.g., from drilling activities) and remediation (e.g., from large truck movement and heavy equipment operations). Temporary noise impacts from construction-related noise would occur within the immediate vicinity of construction sites. Because activities would only occur on a short-term basis, long-term noise impacts would not be expected.

Work for Others Program. During fuel air explosives operations, instantaneous noise levels at the Tonopah Test Range would be very high. However, these noise levels would be intermittent and would not produce significant impacts.

5.1.2.9 Visual Resources. Under Alternative 1, the only program anticipated to have impacts on visual resources is the Environmental Restoration Program. The other programs do not have ground disturbance associated with their activities.

Some new ground disturbance would occur as a result of Environmental Restoration Program activities, and some previously disturbed sites would also be redisturbed. Potential remediation disturbances area could range from 1 or 2 acres at the artillery site, to approximately 200 acres total for the contaminated soils sites. At some of the previously disturbed areas, vegetation has completely recovered, while others, such as landfills and lagoons, remain bare and debris-laden. Many areas of the contaminated soil sites have never suffered vegetation damage. Others are playa surfaces and are either sparsely vegetated or bare. One area of approximately 10,000 acres may have ordnance contamination and an estimated 10 percent of it would be disturbed by vehicle tracks during remediation. The remaining industrial sites are in developed areas.

The Clean Slates 1, 2, and 3 site areas of disturbance would depend upon the characterization and agreed upon cleanup levels by the DOE and the state of Nevada. Resulting from 90 to 200 acres that would be disturbed, 40 acres of this area presently lie on the playa.

Summarizing, up to 200 acres comprised of increments of 1 or 2 acres up to 120 acres would be disturbed visually. Another area of approximately 10,000 acres would be altered by vehicle trailers through the vegetation. Three sites, each approximately 2 m x 2 m (6 ft x 6 ft), are associated with the Clean Slate 1, 2, and 3 tests. In addition to the Clean Slate sites, there are 43 other environmental restoration sites on the Tonopah Test Range that would disturb approximately 80 acres. The landscape character of the Tonopah Test Range is common to the region and is designated as Class C scenic quality. The affected areas would not be visible from public highways. Impacts to visual resources from Environmental Restoration Program activities would be negligible. There could be beneficial impacts to visual resources once revegetated areas have become established.

5.1.2.10 Cultural Resources. Impacts to cultural resources may occur as a result of ground disturbing activities associated with remediation, military testing, and the construction of utilities. Visitation and vehicular traffic may lead to vandalism or artifact collecting that could result in indirect impacts to cultural resources.

Defense Program. The exact nature and location of various Defense Program activities are not known at this time. These activities are expected to be conducted primarily in areas of previous operations and, thus, involve little or no surface disturbance. Another source of potential impact would be from unauthorized artifact collection by workers or visitors brought to the area by specific projects.

Environmental Restoration Program. This program has identified specific areas for characterization and potential remediation. The exact size and configurations will not be known until an agreement with the state of Nevada is reached regarding cleanup levels, and characterization has defined the boundaries involved. Some of these areas have been previously disturbed in conjunction with pre- and post-safety test activities. Previously disturbed areas will likely have little or no potential for archaeological information. Portions of some contaminated sites might present hazards to personnel that outweigh their archaeological information potential. Cultural resource surveys would not be conducted in previously disturbed areas where information potential has been destroyed and might not be implemented where personnel risk is judged as too high. If cultural resources exist in an area too highly contaminated to survey and conduct data recovery, then these resources may be lost when remediation disturbs the surface. The impact potential would likely be low because the known areas of high contamination are generally in areas of previous disturbance and are not associated with areas of high cultural resource potential.

Another potential source of impact would be from unauthorized artifact collection by workers or site visitors, although this is unlikely because site access to visitors and workers during remediation activities would be restricted.

Work for Others Program. Military research and development, such as small arms, artillery, gun, aircraft, and armored vehicle testing, and airdropped armaments, and development of associated electronic systems, might take place. If the activities occurred in an unanticipated area that had not been surveyed for cultural resources then there might be ground-disturbing impacts to cultural resources.

Site-Support Activities. Existing roadways might be used for transport, but, as part of the environmental restoration program, construction of a new road between the Tonopah Test Range and the NTS, crossing the NAFR Complex, has been proposed. Linear constructions, such as roadways that traverse large areas, would be likely to disturb the physical integrity of the cultural resources. A road would increase access and, consequently, the potential for unauthorized artifact collection. Cultural resources surveys would be performed prior to ground disturbing activities proposed under this program. Avoidance or data recovery would be implemented.

AMERICAN INDIAN CULTURAL RESOURCES—This section describes the American Indian concerns associated with implementing Alternative 1, as summarized by the CTGO.

The CTGO knows that the actions considered in the NTS EIS potentially will affect American Indian cultural resources within an area roughly bounded by where these people live today in their traditional lands (Figure 4-47). The proposed NTS EIS actions will have cultural effects within this region of influence because of the cultural centrality of these lands to all three ethnic groups (Western Shoshone, Owens Valley Paiute, and Southern Paiutes). Within this region of influence, specific actions will have direct local impacts. Ultimately, however, any action that moves the NTS away from or back towards its natural state has influence on all Indian people.

The CTGO recognizes that some of the actions proposed in the NTS EIS will have direct impacts on other Indian tribes and organizations. For example, the Project Shoal Area is located on the traditional lands of Northern Paiute people. The Eldorado Valley actions potentially impact the Mohave people. The return of radioactive waste to the NTS has permitted and potentially will permit people like the Alaskan natives to have their lands restored to a natural state (see Project Chariot Report [DOE/NV, 1994b]). Therefore, the CTGO defines the American Indian Region of Influence Map in an effort to focus on the cultural concerns of those people having traditional ties to the NTS, itself, but in so doing, does not intend to preclude the cultural concerns of other Indian ethnic groups.

Defense Program at the Tonopah Test Range—Under Alternative 1, it is expected that American Indian cultural resources will be adversely impacted if further aboveground nuclear tests occur and if natural lands are scraped for construction.

Waste Management Program at the Tonopah Test Range—Under Alternative 1, it is expected that American Indian cultural resources will not be impacted because there is no Waste Management Program on the Tonopah Test Range and none has been identified for this alternative.

Environmental Restoration Program at the Tonopah Test Range—Under Alternative 1, it is expected that American Indian cultural resources will be adversely impacted if natural lands are scraped during environmental restoration. Access to culturally significant places will be increased if environmental restoration is successful, thus reducing Indian people's perception of health and spiritual risks associated with this area. Indian people wish to be involved in identifying environmental restoration methods and in the evaluation of restoration success.

Nondefense Research and Development Program at the Tonopah Test Range—Under Alternative 1, it is expected that American Indian cultural resources will be adversely impacted if natural lands are scraped during Nondefense Research and Development Program actions. At this time, no actions are planned for the Tonopah Test Range.

Work for Others Program at the Tonopah Test Range—Under Alternative 1, it is expected that American Indian cultural resources will be adversely impacted if the Tonopah Test Range continues to be a place where weapons are researched and developed. These actions have and will continue to pollute these lands. American Indian cultural resources will continue to be adversely impacted by military training exercises and weapons tests.

5.1.2.11 Occupational and Public Health and Safety. The Defense, Environmental Restoration, and Work for Others Programs are the only programs expected to result in health and safety impacts to workers at the Tonopah Test Range. Occupational health and safety impacts may potentially result from industrial safety hazards in the workplace (e.g., injuries or fatalities from construction and maintenance), controlled exposure to radiation or hazardous chemicals in the workplace, and accidental exposures to radiation or hazardous chemicals. Impacts to worker health might take the form of injuries or fatalities from industrial hazards, and cancer fatalities or other detrimental health effects from exposure to radiation or hazardous chemicals. Table 5.1-16 summarizes the occupational and public health and safety

Table 5.1-16. Health risks to workers and the public from program activities, Tonopah Test Range, Alternative 1

Program Area	Worker Health Risks						Public Health Risks			
	Occupational Safety Risks		Occupational Radiation Risks		Occupational Chemical Risks		Public Radiation Risks		Public Chemical Risks	
	Injuries	Fatalities	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers[c]	Chemical Hazard Index[d]	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers[c]	Chemical Hazard Index[d]
Defense	2.5	0.0044	0.0025	0.001	8.4×10^{-12}	1.8×10^{-5}	9×10^{-9}	4.1×10^{-9}	1×10^{-10}	9.6×10^{-7}
Environmental Restoration	0.0049	9.7×10^{-4}	2.4×10^{-4}	1.3×10^{-4}	e	e	1.2×10^{-9}	5.7×10^{-10}	e	e
Total	**2.5**	**0.0054**	**0.0027**	**0.0011**	$\mathbf{8.4 \times 10^{-12}}$	$\mathbf{1.8 \times 10^{-5}}$	$\mathbf{1 \times 10^{-8}}$	$\mathbf{4.7 \times 10^{-9}}$	$\mathbf{1 \times 10^{-10}}$	$\mathbf{9.6 \times 10^{-7}}$

a. Number of radiation-induced latent cancer fatalities in the exposed population associated with the activities conducted over the 10-year period of analysis
b. Number of radiation-induced detrimental health effects (e.g., nonfatal cancers, genetic effects) in the exposed population associated with the activities conducted over the 10-year period of analysis
c. Number of chemical-induced cancers (fatal and nonfatal) in the exposed population associated with the activities conducted over the 10-year period of analysis
d. A hazard index of greater than one indicates that the non-cancer health effects could be life-threatening to individuals exposed for one hour or more
e. No reasonably foreseeable scenarios resulting in exposure to chemically hazardous materials have been identified.

impacts for the applicable Tonopah Test Range program areas under Alternative 1.

The remote location of the Tonopah Test Range insulates impacts to the general public. To impact public health and safety, there must be a pathway or a transport mechanism to transmit the hazard to the public. None of the routine activities conducted at the Tonopah Test Range involves hazards that would impact public health and safety. Section 5.1.2.7, Air Quality, identifies no active sources for airborne release of radioactivity or criteria pollutants. Section 5.1.2.2.3 addresses impacts of transportation of radioactive materials and waste. Accidents associated with activities at the Tonopah Test Range could impact public health and safety and are discussed in this section.

Unless otherwise noted, impacts presented in this section are the total impacts for the 10-year period evaluated in this EIS. Results are presented for the applicable program areas, although some program areas do not involve hazards from radiation or hazardous chemicals.

Defense Program. Based on occupational injury and fatality rates for construction activities, the Defense Program at the Tonopah Test Range is expected to result in 2.5 injuries and 0.0044 fatalities to workers during construction activities over the 10-year period evaluated in this EIS. During the same period, no injuries or fatalities are projected as a result of routine program activities.

Based on previous occupational radiation periods, occupational exposure to radiation is not expected to exceed a collective dose to Defense Program workers of about 6-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 0.0025 latent cancer fatalities and 0.0010 other detrimental health effects in the worker population. The risk of accidental exposure to radioactive or hazardous chemical releases contributes nearly zero increase to worker risk of latent cancer fatality or other detrimental health effects.

The health and safety impact to the public from potential Defense Program accidents at Tonopah Test Range could result in about 9.0×10^{-9} latent cancer fatalities and 4.1×10^{-9} other detrimental health effects in the population. Additional risk due to accidental exposure to hazardous chemicals would be even less.

The maximum reasonably foreseeable Defense Program radiological accident at the Tonopah Test Range would be a failure of an artillery fired test assembly, which has a probability of occurrence of 1×10^{-7} (1 in 10,000,000) per year. The following consequences are estimated if this accident occurs:

- Involved worker: Not applicable; involved workers are under cover when the device is fired
- Maximally exposed non-involved worker: 71 rem, 0.037 chance of latent cancer fatality, 0.023 chance of other detrimental effects
- Non-involved worker population at the nearest major facility area: 7,100 person-rem, 5.7 latent cancer fatalities, 2.3 other detrimental effects
- Maximally exposed off-site individual at the nearest point of public access: 2.3 rem, 0.0012 chance of latent cancer fatality, 5.3×10^{-4} chance of other detrimental effects
- Population within 80 km (50 mi): 18 to 310 person-rem, 0.009 to 0.16 chance of a single latent cancer fatality, 0.004 to 0.071 chance of any other detrimental effects.

For Defense Programs hazardous chemical effects at the Tonopah Test Range, the maximum reasonably foreseeable accident would be an explosion of a rocket test assembly containing depleted uranium and beryllium, which has a probability of occurrence of 6×10^{-6} (1 in 170,000) per year. The following consequences are estimated if this accident occurs:

- Involved worker: fatally injured in the explosion

- Maximally exposed non-involved worker: 1.4×10^{-8} chance of cancer, 0.30 noncancer hazard index for potentially life-threatening one-hour concentration

- Non-involved worker population at the nearest major facility area: 1.4×10^{-7} chance of a single cancer, 0.30 noncancer hazard index for potentially life-threatening one-hour concentration

- Maximally exposed off-site individual at the nearest point of public access: 4.1×10^{-7} chance of cancer, 1.0 noncancer hazard index for potentially life-threatening one-hour concentration

- Population within 80 km (50 mi): 1.7×10^{-6} to 1.1×10^{-7} chance of a single cancer, 0.016 to 0.03 noncancer hazard index for potentially life-threatening one-hour concentration.

Environmental Restoration Program. Based on occupational injury and fatality rates for industrial activities, the Environmental Restoration Program is expected to result in 0.0049 injuries and 0.001 fatalities to workers during routine program activities over the 10-year period evaluated in this EIS. During the same period, no injuries or fatalities are expected to result from construction activities.

Based on previous occupational radiation records, occupational exposure to radiation is estimated to result in a collective dose to Tonopah Test Range Environmental Restoration Program workers of about 0.6-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 2.4×10^{-4} latent cancer fatalities and 9.6×10^{-5} other detrimental health effects in the worker population. The risk of accidental exposure to radioactive releases contributes nearly zero increase to worker risk of latent cancer fatality or other detrimental health effects. No Environmental Restoration Program hazardous chemical accident resulting in measurable effects at the Tonopah Test Range has been identified.

The health and safety impact to the public from potential Environmental Restoration Program accidents at Tonopah Test Range could result in about 1.2×10^{-9} latent cancer fatalities and 5.7×10^{-10} other detrimental health effects in the population.

The maximum reasonably foreseeable Environmental Restoration Program radiological accident at the Tonopah Test Range would be an airplane crash into the Project Roller Coaster site, which has a probability of occurrence of 1×10^{-6} (1 in 1,000,000) per year. The following consequences are estimated if this accident occurs:

- Involved worker: fatally injured in the crash

- Maximally exposed non-involved worker: 0.012 rem, 4.8×10^{-6} chance of latent cancer fatality, 1.9×10^{-6} chance of other detrimental effects

- Non-involved worker population at the nearest major facility area: 1.2 person-rem, 4.8×10^{-4} chance of a single latent cancer fatality, 1.9×10^{-4} chance of any other detrimental effects

- Maximally exposed off-site individual at the nearest point of public access: 0.0034 rem, 1.7×10^{-6} chance of latent cancer fatality, 7.8×10^{-7} chance of other detrimental effects

- Population within 80 km (50 mi): 0.2 to 3.3 person-rem, 9.5×10^{-5} to 1.7×10^{-3} chance of a single latent cancer fatality, 4.4×10^{-5} to 7.6×10^{-4} chance of other detrimental effects.

Work for Others Program. The impacts would be the same as those described for the Defense Program.

5.1.2.12 Environmental Justice. Environmental Justice impacts for the region of influence are discussed in Section 5.1.1.12.

5.1.3 Project Shoal Area

The only program that will occur at the Project Shoal Area is the Environmental Restoration Program. Therefore, environmental restoration is the only program discussed for this site. Under Alternative 1, characterization and remediation activities at the Project Shoal Area would continue.

*5.1.3.1 **Land Use.*** Hazardous waste or other waste generated during environmental restoration actions would be disposed of off site at a permitted waste disposal facility. For the purposes of this evaluation, it has been assumed that radioactive waste would be disposed of at NTS facilities.

Some site characterization activities might have minor impacts on surrounding land use. There might be some impact on the use of restricted airspace or the use of the site by the U.S. Navy for strike rescue training. However, such impacts likely would be of short duration during active site characterization. The nearest population center is the community of Fallon, and it is not likely that any of the Alternative 1 actions would result in significant impacts on surrounding land use at the Project Shoal Area. Remediation activity would have the effect of negating any requirement restricting surface land uses near surface ground zero.

Under Alternative 1, continued site characterization and long-term hydrologic monitoring of the site could result in the disturbance of 10 acres of land. The Project Shoal Area, which is periodically used by the U.S. Navy for military maneuvers, consists of approximately 2,560 acres. The 10 acres identified for Environmental Restoration Program activities would represent less than 0.4 percent of the Project Shoal land area. Conflict between Environmental Restoration Program activities and other land uses would be temporary and negligible.

5.1.3.1.1 Site-Support Activities—Road traffic associated with Environmental Restoration Program actions would result in some short-term increases in road use. Water supplies for drilling and other activities would be trucked from off site, and short-term requirements for power would be met through generators.

5.1.3.1.2 Airspace—Under Alternative 1, the Environmental Restoration Program activities anticipated at the Project Shoal Area would not require direct air access other than for intermittent aerial radiological monitoring. Therefore, there would be minimal effects on airspace at the Project Shoal Area.

*5.1.3.2 **Transportation.*** The following sections address the environmental impacts related to transportation activities as defined under Alternative 1. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.1.3.2.1 On-Site Traffic—Environmental Restoration Program activities would be short-term and would require relatively few personnel (less than 10 people at any given time). No public roads currently exist on the site. Minor vehicular traffic is anticipated; therefore, there would be no traffic impacts.

5.1.3.2.2 Off-Site Traffic—Environmental Restoration Program activities would generate only an occasional and minor amount of vehicular traffic (less than 100 vehicle trips per day) on the local access roads and on the immediate regional highway (U.S. Highway 50). In 1993, the average daily traffic on U.S. Highway 50 near the site amounted to 1,340 vehicles (NDOT, 1993); this traffic volume is far below the capacity of U.S. Highway 50 at this location (capacity ranges from 10,000 to 20,000 vehicles per day). Therefore, there would be no traffic impacts on off-site roadways.

5.1.3.2.3 Transportation of Materials and Waste—The highest risk resulting from environmental restoration activities would be in traffic fatalities and injuries. Both were calculated as less than one (person) being affected.

5.1.3.2.4 Other Transportation—Alternative 1 does not assume direct use of local railroads or other modes of transportation; therefore, direct effects on rail and other modes of transportation would be minimal. Furthermore, the anticipated activities at the site do not call for a measurable transportation demand.

5.1.3.3 Socioeconomics. The socioeconomic analysis has been prepared for the region of influence, regardless of where employees work. Therefore, the place of employment would not change the effects in any of the socioeconomic issues. The analysis for this site is included in Section 5.1.1.3.

5.1.3.4 Geology and Soils. Environmental restoration at the Project Shoal Area site would consist of locating and characterizing the mud pit by collecting shallow soil samples from the pit for chemical and radiological analysis, reentering wells that were drilled during the original activities on the site to convert them into groundwater monitoring wells, and monitoring the groundwater to detect any contaminant migration that might occur. Because these wells already exist and drill pads have been prepared, this work would not affect additional geologic media. The only preparation that is expected is clearing of the vegetation around the abandoned wells. The disturbed areas did not cause excessive erosion. They have revegetated naturally, so it is not expected that they would pose an erosional problem for the future.

No known geologic resources (aggregates, clay, coal, minerals, or fossils) would be adversely impacted at the Project Shoal Area from Alternative 1 activities. The site is not located on or near any known or exploitable mineral resources, fossil beds, unique geologic outcrops, or other unique geologic features. The closest mine is an intermittently operated gold mine located approximately 8 km (5 mi) north of the site, but this is not close enough to be affected by any activities that have been or would be conducted on the site under this alternative.

5.1.3.5 Hydrology. The environmental impacts to surface hydrology and groundwater are described in the sections that follow. Discussions of impacts to water quality and water quantity are also presented.

5.1.3.5.1 Surface Hydrology—The impact of Environmental Restoration Program actions on the quality of surface water resources of the Project Shoal Area is not expected to be significant. Road building associated with well drilling might disturb small areas of soils. However, because of the very limited nature of surface water resources at the Project Shoal Area, the impact on surface water flows is expected to be minimal.

The soil-disturbing actions might result in slight increases in sediment yield and some inorganic compounds in the surface water. Given the limited amount of soil disturbance and the scant surface water resources, no significant adverse impacts on surface water quality are anticipated.

5.1.3.5.2 Groundwater—Planned groundwater use by the Environmental Restoration Program at the Project Shoal Area would be minimal and would be limited to that used in the drilling and testing of characterization wells, decontamination of sampling materials, and purging of wells prior to sampling. Annual water requirements for characterization have not been well defined, but are expected to be minimal. Because of the low demand for water, no significant impacts on water resource availability are anticipated. Similarly, because of the limited nature of Environmental Restoration Program activities, no significant adverse impacts on groundwater quality are anticipated.

5.1.3.6 Biological Resources. The only activities planned for this site consist of continued hydrological monitoring at existing wells. In addition, more wells might be drilled at this site, which may result in minor land disturbance. All 10 acres to be disturbed during environmental restoration have been disturbed previously; therefore, there are no likely biological impacts on habitat, population viability of plants or animals, threatened or endangered species, or regionally rare habitats (EG&G/EM, 1993).

5.1.3.7 Air Quality. The Project Shoal Area is located in Nevada Intrastate Air Quality Control Region 147. There are no air quality monitoring stations in the region. Because there are no significant sources of pollutant emissions in the region, the air quality is good. The Air Quality Control Region is designated as unclassifiable/attainment for all pollutants. The quantity of fugitive dust that could be generated from the construction activities was calculated. Other criteria pollutants were not considered because there are no active sources on the site. In addition, mobile source emissions were not calculated because of the minimal number of mobile sources. Emissions from the operation of naval aircraft over the Project Shoal Area would have little impact on surface ambient pollutant concentrations. Studies have shown that resulting concentrations would be about 0.05 percent of the allowable concentration (SAIC/DRI, 1991).

Under the Environmental Restoration Program, about 10 acres of land would be disturbed. The average annual fugitive dust emission (PM_{10}) from Alternative 1 drilling activity would be about 3 tons. Calculations assume that fugitive dust would be reduced by 50 percent as a result of watering the sites. Calculations assume activities are only expected to occur on a short-term basis; therefore, long-term air-quality impacts are not expected.

5.1.3.8 Noise. Most of the noise at the Project Shoal Area would be generated during well drilling operations associated with the Environmental Restoration Program. All drilling operations occur on site, and there are no sensitive noise receptors. Noise impacts associated with increased traffic on access routes were not analyzed because the increase in traffic volume would be negligible.

Noise impacts would occur during site characterization (e.g., drilling) and remediation (e.g., large truck movement and front-end loaders). Temporary impacts resulting from construction-related noise would occur within the immediate vicinity of construction sites. Noise impacts from construction activities in the Project Shoal Area would be negligible because the closest private residence is 8 km (5 mi) west of the Project Shoal Area. Potential construction-related noise levels of 80 to 85 dBA at 15 m (50 ft) from the sources within the Project Shoal Area construction would be reduced to 30 dBA at 8 km (5 mi), which would be lower than ambient noise levels. Activities would only occur on a short-term basis; therefore, long-term noise impacts would not be expected.

5.1.3.9 Visual Resources. The scenic quality for the Project Shoal Area has been designated Class C, and the sensitivity level is low. The Project Shoal Area is approximately 2,560 acres; the affected area (10 acres) would represent less than 0.4 percent of the total area. Impacts from Environmental Restoration Program activities to visual resources would be negligible. Depending on pertinent reclamation factors, disturbed areas could be revegatated after cleanup has been completed. There would be some beneficial impacts to visual resources once revegated areas become established.

5.1.3.10 Cultural Resources. Ground-disturbing activities associated with remediation may effect the physical integrity of cultural resources. Indirect impacts to cultural resources might result from increased visitation and vehicular traffic in archaeologically sensitive areas.

<u>*AMERICAN INDIAN CULTURAL RESOURCES*</u>—*This study area is not within the traditional lands of the Indian people represented by the CTGO. It is recommended by the CTGO that the DOE EIS team directly contact Indian tribes and organizations having traditional lands in the Project Shoal Area. The following tribes were suggested: Fallon Paiute, Walker River Paiute, and Pyramid Lake and Lovelock Paiute Tribes.*

NOTE: The Fallon Paiute, Walker River Paiute, and Lovelock Paiute Tribes were contacted by the DOE in letters dated May 12, 1995.

5.1.3.11 Occupational and Public Health and Safety. The Environmental Restoration Program is the only active program expected to result in health and safety impacts to workers at the Project Shoal Area. No contamination has been detected in surficial soils at this site, and no surface soil remedial actions are proposed. Activities at this site would consist of characterization and hydrologic monitoring. Impacts to worker health might take the form of injuries or fatalities from industrial hazards and cancer fatalities or other detrimental health effects from exposure to radiation or hazardous chemicals.

Table 5.1-17 summarizes the occupational and public health and safety impacts for Environmental Restoration Program activities under Alternative 1.

Table 5.1-17. Health risks to workers and the public from program activities, Project Shoal Area, Alternative 1

Program Area	Worker Health Risks						Public Health Risks			
	Occupational Safety Risks		Occupational Radiation Risks		Occupational Chemical Risks		Public Radiation Risks		Public Chemical Risks	
	Injuries	Fatalities	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers	Chemical Hazard Index	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers	Chemical Hazard Index
Environmental Restoration	1.6×10^{-4}	3.1×10^{-5}	1.7×10^{-5}	9×10^{-6}	c	c	d	d	c	c
Total	**1.6×10^{-4}**	**3.1×10^{-5}**	**1.7×10^{-5}**	**9×10^{-6}**	**c**	**c**	**d**	**d**	**c**	**c**

a. Number of radiation-induced latent cancer fatalities in the exposed population associated with the activities conducted over the 10-year period of analysis
b. Number of radiation-induced detrimental health effects (e.g., nonfatal cancers, genetic effects) in the exposed population associated with the activities conducted over the 10-year period of analysis
c. No reasonably foreseeable scenarios resulting in exposure to chemically hazardous materials have been identified
d. No reasonably foreseeable scenarios resulting in exposure to radiation have been identified.

Because of the remote location of the Project Shoal Area and the nature of planned Environmental Restoration Program activities, no impacts to public health and safety are reasonably foreseeable from either routine activities or accidents. Radioactive contamination is known to exist in the subsurface as a result of past underground nuclear weapons testing. Potential impacts to public health and safety from subsurface contamination of groundwater are discussed in this section.

Environmental Restoration Program. Based on occupational injury and fatality rates for industrial activities, Environmental Restoration Program activities at the Project Shoal Area are expected to result in 1.6×10^{-4} injuries and 3.1×10^{5} fatalities to workers during routine program activities over the 10-year period evaluated in this EIS. During the same period, no injuries or fatalities are expected because of construction activities.

Based on previous occupational radiation records, occupational exposure to radiation is estimated to result in a collective dose to Project Shoal Area Environmental Restoration Program workers of about 0.04 person-rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 1.7×10^{-5} latent cancer fatalities and 6.8×10^{-6} other detrimental health effects in the worker population. No Environmental Restoration Program accidents resulting in measurable radiological or chemically hazardous effects at the Project Shoal Area have been identified.

Subsurface radioactivity from past underground nuclear weapons testing at the Project Shoal Area could provide an exposure pathway for the general public. Transport modeling of tritium-contaminated groundwater at the Project Shoal Area was performed in support of this EIS (Chapman et al., 1995). The modeling results showed that peak tritium concentrations in groundwater could vary from nondetectable to about 20,000 pCi/L (depending on uncertainties in modeling parameters) at the nearest existing public wells. For comparison, EPA's maximum allowable tritium concentration in drinking water is 20,000 pCi/L. At the eastern boundary of the Project Shoal Area, where no well currently exists, peak tritium concentrations could be between 280 pCi/L, arriving 200 years after the test, and 720,000 pCi/L, arriving about 70 years after the test.

Health effects to the public from Project Shoal subsurface radioactivity estimated by Chapman et al. (1995) were based on future predictions of tritium concentrations in well water and on the assumption that a public well could be installed at the boundary of the Project Shoal Area. These impacts are not expected to occur within the 10-year timeframe evaluated in this EIS. The public exposure scenarios assume that a hypothetical individual would consume contaminated well water for 70 years centered around the time of peak tritium concentration in well water. At the eastern boundary of the Project Shoal Area, the maximally exposed public individual is estimated to have a lifetime probability of contracting a fatal cancer between 2×10^{-10} (about one in five billion) and 2×10^{-3} (about one in 500). At the nearest existing public well, a hypothetical maximally exposed individual is estimated to have a lifetime probability of contracting fatal cancer between 4×10^{-24} (essentially zero) and 2×10^{-7} (about one in five million).

5.1.3.12 Environmental Justice. Environmental Justice impacts for the region of influence are discussed in Section 5.1.1.12.

5.1.4 Central Nevada Test Area

The only program that would occur at the Central Nevada Test Area is the Environmental Restoration Program. Therefore, this program is the only one discussed for this site. Characterization and remediation activities at the Central Nevada Test Area would continue.

5.1.4.1 Land Use. Present use of the site is primarily for grazing, wildlife habitat, hunting, and scattered outdoor recreation. The DOE continues long-term monitoring and characterization and would complete needed remediation under this alternative. Sites that might require work include sewage lagoons, trash dumps, four emplacement holes, an uncovered hole, a runoff ditch, and drilling mud pits. Approximately 44 acres would be disturbed by characterization and remediation at the three industrial sites. This would comprise less than 2 percent of the total site, which totals approximately 2,470 acres.

Wastes generated during Environmental Restoration Program activities would be disposed of at off-site permitted disposal facilities. For the purpose of this evaluation, it has been assumed that all radioactive wastes would be disposed of at NTS facilities. Closure in place would be an option evaluated for some sites.

Remediation would permit fewer to no restrictions on surface land uses. Closure in place would result in restricted surface use of the closure to protect the cap. The opportunity for a variety of land-use options would be improved under Alternative 1.

Surrounding land uses are similar to the site land uses with grazing, wildlife habitat, hunting, recreation, public land ranching, and widely scattered private ranch lands but there are no nearby population centers in the region. Environmental Restoration Program activities would have no effect on surrounding land uses.

5.1.4.1.1 Site-Support Activities—Road traffic associated with Environmental Restoration Program activities would result in some short-term increases in road use. Water supplies for drilling and other activities would be trucked from off site, and short-term requirements for power would be met through generators.

5.1.4.1.2 Airspace—There would be no effect on airspace at the Central Nevada Test Area as a result of Alternative 1 Environmental Restoration Program activities.

5.1.4.2 Transportation. The following sections contain the discussion of the environmental impacts related to transportation activities as defined under Alternative 1. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.1.4.2.1 On-Site Traffic—The site is accessed by U.S. Highway 6, and there are no public access roads on site. Traffic generated by Environmental Restoration Program activities would be minimal and not significant.

5.1.4.2.2 Off-Site Traffic—Environmental Restoration Program activities would generate only an occasional and minor amount of vehicular traffic (less than 100 vehicle trips per day). Traffic volume is far below the capacity of U.S. Highway 6 at this location (capacity ranges from 10,000 to 20,000 vehicles per day). Therefore, under Alternative 1, there would be minor vehicular traffic generated. If remediation waste is removed from the site, then traffic on on-site roads would increase, but would be well within their capacity.

5.1.4.2.3 Transportation of Materials and Waste—The highest risk from Environmental Restoration Program activities would be in traffic fatalities and injuries. Both were calculated to be less than one person being affected.

5.1.4.2.4 Other Transportation—Alternative 1 activities do not include direct use of local railroads, air transportation, or other modes of transportation to this site; therefore, direct effects on rail, air, and other modes of transportation would be minimal.

5.1.4.3 Socioeconomics. The socioeconomic analysis has been prepared for the region of influence, regardless of where employees work; therefore, the place of employment would not change the effects in any of the socioeconomic issues. The analysis for this site is included in Section 5.1.1.3.

American Indian socioeconomic impacts due to fluctuations in DOE employment opportunities for tribal members from the CGTO region of influence are discussed in Section 5.1.1.3.

5.1.4.4 Geology and Soils. Environmental Restoration Program activities at the Central Nevada Test Area would consist of characterizing the mud pits at each of the three emplacement holes and remediating them if needed, cleaning up the debris that has been left on the sites, and monitoring the groundwater to detect any contaminant migration that might occur.

No known geologic resources (aggregates, clay, coal, minerals, or fossils) would be adversely impacted at the Central Nevada Test Area from Alternative 1 activities. The site is not located on or near any known or exploitable mineral resources, fossil beds, unique geologic outcrops, or other unique geologic features.

5.1.4.5 ***Hydrology.*** Environmental impacts to surface hydrology and groundwater are described in the sections that follow.

5.1.4.5.1 ***Surface Hydrology***—The impact of Environmental Restoration Program actions on the quantity of surface water resources of the Central Nevada Test Area is not expected to be significant. Road building associated with well drilling might disturb small areas of soils. However, because of the very limited nature of surface water resources at the Central Nevada Test Area, the impact on surface-water flows is expected to be minimal.

The soil-disturbing actions might result in slight increases in sediment yield and some inorganic compounds in the surface water. Given the limited amount of soil disturbance and the scant surface water resources, no significant adverse impacts on surface water quality are anticipated.

5.1.4.5.2 ***Groundwater***—Planned groundwater use by Environmental Restoration Program activities at the Central Nevada Test Area would be limited to that used in the drilling and testing of characterization wells, decontamination of sampling materials, and purging of wells prior to sampling. Annual water requirements for characterization are expected to be minimal. Because of the low demand for water, no significant impacts on water resources availability are anticipated. Similarly, because of the limited nature of Environmental Restoration Program activities, no significant adverse impacts on groundwater quality are anticipated.

5.1.4.6 ***Biological Resources.*** Remediation would likely include the removal of drill pond mud, sewage lagoons, and the transfer of hazardous materials to appropriate disposal sites. Transport of the removed material to approved disposal sites is not likely to impact biological resources because of the stringent safety protocols in place (Appendix I). About 44 acres would be disturbed by Environmental Restoration Program activities. Some of this land has been disturbed previously. Removal of contaminants would have a beneficial, long-term impact on plants and animal populations found on or near the contaminated sites. However, it would also have a negative impact on habitat because areas must be completely or partially cleared of vegetation during this removal process. This program would not negatively affect population viability. Disturbances do not occur where candidate plant species are likely to occur. Candidate species, such as State protected birds and some bats; and economically or recreationally important species, like doves or waterfowl, might be exposed to drilling mud or surfactant in drill sumps constructed for monitoring wells. This could increase their chances of drowning. No threatened or endangered species would likely be affected by these activities.

5.1.4.7 ***Air Quality.*** Ambient air quality has not been monitored for criteria pollutants at the Central Nevada Test Area. However, because the area lacks significant pollution emission sources, the air quality is good. The amount of fugitive dust generated from the construction activities was calculated. Other criteria pollutants were not considered because there are no active sources on the site. In addition, mobile source emissions were not calculated because of the minimal number of mobile sources.

A total of 44 acres of land would be disturbed at the Central Nevada Test Area during environmental restoration activities. The average annual fugitive dust emissions (PM_{10}) from Alternative 1 construction activities would be about 13.2 tons. Fugitive dust emissions assume a 50-percent reduction as a result of watering the construction sites. Air quality impacts would occur during site characterization and remediation (e.g., large truck movement and front-end loaders). Activities are only expected to occur on a short-term basis; therefore, long-term air quality impacts are not expected.

5.1.4.8 ***Noise.*** Noise impacts would occur during site characterization and remediation (e.g., large truck movement and front-end loaders). Temporary impacts resulting from construction-related noise would occur within the immediate vicinity of the construction sites. Noise impacts from construction activities in the Central Nevada Test Area would be negligible because there are no sensitive receptors. Potential construction-related noise levels of 80 dBA to 85 dBA at 15 m (50 ft) from the sources within the Central Nevada Test Area construction would be reduced as the distance increases. Activities are only expected to occur on a short-term basis; therefore, long-term noise impacts are not expected.

5.1.4.9 ***Visual Resources.*** The scenic quality for the Central Nevada Test Area has been designated Class B, and the sensitivity level is low. The affected areas would be revegetated after cleanup has been completed. The Central Nevada Test Area is approximately 2,470 acres; the affected areas (44 acres) would represent less than 2 percent of the total area. Impacts to visual resources from Environmental Restoration Program activities would be negligible. Depending on pertinent reclamation facts, disturbed areas would be revegatated after cleanup has been completed. Beneficial impacts would occur when vegetation becomes established.

5.1.4.10 Cultural Resources. The exact location of all characterization and remediation activities is not known at this time. These activities are expected to be conducted largely in areas of previous operations and thus involve minor new surface disturbance. Other potential sources of impact would be from unauthorized artifact collection by workers or site visitors, although this is unlikely because of the tight control of visitors and workers at a remediation site.

<u>AMERICAN INDIAN CULTURAL RESOURCES</u>— This section describes the American Indian concerns associated with implementing Alternative 1, as summarized by the CTGO.

This study area is not within the traditional lands of the American Indian people represented by the CGTO. It is recommended by the CGTO that the DOE EIS team directly contact Indian tribes and organizations having traditional lands in the Central Nevada Test Area. The following tribes were suggested: Fallon, Paiute, Walker River Paiute, and Pyramid Lake and Lovelock Paiute tribes.

<u>Defense Program</u>—Under Alternative 1, it is expected that American Indian cultural resources will be adversely impacted if further nuclear tests occur and if natural lands are scraped for construction. In this alternative, however, there are no plans for additional tests or construction at the Central Nevada Test Area.

<u>Waste Management Program</u>—Under Alternative 1, it is expected that American Indian cultural resources will not be impacted because there is no Waste Management Program on the Central Nevada Test Area and none has been identified for this alternative.

<u>Environmental Restoration Program</u>—Under Alternative 1, it is expected that American Indian cultural resources on the Central Nevada Test Area will be adversely impacted if natural lands are scraped during environmental restoration. Access to culturally significant places will be increased if environmental restoration is successful, thus reducing Indian peoples' perception of health and spiritual risks associated with this area. Indian people wish to be involved in identifying environmental restoration methods and in the evaluation of restoration success.

<u>Nondefense Research and Development Program</u>— Under Alternative 1, it is expected that American Indian cultural resources will be adversely impacted if the Central Nevada Test Area becomes a place where weapons are researched and developed. No such actions are planned for this alternative, so American Indian cultural resources will not be adversely impacted.

<u>Work for Others Program</u>—Under Alternative 1, it is expected that American Indian cultural resources will be adversely impacted if the Central Nevada Test Area becomes a place where weapons are researched and developed. No such actions are considered in this alternative, so American Indian cultural resources will not be adversely impacted.

5.1.4.11 Occupational and Public Health and Safety. The Environmental Restoration Program is the only active program expected to result in health and safety impacts to workers at the Central Nevada Test Area. Activities at this site would consist of site characterization and remediation with removal of contaminated mud and sludge. Impacts to worker health might take the form of injuries or fatalities from industrial hazards and cancer fatalities or other detrimental health effects from exposure to radiation or hazardous chemicals. Table 5.1-18 summarizes the occupational and public health and safety impacts for Environmental Restoration Program activities under Alternative 1.

Because of the remote location of the Central Nevada Test Area and the nature of planned Environmental Restoration Program activities, no impacts to public health and safety are reasonably foreseeable from either routine activities or accidents. Radioactive contamination is known to exist in the subsurface as a result of past underground nuclear weapons testing. Potential impacts to public health and safety from subsurface contamination of groundwater are discussed in this section.

Environmental Restoration Program. Based on occupational injury and fatality rates for industrial activities, Environmental Restoration Program activities at the Central Nevada Test Area are expected to result in 1.6×10^{-4} injuries and 3.1×10^{-5} fatalities to workers during routine program activities over the 10-year period evaluated in this EIS. During the same period, no injuries or fatalities are expected because of construction activities.

Based on previous occupational radiation records, occupational exposure to radiation is estimated to result in a collective dose to Central Nevada Test Area environmental restoration workers of about 0.04-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 1.7×10^{-5} latent cancer fatalities and 6.8×10^{-6} other detrimental health effects in the worker population. No Environmental Restoration Program accidents resulting in measurable radiological or chemically hazardous effects at the Central Nevada Test Area have been identified.

Subsurface radioactivity from past underground nuclear weapons testing at the Central Nevada Test Area potentially provides an exposure pathway for the general public. Transport modeling of tritium-contaminated groundwater at the Central Nevada Test Area was performed in support of this EIS (Pohlmann et al., 1995). The modeling results show that tritium concentrations in groundwater are never expected to reach concentrations that are detectable (about 1 pCi/L) at any existing public wells. For comparison, the EPA's maximum allowable tritium concentration in drinking water is 20,000 pCi/L. At the southern boundary of the Central Nevada Test Area, where no wells currently exist, tritium concentrations are predicted to have reached a peak of 1.23×10^8 pCi/L about 8 to 15 years after the test (between 1976 and 1983).

Health effects impacts to the public from the Central Nevada Test Area subsurface radioactivity have been estimated by Pohlmann et al. (1995) based on predictions of future tritium concentrations in well water and on the assumption that a public well could be installed at the southern boundary of the Central Nevada Test Area. The public exposure scenarios assume that a hypothetical individual would consume contaminated well water for 70 years centered around the time of peak tritium concentration in well water. At the existing public well nearest to the Central Nevada Test Area, the peak tritium concentration does not reach the well until about 117 years after the test date (about the year 2085). The maximally exposed public individual is estimated to have a lifetime probability of contracting a fatal cancer between 1.7×10^{-24} (essentially zero) and 3.2×10^{-10} (about one in three billion). If a public well were to be drilled at a location near the southern boundary of the Central Nevada Test Area, with a peak tritium concentration of about 1.2×10^8 pCi/L, Pohlmann et al. (1995) estimated that the maximally exposed public individual would have a lifetime probability of contracting a fatal cancer between 1.4×10^{-5} (about one in 70,000) and 5.5×10^{-3} (about one in 200). However, by the year 1996, radioactive decay would result in a 50-percent reduction of the peak

Table 5.1-18. Health risks to workers and the public from program activities, Central Nevada Test Area, Alternative 1

Program Area	Worker Health Risks						Public Health Risks			
	Occupational Safety Risks		Occupational Radiation Risks		Occupational Chemical Risks		Public Radiation Risks		Public Chemical Risks	
	Injuries	Fatalities	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers	Chemical Hazard Index	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers	Chemical Hazard Index
Environmental Restoration	1.6×10^{-4}	3.1×10^{-5}	1.7×10^{-5}	9×10^{-6}	c	c	d	d	c	c
Total	$\mathbf{1.6 \times 10^{-4}}$	$\mathbf{3.1 \times 10^{-5}}$	$\mathbf{1.7 \times 10^{-5}}$	$\mathbf{9 \times 10^{-6}}$	**c**	**c**	**d**	**d**	**c**	**c**

a. Number of radiation-induced latent cancer fatalities in the exposed population associated with the activities conducted over the 10-year period of analysis
b. Number of radiation-induced detrimental health effects (e.g., nonfatal cancers, genetic effects) in the exposed population associated with the activities conducted over the 10-year period of analysis
c. No reasonably foreseeable scenarios resulting in exposure to chemically hazardous materials have been identified
d. No reasonably foreseeable scenarios resulting in exposure to radiation have been identified.

concentration, and additional reduction would result from diffusion in the aquifer. Groundwater sampling and analysis results near the southern boundary of the Central Nevada Test Area have not confirmed these predicted tritium concentrations.

5.1.4.12 Environmental Justice. The Environmental Justice impacts for the region of influence are discussed in Section 5.1.1.12.

5.2 Alternative 2 - Discontinue Operations

Alternative 2, Discontinue Operations, is defined as the discontinuation of DOE/NV and interagency programs and operations at the NTS, the Tonopah Test Range, the Project Shoal Area, and the Central Nevada Test Area. Only those environmental monitoring and security functions necessary for human health and security would be maintained. The DOE would maintain control of the NTS and the Tonopah Test Range, but no activities would take place. All facilities, after operations have ceased, would be placed in cold standby.

Defense Program. Defense Program operations would not be maintained in a state of readiness for nuclear testing, and there would be an overall discontinuation of DOE/NV defense-related activities at the NTS and the Tonopah Test Range.

Waste Management Program. The DOE would maintain only a minimum low-level and mixed waste disposal capability until NTS waste-generating activities completely shut down. After shutdown, on-site monitoring and security functions would be reduced and become part of the sitewide monitoring activity. Transuranic and transuranic mixed waste would be shipped to other DOE facilities for certification, handling, and disposal.

Environmental Restoration Program. All DOE/NV Environmental Restoration Program activities would cease.

Nondefense Research and Development Program. The DOE/NV would discontinue support of ongoing program operations.

Work for Others Program. The DOE/NV would not host projects and activities of other federal agencies. This would include a discontinuation of the use of the NTS airspace and certain lands by the DoD for various training exercises and defense-related research and development projects. However, the DOE would be required to provide for overflights and inspection of the NTS in accordance with international arms control treaties, such as the Open Skies Treaty.

5.2.1 Nevada Test Site

The impacts associated with the discontinuation of Defense, Waste Management, Environmental Restoration, Nondefense Research and Development, and Work for Others Programs are presented in this section. The impacts associated with site-support activities are also presented.

5.2.1.1 Land Use. Alternative 2 would result in no new ground disturbance. No activities would occur for the Defense, Waste Management, Environmental Restoration, Nondefense Research and Development, and Work for Others Programs. Therefore, no impacts to land use would occur. No impacts to surrounding land use have been identified under this alternative.

5.2.1.1.1 Site-Support Activities—The site-support activities at the NTS would be almost entirely discontinued. Only minimal resources would be provided for those monitoring and security functions that would continue at the NTS. A minimal number of facilities would be maintained to support security and monitoring activities and personnel. Services would be effectively eliminated with the exception of minimal security services.

<u>UTILITIES</u>—Electrical, water, and wastewater systems under Alternative 2 would be limited primarily to Mercury. Mercury would be the central location for the security and monitoring personnel who would continue to perform duties at the NTS. The main 34.5-kilovolt (kV) powerline extending into the Yucca Flat area of the NTS would be maintained to provide power for monitoring equipment and services to the north.

The main components of power would remain largely as they exist under Alternative 1. Most of the 427 km (265 mi) of primary and secondary power supply lines on the NTS would remain in place and would be used to power monitoring equipment, security stations, and a few administrative offices.

Most of the water supply lines would be abandoned and either left in place or removed and salvaged; however, water in this system must maintain a constant flow to prevent freezing in extreme temperatures. Water wells would be capped except for those that can be used for monitoring purposes. Water storage sumps and tanks would be drained and removed or filled in and graded over.

The NTS sewage-handling systems would be shut down and remediated. Sewage would be handled locally with septic tanks and leachfields. The number of personnel and the sewage generated in any single location would be too small to support the use of sewage lagoons as they currently exist.

COMMUNICATIONS—The telephone and radio portions of the communication system would be maintained to the extent necessary to support monitoring and security personnel on the NTS. The primary telephone communication link between Las Vegas and the NTS would remain. Radio communications would be the least affected on-site communication under this alternative. Radio communications would be required over much of the NTS to maintain contact capabilities for security personnel.

- Mobile radio communications would be reduced from around 30 nets to approximately 2 nets, and the digital microwave system would be reduced from 3 units to 1 unit. Central monitoring of NTS radio nets would be limited, but would be maintained at Station 900. The station would continue to function as an emergency reporting point for radio and telephone communications. The public safety network would be eliminated because of the lack of need for off-site DOE locations.

- Only minimal telephone communications would be maintained for communication to the Las Vegas area. Because the cost of maintenance would be so high, the functions provided by the DOE/NV central hub and switching network would be turned over to the local commercial telephone system. The Octel Maximum Voice Mail System would be eliminated.

- All video capabilities would be eliminated. Data communications capabilities would be removed except for the portion of the system that would be needed for monitoring purposes.

- There would be no NTS mail systems. The U.S. Post Office in Mercury would shut down.

5.2.1.1.2 Airspace—Under Alternative 2, the only activities that would affect airspace would be defense related; therefore, only Defense and Work for Others Programs are discussed. Occasional flights of helicopter and fixed-wing aircraft carrying supplies and personnel are anticipated, but these flights would not cause significant increases in air traffic.

Defense Program. The overall discontinuation of Defense Program activities would result in fewer traffic operations within NTS airspace relative to the baseline and a possible decrease of congestion in the overlapping airspace. Therefore, there would be no airspace or air traffic impacts from Defense Program activities.

Work for Others Program. With the Work for Others Program, there would be a discontinuation of the use of the NTS airspace by the DoD for various training exercises and defense-related research and development projects. No commercial air passenger, general aviation, or air-cargo activities would occur except for emergency operations or occasional aircraft operations carrying supplies and personnel.

Airspace restrictions under Alternative 2 would be the same as those currently in effect with the Nellis Air Traffic Control Facility. The overflights and inspections required for compliance with international arms control treaties that would be conducted under the Work for Others Program would not result in any airspace or air traffic impacts.

5.2.1.2 ***Transportation.*** The environmental impacts related to transportation activities as defined under Alternative 2 are discussed in the following sections. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.2.1.2.1 ***On-Site Traffic***—Under Alternative 2, access to the NTS would remain strictly controlled for security purposes, and minimal support would be provided to maintain access to those roads and to the infrastructure necessary to support decommissioning operations and long-term environmental monitoring efforts. Traffic generated within the NTS as a result of this alternative is estimated to be 60 trips per day.

Table 5.2-1 summarizes the average daily trip generation that would be attributed to each program. A minimal number of trips would be experienced on Mercury Highway. All key on-site roadways have capacities exceeding 2,000 vehicles per hour for both directions combined (Transportation Research Board, 1994). A comparison of capacity to volumes assigned to each segment shows that no roadway would experience significant traffic congestion under Alternative 2.

Under Alternative 2, there would be no traffic generated on the roads within the NTS as a result of activities associated with Defense, Waste Management, Environmental Restoration, Nondefense Research and Development, and Work for Others Programs. Under Alternative 2, traffic generated on the roads within the NTS as a result of work associated with site-support activities is estimated to be 60 average daily trips. The majority of these trips would be confined to Mercury Highway; however, approximately 10 percent would involve travel to Area 5. There would be no adverse effects on traffic flow as a result of site-support activities.

5.2.1.2.2 ***Off-Site Traffic***—Under Alternative 2, NTS employment on site would be reduced when compared to employment under Alternative 1. Correspondingly, a decrease in daily vehicle trips and traffic volumes on key roadway segments is anticipated, resulting in changes in the level of service. The decrease in vehicle trips during the peak hour was estimated for each roadway segment and subtracted from the baseline to obtain the future project traffic volumes on key roadways.

Traffic impacts were determined based on level of service changes for each of the key roads analyzed. The major traffic generators at the site would be

Table 5.2-1. Average on-site daily trip generation (one-way trips) by program, under Alternative 2

Program	Trips per Day	Difference from Alternative 1
Defense	0	-635
Waste Management	0	-145
Environmental Restoration	0	-390
Nondefense Research and Development	0	-180
Work for Others	0	-190
Site-Support Activities	60	-1820
Total	**60**	**-3310**

from personnel involved with environmental monitoring, security functions, and maintenance of the associated facilities. Table 5.2-2 shows the changes in daily vehicle trips resulting from the loss of employees for each program activity for the years 1996, 2000, and 2005. These changes are all reductions relative to the baseline. After an initial reduction in employment in 1997, employment would remain constant. Under Alternative 2, the access highway to the NTS would experience the greatest reduction in vehicular traffic of an estimated 280 vehicles (in one direction) during the peak hour. Two roadway ramps on the Mercury interchange would experience a similar reduction of 235 vehicles. U.S. Highway 95 between the Mercury interchange and Las Vegas would experience a decrease of 235 vehicles. All other key roads would be likely to experience a reduction of less than 160 vehicles. The projected peak-hour traffic on key roads and the associated levels of service that would result under Alternative 2 for 1996, 2000, and 2005 are shown in Table 5.2-3.

Based on standards of the American Association of State Highway and Traffic Engineers, level of service B is appropriate for freeways and arterials and for rural highways in level or rolling terrain. Level of service C is appropriate for rural, mountainous, urban, and suburban areas. For local roads, level of service D is appropriate in all terrain (AASHTO, 1990). By 2005, all key roads in the immediate vicinity of the site (U.S. Highway 95, the Mercury interchange ramps, and the access highway to the site State Route 433) would continue to operate at level of service C or better, an acceptable level according to the standards of the American Association of State Highway and Traffic Engineers. Under Alternative 2, it is likely that the current bus service to the NTS would be discontinued, resulting in a little less reduction in vehicular traffic than reported above. However, this scenario would not change any level of service on key roadways. Key roads within metropolitan Las Vegas (segments of Interstate 15, U.S. Highway 95, and U.S. Highway 93) currently operate at levels of service ranging from A to F; shortly after 2000, these key roads would all deteriorate to unacceptable level of service F.

These conditions would prevail without Alternative 2 because of cumulative traffic growth (recreational, regional, and commuter traffic). U.S. Highway 93 at Hoover Dam already operates at an unacceptable level of service F, and its level of service would continue to deteriorate further, with

Table 5.2-2. Average off-site daily vehicle trip reduction from Alternative 1, under Alternative 2

Program	1996	2000	2005
Defense	-200	-330	-330
Waste Management	-30	-60	-60
Environmental Restoration	-50	-90	-90
Nondefense Research and Development	-30	-40	-40
Work for Others	-50	-80	-80
Site-Support Activities	-400	-840	-840
Total	**-760**	**-1440**	**-1440**

NOTE: All values are rounded to the nearest 10 and represent a net decrease relative to Alternative 1. Daily trips shown are defined as one-way vehicle trips or vehicle trip ends.

Table 5.2-3. Peak-hour traffic and level of service on key roads, under Alternative 2[a]

Roadway Segments	Capacity VPH[b]	1996 DDHV[c]	1996 LOS[d]	2000 DDHV	2000 LOS	2005 DDHV	2005 LOS
Regional							
I-15 @ California/Nevada state line	6,800	2,968	E	3,726	F	4,687	F
I-15 north of Sahara Avenue interchange	10,200	7,234	F	8,851	F	10,968	F
I-15 north of the downtown expressway interchange	10,200 .	4,392	E	5,502	F	6,931	F
I-15 just north of the 'D' and Washington interchange	10,200	4,029	D	5,046	F	6,357	F
I-15 north of the Cheyenne interchange	6,800	1,864	C	2,618	D	3,602	F
I-15 south of the Lamb Blvd. interchange	6,800	627	A	805	A	1,056	A
I-15 north of West Mesquite interchange (Nevada/Utah state line)	6,800	630	A	875	A	1,188	B
I-80 east of Apex interchange (California/Nevada state line)	6,800	1,750	C	1,995	C	2,309	C
I-80 east of West Wendover interchange (Nevada/Utah state line)	6,800	321	A	400	A	506	A
Local							
U.S. Hwy. 95 south of Jones Blvd. interchange	10,200	7,263	F	9,098	F	11,461	F
U.S. Hwy. 95 north of Sunset Road interchange (East Las Vegas)	6,800	2,581	D	3,240	F	4,076	F
Rancho Road (SR 599) east of the northern U.S. 95/Rancho Road interchange	6,800	1,109	B	1,784	C	2,738	E
U.S. Hwy. 95 south of SR 157 north of Las Vegas	6,800	725	A	766	A	949	A
U.S. Hwy. 95 just east of Mercury interchange	6,800	234	A	150	A	184	A
U.S. Hwy. 95 interchange at Mercury							
Southbound off-ramp	1,300	18	B	10	B	10	B
Southbound on-ramp	1,300	118	B	10	B	10	B
Northbound off-ramp	1,300	118	B	10	B	10	B
Northbound on-ramp	1,300	18	B	10	B	10	B
SR 433, 0.32 km (0.2 mi) north of the Mercury interchange (access to NTS)	2,000	142	B	10	A	10	A
U.S. Hwy. 95 6.1 km (3.8 mi) north of Mercury interchange	2,000	270	C	300	C	350	C
U.S. Hwy. 95 @ Amargosa Valley to Beatty	2,000	56	A	57	A	66	A
U.S. Hwy. 95 north of Beatty	2,000	168	B	182	B	206	B
SR 160 south of U.S. 95	2,000	68	A	79	A	100	A
U.S. Hwy. 93 south of the Nevada/Arizona state line at Hoover Dam	1,500	808	F	964	F	1,172	F
U.S. Hwy. 93 east of westbound off-ramp of Railroad Pass interchange	6,840	2,663	E	3,179	F	3,866	F
U.S. Hwy. 93 north of I-15/U.S. 93 interchange	2,000	121	B	145	B	188	B
U.S. Hwy. 93 south of SR 375 junction near Crystal Springs	2,000	127	B	148	B	182	B
U.S. Hwy. 93 west of SR 375 junction near Crystal Springs	2,000	41	A	44	A	54	A
SR 375 west of U.S. 93 junction at Crystal Springs	1,500	25	A	22	A	25	A
SR 375 east of Warm Springs	1,500	10	A	10	A	10	A
U.S. Hwy. 6 east of Warm Springs at SR 375 junction	1,700	10	A	10	A	10	A
U.S. Hwy. 6 west of Warm Springs at SR 375 junction	1,700	15	A	11	A	13	A
U.S. Hwy. 6 east of Tonopah, west of SR 376	1,700	92	A	78	A	68	A

[a] Traffic volumes, reported as 10 vehicles, should be interpreted as very low volumes
[b] Vehicles per hour
[c] Directional design hourly volume (one direction)
[d] Level of service.

NOTE: SR = State Routes

or without this alternative, mainly because of its geometry (steep grades and narrow curves) and partially because of its moderate traffic volume and truck traffic. All other key roadways would generally continue to operate at level of service C or better.

The following sections address the contribution of environmental monitoring, security, and associated site-support activities to traffic impacts generated by the site and occurring at the access road off U.S. Highway 95.

Defense Program. Under Alternative 2, the loss in the number of employees associated with Defense Program activities would result in approximately 330 daily vehicle trip reductions with respect to Alternative 1 on a typical weekday in 2005. Except for site-support activities, defense-related activities would contribute the most to the reduction in the number of daily vehicle trips and peak-hour vehicles (approximately 23 percent of the total).

Waste Management Program. Under Alternative 2, the loss in the number of employees associated with Waste Management Program activities would result in approximately 60 daily vehicle trip reductions with respect to Alternative 1 on a typical weekday in 2005. The Waste Management Program activities would contribute to an approximate 4-percent reduction in the total number of daily vehicle trips.

Environmental Restoration Program. Under Alternative 2, the loss in the number of employees associated with the Environmental Restoration Program would result in approximately 90 daily vehicle trip reductions with respect to Alternative 1. The Environmental Restoration Program activities would contribute to an approximate 6-percent reduction in the total number of daily vehicle trips.

Nondefense Research and Development Program. Under Alternative 2, the loss in the number of employees associated with the Nondefense Research and Development Program activities would result in approximately 40 daily vehicle trip reductions with respect to Alternative 1. The Nondefense Research and Development activities would contribute slightly less than a 5-percent reduction in the total number of daily vehicle trips.

Work for Others Program. Under Alternative 2, the loss in the number of employees associated with Work for Others Program activities would result in approximately 80 daily vehicle trip reductions with respect to Alternative 1 on a typical weekday in 2005. These activities would contribute to a reduction in the number of daily vehicle trips of slightly less than 6 percent.

Site-Support Activities. Site-support activities are anticipated to cause a reduction of 840 vehicle trips in 2005. The reduction in trips is a result of fewer site-support employees who would be required with the discontinuation of site support activities at the NTS.

5.2.1.2.3 Transportation of Materials and Waste—The Defense, Waste Management, Environmental Restoration, Nondefense Research and Development, and Work for Others Programs would be eliminated, so no hazardous and/or radioactive shipments to the NTS would occur. Therefore, transportation risk under this alternative would decrease.

5.2.1.2.4 Other Transportation—No other modes of transportation would be used; therefore, no transportation impacts would be realized.

5.2.1.3 Socioeconomics. This section addresses the potential socioeconomic effects associated with Alternative 2. The description of socioeconomic conditions includes indicators (population, civilian labor force, employment, unemployment rate, and income) that provide a basis for comparing regional socioeconomic conditions of the site with Alternative 1. In addition, public finance and public services (public education, police and fire protection, and health) are described. The loss of employment and personal income and the increase in unemployment associated with Alternative 2 would result in substantial short-term adverse effects to the regional economy; however, economic and natural growth in the region of influence is expected to compensate for these reductions over time.

American Indian socioeconomic impacts due to fluctuations in DOE employment opportunities for tribal members from the CGTO region of influence are discussed in Section 5.1.1.3.

<u>ECONOMIC ACTIVITY, POPULATION, AND HOUSING</u>. Under Alternative 2, it was assumed that an 86-person workforce would provide the necessary support to maintain minimum environmental monitoring and security functions. With the 86-person workforce, it is estimated that direct payroll and purchases of goods and services

would generate 164 secondary jobs (160 in Clark County and 4 in Nye County). Direct earnings are estimated at $4.2 million annually, and secondary earnings are estimated at more than $4.4 million annually. Of these earnings, $3.9 million in direct earnings and $4.3 million in secondary earnings would remain in Clark County; $0.3 million direct earnings and $0.1 million secondary earnings would remain in Nye County.

The major losses to the region of influence would include contractors and employees of the DOE, who are generally technicians and engineers, and the loss of other employment opportunities associated with the DOE. The region of influence would lose some diversification, thus increasing the influence and dependence on the service industry. The NTS is one of the major employers for technical positions that are usually filled by graduates of Nevada's universities and community colleges (State of Nevada Plan of Action for the Future of the NTS and its Work Force, 1994). In addition to the loss of employment diversification, the local universities would lose grants and other applicable funding. The loss of employment in Nye County would decrease per capita income from an average of $18,144 to $17,008, a decrease of 6.3 percent in 1998. However, economic activity and natural growth would compensate for this reduction.

Although it cannot be quantified, the region of influence and the state of Nevada would experience the loss of the Financial Assistance Award, an award that is negotiated every year between the state of Nevada and the DOE/NV. The Financial Assistance Award is provided to facilitate the accomplishment of activities in environmental safety and health oversight, monitoring, access, and emergency response initiatives to ensure compliance with applicable regulations. The award would be terminated within a year if this alternative were to be implemented. This impact has not been included in this analysis. The amounts change from year to year and cannot be accurately calculated.

Operational employment levels began to decline in 1987. Under Alternative 2, the decrease in employment is assumed to continue until all operations have been discontinued. It has been assumed that the first full year of closure would be 1997; Table 5.2-4 reflects the effects of this alternative to the economic indicators for Clark and Nye Counties. These are the total changes to the region of influence for all programs. Table 5.2-5 lists the housing projections for the region of influence. Figure 5.1-1 illustrates direct employment levels for all alternatives.

Defense Program. In the region of influence, in addition to the loss of 1,472 direct positions, an additional 2,802 secondary positions would be lost for a total of 4,274 jobs. In Clark County, the reduction in civilian employment (4,060 jobs) would contribute to the total increase in the unemployment rate from 5.8 percent under Alternative 1 to 9.0 percent under Alternative 2 in 1997. In Nye County, this decrease would result in a loss of 170 jobs, which would contribute to the total increase in the unemployment rate from 5.2 percent to 11.3 percent in 1997.

Because of work stoppage in this program, it is expected that 1,700 persons would relocate from Clark County, contributing to a total decrease in population of 0.7 percent in 1998. In Nye County, 132 persons would relocate, contributing to the total 1.9 percent decrease in population in 1998.

After discontinuing operations, an estimated 664 households that support the Defense Program would relocate out of Clark County in 1998, contributing to the increase in the housing vacancy rate from an average of 7.9 percent to 8.5 percent in 1998. In Nye County, an estimated 49 households would relocate out of the county, contributing to the increase in the housing vacancy rate in 1998 from an average 16.2 percent to 17.8 percent.

Waste Management Program. In the region of influence, in addition to the loss of 250 direct positions, an additional 476 secondary positions would be lost for a total of 726 jobs. In Clark County, the reduction in civilian employment of 689 jobs would contribute to the total increase in the unemployment rate from 5.8 percent to 9.0 percent in 1996. In Nye County, this decrease would mean a loss of 29 jobs, which would contribute to the total increase in the unemployment rate from 5.2 percent to 11.3 percent in 1997.

Table 5.2-4. Economic activity effects for Clark and Nye counties in 1996, 1997, 1998, 2000, and 2005 totals for all programs, under Alternative 2

Total Alternative 2	1996	1997	1998	2000	2005
Clark County					
Population	1,077,576	1,112,348	1,140,745	1,216,045	1,373,424
Total Jobs	498,230	506,017	522,923	558,389	632,514
Unemployment Rate	7.5	9.0	8.0	7.9	7.7
Personal Income ($Millions)	20,840.0	21,641.8	22,861.1	25,299.7	31,396.2
Nye County					
Population	27,407	28,918	29,928	33,383	37,933
Total Jobs	10,601	10,848	11,487	12,873	14,697
Unemployment Rate	8.6	11.3	8.4	8.0	7.7
Personal Income ($Millions)	57.1	471.3	509.0	592.3	736.1
Changes from Alternative 1 (Alternative 2 effects)					
Clark County					
Population	0	0	-7,496	-7,496	-7,496
Total Jobs	-9,308	-17,899	-17,899	-17,899	-17,899
Unemployment Rate	+ 1.7	+3.2	+ 2.2	+ 2.1	+1.9
Personal Income ($Millions)	- 467.1	-884.7	- 884.7	- 884.7	-884.7
Nye County					
Population	0	0	- 583	- 583	- 583
Total Jobs	- 389	- 748	- 748	- 748	- 748
Unemployment Rate	+ 3.4	+ 6.1	+ 3.2	+ 2.8	+ 2.5
Personal Income ($1,000)	- 23.6	- 44.6	- 44.6	- 44.6	- 44.6

Because of work stoppage in the Waste Management Program, it is expected that 289 persons would relocate from Clark County, which would contribute to the total decrease in population of 0.7 percent in 1998. In Nye County, 22 persons would relocate, which would contribute to the total decrease of 1.9 percent in 1998.

After site closure in 1997, an estimated 1,113 households that support the Waste Management Program would relocate out of Clark County, contributing to the increase in the housing vacancy rate in 1998 from an average of 7.9 percent to 8.5 percent. In Nye County, an estimated eight households would relocate out of the area,

Table 5.2-5. Total housing projections for the region of influence, 1996, 1997, 1998, 2000, and 2005

	Alternative 1 Vacancy Rate (%)	Alternative 2, Housing Demand Decrease	Vacancy Rate (%)	Change in Vacancy Rate
Clark County				
1996	7.8	0	7.8	0.0
1997	7.9	0	7.9	0.0
1998	7.9	2,928	8.5	0.6
2000	7.9	2,928	8.4	0.5
2005	7.9	2,928	8.4	0.5
City of Las Vegas				
1996	7.1	0	7.1	0.0
1997	7.1	0	7.1	0.0
1998	7.1	1,029	7.7	0.6
2000	7.1	1,029	7.6	0.5
2005	7.1	1,029	7.6	0.5
City of North Las Vegas				
1996	5.9	0	5.9	0.0
1997	5.9	0	5.9	0.0
1998	5.9	171	6.4	0.5
2000	5.9	171	6.3	0.4
2005	5.9	171	6.3	0.4
Nye County				
1996	16.2	0	16.2	0.0
1997	16.2	0	16.2	0.0
1998	16.2	218	17.8	1.6
2000	16.2	218	17.5	1.4
2005	16.2	218	17.5	1.3
Town of Tonopah				
1996	17.6	0	17.6	0.0
1997	17.7	0	17.7	0.0
1998	17.9	24	19.2	1.3
2000	18.0	24	19.2	1.2
2005	18.0	24	19.3	1.3
Town of Pahrump				
1996	11.6	0	11.6	0.0
1997	11.6	0	11.6	0.0
1998	11.6	157	13.6	2.0
2000	11.6	157	13.3	1.7
2005	11.6	157	12.9	1.3
Amargosa Valley				
1996	17.8	0	17.8	0.0
1997	17.8	0	17.8	0.0
1998	17.8	8	19.4	1.6
2000	17.9	8	19.3	1.4
2005	17.8	8	19.0	1.2

which would cause the housing vacancy rate to increase in 1998 from an average 16.2 percent to 17.8 percent.

Environmental Restoration Program. In the region of influence, in addition to the loss of 389 direct positions, an additional 740 secondary positions would be lost for a total of 1,129 jobs. In Clark County, the reduction in 1,073 civilian jobs would contribute to the total increase in the unemployment rate from 5.8 percent to 9.0 percent in 1997. In Nye County, the decrease would mean a loss of 45 jobs, which would contribute to the total increase in the unemployment rate from 5.2 percent to 11.3 percent in 1997.

Because of work stoppage in this program, 449 persons would relocate from Clark County, which would contribute to the total decrease in population of 0.7 percent in 1998. In Nye County, a total of 35 persons would relocate, which would contribute to the total decrease of 1.9 percent in 1998.

After site closure in 1997, an estimated 175 households that support the Environmental Restoration Program would relocate out of Clark County, contributing to the increase in the housing vacancy rate in 1998 from an average of 7.9 percent to 8.5. In Nye County, an estimated 13 households would relocate out of the county, contributing to the increase in the housing vacancy rate in 1998 from an average 16.2 percent to 17.8 percent.

Nondefense Research and Development Program. In the region of influence, in addition to the loss of 191 direct positions, an additional 364 secondary positions would be lost for a total of 555 jobs. In Clark County, the reduction of 527 civilian jobs would contribute to the total increase in the unemployment rate from 5.8 percent to 9.0 percent in 1997. In Nye County, the decrease would result in a loss of 22 jobs, which would contribute to the total increase in the unemployment rate from 5.2 percent to 11.3 percent in 1997.

Because of work stoppage in this program, 221 persons would relocate from Clark County, which would contribute to the total decrease in population of 0.7 percent in 1998. In Nye County, a total of 17 persons would relocate, which would also contribute to the total decrease of 1.9 percent in 1998.

After site closure in 1997, an estimated 86 households that support the Nondefense Research and Development Program would relocate from Clark County, contributing to the increase in the housing vacancy rate in 1998 from an average of 7.9 percent to 8.5 percent.

Work for Others Program. In the region of influence, in addition to the loss of 350 direct positions, an additional 666 secondary positions would be lost for a total of 1,016 jobs. In Clark County, the reduction in civilian employment of 965 jobs would contribute to the total increase in the unemployment rate from 5.8 percent to 9.0 percent in 1997. In Nye County, the decrease would translate to a loss of 40 jobs, which would contribute to the total increase in the unemployment rate from 5.2 percent to 11.3 percent in 1997.

Because of work stoppage in the Work for Others Program, 404 persons would relocate from Clark County, which would contribute to the total decrease in population of 0.7 percent in 1998. In Nye County, a total of 31 persons would relocate, which would contribute to the total decrease of 1.9 percent in 1998.

After site closure in 1997, an estimated 158 households that support this program would relocate from Clark County, contributing to the increase in the housing vacancy rate in 1998 from an average of 7.9 percent to 8.5 percent. In Nye County, an estimated 12 households would relocate out of the county, contributing to the increase in the housing vacancy rate in 1998 from an average 16.2 percent to 17.8 percent.

Site-Support Activities. It is estimated that an 86-person workforce would perform these activities. In the region of influence, in addition to the loss of 3,838 direct positions, an additional 7,305 secondary positions would be lost for a total of 11,143 jobs. In Clark County, the reduction of 10,587 civilian jobs would contribute to the total increase in the unemployment rate from 5.8 percent to 9.0 percent in 1997. In Nye County, the decrease would result in a loss of 442 jobs, which would contribute to the total increase in the unemployment rate from 5.2 percent to 11.3 percent in 1997.

Because of work stoppage for site-support activities, 4,433 persons would relocate from Clark County, which would contribute to the total decrease in population of 0.7 percent in 1998. In Nye County, a total of 345 persons would relocate, which would contribute to the total decrease of 1.9 percent in 1998.

After site closure in 1997, an estimated 1,732 households that support this program would relocate out of Clark County, contributing to the increase in the housing vacancy rate in 1998 from an average of 7.9 percent to 8.5 percent. In Nye County, an estimated 129 households would relocate out of the county, contributing to the increase in the housing vacancy rate in 1998 from an average 16.2 percent to 17.8 percent.

PUBLIC FINANCE. The fiscal effects of Alternative 2 are presented in this section. Table 5.2-6 outlines the projected financial summary for Fiscal Years 2000 and 2005 under Alternative 2. The fiscal impact of all alternatives can be determined by subtracting their income statement totals from the Alternative 1 future baseline. The remaining fiscal impact is the specific impact associated with each alternative.

Clark County. The expansion and improvement of the county infrastructure would continue to be the primary focus of Clark County fiscal efforts. In addition, Clark County has undertaken the implementation of a county facilities development program as discussed under Public Finance, Section 4.1.3.

Under Alternative 2, revenues for Clark County would increase because of increases in population, personal income, and total employment in the county. Assuming continued small increases in revenues and slightly larger initial increases in expenditures (see discussion on capital projects under Public Finance, Section 4.1.3), Alternative 2 would result in revenues less expenditures of a negative $5,916,000 in Fiscal Year 2000. It is expected that Clark County would achieve a positive fiscal position by Fiscal Year 2001. In Fiscal Year 2005, revenues less expenditures are expected to be $33,627,000. The fund balance (or reserves) as a percentage of current expense is expected to be 245 percent in 2000 and 374 percent in 2005. To compare with Alternative 1, Clark County revenues over expenditures would be $3,414,000 less in 2000 and in 2005.

City of Las Vegas. Under Alternative 2, revenues over expenditures for the City of Las Vegas are expected to become positive in Fiscal Year 1996 because of increases in population, personal income, and total employment in the city.

Assuming continued increases in revenues and expenditures, this alternative would result in revenues less expenditures of $12,928,000 in Fiscal Year 2000. It is predicted that the city would achieve an increasingly positive fiscal position and by Fiscal Year 2005, revenues over expenditures would be $14,984,000. The fund balance as a percentage of current expense is expected to be 177 percent in 2000 and 267 percent in 2005. To compare with Alternative 1, revenues over expenditures would be $1,452,000 less in 2000 and $1,451,000 less in 2005.

City of North Las Vegas. Expenditures for North Las Vegas are forecast to continue to outpace revenues. Revenues over expenditures in Fiscal Year 2000 would be a negative $7,342,000 and a negative $6,845,000 in Fiscal Year 2005, despite small increases in population, personal income, and total employment in the city. Public safety and capital projects are anticipated to continue to be the largest expenditures. Taxes, which recently decreased (from $10,059,472 in Fiscal Year 1993 to $7,941,972 in Fiscal Year 1994), are expected to grow slowly to 1993 levels by Fiscal Year 2002. The fund balance as a percentage of current expense is expected to be 61 percent in Fiscal Year 2000 and 89 percent in Fiscal Year 2005. To compare with Alternative 1, revenues over expenditures would be $265,000 less in 2000 and 2005.

Table 5.2-6. Projected financial summary for Fiscal Years 2000 and 2005, general, special revenues, debt service, and capital projects funds, under Alternative 2

	Revenues Over Expenditures	Current Expense	Ending Fund Balance	Fund Balance as a Percentage of Current Expense
Fiscal Year 2000				
Clark County	($5,915,892)	$524,197,231	$1,284,861,518	245.11%
City of Las Vegas	$12,928,147	$196,311,179	$348,069,068	177.30%
City of North Las Vegas	($7,341,672)	$46,922,327	$28,626,284	61.01%
Clark County School District	($15,288,842)	$746,755,621	$123,507,085	16.54%
Nye County	$1,284,015	$25,646,743	$13,557,544	52.86%
Town of Tonopah	$73,867	$636,796	$804,554	126.34%
Town of Pahrump	$210,030	$934,496	$1,551,442	166.02%
Nye County School District	($1,529,444)	$26,240,727	($820,589)	-3.13%
Fiscal Year 2005				
Clark County	$33,627,168	$561,664,276	$2,102,270,259	374.29%
City of Las Vegas	$14,983,943	$210,173,311	$560,627,597	266.75%
City of North Las Vegas	($6,844,959)	$50,292,130	$44,991,457	89.46%
Clark County School District	($11,389,185)	$843,399,785	$188,657,527	22.37%
Nye County	$3,172,118	$27,663,424	$24,777,199	89.57%
Town of Tonopah	$71,158	$641,576	$1,165,212	181.62%
Town of Pahrump	$299,760	$1,083,655	$2,881,282	265.89%
Nye County School District	($262,911)	$29,814,400	$3,181,761	10.67%

Clark County School District. Under Alternative 2, revenues for Clark County School District would expand because of increases in population and corresponding school enrollment, although the level of increase would be less than that experienced under Alternative 1. Regular program and undistributed expenditures would likely continue to increase. The school district is not predicted to achieve a positive fiscal position by Fiscal Year 2005. In Fiscal Year 2000, revenues less expenditures would be a negative $15,289,000, and in Fiscal Year 2005, a less negative $11,389,000. The fund balance as a percentage of current expense is expected to be 17 percent in Fiscal Year 2000 and 22 percent in Fiscal Year 2005. To compare with Alternative 1, revenues over expenditures would be $222,000 more in 2000 and $221,000 more in 2005 because of the decreased expenses associated with smaller enrollments.

Nye County. Under Alternative 2, revenues for Nye County would increase slightly because of small increases in population, personal income, and total employment in the county. Assuming continued small increases in expenditures as well, a positive fiscal position is expected to be reached in Fiscal Year 1999. This alternative would result in revenues less expenditures of $1,284,000 in Fiscal Year 2000. In Fiscal Year 2005, revenues less expenditures would be $3,172,000. The fund balance as a percentage of current expense is expected to be 53 percent in Fiscal Year 2000 and 90 percent in Fiscal Year 2005. To compare with Alternative 1, revenues over expenditures would be $283,000 less in 2000 and 2005.

Town of Tonopah. Revenues and expenditures for the town of Tonopah would increase slightly because of small increases in population, personal income, and total employment in the county.

Assuming continued small increases, Alternative 2 would result in revenues less expenditures of $74,000 in Fiscal Year 2000. In Fiscal Year 2005, revenues less expenditures would be $71,000. The fund balance as a percentage of current expense would be 126 percent in Fiscal Year 2000 and 182 percent in Fiscal Year 2005. To compare with Alternative 1, revenues over expenditures would be $5,000 less in 2000 and $4,000 less in 2005.

Town of Pahrump. Under Alternative 2, revenues for the town of Pahrump would increase slightly because of small increases in population, personal income, and total employment in the county. Assuming continued small increases in revenues and slightly smaller initial increases in expenditures compared to Fiscal Year 1994, this alternative would result in revenues less expenditures of $210,000 in Fiscal Year 2000. In Fiscal Year 2005, revenues less expenditures would be $300,000. The fund balance (or reserves) as a percentage of current expense is anticipated to be 166 percent in Fiscal Year 2000 and 266 percent in Fiscal Year 2005. To compare with Alternative 1, revenues over expenditures would be $24,000 less in 2000 and $15,000 less in 2005.

Nye County School District. Under Alternative 2, revenues for Nye County School District would increase slightly because of small increases in population. Local sources would continue to generate the most revenue. Revenues less expenditures are expected to reach a negative $1,529,000 in Fiscal Year 2000 and negative $263,000 in Fiscal Year 2005. The fund balance as a percentage of current expense is expected to be a negative 3 percent in Fiscal Year 2000 and 11 percent in Fiscal Year 2005. To compare with Alternative 1, revenues over expenditures would be $127,000 more in 2000 and 2005.

PUBLIC SERVICES. Table 5.2-7 summarizes the levels of service that would be required under Alternative 2, and the text compares these levels to Alternative 1. In each case, the current levels of service per 1,000 population are assumed to continue.

Public Education. A total of 7,928 full-time equivalent licensed teachers were employed by the Clark County School District in the 1993-94 school year, resulting in a student-to-teacher ratio of 18.33. To continue with this ratio, the Clark County School District would require 11,044 teachers by the school year 2004 to 2005, or 61 less than under Alternative 1. The student-to-teacher ratio for Nye County School District was 16.39 in the school year 1994-95. Assuming this ratio were to be projected in the school year 2004 to 2005, 378 teachers or 6 less than under Alternative 1 would be required.

Police Protection. Assuming the same levels of service in the future, requirements for sworn police and deputy protection in the year 2005 can be examined. The Las Vegas Metropolitan Police Department would require 1,695 sworn police officers or 10 less than under Alternative 1. The North Las Vegas Police Department would require 181 sworn officers or 1 less. The Nye County Sheriff's Office in Tonopah would require 15 sheriff's deputies or no change in the number of sworn officers over Alternative 1. The town of Pahrump Sheriff's Substation would require 51, the Beatty Sheriff's Substation would require 5, and the Amargosa Valley Sheriff's Substation would require 3 or no changes over Alternative 1.

Fire Protection. The following is a discussion of firefighter personnel expected to be required in the year 2005 under Alternative 2. The Clark County Fire Department, which handles urban-area fires in the unincorporated county, would be expected to require 561 firefighters in 2005, or 3 less than under Alternative 1. Some 403 firefighters, or 3 less than under Alternative 1, would be required in the Las Vegas Fire Department in the year 2005. The North Las Vegas Fire Department would require 119 firefighters, or one less than under Alternative 1. The Tonopah, Pahrump, Beatty, and Amargosa Valley Volunteer Fire Departments would require 29, 54, 28, and 35 firefighters, respectively, which is 1 less than under Alternative 1 except for Beatty, which would remain the same.

Health Care. The 1995 levels of service for medical doctors and registered nurses was used to determine future needs based on population growth. In the year 2005, a total of 1,887 (or 10 less than under Alternative 1) medical doctors and 6,653 (36 less) registered nurses would be required in Clark County.

Table 5.2-7. Projected levels of public service for 1996, 2000, and 2005, under Alternative 2

Jurisdiction	Level of Service*	1996	2000	2005
Clark County School District Teachers	18.33	8,665	9,779	11,044
Nye County School District Teachers	16.39	273	333	378
Las Vegas Metropolitan Police Department (Las Vegas and county rural areas)	2.27	1,330	1,501	1,695
North Las Vegas Police Department	1.75	142	160	181
Nye County Sheriff's Office (Tonopah)	3.67	14	15	15
Pahrump Sheriff's Substation	1.85	30	40	51
Beatty Sheriff's Substation	2.59	5	6	5
Amargosa Valley Sheriff's Substation	2.01	2	3	3
Clark County Fire Department (urbanized unincorporated areas)	1.04	440	497	561
Las Vegas Fire Department	0.84	316	357	403
North Las Vegas Fire Department	1.15	93	105	119
Tonopah Volunteer Fire Department	7.09	27	29	29
Pahrump Volunteer Fire Department	1.98	32	43	54
Beatty Volunteer Fire Department and Ambulance Service	14.51	29	31	28
Amargosa Valley Volunteer Fire Department	23.12	26	31	35
Clark County Medical Doctors	1.37	1,481	1,671	1,887
Clark County Registered Nurses	4.84	5,220	5,891	6,653
Nye County Medical Doctors	0.34	9	11	13
Nye County Registered Nurses	1.53	42	51	58

* Level of service is per 1,000 population. The number of school teachers is based on student-to-teacher ratios, and the number of students is based on a percentage of the population.

In Nye County, 13 medical doctors and 58 registered nurses would be required, which is the same number of medical doctors and 1 less registered nurse than Alternative 1.

5.2.1.4 Geology and Soils. No adverse impacts to geology and soils would occur under Alternative 2 for Defense, Waste Management, Environmental Restoration, Nondefense Research and Development, and Work for Others Programs and for site-support activities. However, geologic media disturbed or contaminated by past activities would not be restored, and would continue to be monitored.

5.2.1.5 Hydrology. The environmental impacts to surface hydrology and groundwater are described in the following sections. Discussions of impacts to water quality and water quantity are also presented.

5.2.1.5.1 Surface Hydrology—The surface hydrologic environment adversely impacted by past Defense, Waste Management, Environmental Restoration, Nondefense Research and Development, and Work for Others Programs would not be restored. Therefore, contaminated surface geologic media would continue to be a threat to any surface water present. The minimal site-support activities under Alternative 2 would not impact surface hydrology.

5.2.1.5.2 Groundwater—Under Alternative 2, the demand for water resources would be significantly decreased to levels required for environmental monitoring and potable water supplies for a caretaker workforce. Water quality might be adversely impacted because of the cessation of waste management and restoration activities that protect the groundwater quality. This, in turn, might limit the availability of water for other uses.

5.2.1.6 Biological Resources. Discontinuation of some site-support activities would lead to the shutdown of manmade water sources in several areas on the NTS. This, in turn, would likely influence the distribution of several wildlife species, including horses, deer, and chukar, and could result in loss of some local populations of these species.

A decrease in traffic on the NTS could result in fewer desert tortoises being accidentally killed on roads. However, because so few tortoises have been killed on NTS roads in the past (less than one per year), this decrease would have little positive effect on the tortoise population. At a sitewide level of analysis, there are no anticipated ecosystem-level impacts.

5.2.1.7 Air Quality. This alternative would not adversely affect air quality. Pollutant emissions associated with stationary sources would be essentially eliminated following closure, and mobile source emissions would be substantially reduced. There would be some level of air quality benefit associated with maintaining the site at a reduced level of activity compared with the levels of activity associated with the other alternatives.

Site-support activities could contribute a small portion to total emissions. Under Alternative 2, only environmental monitoring and security functions would be maintained. Stationary source emissions would be eliminated. Mobile source emissions would consist of exhaust emissions from workers' vehicles used to commute to and from the site. Assuming a worst-case scenario of about 100 vehicles traveling to the site, pollutant emissions would be as follows:

- Volatile organic compounds: 5.11 tons per year
- Carbon monoxide: 34.61 tons per year
- Nitrogen oxides: 7.60 tons per year.

These emission rates would be about 14 percent of the off-site mobile emission rates that would occur under Alternative 1. These emissions would be dispersed over a wide area and would not sufficiently increase ambient pollutant concentrations in Nye and Clark Counties to cause or increase violations of the Ambient Air Quality Standards. Thus, the ambient air quality designations in these counties would not change. The air quality impacts of this alternative would be small, but beneficial. A general conformity analysis would not be required (see Section 5.1.1.7).

RADIOLOGICAL AIR QUALITY. Under Alternative 2, effluents would be minimal because of resuspension of soils contaminated in the past. Impacts to the air quality would, therefore, be negligible.

5.2.1.8 Noise. Under this alternative, most noise sources, such as construction and material-handling equipment, boilers, pumps, engines, and wind tunnels, would be eliminated. A minor amount of noise would result from the operation of security and environmental monitoring vehicles on site.

Noise levels would become those typically found in uninhabited desert areas. The major sources of noise would be physical phenomena such as wind, rain, wildlife activities, and an occasional airplane (the wind is the predominant noise source.) Desert noise levels as a result of wind have been measured at an upper limit of 22 dBA for a still desert and 40 dBA for a windy desert.

With site-support activities, ambient noise levels of 30 to 35 dBA would probably be a reasonable estimate for the NTS. A minor amount of noise would result from vehicles used by workers commuting between NTS and Las Vegas on U.S. Highway 95. However, the noise levels generated by the worker's vehicles (about 100 vehicles) would not be detectable in the noise levels generated by the total traffic (buses, trucks, and automobiles) on U.S. Highway 95.

5.2.1.9 Visual Resources. Under Alternative 2, all facilities associated with each program would be abandoned in place. Only maintenance necessary for safety would occur. There could be a slow deterioration of facilities; however, there would be little change in the overall appearance of the existing landscape. Facilities would not be located in areas of high scenic value and would generally not be visible from any public viewpoints. Therefore, under Alternative 2, impacts to visual resources would be negligible.

5.2.1.10 Cultural Resources. Discontinuance of activities would eliminate many impacts to cultural resources. However, some ground-disturbing activities, such as landfill capping, and construction of fencing, may alter the physical integrity of cultural resources. Some sites may be affected by vandalism and artifact collecting. Historic structures may be indirectly impacted by deterioration and neglect. Facilities would be evaluated for their potential to provide historical information, and appropriate consultation with the State Historic Preservation Office (SHPO) would be completed.

Waste Management Program. Direct impacts to cultural resources may result from capping of landfills and security fencing. Capping aggregate will be native soil which may be obtained from areas containing cultural resources. Indirect impacts such as unauthorized artifact collection may occur.

Environmental Restoration Program. Under Alternative 2, work on Environmental Restoration Program projects would be halted by 1996. Inactive sites would be abandoned. At some sites, decommissioning may involve activities designed to make facilities safe.

Nondefense Research and Development Program: Under this alternative there would be no Nondefense Research and Development Programs on the NTS.

Work for Others Program. This program is hosted by the DOE/NV and includes the shared use of certain NTS facilities and resources with other federal agencies such as the DoD. Activities include military training exercises and research and development projects such as weaponry tests. These kinds of activities would be discontinued under Alternative 2. Decommissioning activities might affect cultural resources.

AMERICAN INDIAN CULTURAL RESOURCES—This section describes the American Indian concerns associated with implementing Alternative 2, as summarized by the CGTO.

Defense Program at NTS—Under Alternative 2, there will be no further defense testing and storage activities. American Indian cultural resources will no longer be impacted by defense activities; American Indian people require further information before completely evaluating the cultural impacts of this Defense Program alternative.

Waste Management Program at NTS—Under Alternative 2, it is expected that American Indian cultural resources will continue to be adversely impacted because the waste has not been disposed of in a culturally appropriate manner. Access to culturally significant places on the NTS will be reduced because waste isolation facilities increase Indian people's perception of health and spiritual risks.

Environmental Restoration Program at NTS—Under Alternative 2, it is expected that American Indian cultural resources will be adversely impacted by the monitoring well and access road program, but will be positively impacted by actions that return disturbed lands to its natural condition in a culturally appropriate manner and with the participation of Indian people.

Nondefense Research and Development Program at NTS—Under Alternative 2, it is expected that American Indian cultural resources will not be adversely impacted by visits of students and researchers.

Work for Others Program at NTS—Under Alternative 2, overflights and monitoring required in keeping with International Arms Control treaties have the potential for impacting American Indian cultural resources.

Defense Program at Area 13—Under Alternative 2, American Indian cultural resources will not be adversely impacted because there are no plans for additional tests at the Area 13 site on the NAFR Complex.

Waste Management Program at Area 13—Under Alternative 2, American Indian cultural resources will not be adversely impacted because there are no waste facilities at the Area 13 site on the NAFR Complex.

Environmental Restoration Program at Area 13—Under Alternative 2, it is expected that American Indian cultural resources will be adversely impacted if natural lands are scraped during *environmental restoration. Access to culturally significant places will be increased if environmental restoration is successful, thus reducing Indian people's perception of health and spiritual risks associated with this area. Indian people wish to be involved in identifying environmental restoration methods and in the evaluation of restoration success.*

<u>Nondefense Research and Development Program at Area 13</u>—*Under Alternative 2, it is expected that American Indian cultural resources will not be adversely impacted by discontinuing research and development actions.*

<u>Work for Others Program at Area 13</u>—*Under Alternative 2, it is expected that American Indian cultural resources will not be adversely impacted because no Work for Others Program actions are being planned.*

5.2.1.11 Occupational and Public Health and Safety. Table 5.2-8 summarizes the occupational and public health and safety impacts for applicable program areas under Alternative 2. Site-support activities are estimated to result in a collective dose to workers that would not exceed about 6-person rem in 10 years. This dose could result in about 0.0025 latent cancer fatalities and 0.0010 other detrimental health effects in the worker population. Removal of transuranic and hazardous waste from the NTS under Alternative 2 was assumed to require some period of time to fully implement, and accidents could occur during the implementation period. The risk of accidental exposure to radioactive releases could result in a latent cancer fatality risk to workers of 0.016 and detrimental health effect risk of 0.0064. The risk of a single cancer in the worker population as a result of exposure to hazardous chemicals is estimated to be 5.2×10^{-7}. The risk of life-threatening noncarcinogenic effects to a single worker from accidents during implementation of Alternative 2 is estimated to be 0.48. A hazard index less than 1.0 indicates that no life-threatening noncarcinogenic health effects would be expected to occur.

The health and safety impact to the public from potential Waste Management Program accidents during implementation of Alternative 2 could result in about 4.7×10^{-5} latent cancer fatalities and 2.1×10^{-5} other detrimental health effects in the population. The risk of a single cancer in the population due to accidental exposure to hazardous chemicals would be 2.0×10^{-5}. No noncancer effects to the public from chemical accidents would be expected to occur.

The maximum reasonably foreseeable Waste Management Program radiological accident at the NTS would be a multi-container fire at the Area 5 transuranic waste storage unit, which has a probability of occurrence of 1×10^{-6} (1 in 1,000,000) per year. The following consequences are estimated if this accident occurs:

- <u>Involved worker</u>: plume rise from the fire carries the plume over close-in workers
- <u>Maximally exposed non-involved worker</u>: 3.7 rem, 0.0015 chance of latent cancer fatality, 5.9×10^{-4} chance of other detrimental effects
- <u>Non-involved worker population at the nearest major facility area</u>: 0.10 person-rem, 4.0×10^{-5} chance of a single latent cancer fatality, 1.6×10^{-5} chance of other detrimental effects
- <u>Maximally exposed off-site individual at the nearest point of public access</u>: 0.0036 person-rem, 1.8×10^{-6} chance of latent cancer fatality, 8.3×10^{-7} chance of other detrimental effects
- <u>Population within 80 km (50 mi)</u>: 1.5 to 26 person-rem, 7.5×10^{-4} to 0.013 chance of a single latent cancer fatality, 3.5×10^{-4} to 0.006 chance of other detrimental effects.

For Waste Management Programs hazardous chemical effects, the maximum reasonably foreseeable accident would be a multi-container fire at the Area 5 hazardous waste storage unit, which has a probability of occurrence of 8×10^{-5} (1 in 13,000) per year. The following consequences are estimated if this accident occurs:

- <u>Involved worker</u>: plume rise from the fire carries the plume over close-in workers

Table 5.2-8. Health risks to workers and the public from program activities, Nevada Test Site, Alternative 2

Program Area	Worker Health Risks						Public Health Risks			
	Occupational Safety Risks		Occupational Radiation Risks		Occupational Chemical Risks		Public Radiation Risks		Public Chemical Risks	
	Injuries	Fatalities	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers[c]	Chemical Hazard Index[d]	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers[c]	Chemical Hazard Index[d]
Waste Management	h	h	0.016	0.0064	5.2×10^{-7}	0.48	4.7×10^{-5}	2.1×10^{-5}	2×10^{-5}	3.8×10^{-6}
Site-Support Activities	e	e	0.0025	0.001	f	f	g	g	f	f
Total	**0.0**	**0.0**	**0.019**	**0.0074**	**5.2×10^{-7}**	**0.48**	**4.7×10^{-5}**	**2.1×10^{-5}**	**2×10^{-5}**	**3.8×10^{-6}**

a. Number of radiation-induced latent cancer fatalities in the exposed population associated with the activities conducted over the 10-year period of analysis
b. Number of radiation-induced detrimental health effects (e.g., nonfatal cancers, genetic effects) in the exposed population associated with the activities conducted over the 10-year period of analysis
c. Number of chemical-induced cancers (fatal and nonfatal) in the exposed population associated with the activities conducted over the 10-year period of analysis
d. A hazard index of greater than one indicates that the non-cancer health effects could be life-threatening to individuals exposed for one hour or more
e. No activities
f. No reasonably foreseeable scenarios resulting in exposure to chemically hazardous materials have been identified
g. No reasonably foreseeable scenarios resulting in exposure to radiation have been identified
h. No routine operations anticipated, only shipment and disposal of current waste inventory.

- Maximally exposed non-involved worker: 8.8×10^{-3} chance of cancer, 51 noncancer hazard index for potentially life-threatening one-hour concentration

- Non-involved worker population at the nearest major facility area: 1.0×10^{-4} chance of a single cancer, 0.013 noncancer hazard index for potentially life-threatening one-hour concentration

- Maximally exposed off-site individual at the nearest point of public access: 1.2×10^{-6} chance of cancer, 0.0019 noncancer hazard index for potentially life-threatening one-hour concentration

- Population within 80 km (50 mi): 0.002 to 0.004 chance of a single cancer, 0.0019 noncancer hazard index for potentially life-threatening one-hour concentration.

Subsurface radioactivity from past underground nuclear weapons tests would continue to provide a potential exposure pathway for the public.

Potential health impacts from this exposure scenario are the same as those described in Section 5.1.1.11 under Alternative 1.

Perceptions of radiation effects are discussed in Section 4.1.11 and are well known among the Western Shoshone, Southern Paiute, and Owens Valley Paiute people of this region. These perceptions of risks from radiation are frightening, and remain an important part of our lives. We will always carry these thoughts with us. Today, people are afraid of many things and places in this whole area, but we still love to come out and see our land. We worry about more radiation being brought to this land.

If the DOE wants to better understand our feelings about the impacts of radiation on our cultures, they should support a study of risks from radiation designed, conducted, and produced by the CGTO. At this time there has not been a systematic study of American Indians perceptions of risk. Therefore, it is not possible to provide action by action estimation of risk perception impacts. We believe it is a topic that urgently needs to be studied so that Indian people may better address the actual cultural impacts of proposed DOE actions. There has been recent workshop funded by the National Science Foundation to understand how to research the special issue of culturally based risk perception among American Indian communities, and at least one major project has been funded. Although this is a relatively new topic of restack, it is one that can be more fully understood by research that deeply involves the people being considered. To understand our view of radiation is to begin to understand why we responded in certain ways to past, present, and why we will continue to respond to future DOE activities.

5.2.1.12 Environmental Justice. Environmental Justice analysis involves two tiers of investigation. One is the determination of significant and adverse impacts as a result of the alternative. The other is an evaluation of whether a minority or low-income population is disproportionately affected by these significant and adverse impacts. If there are no significant and adverse impacts, then there would be no significant, disproportionately high and adverse impacts experienced by minority and low-income populations. The location of minority or low-income populations is shown on the figures in Section 4.1.12.

The CGTO has identified impacts to American Indian groups as a result of Alternative 2. While not physically located in Clark, Nye, or Lincoln counties, these groups have traditional ties to the NTS and surrounding areas. Impacts include continued reduced access to environmental restoration sites that would not be remediated. However, the degree of impact to American Indian cultural sites would be less than that associated with Alternative 1. These impacts would be perceived only by American Indian groups and would, therefore, be a disproportionately high impact on these groups.

No other significant adverse impacts as a result of this alternative were ascertained; therefore, there would be no disproportionately high and adverse impacts to other minority and low-income populations.

American Indian concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival especially access violations. These concerns for all sites are discussed in Section 5.2.1.10, Cultural Resources, and Section 5.2.1.11, Occupational and Public Health and Safety. These would only be felt by American Indian people. Therefore, a disproportionate impact would occur. There has not been a systematic study of these issues for the NTS. The CGTO maintains that past, present, and future activities on the NTS have, are, or will impact these American Indian Environmental Justice issues. Although Alternative 2 involves no new activities, it contains the possibility of adversely impacting American Indian Justice issues. For example, if road maintenance is discontinued, it may be difficult for American Indian people to return to the area. Also if DOE/NV Environmental Protection personnel are not available, there may be a difficulty in maintaining consultation with American Indian tribes through the CGTO. Therefore, it is essential to maintain both the physical access to places and the agreement that facilitates access to these places. The CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study, before new activities are approved.

Program-by-program impacts are assessed in Section 5.1.1.12

5.2.2 Tonopah Test Range

This alternative is defined as the discontinuation of DOE/NV activities at the Tonopah Test Range. All U.S. Air Force and the DOE, Albuquerque activities would remain at planned mission levels and requirements. DOE/NV's discontinued programs include the Defense, Environmental Restoration, and Work for Others Programs. Therefore, only impacts resulting from the discontinuation of these programs are discussed for this site.

5.2.2.1 Land Use. Under Alternative 2, there would be no impacts on land use. Current restrictions governing access to areas of plutonium-contaminated soils would continue to be in effect. There would be no impact on surrounding land use as a result of the discontinuation of the DOE/NV Defense, Environmental Restoration, and Work for Others Program actions under Alternative 2.

Under Alternative 2, facilities would be secured, and overall monitoring at the Tonopah Test Range environmental restoration sites would take place. This could result in the closure of 1,616 km^2 (624 mi^2) of land at the Tonopah Test Range. Because activities are presently limited at the Tonopah Test Range, this would have a minor effect on users. To the extent that cessation of activities would reduce impacts on future land uses, this alternative would have a beneficial impact.

5.2.2.1.1 Site-Support Activities—DOE/NV site-support activities at the Tonopah Test Range under Alternative 2 would be discontinued. All site support activities associated with DOE, Albuquerque would continue. The impact from these activities would not exceed those impacts identified under Alternative 1.

<u>FACILITIES</u> - Facilities used by the DOE/NV would be closed and placed in cold standby. All facility support services performed by the DOE, Albuquerque would continue. Operational activities would be the same as those identified under Alternative 1. Joint-use infrastructure would remain the responsibility of the U.S. Air Force.

<u>UTILITIES</u> - Utilities would be maintained to ensure they are free of defects. Utilities not currently used would be shut down and stabilized to the extent possible so that they might be restarted and used at a later time. Water supply systems for DOE activities would remain operational to support DOE activities. The DOE wastewater flow to the sewage system would remain operational. The facultative lagoon would remain in operation and be maintained by the U.S. Air Force. Flows to remote location septic systems would cease as the facilities occupied by the DOE/NV are closed. All solid waste generated at the Tonopah Test Range would be contained in one solid waste disposal unit operated by the U.S. Air Force. This unit would not receive waste from the DOE/NV, but would continue to support all other operations at the Tonopah Test Range.

COMMUNICATIONS - The Tonopah Test Range has fully integrated communication systems of ground-to-ground and ground-to-air links using both radio frequency and land line equipment that ensures full support to test projects, administration, and emergencies. These site-support activities would remain open to support DOE, Albuquerque mission activities.

5.2.2.1.2 Airspace—The airspace over the Tonopah Test Range is Restricted Area R-4809. This airspace is managed by the DOE and is seldom authorized for joint use by civilian aircraft, with the exception of critical in-flight emergencies. Currently, limited flying operations occur over the range by the DOE and U.S. Air Force.

Defense Program. Under Alternative 2, the airspace would continue to be used by the U.S. Air Force and DOE, Albuquerque. Under this alternative, Defense Program activities would most likely be maintained at the current level of air traffic control and navigational aid service and airspace structure. Therefore, with the Defense Program, there would be no airspace or air traffic impacts.

Environmental Restoration Program. The discontinuation of Environmental Restoration Program activities would have no impact to airspace.

Work for Others Program. The Work for Others Program that is managed by DOE/NV and associated with defense-related programs would discontinue the use of the Tonopah Test Range airspace. Other DOE, Albuquerque Work for Others Program activities would continue at levels not to exceed those identified under Alternative 1. Airspace availability would continue to be coordinated between the U.S. Air Force and DOE, Albuquerque to ensure mission requirements are successful.

5.2.2.2 Transportation. The environmental impacts related to transportation activities as defined under Alternative 2 are discussed in the following sections. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.2.2.2.1 On-Site Traffic—The on-site activities would not produce a significant level (or amount) of traffic demand. Therefore, the traffic congestion impacts on the on-site roadways would be minimal.

5.2.2.2.2 Off-Site Traffic—Under Alternative 2, DOE/NV activities at the Tonopah Test Range would be restricted to site monitoring and security, which would generate only an occasional and minor amount of vehicular traffic (less than 25 vehicle trips per day) on the local access roads and on the immediate regional highway (U.S. Highway 6 near Tonopah). In 1993, the average daily traffic on U.S. Highway 6 near Tonopah amounted to 1,095 vehicles. This traffic volume would be far below the capacity of U.S. Highway 6 at this location (in the range of 10,000 to 20,000 vehicles per day). DOE, Albuquerque activities would not exceed levels discussed under Alternative 1. Therefore, there would be no traffic impacts on off-site roadways under Alternative 2.

5.2.2.2.3 Transportation of Materials and Waste—Transportation of materials and waste by DOE/NV from the Tonopah Test Range to authorized facilities, including the NTS, would not occur under Alternative 2. Transportation of materials and waste by the DOE, Albuquerque would be minimal and would not exceed those levels identified under Alternative 1; therefore, no impacts would result.

5.2.2.2.4 Other Transportation—The nature of anticipated activities on this site would not require a measurable transportation demand, direct use of local railroads, nor other modes of transportation. Therefore, direct or indirect effects on rail and other modes of transportation would be minimal.

5.2.2.3 Socioeconomics. The socioeconomic analysis has been prepared for the region of influence, regardless of where employees work. Therefore, the place of employment would not change the effects in any of the socioeconomic indicators. The analysis for this site is included in Section 5.2.1.3.

American Indian socioeconomic impacts due to fluctuations in DOE employment opportunities for *tribal members from the CGTO region of influence are discussed in Section 5.1.1.3.*

5.2.2.4 Geology and Soils. Under Alternative 2, impacts to geologic media, processes, or resources would be the same as those described for the NTS in Section 5.2.1.4.

5.2.2.5 Hydrology. The environmental impacts to surface hydrology and groundwater are described in the following sections.

5.2.2.5.1 Surface Hydrology—Under Alternative 2, impacts to surface hydrology would be the same as those described for the NTS in Section 5.2.1.5.

5.2.2.5.2 Groundwater—Under Alternative 2, the demand for water resources would remain at the same levels discussed for the NTS in Section 5.2.1.5. No significant adverse impacts to either groundwater supply or groundwater quality are anticipated.

5.2.2.6 Biological Resources. All scheduled activities would occur in previously disturbed areas. No habitat would be disturbed on the Tonopah Test Range under Alternative 2. The continued presence of radionuclides on 55 acres of land that would occur under this alternative should have no significant impact on biological resources unless those contaminants enter the regional groundwater.

Defense Program. No significant impacts on biological resources are anticipated.

Environmental Restoration Program. Under Alternative 2, contaminated sites on the Tonopah Test Range, including 55 acres contaminated with radionuclides, would be closed, without removal of contaminants. This might have a negative, but currently unquantifiable, impact on plant and animal populations living on or near that site that would be affected by those contaminants. However, it should not cause a decrease in the viability of populations. Those populations are widespread throughout the region, and the contaminants are limited to relatively small areas. The presence of contaminants in the environment should not affect threatened or endangered species or springs unless those contaminants enter the groundwater and are released at off-site springs.

Work for Others Program. No impacts to biological resources are anticipated as a result of Alternative 2.

Site-Support Activities. Under Alternative 2, the decrease in site-support activities would have no impact on biological resources.

5.2.2.7 Air Quality. Because none of the DOE/NV programs would occur at the Tonopah Test Range, no air quality impacts are expected. DOE, Albuquerque programs would continue at present levels; however, no significant air quality impacts would be expected.

5.2.2.8 Noise. Because none of the DOE/NV programs would occur at the Tonopah Test Range, no noise impacts are expected. DOE, Albuquerque programs would continue at levels not to exceed those identified under Alternative 1; no noise impacts are anticipated.

5.2.2.9 Visual Resources. Under Alternative 2, there would be little change in the overall appearance of the existing landscape. Therefore, impacts to visual resources would be negligible.

5.2.2.10 Cultural Resources. None of the DOE/NV programs would occur at the Tonopah Test Range; therefore, no impacts to cultural resources are anticipated.

AMERICAN INDIAN CULTURAL RESOURCES—This section describes the American Indian concerns associated with implementing Alternative 2, as summarized by the CGTO.

Defense Program—Under Alternative 2, there will be no belowground nuclear testing so American Indian cultural resources will not be adversely impacted.

Waste Management Program—Under Alternative 2, there will be no Waste Management Program on the Tonopah Test Range and none has been identified for this alternative, so it is expected that

American Indian cultural resources will not be adversely impacted.

Environmental Restoration Program—Under Alternative 2, it is expected that American Indian cultural resources will be adversely impacted if natural lands are scraped during environmental restoration. Access to culturally significant places will be increased if environmental restoration is successful, thus reducing Indian people's perception of health and spiritual risks associated with this area. Indian people wish to be involved in identifying environmental restoration methods and in the evaluation of restoration success.

Nondefense Research and Development Program—Under Alternative 2, it is expected that American Indian cultural resources will be adversely impacted if natural lands are scraped during nondefense research and development actions. At this time, no actions are planned for the Tonopah Test Range.

Work for Others Program—Under Alternative 2, it is expected that American Indian cultural resources will be adversely impacted if the Tonopah Test Range continues to be a place where weapons are researched and developed. These actions have and will continue to pollute these lands. American Indian cultural resources will continue to be adversely impacted by military training exercises and weapons tests.

5.2.2.11 Occupational and Public Health and Safety. Under Alternative 2, Defense Program activities at the Tonopah Test Range would continue as under Alternative 1. Table 5.2-9 summarizes the health and safety impacts to workers and the public for applicable Tonopah Test Range program areas under Alternative 2. Based on occupational injury and fatality rates for construction activities, the Defense Program at the Tonopah Test Range is expected to result in 2.5 injuries and 0.0044 fatalities to workers during construction activities over the 10-year period evaluated in the NTS EIS. During the same period, no injuries or fatalities are projected as a result of routine program activities.

Based on previous occupational radiation periods, occupational exposure to radiation is not expected to exceed a collective dose to Defense Program workers of about 6 person-rem in 10-years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 0.0025 latent cancer fatalities and 0.0010 other detrimental health effects in the worker population.

The risk of accidental exposure to radioactive or hazardous chemical releases contributes nearly zero increase to worker risk of latent cancer fatality or other detrimental health effects.

The health and safety impact to the public from potential Defense Program accidents at Tonopah Test Range could result in about 9.0×10^{-9} latent cancer fatalities and 4.1×10^{-9} other detrimental health effects in the population. The risk of a single cancer in the population due to accidental exposure to hazardous chemicals is estimated to be 1.0×10^{-10}. No noncancer effects to the public from chemical accidents would be expected to occur.

The maximum reasonably foreseeable radiological Defense Program accident at the Tonopah Test Range would be the same as described in Section 5.1.2.11 for Alternative 1 (a failure of an artillery fired test assembly, which has a probability of occurrence of 1×10^{-7} [(1 in 10,000,000)] per year).

For Defense Programs hazardous chemical effects at the Tonopah Test Range, the maximum reasonably foreseeable accident also would be the same as described in Section 5.1.2.11 for Alternative 1 (an explosion of a rocket test assembly containing depleted uranium and beryllium, which has a probability of occurrence of 6×10^{-6} [1 in 170,000] per year).

5.2.2.12 Environmental Justice. Environmental Justice impacts for the region of influence are discussed in Section 5.2.1.12.

American Indian concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival especially access violations.

Table 5.2-9. Health risks to workers and the public from program activities, Tonopah Test Range, Alternative 2

Program Area	Worker Health Risks						Public Health Risks			
	Occupational Safety Risks		Occupational Radiation Risks		Occupational Chemical Risks		Public Radiation Risks		Public Chemical Risks	
	Injuries	Fatalities	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers[c]	Chemical Hazard Index[d]	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers[c]	Chemical Hazard Index[d]
Defense	2.5	0.0044	0.0025	0.0010	8.4×10^{-12}	1.8×10^{-5}	9×10^{-9}	4.1×10^{-9}	1×10^{-10}	9.6×10^{-7}
Total	**2.5**	**0.0044**	**0.0025**	**0.0010**	**8.4×10^{-12}**	**1.8×10^{-5}**	**9×10^{-9}**	**4.1×10^{-9}**	**1×10^{-10}**	**9.6×10^{-7}**

a. Number of radiation-induced latent cancer fatalities in the exposed population associated with the activities conducted over the 10-year period of analysis
b. Number of radiation-induced detrimental health effects (e.g., nonfatal cancers, genetic effects) in the exposed population associated with the activities conducted over the 10-year period of analysis
c. Number of chemical-induced cancers (fatal and nonfatal) in the exposed population
d. A hazard index of greater than one indicates that the non-cancer health effects could be life-threatening to individuals exposed for one hour or more.

These impacts are discussed in Section 5.2.3.10, Cultural Resources, and Section 5.2.1.11, Occupational and Public Health and Safety. There has not been a systematic study of these issues for the Tonopah Test Range. The CGTO maintains that past, present, and future activities on the Tonopah Test Range have, do, or will have a disproportionate impact on these American Indian Environment Justice issues. Although Alternative 2 involves no new activities, it contains the possibility of adversely impacting American Indian Environmental issues. If DOE/NV Environmental Protection personnel are not available, there may be a difficulty establishing future consultation with the American Indian tribes through the CGTO. Therefore, it is essential to establish both the physical access to places and agreements that will facilitate access to these places. The CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study before new activities are approved.

5.2.3 Project Shoal Area

Under Alternative 2, all activities at the Project Shoal Area would be discontinued. The only program that is planned for the Project Shoal Area is the Environmental Restoration Program. Therefore, discontinuation of environmental restoration activities is the only program discussed for this site.

5.2.3.1 Land Use. Under Alternative 2, no significant impacts on surrounding land use as a result of Alternative 2 have been identified. The negligible existing baseline impacts of the DOE monitoring would continue under this alternative.

5.2.3.1.1 Site-Support Activities—No impacts as a result of site-support activities would occur under Alternative 2. Existing DOE monitoring activities would continue under this alternative.

5.2.3.1.2 Airspace—Under Alternative 2, the monitoring activities anticipated at the Project Shoal Area would not include direct use of air transportation. Therefore, there would be minimal effects on use of R-4812 airspace at the Project Shoal Area as a result of this alternative.

5.2.3.2 Transportation. The environmental impacts related to transportation activities as defined under Alternative 2 are discussed in the following sections. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.2.3.2.1 On-Site Traffic—Monitoring activities would require relatively few personnel (less than 10 people at any given time). There are no public roads on site. Minor vehicular traffic is anticipated; therefore, there would be no traffic impacts.

5.2.3.2.2 Off-Site Traffic—Monitoring activities would generate an occasional and minor amount of vehicular traffic (less than 100 vehicle trips per day) on the local access roads and on the immediate regional highway (U.S. Highway 50). Therefore, no traffic impacts would occur on off-site roadways under Alternative 2.

5.2.3.2.3 Transportation of Materials and Waste—No transportation of materials and waste would occur under Alternative 2. Therefore, no impacts would result from transport of waste.

5.2.3.2.4 Other Transportation—Under Alternative 2, monitoring activities at the site would result in minimal direct effects on rail and other modes of air transportation.

5.2.3.3 Socioeconomics. The socioeconomic analysis has been prepared for the region of influence, regardless of where employees work. Therefore, the place of employment would not change the effects in any of the socioeconomic indicators. The analysis for this site is included in Section 5.2.1.3.

American Indian socioeconomic impacts due to fluctuations in DOE employment opportunities for tribal members from the CGTO region of influence are discussed in Section 5.1.1.3.

5.2.3.4 Geology and Soils. No known geologic resources (aggregates, clay, coal, minerals, or fossils) would be adversely impacted at the Project Shoal Area if operations were discontinued. The site is not located on or near any known exploitable mineral resources, fossil beds, unique geologic outcrops, or other unique geologic features.

5.2.3.5 Hydrology. Under Alternative 2, the demand for water resources would be significantly decreased to levels required for environmental monitoring. No significant adverse impacts, either to water supply or water quality, are anticipated.

5.2.3.6 Biological Resources. Under Alternative 2, no habitat would be disturbed, and no other activities would be conducted that might impact plants or animals.

5.2.3.7 Air Quality. Because none of the programs occur at the Project Shoal Area, no air quality impacts are expected.

5.2.3.8 Noise. Because none of the programs occur at the Project Shoal Area, no noise impacts are expected.

5.2.3.9 Visual Resources. Under Alternative 2, none of the programs occur at the Shoal Test Area. Therefore, impacts to visual resources would not be expected.

5.2.3.10 Cultural Resources. Because none of the programs occur at the Project Shoal Area, no impacts to Cultural Resources are expected.

<u>AMERICAN INDIAN CULTURAL RESOURCES</u>—*This section describes the American Indian concerns associated with implementing Alternative 2, as summarized by the CGTO.*

This study area is not within the traditional lands of the Indian people represented by the CGTO. It is recommended by the CGTO that the DOE EIS team directly contact Indian tribes and organizations having traditional lands in the Project Shoal Area. The following tribes were suggested: Fallon Paiute, Walker River Paiute, Pyramid Lake, and Lovelock Paiute Tribes.

NOTE: The Fallon Paiute, Walker River Paiute, and Lovelock Paiute Tribes were contacted by the DOE in letters dated May 12, 1995.

5.2.3.11 Occupational and Public Health and Safety. Under Alternative 2, all operations at the Project Shoal Area would cease, except for security and environmental monitoring functions necessary for human health and safety, and security. No human health impacts are estimated for the major program areas because all projects and activities would be discontinued. Subsurface radioactivity from past underground nuclear weapons tests would continue to provide a potential exposure pathway for the public. Potential health impacts from this exposure scenario are the same as those described in Section 5.1.3.11 under Alternative 1.

5.2.3.12 Environmental Justice. Environmental Justice impacts for the region of influence are discussed in Section 5.2.1.12.

American Indian concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival especially access violations. These impacts are discussed in Section 5.2.3.10, Cultural Resources, and Section 5.2.1.11, Occupational and Public Health and Safety. There has not been a systematic study of these issues from the Project Shoal Area site.

This study area is not within the traditional lands of the American Indian people represented by the CGTO. It is recommended by the CGTO that the DOE EIS team directly contact American Indian tribes and organizations having traditional lands in the Project Shoal Area. The following tribes were suggested: Fallon Paiute, Walker River Paiute, Pyramid Lake, and Lovelock Paiute Tribes.

5.2.4 Central Nevada Test Area

The only program that would occur at the Central Nevada Test Area would be the Environmental Restoration Program. Therefore, the discontinuation of environmental restoration activities for this site are the only impacts discussed. Under Alternative 2, all activities at the Central Nevada Test Area would be discontinued.

5.2.4.1 Land Use. Under Alternative 2, all actions planned for the Central Nevada Test Area would be discontinued. No significant impacts on surrounding land use as a result of Alternative 2 have been identified. The negligible existing baseline impacts of the DOE monitoring would continue under this alternative.

5.2.4.1.1 Site-Support Activities—No impacts as a result of site-support activities would occur under Alternative 2. The existing impacts of the DOE monitoring activities would continue under this alternative.

5.2.4.1.2 Airspace—Fallon Naval Air Station intends to create military operating areas in three of Nye County's rural regions; they would be designated Smoky, Duckwater, and Diamond. The Central Nevada Test Area falls under the Duckwater military operating area. This airspace expansion has not yet been filed, but is not expected to impact monitoring activities at the Central Nevada Test Area. In addition, monitoring activities under Alternative 2 would not include direct use of air transportation. Therefore, there would be minimal effects on airspace at the Central Nevada Test Area as a result of Alternative 2.

5.2.4.2 Transportation. The environmental impacts related to transportation activities as defined under Alternative 2 are discussed in the following sections. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.2.4.2.1 On-Site Traffic—Under Alternative 2, monitoring activities would require relatively few personnel (less than 10 at any given time). There are no public roads currently on site, and the low level of personnel anticipated would generate only a minor amount of traffic.

5.2.4.2.2 Off-Site Traffic—Under Alternative 2, environmental monitoring would generate only an occasional and minor amount of vehicular traffic (less than 100 vehicle trips per day). In 1993, U.S. Highway 6 near Warm Springs carried 145 to 210 vehicles average daily traffic. This traffic volume is far below the capacity of U.S. Highway 6 at this location (ranging from 10,000 to 20,000 vehicles per day). Therefore, there would be no adverse traffic impacts on off-site roadways under Alternative 2; thus, no mitigation measures would be required.

5.2.4.2.3 Transportation of Materials and Waste—No transportation of materials and waste would occur at the Central Nevada Test Area under Alternative 2. Therefore, no impacts would result from the transport of waste.

5.2.4.2.4 Other Transportation—Because Alternative 2 does not assume direct use of local railroads, air transportation, or other modes of transportation to this site, direct effects on rail, air, and other modes of transportation would be minimal.

5.2.4.3 Socioeconomics. The socioeconomic analysis is being prepared for the region of influence, regardless of where employees work. Therefore, the place of employment would not change the effects in any of the socioeconomic indicators. The analysis for this site is included in Section 5.2.1.3.

American Indian socioeconomic impacts due to fluctuations in DOE employment opportunities for tribal members from the CGTO region of influence are discussed in Section 5.1.1.3.

5.2.4.4 Geology and Soils. No known geologic resources (aggregates, clay, coal, minerals, or fossils) would be adversely impacted at the Central Nevada Test Area if operations were discontinued. The site is not located on or near any known exploitable mineral resources, fossil beds, unique geologic outcrops, or other unique geologic features.

5.2.4.5 Hydrology. Under Alternative 2, the demand for water resources would be significantly decreased to levels required for environmental monitoring. No significant adverse impacts, either to water supply or water quality, are anticipated.

5.2.4.6 Biological Resources. Under Alternative 2, no impacts to plants or animals are anticipated.

5.2.4.7 Air Quality. Because none of the programs occur at the Central Nevada Test Area, no air quality impacts are expected.

5.2.4.8 Noise. Because none of the programs occur at the Central Nevada Test Area, no noise impacts are expected.

5.2.4.9 Visual Resources. Under Alternative 2, none of the programs occur at the Central Nevada Test Area. Therefore, impacts to visual resources would not be expected.

5.2.4.10 ***Cultural Resources.*** Under Alternative 2 none of the programs occur at the central Nevada Test Area. Therefore, no impacts to cultural resources are expected.

AMERICAN INDIAN CULTURAL RESOURCES—This section describes the American Indian concerns associated with implementing Alternative 2, as summarized by the CGTO.

Defense Program—Under Alternative 2, it is expected that American Indian cultural resources will be adversely impacted if further nuclear tests occur and if natural lands are scraped for construction. In this alternative, however, there are no plans for additional tests or construction at the Central Nevada Test Area.

Waste Management Program—Under Alternative 2, it is expected that American Indian cultural resources will not be impacted because there is no Waste Management Program on the Central Nevada Test Area and none has been identified for this alternative.

Environmental Restoration Program—Under Alternative 2, it is expected that American Indian cultural resources at the Central Nevada Test Area will be adversely impacted if natural lands are scraped during environmental restoration. Access to culturally significant places will be increased if environmental restoration is successful, thus reducing Indian people's perception of health and spiritual risks associated with this area. Indian people wish to be involved in identifying environmental restoration methods and in the evaluation of restoration success.

Nondefense Research and Development Program—Under Alternative 2, it is expected that American Indian cultural resources will be adversely impacted if the Central Nevada Test Area becomes a place where weapons are researched and developed. No such actions are planned for this alternative, so cultural resources will not be adversely impacted.

Work for Others Program—Under Alternative 2, it is expected that American Indian cultural resources will be adversely impacted if the Central Nevada Test Area becomes a place where weapons are researched and developed. No such actions are considered in this alternative, so American Indian cultural resources will not be adversely impacted.

5.2.4.11 ***Occupational and Public Health and Safety.*** Under Alternative 2, all operations at the Central Nevada Test Area would cease except for security and environmental monitoring functions necessary for human health and safety and security. No human health impacts are estimated for the major program areas because all projects and activities would be discontinued. Subsurface radioactivity from past underground nuclear weapons test would continue to provide a potential exposure pathway for the public. Potential health impacts from this exposure scenario are the same as those described in Section 5.1.4.11 under Alternative 1.

5.2.4.12 ***Environmental Justice.*** Environmental Justice impacts for the region of influence are discussed in Section 5.2.1.12.

The American Indian responses regarding Environmental Justice are discussed in Section 4.1.12. American Indian Environmental Justice concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival especially access violations. These impacts are discussed in Section 5.2.4.10, Cultural Resources, and 5.2.1.11, Occupational and Public Health and Safety. There has not been a systematic study of these issues for the Central Nevada Test Area. The CGTO maintains that past, present and future activities on the Central Nevada Test Area have, are, or will impact these American Indian Environmental Justice issues. Alternative 2 contains no new activities, it contains the possibility of adversely impacting these issues. Even though the CGTO has not been permitted to visit the area, the area is especially important due to the concentration of cultural resources. Therefore, this area provides a special opportunity for the DOE to undue past Environmental Justice impacts. The CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice Study, before new activities are approved.

Program-by-program responses are assessed in Section 5.1.1.12 and are not repeated here.

5.3 Alternative 3 - Expanded Use

Alternative 3, Expanded Use of the NTS, is defined as the increased support of both defense and nondefense programs. This alternative includes support for the ongoing DOE/NV missions, as described under Alternative 1, with the addition of many new activities within each program. Alternative 3 includes programs at the NTS, portions of the NAFR Complex, the Tonopah Test Range, the Project Shoal Area, the Central Nevada Test Area, and three Solar Enterprise Zone locations: Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley. The description of Alternative 1 activities is presented in Section 5.1. Therefore, this section summarizes only the additional activities that would be included under Alternative 3. A detailed description of the activities is presented in Appendix A.

Defense Program. Stockpile stewardship, stockpile management, nuclear emergency response, and storage and disposition of weapons-usable fissile material would be the four categories of activities included in the Defense Program under Alternative 3. Stockpile stewardship would consist of the same activities as under Alternative 1 with the addition of more complex hydrodynamic tests and dynamic experiments, advanced nuclear weapons simulators, the National Ignition Facility, and a new large, heavy industrial facility. Stockpile management would be made up of interim storage of nuclear weapons and construction of a stockpile management complex. Nuclear emergency response activities would be the same as those described under Alternative 1. The DOE would be responsible for the management, storage, and disposition of weapons-usable fissile materials from the nation's nuclear weapons dismantlement and weapons production processes.

Waste Management Program. As with Alternative 1, waste management activities at the NTS would continue to be conducted in four primary areas: Areas 3, 5, 6, and 11. The additional waste management activities that would be implemented under Alternative 3 for each area are described below.

The Area 3 Radioactive Waste Management Site activities would be increased to levels consistent with the centralized alternative in the Waste Management Draft Programmatic EIS. Three additional low-level waste disposal craters, one support building, and a truck decontamination facility would be constructed. All new waste disposal facilities will be designed and constructed to meet all applicable regulations. Closure of the additional disposal units would occur when they become full.

The radioactive and mixed waste disposal activities at the Area 5 Radioactive Waste Management Site would be increased to meet the need of additional DOE generators identified to ship waste to the NTS. Two additional low-level waste disposal pits would be opened (pending the approval of a modification to the Resource Conservation and Recovery Act Part B permit) and 20 mixed waste disposal cells would be prepared. Other construction would include a Class I sanitary landfill, a mixed waste storage unit, a low-level storage unit, a Waste Examination Facility, a real-time radiography building, a cotter concentrate treatment facility, and a new access building.

Waste management operations in Area 6 under Alternative 3 would be the same as those described under Alternative 1.

The Area 11 Explosive Ordnance Disposal Unit activities under Alternative 3 would be the same as those described under Alternative 1, except that treatment operations would be increased to a level near maximum capacity.

Environmental Restoration Program. Environmental Restoration Program activities would continue as described under Alternative 1, but would be accelerated. Expanded uses may require cleanup level adjustment in accordance with the applicable environmental requirements.

Nondefense Research and Development Program. Under Alternative 3, the changes in Nondefense Research and Development Program activities include the construction and operation of a Solar Enterprise Zone facility, increased activities at the Spill Test Facility, and increased technology development activities.

Work for Others Program. Activities would be the same as those described under Alternative 1.

5.3.1 Nevada Test Site

The impacts that would occur at the NTS as a result of Alternative 3 are presented in this section.

5.3.1.1 Land Use. Alternative 3 would result in 5,809 acres of new ground disturbance resulting in a total of 64,500 acres compared to 58,729 acres of existing ground disturbance. Most of the new disturbance would be for new facility construction, especially a Solar Enterprise Zone facility (2,402 acres). The Defense Program would contribute 1,000 acres of new disturbance; the Waste Management Program, 209 acres; the Environmental Restoration Program, 51 acres; the Nondefense Research and Development Program, 4,582 acres; the Work for Others Program, 10 acres; and the site-support activities would contribute 30 acres.

Defense Program. Under Alternative 3, the High-Explosive Test Zone acreage would increase from 176 km^2 (68 mi^2) to 422 km^2 (163 mi^2) of land area. All 130 km2 (50 mi^2) of the former Critical Assembly Zone in Area 27 would become part of the Reserved Zone and would become available for diverse short-term testing and experimentation or short-duration exercises and training, such as those associated with Nuclear Emergency Search Team, Federal Radiological Monitoring and Assessment Center, and DoD land navigation. Alternative 3 also includes the creation of a 49-km^2 (19-mi^2) Defense Industrial Zone for stockpile management of weapons, including production; assembly; disassembly or modification; staging, repair, retrofit, and surveillance; and construction of a large, heavy industrial facility. Also included in this zone would be permanent facilities for stockpile stewardship operations involving equipment and activities such as radiography, lasers, special nuclear materials processing, and explosive-pulsed power.

In North Las Vegas the principal impact of the proposed National Ignition Facility project on land use at the North Las Vegas Facility would be the conversion of limited vacant land, which would not be available for other uses. The proposed National Ignition Facility would require about 8 acres, which represents approximately 10 percent of the total land area at the North Las Vegas Facility and 56 percent of land available for development at the North Las Vegas Facility. The impact of this conversion would be reduced somewhat by the existence of other areas on the site that would remain open for future development. Potential onsite impacts to land use could also result from required waste and water system upgrades, but the presence of the National Ignition Facility should not preclude future land uses for development in the city of North Las Vegas or Clark County.

Waste Management Program. Alternative 3 would not involve the expansion of the Radioactive Waste Management Zones in Areas 3 or 5. The land-use areas for solid waste landfills could be expanded to accommodate increased on-site municipal wastes and solid wastes from surrounding rural counties.

Environmental Restoration Program. Characterization and cleanup activities would be commensurate with the designated land uses at the site. Environmental restoration is not considered a land-use designation, but it is an activity required for characterization and re-use of lands and facilities.

Nondefense Research and Development Program. Under Alternative 3, the Nondefense Research and Development Program would designate approximately 62 km^2 (24 mi^2) of land area as a Solar Enterprise Zone. All other activities proposed for this program would be conducted in areas appropriately zoned for the activity.

Work for Others Program. Under Alternative 3, the Research Test Experiment Zone would be designated for defense-related small-scale research and development projects, demonstrations, pilot projects, and outdoor tests and experiments for the development, quality assurance, or reliability of materials and equipment under controlled conditions. This zone area would increase from 36 km2^2 to 298 km^2 (14 mi^2 to 115 mi^2).

5.3.1.1.1 Site-Support Activities—Under Alternative 3, the NTS site-support activities would be modernized and expanded to the extent necessary to provide support for existing activities, as well as new projects and activities not previously conducted at the NTS.

FACILITIES—It is anticipated that the Control Point 1 and Mercury cafeterias would undergo minor renovation. In Area 23, Buildings 117 (offices) and 650 (the medical facilities and laboratory) would be expanded and renovated or modified. A new records management building would be constructed in Area 23, and the existing bulk fuel storage facility in Area 23 would be upgraded.

Current maintenance levels of existing off-site government-owned facilities would continue. The DOE and contractor personnel currently in leased facilities would relocate to the North Las Vegas facility. The North Las Vegas and Remote Sensing Laboratory Facility would be expanded to accommodate additional employees.

SERVICES—Law enforcement, security, fire protection, and health services would be expanded as required with this alternative.

UTILITIES—Power utilities at the NTS would be modified and expanded. The main electrical power substation on the line from Las Vegas would be replaced with a modern substation. A new switching center would be installed, and significant sections of the power grid would be upgraded. Water wells and supply lines would be installed, as necessary, depending on the location of future projects. Waste-handling systems would be built, as necessary, with environmental acceptability as a primary concern.

The NTS substation for the main 138-kV supply line from Las Vegas would be replaced with a modern substation. Along with this modernization, a new switching center and a switching station would be built. The existing 34.5-kV loop that extends primary supply into the forward areas of the NTS would be upgraded at the Area 2 substation. This upgrade would provide a backup feed line to the Rainier substation. There would be no significant increase to the approximately 427 km (265 mi) of primary and secondary power supply lines used on the NTS.

COMMUNICATIONS—Communications systems would be upgraded, mobile radio systems would be replaced with modern digital systems, and monitoring systems would be consolidated. Telephone communications would be enhanced with a modern microwave system and a paging terminal and controller. Fiber-optic links would be extended to facilities requiring extensive data communication capabilities.

The approximately 60 radio systems and 3,500 mobile units would be replaced with a digitally trunked mobile radio system. Administrative issues associated with the change, such as procedures and training, would be modified accordingly. Central monitoring of NTS radio nets maintained at Station 900 would be consolidated and enlarged to provide greater access for equipment and maintenance. This station would function primarily as an emergency reporting point for both radio and telephone. The public safety network, which provides coverage to most of Nevada and portions of nearby states, would be upgraded.

The central hub for telephone communications would be relocated to the Nevada Support Facility in North Las Vegas. The microwave portion of the system would be replaced with state-of-the-art microwave equipment, and the paging terminal and controller would be replaced to provide the highest level of flexibility. Additional Aspen voice mail systems would be added, as necessary, to the Octel maximum system that currently services the DOE/NV community.

The NTS would continue to operate the two existing mail systems. Little or no expansion is anticipated for either of the mail systems as a result of this alternative.

5.3.1.1.2 Airspace—Under Alternative 3, there could be an increase in flying time between commercial airports within and outside Nevada. An increase in the number of operations is also projected. However, this alternative would most likely maintain the current level of air traffic control and navigational aid services, as well as the same airspace structure. Based on past trends and on improvements in communication, this alternative might cause modification and extended flight times for civilian aircraft.

The only activities that would affect airspace would be defense related. Therefore, only Defense and Work for Others Programs will be discussed and evaluated. However, occasional helicopters and fixed-wing aircraft carrying supplies and personnel are anticipated for all programs.

Defense Program. Under Alternative 3, there would be an increase in the support for ongoing defense-related activities located at the NTS, possibly resulting in the increase of air traffic operations. Assuming a 2-percent annual increase, operations would increase by approximately 20 percent over the 10-year study period. This would require additional coordination with other federal agencies to ensure all missions are accommodated.

Work for Others Program. Under Alternative 3, the Work for Others Program activities would cause an increase in the use of the NTS airspace by the DoD for training and defense-related research and development. No commercial air passenger, general aviation, or air cargo activities would occur within the NTS airspace. (Occasional DOE-related aircraft operations carrying supplies and personnel or for emergency operations might take place.) The continuation of operations at the NTS under the Work for Others Program within this alternative would require additional coordination with other military operations and activities to ensure both missions are accommodated.

5.3.1.2 Transportation. The following sections contain the discussion of the environmental impacts related to transportation activities as defined under Alternative 3. The analysis of transportation impacts is presented with respect to on-site traffic, off-site traffic, transportation of materials and waste, and other transportation.

5.3.1.2.1 On-Site Traffic—Traffic generated within the NTS as a result of land uses, projects, and activities associated with Alternative 3 is estimated to be 16,310 vehicle trips per day. Table 5.3-1 shows the average daily trip generation for each program. The daily trips were distributed on site based on existing travel patterns for commuters and the current NTS areas affected by each program.

Table 5.3-2 summarizes the average daily traffic volume for the key roadways on the NTS for Alternative 3. The portion of the average daily traffic volume that would be attributable to each program is also provided. All key on-site roadways have capacities exceeding 2,000 vehicles per hour for both directions combined (Transportation Research Board, 1994). A comparison of capacity to the volumes assigned to each segment on Table 5.3-2 shows that no roadway would experience significant traffic congestion under Alternative 3.

Defense Program—Traffic generated on the roads within the NTS as a result of projects and activities associated with the Defense Program is estimated to be 2,450 average daily trips under Alternative 3. There would be no adverse effects on traffic flow as a result of the Defense Program.

Waste Management Program. Traffic generated on the roads within the NTS as a result of projects and activities associated with the Waste Management Program is estimated to be 1,215 average daily trips under Alternative 3. The Radioactive Waste Management Sites in Areas 3 and 5 would continue operations as described in Alternative 1, with an increase in the scope of service to the entire DOE complex (DOE, 1995b). Projections indicate that the number of inbound shipments from off-site generators would be approximately 4,000 shipments per year, during the next 10 years, for an average of 20 shipments per day. The number of on-site generated waste shipments would remain at six shipments per day, as described under Alternative 1.

Road 5-01, the access to the Radioactive Waste Management Site in Area 5, is scheduled for improvement by the second quarter Fiscal Year 1997. The improvement project is described under Alternative 1 in Section 5.1.1.2.1. No adverse effects on traffic flow would occur as a result of the Waste Management Program.

Table 5.3-1. Average on-site daily trip generator (one-way trips) by program, Alternative 3

Program	Trips per Day On site	Difference from Alternative 1
Defense	2,450	+ 1,815
Waste Management	1,215	+ 1,070
Environmental Restoration	1,400	+ 1,010
Nondefense Research and Development	6,080	+ 5,900
Work for Others	1,130	+ 990
Site-Support Activities	4,035	+ 2,155
Total	**16,310**	**+12,940**

Environmental Restoration Program. Traffic generated on the roads within the NTS as a result of projects and activities associated with the Environmental Restoration Program is estimated to be 1,400 average daily trips under Alternative 3. No adverse effects on traffic flow would occur as a result of the Environmental Restoration Program.

Nondefense Research and Development Program. Traffic generated on the roads within the NTS as a result of projects and activities associated with the Nondefense Research and Development Program is estimated to be 6,080 average daily trips under Alternative 3. Traffic volumes on Jackass Flats Road, Cane Spring Road, and that portion of Mercury Highway that is south of Cane Spring Road would be approximately 3,000 vehicles per day for each segment, representing a substantial increase over Alternative 1. These volumes, however, represent on-site trips that were assumed to be uniformly distributed throughout the day. This, together with the fact that all on-site trips were also assumed to have an endpoint in Mercury, shows that no adverse effects on traffic flow would occur as a result of the Nondefense Research and Development Program.

Work for Others Program. Traffic generated on the roads within the NTS as a result of projects and activities associated with the Work for Others Program is estimated to be 1,130 average daily trips under Alternative 3. No adverse effects on traffic flow would occur as a result of the Work for Others Program.

Site-Support Activities. Traffic generated on the roads within the NTS as a result of site-support activities is estimated to be 4,035 average daily trips under Alternative 3. No adverse effects on traffic flow would occur as a result of site-support activities.

5.3.1.2.2 Off-Site Traffic—Under Alternative 3, on-site NTS employment would be increased relative to the future baseline (Alternative 1). Correspondingly, an increase in daily vehicle trips and traffic volume on key roadways is anticipated.

This increase in vehicle trips was estimated for each roadway segment and added to the baseline to obtain the overall vehicle trips for the project.

Traffic impacts were determined based on level of service changes for each of the key roads analyzed. The major traffic generators at the site resulting from various programs under Alternative 3 are the additional construction and operation employees (totaling 389 employees in 1996; 3,011 employees in 2000; and 2,051 employees in 2005) and their associated activities. Note that the employment figures represent the increment above the baseline

Table 5.3-2. Average daily traffic volumes on key NTS roadway segments under Alternative 3

		Average Daily Traffic Volume						
Roadway	**Segment**	**Defense**	**Waste Management**	**Environmental Restoration**	**Nondefense Research and Development**	**Work for Others**	**Site Support**	**Total**
North								
Buckboard Mesa Rd.	Pahute Mesa Rd. to Airport Rd.	245	0	110	0	0	0	**355**
Mercury Hwy.	Tippipah Hwy. to Ranier Mesa Rd.	490	245	325	0	0	0	**1,060**
Pahute Mesa Rd.	Mercury Hwy. to Stockade Wash Rd.	490	0	215	0	0	0	**705**
Pahute Mesa Rd.	Stockade Wash Rd. to Buckboard Mesa Rd.	245	0	110	0	0	0	**355**
Ranier Mesa Rd.	Mercury Hwy. to Tippipah Hwy.	490	0	110	0	0	0	**600**
Tippipah Hwy.	Mercury Hwy. to Pahute Mesa Rd.	980	0	430	0	0	0	**1,410**
Tippipah Hwy.	Pahute Mesa Rd. to Ranier Mesa Rd.	0	0	110	0	0	0	**110**
South								
Cane Spring Rd.	Lathrop Wells Rd. to Mercury Hwy.	0	0	110	3,000	520	0	**3,630**
Jackass Flats Rd.	Mercury Hwy. to Lathrop Wells Rd.	0	0	325	3,040	565	0	**3,930**
Lathrop Wells Rd.	U.S. Highway 95 to Jackass Flats Rd.	0	0	110	40	45	0	**195**
Mercury Hwy.	Mercury Hwy. to Road 5-01	1,960	1,215	970	3,000	520	405	**8,070**
Mercury Hwy.	Road 5-01 to Cane Spring Rd.	1,960	305	860	3,000	520	405	**7,050**
Mercury Hwy.	Cane Spring Rd. to Tippipah Hwy.	1,960	305	860	0	0	405	**3,530**
Road 5-01	Mercury Hwy. to Area 5 RWMS	0	790	110	0	0	0	**900**
Road 5-07	Mercury Hwy. to Area 5 RWMS	0	120	0	0	0	0	**120**

NOTE: RWMS= Radioactive Waste Management Site.

figures (Alternative 1). Table 5.3-3 shows a summary of average daily vehicle trips increase by each program activity for the years 1996, 2000, and 2005. The year 2000 represents a peak in the increased number of trips.

Under Alternative 3, the NTS access road (State Route 433) would experience the greatest increase in traffic during the peak hour (in one direction). This increase would be 40 vehicles in 1996, 300 in 2000, and 200 in 2005. Similarly, 30 vehicles would be added in 1996 to the Mercury interchange ramps serving Las Vegas, 250 vehicles in 2000, and 135 in 2005. Approximately 100 to 250 vehicles would be added to U.S. Highway 95 between Mercury and Las Vegas in 2000. Most other roadway segments would generally experience less than 100 additional vehicles during the peak hour. This figure would be less by 20 for segments in remote areas. The projected peak-hour traffic on key roads and the associated level of service that would result under Alternative 3 for 1996, 2000, and 2005 are shown in Table 5.3-4.

Based on Association of American State Highway and Transportation Officials standards, level of service B is appropriate for freeways; arterials; and rural, level, or rolling terrain. Level of service C is appropriate for rural (mountainous), urban, and suburban highways. For local roads, level of service D is appropriate in all terrain (AASHTO, 1990).

Under Alternative 3, the access highway to the site (State Route 433) would operate at level of service C in 1996 and level of service D in 2000 and 2005. According to Association of American State Highway and Transportation Officials standards and considering this access to be a local highway, level of service D is acceptable. Roadway ramps at the Mercury interchange would continue to operate at level of service B. U.S. Highway 95 east of Mercury would continue to have excess capacity and would operate at level of service A. However, U.S. Highway 95 north of the Mercury interchange would likely operate at level of service D by 2005.

On the other hand, key roads within metropolitan Las Vegas (segments of Interstate 15, U.S. Highway 95, and U.S. Highway 93) already operate at levels of service ranging from A to F, and by 2000, they would all deteriorate to unacceptable level of service F. These conditions would prevail even without Alternative 3 because of cumulative traffic growth (recreational, regional, and commuter traffic). U.S. Highway 93 at Hoover Dam (rural and mountainous) already operates at unacceptable level of service F, and its level of service would continue to deteriorate further with or without this alternative, owing to its geometry (steep grades and narrow curves) and partially to its moderate traffic volume and truck traffic. All other key roadways would continue to operate at level of service C or better. These conditions would prevail with or without Alternative 3 and with or without any single program activity. The following sections address the contribution of each program activity to traffic impacts. The trips discussed for each program account for construction and operations activities generated by the site and occurring at the access road off U.S. Highway 95.

Defense Program. With the Defense Program, 40 additional daily vehicle trips in 1996, 350 in 2000, and 350 in 2005 would be generated. Except for site support, the defense-related activities would have the highest number of daily vehicle trips, peak-hour vehicles, and the most traffic impacts. The defense activities would contribute 34 percent to total trips added under Alternative 3 in 2005.

Waste Management Program. Under Alternative 3, the Waste Management Program would add 130 vehicle trips on a typical weekday in 2005. The number of daily vehicle trips added would amount to less than 13 percent of trips added by all programs.

Environmental Restoration Program. Under Alternative 3, Environmental Restoration Program activities are expected to be accelerated relative to Alternative 1. The largest number of trips added is expected to be approximately 90, or 9 percent of the total in 2005.

Nondefense Research and Development Program. Under Alternative 3, approximately 40 vehicle trips would be added with this program on a typical weekday. In 2005, the Nondefense activities would contribute less than 4 percent to the total number of daily vehicle trips.

Table 5.3-3. Average daily vehicle trip increase off site under Alternative 3

Program	1996	2000	2005
Defense	40	350	350
Waste Management	20	130	130
Environmental Restoration	30	90	90
Nondefense Research and Development	10	40	40
Work for Others	10	10	10
Site-Support Activities	100	900	410
Total (all programs)	**210**	**1,520**	**1,030**

NOTE: All values are rounded to the nearest 10. Daily trips shown are defined as one-way vehicle trips or vehicle trip ends. Trips shown are the increase from Alternative 1.

Table 5.3-4. Peak-hour traffic volumes and level of service on key off-site roads under Alternative 3 (Page 1 of 2)

Roadway Segments	Capacity VPH[a]	1996 DDHV[b]	1996 LOS[c]	2000 DDHV	2000 LOS	2005 DDHV	2005 LOS
Regional							
I-15 at California/Nevada state line	6,800	2,984	E	3,774	F	4,724	F
I-15 north of Sahara Avenue interchange	10,200	7,343	F	9,188	F	11,226	F
I-15 north of the Downtown Expressway interchange	10,200	4,439	E	5,647	F	7,042	F
I-15 just north of the 'D' and Washington interchange	10,200	4,076	D	5,190	F	6,468	F
I-15 north of the Cheyenne interchange	6,800	1,911	C	2,763	D	3,712	F
I-15 south of the Lamb Blvd. interchange	6,800	658	A	901	A	1,129	B
I-15 north of West Mesquite interchange (Nevada/Utah state line)	6,800	637	A	899	A	1,207	B
I-80 east of Apex interchange (California/Nevada state line)	6,800	1,758	C	2,019	C	2,327	C
I-80 east of the West Wendover interchange (Nevada/Utah state line)	6,800	329	A	424	A	524	A
Local							
U.S. Hwy. 95 south of Jones Blvd. interchange	10,200	7,341	F	9,339	F	12,645	F
U.S. Hwy. 95 north of Sunset Road interchange (East Las Vegas)	6,800	2,597	D	3,288	F	4,113	F
Rancho Road (SR 599) east of the northern U.S. Hwy. 95/Rancho Road interchange	6,800	1,234	B	2,169	D	3,033	E
U.S. Hwy. 95 south of SR 157 north of Las Vegas	6,800	873	A	1,224	B	1,300	B
U.S. Hwy. 95 just east of Mercury interchange	6,800	390	A	633	A	553	A
U.S. Hwy. 95 just south of Boulder City	2,220	599	C	633	C	680	C
U.S. Hwy. 95 interchange at Mercury							
Southbound off-ramp	1,300	42	B	75	B	57	B
Southbound on-ramp	1,300	274	B	489	B	409	B
Northbound off-ramp	1,300	274	B	489	B	409	B
Northbound on-ramp	1,300	42	B	75	B	37	B
SR 433, 0.32 km (0.2 mi) north of the Mercury interchange (access to NTS)	2,200	329	C	588	D	291	D

Table 5.3-4. Peak-hour traffic volumes and level of service on key off-site roads under Alternative 3 (Page 2 of 2)

Roadway Segments	Capacity VPH[a]	1996 DDHV[b]	1996 LOS[c]	2000 DDHV	2000 LOS	2005 DDHV	2005 LOS
U.S. Hwy. 95, 6.1 km (3.8 mi) north of Mercury interchange	2,200	286	C	348	C	390	D
U.S. Hwy. 95 at Amargosa Valley to Beatty	2,000	64	A	82	A	86	A
U.S. Hwy. 95 north of Beatty	2,000	176	B	206	B	226	C
SR160 south of U.S. Hwy. 95	2,000	75	A	103	B	120	B
U.S. Hwy. 93 south of the Nevada/Arizona state line at Hoover Dam	1,500	824	F	1,012	F	1,209	F
U.S. Hwy. 93 east of Westbound off-ramp of Railroad Pass interchange	6,840	2,710	E	3,324	F	3,976	F
U.S. Hwy. 93 north of I-15/U.S. Hwy. 93 interchange	2,000	137	B	193	B	225	C
U.S. Hwy. 93 south of SR 375 junction near Crystal Springs	2,000	134	B	172	B	200	B
U.S. Hwy. 93 west of SR 375 junction near Crystal Springs	2,000	49	A	68	A	72	A
SR 375 west of U.S. Hwy. 93 junction at Crystal Springs	1,500	33	A	46	A	43	A
SR 375 east of Warm Springs	1,500	15	A	27	A	23	A
U.S. Hwy. 6 east of Warm Springs at SR 375 junction	1,700	17	A	29	A	25	A
U.S. Hwy. 6 west of Warm Springs at SR 375 junction	1,700	23	A	35	A	32	A
U.S. Hwy. 6 east of Tonopah, west of SR 376	1,700	100	B	103	B	86	A

[a] Vehicles per hour
[b] Directional design hourly volume (one direction)
[c] Level of service
Note: SR = State Route.

Work for Others Program. Under Alternative 3, employees of the Work for Others Program would add 10 vehicle trips per day.

Site-Support Activities. Site-support activities are expected to add 900 additional vehicle trips in 2000 and 410 in 2005. These trips account for operations activities related to roads, utilities, communications, and other site support. Under Alternative 3, these activities would contribute to approximately 60 percent of the total number of increased daily trips in 2000.

5.3.1.2.3 Transportation of Materials and Waste—Alternative 3 represents a significant increase in the mission of the NTS. The majority of the activities under this alternative are associated with Defense and Waste Management Program activities.

Activities identified for the Defense Program include added responsibilities for the stockpile stewardship mission. Besides the NTS's primary mission of readiness to test nuclear weapons other activities include relocation of assembly/ disassembly activities and management of special nuclear materials (plutonium pits) and other highly explosive materials. The transportation of nuclear explosive materials are required for the following reasons for this alternative:

- Weapons currently stored at classified DoD facilities are returned to the NTS for dismantlement.
- Weapons are returned to the identified assembly area for testing, modification upgrades, and certain component replacement.
- Weapons are returned to DoD facilities upon completion of modification or test of the unit.
- Weapons are shipped between the DOE and DoD facilities for field testing of subsystems.

Under Alternative 3, the Waste Management Program activities also increase based on the DOE mission. The projected generators, waste types, volumes, and shipments are given in Tables 5.3-5 and 5.3-6. Table 5.3.-5 reflects a 10-year average estimate of LLW volumes and shipments by generator sites for Alternative 3. The yearly average for LLW, ignoring NTS generated LLW, is approximately 2,460 shipments/year. The estimates were derived from current waste storage volumes provided by Waste management Draft Programmatic EIS and the projected generated rate for the next 10 years. These volumes and sources are based on the best available information and volumes may change based on the final Waste Management Programmatic EIS or updated waste load inventories or projections from the respective sites. Table 5.3-6 reflects a ten-year average estimate of MW volumes and shipments by generator sites for Alternative 3. The yearly average for MW, ignoring NTS generated MW, is approximately 1,540 shipments/year. Specific detail about DOE-related transportation activities, including associated risk and routes, is provided in Appendix I.

Defense Program. For this EIS, it was assumed that there would be a maximum number of special nuclear material and other high-explosive materials shipments of 2,100 to the NTS. This includes approximately 140 test devices shipments, 1,590 nuclear and high explosives, and 360 plutonium pit shipments. These activities support projected activities associated with underground nuclear testing, assembly/disassembly activities and storage of special nuclear material, and other associated high explosives. On site at the NTS the only hazard would be from the 32 to 40 km (20 to 25 mi) of roadway that the safe-secure trailer would travel; a group of flammable-liquid storage tanks, protected by dikes, is located near Mercury, about 31 m (100 ft) off the roadway.

The health risk estimates from the transportation of Defense Program special nuclear materials were calculated using the model, ADROIT. This model calculates the risk from both incident-free transport and vehicular accidents. The incident-free radiological risk of Latent Cancer Fatalities is 2.14×10^{-3}, the nonradiological risk of health effects from vehicle emissions is 4.01×10^{-3}. The expected number of traffic fatalities is 1.06×10^{-2}. The accident-initiated radiological risk is 1×10^{-6}.

Waste Management and Environmental Restoration Programs. The health risks of transporting low-level waste and mixed waste on the highway were calculated. The results of the transportation risks along the entire route for the 10-year duration of this alternative are shown in Table 5.3-7. Eight vehicle-related fatalities and 108 injuries are estimated. Less than one (0.077) latent cancer fatality is expected. The risks associated under Alternative 3 are higher than the other alternatives because of the large volumes of waste and the greater number of shipments and miles traveled.

Inside Nevada, the vehicle-related fatalities are less than one (0.07), and four injuries are estimated. It is estimated that 0.01 latent cancer fatality would occur in 10 years. Approximately two fatalities and two injuries are expected from on-site transportation of NTS-generated waste and on-site transportation of waste generated off site and shipped to the NTS.

The consequence and probability of the maximum foreseeable accident were calculated for both low-level and mixed waste shipments to the NTS. The most severe consequence from a low-level waste accident would be 2.25×10^{-3} latent cancer fatalities, and 1.04×10^{-3} radiation detriments. The incident free nonradiological risk for waste shipments is 1.20×10^{-2}. The maximum probability of occurrence of this accident would be 8.08×10^{-3}.

For an accident involving mixed waste the radiological consequence would be the same as the low-level waste. For the hazardous chemical portion of the mixed waste, the most severe chemical-induced cancer consequence is 1.1×10^{-6} and the hazard index for the most severe chemical-induced non-cancer is 0.38. The maximum probability of this accident occurring is 3.23×10^{-3}.

5.3.1.3 Socioeconomics. The potential socio-economic effects under Alternative 3 are discussed in this section. The description of socioeconomic

Table 5.3-5 Low-level waste volumes and shipments by generator site[a] under Alternative 3

Generator Site	10-year Volume Projection (m^3)[b]	(yd^3)	Number of Shipments[d]
Aberdeen Proving Ground	790	1,033	21
Ames Laboratory	1,232	1,611	32
Argonne National Laboratory-East	11,265	14,734	296
Bettis Atomic Power Laboratory	9,775	12,788	257
Brookhaven National Laboratory	3,264	4,269	86
Energy Technology Engineering Center	614	803	16
Fermi Laboratory	2,165	2,832	57
Fernald Environmental Management Project	84,177	110,099	2,213
Hanford	170,891	223,517	4,492
Idaho National Engineering Laboratory and Argonne National Laboratory-West	106,934	139,864	2,811
Knolls Atomic Power Laboratory-Kesselring	15,554	20,344	409
Lawrence Berkeley Laboratory	5,099	6,669	134
Lawrence Livermore National Laboratory	1,928	2,522	51
Los Alamos National Laboratory	41,773	54,637	1,098
Inhalation Toxicology Research Institute	344	450	9
Mound	60,027	78,512	1,578
Nevada Test Site	150,000	654	14,000
Oak Ridge National Reservation	26,607	34,801	699
Paducah Gaseous Diffusion Plant	16,996	22,230	447
Pantex Plant	769	1,006	20
Portsmouth Gaseous Diffusion Plant	63,512	83,071	1,670
Princeton Plasma Physics Laboratory	187	245	5
RMI Extrusion Plant	5,528	7,230	146
Rocky Flats Environmental Technology Site	13,759	17,996	2,012
Sandia National Laboratories, CA	219	286	6
Savannah River Site	243,901	319,011	6,411
Stanford Linear Accelerator	3,694	4,832	97
Sandia National Laboratories, NM	351	459	9
West Valley Demonstration Project	67	88	2
Total[g]	**1,041, 422**	**1,362,129**	**39,084**

[a] All volumes are derived from the 1994 Integrated Data Base (DOE, 1995a) and the Waste Management Programmatic EIS (DOE, 1995b) projections. The sites and volumes may change based on the final WMP EIS or updated waste load inventories or projections from the respective DOE sites.
[b] Cubic meters
[c] Cubic yards
[d] Assumes the majority of containers are 1-m x 1-m x 2m (4-ft x 4-ft x 7-ft) boxes
[e] Assumes an average of 12 containers per shipment
[f] Low-level waste
[g] Including internally generated waste.

Table 5.3-6 Mixed waste volumes and shipments by generator site[a], Alternative 3

Generator Site	10-year Volume Projection (m^3)[b]	(yd^3)[c]	Number of Shipments[d,e]
Ames Laboratory	1	1	1
Argonne National Laboratory-East	6,700	8,763	181
Bettis Atomic Power Laboratory	40	52	1
Hanford	120,000	156,954	3,243
Idaho National Engineering Laboratory and Argonne National Laboratory-West	47,390	61,984	1,281
Knolls Atomic Power Laboratory-Kesselring	150	196	4
Lawrence Berkeley Laboratory	4,300	5,624	116
Los Alamos national Laboratory	2,700	3,532	73
Nevada Test Site (ER)[f]	500	196,193	9
Paducah Gaseous Diffusion Plant	600	785	16
Portsmouth Gaseous Diffusion Plant	33,754	44,149	912
RMI Extrusion Plant	25	33	1
Rocky flats Environmental Technology Site	63,000	82,401	9,000
Savannah River site	21, 300	27,859	576
West Valley Demonstration Project	40	52	1
Total[g]	**300,500**	**393,039**	**15,415**

[a] All volumes are derived from the 1994 Integrated Data Base (DOE, 1995a) and the Waste Management Programmatic EIS (DOE, 1995b) inventory projections
[b] Cubic meters
[c] Cubic yards
[d] Assumes the majority of containers are 1-m x 1-m x 2-m (4-ft x 4-ft x 7-ft) boxes
[e] Assumes an average of 12 containers per shipment
[f] Environmental Restroation Program
[g] Includes internally generated waste.

conditions includes indicators (population, civilian labor force, employment, unemployment rate, and income) that provide a basis for comparing regional socioeconomic conditions of the site with the three other alternatives. Public finance and public services (public education, police and fire protection, and health) are described. Alternative 1 was considered equivalent to future baseline conditions without new activities. Table 5.3-8 reflects the effects of economic indicators for this alternative, and Table 5.3-9 describes housing projections.

American Indian socioeconomic impacts due to fluctuations in DOE employment opportunities for tribal members from the CGTO region of influence are discussed in Section 5.1.1.3.

<u>ECONOMIC ACTIVITY, POPULATION, AND HOUSING</u>—Under Alternative 3, it was assumed that direct employment would increase by 867 jobs in 1996, with a maximum increase of 6,718 jobs in 2000, and 4,531 jobs in 2005. It is estimated that direct payroll and purchases of goods and services would generate 2,017 additional secondary jobs in 1996; 12,744 in 2000; and 8,977 in 2005. Of the total employment increase of 13,508 workers, a vast majority (over 97 percent) is expected to live in Clark and Nye counties. Hence, the discussion below concentrates on these two counties.

Table 5.3-7. Transportation risks under Alternative 3

	Transportation Risks	Transportation Risks Inside Nevada	On-site Transportation Risks
Traffic			
Fatalities	8	7×10^{-2}	1
Injuries	108	4	2
Radiation Cancer[a]			
Incident Free[b]	0.077	0.010 ± 0.002	5×10^{-3}
Radiation Detriment[c]			
Incident Free	3.9×10^{-2}	7.9×10^{-3}	4×10^{-3}
Chemical Cancer[d]			
Maximally Exposed Individual[e]	7.5×10^{-5}	9.8×10^{-6}	2×10^{-6}
Chemical Non-cancer (Hazard Index)[f]			
Maximally Exposed Individual	7.9×10^{-3}	1.1×10^{-3}	5×10^{-3}

[a] The number of latent fatal cancers expected due to exposure to ionizing radiation. The cancer can develop and death can occur many years after exposure

[b] Risk due to routine, normal day-to-day operations without accidents or other unexpected or unusual occurrences

[c] The total number of health detriment cases due to exposure to ionizing radiation minus the number of latent fatal cancers. Health detriments includes genetic damage and development of nonfatal cancer

[d] The number of latent cancers expected due to exposure to a chemical carcinogen. Cancer can develop many years after exposure

[e] For accident risk assessment, inhalation exposure to radioactive or chemical materials is assumed to occur under stable atmospheric conditions (Pasquill atmospheric stability Class F). This results in worst-case of maximum exposure

[f] The ratio between the daily intake of a noncarcinogenic toxic chemical and acceptable reference level. A hazard index less than one indicates that exposure will not result in adverse noncarcinogenic health effects.

Within Clark County, a total of 2,756 new jobs in 1996; 18,534 jobs in 2000; and 12,857 jobs in 2005 would be generated under Alternative 3. Within Nye County, this alternative would generate 101 new jobs in 1996; 758 in 2000; and 516 in 2005. An increase of 12,857 in Clark County in 2005 would result in a decrease in the County's unemployment rate from 5.8 percent to 4.7 percent. Similarly, in Nye County, an increase of 516 jobs in 2005 would result in a decrease in the County's unemployment rate from 5.2 percent to 4.7 percent.

Because of an increase in employment opportunities, population in-migration is anticipated. It is estimated that 10,020 persons could relocate to Clark County in 2005 resulting in a population increase of 0.7 percent over the Alternative 1 level of 1,380,920 persons. As many as 656 persons may in-migrate to Nye County in 2005. This would result in a population increase of 1.7 percent over the Alternative 1 level of 38,516 persons.

In 2005, an estimated 3,914 households could relocate to Clark County and 246 households to Nye County under Alternative 3. This would result in a reduction of housing vacancy rates from 7.9 percent to 7.2 percent in Clark County and from 16.2 percent to 14.8 percent in Nye County.

Direct earning levels are estimated at $41.2 million in 1996, $330.7 million in 2000, and $224.6 million in 2005. Secondary earnings are estimated at $53.9 million in 1996, $346.1 million in 2000, and $243.0 million in 2005 in the region of influence. Of these earnings, Clark County would gain a

Table 5.3-8. Economic activity effects for Clark and Nye counties 1996, 1997, 1998, 2000, and 2005, totals for all programs under Alternative 3

	1996	1997	1998	2000	2005
Alternative 3					
Clark County					
Population	4	9	1,159,879	1,244,186	1,390,940
	1,078,21	1,115,69			
Total Jobs	510,294	531,649	553,762	594,822	663,270
Unemployment Rate	5.4	4.8	4.8	4.7	4.7
Personal Income ($Millions)	21,436.5	22,903.5	24,381.9	27,099.4	32,913.5
Nye County					
Population	27,497	29,292	31,216	35,014	39,172
Total Jobs	11,091	11,907	12,765	14,379	15,961
Unemployment Rate	4.9	4.7	4.7	4.7	4.7
Personal Income ($Millions)	486.5	534.6	585.7	683.1	812.2
Changes from Alternative 1 (Alternative 3 effects)					
Clark County					
Population	638	3,351	11,638	20,645	10,020
Total Jobs	2,756	7,733	12,940	18,534	12,857
Unemployment Rate	-0.4	-1.0	-1.0	-1.1	-1.1
Personal Income ($1,000)	129.3	377.0	636.2	915.0	632.6
Nye County					
Population	90	374	705	1,048	656
Total Jobs	101	311	530	758	516
Unemployment Rate	-0.3	-0.5	-0.5	-0.5	-.05
Personal Income ($1,000)	5.8	18.7	32.0	46.2	31.5

total of $90.9 million in 1996, $643.2 million in 2000, and $444.7 million in 2005. For Nye County, this economic activity would generate a total of $4.2 million in 1996, $33.6 million in 2000, and $22.9 million in 2005.

Defense Program. In the region of influence, this program would create 532 new jobs, including 160 direct and 372 secondary positions, in 1996. In 2000, employment in the region of influence would increase by 4,584 jobs. By the end of 2005, total employment increase in the region of influence would remain at 4,584. In Clark County, this program would contribute to 4,359 jobs (1,383 direct and 2,976 secondary) in 2005. For Nye County, this program would contribute 178 jobs (109 direct and 69 secondary) in 2005. In 2005, an estimated 1,897 households that support the Defense Program would relocate to Clark County, and 92 households to Nye County, contributing to a decrease in housing vacancy rates. In North Las Vegas, construction of the proposed National Ignition Facility at the North Las Vegas Facility would require 280 workers during the peak year of construction (1998). Operation of the facility would require 330 direct workers in the peak year of 2003 and continue through the duration of National Ignition Facility operations. These activities would generate too few jobs to affect the socioeconomic region of influence.

Waste Management Program. In the region of influence, this program would create 226 new jobs, including 68 direct and 158 secondary jobs, in 1996. In 2000, employment in the region of influence would increase by 1,634 jobs (563 direct and 1,071 secondary). By the end of 2005, total employment would remain at 1,634. In Clark County, the Waste Management Program would contribute 1,553 jobs (493 direct and

Table 5.3-9. Housing projections for the Nevada Test Site region of influence, 1996, 2000, and 2005, under Alternative 3

	Alternative 1 Vacancy Rate (%)	Alternative 3 Housing Demand Increase	Vacancy Rate (%)	Change in Vacancy Rate
Clark County				
1996	7.8	249	7.8	0.0
2000	7.9	8,064	6.3	-1.6
2005	7.9	3,914	7.2	-0.7
City of Las Vegas				
1996	7.1	88	7.0	-0.1
2000	7.1	2,833	5.5	-1.6
2005	7.1	1,375	6.4	-0.7
City of North Las Vegas				
1996	5.9	31	5.8	-0.1
2000	5.9	489	4.6	-1.3
2005	5.9	237	5.4	-0.05
Nye County				
1996	16.2	34	15.9	-0.3
2000	16.2	393	13.6	-2.6
2005	16.2	246	14.8	-1.4
Town of Tonopah				
1996	17.6	5	17.3	-0.3
2000	18.0	51	15.4	-2.6
2005	18.0	27	16.6	-1.4
Town of Pahrump				
1996	11.6	120	11.3	-0.3
2000	11.6	256	8.8	-2.8
2005	11.6	177	10.1	-1.5
Amargosa Valley				
1996	17.8	1	17.5	-0.3
2000	17.9	15	15.3	-2.6
2005	17.8	9	16.4	-1.4

1,060 secondary) in 2005. In Nye County, the Waste Management Program would contribute 64 jobs (39 direct and 25 secondary) in 2005.

With the workload increase in this program, 1,730 persons would relocate to Clark County, and 88 persons to Nye County. In 2005, an estimated 676 households that support this program would relocate to Clark County, and 33 households to Nye County contributing to a decrease in housing vacancy rates.

Environmental Restoration Program. In the region of influence, this program would create 432 new jobs, including 130 direct and 302 secondary positions, in 1996. In 2000, employment in the region of influence would increase by 1,152 jobs. By the end of 2005, total employment would remain at 1,152. In Clark County, this program would add 1,095 jobs (348 direct and 747 secondary) in 2005. For Nye County, this program would add 45 jobs (27 direct and 18 secondary) in 2005.

Because of the workload increase in the Environmental Restoration Program, 1,220 persons would relocate to Clark County, and 62 persons to Nye County in 2005.

An estimated 477 households that support this program would relocate to Clark County and 23 households to Nye County contributing to a decrease in housing vacancy rates.

Nondefense Research and Development Program. In the region of influence, this program would create a total of 170 jobs, including 51 direct and 119 secondary positions, in 1996. In 2000, employment in the region of influence would increase by 467 jobs. By the end of 2005, total employment would remain at 467. Within Clark County, this program would add 444 jobs (140 direct and 304 secondary) in 2005. For Nye County, this program would add 18 jobs (11 direct and 7 secondary) in 2005. With workload increases in the Nondefense Research and Development Program, 495 persons would relocate to Clark County and 25 persons to Nye County.

The demand for housing in the region of influence would increase as a result of the relocation of households associated with the NTS. In 2005, an estimated 193 households that support this program would relocate to Clark County and an estimated 9 households would relocate to Nye County, contributing to a decrease in housing vacancy rates.

Work for Others Program. In the region of influence, this program would create 27 jobs, including 8 direct and 19 secondary positions, in 1996. In 2000, employment in the region of influence would increase by 23 jobs (8 direct and 15 secondary). By the end of 2005, total employment would remain at 23 jobs. In Clark County, this program would contribute 22 jobs (7 direct and 15 secondary) in 2005. In Nye County, the Work for Others Program would contribute at least one job in 2005. Because of the workload increase in this program, 25 persons are anticipated to relocate in Clark County and one person in Nye County.

In 2005, an estimated 10 households that support the Work for Others Program would relocate to Clark County, and one household to Nye County, contributing to a decrease of housing vacancy rates.

Site-Support Activities. Under Alternative 3, additional employment would be required to support increased construction requirements under other programs. In the region of influence, site-support activities would create 1,497 jobs, including 450 direct and 1,047 secondary positions, in 1996. In 2000, employment in the region of influence would increase by 11,632 jobs (4,009 direct and 7,623 secondary). By the end of 2005, total employment would reach 5,648 (1,822 direct and 3,826 secondary). In Clark County, this program would contribute 5,384 jobs (1,708 direct and 3,676 secondary) in 2005. For Nye County, this program would contribute 210 jobs (129 direct and 81 secondary) jobs in 2005.

Because of workload increases in site-support activities, 1,695 persons would relocate to Clark County, and 234 persons to Nye County.

In 2005, an estimated 661 households that support this program would relocate to Clark County, and 89 households to Nye County, contributing to a decrease in housing vacancy rates.

PUBLIC FINANCE—The fiscal impact of all alternatives can be determined by subtracting their income statement totals from the Alternative 1 future baseline. The remaining fiscal impact is the specific impact associated with each alternative. Projected financial summaries are present in Table 5.3-10, and the text makes comparisons to Alternative 1.

Clark County. The expansion and improvement of the county infrastructure would continue to be the primary focus of Clark County fiscal efforts. In addition, Clark County has undertaken the implementation of a county facilities development program as discussed under Public Finance, Section 4.1.3.

Under Alternative 3, revenues for Clark County would increase because of increases in population, personal income, and total employment in the county. Assuming continued small increases in revenues and slightly larger initial increases in expenditures (see discussion on capital projects under Public Finance, Section 4.1.3), Alternative 3 would result in revenues less expenditures of a

Table 5.3-10. Projected financial summary for fiscal years 2000 and 2005, general, special revenues, debt service, and capital projects funds under Alternative 3

	Revenues Over Expenditures	Current Expense	Ending Fund Balance	Fund Balance as a Percentage of Current Expense
Fiscal Year 2000				
Clark County	($358,416)	$530,896,729	$1,309,506,535	246.66%
City of Las Vegas	$15,421,723	$198,785,755	$358,736,590	180.46%
City of North Las Vegas	($6,963,735)	$47,524,966	$30,459,795	64.09%
Clark County School District	($14,457,373)	$764,036,602	$125,786,513	16.46%
Nye County	$2,042,525	$26,371,978	$15,921,125	60.37%
Town of Tonopah	$85,400	$653,194	$845,107	129.38%
Town of Pahrump	$240,271	$962,762	$1,657,509	172.16%
Nye County School District	($1,173,255)	$27,521,758	$255,400	0.93%
Fiscal Year 2005				
Clark County	$38,981,856	$565,834,291	$2,154,436,001	380.75%
City of Las Vegas	$17,307,927	$211,713,581	$583,469,805	275.59%
City of North Las Vegas	($6,448,959)	$50,667,058	$48,766,937	96.25%
Clark County School District	($10,871,647)	$854,156,107	$194,428,324	22.76%
Nye County	$3,755,368	$28,214,353	$30,575,821	108.37%
Town of Tonopah	$79,266	$652,617	$1,255,095	192.32%
Town of Pahrump	$327,144	$1,107,419	$3,135,982	283.18%
Nye County School District	$7,669	$30,787,544	$5,863,763	19.05%

negative $358,000 in Fiscal Year 2000. In Fiscal Year 2005, revenues less expenditures are expected to be $38,982,000. The fund balance (or reserves) as a percentage of current expense is expected to be 247 percent in 2000 and 381 percent in 2005. To compare with Alternative 1, Clark County revenues over expenditures would be $2,144,000 more in 2000 and $1,941,000 more in 2005.

City of Las Vegas. Under Alternative 3, revenues over expenditures for the City of Las Vegas are expected to become positive in Fiscal Year 1995 because of increases in population, personal income, and total employment in the city. Assuming continued increases in revenues and expenditures, this alternative would result in revenues less expenditures of $15,422,000 in Fiscal Year 2000. It is predicted that by Fiscal Year 2005, revenues over expenditures would be $17,308,000. The fund balance as a percentage of current expense is expected to be 180 percent in 2000 and 275 percent in 2005. To compare with Alternative 1, revenues over expenditures would be $1,042,000 more in 2000 and $873,000 more in 2005.

City of North Las Vegas. Expenditures for North Las Vegas are forecast to continue to outpace revenues. Revenues over expenditures in Fiscal Year 2000 would be a negative $6,964,000 and a less negative $6,449,000 in Fiscal Year 2005. This is despite anticipated increases in population, personal income, and total employment in the city. Public safety and capital projects are anticipated to continue to be the largest expenditures. Taxes, which recently decreased (from $10,059,472 in Fiscal Year 1993 to $7,941,972 in Fiscal Year 1994), are expected to slowly grow to 1993 levels by Fiscal Year 2000. The fund balance as a percentage of current expense is expected to be 64 percent in Fiscal Year 2000 and 96 percent in Fiscal Year 2005. To compare with Alternative 1, revenues over expenditures would be $113,000 more in 2000 and $132,000 more in 2005.

Clark County School District. Under Alternative 3, revenues for the Clark County School District would expand because of increases in population and corresponding school enrollment. Regular program and undistributed expenditures would likely continue to increase. The school district is not predicted to achieve a positive fiscal position by Fiscal Year 2005, even with Alternative 3. With more students and no corresponding increases in revenue by Fiscal Year 2000, revenues less expenditures would be a negative $14,457,000 and, in Fiscal Year 2005, a less negative $10,872,000. The fund balance as a percentage of current expense is expected to be 16 percent in Fiscal Year 2000 and a 0.23 percent in Fiscal Year 2005. To compare with Alternative 1, revenues over expenditures would be $610,000 less in 2000 and $296,000 less in 2005.

Nye County. Under Alternative 3, revenues for Nye County would increase slightly because of increases in population, personal income, and total employment in the county. Assuming continued small increases in expenditures as well, a positive fiscal position is expected to be reached in Fiscal Year 1996. This alternative would result in revenues less expenditures of $2,043,000 in Fiscal Year 2000. In Fiscal Year 2005, revenues less expenditures would be $3,755,000. The fund balance as a percentage of current expense is expected to be 60 percent in Fiscal Year 2000 and 108 percent in Fiscal Year 2005. To compare with Alternative 1, revenues over expenditures would be $476,000 more in 2000 and $300,000 more in 2005.

Town of Tonopah. Revenues and expenditures for the town of Tonopah would increase slightly because of increases in population, personal income, and total employment in the county. Assuming continued increases, Alternative 3 would result in revenues less expenditures of $85,000 in Fiscal Year 2000. In Fiscal Year 2005, revenues less expenditures would be $79,000. The fund balance as a percentage of current expense would be 129 percent in Fiscal Year 2000 and 192 percent in Fiscal Year 2005. To compare with Alternative 1, revenues over expenditures would be $6,000 more in 2000 and $4,000 more in 2005.

Town of Pahrump. Under Alternative 3, revenues for the town of Pahrump would increase slightly because of increases in population, personal income, and total employment in the county. Assuming continued increases in revenues and slightly smaller initial increases in expenditures compared to Fiscal Year 1994, this alternative would result in revenues less expenditures of $240,000 in Fiscal Year 2000. In Fiscal Year 2005, revenues less expenditures would be $327,000. The fund balance (or reserves) as a percentage of current expense is anticipated to be 172 percent in Fiscal Year 2000 and 283 percent in the Fiscal Year 2005. To compare with Alternative 1, revenues over expenditures would be $16,000 more in 2000 and $12,000 more in 2005.

Nye County School District. Under Alternative 3, revenues for the Nye County School District would increase slightly because of increases in population. Local sources would continue to generate the most revenue. Assuming small increases in revenues and expenditures, the school district would see a positive level of revenues over expenditures in Fiscal Year 2005. Revenues less expenditures are expected to be a negative $1,173,000 in Fiscal Year 2000 and $8,000 in Fiscal Year 2005. The fund balance as a percentage of current expense is expected to be 0.93 percent in Fiscal Year 2000 and 19 percent in Fiscal Year 2005. To compare with Alternative 1, revenues over expenditures would be $229,000 more in 2000 and $128,000 more in 2005.

PUBLIC SERVICES —Table 5.3-11 summarizes the level of service that would be required for Alternative 3, and the following text compares them to Alternative 1. In each case, the current level of service per 1,000 population is assumed to continue.

Public Education. A total of 7,928 full-time equivalent licensed teachers were employed by the Clark County School District in the 1993 to 1994 school year, resulting in a student-to-teacher ratio of 18:33. To continue with this ratio, the Clark County School District would require 11,185 teachers by the school year 2004 to 2005, or 80 more than under Alternative 1. The student-to-teacher ratio for Nye County School District was 16:39 in the 1994 to 1995 school year. Assuming this ratio were to be projected in the school year 2004 to 2005, 390 teachers or 6 more than with Alternative 1 would be required.

Police Protection. Assuming the same level of service in the future, requirements for sworn police and deputy protection in the year 2005 can be examined.

Table 5.3-11. Projected levels of public service for the years of 1996, 2000, and 2005 under Alternative 3

Jurisdiction	Level of Service *	Year 1996	Year 2000	Year 2005
Clark County School District Teachers	18.33	8,670	10,005	11,185
Nye County School District Teachers	16.39	274	349	390
Las Vegas Metropolitan Police Department (Las Vegas and county rural areas)	2.27	1,331	1,536	1,717
North Las Vegas Police Department	1.75	142	164	183
Nye County Sheriff's Office (Tonopah)	3.67	14	16	16
Pahrump Sheriff's Substation	1.85	30	42	52
Beatty Sheriff's Substation	2.59	5	6	5
Amargosa Valley Sheriff's Substation	2.01	2	3	3
Clark County Fire Department (urbanized unincorporated areas)	1.04	441	508	568
Las Vegas Fire Department	0.84	317	365	409
North Las Vegas Fire Department	1.15	93	108	121
Tonopah Volunteer Fire Department	7.09	28	30	30
Pahrump Volunteer Fire Department	1.98	32	45	56
Beatty Volunteer Fire Department and Ambulance Service	14.51	29	32	29
Amargosa Valley Volunteer Fire Department	23.12	27	32	36
Clark County Medical Doctors	1.37	1,481	1,710	1,911
Clark County Registered Nurses	4.84	5,223	6,027	6,738
Nye County Medical Doctors	0.34	9	12	13
Nye County Registered Nurses	1.53	42	54	60

* Level of service is per 1,000 population. The number of school teachers is based on student-to-student ratios, and the number of students is based on a percentage of the population.

The Las Vegas Metropolitan Police Department would require 1,717 sworn police officers or 12 more officers than under Alternative 1. The North Las Vegas Police Department would require 183 sworn officers or 1 more sworn police officer over Alternative 1. The Nye County Sheriff's Office in Tonopah would require 16 sheriff deputies or 1 more deputy sheriff over Alternative 1. The town of Pahrump Sheriff's Substation would require 52, the Beatty Sheriff's Substation would require 5, and the Amargosa Valley Sheriff's substation would require 3. This would lead to the requirement for one more deputy sheriff for the town of Pahrump and none for the Beatty and Amargosa Valley Sheriff's substations.

Fire Protection. It can be assumed that the present level of service based on current population can be projected into the future. The Clark County Fire Department, which handles fires in the urbanized unincorporated county, would be expected to require 568 firefighters in 2005, or 4 more than under Alternative 1. Some 409, or 3 more firefighters, would be required in the Las Vegas Fire Department in the year 2005. The North Las Vegas Fire Department would require 113 or 1 more firefighter. The Tonopah, Pahrump, Beatty and Amargosa Valley Volunteer Fire Departments would require 30, 56, 29 and 36 firefighters, respectively. There are changes of zero, one, one, and zero, respectively, in comparison with Alternative 1.

Health Care. The 1995 level of service for medical doctors and registered nurses was used to determine future needs based on population growth. By 2005, a total of 1,911 (14 more than under Alternative 1) medical doctors and 6,738 (49 more) registered nurses would be required in Clark County. In Nye County, 13 medical doctors and 60 registered nurses would be required, which is the same number of medical doctors and one more registered nurse from Alternative 1.

5.3.1.4 Geology and Soils. The following is a discussion of geologic and soils impacts.

Defense Program. Under Alternative 3, adverse impacts to geology and soils media are the same as those discussed under Defense Program in Alternative 1 (Section 5.1.1.4). Storage of weapons or components of weapons in the Device Assembly Facility and in the P-Tunnel has been proposed and, if implemented, could disturb geologic media. New stockpile management activities at the Device Assembly Facility would disturb approximately 29 acres of surface geologic media. Any additional excavation for this purpose would result in permanent loss of the excavated geologic media and could impact slope stability.

The construction and operation of the proposed National Ignition Facility at the North Las Vegas Facility would have no adverse impact on geological resources. The National Ignition Facility would require about 8 of vacant land. The soils at the North Las Vegas Facility are considered acceptable for standard construction techniques. Soil impacts during construction would be short-term and minor with appropriate standard construction erosion and sediment control measures. The site has been disturbed in the past; therefore, construction impacts would be minor. Net soil disturbance during operation would be less than for construction because areas temporarily used for laydown would be restored. Seismic risks would be taken into consideration during design, construction, and operation activities.

Waste Management Program. Adverse impacts to geologic media discussed for the Waste Management Program under Alternative 1 also apply under Alternative 3. Specific other facilities or actions that could adversely impact geologic media include those listed in Appendix A.

Environmental Restoration Program. Under Alternative 3, the adverse impacts to geologic media discussed under the Environmental Restoration Program in Section 5.1.1.4 apply.

Nondefense Research and Development Program. Under Alternative 3, the adverse impacts to geologic media discussed under the Nondefense Research and Development Program in Section 5.1.1.4 apply. Other facilities that could adversely impact geologic media are the Treatability Test Facility and the Area 6 decontamination pad.

Work for Others Program. Under Alternative 3, the adverse impacts to geologic media discussed under the Work for Others Program in Section 5.1.1.4 apply. Other specific actions that could adversely impact geologic media are associated with the demilitarization of conventional weapons.

Site-Support Activities. The impacts associated with site-support activities under Alternative 3 would be the same as those discussed under Alternative 1. Construction of new facilities could adversely impact the geologic media. Impact to geologic media is primarily from clearing of the site, construction of infrastructure, and excavation of aggregate.

5.3.1.5 Hydrology. The environmental impacts to surface hydrology and groundwater are described in the sections that follow . Discussions of impacts to water quality and water quantity are also presented.

5.3.1.5.1 Surface Hydrology—The impacts to surface hydrology for the five programs and site-support activities are presented in this section. One potential impact from all the programs would be alteration of natural drainage paths, resulting in potential preferential erosion of natural or fill deposits, deposition of sediments, ponding of water, or inundation of infrastructure. Activities could have minor effects on drainage patterns and discharge rates because of surface disturbance and altered infiltration rates.

No surface waters are used for water supplies. The ephemeral waters exist in normally dry washes for short periods of time and on the surface of usually dry lakes for periods of days to weeks. Water quality of the ephemeral waters is poor because of naturally high sediment loads and dissolved solids. Change to sediment loads and dissolved solids due to project activities would be minor compared to the natural baselines. No significant change in water quality or quantity is anticipated, and thus the impacts would be negligible.

Defense Program. Under Alternative 3, the adverse impacts to the surface hydrologic environment discussed under the Defense Program in Alternative 1 apply. The additional facilities and activities included under Alternative 3 could increase the adverse impacts to the surface hydrologic environment that are presented under Alternative 1. Information regarding these facilities is presented in Appendix A.

The proposed National Ignition Facility location at the North Las Vegas Facility is outside the 500-year floodplain of the local drainage. Construction of the National Ignition Facility at the North Las Vegas Facility would be expected to have minor to negligible effects on water quality with the implementation of a stormwater pollution and prevention plan to minimize soil erosion, sedimentation, and contamination of stormwater. Measures would be taken to comply with stormwater discharge regulations associated with construction activities.

Waste Management Program. Under Alternative 3, the adverse impacts to the surface hydrologic environment discussed under the Waste Management Program in Section 5.1.1.5 apply. The additional facilities and activities included under Alternative 3 could increase the adverse impacts to the surface hydrologic environment that are presented under Alternative 1.

Environmental Restoration Program. Under Alternative 3, the adverse impacts to the surface hydrologic environment discussed under the Environmental Restoration Program in Section 5.1.1.5 apply.

Nondefense Research and Development Program. Under Alternative 3, the adverse impacts to the surface hydrologic environment discussed under the Nondefense Research and Development Program in Section 5.1.1.5 apply. Specific other facilities that could adversely impact the surface hydrologic environment are the Treatability Test Facility and the Area 6 decontamination pad. The impacts would be the same as those described under Alternative 1.

Work for Others Program. Under Alternative 3, the adverse impacts to the surface hydrologic environment discussed under the Work for Others Program in Section 5.1.1.5 apply.

Site-Support Activities. Under Alternative 3, the impacts to the surface hydrologic environment discussed under site-support activities in Section 5.1.1.5 apply.

5.3.1.5.2 Groundwater—The demand for water resources under Alternative 3 would increase for all programs on the NTS. The major demands would be the Defense Program and a Solar Enterprise Zone facility under the Nondefense Research and Development Program. As a result of the increased demand for water, the impacts for Alternative 3 would be the same as Alternative 1, plus the added effects of the new actions that would be included under Alternative 3.

Defense Program. The impacts of Alternative 3 on the water resources of the NTS include all of the impacts considered under Alternative 1, plus the added impacts of the additional activities. The additional activities would result in a slight increase in water demand relative to Alternative 1, which are reflective of the historical NTS water demand. The additional activities are not expected to affect groundwater quality.

Groundwater would not be used for construction or operation of the proposed National Ignition Facility at the North Las Vegas Facility; all water would be purchased from public suppliers.

Waste Management Program. Under Alternative 3, additional waste disposal capacity would be developed, and minor added water demands would result. It is estimated that 9.251 m^3/yr (7.5 acre-feet per year) of groundwater will be needed for increased waste disposal. No significant adverse impacts are associated with this minor added demand for additional water. It is expected that the additional waste management activities would be similar to ongoing activities and that they would not have an additional impact on the groundwater. The craters that are and would continue to be used at the Area 3 Radioactive Waste Management Site represent the unavoidable adverse impacts that have resulted from past underground nuclear tests. Use of the craters for waste disposal and subsequent capping with engineered covers would prevent the downward migration of precipitation into the waste.

The underground shot cavities beneath the subsidence craters and waste cells in the Area 3 Radioactive Waste Management Site are much deeper than active hydrologic surface processes (infiltration, redistribution, and evapotranspiration) operating beneath the waste unit from the ground surface to a depth of approximately 31 m (100 ft). Current scientific models suggest that the chimney beneath the low-level waste water unit does not enhance or promote vertical groundwater flow between the waste water unit (subsidence crater) and the deep shot cavity. This conceptual model was confirmed by hydrologic data obtained in 1996 from the exploratory borehole completed beneath U-3bl. Water potential data indicate that there is no groundwater movement from 40 m to 96 m (131 ft to 315 ft) depth within the subsurface chimney (Van Cleave, 1996). Given the proximity of Area 5 to Area 3 (22 km [14 mi]) and the very similar hydrologic conditions, the defensible hydrogeologic conceptual model for Area 5 is being tested and validated for the Area 3 Radioactive Waste Management Site. The Environmental Restoration Program will evaluate the potential for groundwater contamination from shot cavities located in the unsaturated zone (more than 100 m [330 ft] above the water table).

After 30 years of waste disposal operation, groundwater monitoring at the Area 5 Radioactive Waste Management Site has not detected any contamination. In addition, field studies conducted to support the performance assessment, which include monitoring of soil moisture and chloride ion concentrations, indicate that water falling on the surface (precipitation) does not reach the groundwater. These studies and the absence of contamination support the conclusion that no groundwater pathway exists beneath the Area 5 Radioactive Waste Management Site. Thus, no impact to groundwater from waste management operations would occur during the timeframe covered in this EIS and long into the future (see Appendix A, Section A.2; Chapter 2, Section 2.5.6; and Chapter 4, Section 4.1.5.2 for additional information).

Environmental Restoration Program. For the Environmental Restoration Program, the impacts would be the same as for Alternative 1, but on an accelerated schedule. Additional restoration actions would be taken, and characterization wells would be drilled at a faster rate.

Acceleration of the Environmental Restoration Program schedule could result in a doubling of characterization water demands to about 246,696 m^3/yr (200 acre-feet per year). The impacts of this increase would not be significant, as the increase represents only a small portion of the available water in all but Yucca Flat.

Because no significant impacts on the water resources were identified and because of constraints on the length of time that would be required for remediation, no significant added impacts are anticipated as a result of accelerated remedial actions under Alternative 3. Small quantities of water would be needed for remedial actions unless active groundwater controls were implemented. In the unlikely event that such controls would be necessary, large-scale groundwater withdrawals (millions of cubic-meter per year [thousands of acre-feet per year]) could be required.

Nondefense Research and Development Program. The water demand for the Nondefense Research and Development Program is likely to be large and would have a significant impact on the availability of the groundwater in the basin in which actions are taken. The peak demand for a Solar Enterprise Zone facility has been estimated at between 4.0 x 10^6 m^3 and 6.8 x 10^6 m^3 (3,250 and 5,550 acre-ft/yr), depending on the final array of power-generating options that would be constructed. The alternate fuel vehicle and other demonstration projects would not have appreciable water demands unless large-volume aquifer testing were conducted. Any such occurrences would be evaluated on a case-by-case basis, and National Environmental Policy Act requirements would be met, as needed. Use of water for a Solar Enterprise Zone facility would more than triple the annual water use at the NTS. The impacts of a Solar Enterprise Zone facility on the water resources of the NTS would depend on the location, aquifer, perennial yield, and other water uses in the area. The two candidate sites for the facility are in Area 25 in Fortymile Canyon and Area 22 in Mercury Valley. The perennial yield of Fortymile Canyon is 9.4 x 10^6 m^3 (7,600 acre-feet per year). The peak historic demand was only 419,384 m^3 (340 acre-ft), leaving as much as 8.9 x 10^6 m^3 (7,260 acre-ft) of water available. Mercury Valley has a perennial yield of 9.9 x 10^6 m^3/yr (8,000 acre-ft/yr) and a peak historic demand of only 527,930 m^3 (428 acre-ft), leaving as much as 9.3 x 10^6 m^3 (7,570 acre-ft) of unappropriated water available.

The perennial yields of the two areas are based on the limited recharge from precipitation and the appreciable underflow from upgradient basins. In Fortymile Canyon, the naturally occurring recharge has been estimated by Scott et al. (1971) to be about 2.8 x 10^6 m^3/yr (2,300 acre-feet per year), with underflow estimated at 7.2 x 10^6 m^3/yr (5,800 acre-feet per year). The location of a Solar Enterprise Zone facility in Fortymile Canyon would increase total groundwater withdrawals from 1.2 x 10^6 to 3.7 x 10^6 m^3 (1,000 to 3,100 acre-ft) above the recharge from precipitation and would thus capture some of the underflow out of the basin. There may not be a one-to-one correspondence between the quantity of water withdrawn in excess of the perennial yield and the reduction in underflow to downgradient basins. The results of preliminary modeling of the groundwater withdrawals indicates that the groundwater level impacts will be localized within the vicinity of the well and most impacts will be upgradient. It is likely that some groundwater will be removed from storage, a process referred to as groundwater mining and there will be a corresponding decrease in the impact on downgradient discharge rates. The results presented herein are preliminary and are adequate for the purposes of this sitewide EIS. More detailed evaluations will be performed as more detailed information on water use by the facility becomes available and will be presented in lower-tiered National Environmental Policy Act documents prior to the development of the water.

The recharge from precipitation over Mercury Valley is slight, estimated at only 3.1 x 10^5 m^3/yr (250 acre-ft/yr) by Scott et al. (1971). Existing historic demands for water have exceeded this amount; thus, the development of water supplies for a Solar Enterprise Zone facility in Mercury Valley would likely capture some portion of the underflow out of the basin into Amargosa Desert (an estimated 2.09×10^7 m³/yr [17,000 acre-ft/yr]).

Sensitive environmental areas downgradient of the NTS include Ash Meadows, Devils Hole, and Death Valley. A recent evaluation of water-level declines in Devils Hole was performed by the Las Vegas Valley Water District (Avon and Durbin, 1994). A statistical analysis of precipitation, water withdrawals in Pahrump Valley, water withdrawals on the NTS, and water levels in Devils Hole was performed as part of this evaluation. The results indicated that there was no relationship between water withdrawals on the NTS to lowering of water levels at Devils Hole. It is considered very unlikely that the withdrawal of the groundwater from the NTS for a Solar Enterprise Zone facility would have any significant adverse impact on downgradient water levels or spring discharge rates.

Site Support Activities. The additional water demand under Alternative 3 includes 3.8×10^4 m³/yr (31 acre-ft/yr) of potable water and 6.5×10^5 m³/yr (525 acre-ft/yr) of nonpotable water. In total, the increase of 6.9×10^5 m³/yr (556 acre-ft) is not a large quantity of water, and added impacts are not considered unless a large portion of that total is withdrawn from Yucca Flat. For Yucca Flat, any increases in groundwater withdrawals would add to the overdraft of groundwater (withdrawals in excess of the perennial yield) of that basin. In Yucca Flat, the total quantity of water needed would be quite small, a few thousands of cubic-meter (tens of acre-feet) at most.

5.3.1.6 Biological Resources. Impacts are as discussed under Alternative 1, except that four major sources of impacts are added: expansion of the Device Assembly Facility for the Stockpile Management project; construction of the large, heavy industrial facilities near the Device Assembly Facility; construction of new facilities for Area 5 Waste Management projects; and implementation of the alternative energy project at one site on the NTS. A total of approximately 15,600 acres could be disturbed under Alternative 3. This represents an increase of 5,700 acres over Alternative 1. A portion of this area (3,000 acres) could be in tortoise habitat on the NTS. Alternative 3 projects could increase the risk of crushing tortoises at construction sites and along roads leading to construction sites. The alternative energy project is sufficiently large that it could negatively affect the viability of some small, local populations of some species if it were sited in an area where those species are found. Given these potential impacts of the alternative energy project, Alternative 3 might reduce biodiversity in the region.

Defense Program. Six defense-related activities would be conducted under Alternative 3. The nuclear emergency response activity would have the same potential impacts described under Alternative 1. The stockpile stewardship activity under Alternative 3 would increase the number of tests to be conducted, which would slightly increase the impact that is described in the introductory paragraph in this section. The hydrodynamic tests and dynamic experiments would be conducted at several appropriate places on the NTS, including two existing facilities in Yucca Flat (the Lyner Complex and the Big Explosives Experimental Facility) and two proposed new facilities. The existing facilities in Yucca Flat are north of the range of the desert tortoise (Rautenstrauch et al., 1994), and operations there are not expected to significantly impact surrounding habitat, the viability of plant or animal populations, or springs.

About 3 acres of habitat would be cleared for each proposed new facility, which would not be enough to influence population viability of plants and animals in these areas. A potential location for the next generator radiographic facility is north of the desert tortoise range. This facility should have no effect on springs. Transportation during construction might be a significant impact on desert tortoises because of the increased risk of crushing individuals along the road.

The stockpile management project includes assembly, disassembly, maintenance, and storage of nuclear devices. Under Alternative 3, a large facility could be built near the Device Assembly Facility in Area 6 to perform all stockpile management functions, including modifying nuclear weapons, quality assurance, testing, and interim storage of pits and components. About 8 acres would be cleared for this facility. Some or all of this land is currently undisturbed habitat. Densities of desert tortoises are relatively high around this site compared to other sites on the NTS (Blomquist et al., 1995). These tortoises might be crushed during construction and transportation activities for the project (U.S. Fish and Wildlife Service, 1992; DOE/NV, 1993). There are no other endangered, threatened, or candidate species at this site (Blomquist et al., 1995). The loss of habitat and associated mortality of individual plants and animals are not expected to significantly affect the viability of their population.

The new large, heavy industrial facilities under Alternative 3 would involve the disturbance of approximately 600 acres on the NTS in Area 6. No rare plants are known to occur at the site. Construction of these facilities should not affect the viability of the more common plant or animal populations because the disturbances are very small relative to the range of those populations. Desert tortoises might be killed during ground-clearing activities if these facilities were located within the range of desert tortoises. Tortoises also might be killed along roads during transportation activities. All surface-disturbing activities may kill or displace other wildlife such as small mammals, reptiles, and soil-dwelling invertebrates. If ground clearing for construction occurs during the breeding season, the eggs of birds in nests on the ground within a project area may be destroyed. Most birds that breed on the NTS are protected under the Migratory Bird Treaty Act.

Because construction of the large, heavy industrial facilities is the only likely activity to occur during the timeframe covered in this EIS, water demands would be low. Because groundwater used for construction would not be taken from the perched aquifers that supply springs on the NTS (Section 4.1.5.2), this action should have little or no impact on those springs. Given the small quantities of groundwater required, there would be no likely impacts on springs off the NTS during the construction phase. However, pumping the large quantities of groundwater needed during the operation phase of this project could impact off-site springs.

The storage and disposition of weapons-usable fissile materials project could occur within the Defense Industrial Zone in Areas 5 and 6 and in existing tunnels in Area 12. Biological resources could be affected by this activity during transportation of construction and waste material and during operation if there were an accidental release of radionuclides. Neither of these is likely to cause important impacts on biological resources because of the relatively small quantities of waste to be transported and because of the safety protocols in place (See Appendix I of this EIS).

Accidents associated with transport of nuclear devices and components, tritium, and associated radioactive waste for the Defense Program would be unlikely. Impacts on biological resources are unlikely to occur for this reason and because of the small quantities that would be released and the small areas impacted should an accident occur.

No original undisturbed native vegetation remains on the site of the North Las Vegas Facility. Few wildlife species exist at the North Las Vegas Facility because it is located in an urbanized area and contains little vegetation. The only species that exist are those adapted to urban habitats. No biological resource impacts are expected. The North Las Vegas Facility is located within urban Las Vegas on previously disturbed land within a fenced site. It is not expected that any threatened, endangered, or rare species exist. No impacts to threatened and endangered species are expected.

Waste Management Program. At the Area 3 Radioactive Waste Management Site, low-level waste would be buried in existing subsidence craters; four filled disposal cells would be closed. In addition, three additional craters would be used for a total of seven craters. Building 3-302 would be expanded, and a truck decontamination station would be constructed. Impacts of these activities were described for Alternative 1. The amount of undisturbed habitat that would be removed is about the same under Alternatives 1 and 3 because most of the project area is already disturbed.

Approximately 145 acres of previously undisturbed land would be disturbed at the Area 5 Radioactive Waste Management Site because of new construction projects. This would result in the loss of plant and wildlife habitat. Disturbances are not expected to impact viability of plant or animal populations. Threatened and endangered species are not likely to be impacted by construction given that no desert tortoises have been seen in the area (EG&G/EM, 1994). Several storage pits and disposal units would be closed. Because these disturbed sites would be revegetated, this activity would have a positive impact on habitat. There would be no effects on springs or their associated biota because there are no springs near this site.

Area 6 Waste Management Program activities and impacts would include all that are described for Alternative 1. In addition, a 14 acres Liquid Waste Treatment System would be constructed in Area 6 in 1996 or 1997. Impacts resulting from the construction and operation of the Liquid Waste Treatment System are presented in the Liquid Waste Treatment System Environmental Assessment, issued in 1995. Bird and bat candidate species and economically and recreationally important species like doves and waterfowl (Greger, 1995) could be exposed to hazardous materials or drown in open evaporative tanks constructed for this facility. Off the site, these doves and waterfowl could be harvested, thereby exposing hunters to contaminants. This site is located outside desert tortoise habitat (EG&G/EM, 1991; Rautenstrauch et al., 1994). There would be no effects on springs or their associated biota. Transportation of wastes to Area 6 would be unlikely to have significant impacts on biological resources because of the low probability of an accidental release during transport, the small quantity likely to be released, and the small area impacted should an accident occur. Area 11 Waste Management Program activities would be similar to those under Alternative 1; thus, impacts would be the same.

Environmental Restoration Program. Activities proposed under Alternative 3 are similar to those described under Alternative 1, with the exception that the rate at which these activities would be initiated and completed is likely to be accelerated. This is not likely to change the nature of the impacts; they should remain as described under Alternative 1.

Nondefense Research and Development Program. Five projects within this program would be conducted under this alternative. For four of these projects (Spill Test Facility, Alternate Fuel Demonstration Project, Environmental Management and Technology Development Project, and National Environmental Research Park), the impacts would not be substantially different from those described under Alternative 1. The fifth project within this program, alternative energy, would result in the destruction of large areas of undisturbed habitat and might use massive quantities of water. The Alternative Energy Solar Power Generating Project would involve the development of one of four technologies or subprojects in Areas 22 or 25 capable of generating electricity from solar energy. For this analysis, it was assumed that one of the four technologies would be developed there and that about 2,400 acres of previously undisturbed habitat would be cleared. This loss of habitat and associated mortality of individuals, disruption of movement patterns and gene flow, and other effects should not have a negative impact on the viability of most species found in that area because those species are common throughout a large region. The DOE/NV will consult with the U.S. Fish and Wildlife Service to evaluate the effects, if any, of the Alternative Energy Project on species listed as endangered, threatened, or candidates under the Endangered Species Act. Nests of birds, protected under the Migratory Bird Treaty Act, may also be destroyed if ground clearing for construction of the project occurred during the breeding season.

The abundance of desert tortoises is very low in the vicinity of proposed sites (EG&G/EM, 1991). If tortoises are within or near the chosen site, they might be killed, injured, or displaced during construction and operation of the facilities. Tortoises also are likely to be killed on roads during transportation activities for this project. Up to 6.8×10^6 m^3 (5,500 acre-ft) of water might be pumped annually from the underground aquifer for this project. Because this groundwater would not be taken from the perched aquifers that supply springs on the NTS (Section 4.1.5.2), this action should have little or no impact on those springs. Although the groundwater under the NTS is connected to springs in Devils Hole National Monument and Ash Meadows National Wildlife Refuge, water use at the NTS should affect neither water quality nor quantity in these springs (Section 5.3.1.5). Finally, construction of site-support facilities, such as a 97 km (60 mi) power line from Las Vegas, local water lines, and a 97 km (60 mi) natural gas pipe line, could adversely affect desert tortoises.

Work for Others Program. The Work for Others Program consists of five projects. The treaty verification, nonproliferation, and counterproliferation research and redevelopment projects would consist of the same activities and would have the same impacts under Alternative 3 as are described under Alternative 1. The joint Demilitarization Technology Program involves demonstration projects designed to explore the feasibility of resource and recycling technologies and destruction technologies that could be used to dispose of conventional munitions and solid rocket motors. Some activities would occur in existing underground facilities. Given the location and methods proposed for minimizing and monitoring vented hazardous gases, there are no expected impacts on biological resources. Activities for the second project, defense-related research and development, are similar to those described under Alternative 1. Therefore, the impacts on biological resources would be the same as those described in Section 5.1.1.6.

Site-Support Activities. Under Alternative 3, the NTS site-support activities would be expanded to the extent necessary to provide support for existing activities, as well as new projects and activities not previously performed at the NTS. Scheduled site support activities could remove at least 62 acres of undisturbed habitat. Potential impacts to biological resources are larger under this alternative relative to the other three alternatives. Given the development of several new projects under Alternative 3, it is likely that development to service these new projects would be sizeable. An example would be the construction of a natural gas pipe line from Las Vegas to service some subprojects within the alternative energy project. Projects of this size could have significant impacts on habitat removal and might lead to the death of desert tortoises because of crushing during construction. Based on historic levels of less than or equal to one tortoise killed on NTS roads per year, this increase in traffic might result in the mortality of two to three tortoises per year. This loss should not affect the viability of the tortoise population on the NTS. Given the number of new projects proposed for the Control Point or Device Assembly Facility areas or for areas along the southern boundary of the NTS, it is also likely traffic would become disproportionately common in areas inhabited by tortoises.

5.3.1.7 Air Quality. This section addresses the potential effects that the five programs and the site-support activities on the NTS might have on regional air quality. Emissions from stationary, mobile, and fugitive dust sources, shown in Tables 5.3-12 and 5.3-13, occur within and outside of the NTS. These emissions would be dispersed over the 3,496-km^2 (1,350-mi^2) area of the test site. At the boundaries of the site, ambient pollutant concentrations would be well below the ambient air standards. Carbon monoxide emissions from mobile sources in the Las Vegas Valley nonattainment area would be approximately 90-tons per year (40 percent of 224 tons, see Table 5.3-12 and Section 5.1.1.7). This value is below the 100-ton carbon monoxide de minimus value shown in Table 5.1-14. Therefore, a general conformity analysis would not be required for this alternative.

Defense Program. The air quality of the NTS is subject to periodic disturbance brought about by routine operations and test detonations. About 521 acres of land would be disturbed during Defense Program construction activities under this alternative. The average annual fugitive dust (PM_{10}) emission rate, including various drilling and construction activities, would be about 15.6 tons. These emissions represent 0.002 percent of the total Nye County fugitive emissions (864,600 tons). These calculations assume that fugitive dust would be reduced by 50 percent as a result of watering the sites. Because construction activities are expected to occur only on a short-term basis, long-term air quality impacts are not expected. Nevada Administrative Code 445, Sections 704 to 7165 regulates surface disturbance of 5 acres or more. The Nevada Division of Environmental Protection, Bureau of Air Quality, issued Operating Permit 2743 to the DOE for variable disturbance of land at the NTS. The permit expires in March 1998. There could be gaseous releases associated with new large, heavy industrial facilities. Pollutant concentrations combined with Alternative 1 concentrations would be in compliance with national and state standards. The transfer of Pantex stockpile management operations to the NTS would increase pollutant emissions. The amount of criteria and hazardous air-pollutant-emission increases at the NTS are shown in Tables 5.3-14 and 5.3-15, respectively.

Table 5.3-12. Summary of NTS construction emissions and mobile source emissions (on site and off site) tons per year, Alternative 3

Program	Construction	Mobile Sources								
		On Site			Off Site					
					Nye County			Clark County		
	Fugitive PM_{10}[a]	CO[b]	VOC[c]	NO_X[d]	CO	VOC	NO_X	CO	VOC	NO_X
Defense	15.6	87.21	11.85	15.53	27.14	4.10	9.59	52.69	7.96	18.60
Waste Management	2.3	31.17	4.24	5.55	9.20	1.47	3.43	18.83	2.85	6.65
Environmental Restoration	220.5	21.89	2.97	3.89	6.81	1.03	2.41	13.23	2.00	4.67
Nondefense Research and Development	360	8.91	1.21	1.59	2.77	0.42	0.98	5.38	0.81	1.90
Work for Others	3.0	0.37	0.05	0.07	0.12	0.02	0.04	0.22	0.03	0.08
Site Support Activities	1.8	221.55	31.10	39.46	68.96	10.42	24.36	133.85	20.23	47.26
Total	**603.2**	**371.10**	**50.42**	**66.09**	**115.50**	**17.46**	**40.81**	**224.20**	**33.88**	**79.16**

a PM_{10} = Particulate matter with a diameter equal to or less than 10 micrometers
b CO = carbon monoxide
c VOC = volatile organic compounds
d NO_X = nitrogen oxides

Table 5.3-13. Site-support activities stationary emissions at the NTS and Nye County, tons

Area	TSP[a]	SO_2[b]	NO_X[c]	HC[d]	CO[e]
Area 1	34.70	3.40	2.20	0.10	0.50
Area 2	87.30	0.00	0.00	0.00	0.00
Area 3	24.37	0.00	0.00	0.00	0.00
Area 6	12.33	3.16	59.60	0.94	39.00
Area 23	1.12	10.62	9.40	0.00	2.54
U.S. DOE Portable[f]	17.68	15.24	229.32	0.00	49.68
Fuel Storage Tanks	0.00	0.00	0.00	31.95	0.00
Total NTS	**177.50**	**32.42**	**300.52**	**32.99**	**91.72**
Total Nye County	**1,685.70**	**960.68**	**933.28**	[g]	**187.68**

[a] Total suspended particulates
[b] Sulfur dioxide
[c] Nitrogen oxides
[d] Hydrocarbon
[e] Carbon monoxide
[f] Compressors
[g] No data; State hydrocarbon emission inventory is not complete.

Source: Bureau of Air Quality, State of Nevada, 1995.

Table 5.3-14. Stockpile management facilities criteria pollutant summary

Pollutant	Pounds per Year	Tons Per Year
CO[a]	49,589.01	24.79
NO_x[b]	119,173.42	59.59
PM[c]	18,604.74	9.30
SO_2[d]	0.22	0.00
Total	**187,367.39**	**93.68**

[a] Carbon monoxide
[b] Nitrogen oxides
[c] Particulate matter
[d] Sulfur dioxide.

Source: Pantex Plant Environmental Information Document, 1995.

Table 5.3-15. Stockpile management facilities hazardous air pollutants emissions summary* under Alternative 3 (Page 1 of 2)

Pollutant	Chemical Abstracts Service (CAS #)	Pounds per Year	Tons per Year
1,1,1-chloroethane	75003	50.14	0.03
1,1,2-trichloroethane	79005	8.34	0.00
2-nitropropane	79469	3.76	0.00
Benzene	71432	201.49	0.10
Carbon Disulfide	75150	59.64	0.03
Carbon Tetrachloride	56235	34.36	0.02
Chlorobenzene	108907	3.94	0.00
Chromium	7440473	4.71	0.00
Cresol	1319773	0.11	0.00
Cresylio Acid	1319773	0.11	0.00
Dibenzofuran	132649	0.16	0.00
Ester Glycol Ethers	Not Applicable	1.89	0.00
Ethene, tricholor	79016	3.48	0.00
Ethyl Benzene	100414	3.34	0.00
Ethylene Dichloride	107062	2.93	0.00
Formaldeyde	50000	127.62	0.06
HCL	7647010	2,438.56	1.22
HF	7664393	2,592.76	1.30
Ketones	Not Applicable	0.061	0.00
Lead	7439921	408.37	0.20
Mercury	Not Applicable	0.00	0.00
Methane Dichloro	75092	12.35	0.01
Methanol	67561	2,411.40	1.21
Methyl Ethyl Ketone	78933	15,581.44	7.79
Methyl Isobutyl Ketone	108101	1.36	0.00
Methylene Chloride	75092	401.39	0.20
Naphthalene	91203	0.90	0.00

Table 5.3-15. Stockpile management facilities hazardous air pollutants emissions summary* under Alternative 3 (Page 2 of 2)

Pollutant	Chemical Abstracts Service (CAS #)	Pounds per Year	Tons per Year
Nickel	7440020	0.36	0.00
Nitrobenzene	98953	0.11	0.00
Phenol	108952	4.92	0.00
Tetrachloroethylene	127184	14.19	0.01
Toluene	10883	1,027.29	0.51
Trichloroethylene	79016	43.00	0.02
Triethylamine	121448	0.00	0.00
Xylene	1330207	489.75	0.25
Total		**25,933.72**	**12.96**

* Amounts less than 0.01 lb/yr or less than 0.01 tons/yr are listed as 0.00.

Source: Pantex Plant Environmental Information Document, 1995.

These emissions are based on the 1993 Pantex emission inventory (Pantex, 1995). The stationary-source criteria pollutant emissions would increase 20 to 30 percent above those shown in Table 5.3-13. If the emissions from the large, heavy industrial facilities were included, emission increases could require a Prevention of Significant Deterioration permit application. The NTS would be considered a major source under Prevention of Significant Deterioration requirements (potential to emit 250 tons per year or more of any air pollutant subject to regulation under the Clean Air Act).

Military aircraft conduct training exercises in the airspace over the NTS, and the pollutant emissions released from these aircraft are distributed over a large area. A study has shown that pollutant ambient air standards. Carbon monoxide emissions from mobile sources in the Las Vegas Valley nonattainment area would be approximately 90-tons per year (40 percent of 224 tons, see Table 5.3-12 and Section 5.1.1.7). This value is below the 100-ton carbon monoxide de minimus value shown in Table 5.1-14. Therefore, a general conformity analysis would not be required for this alternative.

Defense Program. The air quality of the NTS is subject to periodic disturbance brought about by routine operations and test detonations. About 521 acres of land would be disturbed during Defense Program construction activities under this alternative. The average annual fugitive dust (PM_{10}) emission rate, including various drilling and construction activities, would be about emissions from operations contribute no more than 0.05 percent of the allowable ambient concentrations (SAIC/DRI, 1991). Thus, these military aircraft operations have a negligible impact on air quality over the NTS. Aircraft operations at Desert Rock Airport (Mercury) are relatively low (3,500 to 4,000 operations per year); therefore, the emissions resulting from related air and ground activities would be negligible (SAIC/DRI, 1991).

Operation of the proposed National Ignition Facility in North Las Vegas would generate criteria and toxic/hazard pollutants resulting from the combustion of boiler fuel for heating, operation of diesel generators, and solvent cleaning processes. The emissions consist of particulate matter, carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, and volatile organic compounds. Boiler fuel is assumed to be liquefied petroleum gas. Concentrations of pollutants resulting from operation of the proposed National Ignition Facility added to existing concentrations are expected to be within federal and state regulation levels. For additional information, consult the *Draft Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE,1996).

Waste Management Program. The NTS Waste Management Program activities are conducted in four primary areas: Areas 3, 5, 6, and 11. About 75 acres of land would be disturbed over a 10-year period. The average annual fugitive dust emissions (PM_{10}) would be about 2.3 tons. Most of the fugitive dust would be generated during the construction of a new waste storage site.

Calculations assume that fugitive dust would be reduced 50 percent as a result of watering the sites. Because construction activities are expected to occur only on a short-term basis, long-term air quality impacts are not expected.

Environmental Restoration Program. The total fugitive dust emissions (PM_{10}) generated from environmental restoration projects would be about 221 tons per year, compared with the total fugitive dust (PM_{10}) emissions generated in Nye County, which would be about 866,400 tons per year. The total Environmental Restoration Program emissions represent about 0.03 percent of the county's PM_{10} burden.

Nondefense Research and Development Program. One Nondefense Research and Development Program at the NTS with Alternative 3 could impact air quality. The Solar Enterprise Zone facility would be the site of a 100-megawatt (MW) solar generation facility, which would be located in either Area 22 or Area 25. It was assumed that the maximum disturbed area for the facility would be 2,402 acres, and the construction period would be two years. Annual fugitive dust (PM_{10}) emissions would be approximately 360 tons.

Work for Others Program. Under Alternative 3, the use of NTS airspace and certain land by the DoD for training, research, and development would continue and possibly increase. The approximately 10 acres of land disturbance with this program would cause 3 tons of PM_{10} emissions.

Site-Support Activities. Stationary sources at the NTS for emissions include the shaker plant, boilers, aggregate crushing and processing, a concrete batch plant, and fuel storage tanks. Portable compressor emissions are also included. The construction of a large, heavy industrial facility in Area 6, would contribute to the emissions. About 30 acres of land would be disturbed for new facility construction, generating 1.8 tons of PM_{10}.

RADIOACTIVE AIR QUALITY—Air concentrations would have to be 14 times higher than the measured 1993 average concentrations to achieve the maximum CAP-88 air dose assessment modeled dose (see Section 4.1.7). Average concentrations from the five programs and site- support activities are estimated never to equal or exceed this amount. Impact to air quality by radioactive effluents under Alternative 3 would be minimal.

5.3.1.8 Noise. Because of its large size (3,496 km^2 [1,350 mi^2]), noise generated on the NTS does not propagate off site at audible levels. The closest sensitive receptors to the site boundary are residences located 2 km (1.3 mi) to the south in the town of Amargosa Valley. Therefore, NTS noise impacts for this alternative are a result of noise generated during the operation of construction equipment and from the transportation of personnel and materials to and from the site. The NTS total construction and operations workforce under this alternative would increase from 1996 to 2005.

Railroad and aircraft noise was considered. No railroads serve the NTS; therefore, railroad noise impact analyses were not required. Based on composite noise contours developed by the U.S. Air Force in 1994 for subsonic and supersonic flight operations over the NAFR Complex (U.S. Air Force, 1994), the day-night average sound level (L_{dn}) on the NTS portion of the complex resulting from aircraft operations would be less than 50 db. Flight operations at supersonic speeds are not authorized over the NTS (SAIC/DRI, 1991), and subsonic operations are not normally scheduled over the eastern portion of restricted area R-4808, which includes most of the NTS (U.S. Air Force, 1994). Only periodic helicopter and small fixed-wing aircraft operations are conducted from Desert Rock Airport. All noise impacts under Alternative 3 would be the same as those under Alternative 1, with additional impacts resulting from an increase in training exercises.

At the North Las Vegas Facility, the noise background levels are those that would be expected in an urbanized industrial area. No anticipated impacts from additional noise are anticipated for operations activities. Construction activities would contribute a small portion of noise temporarily.

5.3.1.9 ***Visual Resources.*** An analysis has been conducted to determine the effects of Alternative 3 activities on visual resources. Visual impacts were assessed on the potential of activities to alter or conflict with the existing landscape character.

Defense Program. Under Alternative 3, a total of 1,000 acres of new ground disturbance is anticipated to occur for projects related to the Defense Program. The projects would be located in areas of scenic quality common to the area. Most of this ground disturbance would be associated with new construction at the Device Assembly Facility in Area 6, and the large, heavy-industrial facilities, which have not been sited.. Area 6 is currently used for large, heavy industrial activities. It is not anticipated that these facilities would be seen from public viewpoints. Therefore, impacts to visual resources resulting from facility construction and operation on visual resources would be negligible.

Under Alternative 3, a nuclear test would be conducted if directed by the President. Underground testing likely would be conducted in existing drill holes. The test would occur in the existing testing areas that do not have high scenic value and are not visible from public viewpoints. Therefore, impacts to visual resources caused by testing would be negligible.

The North Las Vegas Facility occupies approximately 80 acres in the city of North Las Vegas, Nevada. The area can be described as an urbanized industrial area, and visual resources are typical for such an area. No additional impacts are expected to visual resources.

Waste Management Program. The Waste Management Program would generate approximately 209 acres of new ground disturbance under Alternative 3. The new facilities would be located in areas of scenic quality common to the region, near similar facilities in areas that are already disturbed. None of the Waste Management Program projects would be visible from any public viewpoints. Therefore, impacts to visual resources from waste management operations would be negligible.

Environmental Restoration Program. Under Alternative 3, the Environmental Restoration Program would generate approximately 50 acres of new ground disturbance. Environmental Restoration Program activities would be located in areas of scenic quality common to the region, and none would be visible from any public viewpoints. Depending on pertinent reclamation factors, disturbed areas would be revegetated after remediation is completed. Adverse impacts would be negligible. There would be some beneficial impacts to visual resources once vegetation is reestablished.

Nondefense Research and Development Program. The Nondefense Research and Development Program would cause approximately 2,400 acres of new ground disturbance for the construction of a Solar Enterprise Zone facility. A Solar Enterprise Zone facility is proposed to be located on the southern NTS boundary (Area 22) and would be visible from U.S. Highway 95. However, the scenic quality is classified as Class C. The landscape character of the area is common to the region, and there is a minor amount of existing manmade modification in the highway viewshed. Because of the size of the area affected and the visibility from Highway 95 (a view corridor with a high sensitivity level) there would be adverse impacts to visual resources.

Work for Others Program. Only 10 acres of new ground disturbance would occur for this program under Alternative 3. Although most Work for Others Program activities are proposed for existing facilities, some new construction would occur. Most of the ground disturbance would be related to construction of the facilities. The new facilities would be constructed near existing facilities, which are located in areas with common scenic quality and are not visible from public viewpoints. Therefore, impacts would be negligible.

Site-Support Activities. Approximately 30 acres of new ground disturbance would occur for site-support activities under Alternative 3. Most of the ground disturbance would be related to new road and utility corridor construction to support expanded programs. Ground disturbance would be scattered throughout the NTS. Impacts to visual resources would be negligible.

5.3.1.10 Cultural Resources. The amount of acreage disturbed as a result of activities described for Alternative 3 would increase substantially as compared to Alternative 1. All activities as proposed under Alternative 1 are proposed under Alternative 3 with the addition of construction of fifteen buildings, expansion of waste management and disposal areas, increased road construction, expansion of communications, water control systems and flood protection, increased cleanup activities, and an expansion of power lines and gas lines. A total of 15,600 acres are expected to be disturbed under Alternative 3. Continued visitation and vehicular traffic could lead to vandalism or artifact collecting that could directly affect recorded archaeological sites and archaeologically sensitive areas.

Although archaeological surveys have not been conducted in these areas, it is estimated that more than 67 sites could be impacted by projects associated with this alternative based on surveys conducted in adjacent areas in 1994. The precise location and number of these resources are unknown until archaeological surveys are conducted. Surveys will be conducted prior to any ground-disturbing activities, and impacts would be mitigated through the measures described in Chapter 7. At least eight structures will be decommissioned under Alternative 3. If these buildings are determined to be historically significant, they would be mitigated using measures described in Chapter 7.

Defense Program. Additional impacts are expected from ground disturbances associated with the construction of facilities, upgrading utilities, and construction of a waste management complex. Increased visitation and vehicular traffic in archaeologically sensitive areas could have indirect impacts. All surveys will be performed prior to any ground-disturbing activities or expansion of existing facilities.

At North Las Vegas, the construction and operation of the proposed National Ignition Facility would have no effect on archaeological sites or historic structures that are listed on or eligible to be listed on the National Register of Historical Places or Native American cultural resources.

Waste Management Program. Under Alternative 3, waste management would expand and additional facilities would be constructed in Area 3 and Area 5 at the NTS. An increase in ground disturbance, and an increase in visitation could have an impact on cultural resources.

Environmental Restoration Program. Impacts to cultural resources are the same as those contained in Alternative 1.

Nondefense Research and Development Program. Additional impacts may occur through construction of the Natural Gas facility.

Work for Others Program. Impacts are the same as contained in Alternative 1.

AMERICAN INDIAN CULTURAL RESOURCES—This section contains the description of the American Indian concerns associated with implementing Alternative 3, as summarized by the CGTO.

Defense Program at the NTS—Under Alternative 3, it is expected that American Indian cultural resources will be adversely impacted if new Defense Program operations are undertaken or if current underground nuclear tests are expanded into previously unused areas. Access to culturally significant places will be reduced because Indian peoples' perception of health and spiritual risk will increase if additional testing, storage, disassembly, *or disposal of nuclear and conventional weapons occur.*

Waste Management Program at the NTS—Under Alternative 3, it is expected that American Indian cultural resources will continue to be adversely impacted, in particular, if waste storage facilities are expanded because the waste has not been disposed of in a culturally appropriate manner. Access to culturally significant places on the NTS will be reduced because waste isolation facilities increase Indian people's perception of health and spiritual risks.

Environmental Restoration Program at the NTS—Under Alternative 3, it is expected that American Indian cultural resources will be adversely impacted by an expansion of the monitoring well program and access road activities, but will be positively impacted by actions that return disturbed land to its natural condition in a culturally appropriate manner and with the participation of Indian people.

Nondefense Research and Development Program at the NTS—Under Alternative 3, it is expected that American Indian cultural resources will be adversely impacted by increased visits by students and researchers who collect artifacts, visit sacred areas, and remove plants or animals. Cultural resources will be positively impacted if students and researchers receive proper guidance by Indian people regarding how to visit places and interact with the environment.

Work for Others Program at the NTS—Under Alternative 3, it is expected that American Indian cultural resources will be impacted if the NTS continues to be a place where weapons are stored, disassembled, and disposed. These actions have and will continue to pollute these lands. The presence of conventional and nuclear weapons defines the NTS as a place of destruction which promotes an image that is inappropriate for a place for peaceful relations between Indian ethnic groups. American Indian cultural resources will continue to be impacted by military training exercises and weapons tests.

Defense Program at Area 13—Under Alternative 3, it is expected that American Indian cultural resources will be adversely impacted if nuclear safety tests continue or increase and if natural lands are scraped for construction. In this alternative, however, there are no plans for additional tests at the Area 13 site on the NAFR Complex.

Waste Management Program at Area 13—Under Alternative 3, it is expected that American Indian cultural resources will not be adversely impacted because there is no Waste Management Program on the Area 13 site on the NAFR complex and none has been identified for this alternative.

Environmental Restoration Program at Area 13—Under Alternative 3, it is expected that American Indian cultural resources of the Area 13 site on the NAFR Complex be adversely impacted if natural lands are scraped during environmental restoration. Access to culturally significant places will increase if environmental restoration is successful, thus reducing Indian peoples' perception of health and spiritual risks associated with this area. Indian people wish to be involved in identifying environmental restoration methods and in the evaluation of restoration success.

Nondefense Research and Development Program at Area 13—Under Alternative 3, it is expected that American Indian cultural resources will be adversely impacted if natural lands are scraped during research and development. These actions have and will continue to pollute these lands. American Indian cultural resources will continue to be adversely impacted by military training exercises and weapons tests.

Work for Others Program at Area 13—Under Alternative 3, it is expected that American Indian cultural resources will be impacted if weapon research and development programs continue or are expanded at the Area 13 site. These actions have and will continue to pollute these lands. American Indian cultural resources will continue to be adversely impacted by military training exercises and weapons tests.

5.3.1.11 Occupational and Public Health and Safety. Alternative 3 includes all program activities described under Alternative 1, plus additional activities. For NTS workers, the increased activities are expected to result in a corresponding increase in human health and safety impacts compared with Alternative 1. Table 5.3-16 summarizes the occupational and public health and safety impacts to construction and operations and maintenance personnel for each NTS program area under Alternative 3. Increased impacts to public health and safety can also be anticipated under Alternative 3. For routine activities, these impacts are primarily related to routine air emissions and transportation activities. Potential impacts to the public from routine air emissions of radioactivity and priority pollutants are discussed in Section 5.3.1.7, Air Quality. Transportation impacts are discussed in Section 5.3.1.2. This section contains the discussion of potential impacts to public health and safety from subsurface contamination of groundwater and from accidental releases of radioactivity to the air.

Unless otherwise noted, impacts presented in this section are the total impacts for the 10-year period evaluated in this EIS. Results are presented for each program area although some program areas do not involve hazards from radiation or hazardous chemicals.

Defense Program. Based on occupational injury and fatality rates for construction and other industrial activities and on projected increases in the worker population under Alternative 3, Defense Program activities at the NTS are expected to result in 3.7 injuries to workers during routine program activities and in 61 injuries as a result of construction activities over the 10-year period evaluated in this EIS. During the same period, 0.0066 fatalities are expected because of routine activities, and 0.11 fatalities are expected from construction activities. Based on previous NTS occupational radiation records and on projected increases in the worker population under Alternative 3, occupational exposure to radiation is estimated to result in a collective dose to NTS Defense Program workers of about 115-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 0.046 latent cancer fatalities and 0.018 other detrimental health effects in the worker population. Risk of accidental exposure to workers increases the latent cancer fatality risk by 0.005 and the risk of other detrimental health effects by 0.002. No Defense Program hazardous chemical accident resulting in measurable effects at the NTS has been identified.

The health and safety impact to the public from potential Defense Program accidents could result in about 4.4×10^{-6} latent cancer fatalities and 2.0×10^{6} other detrimental health effects in the population. Should the DOE be directed by the President to conduct underground nuclear-yield testing under Alternative 3, potential accidents associated with venting of radionuclides following a test could result in a risk of about 0.0054 latent cancer fatalities and 0.0025 other detrimental health effects in the population.

The maximum reasonably foreseeable Defense Program radiological accident at the NTS would be the same as described in Section 5.1.1.11 for Alternative 1 (an explosion of high explosives associated with interim stored nuclear weapons at the Area 27 storage bunkers, which has a probability of occurrence of 1×10^{-7} (1 in 10,000,000) per year.

No Defense Program accident resulting in measurable chemically hazardous effects at the NTS has been identified.

Subsurface radioactivity from past underground nuclear weapons tests would continue to be a potential exposure pathway for the public under Alternative 3. Potential impacts to the public would be identical to those described under Alternative 1. The maximally exposed public individual is estimated to have a lifetime probability of contracting a fatal cancer between 8×10^{-13} (about one in one trillion) and 1×10^{-5} (about one in 100,000). The public exposure scenario assumes that the individual consumes contaminated well water for 70 years centered around the time of peak tritium concentration in well water. These impacts are not expected to occur within the 10-year timeframe of this EIS.

Table 5.3-16. Health risks to workers and the public from program activities, Nevada Test Site, Alternative 3

Program Area	Worker Health Risks						Public Health Risks			
	Occupational Safety Risks		Occupational Radiation Risks		Occupational Chemical Risks		Public Radiation Risks		Public Chemical Risks	
	Injuries	Fatalities	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers[c]	Chemical Hazard Index[d]	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers[c]	Chemical Hazard Index[d]
Defense (with nuclear testing)	65	0.12	0.051 (0.053)	0.020 (0.021)	e	e	4.4×10^{-6} (0.0054)	2×10^{-6} (0.0025)	e	e
Waste Management	467	8.7	0.0025	0.010	5.2×10^{-7}	0.48	5.1×10^{-5}	2.3×10^{-5}	2×10^{-5}	3.8×10^{-6}
Environmental Restoration	11	0.035	0.0096	0.0036	3×10^{-7}	0.14	2.3×10^{-10}	1.1×10^{-10}	6×10^{-6}	2.4×10^{-6}
Nondefense Research and Development	8.6	0.015	0.0042	0.0017	3.2×10^{-6}	0.58	f	f	1.9×10^{-4}	1.5×10^{-4}
Work for Others	11	0.019	0.0055	0.0023	8.9×10^{-8}	2.4	2×10^{-7}	9.2×10^{-8}	4.2×10^{-7}	6.4×10^{-7}
Site Support Activities	210	0.37	0.054	0.021	e	e	f	f	e	e
Total (with nuclear testing)	**773**	**9**	**0.13 (0.18)**	**0.059 (0.08)**	**4.1×10^{-6}**	**2.4**	**5.6×10^{-5} (0.0055)**	**2.5×10^{-5} (0.0025)**	**2.3×10^{-4}**	**1.5×10^{-4}**

a. Number of radiation-induced latent cancer fatalities in the exposed population associated with the activities conducted over the 10-year period of analysis
b. Number of radiation-induced detrimental health effects (e.g., nonfatal cancers, genetic effects) in the exposed population associated with the activities conducted over the 10-year period of analysis
c. Number of chemical-induced cancers (fatal and nonfatal) in the exposed population associated with the activities conducted over the10-year period of analysis
d. A hazard index of greater than one indicates that the non-cancer health effects could be life-threatening to individuals exposed for one hour or more
e. No reasonably foreseeable scenarios resulting in exposure to chemically hazardous materials have been identified
f. No reasonably foreseeable scenarios resulting in exposure to radiation have been identified.

For the North Las Vegas Facility, the occupational and public health and safety impacts described in this section are based on analyses documented in the Draft Programmatic EIS for Stockpile and Managmement (DOE, 1996). Potential radiation exposures to workers inside the proposed National Ignition Facility would be kept as low as reasonably achievable through facility design and administrative controls. The average worker inside the facility is estimated to receive about 30 millirem per year, and the worker population inside the facility is estimated to receive a collective dose of 10 person-rem per year. Over the 10-year period of activities considered by the NTS EIS, workers could receive a total dose of 100 person-rem which would result in a risk of 0.04 (about 1 in 25) of a single latent cancer fatality in the worker population. Other workers at the North Las Vegas Facility outside the National Ignition Facility are estimated to receive a collective dose of 0.07 person-rem per year, or a maximum of 0.7 person-rem over 10 years with a corresponding cancer fatality risk of 2.8×10^{-4} (about 1 in 4,000).

Potential radiation exposures to the public within 80 kilometers (50 miles) of the proposed National Ignition Facility would be well within regulatory limits. The maximally exposed public individual is estimated to receive an annual dose of 0.6 millirem per year, which is much less than the limit of 100 millirem per year from all DOE sources. Over the 10-year period of activities considered by the NTS EIS, this individual could receive a total dose of 6 millirem resulting in a risk of 3×10^{-6} (about 1 in 300,000) of contracting a fatal cancer. The entire population within 80 kilometers is estimated to receive a collective dose of 0.6 person-rem per year, or 6 person-rem over 10 years with a corresponding risk of 0.003 (about 1 in 300) of a single latent cancer fatality in the exposed population.

No routine impacts from hazardous chemicals would be expected to occur because only minute quantities of volatile organic compounds are expected to be emitted during routine operations.

The maximum reasonably foreseeable radiological accident associated with the proposed National Ignition Facility involves a severe earthquake that occurs during a maximum-credible-yield fusion experiment. The collapse of beamlines and building structures would potentially result in atmospheric releases of tritium in the tritium processing system, activitated gases in the air, and activated material in the target chamber. The joint frequency of a severe earthquake during a maximum-credible-yield fusion experiment would be less than 2×10^{-8} per year. If this accident occurred, workers at the North Las Vegas Facility could receive a collective dose of 47 person-rem resulting in a risk of 0.019 (about 1 in 50) of a single latent cancer fatality among the worker population. The maximally exposed public individual could receive a dose of 68 millirem resulting in a latent cancer fatality risk of 3.4×10^{-5} (about 1 in 30,000). The population within 80 kilometers could receive a collective dose of 4,900 person-rem per year, potentially resulting in two to three latent cancer fatalities among the exposed population.

The maximum reasonably foreseeable chemical accident associated with the proposed National Ignition Facility involves an accidental release of mercury. People within 239 m (784 feet) of the release could experience adverse health effects from mercury inhalation if not protected (i.e., sheltering inside building, breathing protection). The nearest members of the public would be 210 m (689 ft) west of the facility. The personnel in nearby buildings would likely be protected because the release (typically lasting 15 minutes) would pass by the buildings with little infiltration. Personnel in the NIF Laser and Target Area Building and those outside in the immediate vicinity might be affected.

Waste Management Program. Based on occupational injury and fatality rates for construction and other industrial activities and on projected increases in the worker population under Alternative 3, the Waste Management Program at the NTS is expected to result in 440 injuries to workers during routine program activities and 27 injuries as a result of construction activities over the 10-year period evaluated in this EIS. During the same period, 8.7 fatalities are expected because of routine activities, and 0.048 fatalities are expected from construction activities.

Based on previous NTS occupational radiation records and on projected increases in the worker population under Alternative 3, occupational exposure to radiation is estimated to result in a collective dose to NTS Waste Management Program workers of about 23-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 0.0092 latent cancer fatalities and 0.0037 other detrimental health effects in the worker population. The risk of accidental exposure increases the latent cancer fatality risk by 0.016 and detrimental health effect risk by 0.0064. The risk of a single cancer in the worker population as a result of accidental exposure to hazardous chemicals is estimated to be 5.2×10^{-7}. The risk of life-threatening noncarcinogenic effects to a single worker from Waste Management Program hazardous chemical accidents has a hazard index of 0.48. A hazard index less than 1.0 indicates that no life-threatening noncarcinogenic health effects would be expected to occur.

The health and safety impact to the public from potential Waste Management Program accidents could result in about 5.1×10^{-5} latent cancer fatalities and 2.3×10^{-5} other detrimental health effects in the population. Waste Management Program accidents involving hazardous chemicals could result in about 2.0×10^{-5} cancers in the population. No noncancer effects from chemical accidents would be expected to occur.

The maximum reasonably foreseeable Waste Management Program radiological accident at the NTS would be the same as described in Section 5.1.1.11 for Alternative 1 (an airplane crash into the Area 5 transuranic waste storage unit, which has a probability of occurrence of 6×10^{-7} (1 in 1,700,000) per year.

For Waste Management Programs hazardous chemical effects, the maximum reasonably foreseeable accident would also be the same as described in Section 5.1.1.11 for Alternative 1 (an airplane crash into the Area 5 hazardous waste storage unit, which has a probability of occurrence of 1×10^{-7} (1 in 10,000,000) per year.

Environmental Restoration Program. Based on occupational injury and fatality rates for construction and other industrial activities and on projected increases in the worker population under Alternative 3, Environmental Restoration Program activities at the NTS are expected to result in 8.8 injuries to workers during routine program activities and 2.5 injuries as a result of construction activities over the 10-year period evaluated in this EIS. During the same period, 0.03 fatalities are expected from routine activities, and 0.0044 fatalities are expected from construction activities.

Based on previous NTS occupational radiation records and on projected increases in the worker population under Alternative 3, occupational exposure to radiation is estimated to result in a collective dose to NTS Environmental Restoration Program workers of about 23-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 0.0093 latent cancer fatalities and 0.0037 other detrimental health effects in the worker population. The risk of accidental worker exposure to hazardous chemicals increases the risk of fatal or nonfatal cancer in the worker population by 2.8×10^{-7}. The risk of life-threatening noncarcinogenic effects to workers from Environmental Restoration Program hazardous chemical accidents has a hazard index of 0.14.

The health and safety impact to the public from potential Environmental Restoration Program radiological accidents could result in about 2.3×10^{-10} latent cancer fatalities and 1.1×10^{-10} other detrimental health effects in the population. Environmental Restoration Program accidents involving hazardous chemicals could result in about 1.6×10^{-5} cancers in the population. No noncancer effects to the public from chemical accidents would be expected to occur.

The maximum reasonably foreseeable Environmental Restoration Program radiological accident at the NTS would be the same as described in Section 5.1.1.11 for Alternative 1 (an airplane crash into the Area 13 site, which has a probability of occurrence of 7×10^{-7} [1 in 1,400,000]) per year.

For Environmental Restoration Program hazardous chemical effects, the maximum reasonably foreseeable accident would also be the same as described in Section 5.1.1.11 for Alternative 1 (an airplane crash into a hypothetical environmental restoration site consisting of a composite of hazardous sites across the NTS, which has a probability of occurrence of 7×10^{-7} (1 in 1,400,000) per year.

Nondefense Research and Development Program. Based on occupational injury and fatality rates for construction activities and on projected increases in the worker population under Alternative 3, Nondefense Research and Development Program activities at the NTS are expected to result in 8.6 injuries and 0.015 fatalities to workers during construction activities over the 10-year period evaluated in this EIS. During the same period, no injuries or fatalities are expected because of routine activities.

Based on previous NTS occupational radiation records and on projected increases in the worker population under Alternative 3, occupational exposure to radiation is estimated to result in a collective dose to NTS Nondefense Research and Development Program workers of about 11-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 0.0042 latent cancer fatalities and 0.0017 other detrimental health effects in the worker population. No Nondefense Research and Development Program accident resulting in measurable radiological effects at the NTS has been identified.

The risk of accidental worker exposure to hazardous chemicals increases the risk of a single cancer in the worker population by 3.2×10^{-6}. The risk of life-threatening noncarcinogenic effects to workers from Nondefense Research and Development hazardous chemical accidents has a hazard index of 0.58.

The health and safety impact to the public from potential Nondefense Research and Development Program accidents could result in about 1.9×10^{-4} cancers in the population. No hazardous chemical noncancer effects to the public from chemical accidents would be expected to occur.

For Nondefense Research and Development Program hazardous chemical effects, the maximum reasonably foreseeable accident would be the same as described in Section 5.1.1.11 for Alternative 1 (an airplane crash into the tank farm at the Fuel Spill Test Facility, which has a probability of occurrence of 1×10^{-7} (1 in 10,000,000) per year.

Work for Others Program. Based on occupational injury and fatality rates for construction activities and on projected increases in the worker population under Alternative 3, Work for Others Program activities at the NTS are expected to result in 11 injuries and 0.019 fatalities to workers during construction activities over the 10-year period evaluated in this EIS. During the same period, no injuries or fatalities are expected because of routine activities.

Based on previous NTS occupational radiation records and on projected increases in the worker population under Alternative 3, occupational exposure to radiation is estimated to result in a collective dose to NTS Work for Others Program workers of about 14-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 0.0055 latent cancer fatalities and 0.0022 other detrimental health effects in the worker population. The risk of accidental exposure increases the latent cancer fatality risk by 0.002 and detrimental health effect risk by 0.001. The risk of accidental worker exposure to hazardous chemicals increases the risk of a single cancer in the worker population by 8.9×10^{-8}. The risk of life-threatening noncarcinogenic effects to workers from Work for Others Program hazardous chemical accidents has a hazard index of 2.4.

The health and safety impact to the public from potential Work for Others Program radiological accidents could result in about 2.0×10^{-7} latent cancer fatalities and 9.2×10^{-8} other detrimental health effects in the population. Work for Others Program accidents involving hazardous chemicals could result in about 4.2×10^{-7} cancers in the population. No noncancer effects to the public from chemical accidents would be expected to occur.

The maximum reasonably foreseeable Work for Others Program radiological accident at the NTS would be an inadvertent detonation of a test assembly at the Big Explosives Experimental Facility and release of 1,000 ci of tritium, which has a probability of occurrence of 3×10^{-5} (1 in 33,000) per year. The following consequences are estimated if this accident occurs:

- Involved worker: fatally injured in the explosion
- Maximally exposed non-involved worker: 0.35 rem, 1.4×10^{-4} chance of latent cancer fatality, 5.6×10^{-5} chance of other detrimental effects
- Non-involved worker population at the nearest major facility area: 0.006 person-rem, 2.4×10^{-6} chance of a single latent cancer fatality, 9.6×10^{-7} chance of any other detrimental effects
- Maximally exposed off-site individual at the nearest point of public access: 4.7×10^{-5} rem, 2.4×10^{-8} chance of latent cancer fatality, 1.1×10^{-8} chance of other detrimental effects
- Population within 80 km (50 mi), 0.02 to 0.35 person-rem, 1.0×10^{-5} to 1.8×10^{-4} chance of latent cancer fatality, 4.6×10^{-6} to 8.1×10^{-5} chance of other detrimental effects.

For Work for Others Program hazardous chemical effects, the maximum reasonably foreseeable accident would be a depleted uranium and beryllium release as a result of an unplanned detonation of a test assembly at the Big Explosives Experimental Facility, which has a probability of occurrence of 1×10^{-3} (1 in 1,000) per year. The following consequences are estimated if this accident occurs:

- Involved worker: fatally injured in the explosion
- Maximally exposed non-involved worker: 8.0×10^{-4} chance of fatal or nonfatal cancer, 240 noncancer hazard index for potentially life-threatening one-hour concentration
- Non-involved worker population at the nearest major facility area: 2.8×10^{-6} chance of a single cancer, 0.023 noncancer hazard index for potentially life-threatening one-hour concentration
- Maximally exposed off-site individual at the nearest point of public access: 6.3×10^{-9} chance of cancer, 6.4×10^{-5} noncancer hazard index for potentially life-threatening one-hour concentration
- Population within 80 km (50 mi): 1.3×10^{-5} to 5.6×10^{-7} chance of a single cancer, 6.4×10^{-5} noncancer hazard index for potentially life-threatening one-hour concentration.

Site-Support Activities. Under Alternative 3, site-support activities at the NTS are expected to result in 210 injuries and 0.37 fatalities as result of construction activities during the 10-year period evaluated in this EIS. No injuries or fatalities are projected as a result of routine site-support activities.

Occupational exposure to radiation is expected to result in a collective dose to NTS site-support workers of about 135-person rem in 10 years. This dose could result in about 0.054 latent cancer fatalities and about 0.022 other detrimental health effects in the worker population.

Perceptions of radiation effects are discussed in Section 5.1.1.11 and are well known among the Western Shoshone, Southern Paiute, and Owens Valley Paiute people of this region. These perceptions of risks from radiation are frightening, and remain an important part of our lives. We will always carry these thoughts with us. Today, people are afraid of many things and places in this whole area, but we still love to come out and see out land. We worry about more radiation being brought to this land.

If the DOE wants to better understand our feelings about the impacts of radiation on our cultures, they should support a study of risks from radiation designed, conducted, and produced by the CGTO.

At this time there has not been a systematic study of American Indian's perception of risk. Therefore, it is not possible to provide action-by-action estimation of risk perception impacts. We believe it is a topic that urgently needs to be studied so that Indian people may better address the actual cultural impacts of proposed DOE actions. There have been recent workshops funded by the National Science Foundation to understand how to research the special issue of culturally based risk perception among American Indian communities, and at least one major project has been funded. Although this is a relatively new topic of research, it is one that can be more fully understood by research that deeply involves the people being considered. To understand our view of radiation is to begin to understand why we responded in certain ways to past, present, and why we will continue to respond to future DOE activities.

5.3.1.12 Environmental Justice. Environmental Justice analysis is conducted in two steps. One is the determination of significant and adverse impacts as a result of the alternative. The other is an evaluation of whether a minority or low-income population is disproportionately affected by these significant and adverse impacts. If there are no significant and adverse impacts, there would be no significant, disproportionately high and adverse impacts experienced by minority and low-income populations. The location of minority or low-income populations is shown on the figures in Section 4.1.12.

The CGTO has identified impacts to American Indian groups as a result of Alternative 3. While not physically located in Clark, Nye, or Lincoln Counties, these groups have traditional ties to the NTS and surrounding areas. Impacts would include continued reduced access to culturally significant areas, the potential for unauthorized artifact collection, and the potential for culturally inappropriate environmental restoration techniques. Because of the expansion of activities under Alternative 3, potential impacts would be greater than those listed under Alternative 1. These impacts would be perceived only by American Indian groups and would, therefore, be a disproportionately high impact on these groups.

No other significant adverse impacts as a result of this alternative were ascertained; therefore, there would be no disproportionately high and adverse impacts to other minority and low-income populations.

American Indian concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival especially access violations. These impacts are discussed in Section 5.2.1.10, Cultural Resources, and 5.2.1.11, Occupational and Public Health and Safety. There has not been a systematic study of these issues for the NTS. The CGTO maintains that past, present and future activities on the NTS have, are, or will disproportionately impact these American Indian people. Under the Expanded Use Alternative 3, there is a high potential of adverse impacts to these issues. As more activities occur, both risks from radiation and reduced access from land disturbance is expected to occur. The CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study, before new activities are approved.

Action-by-action responses are accessed in Section 5.1.1.12 and are not repeated here.

5.3.2 Tonopah Test Range

Under Alternative 3, the Defense, Environmental Restoration, and Work for Others Programs at the Tonopah Test Range would continue. In addition, a variety of proposed tests would be conducted at the Tonopah Test Range. The activities associated with Alternative 3 are summarized below. A detailed description of the activities is presented in Appendix A.

Defense Program. Under Alternative 3, Tonopah Test Range activities would include the same activities as under Alternative 1, with the addition of a variety of proposed tests. The proposed tests would include robotics, smart transportation, a variety of burn tests, smoke obscuration operations, thermal test operation facility, climatic test operation facility, armor/antiarmor tests, and infrared tests.

Environmental Restoration Program. Environmental Restoration Program activities would continue at current or accelerated rates.

Work for Others Program. Current Work for Others Program activities would continue at the Tonopah Test Range. Activities would be the same as those described for Alternative 1 in Section 5.1.2.

Site-Support Activities. Site-support activities under Alternative 3 would be increased as a result of increased activities at the Tonopah Test Site.

*5.3.2.1 **Land Use.*** Under Alternative 3, the actions taken at the Tonopah Test Range would be the same as for Alternative 1, including the addition of Nondefense Research and Development and Work for Others Programs. The Environmental Restoration Program would accelerate its schedule.

Defense Program. Alternative 3 would include all activities identified under Alternative 1 and any increase of defense-related missions not evaluated in the baseline, resulting in more demands on the airspace by the DOE. This would require additional coordination with the U.S. Air Force to ensure both missions are accommodated.

Environmental Restoration Program. Two Environmental Restoration Program projects at the Tonopah Test Range could result in land disturbance under Alternative 3. One project would consist of the restoration of approximately 200 acres for the Soils Media Corrective Action Unit. The second project would consist of 43 Environmental Restoration Program sites identified at the Tonopah Test Range.

Impacts to land-use resources from Environmental Restoration Program activities would be mostly beneficial, making contaminated lands usable subject to restrictions and tenant uses. Adverse impacts would be negligible. The 1,025 acres identified for Environmental Restoration Program projects would represent less than 0.3 percent of the Tonopah Test Range land area.

Work for Others Program. Under Alternative 3, the activities conducted would be similar to those activities identified under Alternative 1 and other Defense Program activities. Therefore, the impact would be similar.

*5.3.2.1.1 **Site-Support Activities***—Site-support activities under Alternative 3 would include those identified under Alternative 1, as well as any expansions needed. This could require additional facilities, services, utilities, and communications, depending on growth in certain testing activities.

Maintenance support of all facilities would continue at present levels. New facilities could be built as required for expansion of activities. Law enforcement, security, fire protection, and health services would expand to match increased activities. Off-site administrative support would be primarily located in Las Vegas, Nevada, and Albuquerque, New Mexico, and their number would increase as needed to serve the Tonopah Test Range.

All utilities would be maintained to ensure they are free of defects. Utilities that are currently not in use might be required to be powered up. Additional support lines could be established. It is anticipated that the present water system would provide sufficient support for an increase in activities, and the present wastewater system would be sufficient to support all growth within Areas 3 and 9. No additional expansion of solid waste units or support construction would be required to support an increase in solid waste. The communication systems described in Section 4.2.1.3 would have the capability of being expanded as needed to support all increased activities at the Tonopah Test Range.

*5.3.2.1.2 **Airspace***—Airspaceactionsassociated with Alternative 3 would most likely be similar to those discussed under Alternative 1. Current levels of air traffic control and navigational air service, as well as airspace structure, would be maintained.

Under this alternative, the only activities that would affect airspace would be defense-related. Therefore, only the Defense and Work for Others Programs are discussed.

Defense Program. Alternative 3 includes all activities identified in Alternative 1 and any increase of defense-related missions not evaluated in the baseline, resulting in more demands on the airspace by the DOE. This would require additional coordination with the U.S. Air Force to ensure both missions are accommodated.

Work for Others Program. With the Work for Others Program, the continuation of the use of the Tonopah Test Range airspace for various military training exercises and for defense-related activities is anticipated. No commercial air passenger or general aviation activities are anticipated. Occasional air cargo, fixed-wing, and helicopter transit are expected.

Airspace requirements under Alternative 3 would be the same as those currently in effect with Nellis Air Force Base Air Traffic Control Facility, assuming coordination of air traffic control at the Tonopah Test Range and its surrounding areas. The continuation of operations at the Tonopah Test Range under the Work for Others Program under Alternative 3 would require additional coordination with the U.S. Air Force to ensure both missions are accommodated.

5.3.2.2 Transportation. The following sections contain the discussion of the environmental impacts related to transportation activities, as defined under Alternative 3. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.3.2.2.1 On-Site Traffic—Traffic volumes on the Tonopah Test Range are below 1,000 vehicles per day on any roadway. Activities associated with the Tonopah Test Range would add minimal traffic to the already underused roadways. Federal agencies that use the Tonopah Test Range would continue to maintain some of the transportation infrastructure.

5.3.2.2.2 Off-Site Traffic—Under Alternative 3, activities at the Tonopah Test Range as a result of the Defense, Environmental Restoration, and Work for Others Programs would generate only an occasional and minor amount of vehicular traffic on the local access roads and on the immediate regional highway (U.S. Highway 6 near Tonopah). There would be no traffic impacts on off-site roadways under Alternative 3 .

5.3.2.2.3 Transportation of Materials and Waste—The impacts resulting from the transportation of materials and waste under Alternative 3 would be the same as those described under Alternative 1 in Section 5.1.2.2.3.

5.3.2.2.4 Other Transportation—Under Alternative 3, the impacts related to other transportation would be the same as those described under Alternative 1 in Section 5.1.2.2.4. In addition, the increase in personnel under Alternative 3 might require multiple airplane trips.

5.3.2.3 Socioeconomics. The socioeconomic analysis has been prepared for the region of influence, regardless of where employees work. Therefore, the place of employment would not change the effects in any of the socioeconomic indicators. The analysis for this site is included in Section 5.3.1.3.

5.3.2.4 Geology and Soils. The impacts to geology and soils resulting from three programs and site-support activities are presented in this section.

Defense Program. Under Alternative 3 for the Tonopah Test Range, the adverse impacts to geologic media discussed under the Defense Program in Section 5.1.2.4 apply. An additional 2.8 acres are anticipated to be impacted by excavation of the surface for installation of infrastructure or test facilities. Weapons tests are anticipated to impact an additional 9 m^2 (100 ft^2) of surface geologic media.

Environmental Restoration Program. Under Alternative 3, the adverse impacts to geologic media discussed under the Environmental Restoration Program in Section 5.1.2.4 apply.

Work for Others Program. Under Alternative 3, the adverse impacts to geology and soils are similar to the impacts discussed for the Defense Program under this alternative.

Site-Support Activities. Impacts are not expected as a result of site-support activities.

5.3.2.5 Hydrology. The environmental impacts to surface hydrology and groundwater are described. Discussions of impacts to water quality and water quantity are also presented.

5.3.2.5.1 Surface Hydrology—The impacts to surface hydrology for the programs and site- support activities are presented in this section. One potential impact from all programs would be the alteration of natural drainage paths, resulting in potential preferential erosion of natural or fill deposits, deposition of sediments, ponding of water, or inundation of infrastructure.

Some negligible increase in surface water flows may occur if appreciable areas were paved or the natural runoff characteristics were otherwise altered. The impact would not be considered significant.

Defense Program. Adverse impacts to the surface hydrologic environment discussed under the Defense Program in Section 5.1.2.5 apply under Alternative 3 of the Tonopah Test Range. An additional 2.8 acres are anticipated to be impacted by excavation of the surface for installation of infrastructure or test facilities. Weapons tests are anticipated to impact an additional 9 m^2 (100 ft^2) of surface geologic media.

Environmental Restoration Program. Under Alternative 3, the adverse impacts to the surface hydrologic environment discussed under the Environmental Restoration Program in Section 5.1.2.5 apply under Alternative 3.

Work for Others Program. Under Alternative 3, Work for Others Program activities are similar to Defense Program activities; therefore, the potential impacts to surface hydrology would be similar.

Site-Support Activities. Site-support activities at the Tonopah Test Range are not expected to significantly impact surface waters.

5.3.2.5.2 Groundwater—For the Tonopah Test Range, the impacts are the same as discussed under Alternative 1. The increase of defense-related activities or acceleration of Environmental Restoration Program activities is not expected to have significant impacts on water demand under Alternative 3.

5.3.2.6 Biological Resources. Only three programs, Defense, Environmental Restoration, and Work for Others, would occur on the Tonopah Test Range under Alternative 3. The discussion for these three programs follows.

Defense Program. The projects under Alternative 3 are similar to those proposed under Alternative 1, except that more tests would be performed in previously disturbed areas. As was concluded for Alternative 1, there would be no impacts on biological resources.

Environmental Restoration Program. The activities under Alternative 3 for this program are similar to those described under Alternative 1 with the exception of the acceleration of scheduled activities associated with this program. This is not likely to change the nature of the impacts as described under Alternative 1.

Work for Others. The activities associated with this program are similar to activities associated with Defense Program activities. Therefore, there would be no impacts to biological resources.

Site-Support Activities. The impacts to biological resources would be the same as those described under Alternative 1 in Section 5.1.2.6.

5.3.2.7 Air Quality. Under Alternative 3, impacts to air quality would be the same as those described under Alternative 1 in Section 5.1.2.7. Increased defense-related programs and the acceleration of the environmental restoration activities would not significantly impact the air quality of the area.

5.3.2.8 Noise. Under Alternative 3, noise impacts would be the same as those described under Alternative 1 in Section 5.1.2.8.

5.3.2.9 Visual Resources. The impacts to visual resources under Alternative 3 would be similar to those described under Alternative 1 in Section 5.1.2.9.

5.3.2.10 Cultural Resources. The impacts to cultural resources on the Tonopah Test Range as a result of activities included under Alternative 3 are presented in this section.

Defense Program. Additional impacts are expected from increased testing, which may result in ground disturbances or a modification of existing structures. Archaeological sites have been recorded in the area, and indirect impacts to these sites could occur as a result of increased visitation to the site.

Environmental Restoration Program. Impacts to cultural resources are the same as those contained in Alternative 1.

Waste Management Program. Under Alternative 3, waste management would expand and additional facilities would be constructed at Areas 3 and 5 at the NTS. An increase in ground disturbances and an increase in visitation could have an impact on cultural resources.

AMERICAN INDIAN CULTURAL RESOURCES—This section describes the American Indian concerns associated with implementing Alternative 3, as summarized by the CGTO.

Defense Program—Under Alternative 3, it is expected that American Indian cultural resources would be adversely impacted if additional underground nuclear tests occur or if new areas are used for expanded testing programs.

Waste Management Program—Under Alternative 3, it is expected that American Indian cultural resources would not be adversely impacted. There is no Waste Management Program on the Tonopah Test Range, and none has been identified for this alternative.

Environmental Restoration Program—Under Alternative 3, it is expected that American Indian cultural resources would be adversely impacted if natural lands are scraped during environmental restoration. Access to culturally significant places would be increased if environmental restoration were successful, thus reducing Indian peoples' perception of health and spiritual risks associated with this area. Indian people wish to be involved in identifying environmental restoration methods and in the evaluation of restoration success.

Nondefense Research and Development Program. Additional impacts may occur through construction of the Natural Gas Facility.

Work for Others Program. Impacts are the same as contained in Alternative 1.

Site-Support Activities. Impacts are the same as contained in Alternative 1.

Nondefense Research and Development Program—Under Alternative 3, it is expected that American Indian cultural resources would be adversely impacted if natural lands are scraped during any nondefense research and development actions.

Work for Others Program—Under Alternative 3, it is expected that American Indian cultural resources would be impacted if Tonopah Test Range weapons research and development programs were expanded. These actions have and will continue to pollute these lands. American Indian cultural resources will continue to be adversely impacted by military training exercises and weapons tests.

5.3.2.11 Occupational and Public Health and Safety. Alternative 3 includes all program activities described under Alternative 1 plus additional activities. For Tonopah Test Range workers, the increased activities are expected to result in a corresponding increase in human health and safety impacts compared to Alternative 1. Table 5.3-17 summarizes the occupational and public health and safety impacts for the applicable Tonopah Test Range programs under Alternative 3.

As under Alternative 1, none of the routine activities conducted at the Tonopah Test Range under Alternative 3 involves hazards that would impact public health and safety. Section 5.3.2.7, Air Quality, identifies no active sources for airborne release of radioactivity or criteria pollutants. Section 5.1.2.2.3 addresses the impacts of transportation of radioactive materials and waste. Accidents associated with activities at the Tonopah Test Range could impact public health and safety, and are discussed in this section.

Table 5.3-17. Health risks to workers and the public from program activities, Tonopah Test Range, Alternative 3

Program Area	Worker Health Risks						Public Health Risks			
	Occupational Safety Risks		Occupational Radiation Risks		Occupational Chemical Risks		Public Radiation Risks		Public Chemical Risks	
	Injuries	Fatalities	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers[c]	Chemical Hazard Index[d]	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers[c]	Chemical Hazard Index[d]
Defense	2.6	0.0046	0.0028	0.0011	8.4×10^{-12}	1.8×10^{-5}	9×10^{-9}	4.1×10^{-9}	1×10^{-10}	9.6×10^{-7}
Environmental Restoration	0.0054	0.0011	2.6×10^{-4}	1.4×10^{-4}	e	e	1.2×10^{-9}	5.7×10^{-10}	e	e
Total	**2.6**	**0.0057**	**0.0031**	**0.0012**	**8.4×10^{-12}**	**1.8×10^{-5}**	**1×10^{-8}**	**4.7×10^{-9}**	**1×10^{-10}**	**9.6×10^{-7}**

a. Number of radiation-induced latent cancer fatalities in the exposed population associated with the activities conducted over the 10-year period of analysis
b. Number of radiation-induced detrimental health effects (e.g., nonfatal cancers, genetic effects) in the exposed population associated with the activities conducted over the 10-year period of analysis
c. Number of chemical-induced cancers (fatal and nonfatal) in the exposed population associated with the activities conducted over the 10-year period of analysis
d. A hazard index of greater than one indicates that the non-cancer health effects could be life-threatening to individuals exposed for one hour or more
e. No reasonably foreseeable scenarios resulting in exposure to chemically hazardous materials have been identified.

Defense Program. Based on occupational injury and fatality rates for construction activities, the Defense Program at the Tonopah Test Range is expected to result in 2.6 injuries and 0.0046 fatalities to workers during construction activities over the 10-year period evaluated in this EIS. During the same time period, no injuries or fatalities are projected as a result of routine program activities. Based on previous occupational radiation records, occupational exposure to radiation is not expected to exceed a collective dose to Defense Program workers of about 7-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 0.0028 latent cancer fatalities and 0.0011 other detrimental health effects in the worker population. The risk of accidental exposure to radioactive or hazardous chemical releases contributes nearly zero increase to the risk of latent cancer fatality or detrimental health effect.

The health and safety impact to the public from potential Defense Program accidents at Tonopah Test Range could result in about 9.0×10^{-9} latent cancer fatalities and 4.1×10^{-9} other detrimental health effects in the population. Additional risk due to accidental exposure to hazardous chemicals would be even less.

The maximum reasonably foreseeable Defense Program radiological accident at the Tonopah Test Range would be the same as described in Section 5.1.2.11 for Alternative 1 (a failure of an artillery fired test assembly, which has a probability of occurrence of 1×10^{-7} [1 in 10,000,000] per year).

For Defense Programs hazardous chemical effects at the Tonopah Test Range, the maximum reasonably foreseeable accident would also be the same as described in Section 5.1.2.11 for Alternative 1 (an explosion of a rocket test assembly containing depleted uranium and beryllium, which has a probability of occurrence of 6×10^{-6} [1 in 170,000] per year).

Environmental Restoration Program. Based on occupational injury and fatality rates for industrial activities, the Environmental Restoration Program is expected to result in 0.0054 injuries and 0.0011 fatalities to workers during routine program activities over the 10-year period evaluated in this EIS. During the same period, no injuries or fatalities are expected to result from construction activities.

Based on previous occupational radiation records, occupational exposure to radiation is estimated to result in a collective dose to Tonopah Test Range Environmental Restoration Program workers of about 0.7-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 2.6×10^{-4} latent cancer fatalities and 1.2×10^{-4} other detrimental health effects in the worker population. The risk of accidental exposure to radioactive releases contributes nearly zero increase to the risk of latent cancer fatality or detrimental health effect. No Environmental Restoration Program hazardous chemical accident resulting in measurable effects at the Tonopah Test Range has been identified.

The health and safety impact to the public from potential Environmental Restoration Program accidents at Tonopah Test Range could result in about 1.2×10^{-9} latent cancer fatalities and 5.7×10^{-10} other detrimental health effects in the population.

The maximum reasonably foreseeable Environmental Restoration Program radiological accident at the Tonopah Test Range would be the same as described in Section 5.1.2.11 for Alternative 1 (an airplane crash into the Project Roller Coaster site, which has a probability of occurrence of 1×10^{-6} [1 in 1,000,000] per year).

5.3.2.12 Environmental Justice. Impacts for Environmental Justice for this site are discussed for the region of influence in Section 5.3.1.12.

American Indian concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival especially access violations. These impacts are discussed in Section 5.3.2.10, Cultural Resources, and 5.3.1.11, Occupational and Public Health and Safety. There has not been a systematic study of these issues for the Tonopah Test Range. The CGTO maintains that past, *present, and future activities on the Tonopah Test Range have, are or will disproportionately impact the American Indian people. Under the Expanded Use Alternative 3, there is a high potential of adverse impacts. As more activities occur, both risks from radiation and reduced access from land disturbance is expected to occur. The CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study, before new activities are approved.*

Program-by-program responses are assessed in Section 5.1.1.12 and are not repeated here.

5.3.3 Project Shoal Area

The Environmental Restoration Program is the only program scheduled for the Project Shoal Area under this alternative; therefore, it is the only program discussed. Characterization and remediation activities would continue as in Alternative 1 with the possibility of accelerated schedules.

5.3.3.1 Land Use. The completion of the actions on an accelerated schedule would not appreciably decrease the time required for any given activity. Site characterization or feasibility studies action would be initiated sooner under this alternative. No impacts to land use are expected. Because of the remoteness of this site and the compatible surrounding land uses, no impacts are anticipated to surrounding land uses.

5.3.3.1.1 Site-Support Activities—No significant impacts on site-support activities would occur as a result of Alternative 3 actions. Requirements for water, power, and other facilities would not be increased from Alternative 1 levels.

5.3.3.1.2 Airspace—Under Alternative 3, the Environmental Restoration Program activities anticipated at the Project Shoal Area would not use air transportation. Therefore, there would be minimal effects on airspace at the Project Shoal Area as a result of this alternative.

5.3.3.2 Transportation. The following sections address the environmental impacts related to transportation activities as defined under Alternative 3. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.3.3.2.1 On-Site Traffic—Environmental Restoration Program activities at the Project Shoal Area would be short-term and would require relatively few personnel (less than 10 people at any given time). Therefore, no traffic impacts are expected.

5.3.3.2.2 Off-Site Traffic—Under Alternative 3, Environmental Restoration Program activities would generate only an occasional and minor amount of vehicular traffic (less than 100 vehicle trips per day) on the local access roads and on the immediate regional highway (U.S. Highway 50). Therefore, under Alternative 3, there would be no traffic impacts on off-site roadways.

5.3.3.2.3 Transportation of Materials and Waste—The transport of materials and wastes from the Project Shoal Area would not have a significant impact on the overall risk estimates; chances for getting cancer or having radiation detriment from these shipments would be highly unlikely.

5.3.3.2.4 Other Transportation—Because Alternative 3 activities would not include direct use of local railroads or other modes of air transportation to the Project Shoal Area, direct effects on rail and other modes of transportation are expected to be minimal. Furthermore, the anticipated activities at the site do not call for a measurable transportation demand.

5.3.3.3 Socioeconomics. The socioeconomic analysis has been prepared for the region of influence, regardless of where employees work. Therefore, the place of employment would not change the effects in any of the socioeconomic indicators. The analysis for this site is included in Section 5.3.1.3.

5.3.3.4 Geology and Soils. Under Alternative 3, the impacts to geology and soils would be the same as those described under Alternative 1 in Section 5.1.3.4. Acceleration of the restoration schedule would not significantly impact geology and soils.

5.3.3.5 ***Hydrology.*** Actual water demand on an accelerated schedule would not vary appreciably from Alternative 1, in which only minimal quantities of water would be required.

5.3.3.6 ***Biological Resources.*** The activities at this site would be similar to those described under Alternative 1, so the impacts would be the same as those described under Alternative 1.

5.3.3.7 ***Air Quality.*** Emissions from the operation of U.S. Navy aircraft over the Project Shoal Area would have little impact on surface ambient pollutant concentrations. Studies have shown that resulting concentrations would be about 0.05 percent of allowable concentrations (SAIC/DRI, 1991). About 10 acres of land would be disturbed during the Environmental Restoration Program. The average annual fugitive dust emission (PM_{10}) from Alternative 3 drilling activity would be about 3 tons. Fugitive dust calculations assume a 50-percent reduction as a result of watering the sites. Because activities are only expected to occur on a short-term basis, long-term air quality impacts are not expected.

5.3.3.8 ***Noise.*** Under Alternative 3, noise impacts would be the same as those described under Alternative 1 in Section 5.1.3.8.

5.3.3.9 ***Visual Resources.*** Impacts to visual resources under Alternative 3 would be similar to those described under Alternative 1 in Section 5.1.3.9.

5.3.3.10 ***Cultural Resources.*** Indirect impacts to cultural resources might result from increased visitation and vehicular traffic in archaeologically sensitive areas. The indirect impacts would be monitored through site visits by archaeologists.

<u>*AMERICAN INDIAN CULTURAL RESOURCES*</u>*— This section describes the American Indian concerns associated with implementing Alternative 3, as summarized by the CGTO.*

This study is not within the traditional lands of the Indian people represented by the CGTO. It is recommended by the CGTO that the DOE EIS team directly contact Indian tribes and organizations having traditional lands in the Project Shoal test site area. The following tribes were suggested: Fallon Paiute, Walker River Paiute, Pyramid Lake, and Lovelock Paiute Tribes.

Note: The Fallon Paiute, Walker River Paiute, and Lovelock Paiute Tribes were contacted by the DOE in letters dated May 12, 1995.

5.3.3.11 Occupational and Public Health and Safety. The Environmental Restoration Program is the only active program expected to result in health and safety impacts to workers at the Project Shoal Area under Alternative 3. No contamination has been detected in surficial soils at this site, and no surface soil remedial actions are proposed. Activities at this site would consist of characterization and hydrologic monitoring. Alternative 3 accelerates the program activities described under Alternative 1. For Project Shoal Area workers, the increased activities are expected to result in a corresponding increase in human health and safety impacts compared to Alternative 1. Table 5.3-18 summarizes the occupational and public health and safety impacts for Environmental Restoration Program activities under Alternative 3. As in Alternative 1, no impacts to public health and safety are reasonably foreseeable from either routine activities or accidents under Alternative 3. Potential impacts to public health and safety from subsurface contamination of groundwater are the same as those discussed under Alternative 1 in Section 5.1.3.11.

Environmental Restoration Program. Based on occupational injury and fatality rates for industrial activities, Environmental Restoration Program activities at the Project Shoal Area are expected to result in 1.7 x 10^{-4} injuries and 3.4 x 10^{5} fatalities to workers during routine program activities over the 10-year period evaluated in this EIS. During the same period, no injuries or fatalities are expected from construction activities.

Based on previous occupational radiation records, occupational exposure to radiation is estimated to result in a collective dose to Project Shoal Area Environmental Restoration Program workers of about 0.05-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could

Table 5.3-18. Health risks to workers and the public from program activities, Project Shoal Area, Alternative 3

Program Area	Worker Health Risks						Public Health Risks			
	Occupational Safety Risks		Occupational Radiation Risks		Occupational Chemical Risks		Public Radiation Risks		Public Chemical Risks	
	Injuries	Fatalities	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers	Chemical Hazard Index	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers	Chemical Hazard Index
Environmental Restoration	1.7×10^{-4}	3.4×10^{-5}	1.9×10^{-5}	7.6×10^{-6}	c	c	d	d	c	c
Total	1.7×10^{-4}	3.4×10^{-5}	1.9×10^{-5}	7.6×10^{-6}	c	c	d	d	c	c

a. Number of radiation-induced latent cancer fatalities in the exposed population associated with the activities conducted over the 10-year period of analysis
b. Number of radiation-induced detrimental health effects (e.g., nonfatal cancers, genetic effects) in the exposed population associated with the activities conducted over the 10-year period of analysis
c. No reasonably foreseeable scenarios resulting in exposure to chemically hazardous materials have been identified
d. No reasonably foreseeable scenarios resulting in exposure to radiation have been identified.

result in about 1.9×10^{-5} latent cancer fatalities and 7.6×10^{-6} other detrimental health effects in the worker population. No Environmental Restoration Program accidents resulting in measurable radiological or chemically hazardous effects at the Project Shoal Area have been identified.

5.3.3.12 Environmental Justice. Impacts for Environmental Justice at this site are discussed for the region of influence in Section 5.3.1.12. *American Indian concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3)cultural survival especially access violations. The impacts are discussed in Section 5.3.8.10, Cultural Resources, and 5.3.1.11, Occupational and Public Health and Safety. There has been no systematic study of these issues for the Project Shoal Area.*

The study area is not within the traditional lands of the American Indian people represented by the CGTO. It is recommended by the CGTO that the DOE EIS team directly contact American Indian tribes and organizations having traditional lands in the Project Shoal Area. The following tribes were suggested: Fallon Paiute, Walker River Paiute, Pyramid Lake, and Lovelock Paiute Tribes

5.3.4 Central Nevada Test Area

The Environmental Restoration Program is the only program planned for the Central Nevada Test Area under this alternative; therefore, it is the only program discussed. Characterization and remediation activities would continue, but might be accelerated relative to Alternative 1.

5.3.4.1 Land Use. Under Alternative 3, the actions taken at the Central Nevada Test Area are the same as under Alternative 1, but on an accelerated schedule. An accelerated schedule would not appreciably decrease the time required for any given activity; e.g., site characterization or feasibility studies. The actions simply would be initiated sooner under this alternative. No land-use impacts are expected because of the remoteness of the Central Nevada Test Area and similar land use surrounding it. Fallon Naval Air Station intends to create military operating areas in three of Nye County's rural regions; they would be designated Smoky, Duckwater, and Diamond. The Central Nevada Test Area falls under the Duckwater military operating area.

This airspace expansion has not yet been filed and would not affect Environmental Restoration Program activities at the Central Nevada Test Area. Therefore, there would be minimal effects on airspace at the Central Nevada Test Area as a result of Alternative 3. No other programs are scheduled at the Central Nevada Test Area.

5.3.4.2 Transportation. The following sections address the discussion of the environmental impacts related to transportation activities as defined under Alternative 3. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.3.4.2.1 On-Site Traffic—Environmental Restoration Program activities at the Central Nevada Test Area would be short-term and would require relatively few personnel (less than 10 at any given time). There are no public roads currently on site, and the low level of personnel anticipated would generate a minor amount of traffic.

5.3.4.2.2 Off-Site Traffic—Under Alternative 3, Environmental Restoration Program activities would generate only an occasional and minor amount of vehicular traffic (less than 100 vehicle trips per day). Therefore, under Alternative 3, there would be minor vehicular traffic generated and no traffic impacts on off-site roadways.

5.3.4.2.3 Transportation of Materials and Waste—The transport of radioactive waste from the Central Nevada Test Area would not have a significant impact on the overall risk estimates; that is, the chances of getting cancer or having radiation detriment from these shipments is highly unlikely.

5.3.4.2.4 Other Transportation—Because Alternative 3 activities do not include direct use of local railroads, air transportation, or other modes of transportation to this site, direct effects on rail, air, and other modes of transportation are expected to be minimal.

5.3.4.3 Socioeconomics. The socioeconomic analysis has been prepared for the region of influence, regardless of where employees work. Therefore, the place of employment would not change the effects in any of the socioeconomic indicators. The analysis for this site is included in Section 5.3.1.3.

5.3.4.4 Geology and Soils. Potential impacts to the geology of the Central Nevada Test Area are the same as described for Alternative 1 in Section 5.1.4.4.

5.3.4.5 Hydrology. Under Alternative 3, the Environmental Restoration Program actions would be accelerated. Water demand on an accelerated schedule would not vary appreciably from Alternative 1, in which only minimal quantities of water would be required.

5.3.4.6 Biological Resources. The activities at this site under Alternative 3 are similar to those described under Alternative 1. Therefore, the impacts are the same as those described under Alternative 1 in Section 5.1.4.6.

5.3.4.7 Air Quality. Under Alternative 3, air quality impacts at the Central Nevada Test Area would be the same as those described for Alternative 1 in Section 5.1.4.7.

5.3.4.8 Noise. Noise impacts as a result of Alternative 3 would be the same as those described for Alternative 1 in Section 5.1.4.8.

5.3.4.9 Visual Resources. Under Alternative 3, the impacts to visual resources would be similar to those described for Alternative 1 in Section 5.1.4.9.

5.3.4.10 Cultural Resources. Under Alternative 3, impacts to cultural resources on the Central Nevada Test Area would be identical to those defined for Alternative 1 in Section 5.1.4.10.

AMERICAN INDIAN CULTURAL RESOURCES—This section describes the American Indian concerns associated with implementing Alternative 3, as summarized by the CGTO.

Defense Program—Under Alternative 3, it is expected that American Indian cultural resources will be adversely impacted if nuclear tests continue or increase and if natural lands are scraped for construction. In this alternative, however, there are no plans for additional tests or construction at the Central Nevada Test Area.

Waste Management Program—Under Alternative 3, it is expected that American Indian cultural resources will not be adversely impacted because there is no Waste Management Program on the Central Nevada Test Area and none has been identified for this alternative.

Environmental Restoration Program—Under Alternative 3, it is expected that American Indian cultural resources on the Central Nevada Test Area will be adversely impacted if natural lands are scraped during environmental restoration. Access to culturally significant places will be increased if environmental restoration is successful, thus reducing Indian people's perception of health and spiritual risks associated with this area. Indian people wish to be involved in identifying environmental restoration methods and in the evaluation of restoration success.

Nondefense Research and Development Program—Under Alternative 3, it is expected that American Indian cultural resources will be adversely impacted if natural lands are scraped during weapons research and development. No such actions are planned for this alternative, so cultural resources will not be adversely impacted.

Work for Others Program—Under Alternative 3, it is expected that American Indian cultural resources will be impacted if weapon research and development programs are implemented in the Central Nevada Test Area. No such actions are planned for this alternative, so American Indian cultural resources will not be adversely impacted.

5.3.4.11 Occupational and Public Health and Safety. The Environmental Restoration Program is the only active program expected to result in health and safety impacts to workers at the Central Nevada Test Area under Alternative 3. Activities at this site would consist of site characterization and remediation with removal of contaminated mud and sludge. Alternative 3 accelerates the program activities described under Alternative 1. For Central Nevada Test Area workers, the increased activities are expected to result in a corresponding increase in human health and safety impacts compared to Alternative 1. Table 5.3-19 summarizes the occupational and public health and safety impacts for Environmental Restoration Program activities under Alternative 3. As under Alternative 1, no impacts to public health and safety are reasonably foreseeable from either routine activities or accidents under Alternative 3. Potential impacts to public health and safety from subsurface contamination of groundwater are the same as those discussed for Alternative 1 in Section 5.1.4.11

Environmental Restoration Program. Based on occupational injury and fatality rates for industrial activities, Environmental Restoration Program activities at the Central Nevada Test Area are expected to result in 1.7×10^{-4} injuries and 3.4×10^{-5} fatalities to workers during routine program activities over the 10-year period evaluated in this EIS. During the same period, no injuries or fatalities are expected because of construction activities.

Based on previous occupational radiation records, occupational exposure to radiation is estimated to result in a collective dose to Central Nevada Test Area Environmental Restoration Program workers of about 0.05-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 1.9×10^{-5} latent cancer fatalities and 7.6×10^{-6} other detrimental health effects in the worker population. No Environmental Restoration Program accidents resulting in measurable radiological or chemically hazardous effects at the Central Nevada Test Area have been identified.

5.3.4.12 Environmental Justice. Impacts for Environmental Justice for this site are discussed for the region of influence under Alternative 1 in Section 5.3.1.12.

American Indian Environmental Justice concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival especially access violations. These impacts are discussed in Section 5.3.4.10, Cultural Resources, and Section 5.3.1.11, Occupational and Public Health and Safety. There has not been a systematic study of these issues for the Central Nevada Test Area. The CGTO maintains that past, present, and future activities on the Central Nevada Test Area have, are, or will impact these American Indian Environmental Justice issues. Under the Expanded Use Alternative 3, there is a high potential of adverse impacts to these issues, As more activities occur, both risks from radiation and reduced access from land disturbance is expected to occur. Even though the CGTO has not been permitted to visit the area, the area is especially important due to the concentration of cultural resources. Therefore, this area provides a special opportunity for the DOE to undue past Environmental Justice impacts. The CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study, before new activities are approved. Program-by-program responses are assessed in Section 5.1.1.12.

5.3.5 Eldorado Valley

A Solar Enterprise Zone facility would be developed as part of the Nondefense Research and Development Program under Alternative 3. The only activity being considered for Eldorado Valley is the Solar Enterprise Zone facility. Therefore, it is the only program discussed for this site. A sitewide environmental impact statement, supplemental environmental impact statement, and/or other environmental analysis would be performed to describe all impacts should this site be chosen for a Solar Enterprise Zone facility. Project plans, site preparation, technical studies, and worker transition training development and implementation would also be accomplished.

According to the Nevada Solar Enterprise Zone Task Force Work Group (DOE/NV, 1994c), a reinforcement of the natural gas supply system could be required. Water supplies would also have to be secured for the site, and conveyance systems would have to be installed.

Construction of a 19-km (12-mi) water line from Boulder City and a 10-km (6-mi) natural gas line are necessary to support the alternative energy project at this site.

5.3.5.1 Land Use. The location of the Solar Enterprise Zone facility at the Eldorado Valley would not result in significant impacts on land use.

Table 5.3-19. Health risks to workers and the public from program activities, Central Nevada Test Area, Alternative 3

Program Area	Worker Health Risks						Public Health Risks			
	Occupational Safety Risks		Occupational Radiation Risks		Occupational Chemical Risks		Public Radiation Risks		Public Chemical Risks	
	Injuries	Fatalities	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers	Chemical Hazard Index	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers	Chemical Hazard Index
Environmental Restoration	1.7×10^{-4}	3.4×10^{-5}	1.9×10^{-5}	7.6×10^{-6}	c	c	d	d	c	c
Total	**1.7×10^{-4}**	**3.4×10^{-5}**	**1.9×10^{-5}**	**7.6×10^{-6}**	**c**	**c**	**d**	**d**	**c**	**c**

a. Number of radiation-induced latent cancer fatalities in the exposed population associated with the activities conducted over the 10-year period of analysis
b. Number of radiation-induced detrimental health effects (e.g., nonfatal cancers, genetic effects) in the exposed population associated with the activities conducted over the 10-year period of analysis
c. No reasonably foreseeable scenarios resulting in exposure to chemically hazardous materials have been identified
d. No reasonably foreseeable scenarios resulting in exposure to radiation have been identified.

Designation of the site for renewable energy development would be consistent with surrounding land uses, such as a tortoise preserve.

This site falls within the Las Vegas terminal control area. A Solar Enterprise Zone facility at this site would not be expected to affect aircraft operations in the vicinity of McCarran International Airport. However, the construction of the Dish/Stirling solar trough and other facilities (energy corridors) would need to be coordinated with airport management and the Federal Aviation Administration to ensure obstacle clearance criteria and safety; e.g., the elimination of possible glare from dishes.

*5.3.5.2 **Transportation.*** The analysis of transportation impacts is presented with respect to on-site and off-site traffic.

*5.3.5.2.1 **On-Site Traffic***—Assuming that employees commute daily to work by private passenger cars (not buses), there would be 1,060 daily vehicle trips generated, based on the rate 3.02 daily vehicle trip ends per employee (ITE, 1991) and 0.44 vehicle trip ends per employee during peak hours. During peak hours, the project would generate 150 vehicle trips in both directions or 120 trips in the peak direction. This would not affect on-site traffic appreciably.

*5.3.5.2.2 **Off-Site Traffic***—U.S. Highway 95 would be the major regional access to the site; U.S. Highway 95 is a two-lane, two-way rural highway south of Boulder City with 6,600 average daily traffic in 1993. The projected peak-hour traffic and associated level of service for 1996, 2000, and 2005 are shown in Table 5.3-4. With the Solar Enterprise Project, U.S. Highway 95 near the site would continue to operate at level of service C.

*5.3.5.3 **Socioeconomics.*** The socioeconomic analysis has been prepared for the region of influence regardless of where employees work. Therefore, the place of employment would not change the effects in any of the socioeconomic indicators. The analysis for this site is included in Section 5.3.1.3.

*5.3.5.4 **Geology and Soils.*** There would be some impacts on the geologic resources and soils of Eldorado Valley as a result of the development of a Solar Enterprise Zone facility. An extensive area of soils would be disturbed and, if blasting is required, some minor ground motion might be induced. Aggregate would be required for roads and concrete; however, the aggregate resources of the region are very large, and the use of aggregate for a Solar Enterprise Zone facility would not result in a significant loss of resources.

*5.3.5.5 **Hydrology.*** The impact of a Solar Enterprise Zone facility on the hydrology and water resources of Eldorado Valley would depend on the source of the water. It is anticipated that the water requirements would be met through the purchase of water directly from Boulder City and the city of Henderson. The purchase and use of this water would increase the total use of Colorado River water in southern Nevada, but by a very small percentage. The application of this water to a Solar Enterprise Zone facility would represent an opportunity for gain or loss depending on other potential uses for the water.

The perennial yield of Eldorado Valley is only 6.2×10^5 m^3/yr (500 acre-feet per year), and the basin is already overdrafted. Groundwater withdrawals for support of a Solar Enterprise Zone facility would result in additional overdrafting and would result in a continual lowering of water levels in the vicinity of water supply wells.

If groundwater withdrawals from the basin are permitted and used, then the effects on water levels in the basin would be significant. Assuming a 40-year project peak, water demand and aquifer transmissivity of 189,265 L/day (50,000 gal/day) per foot and the conservative assumptions behind this non-equilibrium equation (Driscoll, 1986), the drawdown in water levels for a Solar Enterprise Zone facility can be predicted. The estimated drawdown for this scenario is appreciable, 31 m (100 ft) in the immediate vicinity of the pumping well field and as much as 9 m (30 ft) at a distance of 6 km (4 mi) from the well field.

*5.3.5.6 **Biological Resources.*** A Solar Enterprise Zone facility would involve the development of up to four technologies or subprojects capable of generating electricity from solar energy. For this analysis, it was assumed that one of the four technologies would be developed, and about 2,400 acres of previously undisturbed habitat would be cleared for the site, and 420 acres for utility corridors. Loss of habitat and associated mortality of individuals, disruption of movement patterns and gene flow, and other effects should not have a negative impact on the viability of most species found in this area. The species are common throughout a large, relatively undisturbed region. No threatened, endangered, or candidate plants or animals are known to occur in the proposed area; however, this area has not been thoroughly surveyed. If populations of rare species are found, this project might impact their viability. Nests of birds, protected under the Migratory Bird Treaty Act, may be destroyed if ground clearing for construction of the project occurred during the breeding season. The abundance of desert tortoises is low in the vicinity of the proposed site (U.S. Fish and Wildlife Service, 1994), and the site is not critical habitat for this species. Tortoises living within the site could be killed, injured, or displaced during construction of the facility. Tortoises are also likely to be killed on roads during transportation activities for this project.

Construction of water and natural gas lines could significantly impact populations of rare species or the threatened desert tortoises. However, the locations of these support facilities have not been finalized, and the impacts, therefore, cannot be accurately evaluated.

5.3.5.7 Air Quality. Construction of a 100-MW solar-generated electric power station at Eldorado Valley would generate fugitive dust (PM_{10}) emissions during ground-disturbing activities. In addition, mobile source emissions would be generated by construction employee vehicles.

About 2,400 acres of land would be disturbed during a two-year period. The average annual fugitive dust (PM_{10}) emission from this activity would be about 360 tons. Fugitive dust generated from construction of the solar-powered electric power plant would be minor.

Mobile-source emissions would consist of exhaust emissions from vehicles used by construction employees to commute to and from the site. Assuming about 350 vehicles per day would travel to the site, pollutant emissions would be as follows:

- Volatile Organic Compounds: 10.57 tons/yr
- Carbon Monoxide: 71.66 tons/yr
- Nitrogen Oxides: 15.74 tons/yr

These emissions would be dispersed over a wide area and would not increase ambient pollutant concentrations sufficiently outside the Las Vegas Valley to cause any violations of the Ambient Air Quality Standards. Eldorado Valley is outside of the Las Vegas Valley, which is classified as a nonattainment area for carbon monoxide. However, emissions from vehicles driven by construction employees generated in the Las Vegas area may contribute to this area continuing to be classified as nonattainment for carbon monoxide.

5.3.5.8 Noise. Noise generation related to the construction of a Solar Enterprise Zone facility technology equipment would occur under Alternative 3. Temporary impacts resulting from construction-related noise would occur within the immediate vicinity of the construction sites. Noise impacts would be negligible. The site is located within a remote area, and no sensitive receptors are close to the construction area. Potential construction-related noise levels of 80 to 85 dBA at 15 m (50 ft) from construction equipment (e.g., large trucks and front-end loaders) would be reduced as distance increases. Because activities are only expected to occur on a short-term basis, long-term noise impacts are not expected.

5.3.5.9 Visual Resources. A Solar Enterprise Zone facility proposed for the Eldorado Valley site would disturb approximately 2,400 acres, representing about 40 percent of the site. The landscape of Eldorado Valley is common to the region. However, the site has a high visual sensitivity level because it is crossed by U.S. Highway 95. There are also three U.S. Bureau Land Management wilderness study areas within the site's viewshed. Because of the size of the area affected and the visibility from U.S. Highway 95, there would be adverse visual impacts.

5.3.5.10 Cultural Resources. The construction of a Solar Enterprise Zone facility and the expansion of existing facilities is likely to impact both previously recorded and undiscovered cultural resources in Eldorado Valley. Indirect impacts might result from increased visitation and vehicular traffic in archaeologically sensitive areas.

AMERICAN INDIAN CULTURAL RESOURCES—This section describes the American Indian concerns associated with the potential development of a Solar Enterprise Zone facility in the Eldorado Valley.

It is expected that American Indian cultural resources will be adversely impacted if a solar production facility is constructed and operated.

Work for Others Program—It is unlikely that Work for Others Program activities will be implemented in Eldorado Valley; therefore, no adverse impacts on American Indian resources are expected under Alternative 3.

5.3.5.11 Occupational and Public Health and Safety. Health and safety issues at a Solar Enterprise Zone facility site would be related to construction activities and are not expected to be out of the ordinary; therefore, impacts would be minimal.

5.3.5.12 Environmental Justice. Impacts for Environmental Justice for this site are discussed for the region of influence in Section 5.3.1.12.

American Indian concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival especially access violations. These impacts are discussed in Section 5.3.5.10, Cultural Resources, and Section 5.3.1.11, Occupational and Public Health and Safety. There has not been a systematic study of these issues for the Eldorado Valley. The CGTO maintains that past activities in the Eldorado Valley have impacted these American Indian issues, especially Holy Land violations. This constitutes a disproportionate impact on American Indian People. The CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study before new activities are approved.

5.3.6 Dry Lake Valley

A Solar Enterprise Zone facility would be developed as part of the Nondefense Research and Development Program under Alternative 3. The only activity being considered for Dry Lake Valley is the location of a Solar Enterprise Zone facility. Therefore, Nondefense Research and Development is the only program discussed. A sitewide environmental impact statement, supplemental environmental impact statement, and/or other environmental studies could be performed to describe all impacts should this site be chosen for a Solar Enterprise Zone facility. Project plans, site preparation, technical studies, and worker-transition training development and implementation could also be accomplished.

Three important support activities must be completed before a Solar Enterprise Zone facility could be constructed at this site. A 2-km (1-mi) natural gas pipe line would need to be constructed to allow connection to the Kern River pipe line. A 48-km (30-mi) power line would need to be constructed for a solar energy generating facility. Water would have to be pumped to this site, perhaps from Moapa Valley.

5.3.6.1 Land Use. The location of a Solar Enterprise Zone facility at the Dry Lake Valley would not result in significant impacts on land uses. The designation of the site for renewable energy development is consistent with surrounding land uses, which include an industrial park, the municipal landfill, a co-generation facility, and, to the northeast of California Wash, The Reid Gardner Power Station, a coal-fired power plant.

This site falls within the NAFR Complex and the Las Vegas terminal control area. A Solar Enterprise Zone facility at this site would not be expected to affect aircraft operations. The construction of the Dish/Stirling solar trough and other facilities (energy corridors) would need to be coordinated with the Federal Aviation Administration and airport management to ensure obstacle clearance criteria and safety; e.g. avoidance of conflicting glare from dishes.

5.3.6.2 Transportation. The analysis of transportation impacts is presented with respect to on-site and off-site traffic.

5.3.6.2.1 On-Site Traffic—Assuming that employees commute daily to work by private passenger cars (not buses), there would be 1,060 daily vehicle trips generated, based on the rate of 3.02 daily vehicle trip end per employee (ITE, 1991) and 0.44 vehicle trip end per employee during peak hours. During peak hours, the project would generate 150 vehicle trips in both directions or 120 trips in the peak direction. This on-site traffic would have very little impact on the site.

5.3.6.2.2 Off-Site Traffic—Interstate 15 would be the major regional access to the site; Interstate 15 is a four-lane divided freeway with 12,906 average daily traffic in 1993 south of the Lamb Boulevard intersection. The projected peak-hour traffic and associated level of service for 1996, 2000, and 2005 are shown in Table 5.3-4. With a Solar Enterprise Zone facility, U.S. Highway 93 near the site would continue to operate at level of service B or better.

5.3.6.3 Socioeconomics. The socioeconomic analysis has been prepared for the region of influence, regardless of where employees work. Therefore, the place of employment would not change the effects in any of the socioeconomic indicators. The analysis for this site is included under Section 5.3.1.3.

5.3.6.4 Geology and Soils. There would be some impacts on the geologic resources and soils of Dry Lake Valley as a result of the development of a Solar Enterprise Zone facility. An extensive area of soils would be disturbed and, if blasting is required, some minor ground motion might be induced. Aggregate would be required for roads and concrete. However, the aggregate resources of the region are very large, and the use of aggregate for a Solar Enterprise Zone facility would not result in a significant loss of resources.

5.3.6.5 Hydrology. The lack of a water supply for the construction and operation of a Solar Enterprise Zone facility is a serious limitation in Dry Lake Valley. The perennial yield of the basin is only 4.9×10^5 m^3/yr (400 acre-feet per year). There are 1.1×10^6 m^3/yr (930 acre-feet per year) of existing water rights, and more applications for water rights have been made totaling more than 2.6×10^7 m^3/yr (21,000 acre-feet per year). It is unlikely that water rights could be secured within the basin unless the use of water for a Solar Enterprise Zone facility is designated as a preferred use. In this event, the impacts of pumping would be similar to those described for the Eldorado Valley location (i.e., water level declines as much as 31 m [100 ft] in the vicinity of the operating well field and as much as 9 m [30 ft] at a distance of 6 km [4 mi] from the well field). Most likely, outflow to the California Wash would be slightly reduced, but, because of the low volume of such a reduction and the poor quality of that discharge, the impact to downgradient basins would be minimal.

If the proposed facility is not designated as a preferred use, then it is not likely that the large-scale water withdrawals needed for a Solar Enterprise Zone facility would be permitted. In this case, a source of water for the construction and operation of a Solar Enterprise Zone facility would have to be located beyond the basin boundaries.

Alternate locations for the development of a water supply are limited. The groundwater basins in the vicinity of Dry Lake Valley are either already designated as critical groundwater basins, do not have adequate groundwater resources to support such a project, or have numerous outstanding water right applications. Pending the identification of a source of water for the proposed location in Dry Lake Valley, no analyses can be performed to predict the effects on the basin from which the water is obtained.

5.3.6.6 Biological Resources. It is assumed that about 2,400 acres of previously undisturbed habitat would be cleared for the site, and 560 acres for utility corridors. This loss of habitat and associated mortality of individuals, disruption of movement patterns and gene flow, and other effects would not have a negative impact on the viability of most species found in this area. The species are common throughout a large, relatively undisturbed region. A survey of the site to be disturbed has not been conducted; therefore, it is not possible to determine if any rare species would be affected. Nests of birds, protected under the Migratory Bird Treaty Act, may be destroyed if ground clearing for construction of the project occurred during the breeding season.

However, two State-protected plant species are found in this valley. If the facility causes the destruction of a population of one of these or any other rare species, the viability of that species might be significantly affected. Desert tortoises are found throughout this valley, but their densities are generally low (Clark County, 1990). This site is not critical habitat for desert tortoises. Tortoises living within the site might be killed, injured, or displaced during construction of the facility. Some tortoises could be killed on roads during transportation activities for this project.

Construction of site-support facilities, such as a water line and a natural gas pipe line, might significantly impact populations of rare species or the threatened desert tortoises.

Water sources for a Solar Enterprise Zone facility are not currently known. Given the limited water availability in this and surrounding valleys (see Section 5.3.6.5), water use may have negative impacts on springs and their associated biota, including some threatened or endangered species.

5.3.6.7 Air Quality. Construction of a Solar Enterprise Zone facility at Dry Lake Valley would generate fugitive dust (PM_{10}) emissions during ground-disturbing activities. In addition, mobile-source emissions would be generated by construction employee vehicles.

About 2,400 acres of land would be disturbed during a two-year period. The average annual fugitive dust (PM_{10}) emission from this activity would be about 360 tons. Fugitive dust generated from construction of a solar-electric power plant would be minor.

Mobile-source emissions would consist of exhaust emissions from vehicles used by construction employees to commute to and from the site. Assuming about 350 vehicles per day would travel to the site, pollutant emissions would be as follows:

- Volatile Organic Compounds: 6.61 tons/yr
- Carbon Monoxide: 44.79 tons/yr
- Nitrogen oxides: 9.84 tons/yr

These emissions would be dispersed over a wide area and would not increase ambient pollutant concentrations sufficiently outside the Las Vegas Valley to cause any violations of the Ambient Air Quality Standards. The Dry Lake Valley is outside of the Las Vegas Valley, which is classified as a nonattainment area for carbon monoxide. However, emissions from vehicles driven by construction employees generated in the Las Vegas area may contribute to this area continuing to be classified as nonattainment for carbon monoxide.

5.3.6.8 Noise. Noise impacts in Dry Lake Valley as a result of siting a Solar Enterprise Zone facility would be the same as those described for Eldorado Valley in Section 5.3.5.8.

5.3.6.9 Visual Resources. The landscape of Dry Lake Valley is common to the region and is near an industrial development. The Nevada Power Company is planning to develop four additional power plants at this site, which already contains electrical power equipment. The site has a high visual sensitivity level because it is near Interstate 15. Construction of a Solar Enterprise Zone facility at this site would result in adverse impacts; however, the degree of contrast would be moderate because of the extensive man-made modifications already existing in the areas.

5.3.6.10 Cultural Resources. The construction of a Solar Enterprise Zone facility and the expansion of existing facilities would likely impact both previously recorded and undiscovered cultural resources in Dry Lake Valley. In particular, those sites associated with shoreline adaptations and the historically important Spanish Trail/Mormon Road might be affected. The precise nature of these impacts is unknown. However, any project that involves ground disturbance or modification to existing structures or features is likely to impact resources. Indirect impacts might result from increased visitation and vehicular traffic in archaeologically sensitive areas.

AMERICAN INDIAN CULTURAL RESOURCES—*This section describes the American Indian concerns associated with the development of a Solar Enterprise Zone facility, as summarized by the CGTO.*

It is expected that American Indian cultural resources will be adversely impacted if a Solar Enterprise Zone facility is constructed and operated.

5.3.6.11 Occupational and Public Health and Safety. Occupational and public health and safety issues at this site would be related to construction activities. Therefore, impacts are expected to be minimal.

5.3.6.12 Environmental Justice. Impacts for Environmental Justice for this site are discussed for the region of influence in Section 5.3.1.12.

American Indian Environmental Justice include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival especially access violations. These impacts are discussed in Section 5.3.6.10, Cultural Resources, and 5.3.1.11, Occupational and Public Health and Safety. There has not been a systematic study of these issues for the Dry Lake Valley, The CGTO maintains that past activities in the Dry Lake Valley have disproportionately impacted American Indian people, especially, Holy Land violations. Any activities occurring near Indian reservations further precludes future opportunities for expansion and access to these lands for any purpose. The CGTO should be funded to design conduct, and produce a systematic American Indian Environmental Justice study before new activities are approved.

Program-by-program responses are assessed in 5.1.1.12 and are not repeated here.

5.3.7 Coyote Spring Valley

A Solar Enterprise Zone facility would be developed as part of the Nondefense Research and Development Program under Alternative 3. Because this is the only alternative being considered for Coyote Spring Valley, Nondefense Research and Development is the only program discussed for this site. A sitewide EIS, supplemental environmental EIS, and/or other environmental studies would be performed to describe all impacts should this site be chosen for a Solar Enterprise Zone facility. Project plans, site preparation, technical studies, and worker transition training development and implementation would also be accomplished.

To maintain continuous power production, an 85 km (53-mi) natural gas pipe line would have to be constructed to tie into the Kern River pipe line. Development of any but the smallest subprojects would require upgrading of the power line system to this site. Water availability remains an unsettled issue, thus the size and location of water pipe line corridors are currently unknown.

5.3.7.1 Land Use. Alternative 3 actions would not significantly impact land uses. Surrounding land uses include wildlife management, mining, and recreation.

The Coyote Spring Valley falls within the NAFR Complex and the Las Vegas terminal control area. A Solar Enterprise Zone facility at this site would not be expected to affect aircraft operations. However, the construction of the Dish/Stirling solar trough and other facilities (energy corridors) would need to be coordinated with the Federal Aviation Administration and airport management to ensure obstacle clearance criteria and safety; e.g., elimination of possible glare from dishes.

American Indian concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival especially access violations. These impacts are discussed in Section 5.3.7.10, Cultural Resources, and Section 5.3.1.11, Occupational and Public Health and Safety. There has not been a systematic study of the issues for the Coyote Spring Valley. The CGTO maintains that past activities in the Coyote Spring Valley have disproportionately impacted the American Indian people, especially regarding Holy Land violations. This area was traditional lands for Southern Paiutes especially the Moapa Paiute Tribe. Any activities occurring near Indian reservations further precludes future opportunities for expansion and access to these lands for any purpose. The CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study before new activities are approved.

Program-by-program responses are assessed in 5.1.1.12 and are not repeated here.

5.3.7.2 Transportation. The analysis of transportation impacts is presented with respect to on-site and off-site traffic.

5.3.7.2.1 On-Site Traffic—Assuming that employees commute daily to work by private passenger cars (not buses), there would be 1,060 daily vehicle trips generated, based on the rate of

3.02 daily vehicle trip ends per employee (ITE, 1991) and 0.44 vehicle trip ends per employee during peak hours. During the peak hours, the project would generate 150 vehicle trips in both directions or 120 trips in the peak direction. These trips would not significantly impact the site.

5.3.7.2.2 Off-Site Traffic—U.S. Highway 93 would be the major regional access to the site; U.S. Highway 93 is a two-lane, two-way rural highway with 1,210 average daily traffic in 1993 south of State Route 375 Junction. The projected peak-hour traffic and associated level of service for 1996, 2000, and 2005 are shown in Table 5.3-4. With a Solar Enterprise Zone Project, U.S. Highway 93 near the site would continue to operate at level of service C or better.

5.3.7.3 Socioeconomics. One of the objectives of a Solar Enterprise Zone facility in Coyote Spring Valley is to provide local employment and economic benefits to offset the impact of defense conversion on the NTS. A Solar Enterprise Zone facility would stimulate the economy of Coyote Spring Valley and Lincoln County, while simultaneously serving national energy and environmental objectives. Building individual solar projects would provide construction jobs for a short period of time, while a fairly small, stable workforce would be required for sustained operation and maintenance of the facilities.

Solar energy could help meet the increased demand for electricity without damaging the environment. The development of a new science and manufacturing base mission is important. At the same time, environmental concerns create a growing demand for alternative generating technologies.

The socioeconomic impacts of a Solar Enterprise Zone facility will be presented when more information with respect to economic activity, population, housing, public finance, and public services is available. A sitewide EIS, supplemental EIS, and/or other environmental studies will be performed to describe all socioeconomic impacts. In addition, project plans, site preparation, technical studies, and worker transition training development and implementation would be accomplished.

5.3.7.4 Geology and Soils. There would be some impacts on the geologic resources and soils of Coyote Spring Valley as a result of the development of a Solar Enterprise Zone facility. An extensive area of soils would be disturbed, and, if blasting is required, some minor ground motion might be induced. Aggregate would be required for roads and concrete. However, the aggregate resources of the region are very large, and the use of aggregate for a Solar Enterprise Zone facility would not result in a significant loss of resources. If the Coyote Spring Valley site is selected for a Solar Enterprise Zone facility, a site-specific environmental document would be prepared that covers the impacts of construction and operation of the facility.

5.3.7.5 Hydrology. Although the water resources of Coyote Spring Valley are appreciable, they have been the focus of some of the largest water right filings ever made in the state of Nevada. The perennial yield of the basin is large (2.2×10^7 m^3/yr [18,000 acre-feet per year]); however, almost all of this quantity is based on the assumption that half the underflow that discharges out of the basin could be captured and placed to a beneficial use within Coyote Spring Valley.

Even though the current groundwater use in Coyote Spring Valley is minimal, there have been many applications to appropriate groundwater within the basin. Applications that have been filed total 5.2 m^3/yr (185 ft^3/sec) or 1.7×10^8 m^3/yr (133,940 acre-feet per year). Obviously, only a small portion, if any, of these water right applications will ever be granted. Unless the use of water for a Solar Enterprise Zone facility is designated as a preferred use, there would be little chance that groundwater might be appropriated in Coyote Spring Valley for its construction and operation.

The impacts of the water withdrawals from the carbonate aquifer in Coyote Spring Valley may be estimated on the basis of prior tests conducted by the U.S. Air Force. The U.S. Air Force conducted numerous well and aquifer tests, including a 30-day test at 12,870 L/min (3,400 gal/min), the same peak amount that might be required for a Solar Enterprise Zone facility. During testing, water levels were measured in adjacent monitoring wells in the downgradient basin and spring discharge rates at the

Muddy Springs area. No declines in water levels or spring discharge rates could be detected that were attributed to the testing of the carbonate well.

Thus, significant impacts from the pumping of this well at equal or lower rates for the Solar Enterprise Zone facility would not be likely. A localized lowering of water levels would occur in the vicinity of the pumping well, but, based on testing results, would be less than 6 m (20 ft) at the well and less than 1.5 m (5 ft) at a distance of 100 m (330 ft) after 20 years of continuous pumping. These impacts are not considered significant.

*5.3.7.6 **Biological Resources.*** It is assumed that about 2,400 acres of previously undisturbed habitat would be cleared for the site, and 960 acres for utility corridors. This loss of habitat and associated mortality of individuals, disruption of movement patterns and gene flow, and other effects should not have a negative impact on the viability of most species found in this area. The species are common throughout a large region. However, because a survey of the proposed site has not been conducted, it is not possible to determine if rare species will be affected. Nests of birds, protected under the Migratory Bird Treaty Act, may be destroyed if ground clearing for construction of the project occurred during the breeding season.

This valley generally has a low-to-moderate density of desert tortoises, but some areas in this valley have moderately high-to-high densities (Garcia et al., 1982). Tortoises living within the project site may be killed, injured, or displaced during construction of the facility. Tortoises also are likely to be killed on roads during transportation activities for this project. Because the abundance of desert tortoises is higher in Coyote Spring Valley than in the other sites considered for a Solar Enterprise Zone facility, and because this site is within critical habitat for desert tortoises, development of the project at this site would likely have a greater negative impact on desert tortoises than development elsewhere. Because of the presence of critical habitat, final siting discussions should be strongly influenced by potential impacts on biological resources.

It is proposed that 6.8×10^6 m^3 (5,500 acre/ft) of groundwater be pumped from Coyote Spring Valley. This groundwater withdrawal is not expected to influence water quality or quantity in nearby springs (see Section 5.3.7.5) and thus should have no biological impacts.

Construction of these infrastructure support facilities could significantly impact populations of rare species or the threatened desert tortoises.

*5.3.7.7 **Air Quality.*** Construction of a Solar Enterprise Zone facility in Coyote Spring Valley would generate fugitive dust (PM_{10}) emissions during ground-disturbing emissions. In addition, mobile-source emissions would be generated by construction employee vehicles.

About 2,400 acres of land would be disturbed during a two-year period. The average annual fugitive dust (PM_{10}) emission from this activity would be about 360 tons. Mobile-source emissions would consist of exhaust emissions from vehicles used by construction employees to commute to and from the site. Assuming about 350 vehicles per day would travel to the site, pollutant emissions would be as follows:

- Volatile Organic Compounds: 13.21 ton/yr
- Carbon Monoxide: 89.58 ton/yr
- Nitrogen Oxides: 19.67 ton/yr

These emissions would be dispersed over a wide area and would not increase ambient pollutant concentrations sufficiently to cause any violations of the Ambient Air Quality Standards. Coyote Spring Valley is outside of the Las Vegas Valley, which is classified as a nonattainment area for carbon monoxide. However, emissions from vehicles driven by construction employees generated in the Las Vegas area may contribute to this area continuing to be classified as nonattainment for carbon monoxide.

5.3.7.8 Noise. Noise impacts at Coyote Spring Valley would be the same as those described for Eldorado Valley in Section 5.3.5.8.

*5.3.7.9 **Visual Resources.*** The visual quality of Coyote Spring Valley has been designated as Class B because of the extensive panoramic views of the surrounding mountain ranges. In addition, the Solar Enterprise Zone facility site has high visual sensitivity because it is visible from the west on U.S. Highway 93. There are also three U.S. Bureau of Land Management Wilderness Study Areas within the site's viewshed. Construction of a Solar Enterprise Zone facility would greatly change the landscape character of Coyote Spring Valley, adversely impacting visual resources.

5.3.7.10 ***Cultural Resources.*** The construction of a Solar Enterprise Zone facility is likely to impact both previously recorded and undiscovered cultural resources in Coyote Spring Valley. Indirect impacts might result from increased visitation and vehicular traffic in archaeologically sensitive areas.

AMERICAN INDIAN CULTURAL RESOURCES— *This section describes the American Indian concerns associated with the development of a Solar Enterprise Zone facility in Coyote Spring Valley, as summarized by the CGTO.*

It is expected that American Indian cultural resources at Coyote Spring Valley will be adversely impacted if a Solar Enterprise Zone facility is constructed and operated.

5.3.7.11 Occupational and Public Health and Safety. Health and safety impacts at this site are expected to be minor. The health and safety issues are related to construction activities that are expected to be typical.

5.3.7.12 Environmental Justice. Impacts for Environmental Justice for this site are discussed for the region of influence in Section 5.3.1.12.

American Indian concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival especially access violations. These impacts are discussed in Section 5.3.7.11, Occupational and Public Health and Safety. There has not been a systematic study of these issues for the Coyote Spring Valley. The CGTO maintains that past activities in the Coyote Spring Valley have disproportionately impacted the American Indian people, especially regarding Holy Land violations. This area was traditional lands for Southern Paiutes especially the Moapa Paiute Tribe. Any activities occurring near Indian reservations further precludes future opportunities for expansion and access to these land for any purpose. The CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study before new activities are approved.

5.4 Alternative 4 - Alternate Use of Withdrawn Lands

Under Alternative 4, Alternate Use of Withdrawn Lands, all defense-related activities and most Work for Others Program activities at the NTS would be discontinued. A possible exception would be the allowance for an increased use of airspace by the U.S. Air Force. The primary activities anticipated under this alternative would be the continuation of waste management operations in support of NTS environmental restoration and waste-generating activities associated with projects sited at the NTS under this alternative. This alternative includes programs at the NTS, the NAFR Complex, the Project Shoal Area, the Central Nevada Test Area, and the three Solar Enterprise Zone locations: Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley, as well as the release of approximately 526 km^2 (203 mi^2) of lands currently within the NTS for public education and recreation. This section contains the summary of activities that are unique to Alternative 4. A more detailed description of the activities is presented in Appendix A.

Defense Program. All defense-related activities would be discontinued at the NTS. The Tonopah Test Range would continue to conduct the passive tests identified under Alternative 1 and described in Appendix A.

Waste Management Program. Under Alternative 4, the Waste Management Program would include the activities described under Alternative 3; however, these activities would be scaled back to provide service solely for the DOE waste generated within Nevada.

Environmental Restoration Program. Environmental restoration activities would continue at current or accelerated rates. Cleanup levels and remediation could be stricter (where applicable), based on designated land use and potential return of some lands to the public domain.

Nondefense Research and Development Program. Under Alternative 4, the Nondefense Research and Development Program activities would be the same as described under either Alternative 1 or 3. The Spill Test Facility, Alternative Fuels Demonstration Projects, and Environmental Research Park activities would be as described under Alternative 1. The alternative energy and environmental management and technology development activities would be as described under Alternative 3.

Work for Others Program. Activities would be the same as those described under Alternative 2 with the one exception. It is anticipated that there would be an increased use of NTS airspace by the U.S. Air Force.

5.4.1 Nevada Test Site

Under Alternative 4, the DOE would discontinue all defense-related activities and most Work for Others Program activities. The program categories applicable under Alternative 4 are Waste Management, Environmental Restoration, Nondefense Research and Development, and Work for Others. However, the discontinuation or reduction of the Defense Program and Work for Others Program could result in some impacts. Therefore, all five programs are discussed under Alternative 4 when impacts are possible.

5.4.1.1 Land Use. The primary difference between this alternative and Alternative 1 is that no Defense Program activities would occur under Alternative 4. Consequently, no land-use demands would be made to accommodate the construction and operation of advanced nuclear weapons simulators; construction of a facility for storing nuclear weapons and their components and for their assembly and disassembly; long-term storage of weapons-usable fissile material; a large, heavy-industrial facility; and the National Ignition Facility.

The DOE would relinquish its control of R-4808 airspace. It is assumed that the U.S. Air Force would retain control of that portion of R-4808 not overlying the NTS. Airspace over the NTS would then be publicly accessible. The bulk of the activities anticipated under this alternative would be the continuation of Waste Management Program operations in support of NTS environmental restoration and other NTS activities associated with projects sited at the NTS under Alternative 4. This alternative would result in approximately 4,600 acres of new ground disturbance. The single most important construction activity, which also appears under Alternatives 1 and 3, would be the Solar Enterprise Zone, which would disturb 2,402 acres.

Waste Management Program. Waste Management Program operations and construction would include all the activities listed under Alternative 1, with the restriction that these services be provided solely for the DOE waste generation within Nevada. The construction of new or expanded disposal facilities would change the land-use status of limited areas adjacent to existing disposal sites. The areas used for waste disposal would be committed for the long term to that use and would be unavailable for other, less restricted uses.

Environmental Restoration Program. The Environmental Restoration Program under Alternative 4 would continue as identified under Alternative 1. The acceleration of some actions might allow more rapid changes in the land-use status of areas that contain contaminated soils and former industrial sites.

Nondefense Research and Development Program. Under Alternative 4, land areas previously designated as nuclear test zones and nuclear and high-explosive test zones would be designated as Nondefense Research and Development Program testing zones; this new zone designation would represent an approximately 2,849 km^2 (1,100 mi^2) increase in land use. In addition, minor modifications to land-use status would be needed to accommodate some actions. The construction and operation of a Solar Enterprise Zone facility would preclude other land use within the zone.

Work for Others Program. Under Alternative 4, it is anticipated that the NTS airspace would be accessible by the public. Conventional weapons demilitarization activities would not be sited at the NTS under this alternative, and defense-related research and training by other government agencies would not be conducted at the NTS. Therefore, these lands would be available for a greater variety of unrestricted land uses. However, the DOE would be required to provide for overflights and inspections of the NTS in accordance with international arms control treaties.

Potential Public Uses of Relinquished NTS Lands. Under Alternative 4, likely public uses of NTS lands would include educational and recreational activities.

Public education use of NTS lands would focus on the unique and remote characteristics of the site and the availability of existing site support for public activities. A nuclear era museum located at the NTS highlighting the testing activities would be an important contribution to a better understanding of the United States' nuclear programs. The NTS is the only place where the public can see how the nuclear era unfolds; they can revisit nuclear rocket development and see the impacts that weapons effects testing had on common structures. The public could also learn more about the testing conducted for peaceful purposes (Plowshare tests), as well as the other programs that were part of the nuclear era. Student education through field trips and studies have taken place in the past to a limited extent. This type of education would allow students to see firsthand some of the nuclear testing impacts, as well as the geology and biology on the NTS. The environmental impacts as a result of this activity would be relatively minor.

Public recreation on the NTS would focus on scenic areas, such as Timber Mountain and the isolated forested areas. Timber Mountain is a National Natural Landmark and is one of the best examples of a caldera with all the associated volcanic features. This area is also the location of American Indian petroglyphs. The road system on the NTS would provide a location for such events as 42 km (26 mi) marathon runs, closed-circuit bicycle and car races, and similar activities. The variety of terrain, the ability to control traffic in a cost-effective manner, and the available medical facilities make this an attractive alternative. Deer herds on the NTS have not been hunted within the site boundaries for many decades. A hunt could be run similar to the bighorn sheep trophy hunt, in which a drawing is held for a limited number of hunters who must attend a one-day training session to be properly oriented. These events could represent a widening of the types of land uses on the NTS to include dispersed and organized recreation. Additional recreational use could result in impacts to other natural and cultural resources found on the NTS.

Relinquished NTS Lands. Under Alternative 4, an area of approximately 526 km^2 (203 mi^2) of currently withdrawn land has been identified for possible turn-back to the jurisdiction and management of the U.S. Bureau of Land Management pursuant to the provisions of the Federal Land Policy and Management Act. Should such an option be pursued, the U.S. Bureau of Land Management would conduct an evaluation of the suitability of the land for return to the public domain, and assess the value of the resources associated with the land for existing programs. If the lands were accepted for return to the public domain, the U.S. Bureau of Land Management would determine the proper management prescriptions for the lands being returned.

5.4.1.1.1 Site-Support Activities—The NTS site-support activities would be reduced under this alternative. However, land-use designations are not expected to be impacted by this reduction in site support. Facilities associated with security and environmental monitoring would remain at a reduced level. Services required for this activity under Alternative 4 would be reduced.

UTILITIES—The power grid would remain largely as it is described under Alternative 1. Parts of the grid could be shut off and abandoned; however, the lines and substations would not be removed because of the potential for future power requirements in remote locations to support environmental restoration and other turn-back activities. Power would continue to be provided by the existing 138 kV supply lines.

Approximately 161 km (100 mi) of water supply lines would continue to be used for distributing water to various facilities around the NTS. In addition to the distribution lines, there would be numerous wells, water storage sumps, and tanks. Many of these water distribution and storage utilities would be shut down and abandoned or removed. It is not known at this time which utilities would need to remain functional to support the environmental restoration activities. The wells and storage utilities that support waste management activities in Areas 3 and 5 would remain in use. Some of the utilities in Areas 23 and 25 would also remain in use to support base camp and Yucca Mountain Project activities.

The NTS sewage handling systems include sewage lagoons and septic tanks with leachfields. Most of the sewage handling systems would be discontinued and remediated. The sewage systems in Areas 3 and 5 might need to be expanded to provide coverage for the increase in waste management activities. The sewage systems in Areas 23 and 25 might receive some reduction in capacity.

COMMUNICATION—Radio communications would be controlled through remote-control units. These units would use telephone-radio-telephone order lines connected to local transceivers. Mobile radio communications, which are primarily provided by digital microwave systems, would be reduced from three separate systems to one or two systems as mandated by the level of activity. Central monitoring of NTS radio nets would continue to be maintained at Station 900. This station function would remain as an emergency reporting point for both radio and telephone. The public safety network, which provides coverage to most of Nevada and portions of nearby states, would be abandoned.

The system components would remain intact. It would take less effort and expense to maintain the system than it would to remove the system. The existing features of the NTS telecommunications network would be more than adequate to support the level of activity at the NTS.

Video and data communications would continue to be provided by the digital microwave system as it is at this time. This system would continue to provide for security and alarms, as necessary.

Retention of site infrastructure would require that the associated land uses remain similar to the present uses. Land use is already established in a zone surrounding the radioactive waste management facilities in Areas 3 and 5. Neither area would require additional land designated for disposal. Land so used would be restricted for most other uses for the long term to ensure the integrity of the closure and the safety of those who might inadvertently breach the waste. Construction of the Solar Enterprise Zone facilities would represent a long-term, single-land use, which could be reversed when the project is completed and the site restored.

5.4.1.1.2 Airspace—There are few proposed changes in airspace associated with the other federal agency programs within this area. These changes would be local and would not change the overall NAFR Complex airspace structure. These changes are usually minor path changes to accommodate population changes in the areas of concern. The changes might redefine the boundaries between restricted areas R-4807 and R-4808 and redesignate a restricted area to facilitate joint use by civilian aircraft.

Under this alternative, the restricted airspace that overlies the NTS would be relinquished and would be available for commercial and general aviation use.

All defense-related activities at the NTS would be discontinued. Therefore, the discontinuation of airspace operations at the NTS associated with the Defense Program and Work for Others Program under this alternative would result in a beneficial impact for civilian air traffic.

The DOE would be required to provide for overflights and inspections for the NTS in accordance with international arms control treaties.

It is estimated that 200,000 people could visit the NTS for recreational purposes each year. It is possible that some visitors would come by air; however, the anticipated air traffic would be minimal, and its impact on airspace would be insignificant.

There are few proposed changes in airspace associated with the NAFR Complex mission (SAIC/DRI, 1991). These changes would be local and would not change the overall airspace structure. Examples of changes would include relocation of a visual military training route to avoid residential areas in Pahrump, redefining the boundary between the restricted areas R-4807 and R-4808, and redesignating a restricted area to facilitate joint use by civil aircraft.

5.4.1.2 ***Transportation.*** The following sections address the environmental impacts related to transportation activities as defined under Alternative 4.

The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.4.1.2.1 On-Site Traffic—Traffic generated within the NTS as a result of the land use, projects, and activities associated with Alternative 4 is estimated to be 12,180 trips per day. Table 5.4-1 shows the estimates of average daily trips for each program. The daily trips were distributed on site, based on existing travel patterns for commuters and the current NTS areas affected by each program. Table 5.4-2 summarizes the average daily traffic volume for the key roadways on the NTS for Alternative 4. The portion of the average daily traffic volume that would be attributable to each program is also provided. All key on-site roadways have capacities exceeding 2,000 vehicles per hour for both directions combined (Transportation Research Board, 1994). A comparison of capacity to the volumes assigned to each segment on Table 5.4-2 shows that no roadway would experience any significant traffic congestion under Alternative 4.

Defense Program. Impacts resulting from the discontinuation of Defense Program activities under Alternative 4 would be the same as those described for Alternative 2 in Section 5.2.1.2.1.

Waste Management Program. Traffic generated on the roads within the NTS as a result of projects and activities associated with waste management is estimated to be 200 average daily trips under Alternative 4.

Road 5-01, the access to the Radioactive Waste Management Site in Area 5, is scheduled for improvement by the second quarter of Fiscal Year 1997. The improvement project is described under Alternative 1 in Section 5.1.1.2.1. No adverse effects on traffic flow would occur as a result of the Waste Management Program.

Environmental Restoration Program. Traffic generated on the roads within the NTS as a result of projects and activities associated with the Environmental Restoration Program is estimated to be 480 average daily trips for Alternative 4. No adverse effects on traffic flow would occur as a result of the Environmental Restoration Program.

Nondefense Research and Development Program. Traffic generated on the roads within the NTS as a result of projects and activities associated with the Nondefense Research and Development Program is estimated to be 10,680 average daily trips under Alternative 4. Traffic volumes on Jackass Flats Road, Cane Spring Road, and the portion of Mercury Highway that is south of Cane Spring Road would be approximately 5,300 vehicles per day for each segment, representing a substantial increase over Alternative 1. These volumes, however, represent on-site trips that were assumed to be uniformly distributed throughout the day. This, together with the fact that all on-site trips were also assumed to have an endpoint in Mercury, shows that no adverse effects on traffic flow would occur as a result of the Nondefense Research and Development Program.

Work for Others Program. Traffic generated on the roads within the NTS as a result of projects and activities associated with the Work for Others Program is estimated to be 60 average daily trips under Alternative 4. No adverse effects on traffic flow would occur as a result of the Work for Others Program.

Site-Support Activities. Traffic generated on the roads within the NTS as a result of site-support activities is estimated to be 760 average daily trips under Alternative 4. No adverse effects on traffic flow would occur as a result of site-support activities.

5.4.1.2.2 Off-Site Traffic—The major traffic generators at the site with the various programs under Alternative 4 would be the construction and operations employees and their associated activities. Table 5.4-3 shows the changes in the average daily vehicle trips generated by each program activity for the years 1996, 2000, and 2005. These overall changes reflect reductions for the Defense Program, Work for Others Program, and site-support activities and slight increases for other programs relative to Alternative 1.

Under Alternative 4, vehicular traffic would decrease on key roadways from 1996 to 2005. The greatest reduction in traffic would occur in 2000 and 2005 on the access highway to the NTS, by approximately 120 vehicles during the peak hour.

Table 5.4-1. Average on-site daily vehicle trip generation (one-way trips) by program, Alternative 4

Program	Trips per Day	Difference from Alternative 1
Defense	0	-635
Waste Management	200	+55
Environmental Restoration	480	+90
Nondefense Research and Development	10,680	+10,500
Work for Others	60	-80
Site-Support Activities	760	-1,120

The ramps on the Mercury interchange and U.S. Highway 95 between Mercury and Las Vegas would also experience a reduction of 100 vehicles during peak hours. The traffic on all other key roads are likely to be reduced by less than 100 vehicles. Trip generations would remain constant after an initial reduction in 1997. The projected peak-hour traffic on key roads and the associated level of service that would result under Alternative 4 for 1996, 2000, and 2005 are shown in Table 5.4-4. By 2005, all key roads in the immediate vicinity of the site (U.S. Highway 95, the Mercury interchange ramps, and the access highway to the site State Route 433) would continue to operate at level of service C or better, which is acceptable according to Association of American State Highway and Transportation Officials Standards.

Key roads within metropolitan Las Vegas (segments of Interstate 15, U.S. Highway 95, and U.S. Highway 93) already operate at levels of service ranging from A to F; by 2000, they would all deteriorate to unacceptable level of service F. These conditions would prevail even without Alternative 4 because of cumulative traffic growth (recreational, regional, and commuter traffic). U.S. Highway 93 at Hoover Dam already operates at unacceptable level of service F, and its level of service would continue to deteriorate further with or without this alternative because of its geometry (steep grades and narrow curves) and partially to its moderate traffic volume and truck traffic. All other key roadways, in general, would continue to operate at level of service C or better (Table 5.4-4).

The conditions described above would prevail with or without Alternative 4 and with or without any single program activity. The following sections address the contribution of each program to traffic impacts.

Defense Program. Under Alternative 4, a vehicle trip reduction on a typical weekday of 330 trips under Alternative 1 would occur by 2005. These trips account for construction and operations activities generated by workers at the site and would occur at the access road off U.S. Highway 95.

Waste Management Program. Under Alternative 4, the Waste Management Program would generate 40 more vehicle trips than Alternative 1.

Environmental Restoration Program. Under Alternative 4, employees associated with the Environmental Restoration Program would generate 90 more trips than Alternative 1.

Nondefense Research and Development Program. Under Alternative 4, employees associated with the Nondefense Research and Development Program would generate 40 vehicle trips above Alternative 1 in 2005.

Table 5.4-2. Average daily traffic volumes on key NTS roadway segments, Alternative 4

		Average Daily Traffic Volume						
Roadway	Segment	Defense	Waste Management	Environmental Restoration	Nondefense Research and Development	Work for Others	Site Support Activities	Total
North								
Buckboard Mesa Rd.	Pahute Mesa Rd. to Airport Rd.	0	0	35	0	0	0	**35**
Mercury Hwy.	Tippipah Hwy. to Ranier Mesa Rd.	0	40	110	0	0	0	**150**
Pahute Mesa Rd.	Mercury Hwy. to Stockade Wash Rd.	0	0	75	0	0	0	**75**
Pahute Mesa Rd.	Stockade Wash Rd. to Buckboard Mesa Rd.	0	0	35	0	0	0	**35**
Ranier Mesa Rd.	Mercury Hwy. to Tippipah Hwy.	0	0	35	0	0	0	**35**
Tippipah Hwy.	Mercury Hwy. to Pahute Mesa Rd.	0	0	150	0	0	0	**150**
Tippipah Hwy.	Pahute Mesa Rd. to Ranier Mesa Rd.	0	0	35	0	0	0	**35**
South								
Cane Spring Rd.	Lathrop Wells Rd. to Mercury Hwy.	0	0	35	5,300	30	0	**5,365**
Jackass Flats Rd.	Mercury Hwy. to Lathrop Wells Rd.	0	0	110	5,340	30	0	**5,480**
Lathrop Wells Rd.	U.S. Hwy. 95 to Jackass Flats Rd.	0	0	35	40	0	0	**75**
Mercury Hwy.	Mercury Hwy. to Road 5-01	0	200	330	5,300	30	75	**5,935**
Mercury Hwy.	Road 5-01 to Cane Spring Rd.	0	50	295	5,300	30	75	**5,750**
Mercury Hwy.	Cane Spring Rd. to Tippipah Hwy.	0	50	295	0	0	75	**420**
Road 5-01	Mercury Hwy. to Area 5 RWMS	0	130	40	0	0	0	**170**
Road 5-07	Mercury Hwy. to Area 5 RWMS	0	20	0	0	0	0	**20**

NOTE: RWMS = Radioactive Waste Management Site.

Table 5.4-3. Average off-site daily vehicle trip change, Alternative 4

Program	1996	2000	2005
Defense	-200	-330	-330
Waste Management	40	40	40
Environmental Restoration	90	90	90
Nondefense Research and Development	40	40	40
Work for Others	-50	-80	-80
Site Support Activities	-250	-370	-370
Total (all programs):	**-330**	**-610**	**-610**

NOTE: All values are rounded to the nearest 10. Daily trips shown are defined as one-way vehicle trips or vehicle trip ends. Trips shown are the change from Alternative 1.

Table 5.4-4. Peak-hour traffic volume and level of service on key roads, Alternative 4 (Page 1 of 2)

Roadway Segments	Capacity VPH[a]	1996 DDHV[b]	1996 LOS[c]	2000 DDHV	2000 LOS	2005 DDHV	2005 LOS
Regional							
I-15 @ California/Nevada state line	6,800	2,975	E	3,739	F	4,701	F
I-15 north of Sahara Avenue interchange	10,200	7,283	F	8,944	F	11,062	F
I-15 north of the downtown expressway interchange	10,200	4,413	E	5,642	F	6,971	F
I-15 just north of the 'D' and Washington interchange	10,200	4,050	D	5,086	F	6,397	F
I-15 north of the Cheyenne interchange	6,800	1,885	C	2,658	D	3,642	F
I-15 south of the Lamb Blvd. interchange	6,800	641	A	832	A	1,082	B
I-15 north of West Mesquite interchange (Nevada/Utah state line)	6,800	633	A	882	A	1,195	B
I-80 east of Apex interchange (California/Nevada state line)	6,800	1,753	C	2,002	C	2,316	C
I-80 east of the West Wendover interchange (Nevada/Utah state line)	6,800	325	A	407	A	512	A
Local							
U.S. Hwy. 95 south of Jones Blvd. interchange	10,200	7,297	F	9,165	F	11,528	F
U.S. Hwy. 95 north of Sunset Road interchange (East Las Vegas)	6,800	2,588	D	3,253	F	4,090	F
Rancho Road, SR 599 east of the northern U.S. 95/Rancho Road interchange	6,800	1,164	B	1,891	C	2,845	E
U.S. Hwy. 95 south of SR 157 north of Las Vegas	6,800	791	A	893	A	1,077	B
U.S. Hwy. 95 just east of Mercury interchange	6,800	303	A	284	A	318	A
U.S. Hwy. 95 just south of Boulder City	2,200	599	C	635	C	680	C
U.S. Hwy. 95 interchange at Mercury							
Southbound off-ramp	1,300	29	B	22	B	22	B
Southbound on-ramp	1,300	187	B	141	B	141	B
Northbound off-ramp	1,300	187	B	141	B	141	B
Northbound on-ramp	1,300	29	B	22	B	22	B
SR 433, 0.32 km (0.2 mi) north of the Mercury interchange (access to NTS)	2,200	225	C	169	B	169	B

Table 5.4-4. Peak-hour traffic volume and level of service on key roads, Alternative 4
(Page 2 of 2)

Roadway Segments	Capacity VPH[a]	1996 DDHV[b]	1996 LOS[c]	2000 DDHV	2000 LOS	2005 DDHV	2005 LOS
U.S. Hwy. 95, 6.1 km (3.8) mi north of Mercury interchange	2,200	276	C	311	C	362	C
U.S. Hwy. 95 @ Amargosa Valley to Beatty	2,000	59	A	63	A	72	A
U.S. Hwy. 95 north of Beatty	2,000	171	B	187	B	211	B
SR 160 south of U.S. Hwy. 95	2,000	71	A	85	A	106	A
U.S. Hwy. 93 south of the Nevada/Arizona state line at Hoover Dam	1,500	815	F	977	F	1,186	F
U.S. Hwy. 93 east of westbound off-ramp of Railroad Pass interchange	6,840	2,684	E	3,219	F	3,906	F
U.S. Hwy. 93 north of I-15/U.S. 93 interchange	2,000	128	B	158	B	201	B
U.S. Hwy. 93 south of SR 375 junction near Crystal Springs	2,000	130	B	155	B	189	B
U.S. Hwy. 93 west of SR 375 junction near Crystal Springs	2,000	44	A	50	A	60	A
SR 375 west of U.S. 93 junction at Crystal Springs	1,500	28	A	29	A	31	A
SR 375 east of Warm Springs	1,500	11	A	10	A	11	A
U.S. Hwy. 6 east of Warm Springs at SR 375 junction	1,700	13	A	12	A	13	A
U.S. Hwy. 6 west of Warm Springs at SR 375 junction	1,700	19	A	18	A	20	A
U.S. Hwy. 6 east of Tonopah, west of SR 376	1,700	96	B	85	A	75	

[a] Vehicles per hour
[b] Directional design hourly volume based on thirtieth peak hour and a 70/30 split for direction (one direction)
[c] Level of service.

NOTE: SR=State Route.

Work for Others Program. Under Alternative 4, employees associated with this program would generate 80 vehicle trips below Alternative 1 in 2005.

Potential Turn-Back Uses. Under Alternative 4, it is estimated that 200,000 people would visit the NTS for recreational purposes and for museum visits. Weekends would be the peak period for these visits. On average, there would be 500 to 600 persons per day, generally less than 200 vehicles per day (one way), assuming 3 persons per car and 90 percent passenger cars and 10 percent buses, or less than 40 vehicles during peak hours. This volume is not large enough to affect any level of service on any key road segment.

Site-Support Activities. Under Alternative 4, the discontinuation of programs would result in a corresponding loss of site-support personnel. A reduction of 370 vehicle trips would occur by 2005. These trips would account for activities related to roads, utilities, communications, and other site support.

5.4.1.2.3 Transportation of Materials and Waste—Under Alternative 4, no off-site transportation of low-level waste, mixed waste, or nuclear materials would occur. The waste volumes for NTS-generated waste that would be transported on-site are given in Table 5.4-5.

The human health risks associated with on-site transportation would generally be small, particularly in comparison with off-site transportation risks, primarily because of the differences in distance traveled and population densities and the lower rates of speed. On-site transportation risks would not contribute significantly to the total risk of any alternative. Results of the on-site transportation risk analysis under Alternative 4 are shown in Table 5.4-6. The highest risk would be from vehicle-related fatalities and injuries. Cargo-related risks would be small because of the low gamma activity in the NTS-generated waste and the small exposed population.

Table 5.4-5. NTS-generated waste 10-year volumes

Program	Waste Type	m^3
Total NTS low-level and mixed waste generated by all programs	Low-level waste	150,000
	Mixed waste	500

5.4.1.2.4 Other Transportation—Because Alternative 4 activities do not include direct use of local railroads, air, or other modes of transportation, direct effects on rail, air, and other modes of transportation are expected to be minimal. Furthermore, given the nature and scale of anticipated activities under Alternative 4, transportation demand for other than commuters is expected to remain minimal. There would be little indirect impact on other modes of transportation.

5.4.1.3 Socioeconomics. This section addresses the potential socioeconomic effects associated with Alternative 4. The description of socioeconomic conditions includes indicators (population, civilian labor force, employment, unemployment rate, and income) that provide a basis for comparing regional socioeconomic conditions of the site with Alternative 1. In addition, public finance and public services (public education, police and fire protection, and health) are described. Alternative 1 was considered equivalent to future baseline conditions without new activities.

American Indian socioeconomic impacts due to fluctuations in DOE employment opportunities for tribal members from the CGTO region of influence are discussed in Section 5.1.1.3.

ECONOMIC ACTIVITY, POPULATION, AND HOUSING—The net effect of Alternative 4 is the loss of 4,625 jobs (1,496 direct and 3,129 secondary) in 1996 and 7,981 jobs (2,748 direct and 5,233 secondary) in 2000 and 2005 (Table 5.4-7). In Clark County, this employment would generate the loss of 4,401 jobs in 1996; 7,582 in 2000; and 7,582 in 2005. In Nye County, this employment would contribute to the total loss of 179 jobs in 1996; 317 jobs in 2000; and 317 jobs in 2005 (see Figure 5.1-1).

The total earning levels are estimated to decrease by \$157.0 million in 1996 and \$277.0 million in 2000 and 2005. Of these decreased earnings, Clark County would lose a total of \$149.4 million in 1996 and \$263.3 million in 2000 and 2005. For Nye County, this economic activity would generate a decrease in earnings of \$7.5 million in 1996 and \$13.7 million in 2000 and 2005.

Out-migration analysis was based on historical unemployment. The lowest unemployment rate for Clark County in the last 20 years was 4.7 percent in 1990, and the highest was 10.9 percent in 1975 and 1982. The volatile unemployment rates and the high increase in population indicate that a midpoint would provide a more realistic analysis. For this analysis, 7.7 percent was assumed for Clark County unemployment. The same analysis was done for Nye County. The lowest unemployment rate was 1.8 percent in 1970, and 10.9 percent was the highest rate in 1987. A more realistic assumption rate of 4.7 percent was used for Nye County. Alternative 4 would not generate or lose enough jobs to reach the base unemployment rate. Therefore, no out-migration would be triggered, and it can be assumed that no change in population or housing demand would be generated.

Defense Program. Total employment lost as a result of Alternative 4 would include both direct and secondary jobs. In the region of influence, in addition to the loss of 1,472 direct positions, an additional 2,802 secondary positions would be lost

Table 5.4-6. On-site transportation risks from NTS-generated wastes, Alternative 4

Consequence	Risk
Vehicle-related fatalities	0.06
Radiation-induced cancer fatalities	$9x10^{-8}$
Radiation-induced detriment	$7x10^{-8}$

Table 5.4-7. Economic activity effects for Clark and Nye Counties, 1996, 1997, 1998, 2000, and 2005 totals for all programs, Alternative 4

Total Alternative 4	1996	1997	1998	2000	2005
Alternative 4					
Clark County					
Population	1,077,576	1,112,348	1,148,241	1,223,541	1,380,920
Total Jobs	503,137	516,334	533,240	568,706	642,831
Unemployment Rate	6.6	7.2	7.1	7.0	6.9
Personal Income ($Millions)	21,094.5	22,151.8	23,371.1	25,809.8	31,906.3
Nye County					
Population	27,407	28,918	30,511	33,966	38,516
Total Jobs	10,811	11,279	11,918	13,304	15,128
Unemployment Rate	6.7	7.8	7.7	7.4	6.9
Personal Income ($Millions)	470.3	497.1	534.8	618.1	761.9
Changes from Alternative 1 (Alternative 4 effects)					
Clark County					
Population	0	0	0	0	0
Total Jobs	-4,401	-7,582	-7,582	-7,582	-7,582
Unemployment Rate	0.8	1.4	1.3	1.2	1.1
Personal Income ($1,000)	-212.6	-374.6	-374.6	-374.6	-374.6
Nye County					
Population	0	0	0	0	0
Total Jobs	-179	-317	-317	-317	-317
Unemployment Rate	1.5	2.6	2.5	2.2	1.7
Personal Income ($1,000)	-10.4	-18.8	-18.8	-18.8	-18.8

for a total of 4,274 jobs. Secondary positions are lost because of the decrease in procurement and personal consumption expenditures of site personnel. In Clark County, the reduction in civilian employment (4,060 jobs) would contribute to the total increase in the unemployment rate from 5.8 percent to 6.9 percent in 2005. In Nye County, the decrease in employment would result in a loss of 170 jobs, which would contribute to the total increase in the unemployment rate from 5.2 percent to 7.1 percent in 2005.

Waste Management Program. In the region of influence, this program would create a total of 454 jobs, including 157 direct and 297 secondary positions, starting in 1996 and continuing through 2005. In Clark County, this program would contribute 431 jobs (141 direct and 290 secondary), and in Nye County, it would contribute 18 jobs (11 direct and 7 secondary). In Clark County, this increase in civilian employment (431 jobs) would help maintain a total unemployment rate at 6.9 percent, higher when compared to the Alternative 1 level of 5.8. In Nye County, the increase of 18 jobs would help maintain the total unemployment rate at 7.1 percent, again higher when compared to the Alternative 1 level of 5.2 percent.

Environmental Restoration Program. In the region of influence, this program would create a total of 1,150 jobs, including 396 direct and 754 secondary positions, starting in 1996 and continuing through 2005. In Clark County, this program would contribute 1,093 jobs (357 direct and 736 secondary), and in Nye County, it would contribute 46 jobs (28 direct and 18 secondary). In Clark County, this increase in civilian employment (1,093 jobs) would help maintain a total unemployment rate at 6.9 percent, higher when compared to the Alternative 1 level of 5.8. In Nye County, the increase of 46 jobs would help maintain the total unemployment rate at 7.1 percent, again higher when compared to the Alternative 1 level of 5.2 percent.

Nondefense Research and Development Program. In the region of influence, the Nondefense Research and Development Program would create 468 jobs (including 161 direct and 307 secondary positions) starting in 1996 and continuing through 2005. In Clark County, this program would contribute 444 jobs (145 direct and 299 secondary) in 2005. In Nye County, this program would contribute 19 jobs (11 direct and 8 secondary) in 2005. In Clark County, this increase in civilian employment (444 jobs) would help maintain the total unemployment rate at 6.9 percent, higher when compared to the Alternative 1 level of 5.8 percent. In Nye County, the increase of 19 jobs would help maintain the total unemployment rate at 7.1 percent, again higher when compared to the Alternative 1 level of 5.2 percent.

Work for Others Program. In the region of influence, in addition to the loss of 350 direct positions, an additional 666 secondary positions would be lost for a total of 1,016 jobs under Alternative 4. Secondary positions are lost because of the decrease in procurement and personal consumption expenditures of site personnel. In Clark County, the reduction of civilian employment (965 jobs) would help maintain a total unemployment rate at 6.9 percent, higher when compared to the Alternative 1 level of 5.8 percent. In Nye County, the reduction of 40 jobs would help maintain the total unemployment rate at 7.1 percent, again higher when compared to the Alternative 1 level of 5.2 percent.

Site-Support Activities. In the region of influence, in addition to the loss of 1,640 direct positions, an additional 3,123 secondary positions would be lost for a total of 4,763 jobs. In Clark County, the reduction of civilian employment (4,525 jobs) would help maintain a total unemployment rate at 6.9 percent, higher when compared to the Alternative 1 level of 5.8. In Nye County, the reduction of 189 jobs would help maintain the totalunemployment rate at 7.1 percent, again higher when compared to the Alternative 1 level of 5.2 percent.

<u>PUBLIC FINANCE</u>—The fiscal effects of Alternative 4 are presented in this section. Table 5.4-8 outlines the projected financial summary for Fiscal Years 2000 and 2005 under Alternative 4. The fiscal impact of each alternative can be determined by subtracting its income statement totals from the Alternative 1 future baseline. The remaining fiscal impact is the specific impact associated with each alternative.

Clark County. The expansion and improvement of the county infrastructure would continue to be the primary focus of Clark County fiscal efforts. In addition, Clark County has undertaken the implementation of a county facilities development program as discussed in Public Finance, Section 4.1.3.

Under Alternative 4, revenues for Clark County would increase because of increases in personal income and total employment in the county. Assuming continued small increases in revenues and slightly larger initial increases in expenditures (see discussion on capital projects in Public Finance, Section 4.1.3), Alternative 4 would result in revenues less expenditures of a negative $4,289,000 in Fiscal Year 2000. Clark County is anticipated to achieve a positive fiscal position in Fiscal Year 2001. In Fiscal Year 2005, revenues less expenditures are expected to be $35,254,000. The fund balance (or reserves) as a percentage of current expense is expected to be 246 percent in 2000 and 247 percent in 2005. To compare with Alternative 1, Clark County revenues over expenditures would be $1,787,000 more in 2000 and 2005.

City of Las Vegas. Under Alternative 4, revenues over expenditures for the city of Las Vegas are expected to become positive in Fiscal Year 1995 because of increases in personal income and total employment in the city. Assuming continued increases in revenues and expenditures, this alternative would result in revenues less expenditures of $13,652,000 in Fiscal Year 2000. It is predicted that by Fiscal Year 2005, revenues over expenditures would be $15,708,000. The fund balance as a percentage of current expense is expected to be 179 percent in 2000 and 269 percent in 2005.

To compare with Alternative 1, revenues over expenditures would be $728,000 less in 2000 and $727,000 less in 2005.

City of North Las Vegas. Expenditures for North Las Vegas are forecast to continue to outpace revenues. Revenues over expenditures in Fiscal Year 2000 would be a negative $7,229,000 and a less negative $6,732,000 in Fiscal Year 2005. This is despite increases in personal income and total employment in the city. Public safety and capital projects are anticipated to continue to be the largest expenditures. Taxes, which recently decreased (from $10,059,472 in Fiscal Year 1993 to $7,941,972 in Fiscal Year 1994), are expected to slowly grow to 1993 levels by Fiscal Year 2001. The fund balance as a percentage of current expense is expected to be 62 percent in Fiscal Year 2000 and 92 percent in Fiscal Year 2005.

Clark County School District. Revenues over expenditures would be the same as Alternative 1. This is because school enrollment, along with revenues and expenditures, is largely population-driven, and the population levels under Alternatives 1 and 4 are the same. In other words, Alternative 4 would cause no change in population growth as compared to the future baseline, which is Alternative 1.

Nye County. Under Alternative 4, revenues for Nye County would increase slightly because of increases in personal income and total employment. Assuming continued small increases in expenditures as well, a positive fiscal position is expected to be reached in Fiscal Year 1999. This alternative would result in revenues less expenditures of $1,549,000 in Fiscal Year 2000. In Fiscal Year 2005, revenues less expenditures would be $3,437,000. The fund balance as a percentage of current expense is expected to be 56 percent in Fiscal Year 2000 and 96 percent in Fiscal Year 2005. To compare with Alternative 1, revenues over expenditures would be $18,000 less in 2000 and 2005.

Town of Tonopah. Revenues and expenditures for the town of Tonopah would increase slightly because of increases in personal income and total employment in Nye County. Assuming continued increases, Alternative 4 would result in revenues less expenditures of $78,000 in Fiscal Year 2000. In Fiscal Year 2005, revenues less expenditures would be $75,000. The fund balance as a percentage of current expense would be 127 percent in Fiscal Year 2000 and 185 percent in Fiscal Year 2005. To compare with Alternative 1, revenues over expenditures would be $973 less in 2000 and $867 less in 2005.

Table 5.4-8. Projected financial summary for Fiscal Years 2000 and 2005, general, special revenues, debt service, and capital projects funds, Alternative 4

	Revenues Over Expenditures	Current Expense	Ending Fund Balance	Fund Balance as a Percentage of Current Expense
Fiscal Year 2000				
Clark County	($4,289,294)	$525,981,796	$1,293,385,985	245.90%
City of Las Vegas	$13,651,877	$196,970,437	$351,723,082	178.57%
City of North Las Vegas	($7,228,619)	$47,082,837	$29,273,582	62.17%
Clark County School District	($15,067,362)	$751,358,806	$124,171,528	16.53%
Nye County	$1,548,679	$25,905,977	$14,389,689	55.55%
Town of Tonopah	$77,644	$642,646	$818,617	127.38%
Town of Pahrump	$219,195	$944,592	$1,587,323	168.04%
Nye County School District	($1,402,124)	$26,698,631	($438,631)	-1.64%
Fiscal Year 2005				
Clark County	$35,253,767	$857,606,688	$2,118,927,717	247.07%
City of Las Vegas	$15,707,678	$210,832,569	$567,900,255	269.36%
City of North Las Vegas	($6,731,905)	$50,452,640	$46,204,023	91.58%
Clark County School District	($11,167,703)	$848,002,970	$190,429,375	22.46%
Nye County	$3,436,783	$27,922,658	$26,932,650	96.45%
Town of Tonopah	$74,514	$646,767	$1,196,893	185.06%
Town of Pahrump	$309,912	$1,094,844	$2,965,888	270.90%
Nye County School District	($135,592)	$30,272,304	$4,200,315	13.88%

Town of Pahrump. Under Alternative 4, revenues for the town of Pahrump would increase slightly because of increases in personal income and total employment in Nye County. Assuming continued increases in revenues and slightly smaller initial increases in expenditures compared to Fiscal Year 1994, this alternative would result in revenues less expenditures of $219,000 in Fiscal Year 2000. In Fiscal Year 2005, revenues less expenditures would be $310,000. The fund balance (or reserves) as a percentage of current expense is anticipated to be 168 percent in Fiscal Year 2000 and 271 percent in Fiscal Year 2005. To compare with Alternative 1, revenues over expenditures would be $5,000 less in 2000 and 2005.

Nye County School District. Revenues over expenditures would be the same as under Alternative 1. This is because school enrollment along with revenues and expenditures are largely population-driven, and the population levels under Alternatives 1 and 4 would be the same. In other words, Alternative 4 would cause no change in population growth as compared to the future baseline, which is Alternative 1.

PUBLIC SERVICES—Effects to key local public services are determined by the change in demand for personnel. The public service impacts can be determined by subtracting total personnel required from the Alternative 1 future baseline. The addition or reduction in personnel required would be the specific impact associated with that alternative. The current levels of service per 1,000 population discussed in Chapter 4 are assumed to continue. Alternative 4 has no in- or out-migration triggered by high or low levels of employment; therefore, this alternative has the same population level as Alternative 1. In all cases, there is no change in levels of service over the future baseline (Alternative 1).

5.4.1.4 Geology and Soils. This section addresses the potential impacts to geology and soils in each program under Alternative 4.

Defense Program. Under Alternative 4, the impacts to geology and soils would be the same as those described under Alternative 2 in Section 5.2.1.4.

Waste Management Program. Waste Management Program activities are anticipated to result in the same adverse impacts to geologic media, processes, or resources as described under the Waste Management Program under Alternative 1 in Section 5.1.1.4.

Environmental Restoration Program. Environmental Restoration Program activities are anticipated to result in adverse impacts to geologic media, processes, or resources as described under the Environmental Restoration Program under Alternative 1 in Section 5.1.1.4.

Nondefense Research and Development Program. Nondefense Research and Development Program activities are anticipated to result in the same adverse impacts to geologic media, processes, or resources as described under Alternative 1 and 3, Sections 5.1.1.4 and 5.3.1.4, respectively.

Work for Others Program. Work for Others Program activities are not anticipated to result in the same adverse impacts to geologic media, processes, or resources beyond those from past activities as described in the Work for Others Program under Alternative 1 in Section 5.1.1.4.

Site-Support Activities. The impacts associated with site-support activities under Alternative 4 would be the same as those discussed under Alternative 3 in Section 5.3.1.4.

5.4.1.5 Hydrology. The section addresses the impacts of each program to surface hydrology and groundwater. Because groundwater is the main source of water at the NTS, water resource impacts are presented in the groundwater section.

5.4.1.5.1 Surface Hydrology—The environmental impacts to surface hydrology from each program under Alternative 4 are presented in this section.

Defense Program. Under Alternative 4, all defense-related activities would be discontinued. Therefore, the impacts would be the same as those described under Alternative 2 in Section 5.2.1.5.

Waste Management Program. Waste Management Program activities are anticipated to result in the same adverse impacts to the surface hydrologic environment as described for Waste Management under Alternative 1 in Section 5.1.1.5.

Environmental Restoration Program. Environmental Restoration Program activities are anticipated to result in the same adverse impacts to the surface hydrologic environment as described for Environmental Restoration under Alternative 1 in Section 5.1.1.5.

Nondefense Research and Development Program. Nondefense Research and Development Program activities are anticipated to result in the same adverse impacts to the surface hydrologic environment as described for the Nondefense Research and Development Program under Alternatives 1 and 3 in Sections 5.1.1.5 and 5.3.1.5, respectively.

Work for Others Program. Work for Others Program activities are not anticipated to result in adverse impacts to the surface hydrologic environment beyond those from past activities as described for the Work for Others Program under Alternative 1 in Section 5.1.1.5.

Site-Support Activities. The impacts associated with site-support activities under Alternative 4 would be the same as those discussed under Alternative 3.

5.4.1.5.2 Groundwater—The demand for water resources under Alternative 4 would be greatly reduced. In fact, the demand for water resources would be substantially less than those of recent years because of the cessation of actions required to maintain test readiness.

Defense Program. Under Alternative 4, the impacts to groundwater would be the same as those described under Alternative 2 in Section 5.2.1.5.

Waste Management Program. Under Alternative 4, the water demand for Waste Management Program activities would be reduced from Alternative 1 levels. Because the demand for water would be insignificant (less than 1,233 m^3/yr [1 ac-ft/yr]), there would be no significant impacts associated with groundwater withdrawals for waste management.

Environmental Restoration Program. The demand for water resources for Environmental Restoration Program activities would accelerate under Alternative 4 if specific actions are accelerated; however, the total demand for water for environmental actions would still be quite small, less than 2.5×10^5 m^3 (200 ac-ft/yr). No significant impacts on water resources are anticipated because of an acceleration of Environmental Restoration Program activities under Alternative 4.

Nondefense Research and Development Program. The actions under Alternative 4 for this program are the same as those under Alternative 3; therefore, the expected impacts on water resources would be similar. The major demand for water would be for the Solar Enterprise Zone. The impacts would be as described under Alternative 3, except that any reductions in underflow to downgradient basins would be reduced. No significant impacts on water resources are anticipated under Alternative 4.

Work for Others Program. The water demand for the Work for Others Program under Alternative 4 would be reduced from Alternative 1. Because the demand for water would be insignificant, there are no significant impacts associated with groundwater withdrawals for the Work for Others Program.

Site Support Activities. The reduction in site support activities and personnel would result in an overall decrease in water demand. However, support activities for environmental restoration actions might offset this water demand reduction.

5.4.1.6 Biological Resources. The Solar Enterprise Zone Project would significantly increase the risk of tortoises being crushed during construction and would remove approximately 2,400 acres of undisturbed habitat. Surface-disturbing activities may kill or displace wildlife such as small mammals, reptiles, and soil-dwelling invertebrates. If ground clearing for construction occurs during the breeding season, the eggs of birds in nests on the ground within a project area may be destroyed. Most birds that breed on the NTS are protected under the Migratory Bird Treaty Act. Under this alternative, approximately 14,300 acres may be disturbed. This project would also greatly increase traffic compared to Alternative 1 and thus the risk of accidental crushing of tortoises. The Alternative Energy Project would be sufficiently large to remove small localized populations depending on final siting decisions. Given these potential impacts of the Alternative Energy Project, Alternative 4 could reduce biodiversity in the region.

Defense Program. Under Alternative 4, the impacts to biological resources would be the same as those described under Alternative 2 in Section 5.2.1.6.

Waste Management Program. Under Alternative 4, this program would consist of activities in Areas 3, 5, 6, and 11 on the NTS. Activities at these sites would be similar to those described under Alternative 1, and only 11 acres of habitat would be disturbed; therefore, the impacts of this program would be less than those described under Alternative 1.

Environmental Restoration Program. Under Alternative 4, activities from this program are similar to those described under Alternative 1, except that the rate at which these activities would be initiated and completed is likely to be accelerated; therefore, impacts would also be similar.

Nondefense Research and Development Program. Five of the projects in this program would be in operation under Alternative 4. For four of these projects (Environmental Management and Technology Development, Alternative Fuels Demonstration Projects, National Environmental Research Park, and Spill Test Facility), the impacts would be similar to those described under Alternative 1. Activities and impacts for the fifth, the Alternative Energy project, would be the same as those described under Alternative 3.

Work for Others Program. The only activity that would occur is treaty verification; therefore, there are no anticipated impacts on biological resources.

Site-Support Activities. Activities associated with site-support activities should be about 75 percent less than under Alternatives 1 and 3. About 18 acres of habitat would be disturbed during construction and maintenance of roads under Alternative 4. As was concluded under Alternative 1, these activities would have little or no impact on biological resources.

Potential Public Uses of Relinquished NTS Lands. Activities associated with these proposed uses are not likely to adversely affect biological resources on the NTS. Trophy hunts for deer would be run by the Nevada Division of Wildlife with the intent to provide recreation while maintaining healthy herds. Few individuals will be removed and population viability will not be adversely affected. Other public uses of the NTS for such activities like educational tours or bike and car racing are not expected to significantly impact biological resources as long as no off-road vehicle use is permitted.

5.4.1.7 Air Quality. This section addresses the potential effects that the five programs and site-support activities of the NTS might have on regional air quality. The region of influence for this air quality analysis includes Nye and Clark counties, Nevada. Construction and mobile-source emissions are shown in Table 5.4-9, and site-support activities stationary-source emissions are shown in Table 5.4-10.

Carbon monoxide emissions from mobile sources in the Las Vegas Valley nonattainment area would be approximately 61 tons per year (40 percent of 153 tons, see Table 5.4-9 and Section 5.1.1.7). This value is below the 100 ton carbon monoxide de minimus value shown in Table 5.1-14; therefore, a general conformity analysis would not be required for this alternative.

Defense Program. Under Alternative 4, the impacts to air quality would be the same as those described under Alternative 2 in Section 5.2.1.7.

Even a doubling in the increased use of airspace would contribute only about 0.10 percent to the allowable ambient pollutant surface concentrations (SAIC/DRI, 1991). Thus, the emission reduction would provide a small beneficial impact on the regional air quality.

Waste Management Program. Waste Management Program impacts under Alternative 4 would be the same as those described under Alternative 1. No new construction would occur, and fugitive dust emissions were not estimated. No air quality impacts are anticipated.

Environmental Restoration Program. Under this alternative, the Environmental Restoration Program impacts would be the same as those described under Alternative 3.

Nondefense Research and Development Program. Under Alternative 4, impacts would be the same as those described under Alternative 3.

If lands are redesignated as turn-back areas, one potential use that has been proposed is a nuclear era museum. Available facilities would be used and no new construction would be required. It has been estimated that about 200,000 people would visit the museum each year. Exhaust emissions would be produced by the visitors' vehicles. Assuming an average of three occupants per vehicle, approximately 66,700 vehicles would visit the area each year. For the purpose of emission calculations, it was assumed that a trip would consist of 145 km (90 mi) in Nye County and 97 km (60 mi) in Clark County. The 145 km (90 mi) in Nye County would include travel on the site.

Work for Others Program. Emissions from increased use of NTS airspace would have a negligible effect on surface air quality. A doubling of airspace usage would produce no more then 0.10 percent of the allowable surface-pollutant concentration (SAIC/DRI, 1991). There would be no construction activity on-site, and off-site emissions would be negligible.

Site-Support Activities. Emissions from NTS stationary sources related to site-support activities are shown in Table 5.4-10. Examples of the sources include boilers, fuel storage tanks, and a concrete batch plant. Portable compressor emissions are also included. Total Nye County emissions are presented in the table for comparison with NTS emissions. These emissions were obtained from the Bureau of Air Quality (State of Nevada, 1995). It is anticipated that 14 acres of land would be disturbed, generating 4.2 tons of fugitive dust (PM_{10}) emissions.

RADIOLOGICAL AIR QUALITY—Impacts to the air quality from radioactive effluents under Alternative 4 would be the same as under Alternative 2.

5.4.1.8 Noise. This section addresses the potential effects of the five programs and site-support activities on noise.

Defense Program. Under Alternative 4, the impacts of noise would be the same as those described under Alternative 2 in Section 5.2.1.8.

Waste Management Program. Noise impacts associated with Waste Management Program activities under Alternative 4 would be similar to those described under Alternative 1 in Section 5.1.1.8.

Environmental Restoration Program. Noise impacts from Environmental Restoration Program activities under Alternative 4 would be the same as described under Alternative 1 in Section 5.1.1.8. The noise levels produced by environmental restoration activities with this alternative would produce only minor noise impacts, both on site and off site.

Nondefense Research and Development Program. Noise impacts under Alternative 4 of the Nondefense Research and Development Program would be the same as those discussed under Alternative 1, in Section 5.1.1.8.

Work for Others Program. Overflights to support treaty verification are flown at high altitudes and would not be detectable on or near the NTS.

Site-Support Activities. Transportation noise levels on the site would be minimal and would not produce any noise impacts.

5.4.1.9 Visual Resources. The effects of Alternative 4 on visual resources are presented in this section.

Increased public access for museum visits, road races, special hunts, and other recreation would make substantially more area of the NTS visible to increasing numbers of visitors, thus increasing the impact of existing or new development on visual resources. However, much of the landscape character is common to the region. Some operations would produce PM^{10} and mobile-source emissions.

Defense and Work for Others Programs. Under Alternative 4, all facilities associated with each program would be abandoned in place. Only maintenance necessary for safety would occur. There could be a slow deterioration of facilities; however, there would be little change in the overall appearance of the existing landscape. Sensitivity levels could increase because of greater public access. Therefore, impacts to visual resources would be negligible.

Waste Management Program. Under Alternative 4, the Waste Management Program would continue its activities at a reduced level. No new ground disturbance would occur, and activities would take place in areas currently used for waste management. Impacts to visual resources would be negligible.

Table 5.4-9. Summary of Nevada Test Site construction emissions and mobile source emissions (on site and off site), tons per year, Alternative 4

Program	Construction	Mobile Sources								
		On Site			Off Site					
					Nye County			Clark County		
	Fugitive PM_{10}[a]	CO[b]	VOC[c]	NO_x[d]	CO	VOC	NO_x	CO	VOC	NO_x
Defense	NA[e]	NA	NA	NA	NA	NA	NA	NA	NA	NA
Waste Management	NA	11.50	1.56	2.05	6.09	0.91	1.58	11.83	1.76	3.07
Environmental Restoration	220.5	22.24	3.02	3.96	11.78	1.75	3.06	22.88	3.40	5.93
Nondefense Research and Development Program[f]	360	10.00	1.36	1.78	72.76	9.86	14.87	51.25	7.57	11.65
Work for Others	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Site Support Activities	4.2	64.76	8.80	11.53	34.32	5.10	8.90	66.62	9.90	17.28
Total	**584.70**	**108.47**	**14.74**	**19.32**	**124.95**	**17.62**	**28.41**	**152.58**	**22.63**	**37.93**

a. Particulate matter with a diameter equal to or less than 10 micrometers
b. Carbon monoxide
c. Volatile organic compounds
d. Nitrogen oxides
e. Not applicable
f. Includes nuclear era museum.

Table 5.4-10. Site support activities stationary source emission at the NTS and Nye County, tons per year, Alternative 4

Area	TSP [a]	SO_2 [b]	NO_X [c]	Hc[d]	Co[e]
Area 1	34.70	3.40	2.20	0.10	0.50
Area 6	6.50	0.0	0.0	0.0	0.0
Area 23	1.12	10.62	9.40	0.0	2.54
U.S. DOE Portable[f]	17.68	15.24	229.32	0.0	49.68
Fuel Storage Tanks	0.00	0.00	0.00	10.68	0.00
Total	60.00	29.26	240.92	10.78	52.72
Nye County	1,685.70	960.68	933.28	____[g]	187.68

[b] Total suspended particulates
[b] Sulfur dioxide
[c] Nitrogen oxides
[d] Hydrocarbon
[c] Carbon monoxide
[f] Compressors
[g] No data; Nye County hydrocarbon emission inventory is not complete.

Source: Bureau of Air Quality, State of Nevada, 1995.

Environmental Restoration Program. Under Alternative 4, the Environmental Restoration Program impacts would be similar to those described under Alternative 3 in Section 5.3.1.9. However, sensitivity levels could increase because of greater public access to the NTS.

Nondefense Research and Development Program. The Nondefense Research and Development Program impacts under Alternative 4 would be the same as those described under Alternative 3 in Section 5.3.1.9.

Site-Support Activities. Approximately 14 acres of new ground disturbance would occur for site-support activities under this alternative. Most ground disturbance would be related to new road and utility corridor construction. The ground disturbance would be scattered throughout the NTS. Impacts to visual resources would be negligible.

5.4.1.10 Cultural Resources. Impacts would be similar to those listed under Alternative 3. However, the total amount of acreage disturbed will be reduced to 14,400 acres, because of a reduction in defense-related testing, reduction in the size of waste facilities, and a lack of landlord-related construction. Continued visitation and vehicular traffic could lead to vandalism or artifact collecting that could indirectly affect recorded archaeological sites and archaeologically sensitive areas.

Although archaeological surveys have not been conducted in these areas, it is estimated that more than 67 sites could be impacted by projects associated with this alternative based on surveys conducted in adjacent areas in 1994. The precise location and number of these resources are unknown until archaeological surveys are conducted. Surveys will be conducted prior to any ground-disturbing activities, and impacts would be mitigated through the measures described in Chapter 7. At least eight structures will be decommissioned under Alternative 4. If these buildings are determined to be historically significant, they would be mitigated using measures described in Chapter 7.

Defense Program. Under Alternative 4, the impacts to cultural resources would be the same as those described under Alternative 2 in Section 5.2.1.10.

Waste Management Program. Under Alternative 4, the Waste Management Program would continue its activities at a reduced level. At Area 5, construction for new facilities has been proposed. These activities may disturb the physical integrity of some cultural resources. Increased pedestrian activity and vehicular traffic could result in unauthorized artifact collecting and vandalism that could indirectly affect cultural resources.

Environmental Restoration Program. Under Alternative 4, the impacts to cultural resources would be the same as those contained in Section 5.1.1.10. All Environmental Restoration Program activities are expected to accelerate. Accelerated remediation at contaminated sites would be likely to result in both direct and indirect impacts to cultural resources.

Few sites have been recorded directly within the area of potential effect for Area 13, and impacts directly within the area of potential effect are predicted to be minimal. However, sites have been recorded in the general area, and it is likely that indirect impacts to these sites might be incurred as a result of increased visitation to the site area.

Nondefense Research and Development Program. Direct impacts to cultural resources are likely to result from the construction of new facilities and utility upgrades associated with the Solar Enterprise Zones located on the NTS and at one other off-site location. Additional facilities may be required under the Environmental Management and Technology Development Program. Construction of such facilities may also result in impacts to undiscovered cultural resources. Indirect impacts resulting from increased access to the NTS as part of the Environmental Research Park may occur.

Work for Others Program. Many activities would be discontinued under Alternative 4. The two exceptions would be for treaty verification and the increased use of NTS airspace by the U.S. Air Force. Because most activities would be discontinued under Alternative 4, there would be no impacts to cultural resources.

Site-Support Activities. Cultural resource impacts from Site-support activities under Alternative 4 would be the same as those described under Alternative 1 in Section 5.1.1.10.

AMERICAN INDIAN CULTURAL RESOURCES—This section describes the American Indian concerns associated with implementing Alternative 4, as summarized by the CGTO.

Defense Program at NTS—Under Alternative 4, it is expected that American Indian cultural resources will no longer be impacted by defense activities; however, oversight and monitoring have the potential for impacting American Indian cultural resources. Indian people require further information before completely evaluating the cultural impacts of this Defense Program alternative.

Waste Management Program at NTS—Under Alternative 4, it is expected that American Indian cultural resources will continue to be adversely impacted because the waste has not been disposed of in a culturally appropriate manner. Access to culturally significant places on the NTS will be reduced because waste isolation facilities increase Indian people's perception of health and spiritual risks.

Environmental Restoration Program at NTS—Under Alternative 4, it is expected that American Indian cultural resources will be adversely impacted by monitoring well program and access road activities, but will be positively impacted by actions that return disturbed lands to their natural condition in a culturally appropriate manner and with the participation of Indian people.

Nondefense Research and Development Program at NTS—Under Alternative 4, it is expected that American Indian cultural resources will be adversely impacted by visits by students and researchers.

Work for Others Program at the NTS—Under Alternative 4, it is expected that American Indian cultural resources will be impacted if activities at the Spill Test Facility in Area 5, the Treatability Test Facility in Area 25, and the newly renovated decontamination pad in Area 6 are expanded. It is expected that American Indian cultural resources will continue to be adversely impacted by military training exercises and weapons.

Defense Program at Area 13—Under Alternative 4, it is expected that American Indian cultural resources will not be impacted.

Waste Management Program at Area 13—Under Alternative 4, it is expected that American Indian cultural resources will not be impacted because there is no program at the Area 13 site and none has been identified.

Environmental Restoration Program at Area 13—Under Alternative 4, it is expected that American Indian cultural resources will be adversely impacted if natural lands are scraped during environmental restoration. Access to culturally significant places will be increased if environmental restoration is successful, thus reducing Indian people's perception of health and spiritual risks associated with this area. Indian people wish to be involved in identifying environmental restoration methods and in the evaluation of restoration success.

Nondefense Research and Development Program at Area 13—Under Alternative 4, it is expected that American Indian cultural resources will be adversely impacted if military training exercises and weapons tests continue.

Work for Others Program at Area 13.—Under Alternative 4, it is expected that American Indian cultural resources will be impacted if the military training exercises and weapons test continue.

5.4.1.11 Occupational and Public Health and Safety. Most of the program activities under the Defense Program and Work for Others Program would be discontinued under Alternative 4. Waste Management Program activities would be reduced in scope compared to Alternative 3. Activities under the Environmental Restoration and Nondefense Research and Development programs would be similar to Alternative 3. Table 5.4-11 summarizes the occupational public health and safety impacts for each NTS program under Alternative 4.

Impacts to public health and safety under Alternative 4 are primarily related to routine air emissions. Potential impacts to the public from routine air emissions of radioactivity and priority pollutants are discussed in Section 5.4.1.7, Air Quality. Transportation impacts, which are discussed in Section 5.4.1.2, Transportation, would be reduced by the elimination of waste shipments to the NTS from other sites.

Subsurface radioactivity from past underground nuclear weapons tests would continue to be a potential exposure pathway for the public under Alternative 4. Potential impacts to the public would be identical to those described under Alternative 1. The maximally exposed public individual is estimated to have a lifetime probability of contracting a fatal cancer between 8 X 10^{-13} (about one in one trillion) and 1 x 10^{-5} (about one in 100,000). The public exposure scenario assumes that the individual consumes contaminated well water for 70 years centered around the time of peak tritium concentration in well water. These impacts are not expected to occur within the 10-year timeframe of this EIS.

Defense Program. Under Alternative 4, the impacts to public health and safety would be the same as those described under Alternative 2 in Section 5.2.1.11.

Waste Management Program. Based on occupational injury and fatality rates for construction and other industrial activities and on projected changes in the worker population under Alternative 4, the Waste Management Program at the NTS is expected to result in 50 injuries to workers during routine program activities and 14 injuries as a result of construction activities over the 10-year period evaluated in this EIS. During the same time period, 0.95 fatalities are expected because of routine activities, and 0.024 fatalities are expected to result from construction activities.

Based on previous NTS occupational radiation records and on projected changes in the worker population under Alternative 4, occupational exposure to radiation is estimated to result in a collective dose to NTS Waste Management Program workers of about 10-person rem in 10 years. Based on the dose to health effects

Table 5.4-11. Health risks to workers and the public from program activities, Nevada Test Site, Alternative 4

Program Area	Worker Health Risks						Public Health Risks			
	Occupational Safety Risks		Occupational Radiation Risks		Occupational Chemical Risks		Public Radiation Risks		Public Chemical Risks	
	Injuries	Fatalities	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers[c]	Chemical Hazard Index[d]	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers[c]	Chemical Hazard Index[d]
Defense	e	e	e	e	e	e	e	e	e	e
Waste Management	64	0.97	0.020	0.0099	5.2×10^{-7}	0.48	5.1×10^{-5}	2.3×10^{-5}	2×10^{-5}	3.8×10^{-6}
Environmental Restoration	10	0.031	0.0085	0.0034	3×10^{-7}	0.14	2.3×10^{-10}	1.1×10^{-10}	6×10^{-6}	2.4×10^{-6}
Nondefense Research and Development	8.6	0.0015	f	f	3.2×10^{-6}	0.58	f	f	1.9×10^{-4}	1.5×10^{-4}
Work for Others	e	e	e	e	e	e	e	e	e	e
Site Support Activities	19	0.033	0.046	0.018	f	f	g	g	f	f
Total	**102**	**1**	**0.075**	**0.031**	$\mathbf{4 \times 10^{-6}}$	**0.58**	$\mathbf{5.1 \times 10^{-5}}$	$\mathbf{2.3 \times 10^{-5}}$	$\mathbf{2.3 \times 10^{-4}}$	$\mathbf{1.5 \times 10^{-4}}$

a. Number of radiation-induced latent cancer fatalities in the exposed population associated with the activities conducted over the 10-year period of analysis
b. Number of radiation-induced detrimental health effects (e.g., nonfatal cancers, genetic effects) in the exposed population associated with the activities conducted over the 10-year period of analysis
c. Number of chemical-induced cancers (fatal and nonfatal) in the exposed population associated with the activities conducted over the 10-year period of analysis
d. A hazard index of greater than one indicates that the non-cancer health effects could be life-threatening to individuals exposed for one hour or more
e. No activities
f. No reasonably foreseeable scenarios resulting in exposure to radiation have been identified
g. No reasonably foreseeable scenarios resulting in exposure to hazardous chemicals have been identified.

correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 0.004 latent cancer fatalities and 0.0016 other detrimental health effects in the worker population.

The risk of accidental exposure increases the latent cancer fatality risk by 0.016 and detrimental health effect risk by 0.0064. The risk of a single cancer in the worker population as a result of accidental exposure to hazardous chemicals is estimated to be 5.2 x 10^{-7}. The risk of life-threatening noncarcinogenic effects to a single worker from Waste Management Program hazardous chemical accidents has a hazard index of 0.48. A hazard index less than 1.0 indicates that no life-threatening noncarcinogenic health effects would be expected to occur.

The health and safety impact to the public from potential Waste Management Program accidents could result in about 5.1 x 10^{-5} latent cancer fatalities and 2.3 x 10^{-5} other detrimental health effects in the population. Waste Management Program accidents involving hazardous chemicals could result in about 2.0 x 10^{-5} cancers in the population. No noncancer effects from chemical accidents would be expected to occur.

The maximum reasonably foreseeable Waste Management Program radiological accident at the NTS would be the same as described in Section 5.1.1.11 for Alternative 1 (an airplane crash into the Area 5 transuranic waste storage unit, which has a probability of occurrence of 6 x 10^{-7} [1 in 1,700,000] per year).

For Waste Management Programs hazardous chemical effects, the maximum reasonably foreseeable accident would also be the same as described in Section 5.1.1.11 for Alternative 1 (an airplane crash into the Area 5 hazardous waste storage unit, which has a probability of occurrence of 1 x 10^{-7} [1 in 10,000,000] per year).

Environmental Restoration Program. Based on occupational injury and fatality rates for construction and other industrial activities, and projected changes in the worker population under Alternative 4, the Environmental Restoration Program at the NTS is expected to result in 8 injuries to workers during routine program activities and about 2 injuries as a result of construction activities over the 10-year period evaluated in this EIS. During the same period, 0.027 fatalities are expected because of routine activities, and 0.004 fatalities are expected to result from construction activities.

Based on previous NTS occupational radiation records and on projected changes in the worker population under Alternative 4, occupational exposure to radiation is estimated to result in a collective dose to NTS Environmental Restoration Program workers of about 21-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 0.0085 latent cancer fatalities and 0.0034 other detrimental health effects in the worker population.

The risk of accidental worker exposure to hazardous chemicals increases the risk of a single cancer in the worker population by 2.8 x 10^{-7}. The risk of life-threatening noncarcinogenic effects to a single worker from Environmental Restoration Program hazardous chemical accidents has a hazard index of 0.14.

The health and safety impact to the public from potential Environmental Restoration Program accidents could result in about 2.3 x 10^{-10} latent cancer fatalities and 1.1 x 10^{-10} other detrimental health effects in the population. Environmental Restoration Program accidents involving hazardous chemicals could result in about 1.6 x 10^{-5} cancers in the population. No noncancer effects to the public from chemical accidents would be expected to occur.

The maximum reasonably foreseeable Environmental Restoration Program radiological accident at the NTS would be the same as described in Section 5.1.1.11 for Alternative 1 (an airplane crash into the Area 13 site, which has a probability of occurrence of 7 x 10^{-7} [1 in 1,400,000] per year).

For Environmental Restoration Program hazardous chemical effects, the maximum reasonably foreseeable accident would also be the same as described in Section 5.1.1.11 for Alternative 1 (an airplane crash into a hypothetical environmental restoration site consisting of a composite of hazardous sites across the NTS, which has a probability of occurrence of 7 x 10^{-7} [1 in 1,400,000] per year).

Nondefense Research and Development Program. Based on occupational injury and fatality rates for construction activities and on projected changes in the worker population under Alternative 4, the Nondefense Research and Development Program at the NTS is expected to result in about 9 injuries and 0.015 fatalities to workers during construction activities over the 10-year period evaluated in this EIS. During the same period, no injuries or fatalities are expected because of routine activities.

Based on previous NTS occupational radiation records and on projected changes in the worker population under Alternative 4, occupational exposure to radiation is estimated to result in a collective dose to NTS Nondefense Research and Development Program workers of about 11-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 0.0042 latent cancer fatalities and 0.0017 other detrimental health effects in the worker population.

No Nondefense Research and Development Program accident resulting in measurable radiological effects at the NTS has been identified.

The risk of accidental worker exposure to hazardous chemicals increases the risk of a single cancer in the worker population by 3.2 x 10^{-6}. The risk of life-threatening noncarcinogenic effects to a single worker from Nondefense Research and Development hazardous chemical accidents has a hazard index of 0.58.

The health and safety impact to the public from potential Nondefense Research and Development Program accidents could result in about 1.9 x 10^{-4} cancers in the population. No noncancer effects to the public from chemical accidents would be expected to occur.

For Nondefense Research and Development Program hazardous chemical effects, the maximum reasonably foreseeable accident would be the same as described in Section 5.1.1.11 for Alternative 1 (an airplane crash into the tank farm at the Fuel Spill Test Facility, which has a probability of occurrence of 1 x 10^{-7} [1 in 10,000,000] per year).

Work for Others Program. Under Alternative 4, the impacts to public health and safety would be the same as those described under Alternative 2 in Section 5.2.1.11.

Site-Support Activities. Site-support activities are distributed among the program areas. Under Alternative 4, site-support activities at the NTS are expected to result in 19 injuries and 0.033 fatalities as a result of construction activities during the 10-year period evaluated by this EIS. No injuries or fatalities are projected as a result of routine site-support activities.

Occupational exposure to radiation is expected to result in a collective dose to NTS site-support workers of about 0.046-person rem in 10 years. This dose could result in about 0.063 latent cancer fatalities and about 0.025 other detrimental health effects in the worker population.

Perceptions of radiation effects are discussed in Section 4.1.11 and are well known among the Western Shoshone, Southern Paiute, and Owens Valley Paiute people of this region. These perceptions of risks from radiation are frightening, and remain an important part of our lives. We will always carry these thoughts with us. Today, people are afraid of many things and places in this whole area, but we still love to come out and see our land. We worry about more radiation being brought to this land.

If the DOE wants to better understand our feelings about the impacts of radiation on our cultures, they should support a study of risks from radiation designed, conducted, and produced by the CGTO. At this time there has not been a systematic study of American Indians' perceptions of risk. Therefore, it is not possible to provide action by action estimation of risk perception impacts. We believe it is a topic that urgently needs to be studied so that

Indian people may better address the actual cultural impacts of proposed DOE actions. There have been recent workshops funded by the National Science Foundation to understand how to research the special issue of culturally based risk perception among American Indian communities, and at least one major project has been funded. Although this is a relatively new topic of research, it is one that can be more fully understood by research that deeply involves the people being considered. To understand our view of radiation is to begin to understand why we responded in certain ways to past and present, and why we will continue to respond to future DOE activities.

5.4.1.12 ***Environmental Justice.*** Environmental Justice analysis involves two tiers of investigation. One is the determination of significant and adverse impacts as a result of the alternative. The other is an evaluation of whether a minority or low-income population is disproportionately affected by these significant and adverse impacts. If there are no significant and adverse impacts, there would be no significant, disproportionately high and adverse impacts experienced by minority and low-income populations. The location of minority or low-income populations is shown on the figures in Section 4.1.12.

The CGTO has identified impacts to American Indian groups as a result of Alternative 4. While not physically located in Clark, Nye, or Lincoln counties, these groups have traditional ties to the NTS and surrounding areas. Impacts would include continued reduced access to culturally significant areas, the potential for unauthorized artifact collection, and the potential for culturally inappropriate environmental restoration techniques. With Alternative 4, access impacts would be less than with Alternative 1. However, the potential for unauthorized artifact collection would be increased because of the increased number of visitors. These impacts would be perceived only by American Indian groups and would, therefore, have a disproportionately high impact on these groups.

No other significant adverse impacts as a result of this alternative were ascertained; therefore, there would be no disproportionately high and adverse impacts to other minority and low-income populations.

American Indian Environmental Justice concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival, especially access violations. These impacts are discussed in Section 5.4.1.10, Cultural Resources, and Section 5.4.1.11, Occupational and Public Health and Safety. There has not been a systematic study of these issues for the NTS. The CGTO maintains that past, present, and future activities on the NTS have, are, or will disproportionately impact these American Indian people. Under Alternative 4, there is a high potential of adverse impacts to these issues, even though most DOE activities would be discontinued. The continuation of waste management operations, the physical activities associated with environmental restoration and other planned activities are expected to cause both risks from radiation and reduced access from the land disturbance which is expected to occur. The CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study before new activities are approved.

Program-by-program responses are assessed in Section 5.1.1.12 and are not repeated here.

5.4.2 Tonopah Test Range

Under Alternative 4 for the Tonopah Test Range, activities are restricted to the Defense Program, Environmental Restoration Program, Work for Others Program, and site support activities. Therefore, these are the only programs discussed in all sections, with the exception of Section 5.4.2.1.2, Airspace.

Defense Program. Under Alternative 4, Tonopah Test Range activities associated with maintaining readiness and assisting with the DOE weapons research and design would be in accordance with treaty requirements. Certain defense-related activities might be scaled down or discontinued.

Environmental Restoration Program. Environmental Restoration Program activities at the

Tonopah Test Range would continue at current or accelerated rates.

Work for Others Program. Under Alternative 4, the DOE would continue to support other federal agencies' programs and research and development projects, as well as provide for overflights and inspections of the Tonopah Test Range in accordance with international arms control treaties such as the Open Skies Treaty.

5.4.2.1 Land Use. There would be no significant adverse impacts on surrounding land use as a result of the cleanup goals under this alternative. Other land-use impacts would be the same as those discussed under Alternative 1.

5.4.2.1.1 Site-Support Activities—Under Alternative 4, three scenarios could occur with respect to site-support activities. If the planned programs are aligned with the DOE or other federal agencies, site-support requirements could increase by 20 percent. Otherwise, the intended users of the Tonopah Test Range would have to determine if all site-support activities could be integrated within their operations. If not, some site-support activities would cease.

Facilities would be maintained to prevent deterioration. Efforts that would be required to conserve needed services would continue. In addition, services would increase with new technologies and programs at the Tonopah Test Range. Utilities would be maintained to ensure they are in working order. Utilities that are not currently being used could be put back into service if new technologies and operations were started at the Tonopah Test Range. It is estimated that the water supply system and the wastewater system would support new activities. The estimated lifespan of the sanitary landfill would support all new activities at the Tonopah Test Range. The communications systems have the capacity to be expanded to meet the needs of new activities at the Tonopah Test Range.

5.4.2.1.2 Airspace—Airspace actions associated with Alternative 4 would most likely be similar to those discussed under Alternative 1. Maintenance of the current level of air traffic control, as well as the same airspace structure, would continue.

Defense Programs. The continuation of Defense Program operations at the Tonopah Test Range under Alternative 4 would not result in any airspace or air traffic impacts. The continued coordination with the U.S. Air Force would be required to ensure that both missions are accommodated.

Environmental Restoration Program. Environmental Restoration Program activities would have no impact on airspace at the Tonopah Test Range.

Work for Others Program. Airspace requirements under Alternative 4 would be the same as those described under Alternative 1, with the Nellis Air Force Base Air Traffic Control Facility assuming coordination of air traffic control at the Tonopah Test Range and surrounding area. The continuation of operations at the Tonopah Test Range under the Work for Others Program under this alternative would result with continued coordination between the DOE and the U.S. Air Force to ensure that both missions are accommodated.

5.4.2.2 Transportation. The following sections address the environmental impacts related to transportation activities as defined under Alternative 4. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.4.2.2.1 On-Site Traffic—Traffic volumes on the Tonopah Test Range roadways are believed to be below 1,000 vehicles per day on any roadway. Activities associated with Tonopah Test Range programs would add a very small amount of traffic volume to these already under used roadways.

5.4.2.2.2 Off-Site Traffic—Under Alternative 4, activities at the Tonopah Test Range as a result of Defense, Environmental Restoration, and Work for Others Programs would generate only minor amounts of vehicular traffic on the local access roads and on the immediate regional highway (U.S. Highway 6 near Tonopah). In 1993, the average daily traffic on U.S. Highway 6 near Tonopah amounted to 1,095 vehicles. This traffic volume is far below the capacity of U.S. Highway 6 at this location. Therefore, under Alternative 4, there would be no traffic impacts on off-site roadways.

5.4.2.2.3 Transportation of Materials and Waste—Under Alternative 4, the risks discussed in Section 5.1.2.2.3 apply. To summarize the risks (for all the DOE/NV environmental restoration sites), the highest risk is in traffic fatalities and injuries. Both were calculated as less than one person being affected. Even if the environmental restoration projects were accelerated under this alternative, the risks would remain the same. These risks are based on the number of shipments and not on annual rate.

5.4.2.2.4 Other Transportation—Under Alternative 4, the impacts related to other transportation would be similar to those described under Alternative 1 in Section 5.1.2.2.4.

5.4.2.3 Socioeconomics. The socioeconomic analysis has been prepared for the region of influence, regardless of where employees work. Therefore, the place of employment would not change the effects in any of the socioeconomic issues. The analysis for this site is included in Section 5.4.1.3.

American Indian socioeconomic impacts due to fluctuations in DOE employment opportunities for tribal members from the CGTO region of influence are discussed in Section 5.1.1.3.

5.4.2.4 Geology and Soils. Impacts to geology and soils under Alternative 4 would be the same as those described for Alternative 1 in Section 5.1.2.4.

5.4.2.5 Hydrology. The potential impacts to hydrology under Alternative 4 are discussed in this section. The discussion is broken into two subsections: surface hydrology and groundwater.

5.4.2.5.1 Surface Hydrology—Impacts to surface hydrology as a result of Alternative 4 are the same as those described under Alternative 1 in Section 5.1.2.5.

5.4.2.5.2 Groundwater—Water demand, impacts, and productivity are the same for the Tonopah Test Range as those described under Alternative 3 and are not significantly different from those under Alternative 1. There would be no significant additive or subtractive impacts under Alternative 4.

5.4.2.6 Biological Resources. Under Alternative 4, the impacts to biological resources would be the same as those described under Alternative 1 in Section 5.1.2.6.

5.4.2.7 Air Quality. Under Alternative 4, the impacts to air quality would be the same as those described under Alternative 1 in Section 5.1.2.7.

5.4.2.8 Noise. Noise impacts as a result of Alternative 4 for the Environmental Restoration and Work for Others Programs would be the same as those described under Alternative 1 in Section 5.1.2.8. The only impact to noise as a result of Defense Program activities would be the periodic, short-term noise caused by artillery and explosive testing operations.

5.4.2.9 Visual Resources. Under Alternative 4, the only program anticipated to have impacts on visual resources at the Tonopah Test Range would be the Environmental Restoration Program. The impacts to visual resources would be the same as those described under Alternative 1 in Section 5.1.2.9.

5.4.2.10 Cultural Resources. Direct impacts to cultural resources include ground disturbing activities associated with new construction, and possible off-road vehicle travel. Direct impacts such as unauthorized artifact collecting and vandalism, may also occur.

Defense Program. Under Alternative 4, the impacts to cultural resources would include ground disturbing activities associated with off-road vehicle travel for the Smart Transportation Project and construction of the Climatic Test Operation Facility (Appendix A). Increased access may result in unauthorized artifact collecting.

Waste Management Program. Under Alternative 4, no waste management activities will occur at the

Tonopah Test Range. Therefore, cultural resources will not be affected.

Environmental Restoration Program. Under Alternative 4, direct impacts to archaeological resources from cleanup activities could include disturbance of sites found within the area of potential effect. Indirect impacts could result from increased visitation to the site area.

Work for Others Program. Treaty verification activities at the Tonopah Test Range would have no impact on cultural resources.

Site-Support Activities. Impacts resulting from site-support activities under Alternative 4 would be the same as those described under Alternative 3 in Section 5.3.2.10.

AMERICAN INDIAN CULTURAL RESOURCES—This section addresses the American Indian cultural concerns associated with implementing Alternative 4, as summarized by the CGTO.

Defense Program—Under Alternative 4, it is expected that American Indian cultural resources will not be impacted by defense activities; however, overflights and monitoring have the potential for impacting American Indian cultural resources. Indian people require further information before completely evaluating the cultural impacts of this Defense Program alternative.

Waste Management Program—Under Alternative 4, it is expected that American Indian cultural resources will not be adversely impacted because there are no actions planned.

Environmental Restoration Program—Under Alternative 4, it is expected that American Indian cultural resources will be adversely impacted if natural lands are scraped during environmental restoration. Access to culturally significant places will be increased if environmental restoration is successful, thus reducing Indian people's perception of health and spiritual risks associated with this area. Indian people wish to be involved in identifying environmental restoration methods and in the evaluation of restoration success.

Nondefense Research and Development Program—Under Alternative 4, it is expected that American Indian cultural resources will not be impacted because no activities are planned under this alternative.

Work for Others Program—Under Alternative 4, it is expected that American Indian cultural resources will be impacted by military training exercises and conventional weapons tests.

5.4.2.11 Occupational and Public Health and Safety. Under Alternative 4, the only activities that would be important to health and safety are associated with the Environmental Restoration Program. Defense Program activities are mostly discontinued. Table 5.4-12 summarizes the occupational and public health and safety impacts for the applicable Tonopah Test Range program areas under Alternative 4. None of the activities under Alternative 4 have a potential to impact public health and safety.

Defense Program. Based on occupational injury and fatality rates for construction activities, the Defense Program at the Tonopah Test Range is expected to result in 2.5 injuries and 0.0044 fatalities to workers during construction activities over the 10-year period evaluated in this EIS. During the same period, no injuries or fatalities are projected as a result of routine program activities.

Based on previous occupational radiation periods, occupational exposure to radiation is not expected to exceed a collective dose to Defense Program workers of about 6 person-rem in 10-years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 0.0025 latent cancer fatalities and 0.001 other detrimental health effects in the worker population.

The risk of accidental exposure to radioactive or hazardous chemical releases contributes nearly zero increase to the risk of latent cancer fatality or detrimental health effect.

The health and safety impact to the public from potential Defense Program accidents at Tonopah

Test Range could result in about 9.0 x 10^{-9} latent cancer fatalities and 4.1 x 10^{-9} other detrimental health effects in the population. Additional risk due to accidental exposure to hazardous chemicals would be even less.

The maximum reasonably foreseeable Defense Program radiological accident at the Tonopah Test Range would be the same as described in Section 5.1.2.11 for Alternative 1 (a failure of an artillery fired test assembly, which has a probability of occurrence of 1 x 10^{-7} [1 in 10,000,000] per year).

For Defense Programs hazardous chemical effects at the Tonopah Test Range, the maximum reasonably foreseeable accident also would be the same as described in Section 5.1.2.11 for Alternative 1 (an explosion of a rocket test assembly containing depleted uranium and beryllium, which has a probability of occurrence of 6 x 10^{-6} [1 in 170,000] per year).

Environmental Restoration Program. Based on occupational injury and fatality rates for industrial activities, Environmental Restoration Program activities are expected to result in 0.0049 injuries and 0.001 fatalities to workers during routine program activities over the 10-year period evaluated in this EIS. During the same period, no injuries or fatalities are expected to result from construction activities.

Based on previous occupational radiation records, occupational exposure to radiation is estimated to result in a collective dose to Tonopah Test Range Environmental Restoration Program workers of about 0.6-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 2.4 x 10^{-4} latent cancer fatalities and 9.6x10^{-5} other detrimental health effects in the worker population.

The risk of accidental exposure to radioactive releases contributes nearly zero increase to the risk of latent cancer fatality or detrimental health effect. No Environmental Restoration Program hazardous chemical accident resulting in measurable effects at the Tonopah Test Range has been identified.

The health and safety impact to the public from potential Environmental Restoration Program accidents at Tonopah Test Range could result in about 1.2 x 10^{-9} latent cancer fatalities and 5.7 x 10^{-10} other detrimental health effects in the population. The maximum reasonably foreseeable Environmental Restoration Program radiological accident at the Tonopah Test Range would be the same as described in Section 5.1.1.11 for Alternative 1 (an airplane crash into the Project Roller Coaster site, which has a probability of occurrence of 1 x 10^{-6} [1 in 1,000,000] per year).

5.4.2.12 Environmental Justice. Environmental Justice impacts for the region of influence are the same as those described in Section 5.4.1.12.

American Indian Environmental Justice concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival, especially access violations. These impacts are discussed in Section 5.4.2.10, Cultural Resources, and Section 5.4.1.11, Occupational and Public Health and Safety. There has not been a systematic study of these issues for the Tonopah Test Range. The CGTO maintains that past, present and future activities on the Tonopah Test Range have, are, or will disproportionately impact the American Indian people. Under Alternative 4, there is a high potential of adverse impacts to these issues. As more activities occur, both risks from radiation and reduced access from land disturbance is expected to occur. The CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study before new activities are approved.

Program-by-program responses are assessed in Section 5.1.1.12 and are not repeated here.

5.4.3 Project Shoal Area

Under Alternative 4, activities at the Project Shoal Area would be limited to Environmental Restoration Program activities; therefore, it is the only program discussed in this section. Activities

Table 5.4-12. Health risks to workers and the public from program activities, Tonopah Test Range, Alternative 4

Program Area	Worker Health Risks						Public Health Risks			
	Occupational Safety Risks		Occupational Radiation Risks		Occupational Chemical Risks		Public Radiation Risks		Public Chemical Risks	
	Injuries	Fatalities	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers[c]	Chemical Hazard Index[d]	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers[c]	Chemical Hazard Index[d]
Defense	2.5	0.0044	0.0025	0.001	8.4×10^{-12}	1.8×10^{-5}	9×10^{-9}	4.1×10^{-9}	1×10^{-10}	9.7×10^{-7}
Environmental Restoration	0.0049	9.7×10^{-4}	2.4×10^{-4}	9.5×10^{-5}	e	e	1.2×10^{-9}	5.7×10^{-10}	e	e
Total	**2.5**	**0.0054**	**0.0027**	**0.0011**	**8.4×10^{-12}**	**1.8×10^{-5}**	**1×10^{-8}**	**4.7×10^{-9}**	**1×10^{-10}**	**9.7×10^{-7}**

a. Number of radiation-induced latent cancer fatalities in the exposed population associated with the activities conducted over the 10-year period of analysis
b. Number of radiation-induced detrimental health effects (e.g., nonfatal cancers, genetic effects) in the exposed population associated with the activities conducted over the 10-year period of analysis
c. Number of chemical-induced cancers (fatal and nonfatal) in the exposed population associated with the activities conducted over the 10-year period of analysis
d. A hazard index of greater than one indicates that the non-cancer health effects could be life-threatening to individuals exposed for one hour or more
e. No reasonably foreseeable scenarios resulting in exposure to chemically hazardous materials have been identified.

include continuation of characterization and remediation actions at the Project Shoal Area.

5.4.3.1 Land Use. Under Alternative 4, the impacts expected at the project area would be the same as under Alternative 1. Continued site characterization and long-term hydrologic monitoring could result in the disturbance of 10 acres of land. The 10 acres identified for Environmental Restoration Program activities would represent less than 0.4 percent of the project land area. Adverse impacts from Environmental Restoration Program activities to land-use resources would be negligible.

5.4.3.1.1 Site-Support Activities—Impacts resulting from Alternative 4 would be the same as those described under Alternative 1 in Section 5.1.3.1.1.

5.4.3.1.2 Airspace—Under Alternative 4, impacts to airspace would be the same as those described under Alternative 1 in Section 5.1.3.1.2.

5.4.3.2 Transportation. The following sections address the environmental impacts related to transportation activities as defined under Alternative 4. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of radioactive materials and waste, and other transportation.

5.4.3.2.1 On-Site Traffic—Environmental Restoration Program activities would be short-term and would require relatively few personnel (less than 10 people at any given time). No public roads currently exist on the site. Minor vehicular traffic is anticipated, but no traffic impacts are expected.

5.4.3.2.2 Off-Site Traffic—Environmental Restoration Program activities would generate only an occasional and minor amount of vehicular traffic (less than 100 vehicle trips per day) on the local access roads and on the immediate regional highway (U.S. Highway 50). In 1993, the average daily traffic on U.S. Highway 50 near the site amounted to 1,340 vehicles (NDOT, 1993); this traffic volume is far below the capacity of U.S. Highway 50 at this location. Therefore, under Alternative 4, there would be no traffic impacts on off-site roadways.

5.4.3.2.3 Transportation of Materials and Waste—Under Alternative 4, the risks discussed in Section 5.1.3.2.3 apply. The highest risk from environmental restoration activities would be in traffic fatalities and injuries. Both were calculated as less than one person being affected. Even if the environmental restoration activities were accelerated under this alternative, the risks would remain the same. These risks are based on shipments and not an annual rate.

5.4.3.2.4 Other Transportation—Because Alternative 4 would not include direct use of local railroads, air transportation, or other modes of transportation to the Project Shoal Area, direct effects on rail, air, and other modes of air transportation are expected to be minimal.

5.4.3.3 Socioeconomics. The socioeconomic analysis has been prepared for the region of influence, regardless of where employees work. Therefore, the place of employment would not change the effects in any of the socioeconomic issues. The analysis for this site is included in Section 5.4.1.3.

American Indian socioeconomic impacts due to fluctuations in DOE employment opportunities for tribal members from the CGTO region of influence are discussed in Section 5.1.1.3.

5.4.3.4 Geology and Soils. The Project Shoal Area would be used for any of the described expanded uses, so the potential impacts to the geology and soils would be the same as described under Alternative 1 in Section 5.1.3.4.

5.4.3.5 Hydrology. Under Alternative 4, the impacts to surface water and groundwater would be the same as those described under Alternative 1 in Section 5.1.3.5. Acceleration of the schedule would not significantly impact water demand.

5.4.3.6 Biological Resources. The impacts to biological resources under Alternative 4 would be very similar to those described under Alternative 1 in Section 5.1.3.6.

5.4.3.7 Air Quality. Under Alternative 4, the impacts to air quality would be the same as those described under Alternative 1 in Section 5.1.3.7.

5.4.3.8 Noise. Noise impacts as a result of Alternative 4 would be the same as those described under Alternative 1 in Section 5.1.3.8.

5.4.3.9 Visual Resources. Under Alternative 4, impacts to visual resources would be the same as described under Alternative 1 in Section 5.1.3.9.

5.4.3.10 Cultural Resources. Impacts to cultural resources under Alternative 4 would be the same as those described under Alternative 1 in Section 5.1.3.10.

AMERICAN INDIAN CULTURAL RESOURCES—This section describes the American Indian concerns associated with implementing Alternative 4 as summarized by the CGTO.

This study area is not within the traditional lands of the Indian people represented by the CGTO. It is recommended by the CGTO that the DOE NTS EIS team directly contact Indian tribes and organizations having traditional lands in the Project Shoal Area. The following tribes were suggested: Fallon Paiute, Walker River Paiute, Pyramid Lake, and Lovelock Paiute Tribes.

NOTE: The Fallon Paiute, Walker River Paiute, and Lovelock Paiute Tribes were contacted by the DOE in letters dated May 12, 1995.

5.4.3.11 Occupational and Public Health and Safety. The Environmental Restoration Program is the only program expected to result in health and safety impacts to workers at the Project Shoal Area under Alternative 4. No contamination has been detected in surficial soils at this site, and no surface soil remedial actions are proposed. Activities at this site would consist of characterization and hydrologic monitoring. Alternative 4 would accelerate the program activities described under Alternative 1. For Project Shoal workers, the increased activities are expected to result in a corresponding increase in human health and safety impacts compared to Alternative 1. Table 5.4-13 summarizes the occupational and public health and safety impacts for Environmental Restoration Program activities under Alternative 4.

As under Alternative 1, no impacts to public health and safety are reasonably foreseeable from either routine activities or accidents under Alternative 4. Potential impacts to public health and safety from subsurface contamination of groundwater are the same as those discussed under Alternative 1 in Section 5.1.3.11.

Environmental Restoration. Based on occupational injury and fatality rates for industrial activities, Environmental Restoration Program activities at the Project Shoal Area are expected to result in 1.6×10^{-4} injuries and 3.1×10^{-5} fatalities to workers during routine program activities over the 10-year period evaluated in this EIS. During the same time period, no injuries or fatalities are expected because of construction activities.

Based on previous occupational radiation records, occupational exposure to radiation is estimated to result in a collective dose to Project Shoal Area Environmental Restoration Program workers of about 0.04-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 1.7×10^{-5} latent cancer fatalities and 6.8×10^{-6} other detrimental health effects in the worker population.

No Environmental Restoration Program accidents resulting in measurable radiological or chemically hazardous effects at the Project Shoal Area have been identified.

5.4.3.12 Environmental Justice. Environmental Justice impacts for the region of influence would be the same as those discussed in Section 5.4.1.12.

The American Indian response regarding Environmental Justice is discussed in Section 4.1.12. American Indian Environmental Justice concerns include: (1) Holy Land violations. (2) perceived risks from radiation, and (3) cultural survival especially access violations. There has been no systematic study of these issues for the Project Shoal Area site.

This study area is not within the traditional lands of the American Indian people represented by the Consolidated Group of Tribes and Organizations. It is recommended by the CGTO that the DOE NTS EIS team directly contact American Indian tribes and organizations having traditional lands in the Project Shoal Area. The following tribes were suggested: Fallon Paiute, Walker River Paiute, Pyramid Lake, and Lovelock Paiute Tribes.

5.4.4 Central Nevada Test Area

Under Alternative 4, the programs at the Central Nevada Test Area would be limited to the Environmental Restoration Program; therefore, the only impacts discussed in this section are the results of that program. Activities would include continuation of characterization and remediation actions at the Central Nevada Test Area.

5.4.4.1 Land Use. Under Alternative 4, the impacts expected at the Central Nevada Test Area would be the same as under Alternative 1. Acceleration of activities and more stringent cleanup requirements would impact the schedule, but impacts to land use are not expected.

5.4.4.1.1 Site-Support Activities—No significant impacts on site-support activities would occur as a result of Alternative 4 actions. Requirements for water, power, and other facilities would not be increased over Alternative 1.

5.4.4.1.2 Airspace—There would be minimal effects on airspace at the Central Nevada Test Area as a result of Alternative 4.

5.4.4.2 Transportation. The following sections address the environmental impacts related to transportation activities as defined under Alternative 4. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.4.4.2.1 On-Site Traffic—Environmental Restoration Program activities would be short term and would require relatively few personnel (less than 10 at any given time). There are no public roads currently on the site, and the low level of personnel anticipated would generate a minor amount of traffic. No public roads currently exist on the Central Nevada Test Area.

5.4.4.2.2 Off-Site Traffic—Under Alternative 4, there would be minor vehicular traffic generated. No traffic impacts are expected on off-site road ways. The impacts would be the same as those described under Alternative 1 in Section 5.1.4.2.2.

5.4.4.2.3 Transportation of Materials and Waste—Under Alternative 4, the risks discussed in Section 5.1.4.2.3 apply. Even if the Environmental Restoration Program activities were accelerated under this alternative, the risks would remain the same. These risks are based on the number of shipments and not on an annual rate.

5.4.4.2.4 Other Transportation—Because Alternative 4 activities do not include direct use of local railroads, air transportation, or other modes of transportation to this site, direct effects on rail, air, and other modes of transportation are expected to be minimal.

5.4.4.3 Socioeconomics. The socioeconomic analysis has been prepared for the region of influence, regardless of where employees work; therefore, the place of employment would not change the effects in any of the socioeconomic issues. The analysis for this site is included under Section 5.4.1.3.

American Indian socioeconomic impacts due to fluctuations in DOE employment opportunities for tribal members from the CGTO region of influence are discussed in Section 5.1.1.3.

5.4.4.4 Geology and Soils. The Central Nevada Test Area would not be used for any of the described expanded uses, so the potential impacts to geology and soils would be the same as described under Alternative 1 in Section 5.1.4.4.

5.4.4.5 Hydrology. Under Alternative 4, the impacts to surface water and groundwater would be the same as those described under Alternative 1 in Section 5.1.3.5. Acceleration of the activities would not significantly impact water demand.

Table 5.4-13. Health risks to workers and the public from program activities, Project Shoal Area, Alternative 4

Program Area	Worker Health Risks						Public Health Risks			
	Occupational Safety Risks		Occupational Radiation Risks		Occupational Chemical Risks		Public Radiation Risks		Public Chemical Risks	
	Injuries	Fatalities	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers	Chemical Hazard Index	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers	Chemical Hazard Index
Environmental Restoration	1.6×10^{-4}	3.1×10^{-5}	1.7×10^{-5}	6.8×10^{-6}	c	c	d	d	c	c
Total	**1.6×10^{-4}**	**3.1×10^{-5}**	**1.7×10^{-5}**	**6.8×10^{-6}**	**c**	**c**	**d**	**d**	**c**	**c**

a. Number of radiation-induced latent cancer fatalities in the exposed population associated with the activities conducted over the 10-year period of analysis
b. Number of radiation-induced detrimental health effects (e.g., nonfatal cancers, genetic effects) in the exposed population associated with the activities conducted over the 10-year period of analysis
c. No reasonably foreseeable scenarios resulting in exposure to chemically hazardous materials have been identified
d. No reasonably foreseeable scenarios resulting in exposure to radiation have been identified.

*5.4.4.6 **Biological Resources.*** The impacts to biological resources under Alternative 4 would be the same as those described under Alternative 1 in Section 5.1.4.6.

*5.4.4.7 **Air Quality.*** Under Alternative 4, the impacts to air quality would be the same as those described for Alternative 1 in Section 5.1.4.7.

*5.4.4.8 **Noise.*** Noise impacts as a result of Alternative 4 would be the same as those described under Alternative 1 in Section 5.1.4.8.

*5.4.4.9 **Visual Resources.*** Under Alternative 4, impacts to visual resources would be the same as those described under Alternative 1 in Section 5.1.4.9.

5.4.4.10 Cultural Resources. Under Alternative 4, impacts to cultural resources would be the same as those described under Alternative 1 in Section 5.1.4.10.

AMERICAN INDIAN CULTURAL RESOURCES—This section describes the American Indian concerns associated with implementing Alternative 4, as summarized by the CGTO.

Defense Program—Under Alternative 4, it is expected that American Indian cultural resources will not be impacted.

Waste Management Program—Under Alternative 4, it is expected that American Indian cultural resources will not be impacted.

Environmental Restoration Program—Under Alternative 4, it is expected that American Indian cultural resources on the Central Nevada Test Area will be impacted if natural lands are scraped during environmental restoration. Access to culturally significant places will be increased if environmental restoration is successful, thus reducing Indian people's perception of health and spiritual risks associated with this area. Indian people wish to be involved in identifying environmental restoration methods and in the evaluation of restoration success.

Nondefense Research and Development Program—Under Alternative 4, it is expected that American Indian cultural resources will not be adversely impacted.

Work for Others Program—Under Alternative 4, it is expected that American Indian cultural resources will not be impacted.

5.4.4.11 Occupational and Public Health and Safety. The Environmental Restoration Program is the only active program expected to result in health and safety impacts to workers at the Central Nevada Test Area under Alternative 4. Activities at this site would consist of site characterization and remediation with removal of contaminated mud and sludge. Alternative 4 accelerates the program activities described under Alternative 1. For Central Nevada Test Area workers, the increased activities are expected to result in a corresponding increase in human health and safety impacts compared to Alternative 1. Table 5.4-14 summarizes the occupational and public health and safety impacts for Environmental Restoration Program activities under Alternative 4.

As in Alternative 1, no impacts to public health and safety are reasonably foreseeable from either routine activities or accidents under Alternative 4. Potential impacts to public health and safety from subsurface contamination of groundwater are the same as those discussed under Alternative 1 in Section 5.1.4.11.

Environmental Restoration Program. Based on occupational injury and fatality rates for industrial activities, Environmental Restoration Program activities at the Central Nevada Test Area are expected to result in 1.6×10^{-4} injuries and 3.1×10^{-5} fatalities to workers during routine program activities over the 10-year period evaluated in this EIS. During the same period, no injuries or fatalities are expected because of construction activities.

Based on previous occupational radiation records, occupational exposure to radiation is estimated to result in a collective dose to Central Nevada Test Area Environmental Restoration Program workers of about 0.04-person rem in 10 years. Based on the dose to health effects correlation factors recommended by the International Commission on Radiological Protection (1991), this dose could result in about 1.7×10^{-5} latent cancer fatalities and 6.8×10^{-6} other detrimental health effects in the worker population.

No Environmental Restoration Program accidents resulting in measurable radiological or chemically hazardous effects at the Central Nevada Test Area have been identified.

5.4.4.12 Environmental Justice. Environmental Justice impacts for the region of influence would be the same as those discussed in Section 5.4.1.12.

American Indian Environmental Justice concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival especially access violations. These impacts are discussed in Section 5.4.4.10, Cultural Resources, and Section 5.4.1.11, Occupational and Public Health and Safety. There has not been a systematic study of these issues for the Central Nevada Test Area. The CGTO maintains that past, present, and future activities on the Central Nevada Test Area have, are, or will disproportionately impact the American Indian people. Under Alternative 4, there is a high potential of adverse impact. As more activities occur, both risks from radiation and reduced access from land disturbance is expected to occur. Even though the CGTO has not been permitted to visit the area, the area is especially important due to the concentration of cultural resources. Therefore, this area provides a special opportunity for the DOE to resolve past Environmental Justice impacts. The CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study, before new activities are approved.

Program-by-program responses are assessed in Section 5.1.1.1.2 and are not repeated here.

5.4.5 Eldorado Valley

Under Alternative 4, the only program expected to occur in Eldorado Valley is the Nondefense Research and Development Program; therefore, the impacts discussed in this section are limited to that program. A sitewide EIS, supplemental EIS, and or other environmental studies could be performed to describe all impacts should this site be chosen for a Solar Enterprise Zone facility. Project plans, site preparation, technical studies, and worker-transition training development and implementation could also be accomplished.

5.4.5.1 Land Use. The location of a Solar Enterprise Zone facility in Eldorado Valley would not result in significant impacts on land uses under Alternative 4. The designation of the site for renewable energy development is consistent with the plans for a tortoise preserve and other uses for the annexed land. Boulder City has already designated 6,000 acres of the land annexed for the purpose of renewable resource development. This designation is consistent with the location of a Solar Enterprise Zone facility in Eldorado Valley.

A Solar Enterprise Zone facility at this site, under Alternative 4, would have the same impacts as described under Alternative 3 in Section 5.3.5.1.

5.4.5.2 Transportation. The following sections address the environmental impacts related to transportation activities as defined under Alternative 4. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.4.5.2.1 On-Site Traffic—Impacts under Alternative 4 would be the same as those described under Alternative 3 in Section 5.3.5.2.1.

5.4.5.2.2 Off-Site Traffic—Under Alternative 4, impacts would be the same as those described under Alternative 3 in Section 5.3.5.2.2.

5.4.5.2.3 Transportation of Materials and Waste—This section is not applicable to the Eldorado Valley Solar Enterprise Zone site.

5.4.5.2.4 Other Transportation—Because this alternative does not assume extensive transportation of personnel and materials via rail or air, impacts to these transportation modes would be minimal and would not be significant.

5.4.5.3 Socioeconomics. The socioeconomic analysis has been prepared for the region of influence regardless of where employees work. Therefore, the place of employment would not change the effects in any of the socioeconomic indicators. The analyses for this site is included in Section 5.4.1.3.

Table 5.4-14. Health risks to workers and the public from program activities, Central Nevada Test Area, Alternative 4

Program Area	Worker Health Risks						Public Health Risks			
	Occupational Safety Risks		Occupational Radiation Risks		Occupational Chemical Risks		Public Radiation Risks		Public Chemical Risks	
	Injuries	Fatalities	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers	Chemical Hazard Index	Radiation LCFs[a]	Radiation Detriment[b]	Chemical Cancers	Chemical Hazard Index
Environmental Restoration	1.6×10^{-4}	3.1×10^{-5}	1.7×10^{-5}	6.8×10^{-6}	c	c	d	d	c	c
Total	**1.6×10^{-4}**	**3.1×10^{-5}**	**1.7×10^{-5}**	**6.8×10^{-6}**	**c**	**c**	**d**	**d**	**c**	**c**

a. Number of radiation-induced latent cancer fatalities in the exposed population associated with the activities conducted over the 10-year period of analysis

b. Number of radiation-induced detrimental health effects (e.g., nonfatal cancers, genetic effects) in the exposed population associated with the activities conducted over the 10-year period of analysis

c. No reasonably foreseeable scenarios resulting in exposure to chemically hazardous materials have been identified

d. No reasonably foreseeable scenarios resulting in exposure to radiation have been identified.

American Indian socioeconomic impacts due to fluctuations in DOE employment opportunities for tribal members from the CGTO region of influence are discussed in Section 5.1.1.3.

5.4.5.4 Geology and Soils. Impacts on the geologic resources and soils of Eldorado Valley, as a result of developing a Solar Enterprise Zone facility would be the same under Alternative 4 as under Alternative 3 and are described in Section 5.3.5.4.

5.4.5.5 Hydrology. Surface water and groundwater impacts under Alternative 4 would be the same for Eldorado Valley as Alternative 3. There would be no significant impacts under Alternative 4, as described in Section 5.3.5.5.

5.4.5.6 Biological Resources. The impacts at this site under Alternative 4 would be the same as those under Alternative 3, as described in Section 5.3.5.6.

5.4.5.7 Air Quality. Under Alternative 4, impacts to air quality would be the same as those described under Alternative 3 in Section 5.3.5.7.

5.4.5.8 Noise. Noise impacts under Alternative 4 would be the same as those described under Alternative 3 in Section 5.3.5.8.

5.4.5.9 Visual Resources. The impacts on the visual resources of Eldorado Valley under Alternative 4 would be the same as those under Alternative 3, as described in Section 5.3.5.9.

5.4.5.10 Cultural Resources. Under Alternative 4, impacts to cultural resources would be the same as those described under Alternative 1 in Section 5.1.1.10.

AMERICAN INDIAN CULTURAL RESOURCES—This section describes the American Indian concerns associated with implementing Alternative 4, as summarized by the CGTO.

Defense Program—Under Alternative 4, American Indian cultural resources will not be impacted because no Defense Program activities are scheduled for Eldorado Valley.

Waste Management Program—Under Alternative 4, American Indian cultural resources will not be impacted because no Waste Management Program activities are scheduled for Eldorado Valley.

Environmental Restoration Program—Under Alternative 4, no environmental restoration activities are planned for Eldorado Valley; therefore, no adverse impacts to American Indian resources are expected.

Nondefense Research and Development Program—Under Alternative 4, it is expected that American Indian cultural resources will be adversely impacted if a solar production facility is constructed and operated.

Work for Others Program—It is unlikely that Work for Others Program activities will be implemented in Eldorado Valley; therefore, no adverse impacts on American Indian resources are expected under Alternative 4.

5.4.5.11 Occupational and Public Health and Safety. Minimal occupational health and safety impacts are expected as a result of construction and operation of a Solar Enterprise Zone facility. All activities at the site would be conducted in compliance with Occupational Safety and Health Administration regulations and requirements.

5.4.5.12 Environmental Justice. Environmental Justice impacts in the region of influence would be the same as those described in Section 5.4.1.12.

American Indian concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival, especially access violations. These impacts are discussed in Section 5.4.5.10, Cultural Resources, and Section 5.4.1.11, Occupational and Public Health and Safety. There has not been a systematic study of these issues for the Eldorado Valley. The CGTO maintains that past activities in the Eldorado Valley have disproportionately impacted the American Indian people, especially regarding Holy Land violations. The CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study before new activities are approved.

5.4.6 Dry Lake Valley

Activities at Dry Lake Valley are limited to the Nondefense and Research Program; therefore, impacts discussed in this section would be the result of Nondefense and Research Program activities. A sitewide environmental impact statement, supplemental environmental impact statement, and or other environmental studies could be performed to describe all impacts should this site be chosen for a Solar Enterprise Zone facility. Project plans, site preparation, technical studies, and worker-transition training development and implementation could also be accomplished.

5.4.6.1 Land Use. The location of a Solar Enterprise Zone facility in Dry Lake Valley would not result in significant impacts on land uses under Alternative 4. The designation of the site for renewable energy development is consistent with the plans for energy production in this area.

The impacts to airspace under Alternative 4 would be the same as those described under Alternative 3 in Section 5.3.6.1.

5.4.6.2 Transportation. The following sections address the environmental impacts related to transportation activities as defined under Alternative 4. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.4.6.2.1 On-Site Traffic—Impacts would be the same as described under Alternative 3, Section 5.3.6.2.1.

5.4.6.2.2 Off-Site Traffic—U.S. Highway 93 would be the major regional access to the site. It is a two-lane, two-way rural highway with 1,210 average daily traffic in 1993 south of State Route 375 Junction. The projected peak hour traffic and associated level of service for 1996, 2000, and 2005 are shown in Table 5.4-4. With the Solar Enterprise Zone facility in operation, U.S. Highway 93 near the site would continue to operate at level of service C or better.

5.4.6.2.3 Transportation of Materials and Waste—Transportation of materials and waste are not expected to occur at a Solar Enterprise Zone facility. Therefore, this section is not applicable to this site.

5.4.6.2.4 Other Transportation—Because activities under Alternative 4 do not include extensive rail or air transportation of personnel and materials, impacts to these transportation modes would be minimal and would not be significant.

5.4.6.3 Socioeconomics. The socioeconomic analysis has been prepared for the region of influence regardless of where employees work. Therefore, the place of employment would not change the effects in any of the socioeconomic indicators. The analyses for this site is included in Section 5.4.1.3.

American Indian socioeconomic impacts due to fluctuations in DOE employment opportunities for tribal members from the CGTO region of influence are discussed in Section 5.1.1.3

5.4.6.4 Geology and Soils. Impacts on the geologic resources and soils of Dry Lake Valley as a result of the development of a Solar Enterprise Zone facility would be the same under Alternative 4 as under Alternative 3 in Section 5.3.6.4.

5.4.6.5 Hydrology. Surface water and groundwater impacts under Alternative 4 would be the same as those described under Alternative 3 in Section 5.3.6.5.

5.4.6.6 Biological Resources. The impacts to biological resources at this site under Alternative 4 would be the same as under Alternative 3, as described in Section 5.3.6.6.

5.4.6.7 Air Quality. Impacts to air quality would be the same as those described under Alternative 3 in Section 5.3.6.7.

5.4.6.8 Noise. Noise impacts under Alternative 4 would be the same as those described under Alternative 3 in Section 5.3.6.8.

5.4.6.9 ***Visual Resources.*** The impacts on the visual resources of Dry Lake Valley under Alternative 4 would be the same those under Alternative 3, as described in Section 5.3.6.9.

5.4.6.10 ***Cultural Resources.*** Under Alternative 4, impacts to cultural resources at Dry Lake Valley would be the same as those described for Alternative 3 in Section 5.3.6.10.

AMERICAN INDIAN CULTURAL RESOURCES—This section describes the American Indian concerns associated with implementing Alternative 4, as summarized by the CGTO.

Defense Program—Under Alternative 4, American Indian cultural resources will not be impacted because no Defense Program activities are scheduled for Dry Lake Valley.

Waste Management Program—Under Alternative 4, American Indian cultural resources will not be impacted because no Waste Management Program activities are scheduled for Dry Lake Valley.

Environmental Restoration Program—No environmental restoration activities are planned for Dry Lake Valley; therefore, no adverse impacts to American Indian resources are expected under Alternative 4.

Nondefense Research and Development Program—Under Alternative 4, it is expected that American Indian cultural resources will be adversely impacted if a solar production facility is constructed and operated.

Work for Others Program—It is unlikely that Work for Others Program activities will be implemented in Dry Lake Valley; therefore, no adverse impacts on American Indian resources are expected under Alternative 4.

5.4.6.11 ***Occupational and Public Health and Safety.*** Minimal occupational health and safety impacts are expected as a result of construction and operation of a Solar Enterprise Zone facility. All activities at the site would be conducted in compliance with Occupational Safety and Health Administration regulations and requirements.

5.4.6.12 ***Environmental Justice.*** Environmental Justice impacts for the region of influence would be the same as those discussed in Section 5.4.1.12.

American Indian concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival, especially access violations. These impacts are discussed in Section 5.4.6.10, Cultural Resources, and Section 5.4.1.11, Occupational and Public Health and Safety. There has not been a systematic study of these issues for the Dry Lake Valley have disproportionately impacted these American Indian people especially regarding Holy Land violations. Any activities occurring near Indian reservations further precludes future opportunities for expansion and access to these lands for any purpose. The CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study before new activities are approved.

Program-by-program responses are assessed in Section 5.1.1.12 and are not repeated here.

5.4.7 Coyote Spring Valley

Under Alternative 4, the Nondefense Research and Development Program would be the only program conducting activities; therefore, the impacts discussed in this section are limited to Nondefense Research and Development Program activities. A sitewide EIS, supplemental EIS, and or other environmental studies could be performed to describe all impacts should this site be chosen for a Solar Enterprise Zone facility. Project plans, site preparation, technical studies, and worker-transition training development and implementation could also be accomplished.

5.4.7.1 ***Land Use.*** Under Alternative 4, alternative energy projects would be located as approved. Alternative 4 actions would not significantly impact surrounding land uses, which include wildlife management, mining, and recreation.

Under Alternative 4, impacts to airspace would be the same as those described under Alternative 3 in Section 5.3.7.1.2.

5.4.7.2 ***Transportation.*** The following sections address the environmental impacts related to transportation activities as defined under Alternative 4. The analysis of transportation impacts is presented with respect to on-site and off-site traffic, transportation of materials and waste, and other transportation.

5.4.7.2.1 On-Site Traffic—Impacts to on-site traffic under alternative 4 would be the same as those described under Alternative 3 in Section 5.3.7.2.1.

5.4.7.2.2 Off-Site Traffic—Impacts to off-site traffic would be the same as those described under Alternative 3 in Section 5.3.7.2.2.

5.4.7.2.3 Transportation of Materials and Waste—Transportation of materials and waste are not expected at the Solar Enterprise Zone facility. Therefore, this section is not applicable to this site.

5.4.7.2.4 Other Transportation—Because this alternative's activities do not include extensive rail or air transportation of personnel and materials, impacts to these transportation modes would be minimal and would not be significant.

5.4.7.3 ***Socioeconomics.*** A major objective of the Solar Enterprise Zone facility in Coyote Spring Valley is to provide local employment and economic benefits to offset the impact of defense conversion and Alternative 4 activities on the NTS. A Solar Enterprise Zone facility would stimulate the economy of Coyote Spring Valley and Lincoln County, while simultaneously serving national energy and environmental objectives. Building individual solar projects would provide construction jobs for a short period of time, while a fairly small, stable work force would be required for sustained operation and maintenance of the facilities.

Solar energy could fill the increased demand for electricity without damaging the environment. The development of a new science and manufacturing base mission is important. At the same time, environmental concerns create a growing demand for alternative generating technologies.

The socioeconomic impacts of the Solar Enterprise Zone facility will be presented when more information with respect to economic activity, population, housing, public finance, and public services is available. A sitewide EIS, supplemental EIS, and/or other environmental studies will be performed to describe all socioeconomic impacts. In addition, project plans, site preparation, technical studies, and worker-transition training development and implementation could be accomplished.

American Indian socioeconomic impacts due to fluctuations in DOE employment opportunities for tribal members from the CGTO region of influence are discussed in 5.1.1.3.

5.4.7.4 ***Geology and Soils.*** There would be the same impacts on the geologic resources and soils of Coyote Spring Valley as a result of the development of a Solar Enterprise Zone under Alternative 4 as under Alternative 3. Impacts under Alternative 3 are described in Section 5.3.7.4.

5.4.7.5 ***Hydrology.*** Surface water and groundwater impacts under Alternative 4 would be the same as those described under Alternative 3 in Section 5.3.7.5.

5.4.7.6 ***Biological Resources.*** The impacts to biological resources activities at this site under Alternative 4 would be the same as under Alternative 3. These are described in Section 5.3.7.6.

5.4.7.7 ***Air Quality.*** Impacts to air quality under Alternative 4 would be the same as those described under Alternative 3 in Section 5.3.7.7.

5.4.7.8 ***Noise.*** Noise impacts under this alternative would be the same as those described under Alternative 3 in Section 5.3.7.8.

5.4.7.9 ***Visual Resources.*** The impacts to visual resources of Coyote Spring Valley under Alternative 4 would be the same as those described under Alternative 3 in Section 5.3.7.9.

5.4.7.10 ***Cultural Resources.*** Impacts to cultural resources would be the same as those described under Alternative 3 in Section 5.3.7.10.

AMERICAN INDIAN CULTURAL RESOURCES—This section describes the American Indian concerns associated with implementing Alternative 4, as summarized by the CGTO.

Defense Program—Under Alternative 4, American Indian cultural resources will not be impacted because no Defense Program activities are scheduled for Coyote Spring Valley.

Waste Management Program—Under Alternative 4, American Indian cultural resources will not be impacted because no Waste Management Program activities are scheduled for Coyote Spring Valley.

Environmental Restoration Program—No environmental restoration activities are planned for Coyote Spring Valley; therefore, no adverse impacts to American Indian resources are expected under Alternative 4.

Nondefense Research and Development Program—Under Alternative 4, it is expected that American Indian cultural resources at Coyote Spring Valley will be adversely impacted if a solar production facility is constructed and operated.

Work for Others Program—It is unlikely that Work for Others Program activities will be implemented in Coyote Spring Valley; therefore, no adverse impacts on American Indian resources are expected under Alternative 4.

5.4.7.11 Occupational and Public Health and Safety. Minimal occupational health and safety impacts are expected as a result of construction and operation of a Solar Enterprise Zone facility. All activities at the site would be conducted in compliance with Occupational Safety and Health Administration regulations and requirements.

5.4.7.12 Environmental Justice. The Environmental Justice impacts for the region of influence are the same as those discussed in Section 5.4.1.12.

American Indian Environmental Justice concerns include: (1) Holy Land violations, (2) perceived risks from radiation, and (3) cultural survival, especially access violations. There has not been a systematic study of these issues for the Coyote Spring Valley The CGTO maintains that past activities in the Coyote Spring Valley have impacted these American Indian Environmental Justice issues, especially Holy Land violations. This area was traditional lands for Southern Paiutes especially the Moapa Paiute Tribe. Any activities occurring near Indian reservations further precludes future opportunities for expansion and access to these lands for any purpose. The CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study before new activities are approved.

Program-by program responses are assessed in Section 5.1.1.12 and are not repeated here.

5.5 Unavoidable Adverse Effects

Unavoidable impacts constitute a substantial adverse change to existing environmental conditions that cannot be fully mitigated by implementing mitigation measures. The potential unavoidable adverse impacts that could arise from implementing the alternatives discussed in Chapter 5 are summarized below. Under Alternatives 1, 2, 3, and 4, the unavoidable adverse impacts of past underground nuclear testing activities would remain.

5.5.1 Alternative 1

The unavoidable adverse effects that would result from implementing Alternative 1 are presented in the following sections.

5.5.1.1 Nevada Test Site. All continuing programs and operations at the NTS would produce some environmental impacts that are not mitigated. The unavoidable adverse effects at the NTS are presented in this section.

UNDERGROUND TESTING—First and foremost among the unavoidable adverse effects are the impacts resulting from underground testing, both in terms of the magnitude of the impacts and their duration. As noted in the *Final Environmental Impact Statement, Nevada Test Site, Nye County, Nevada* (ERDA, 1977), other activities conducted at the NTS "for the most part are registered immediately and those effects are very small in comparison with the effects of underground nuclear testing." Under Alternative 1, the DOE would maintain the readiness and capability to conduct one or more underground nuclear weapons tests, if directed by the President, within the 10-year timeframe.

The major unavoidable effects of underground testing include the release of large quantities of radioactivity into the subsurface, the formation of new subsidence craters, and the generation of ground motion that might be felt outside the boundaries of the NTS.

The underground nuclear tests conducted under Alternative 1 would contaminate the subsurface with a large amount of short- and long-lived radionuclides. As discussed in Section 4.1.2, approximately 45,000 Ci/kt would remain in the subsurface 180 days after a test. The types of radionuclides produced are further discussed in Section 4.1.5.2, with tritium likely to be the most abundant radionuclide. Many of the other radionuclides would remain bound up in the melt glass in the event cavity. Some groundwater might be unavoidably contaminated if the shot cavity is below or intercepts the water table. The surface areas below which the contaminants are released are strictly controlled for safety and security reasons.

An underground nuclear test would also unavoidably disrupt the integrity of the subsurface geologic environment. Contamination might extend as far as five times the radii of the cavity from the shot point. Following the tests, subsidence craters often form because of the collapse of the geologic units. These impacts preclude the use of the geologic values inherent at the site for the long term. Subsidence craters alter the natural surface drainage and might locally increase soil erosion. Preferential drainage from subsidence craters down the rubble chimney to the shot cavity might occur and might contaminate the groundwater as a result, although little data exist to determine whether this is the case.

Ground motions accompanying underground nuclear explosions and some other tests conducted at the NTS are felt in Las Vegas, Nevada, and elsewhere in the surrounding region. Occasionally, ground motion from a larger test might cause nonstructural off-site damage, such as plaster cracks. A larger underground test could cause perceptible motion at off-site locations, particularly in high-rise structures in Las Vegas.

SUBCRITICAL EXPERIMENTS—Underground subcritical experiments would produce some physical effects on the geologic media. Approximately 2,314 m^3 (81,700 ft^3) would be disturbed each year in association with the conduct of up to four experiments. Irreversible effects would include the deposition of radiological material within and near the cavity mined in the subsurface. Approximately 20 acres of surface geologic media are currently disturbed in association with the Lyner Complex, where these experiments would be conducted.

LAND USE—Land uses would continue to be restricted at the underground test areas and at the radioactive waste management sites because of subsurface contamination and the presence of landfilled wastes, respectively. Revegetation of the surfaces as sections of the radioactive waste management sites are closed would create stable soils and better habitat. Decommissioning of some contaminated facilities would result in their demolition. If the facility is of historic significance, as many of them are, the loss of the structure would represent an unavoidable adverse impact. The loss would be partially mitigated by data gathered in accordance with the documentation requirements of the Historical American Buildings Survey/ Historical Engineering Records system of the National Park Service.

Airspace restrictions would continue to prohibit commercial and general aviation use. Because the NTS airspace is nearly surrounded by NAFR Complex restricted airspace, the added increment of limitation would be minor.

TRANSPORTATION—Vehicular traffic at the NTS would continue at about 1,890 average daily trips, while off-site trips would continue at a rate of about 2,480. The contribution of NTS-related traffic to the Las Vegas area's already unsatisfactory level of service on major roadways would be minimal. Though a small increment in emissions would not cause additional violations, mobile-source emissions would continue to contribute to the Las Vegas Valley's sometimes poor air quality.

GEOLOGY AND SOILS—The impact to geology and soils is presented in the discussion of the underground testing effects.

HYDROLOGY—The impacts to hydrology are discussed in the underground testing effects section.

BIOLOGICAL RESOURCES—Surface disturbance associated with remediation, construction, and testing programs would cause unavoidable impacts on habitat. Surface-disturbing activities may kill or displace wildlife such as small mammals, reptiles, and soil-dwelling invertebrates. If ground clearing for construction occurs during the breeding season, the eggs of birds in nests on the ground within a project area may be destroyed. Despite attempts to find and relocate desert tortoises before events occur that could threaten them, some tortoises, particularly juveniles, might be missed and could be killed by heavy equipment or vehicles. Training exercises that take place in desert tortoise habitat could result in tortoise mortality. Normal road traffic on the NTS has resulted in less than one tortoise mortality per year. This rate would be anticipated to continue. Wildfires in tortoise habitat would also constitute a source of potential tortoise mortality.

Sumps at the underground test area wells and open containers at the proposed Liquid Waste Treatment System Facility might attract some birds, bats, or mammals and cause their deaths through drowning or contamination. Although not studied, it is likely that losses would be very small. Developed areas of the NTS that have buildings, roads, storage lots, sewage lagoons, and other infrastructure would remain unavailable for natural habitat.

AIR QUALITY—Certain activities would produce PM_{10} and mobile-source emissions. Particulate matter less than 10 microns (PM_{10}) would be produced through surface disturbance. Particulates would not threaten Nye County's attainment, however, and would only contribute 0.03 percent of the County's total. Similarly, the PM_{10} contribution to Clark County's total would be very small.

VISUAL RESOURCES—Developed areas of the NTS that have buildings, roads, storage lots, sewage lagoons, and other infrastructure would continue in many cases to affect the viewshed. Project areas are initially accessed by graded gravel or dirt roads. If the projects become long-term, these roads would require upgrading, which would have increased impacts on habitat and visual resources.

CULTURAL RESOURCES—If cultural resources exist in an area too highly contaminated to survey or to conduct data recovery, then these resources may be lost when remediation disturbs the surface. This is an unavoidable impact. Impacts resulting from the illicit collection of artifacts by NTS workers may be partially mitigated through education, but it is likely that some workers would persist in such activities. This would be an unavoidable impact.

OCCUPATIONAL AND PUBLIC HEALTH AND SAFETY—Preparations for activities, such as the Big Explosives Experimental Facility and radioactive waste management sites, would result in new surface disturbances. Similarly, Environmental Restoration Program activities would disturb surface areas during the process of remediating industrial sites, plutonium-contaminated soils, Defense Nuclear Agency sites, and during the preparation of well pads for groundwater characterization. Approximately 1,890 acres on the NTS and 1,169 acres on the NAFR Complex would be affected. It should be noted, however, that the restoration of contaminated areas represents the mitigation of impacts that have resulted from past actions at the NTS. Thus, the unavoidable negative impacts associated with these actions would be counterbalanced by the reduction in the risk to human health caused by the contamination.

NOISE—While there would be no off-site impacts, temporary high noise levels would prevail in the proximity of operations like the Spill Test Facility, drilling operations, and the Big Explosives Experimental Facility during detonations.

5.5.1.2 Tonopah Test Range. Remediation of the environmental restoration sites and the Soils

Media Corrective Action Unit areas would result in removal of the vegetation and surface soil layers. This would produce PM_{10} at about 27 kilograms (kg) (60 pounds [lb]) per acre per year. Particulates and mobile-source emissions represent a minor degradation of the air quality. Vegetation and some animals would be destroyed, but no population's viability would be threatened. Visual resources would be unavoidably altered. Removal of vegetation and disturbed soils that differ from the surroundings in color or tone would become visually evident until revegetation had progressed. In some cases, however, vegetation types might be substantially different from that in surrounding areas if rehabilitation with local native species is unsuccessful. The change in species could produce areas that differ in color, tone, or texture from the surroundings. Since these areas are not located where they can be observed from public viewpoints and are classified as common scenery, the effects to visual resources would be minor.

GEOLOGY AND HYDROLOGY—Grading of the surface for restoration of the Soils Media Corrective Action Unit sites would cause some minor alteration of surface-water drainage patterns and some accelerated erosion until stabilization occurred. Minor use of groundwater for dust control and revegetation of the Soils Media Corrective Action Unit sites would be an unavoidable, but minor, impact.

NOISE—Local noise from heavy equipment and drill rigs would be an unavoidable, but minor, impact.

CULTURAL RESOURCES—In some cases, contamination levels might pose an unacceptable high risk to archeological surveyors. Any cultural resources in these areas would be lost to surface disturbance during remediations. The necessity of removing cultural resource materials that would otherwise be destroyed by remediation activities would represent a benefit to the present knowledge base. However, data recovered represent a benefit to the present knowledge base. However, materials removed from their context and studied with present technology would be unavailable for subsequent study using improved future technologies.

*5.5.1.3 **Project Shoal and Central Nevada Test Areas.*** Monitoring, characterization, and minor remediation would result in very limited surface disturbance, totaling about 54 acres. This would result from well drilling, minor excavation, and backfilling of the Project Shoal area emplacement shaft. Small amounts of PM_{10} and mobile-source emissions would be produced. Heavy equipment and drill rig operations would produce sporadic local noise.

Remediation activities might require data recovery from some cultural resource sites. Removing cultural resource materials that would otherwise be destroyed by these activities would represent a benefit to the present knowledge base. However, materials removed from their context and studied with present technology would be unavailable for subsequent study using improved future technologies. Impacts resulting from the illicit collection of artifacts by workers may be partially mitigated through education, but it is likely that some workers would persist in such activities. This would be an unavoidable impact.

Geologic media contaminated by the test would remain contaminated and would be unavailable for other uses. Groundwater in the vicinity of the shot cavity at each test area might be contaminated and, if so, would remain unavailable for any use.

5.5.2 Alternative 2

The unavoidable adverse effects resulting from implementation of Alternative 2 are discussed in the following sections.

5.5.2.1 Nevada Test Site. Closure of operations at the NTS would produce some environmental impacts that could not be mitigated, but significantly fewer than those under Alternative 1. Areas developed with buildings, roads, storage lots, sewage lagoons, and other infrastructure, except as slowly modified by deterioration, would remain unavailable for natural habitat and would continue to affect the viewshed in many cases. There would be minor production of PM_{10} from operations at the radioactive waste management sites as they finish operations and close, and from security patrols on unpaved roads. Monitoring and patrols would produce minor mobile-source emissions. These would be reduced when compared to Alternative 1. The facilities would no longer contribute to research and development, training, and employment levels.

Deterioration of unmaintained facilities and infrastructure would result in a need for major repairs or demolition and reconstruction if the site were to be reactivated at some future time.

Closure of the NTS would result in unavoidable adverse impacts to the regional socioeconomic conditions, including the loss of a substantial number of relatively high-paying jobs, increases in unemployment rates, loss of economic diversification, and out-migration of DOE and contractor employees and their families. These adverse effects would be relatively short term. Unrelated and economic community growth would be expected to overshadow these effects in time.

Preparations for closure activities at the radioactive waste management sites would result in minor new surface disturbances. At those sites where action would be necessary because of hazard or monitoring requirements, the Environmental Restoration Program would disturb some surface areas in the process of stabilizing or remediating industrial sites and Defense Nuclear Agency sites and in the preparation of well pads for groundwater monitoring. The total disturbance would be considerably less than with Alternative 1.

Subsurface contamination from historic underground nuclear tests would continue to restrict access to the underground zone surrounding the expended test for reasons of safety and security. The presence of subsidence craters would result in alteration of surface drainages and increased soil erosion. Most of the radionuclides are thought to be bound up in the melt glass surrounding the shot cavity. However, some groundwater would be unavoidably contaminated if the shot cavity was below, or intercepted, the water table. Preferential drainage from subsidence craters down the rubble chimney might occur and might contaminate the groundwater. The underground effects of this alternative vary little from those in Alternative 1 except that there would be no remediation of the underground testing areas other than possible long-term institutional controls.

Surface disturbances have caused unavoidable impacts on habitat that would not be restored under Alternative 2. Normal road traffic at the NTS has resulted in less than one tortoise mortality per year. This rate would be anticipated to decline with the decreased road traffic under Alternative 2. Wildfires in tortoise habitat would also constitute a source of potential tortoise mortality.

Shutdown of some wells would result in drying up of associated sumps that are presently perennial water sources. Wildlife that is dependent upon these sources and unable to relocate would be unavoidably lost.

Sumps at Underground Test Area wells would be temporarily wet during sampling activities and might attract some birds, bats, or mammals and cause their deaths through drowning or contamination.

Under Alternative 2, on-site average daily trips at the NTS would decrease by 1,868, while off-site trips would decrease by 760 in 1996, and by 1,440 in 2000 and 2005. The contribution of NTS-related traffic to the Las Vegas area's already unsatisfactory level of service on major roadways would be minimal. Though a small increment that would not cause additional violations, mobile-source emissions would continue to contribute to the Las Vegas Valley's sometimes poor air quality.

The NAFR Complex airspace restrictions would continue to prohibit commercial and general aviation use. Since the NTS airspace is nearly surrounded by NAFR Complex restricted airspace, the added increment of limitation would be minor.

Since the site would be locked up, the NTS would be unavailable for most human-oriented land use. Natural recovery would slowly progress, and ecosystems would begin to approach an equilibrium largely unaffected by humans.

Impacts resulting from the illicit collection of artifacts by workers may be partially mitigated through education, but it is likely that some workers would persist in such activities. This would be an unavoidable impact.

5.5.2.2 Tonopah Test Range. No Environmental Restoration Program projects would occur except at those sites that present an immediately hazardous situation. This would result in no change to present land use. Presently, applicable land-use restrictions would continue to limit the types of access and activities for which these lands could be used.

Affected soils would remain unavoidably contaminated, thereby restricting their use and potentially reducing their productive capacity. Under certain conditions, it would be possible for surface water to transport contamination to other areas and become contaminated itself. Similarly, under certain uncommon conditions, it would be possible for air to suspend and transport contamination to other areas.

5.5.2.3 Project Shoal and Central Nevada Test Areas. Geologic media contaminated by each of the tests would remain so and would be unavailable for other use. Groundwater in the vicinity of each shot cavity might be contaminated and, if so, would remain unavailable for any use. A contaminated mud pit at the Central Nevada Test Area would not be remediated.

5.5.3 Alternative 3

The unavoidable adverse effects resulting from implementation of Alternative 3 are discussed in the following sections.

5.5.3.1 Nevada Test Site. The unavoidable adverse environmental impacts addressed in this alternative would include those discussed for Alternative 1, as well as additional ones. New projects, which would include a facility for handling and storing weapons-usable fissile materials; expansion of the Device Assembly Facility; and a large, heavy-industrial facility, would increase the amount of land committed to other land use. Some additional disposal area would result from increased disposal of low-level waste, mixed waste, and sanitary waste. Since this disposal would occur within the boundaries of the sites already designated for waste disposal, it would not represent a significant new commitment of land use.

No specific location has been proposed for some of these projects, so it is not possible to identify impacts precisely. Therefore, a range of potential impacts is discussed in terms of how these differ from the impacts in Alternative 1.

Visual impacts would vary with location, but would generally be negligible because most of the NTS is not visible from public viewpoints, and much of the site has scenery common to the region.

An added increment of air contaminants would result both from construction and operations. The effect of one or more underground nuclear tests would be the same as under Alternative 1.

Most of the additional projects proposed would affect relatively limited surface areas. The notable exception would be the alternative energy proposal. Depending upon the technology or technologies pursued, the solar energy projects could affect up to 2,400 acres. If located in habitats containing plants of limited distribution, the viability of the population could be threatened. Increased road traffic, in addition to habitat destruction and crushing because of construction activity, would result in increased tortoise mortality. The overall doubling of traffic on the NTS would likely produce tortoise mortality of about two per year.

Increased groundwater pumping at the NTS might have the potential to reduce discharge at regional springs such as Devils Hole and Ash Meadows. Devils Hole harbors a population of pupfish, which is very sensitive to falling water levels. Ash Meadows has a great number of sensitive species of fish, invertebrates, and plants dependent upon its springs.

Project areas would initially be accessed by graded gravel or dirt roads. Traffic impacts resulting from the construction of new facilities would peak during the construction phase. If the projects become long term, these roads would require upgrading that would create additional visual, erosional, and habitat impacts.

Average daily trips on the NTS would be about 13,300, an increase of 11,400 over Alternative 1. Additional off-site average daily trips over Alternative 1 would range from 210 in 1996 to a high of 1,520 in 2000. This would not cause any air-quality violations. The increased traffic would add a small increment to the Las Vegas area's freeways and arterials, which are anticipated to be at unacceptable levels of service without any NTS activity. This would also add a small increment of pollution to the sometimes poor air quality of the Las Vegas Valley.

Because of the presence of a doubled workforce, an increase in vandalism to cultural resource sites would occur. Despite efforts to control workers' impacts on cultural resources by training, site avoidance through relocation of activities, or data recovery, some individuals would persist in vandalizing sites. This is, to some degree, an unavoidable impact.

Decommissioning of some contaminated facilities would result in their demolition. If the facility is of historic significance, as many of them are, the loss of the structure would represent an unavoidable adverse impact. The loss would be partially mitigated by data gathered in accordance with the documentation requirements of the Historical American Buildings Survey/Historical American Engineering Records system of the National Park Service.

If cultural resources exist in an area too highly contaminated to survey or to conduct data recovery, then these resources may be lost when remediation disturbs the surface. This is an unavoidable impact. Impacts resulting from the illicit collection of artifacts by NTS workers may be partially mitigated through education, but it is likely that some workers would persist in such activities. This would be an unavoidable impact.

5.5.3.2 Tonopah Test Range. Risk to the public would remain the same as that discussed under Alternative 1.

Remediation of the Environmental Restoration Program sites and the Soils Media Corrective Action Unit areas would unavoidably result in removal of the vegetation and surface soil layers. This would produce PM_{10} at a rate of 27 kg (60 lb) per acre per year in the case of the Environmental Restoration Program sites. Particulates and mobile-source emissions would represent a degradation of air quality, though minor in this case. Vegetation and some animals would be destroyed, but no population's viability would be threatened. Visual resources would be unavoidably altered. Removal of vegetation and disturbance of soils that differ from the surroundings in color or tone would become visually evident until recovery had progressed. In some cases, however, vegetation types might be substantially different from that in surrounding areas if rehabilitation with local native species is unsuccessful. The change in species could produce areas that differ in color, tone, or texture from the surroundings. Since these areas are not located where they can be observed from public viewpoints and are classified as common scenery, the effects to the visual resource would be minor. Grading of the surface for restoration of the Soils Media Corrective Action Unit sites would cause some minor alteration of surface-water drainage patterns and some accelerated erosion until stabilization occurred. Minor use of groundwater for dust control and revegetation of the Soils Media Corrective Action Unit sites would be an unavoidable, though minor impact.

Local production of noise from heavy equipment and drill rigs would be a minor impact.

The necessity of removing cultural resource materials that would otherwise be destroyed by remediation activities would represent a benefit to the present knowledge base. However, materials removed from their context and studied with present technology would be unavailable for subsequent study using improved future technologies. In some cases, contamination levels might pose an unacceptably high risk to archeological surveyors. Any cultural resources in these areas would be lost to surface disturbance during remediation.

5.5.3.3 Project Shoal and Central Nevada Test Areas. Monitoring, characterization, and any minor remediation would result in very limited surface disturbance. This would result from well drilling, minor excavation, and backfilling of the Project

Shoal Area emplacement shaft. Small amounts of PM_{10} and mobile-source emissions would be produced. Heavy equipment and drill rig operation would produce temporary local noise. Drilling sumps would pose a minor threat to some animals. The level of habitat recovery would depend upon the degree to which native plants could be reestablished.

Remediation activities might require data recovery from some cultural resource sites. Removing cultural resource materials that would otherwise be destroyed by these activities would represent a benefit to the present knowledge base. However, materials removed from their context and studied with present technology would be unavailable for subsequent study using improved future technologies.

Geologic media contaminated by the test would remain contaminated and would be unavailable for other uses. Groundwater in the vicinity of the shot cavity might be contaminated and, if so, would remain unavailable for any use.

5.5.3.4 Eldorado Valley. Land used for this proposal is designated for renewable energy development and would be committed to a single use. Depending on where in Eldorado Valley the project is sited, existing land use would be affected to a greater or lesser degree. Some of the more intensive present uses of the playa are recreational, including land sailing, model aircraft flying, ultralight operations, off-highway vehicle use, and camping. Areas off the playa are used for bird hunting and off-highway vehicle races. All these uses would be incompatible within the area developed for solar generation; those uses that disturb the surface would probably be considered undesirable in the vicinity of collectors where they cause airborne particulates. The loss of these opportunities would be an unavoidable adverse impact.

Some power and natural gas line construction would be necessary. This construction would create additional access roads in the region. Access roads would cause habitat fragmentation and adverse effects to tortoises and other species. Fragmentation would reduce or prevent movement and consequently would affect gene-pool flow in less mobile species like tortoises. Construction of the projects would cause an increase in traffic in the area with potential to increase tortoise mortality on the highways and roads and on the construction sites themselves. A total of up to 2,400 acres of habitat could be lost to project construction, and approximately 42 acres may be lost to power and pipe line construction. A similar amount of soils would be disturbed.

The site lies within the Class B airspace (Terminal Control Area) for McCarran International Airport. Glare from the collectors could affect aircraft operations. Should this occur, operations at the Solar Enterprise Zone facility would have to be altered to lessen the effect, which would adversely affect its production, or airport operations would have to be modified to avoid this conflict.

Although the scenery is common to the region, the site is viewed by large numbers of the public traveling Highway 95 and engaging in recreational pursuits. There are also three U.S. Bureau of Land Management Wilderness Study Areas within the site's viewshed. Construction of the solar facilities and associated infrastructure would create considerable change in the visual environment of the valley.

Surface disturbance and construction would result in the production of PM_{10} and mobile-source emissions. Local noise levels would be present during construction. Recovery of cultural resource data would be a short-term benefit, but would reduce the opportunity to gain greater data recovery using enhanced future technologies.

5.5.3.5 Dry Lake Valley. Land used for this proposal would be committed to a single use. Some areas of the valley are used for occasional off-highway vehicle races. This use would be incompatible within the area developed for solar generation, and because it disturbs the surface, it would probably be considered undesirable in the vicinity of collectors because of airborne particulates. The loss of vehicle race opportunities would be an unavoidable adverse impact.

A limited amount of power and natural gas line construction would be necessary. A proposal exists to construct a water line to Coyote Spring Valley to support the facility. This construction would create additional access roads in the region. Access roads would cause habitat fragmentation and adverse effects to tortoises and other species. Fragmentation would reduce or prevent movement and consequently would affect gene-pool flow in less mobile species like tortoises. The water line has the potential to affect a large area of tortoise habitat in the area to the north along the west side of the Arrow Canyon Range. Construction of the projects would cause an increase in traffic in the area with potential to increase tortoise mortality on the highways and roads and on the construction sites. A total of 2,400 acres of habitat could be lost to project construction, and approximately 560 acres may be lost to power and pipe line construction.

Depending on the quantity of water involved and the source of that water, the use of groundwater from Coyote Spring Valley would have the potential to affect discharge at Muddy Spring, which has a population of threatened Moapa dace.

The site lies within the Class B (Terminal Control Area) for McCarran International Airport and Nellis Air Force Base. Glare from the collectors could affect aircraft operations. In that event, either the solar facility would have to alter its operations to lessen the effect, which would adversely affect its production, or the airfields would have to modify their operations to avoid conflict.

Although the scenery is common to the region, the site is viewed by large numbers of the public traveling the highways and engaging in recreational pursuits. Construction of the solar facilities and associated infrastructure would have a large impact on the visual environment.

Surface disturbance and construction would result in the production of PM_{10} and mobile-source emissions. Local noise levels would be present during construction.

Recovery of cultural resource data would be a short-term benefit, but would reduce the opportunity to gain greater data recovery using enhanced future technologies.

5.5.3.6 Coyote Spring Valley. Land used for this proposal would be committed to a single use. Some areas of the valley are lightly used for dispersed recreation. This use would be incompatible within the area developed for solar generation. The loss of the opportunities would be a minor unavoidable adverse impact.

Substantial power and natural gas line construction would be necessary. A water line would have to be constructed to support the facility. This construction would create additional access roads in the region. Access roads would cause habitat fragmentation and adverse effects to tortoises and other species. Fragmentation would reduce or prevent movement and consequently would affect gene-pool flow in less mobile species like tortoises. Construction of the projects would cause an increase in traffic in the area with potential to increase tortoise mortality on the highways and roads, and on the construction sites. A total of 2,400 acres of habitat could be lost to project construction, and approximately 960 acres may be lost to power and pipe line construction. The habitat in Coyote Spring Valley has been designated by the U.S. Bureau of Land Management as critical habitat for the threatened desert tortoise. Specific project locations are necessary before a determination can be made regarding the potential to adversely affect any other sensitive species present in the valley.

Depending on the quantity of water involved, the use of groundwater from Coyote Spring Valley would have the potential to affect discharge at Muddy Spring, which has a population of threatened Moapa dace. The use of groundwater might also have the potential to affect local springs in the valley.

Scenic quality of the site has been designated Class B. The site is viewed by the public traveling U.S. Highway 93 and engaging in recreational pursuits. There are also three U.S. Bureau of Land Management Wilderness Study Areas within the site's viewshed. Construction activities of the solar facilities and associated infrastructure would greatly change the landscape character of Coyote Spring Valley and have an adverse impact on the visual environment.

Recovery of cultural resource data would be a short-term benefit, but would reduce the opportunity to gain greater data recovery using enhanced future technologies.

5.5.4 Alternative 4

The unavoidable adverse effects resulting from the implementation of Alternative 4 are discussed in the following sections.

5.5.4.1 Nevada Test Site. Continued operations at the NTS, even without the Defense Program, would produce some environmental effects that remain unmitigated. Areas would remain developed in buildings, roads, storage lots, sewage lagoons, and other infrastructure, as in Alternative 1, and would be unavailable for natural habitat. In addition, development of a Solar Enterprise Zone facility would affect a land base of up to 2,400 acres. This may substantially increase the impact on public viewsheds as the solar site proposed for Area 22 may be visible from U.S. Highway 95. Increased public access for museum visits, road races, special hunts, and other recreation would make substantially more area of the NTS visible to increasing numbers of visitors, thus increasing the impact of existing or new development on visual resources. However, much of the scenery in the region is common. Some operations would produce PM_{10} and mobile-source emissions.

Underground test areas would unavoidably remain contaminated and result in continued restricted access to the subsurface. Construction sites and subsidence craters would result in altered surface drainage and increased soil erosion. Most of the radionuclides are thought to be bound up in the melt glass surrounding the shot cavity. However, some groundwater would be unavoidably contaminated when the shot cavity was below, or intercepted, the water table. Preferential drainage from craters down the rubble chimney might occur and might contaminate the groundwater as a result. There would not be the small additional increment of impact with this alternative as no further underground nuclear tests would occur.

Surface disturbance would cause unavoidable impacts on habitat. While no additional increment would ensue because of the Defense Program, a Solar Enterprise Zone facility would require a substantial acreage. If the Solar Enterprise Zone facility were located in an area that supports sensitive species, a threat to their viability would exist. Reduced habitat and increased risk of crushing during construction and on roads would unavoidably affect tortoises if the sites were located in their habitat. Increased groundwater use for the Solar Enterprise Zone efforts might adversely affect discharge at regional springs. Reductions at Devils Hole and Ash Meadows could have a large impact on the numerous sensitive species depending on the water levels and discharge rates.

Some mortality might occur to birds, bats, and other mammals through drowning or contamination at the Underground Test Area well sumps and open tanks at the Liquid Waste Treatment System Facility.

Particulate and mobile-source emissions would not threaten attainment in Nye County. They would not cause additional violations in Clark County, but would add a small increment to Clark County's existing air-quality problems.

Average daily trips offsite would fall by 330 relative to Alternative 1. This would cause an additional small increment to the unsatisfactory levels of service on key roadways in the Las Vegas Valley.

Termination of Defense Program activities at the NTS would result in unavoidable adverse impacts to the regional socioeconomic conditions including the loss of 4,625 (1,496 direct and 3,129 secondary) jobs in 1996 and 7,981 (2,748 direct and 5,233 secondary) in 2000 and 2005. These adverse effects would be relatively short-term, and economic and natural growth would be expected to compensate for these effects over time.

Because of the presence of landfill wastes, some land uses would continue to be restricted at the radioactive waste management sites and the solid waste landfills.

If cultural resources exist in an area too highly contaminated to survey or to conduct data recovery, then these resources may be lost when remediation disturbs the surface. This is an unavoidable impact. Impacts resulting from the illicit collection of artifacts by NTS workers may be partially mitigated through education, but it is likely that some workers would persist in such activities. This would be an unavoidable impact. Increased numbers of workers and other staff during portions of the period analyzed in this EIS would result in an unavoidable adverse impact on cultural resources. Decommissioning of some contaminated facilities would result in their demolition. If the facility is of historic significance, as many of them are, the loss would be partially mitigated by data gathered in accordance with the documentation requirements of the Historical American Buildings Survey/Historical American Engineering Record system of the National Park Service.

5.5.4.2 ***Tonopah Test Range***. Remediation of the Environmental Restoration Program sites and the Soils Media Corrective Action Unit areas would unavoidably result in removal of the vegetation and surface-soil layers. This would produce PM_{10} in the case of the Environmental Restoration Program sites. Particulates and mobile-source emissions would represent a degradation of the air quality, though minor in this case. Vegetation and some animals would be destroyed, but no population's viability would be threatened. Visual resources would be unavoidably altered. Removal of vegetation and disturbance of soils that differ from the surroundings in color or tone would become evident until recovery had progressed. In some cases, however, vegetation types might be substantially different from that in surrounding areas if rehabilitation with local native species were unsuccessful. The change in species could produce areas that differ in color, tone, and/or texture from the surroundings. Since these areas are not located where they can be observed from public viewpoints and are classified as common scenery, the effects to the visual resource would be minor.

Grading of the surface for restoration of the Soils Media Corrective Action Unit sites would cause some minor alteration of surface-water drainage patterns and some accelerated erosion until stabilization occurred. Minor use of groundwater for dust control and revegetation of the Soils Media Corrective Action Unit sites would be an unavoidable, though minor impact.

Local noise from heavy equipment and drill rigs would be a minor impact.

The necessity of removing cultural resource materials that would otherwise be destroyed by remediation activities would represent a benefit to the present knowledge base. However, materials removed from their context and studied with present technology would be unavailable for subsequent study using improved future technologies. In some cases, contaminated lands might pose an unacceptably high risk to archeological surveyors. Any resources in these areas would be lost to surface disturbance during remediation.

5.5.4.3 ***Project Shoal and Central Nevada Test Areas***. Monitoring, characterization, and any minor remediation would result in very limited surface disturbance. This would result from well drilling, minor excavation, and backfilling of the Project Shoal Area emplacement shaft. Small amounts of PM_{10} and mobile-source emissions would be produced. Heavy equipment and drill rig operations would produce temporary local noise.

Well drilling and characterization activities might require data recovery from some cultural resource sites. Removing cultural resource materials that would otherwise be destroyed by these activities would represent a benefit to the present knowledge base. However, materials removed from their context and studied with present technology would be unavailable for subsequent study using improved future technologies. Impacts resulting from the illicit collection of artifacts by workers may be partially mitigated through education, but it is likely that some workers would persist in such activities. This would be an unavoidable impact.

Geologic media contaminated by the tests would remain contaminated and would be unavailable for other uses. Groundwater in the vicinity of the shot cavity might be contaminated and, if so, would remain unavailable for any use.

5.5.4.4 Eldorado Valley. Land used for this proposal would be designated for renewable energy development and would be committed to a single use. Depending on where in Eldorado Valley the project is sited, existing land uses would be affected to a greater or lesser degree. Some of the more intensive present uses of the playa are recreational, including land sailing, model aircraft flying, ultralight operations, off-highway vehicle use, and camping. Areas off the playa are used for bird hunting and off-highway vehicle races. All these uses would be incompatible within the area developed for solar generation, and those uses that disturb the surface would probably cause airborne particulates. This would be considered undesirable in the vicinity of solar collectors. The loss of these opportunities would be an unavoidable adverse impact.

Some power and natural gas line construction would be necessary. This construction would create additional access roads in the region. Access roads would cause habitat fragmentation and adverse effects to tortoises and other species. Fragmentation would reduce or prevent movement and, consequently, would affect gene-pool flow in less mobile species like tortoises. Construction of the projects would cause an increase in traffic in the area with the potential to increase tortoise mortality on the highways and roads and on the construction sites themselves. A total of 2,400 acres of habitat could be lost to project construction, and an unknown additional amount would be lost to power and pipe line construction.

The site lies within the Class B airspace (Terminal Control Area) for McCarran International Airport. Glare from the solar collectors could affect aircraft operations. Should this occur, operations at the Solar facility would have to be altered to lessen the effect, which would adversely affect its production, or airport operations would have to be modified to avoid this conflict.

Although the scenery is common to the region, the site is viewed by large numbers of the public traveling Highway 95 and engaging in recreational pursuits. There are also three U.S. Bureau of Land Management Wilderness Study areas within the site's viewshed. Construction of the solar facilities and associated infrastructure would create considerable change in the visual environment of the valley.

Surface disturbance and construction would result in the production of PM_{10} and mobile-source emissions. Local noise levels would be present during construction.

Recovery of cultural resource data would be a short-term benefit, but would reduce the opportunity to gain greater data recovery using enhanced future technologies. Construction of roads in areas proposed for solar generating facilities may increase access to archaeologically sensitive areas. This could result in unavoidable impacts such as vandalism and illicit artifact collecting.

5.5.4.5 Dry Lake Valley. Land used for this proposal would be committed to a single use. Some areas of the valley are used for occasional off-highway vehicle races. These races would be incompatible within the area developed for solar generation because the races disturb the surface. The loss of vehicle race opportunities would be an unavoidable adverse impact.

A limited amount of power and natural gas line construction would be necessary. A proposal exists to construct a water line to Coyote Spring Valley to support the facility. This construction would create additional access roads in the region. Access roads would cause habitat fragmentation and adverse effects to tortoises and other species. Fragmentation would reduce or prevent movement and, consequently, would affect gene-pool flow in less mobile species like tortoises. The water line has the potential to affect a large area of tortoise habitat in the area to the north along the west side of the Arrow Canyon Range. Construction of the projects would cause an increase in traffic in the area with potential to increase tortoise mortality on the highways and roads and on the construction sites. A total of 2,400 acres of habitat could be lost to project construction; and 560 acres would be lost to power and pipe line construction. Depending upon the quantity of water involved, the use of groundwater from Coyote Spring Valley would have the potential to affect discharge at Muddy Spring, which has a population of threatened Moapa dace.

The site lies within the Class B airspace (Terminal Control Area) for McCarran International Airport and Nellis Air Force Base. Glare from the collectors could affect aircraft operations. Should this occur, operations at the Solar Enterprise Zone facility would have to be altered to lessen the effect, which would adversely affect its production, or airport operations would have to be modified to avoid this conflict.

The scenery is common to the region, and the site is viewed by the public traveling Highway 93 and Interstate 15 and engaging in recreational pursuits. However, construction of solar facilities and associated infrastructure would have a minor impact on the visual environment because of extensive man-made modifications to the area.

Recovery of cultural resource data would be a short-term benefit, but would reduce the opportunity to gain greater data recovery using enhanced future technologies. Construction of roads in areas proposed for solar generating facilities may increase access to archaeologically sensitive areas. This could result in unavoidable impacts such as vandalism and illicit artifact collecting.

5.5.4.6 Coyote Spring Valley. Land used for this proposal would be committed to a single use. Some areas of the valley are lightly used for dispersed recreation. This use would be incompatible within the area developed for solar generation. The loss of recreation opportunities would be a minor unavoidable adverse impact.

Substantial power and natural gas line construction would be necessary. A water line would have to be constructed to support the facility. This construction would create additional access roads in the region. Access roads would cause habitat fragmentation and adverse effects to tortoises and other species. Fragmentation would reduce or prevent movement and, consequently, would affect gene-pool flow in less mobile species like tortoises. Construction of the projects would cause an increase in traffic in the area with potential to increase tortoise mortality on the highways and roads and on the construction sites themselves. A total of 2,400 acres of habitat could be lost to project construction, and 960 acres would be lost to power and pipe line construction. This habitat in Coyote Spring Valley has been designated by the U.S. Bureau of Land Management as critical habitat for the threatened desert tortoise. Specific project locations are necessary before a determination can be made regarding the potential to adversely affect any sensitive species present in the valley. Depending on the quantity of water involved, the use of groundwater from Coyote Spring Valley would have the potential to affect discharge at Muddy Spring, which has a population of threatened Moapa dace. The use of groundwater might also have the potential to affect local springs in the valley.

Scenic quality of the site has been designated Class B and the site is viewed by the public traveling Highway 93 or engaging in recreational pursuits. There are also three U.S. Bureau of Land Management Wilderness Areas within the site's viewshed. Construction activities, and the solar activities and associated infrastructure would greatly change the landscape character of Coyote Spring Valley and have an adverse impact on the visual environment.

Recovery of cultural resource data would be a short-term benefit, but would reduce the opportunity to gain greater data recovery using enhanced future technologies.

5.6 Relationship of Short-Term Uses and Long-Term Productivity

Short-term uses are defined as those that take place during the 10-year timeframe covered in this EIS analysis. Long-term is defined as the time period beyond the 10-year timeframe of the NTS EIS analysis. If the resource cannot be rehabilitated to its most productive long-term use within a 10-year timeframe, then it is considered in this analysis to be impaired for the long term.

5.6.1 Alternative 1

The relationship of short-term use and long-term productivity under Alternative 1 is discussed in the following sections.

5.6.1.1 Nevada Test Site. The majority of effects on long-term productivity would result from the continuation of present land use and from future land use associated with Alternative 1. Developed areas like Mercury, forward area camps, drill yards, roads, power lines, and waste disposal sites would continue to be largely unproductive ecologically, but would continue long-term contributions through their support of research and development and training. Operating waste disposal sites would contribute to long-term productivity through the remediation of other areas and their return to productive uses. The Big Explosives Experimental Facility would result in surface clearing on 30 acres, which could be remediated and made available for most uses upon cessation of operations. The Big Explosives Experimental Facility's 7,080-acre buffer area would be unavailable for human use, but the ecological productivity should remain largely intact.

An underground nuclear test would result in the subsurface being unavailable for the long term. Following an underground nuclear test, the surface 40 acres could be available for limited uses unless cavity collapse has not occurred. Underground subcritical experiments would result in the mined cavity being unavailable for the long term. Following subcritical experiments, the land surface would be unaffected and unrestricted. Similarly, the Area 3 and Area 5 Waste Management Program sites would have an area of 34 acres of disturbed surface and an area of 821 acres of buffer zones. The disturbed areas would be restricted from subsurface access for the long term, and the surface would be restricted from most uses. Rehabilitation of the surface following closure would restore ecological productivity unless rock armor is used in closure. Rock armor would result in a sterile surface for the long term. The area in the buffer zones would have some restrictions on surface uses designed to prevent intrusion into the buried waste. Because it would likely remain undisturbed, its ecological productivity would remain unimpaired for the long term. Eighty acres would be disturbed for the long term in conjunction with weapons assembly/disassembly/interior storage.

Geologic resources and groundwater in the vicinity of the underground nuclear test would have long-term impairment of productivity. Disruption and contamination would mean the unavailability of the geologic resources in the vicinity of the shot cavity for the long term. While the effect on groundwater of underground tests detonated in or near the water table remains to be determined, any contamination in excess of regulatory levels would mean the long-term unavailability of the affected water. There also exists the possibility that collapse craters and their rubble chimney would provide preferential pathways from the surface to the vicinity of shot cavities, which could result in groundwater contamination.

Previous groundwater use in Yucca Flat has exceeded the perennial yield. However, during 1984 to 1994, water levels rose 26 m (85 ft), suggesting that reductions in the water table might not be long term. Activities within this alternative would disturb nearly 9,900 acres, most of which has been previously disturbed.

Depending on cleanup levels, the Environmental Restoration Program would result in the disturbance of up to 9,800 acres through soil removal to remediate contaminated areas. Where removed soil would be disposed of, its productivity would be lost for the long term. Revegetation would be implemented where environmental conditions favor success, which would enhance long-term productivity. Where site conditions are unfavorable, slow natural rehabilitation would impair long-term ecological productivity. Site remediation would make these areas available for other uses, thus the short-term effects of site remediation would ultimately result in enhanced long-term productivity.

Operations of the Liquid Waste Treatment System and the Spill Test Facilities might produce some limited short-term wildlife mortality. Long-term productivity would be enhanced by the remediation at the Liquid Waste Treatment System. It would contribute to understanding the effects of underground testing on the groundwater. Similarly, what is learned through use of the Spill Test Facility would assist in mitigating the environmental effects of accidental hazardous substance releases.

Visual resources would be altered by the surface manifestations of underground tests. Some Environmental Restoration Program activities and waste management sites could result in surface disturbance. Surface cratering and the slow recovery of vegetation in arid environments would cause a long-term visual resource effect. Most of the NTS is comprised of common scenery and is not visible from public viewpoints. This reduces the impact of the long-term effects.

Cultural resources that cannot be avoided by a project would be subjected to data recovery in order to mitigate the impact of the activity on their values. While this enhances the short-term knowledge base, it also removes some of the potential for an even greater recovery of information to be gained through future studies using improved technology. Vandalism and illicit artifact collecting within archaeologically sensitive areas are likely to cause a negative impact to cultural resources over the long term.

5.6.1.2 Tonopah Test Range. Surface disturbance for both the Soils Media Corrective Action Unit and the Environmental Restoration Program industrial site remediation would produce short-term disruption of the ecosystem and soils. Ecological productivity would be reduced for the short term, but would probably be enhanced over the long term because of the removal of contamination. Variables would be the amount of soil removed and the ultimate success in reestablishing native vegetation species. There would be some short-term alteration of surface-water drainage patterns. Some PM_{10} would be produced in the short term from the Environmental Restoration Program sites. Temporary mobile-source emissions would be produced, but there would be no long-term effects.

Visual resources would be affected. The slow natural recovery of vegetation in arid environments would cause a long-term visual effect.

Noise associated with remediation heavy equipment and drill rigs would cause local short-term noise and no long-term effects.

Recovery of cultural resource data would be a short-term benefit, but would reduce the opportunity to gain greater data recovery using enhanced future technologies. Vandalism and illicit artifact collecting within archaeologically sensitive areas are likely to cause a negative impact to cultural resources over the long term.

5.6.1.3 Project Shoal and Central Nevada Test Areas. Short-term effects would be noise, minor local air-quality effects, and a very minor localized decline in ecological productivity at the sites of surface disturbance. Restoration of the drilling mud pits at the Central Nevada Test Area and other areas of contamination would increase the long-term ecological productivity. The long-term effect would be to open the area to a greater variety of land use since monitoring and surface remediation would assure that no accessible contamination is present.

5.6.2 Alternative 2

The relationship of short-term uses and long-term productivity under Alternative 2 are discussed in the following sections.

5.6.2.1 Nevada Test Site. Short-term use would consist primarily of shutdown activities, which would be similar to the levels of Waste Management and Environmental Restoration Program activities proposed in Alternative 1. However, Alternative 2 shutdown activities would be more limited in scope and duration. Consequently, they pose less potential to impact the site's resources than Alternative 1.

Short-term "nonuse" of the site would mean that developed areas would remain standing and undergo slow decay. Decay of some historic structures could result in the loss of data relating to the theme of nuclear development over the long term. Only those limited facilities needed to support security and long-term environmental monitoring would be maintained. The remaining industrial areas, e.g., Mercury and the forward area camps, would slowly regain their ecological productivity as they physically decline. Compared to Alternative 1, some recovery of ecological productivity would occur. However, the lack of maintenance would result in either extensive repairs or demolition and reconstruction should the site be reactivated.

Waste disposal would result in some minor amount of land being committed to long-term use as a disposal site. Alternative uses would be very limited because of the need to protect the subsurface from intrusion.

Environmental Restoration Program activities would cease except for those sites that are immediately hazardous. This would mean that over the long term, contaminants could slowly spread in soils, geologic media, and groundwater, thus affecting much larger areas.

Migration of uncontained contaminants over the long term could cause restrictions on land and groundwater use in surrounding lands, primarily the NAFR Complex. Some presently contaminated areas would remain contaminated and would be of restricted use for the long term. Lined drilling sumps that partially fill with precipitation would continue to cause some drowning of animals and birds.

Clark County unemployment would rise an additional 3.2 percent under Alternative 2, while Nye County rates would rise an additional 6.1 percent in 1997 when compared to Alternative 1. Similarly, housing vacancy rates for Clark County would rise from 7.9 percent with Alternative 1 to 8.5 percent with Alternative 2 in 1998. Nye County vacancy rates would rise from 16.2 percent to 17.8 percent in 1998. Over the long term, growth in these areas would compensate for these losses. The lasting effect would be the out-migration of technical and engineering personnel and the loss of significant employment opportunities for graduates of Nevada's universities.

Vastly reduced groundwater pumping would result in aquifer recovery and enhanced storage. Long-term effects on springs in regional discharge areas might include maintenance of current flows or enhanced flows.

Some continuing effects on biological resources would exist because of shutoff of water sources that support populations of birds and animals. Tortoise mortality would decline because of limited traffic on roads. Potential public health risk from tritium in the groundwater would remain the same as under Alternative 1.

5.6.2.2 Tonopah Test Range. No short-term effects would accumulate under Alternative 2. The chief potential long-term effects would depend on the amount of migration or spreading that would occur from those sites that are presently contaminated. Migration could affect potential future land-use options and soil productivity. Remediation would be economically unfeasible if contaminants migrate.

5.6.2.3 Project Shoal and Central Nevada Test Areas. There would be no short-term effects. Some limited use of the land could be viable for the long term; access to the subsurface would remain restricted.

There would be no short-term need to conduct data recovery at cultural resource sites; therefore, the resource sites would remain available to future researchers. They might be able to obtain greater data recovery because of enhanced future technology. These resource sites would, however, remain vulnerable to vandalism and the consequent loss of all data.

5.6.3 Alternative 3

The relationship of short-term uses and long-term productivity under Alternative 3 are discussed in the following sections.

5.6.3.1 Nevada Test Site. The majority of effects on long-term productivity would result from the continuation of present land uses and from future land uses associated with this alternative. Developed areas (e.g., Mercury, forward area camps, drill yards, roads, power lines, and waste disposal sites) would continue to be largely unproductive ecologically, but would continue long-term contributions through their support of research and development, and training. A large area would be unproductive ecologically within the alternative energy sites. However, the energy produced would be clean and would prevent the occurrence elsewhere of the more significant impacts associated with other forms of energy production, such as fossil, fuels, hydropower, and nuclear. Thus, alternative energy production would create a substantial long-term benefit. Operation of waste disposal sites would contribute to long-term productivity through the remediation of other areas and their return to productive uses. The Big Explosives Experiment Facility would result in surface clearing on 30 acres, which could be remediated and made available for most uses upon cessation of operations. Its 7,000-acre buffer area would be unavailable for human use, but the ecological productivity should remain largely intact. Underground nuclear tests would result in the subsurface being unavailable for the long term. The surface above an underground test could be available for limited use unless cavity collapse has occurred at the underground test. Underground subcritical experiments would result in the mined cavity being unavailable for the long term. Following subcritical experiments, the land surface would be unaffected and unrestricted. The Waste Management Program sites would be restricted from subsurface access for the long term. Rehabilitation of the surface upon closure would result in restored ecological productivity unless rock armor is used in closure. Construction of a large, heavy-industrial facility, expansion of the Device Assembly Facility, facilities for the handling and storage of weapons-usable fissile materials, and advanced hydrodynamic testing would take land and habitat out of production for the long term. The area involved would be very small compared to the size of the NTS and would have limited effect.

Geologic resources and groundwater would have long-term impairment on productivity with an underground nuclear test. Disruption and contamination would cause the unavailability of geologic resources in the vicinity of the shot cavity for the long term. While the effect on groundwater of underground tests detonated in or near the water table remains to be determined, any contamination in excess of regulatory levels would mean the long-term unavailability of the affected water. There also exists the possibility that collapsed craters would provide preferential pathways down rubble chimneys from the surface to the vicinity of shot cavities. This could result in groundwater contamination.

Previous groundwater use in Yucca Flat has exceeded the perennial yield. However, during 1984 to 1994, water levels rose 26 m (85 ft), suggesting that reductions in the water table might not be long term. This alternative would result in substantially greater groundwater use, which might result in long-term effects on the aquifer.

Depending on cleanup levels, Environmental Restoration Program activities would result in the disturbance of up to 9,800 acres through soil removal to remediate contaminated areas. The productivity of removed soil would be lost for the long term. Revegetation would be implemented where environmental conditions favor success. Success would enhance long-term productivity. Where site conditions are unfavorable, slow natural rehabilitation would impair long-term ecological productivity. Site remediation would make these areas available for other uses. The short-term effects of remediation would ultimately result in enhanced long-term productivity.

Operations of the Liquid Waste Treatment Facility and the Spill Test Facility might produce some limited short-term wildlife mortality; long-term productivity would be enhanced by the remediation that the Liquid Waste Treatment System would support. Operations would contribute to understanding the effects of underground testing on the groundwater. Similarly, what is learned through use of the Spill Test Facility would assist in mitigating the environmental effects of accidental hazardous substance releases.

Visual resources would be affected by underground tests. Some Environmental Restoration Program activities and waste management sites could result in surface disturbance. Surface cratering and the slow recovery of vegetation in arid environments would cause a long-term visual resource effect. Most of the NTS is comprised of common scenery and is not visible from public viewpoints. This would reduce the impact of the long-term effects.

Cultural resources that cannot be avoided by a project are subjected to data recovery. While this enhances the short-term knowledge base, it also removes some of the potential for an even greater recovery of information to be gained through future studies using improved technology. Implementation of the new projects proposed in Alternative 3 would result in the need to conduct surveys over large areas and to recover the data from these sites. This would represent an increase in the impact of Alternative 3 on cultural resources as compared to Alternative 1. Vandalism and illicit artifact collecting within archaeologically sensitive areas are likely to increase as compared to Alternatives 1 and 2. This could result in a cumulative negative impact to cultural resources over the long term.

5.6.3.2 Tonopah Test Range. Surface disturbance for both Soils Media Corrective Action Unit and the Environmental Restoration Program industrial site remediation would produce short-term disruption of the ecosystem and soils. Ecological productivity would be reduced for the short term, but would probably be enhanced over the long term because of the removal of contamination. Variables would be the amount of soil removed and the ultimate success in reestablishing native vegetation species. See Section 4.1.6, Biological Resources (FLORA), for a description of variables that influence natural plant succession rates, revegetation techniques, and revegetation success. There would be some short-term alteration of surface-water drainage patterns. Some PM_{10} would be produced in the short term from the Environmental Restoration Program sites. Temporary mobile-source emissions would be produced. There would be no long-term effects.

Visual resource would be affected. The slow natural recovery of vegetation in arid environments would cause a long-term visual effect.

Noise associated with remediation heavy equipment and drill rigs would cause local short-term noise and no long-term effects.

Recovery of cultural resource data would be a short-term benefit, but would reduce the opportunity to gain greater data recovery using enhanced future technologies. Vandalism and illicit artifact collecting within archaeologically sensitive areas are likely to cause a negative impact to cultural resources over the long term.

5.6.3.3 Project Shoal and Central Nevada Test Areas. Short-term effects would be noise, minor local air-quality effects, and a very minor localized decline in ecological productivity at the sites of surface disturbance. Restoration of the drilling mud pits at the Central Nevada Test Area and other areas of contamination would increase the long-term ecological productivity. The long-term effect would be to open the area to a greater variety of land use. Monitoring and surface remediation would ensure that no accessible contamination would be present.

Recovery of cultural resource data would be a short-term benefit, but would reduce the opportunity to gain greater data recovery using enhanced future technologies. Vandalism and illicit artifact collecting within archaeologically sensitive areas are likely to cause a negative impact to cultural resources over the long term.

Contaminated geologic media and groundwater would remain unavailable for the long term.

5.6.3.4 Eldorado Valley. Land use would be committed to a single use for the long term. Other primarily recreational uses would be precluded or substantially reduced. The installation or upgrading of infrastructure would facilitate future development in the valley. The long-term effect on the area's low-density tortoise population would be negative. Since it is difficult to restore pristine conditions in arid environments, it would be likely that even upon removal of a solar project, habitat would not reach its former condition over the long term.

The use of aggregate and fill materials for construction would be a long-term commitment of these resources, which are common in the region.

The necessity of removing cultural resource materials that would otherwise be destroyed by construction would represent an impact. Data recovered represents a benefit to the present knowledge base. However, materials removed from their context and studied with present technology would be unavailable for subsequent study using improved future technologies. Construction of roads in areas proposed for solar generating facilities may increase access to archaeologically sensitive areas. This could result in unavoidable long-term impacts such as vandalism and illicit artifact collecting.

5.6.3.5 Dry Lake Valley. Land use would be committed to a single use for the long term. Other primarily recreational uses would be precluded or substantially reduced. The installation or upgrading of infrastructure would facilitate future development in the valley. The long-term effect on the area's low- density tortoise population would be negative. Construction of a water line to Dry Lake Valley has the potential to substantially impact tortoise habitat. This would have a substantial long-term impact on tortoise populations to the north, particularly if existing power line rights-of-way were not used. Additionally, if groundwater use were sufficient to reduce the discharge at Muddy Spring, there could be an impact on its Moapa dace population. Since it is difficult to restore pristine conditions in arid environments, it is likely that even upon removal of a solar project, the habitat would not reach its former condition over the long term.

The use for construction of aggregate and fill materials, which are common in the region, would be a long-term commitment of these resources.

Removing cultural resource materials that would otherwise be destroyed by construction would represent a benefit to the present knowledge base. However, materials removed from their context and studied with present technology would be unavailable for subsequent study using improved future technologies.

5.6.3.6 Coyote Spring Valley. Land use would be committed to a single use for the long term. Other primarily dispersed light recreational uses would be precluded or substantially reduced. Depending on the location within the valley, the long-term effect on the area's tortoise population and critical habitat for this species would be negative. Construction of a water line in Coyote Spring Valley has the potential to substantially impact tortoise habitat. This could have a substantial long-term impact on tortoise populations particularly if existing power line rights-of-way were not used. The installation or upgrading of infrastructure would facilitate future development in the valley. Additionally, if groundwater use were sufficient to reduce the discharge at Muddy Spring, there could be an impact on its Moapa dace population. If local spring discharges were reduced or stopped, species dependent on them could be lost for the long term. Because it is difficult to restore pristine conditions in arid environments, it would be likely that even upon removal of a solar project, the habitat would not reach its former condition over the long term.

The use for construction of aggregate and fill materials, which are common in the region, would be a long-term commitment of these resources.

Removing cultural resource materials that would otherwise be destroyed by construction would represent a benefit to the present knowledge base. However, removed from their context these materials would be unavailable for subsequent study using improved future technologies. Construction of roads in areas proposed for solar-generating facilities may increase access to archaeologically sensitive areas. This could result in unavoidable long-term impacts such as vandalism and illicit artifact collecting.

5.6.4 Alternative 4

The relationship of short-term use and long-term productivity under Alternative 4 is discussed in the following sections.

5.6.4.1 Nevada Test Site. The majority of effects on long-term productivity would result from the continuation of present land use and from future land use associated with Alternative 4. Developed areas like Mercury, e.g., forward area camps, drill yards, roads, power lines, and waste disposal sites, would continue to be largely unproductive ecologically, but would continue long-term contributions through their support of research and development and training. Operating waste disposal sites would contribute to long-term productivity through the remediation of other areas and their return to productive uses. Similarly, the waste management sites would be restricted from subsurface access for the long term. Rehabilitation of the surface upon closure would result in restored ecological productivity.

Previous underground testing has resulted in long-term impairment of geologic resources and groundwater productivity, but Alternative 4, unlike Alternative 1 would not include the impacts of additional underground nuclear tests. Disruption and contamination would mean the unavailability of the geologic resources in the vicinity of the shot cavity for the long term. The effect on groundwater of underground tests detonated in or near the water table remains to be determined. Any contamination in excess of regulatory levels would mean the long-term unavailability of the affected water. There also exists the possibility that collapsed craters would provide preferential pathways from the surface down rubble chimneys to the vicinity of shot cavities, which could result in groundwater contamination.

There are two candidate sites at the NTS for the Solar Enterprise Zone facility, Fortymile Canyon in Area 25 and Mercury Valley in Area 22. Peak historic demand has not exceeded perennial yield at either location. However, a Solar Enterprise Zone facility would require a substantial increase in groundwater use. Total groundwater withdrawal would increase above the natural recharge of the affected aquifer. This would require the use of some underflow and could result in long-term effects on groundwater resources.

Depending on cleanup levels, Environmental Restoration Program activities would result in the disturbance of up to 9,800 acres, through soil removal to remediate contaminated areas. Removed soil productivity would be lost for the long term. See Section 4.1.6, Biological Resources (FLORA), for a description of natural plant succession rates, revegetation techniques, and revegetation success. Revegetation would be implemented where environmental conditions favor success. Success would enhance long-term productivity. Where site conditions are unfavorable, slow natural rehabilitation would impair long-term ecological productivity. Site remediation would make these areas available for other uses. The short-term effects of remediation would ultimately result in enhanced long-term productivity.

Operations of the Liquid Waste Treatment System and the Spill Test Facility might produce some limited short-term wildlife mortality; long-term productivity would be enhanced by the remediation that the Liquid Waste Treatment System would support and by its contribution to understanding the effects of underground testing on the groundwater. Similarly, what is learned through use of the Spill Test Facility would assist in mitigating the environmental effects of accidental hazardous substance releases.

Visual resources would be affected by some Environmental Restoration Program activities that result in surface disturbance, and waste management sites. The slow recovery of vegetation in arid environments would cause a long-term visual resource effect. Much of the NTS is comprised of common scenery, but would become more visible to the public with its opening to other public uses. This would increase the impact of the long-term effects.

Cultural resources that cannot be avoided by a project are subjected to data recovery to mitigate the impact of the activity on their values. While this enhances the short-term knowledge base, it also removes some of the potential for an even greater recovery of information to be gained through future studies using improved technology.

5.6.4.2 Tonopah Test Range. Surface disturbance for both the Soils Media Corrective Action Unit and the Environmental Restoration Program site remediation would produce short-term disruption of the ecosystem and soils. Ecological productivity would be reduced for the short term, but would probably be enhanced over the long term because of the removal of contamination. Variables would be the amount of soil removed and the ultimate success in reestablishing native vegetation species. There would be some short-term alteration of surface-water drainage patterns. Some PM_{10} would be produced in the short term from the Environmental Restoration Program sites. Temporary mobile-source emissions would be produced. There would be no long-term effects.

Visual resources would be affected. The slow natural recovery of vegetation in arid environments would cause a long-term visual effect.

Noise associated with remediation heavy equipment and drill rigs would cause local short-term noise and no long-term effects.

Recovery of cultural resource data would be a short-term benefit, but would reduce the opportunity to gain greater data recovery using enhanced future technologies. Vandalism and illicit artifact collecting within archaeologically sensitive areas are likely to cause a negative impact to cultural resources over the long term.

5.6.4.3 Project Shoal and Central Nevada Test Areas. Short-term effects would be noise, minor local air-quality effects, and a very minor localized decline in ecological productivity at the sites of surface disturbance. Restoration of the drilling mud pits at the Central Nevada Test Area and other areas of contamination would increase long-term ecological productivity. The long-term effect would be to open the area to a greater variety of land uses since monitoring and surface remediation would ensure that no accessible contamination would be present.

Recovery of cultural resource data would be a short-term benefit, but would reduce the opportunity to gain greater data recovery using enhanced future technologies. Vandalism and illicit artifact collecting within archaeologically sensitive areas are likely to cause a negative impact to cultural resources over the long term.

Contaminated geologic media and groundwater would remain unavailable for the long term.

5.6.4.4 Eldorado Valley. Land use would be committed to a single use for the long term. Other primarily recreational use would be precluded or substantially reduced. The installation or upgrading of infrastructure would facilitate future development in the valley. The long-term effect on the area's low- density tortoise population would be negative. Since it is difficult to restore pristine conditions in arid environments, it would be likely that, even upon removal of a solar project, the habitat would not reach its former condition over the long term.

The use of aggregate and fill materials for construction would be a long-term commitment of these resources, which are common in the region.

The necessity of removing cultural resource materials that would otherwise be destroyed by construction would represent a benefit to the present knowledge base. However, materials removed from their context and studied with present technology would be unavailable for subsequent study using improved future technologies. Construction of roads in areas proposed for solar-generating facilities may increase access to archaeologically sensitive areas. This could result in unavoidable long-term impacts such as vandalism and illicit artifact collecting.

5.6.4.5 Dry Lake Valley. Land use would be committed to a single use for the long term. Other primarily recreational use would be precluded or substantially reduced. The long-term effect on the area's low-density tortoise population would be negative. Construction of a water line to Dry Lake Valley has the potential to substantially impact tortoise habitat. This would have a substantial long-term impact on tortoise populations to the north, particularly if existing power line rights-of-way were not used. The installation or upgrading of infrastructure would facilitate future development in the valley. Additionally, if groundwater use were sufficient to reduce the discharge at Muddy Spring, there could be an impact on its Moapa dace population. Since it is difficult to restore pristine conditions in arid environments, it would be likely that, even upon removal of a solar project, habitat would not reach its former condition over the long term.

The use of aggregate and fill materials for construction would be a long-term commitment of these resources, which are common in the region.

The necessity of removing cultural resource materials that would otherwise be destroyed by construction would represent a benefit to the present knowledge base. However, materials removed from their context and studied with present technology would be unavailable for subsequent study using improved future technologies. Construction of roads in areas proposed for solar-generating facilities may increase access to archaeologically sensitive areas. This could result in unavoidable long-term impacts such as vandalism and illicit artifact collecting.

5.6.4.6 Coyote Spring Valley. Land use would be committed to a single use for the long term. Other primarily dispersed light recreational uses would be precluded or substantially reduced. Depending on the location within the valley, the long-term effect on the area's tortoise population and critical habitat for this species would be negative. Construction of a water line in Coyote Spring Valley has the potential to substantially impact tortoise habitat. This could have a substantial long-term impact on tortoise populations, particularly if existing power line rights-of-way were not used. The installation or upgrading of infrastructure would facilitate future development in the valley. Additionally, if groundwater use were sufficient to reduce the discharge at Muddy Spring, there could be an impact on its Moapa dace population. If local spring discharges were reduced or stopped, species dependent on them could be lost for the long term. Since it is difficult to restore pristine conditions in arid environments, it would be likely that, even upon removal of a solar project, habitat would not reach its former condition over the long term.

The use for construction of aggregate and fill materials would be a long-term commitment of the resources that are common in the region.

The necessity of removing cultural resource materials that would otherwise be destroyed by construction would represent a benefit to the present knowledge base. However, materials removed from their context and studied with present technology would be unavailable for subsequent study using improved future technologies. Construction of roads in areas proposed for solar generating facilities may increase access to archaeologically sensitive areas. This could result in unavoidable long-term impacts such as vandalism and illicit artifact collecting.

5.7 Irreversible and Irretrievable Commitment of Resources

This section identifies the major irreversible and irretrievable commitments of resources that are identifiable at the sitewide level of analysis. A commitment of resources is irreversible when its primary or secondary impacts limit the future options for a resource. An irretrievable commitment refers to the use or consumption of resources neither renewable nor recoverable for later use by future generations. The major irreversible and irretrievable commitment is land use, with lesser commitments of harvestable products, materials, groundwater, and energy.

Implementation of any of the alternatives would result in a permanent commitment of certain air, groundwater, soil, biota, mineral, surface, and subsurface resources. There would be an irreversible and irretrievable commitment of the associated natural resource services. In addition to the National Environmental Policy Act requirement to identify the irreversible and irretrievable commitments of resources, it is also the intent of the DOE to identify these resources within the meaning of the Comprehensive Environmental Response, Compensation, and Liability Act, Section 107(f)(1). Section 107(f)(1) which addresses natural resource damage liability and states that the liability is obviated if:

> ". . . the damages to natural commitments of resources complained of were specifically identified as irreversible and irretrievable commitments of resources in an environmental impact statement, or other comparable environmental analysis, and the decision to grant a permit or license authorizes such commitment of natural resources, and the facility or project was otherwise operating within the terms of its permit or license, so long as, in the case of damages to an Indian tribe occurring pursuant to a Federal permit or license, the issuance of that permit or license was not inconsistent with the fiduciary duty of the United States with respect to such Indian tribe."

5.7.1 Alternative 1

The irreversible and irretrievable commitments of resources that would result under Alternative 1 are presented for the NTS, the Tonopah Test Range, the Project Shoal Area, and the Central Nevada Test Area.

5.7.1.1 Nevada Test Site. Developed areas like Mercury, Area 12 Camp, Area 25 Complex, Control Point 1, and so on would remain in an urban or industrial configuration. Thus, a long-term land-use commitment exists that would preclude alternative, nonurban use. Natural habitat productivity at these locations would be reduced. Even with removal of the structures and infrastructure, completely natural conditions would be unlikely to be achieved.

Although technically reversible through excavation and clean closure, use of the radioactive waste management facilities for waste disposal would result in an irreversible and irretrievable commitment of the sites and surrounding buffer areas. Land uses would be severely restricted, as would access to the subsurface. Some surface areas would be rehabilitated upon closure and would provide natural habitat, but little other human use. Most closures would likely be designed using rock armor to inhibit vegetation or burrowing by animals. Sanitary and construction landfills would represent an irreversible and irretrievable commitment of the subsurface and some limitation of the surface uses.

Underground nuclear tests would represent, in large part, an irreversible and irretrievable commitment of the subsurface for any subsequent use. The surface above an underground nuclear test would be restricted from all access if cratering has not occurred. Where cratering has occurred, some limited surface use would be permissible. Underground subcritical experiments would result in an irreversible and irretrievable commitment of the mined cavity for subsequent use. Following subcritical experiments, the land surface would be unaffected and unrestricted.

Decontamination and decommissioning activities would produce mixed results depending on the remedy selected. Entombment would result in an irretrievable and irreversible commitment of the surface or associated subsurface for most land use. Most decontamination and decommissioning activities would result in either decontamination and consequent availability of the facility for other use or demolition of the facility and disposal. Reuse would entail the facility remaining in an industrial mode, which would represent a long-term commitment to that type of land use. Demolition of the facility would result in the land's availability for other development or for site rehabilitation and use as natural habitat.

Although technically reversible through excavation and clean closure, closure in place would result in an irreversible and irretrievable commitment for those Resource Conservation and Recovery Act industrial sites that are so treated. Land use on these sites and in a surrounding buffer zone would be severely constrained. Rehabilitation by revegetation would permit their functioning as natural habitat, but closure would likely be designed using rock armor to inhibit vegetation or burrowing by animals.

Continued airspace restriction would represent an irreversible and irretrievable commitment because access would be limited to government use only, to the detriment of general aviation and commercial users.

Energy and materials utilized in the construction, operation, maintenance, decontamination, demolition, and closure of the facilities would be irreversibly and irretrievably committed. Detonation of high or nuclear explosives would be an irreversible and irretrievable commitment of energy resources.

Industrial accidents resulting in injuries or deaths and latent cancer fatalities caused by worker exposure to radiation at the NTS would represent an irreversible and irretrievable commitment of human resources.

Continued restriction of harvest of products like game, pine nuts, or grass, and maintenance of areas in development that precludes their natural productivity, would represent an irretrievable commitment of resources. However, the area of the

NTS that would be developed or committed to such use as radioactive waste disposal is a small fraction of the total area.

Removal of soils for environmental restoration projects would result in their irreversible and irretrievable loss since they would be landfilled and any associated natural resource services that they provide would be lost as well. Environmental restoration would involve up to about 9,800 acres, most of which have been previously disturbed. The amount that would be redisturbed during remediation depends, first, upon the levels of contamination that would be determined during characterization and, second, upon the agreements reached with the state of Nevada regarding cleanup levels.

The conduct of one or more underground nuclear tests would result in an undetermined impact on groundwater quality if it occurred in or near the water table. Any groundwater contamination in excess of EPA drinking water standards would constitute an irreversible and irretrievable commitment of a presently unquantifiable amount of water. Similarly, any contamination of groundwater above EPA drinking water standards at the existing underground test cavity locations would represent an irreversible and irretrievable commitment of the resource.

The subsurface area and geologic values at existing and future potential underground test cavity locations would represent an irreversible and irretrievable commitment of their associated natural resource services.

A total of 2.1 x 10^6 m^3 per year (5.5 x 10^8 gal/yr) of water would be used to support all NTS programs under Alternative 1. This water would represent an irreversible and irretrievable commitment of this resource.

Electric usage would total 6.9 x 10^6 kW hrs/month, while fuel usage would total 708 m^3 per month (187,000 gal/month), which would represent an irreversible and irretrievable commitment of the energy resources.

A total of about 59,000 acres has been disturbed to date, and an additional 9,900 acres would be disturbed over the next 10 years. With the exception of some of those areas that would be remediated under the Environmental Restoration Program, most of these acres would be irreversibly and irretrievably committed to their present uses. This would result in a minimal to total reduction of their associated natural resource services.

When an activity cannot be relocated, cultural resources must be removed in the process of data recovery. To the extent that this action precludes future data recovery using improved technology, it would represent an irreversible and irretrievable commitment of the information value represented. If cultural resources exist in an area too highly contaminated to survey or to conduct data recovery, these resources may be lost when remediation disturbs the surface. This is an irreversible and irretrievable loss of the information value that such resources contain. Vandalism and illicit artifact collecting within archaeologically sensitive areas are likely to result in irreversible and irretrievable loss of their information value.

5.7.1.2 Tonopah Test Range. Much of the activity at the Tonopah Test Range takes place on the playas, hence surface disturbance would produce no effects on most other resources. No new surface disturbance would occur under Alternative 1. Removal of soils for environmental restoration projects would result in their irreversible and irretrievable loss since they would be landfilled and any associated natural resource services that they provide would be lost as well. Environmental restoration activities could involve several hundred acres, most of which have been previously disturbed. The amount that would be redisturbed during remediation depends, first, upon the levels of contamination that would be determined during characterization and, second, upon the agreements reached with the state of Nevada regarding cleanup levels. With the exception of some of those areas that would be remediated under the Environmental Restoration Program, most of these acres would be irreversibly and irretrievably committed to their present uses. This would result in a minimal to total reduction of their associated natural resource services.

When an activity cannot be relocated, cultural resources must be removed in the process of data recovery. To the extent that this action precludes future data recovery using improved technology, it would represent an irreversible and irretrievable commitment of the information value represented. If cultural resources exist in an area too highly contaminated to survey or to conduct data recovery, these resources may be lost when remediation disturbs the surface. This is an irreversible and irretrievable loss of the information value that such resources contain. Vandalism and illicit artifact collecting within archaeologically sensitive areas are likely to result in irreversible and irretrievable loss of their information value.

5.7.1.3 Project Shoal and Central Nevada Test Areas. About 10 acres at the Project Shoal Area and 40 acres at the Central Nevada Test Area would be disturbed through environmental remediation. Most of these areas were previously disturbed, so this would represent a setback in the ecological succession that has occurred. In addition, the subsurface areas at the cavity locations and any associated groundwater contaminated above EPA drinking water standards would represent an irreversible and irretrievable commitment of their associated natural resource services.

Some cultural resource site data recovery represents, to a degree, an irreversible and irretrievable commitment of the potential information resource represented. This is because the recovery in the future of some information would be precluded due to the limited capability of present technology to recover certain information. Other irreversible and irretrievable losses may be incurred as a result of vandalism and illicit artifact collecting.

5.7.2 Alternative 2

The irreversible and irretrievable commitment of resources that would result under Alternative 2 are presented for the NTS, the Tonopah Test Range, the Project Shoal Area, and the Central Nevada Test Area.

5.7.2.1 Nevada Test Site. Developed areas like Mercury, Area 12 Camp, Area 25 Complex, and Control Point 1 would remain in an urban or industrial configuration. Thus, a long-term land-use commitment exists that would preclude alternative, nonurban uses. Natural habitat productivity at these locations would be reduced.

Although less use of the radioactive waste management facilities for waste disposal would occur with this alternative than with Alternative 1, there would still be an irreversible and irretrievable commitment of the sites and surrounding buffer areas. Land use would be severely restricted as would access to the subsurface. Some surface areas would be rehabilitated upon closure and would provide natural habitat, but little other human use. Most closures would be designed using rock armor to inhibit vegetation or burrowing by animals. Sanitary and construction landfills would represent an irreversible and irretrievable commitment of the subsurface and some limitation of the surface uses.

The effects of this alternative would be similar to those of Alternative 1. An insignificant lower increment of effect would exist since there would be no Defense Program activities. The existing underground nuclear test areas represent, in large part, an irreversible and irretrievable commitment of the subsurface for any subsequent uses. The surface would continue to be restricted from all access if cratering has not occurred.

Continued airspace restriction would represent an irreversible and irretrievable commitment of that access to government uses only, to the detriment of general aviation and commercial users.

Continued restriction of harvest of annually perishable products like game, pine nuts, or grass and maintenance of areas in development that precludes their natural productivity represent an irretrievable commitment of resources. However, the area of the NTS that is developed or committed to such uses as radioactive waste disposal is a small fraction of the total area.

Any contamination of groundwater above EPA drinking water standards at the existing underground test cavity locations would represent an irreversible and irretrievable commitment of the resource.

The subsurface area and geologic values at the existing underground test cavity locations would represent an irreversible and irretrievable commitment of their associated natural resource services. Contaminated soils that are not remediated would be irretrievably lost as a soil resource.

Water used to support the environmental monitoring and security functions remaining at the NTS under Alternative 2 would represent an irreversible and irretrievable commitment of the resource.

Electric usage would total 89,744 kW hrs/month, while fuel usage would total 11 m^3 per month (2,778 gal/month), which would represent an irreversible and irretrievable commitment of the energy resources.

A total of about 59,000 acres has been disturbed to date, and no additional acres would be disturbed over the next 10 years. These acres would be irreversibly and irretrievably committed to their present use. This would result in a minimal to total reduction of their associated natural resource services.

5.7.2.2 Tonopah Test Range. The only irreversible and irretrievable commitment that would occur is if contaminant migration was such that future remediation were rendered to be uneconomic.

5.7.2.3 Project Shoal and Central Nevada Test Areas. Contaminated mud pits at the Project Shoal and Central Nevada Test Areas would remain irreversible and irretrievable commitments to a restricted land use in their vicinity. In addition, the subsurface area at the cavity locations and any associated groundwater contaminated above EPA drinking water standards would represent an irreversible and irretrievable commitment of their associated natural resource services.

5.7.3 Alternative 3

The irreversible and irretrievable commitment of resources that would result under Alternative 3 is presented for the NTS, the Tonopah Test Range, the Project Shoal Area, the Central Nevada Test Area, Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley.

5.7.3.1 Nevada Test Site. Developed areas like Mercury, Area 12 Camp, Area 25 Complex, Control Point 1, and so on are likely to remain in an urban or industrial configuration. Thus, a long-term commitment exists that would preclude alternative, nonurban use. Natural habitat productivity at these locations would be reduced. Even with removal of the structures and infrastructure, completely natural conditions would be unlikely to be achieved.

Although technically reversible through excavation and clean closure, use of the radioactive waste management facilities for waste disposal would result in an irreversible and irretrievable land use commitment of the sites and surrounding buffer areas. Land use would be severely restricted as would access to the subsurface. Some surface areas would be rehabilitated upon closure and would provide natural habitat, but little other human use. Most closures would be designed using rock armor to inhibit vegetation or burrowing by animals. Sanitary and construction landfills would represent an irreversible and irretrievable commitment of the subsurface and some limitation of the surface uses. Rehabilitation of the surface upon closure would make the sites available as natural habitat.

Underground nuclear tests would represent, in large part, an irreversible and irretrievable commitment of the subsurface for any subsequent use. The surface above an underground nuclear test would be restricted from all access if cratering has not occurred. Where cratering has occurred, some limited surface use would be permissible. Underground subcritical experiments would result in an irreversible and irretrievable commitment of the mined cavity for any subsequent use. Following subcritical experiments, the land surface would be unaffected and unrestricted.

Decontamination and decommissioning activities would produce mixed results depending on the remedy selected. Entombment would result in an irretrievable and irreversible commitment of the surface or associated subsurface for most land use. Most decontamination and decommissioning activities would result in either decontamination and consequent availability of the facility for other use or demolition of the facility and disposal. Reuse would entail the facility remaining in an industrial mode, which represents a long-term commitment to that type of land use. Demolition of the facility would result the land's availability for other development or for site rehabilitation and use as natural habitat.

Although technically reversible through excavation and clean closure, closure in place would result in an irreversible and irretrievable commitment for those Resource Conservation and Recovery Act industrial sites that are so treated. Land use above these sites and in a surrounding buffer zone would be severely constrained. Rehabilitation by revegetation would permit their functioning as natural habitat, but closures would likely be designed using rock armor to inhibit vegetation or burrowing by animals.

Continued airspace restriction would represent an irreversible and irretrievable commitment of that access to government use only.

Energy and materials utilized in the construction, operation, maintenance, decontamination, demolition, and closure of the facilities would be irreversibly and irretrievably committed. Detonation of high or nuclear explosives would be an irreversible and irretrievable commitment of energy resources. Additional projects, including the alternative energy developments, would constitute a greater commitment of resources than would Alternative 1.

Industrial accidents resulting in injuries or deaths and latent cancer fatalities caused by worker exposure to radiation at the NTS would represent an irreversible and irretrievable commitment of human resources.

Continued restriction of harvest of products like game, pine nuts, or grass and maintenance of areas in development that precludes their natural productivity would represent an irretrievable commitment of resources. However, the area of the NTS that is developed or committed to such use as radioactive waste disposal is a small fraction of the total area.

Removal of soils for environmental restoration projects would result in their irreversible and irretrievable loss since they would be landfilled, and any associated natural resource services that they provide would be lost as well. See Section 4.1.6, Biological Resources (FLORA), for a description of variables that influence natural plant succession rates, revegetation techniques, and revegetation success. Where suitable subsoils occur with acceptable parameters (e.g., low soluble salts, appropriate texture, and adequate quantities to ensure plant establishment and rooting), they could be used directly for revegetation. Subsoils could be amended, if necessary, to provide a suitable substrate for plant establishment and growth. Amendments would be based on a site evaluation of what soil resources are available and prevailing site conditions (e.g., climatic conditions). See Section 5.1.1.4 for a discussion of reclamation options. Environmental restoration would involve up to about 9,800 acres, most of which have been previously disturbed. The amount that would be redisturbed during remediation depends, first, upon the levels of contamination that would be determined during characterization and, second, upon the agreements reached with the state of Nevada regarding cleanup levels.

The conduct of one or more underground nuclear tests would result in an undetermined impact on ground water quality if it occurred in or near the water table. Any groundwater contamination in excess of EPA drinking water standards would constitute an irreversible and irretrievable commitment of a presently unquantifiable amount of water. Similarly, any contamination of groundwater above EPA drinking water standards at the existing underground test cavity locations would represent an irreversible and irretrievable commitment of the resource.

The subsurface area and geologic values at the existing and potential future underground test cavity locations would represent an irreversible and irretrievable commitment of their associated natural resource services.

A total of 1.1×10^7 m^3 per year (2.9×10^9 gal/yr) of water would be used to support all NTS programs under Alternative 3. This water would represent an irreversible and irretrievable commitment of this resource.

Electric usage would total 1.4×10^6 kW hrs/month, while fuel usage would total 1,427 m^3 per month (376,987 gal/month).

A total of about 59,000 acres has been disturbed to date, and approximately 15,600 more acres would be disturbed over the next 10 years. With the exception of some of those areas that would be remediated under the Environmental Restoration Program, most of these acres would be irreversibly and irretrievably committed to their present and proposed use. This would result in a minimal to total reduction of their associated natural resource services.

When an activity cannot be relocated, cultural resources must be removed in the process of data recovery. To the extent that this action precludes future data recovery using improved technology, it would represent an irreversible and irretrievable commitment of the information value represented. If cultural resources exist in an area too highly contaminated to survey or to conduct data recovery, these resources may be lost when remediation disturbs the surface. This is an irreversible and irretrievable loss of the information value that such resources contain. Vandalism and illicit artifact collecting within archaeologically sensitive areas are likely to result in irreversible and irretrievable loss of their information value.

5.7.3.2 Tonopah Test Range. Much of the activity at the Tonopah Test Range takes place on the playas, hence surface disturbance would produce no effects on most other resources. No new surface disturbance would occur under Alternative 3. Removal of soils for environmental restoration projects would result in their irreversible and irretrievable loss since they would be landfilled, and any associated natural resource services that they provide would be lost as well. Environmental restoration activities could involve several hundred acres, most of which has been previously disturbed. The amount that would be redisturbed during remediation depends, first, upon the levels of contamination that would be determined during characterization and, second, upon the agreements reached with the state of Nevada regarding cleanup levels. With the exception of some of those areas that would be remediated under the Environmental Restoration Program, most of these acres would be irreversibly and irretrievably committed to their present use. This would result in a minimal to total reduction of their associated natural resource services.

When an activity cannot be relocated, cultural resources must be removed in the process of data recovery. To the extent that this action precludes future data recovery using improved technology, it would represent an irreversible and irretrievable commitment of the information value represented. Other irreversible and irretrievable losses may result from vandalism and illicit artifact collecting.

5.7.3.3 Project Shoal and Central Nevada Test Areas. About 10 acres at the Project Shoal Area and 40 acres at the Central Nevada Test Area would be disturbed through environmental remediation. Most of these areas were previously disturbed, so this would represent a setback in the ecological succession that has occurred. In addition, the subsurface area at the cavity locations and any associated groundwater contaminated above EPA drinking water standards would represent an irreversible and irretrievable commitment of their associated natural resource services.

Some cultural resource site data recovery represents, to a degree, an irreversible and irretrievable commitment of the potential information resource represented. This is because the recovery in the future of some information would be precluded due to the limited capability of present technology to recover certain information. Other irreversible and irretrievable losses may result from vandalism and illicit artifact collecting.

5.7.3.4 Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley. The irreversible and irretrievable commitment of resources resulting from the construction and operation of a Solar Enterprise Zone facility in Eldorado, Dry Lake, or Coyote Spring Valleys would be the same and are presented in the following section. Ecological productivity would be greatly reduced or completely stopped during the period of time in which the Solar Enterprise Zone facility would be operating. The ecosystem's contribution would be irretrievably lost for that period of time and would likely never return to its present status.

The use of materials for construction would be an irreversible and irretrievable long-term commitment of the resources.

Some cultural resource site data recovery represents, to a degree, an irreversible and irretrievable commitment of the potential information resource represented. This is because the future recovery of some data would be precluded due to the limited capability of present technology to recover certain information.

Construction of roads in areas proposed for solar generating facilities is likely to result in a greater incidence of vandalism and illicit artifact collecting within archaeologically sensitive areas. This could result in an irreversible and irretrievable loss of their information value.

5.7.4 Alternative 4

The irreversible and irretrievable commitment of resources that would result under Alternative 4 is presented for the NTS, the Tonopah Test Range, the Project Shoal Area, the Central Nevada Test Area, Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley.

5.7.4.1 Nevada Test Site. Developed areas like Mercury, Area 12 Camp, Area 25 Complex, and Control Point 1 are likely to remain in an urban or industrial land use. Thus, a long-term land-use commitment exists that would preclude alternative, nonurban use. Natural habitat productivity at these locations would be reduced. Even with removal of the structures and infrastructure, completely natural conditions would be unlikely to be achieved.

Although technically reversible through excavation and clean closure, use of the radioactive waste management facilities for waste disposal would result in an irreversible and irretrievable commitment of the sites and surrounding buffer areas. Land use would be severely restricted as would access to the subsurface. Some surface areas would be rehabilitated upon closure and would provide natural habitat, but little other human use. Most closures would be designed using rock armor to inhibit vegetation or burrowing by animals. Sanitary and construction landfills would represent an irreversible and irretrievable commitment of the subsurface and some limitation of the surface use.

Past underground nuclear tests would represent, in large part, a continuing irreversible and irretrievable commitment of the subsurface for any subsequent use. The surface above an underground test would be restricted from all access if cratering has not occurred. Where cratering has occurred, some limited surface use would be permissible.

Decontamination and decommissioning activities would produce mixed results depending on the remedy selected. Entombment would result in an irretrievable and irreversible commitment of the surface or associated subsurface for most land use. Most decontamination and decommissioning activities would result in either decontamination and consequent availability of the facility for other use or demolition of the facility and disposal. Reuse would entail the facility remaining in an industrial mode that represents a long-term commitment to that type of land use. Demolition of the facility would result in the land's availability for other development or for site rehabilitation and use as a natural habitat.

Although technically reversible through excavation and clean closure, closure in place would result in an irreversible and irretrievable commitment for those Resource Conservation and Recovery Act industrial sites that are so treated. Land use at these sites and in a surrounding buffer zone would be severely constrained. Rehabilitation by revegetation would permit their functioning as natural habitat, but closures would likely be designed using rock armor to inhibit vegetation or burrowing by animals.

Energy and materials utilized in the construction, operation, maintenance, decontamination, demolition, and closure of facilities would be irreversibly and irretrievably committed.

Industrial accidents resulting in injuries at the NTS could, depending on the type of injury, represent an irreversible and irretrievable commitment of human resources.

Continued restriction of harvest of annually perishable products like some game, pine nuts, or grass and maintenance of areas in development that precludes their natural productivity, represents an irretrievable commitment of resources. However, the area of the NTS that is developed or committed to such use as radioactive waste disposal is a small fraction of the total area.

Removal of soils for environmental restoration projects would result in their irreversible and irretrievable loss since they would be landfilled, and any associated natural resource services that they provide would be lost as well. Environmental restoration activities would involve up to about 9,800 acres, most of which has been previously disturbed. The amount that would be redisturbed during remediation depends, first, upon the levels of contamination that would be determined during characterization and, second, upon the agreements reached with the state of Nevada regarding cleanup levels.

Any contamination of groundwater above EPA drinking water standards at the existing underground test cavity locations would represent an irreversible and irretrievable commitment of the resource.

The subsurface area and geologic values at the existing underground test cavity locations would represent an irreversible and irretrievable commitment of their associated natural resource services.

A total of 8.1 x 10^6 m^3 per year (2.1 x 10^9 gal/yr) of water would be used to support all NTS programs under Alternative 4. This water would represent an irreversible and irretrievable commitment of this resource.

Electric usage would total 4.6 x 10^6 kW hrs/month, while fuel usage would total 461 m^3 per month (121,671 gal/month) that would represent an irreversible and irretrievable commitment of the energy resources.

A total of about 59,000 acres has been disturbed to date and approximately 14,400 more acres would be disturbed over the next 10 years. With the exception of some of the areas that would be remediated under the Environmental Restoration Program, most of these acres would be irreversibly and irretrievably committed to their present and proposed use. This would result in a minimal to total reduction of their associated natural resource services.

When an activity cannot be relocated, cultural resources must be removed in the process of data recovery. To the extent that this action precludes future data recovery using improved technology, it would represent an irreversible and irretrievable commitment of the information value represented. If cultural resources exist in an area too highly contaminated to survey or to conduct data recovery, these resources may be lost when remediation disturbs the surface. This is an irreversible and irretrievable loss of the information value that such resources contain. Vandalism and illicit artifact collecting within archaeologically sensitive areas are likely to result in irreversible and irretrievable loss of their information value.

5.7.4.2 Tonopah Test Range. Much of the activity at the Tonopah Test Range takes place on the playas hence, surface disturbance would produce no effects on most other resources. No new surface disturbance would occur under Alternative 4. Removal of soils for environmental restoration projects would result in their irreversible and irretrievable loss since they would be landfilled, and any associated natural resource services that they provide would be lost as well. Environmental restoration could involve several hundred acres, most of which has been previously disturbed. The amount that would be redisturbed during remediation depends first, upon the levels of contamination which would be determined during characterization and second, upon the agreements reached with the state of Nevada regarding cleanup levels. With the exception of some of the areas that would be remediated under the Environmental Restoration Program, most of the acres would be irreversibly and irretrievably committed to their present use. This would result in a minimal to total reduction of their associated natural resource services.

When an activity cannot be relocated, cultural resources must be removed in the process of data recovery. To the extent that this action precludes future data recovery using improved technology, it would represent an irreversible and irretrievable commitment of the information value represented. Other irreversible and irretrievable losses may result from vandalism and illicit artifact collecting.

5.7.4.3 Project Shoal and Central Nevada Test Areas. About 10 acres at the Project Shoal Area and 40 acres at the Central Nevada Test Area would be disturbed through environmental remediation. Most of these areas were previously disturbed, so this would represent a setback in the ecological succession that has occurred. In addition, the subsurface area at the cavity locations and any associated groundwater contaminated above EPA drinking water standards would represent an irreversible and irretrievable commitment of their associated natural resource services.

Some cultural resource site data recovery represents, to a degree, an irreversible and irretrievable commitment of the potential information resource represented. This is because the recovery in the future of some information would be precluded due to the limited capability of present technology to recover certain information. Other irreversible and irretrievable losses may result from vandalism and illicit artifact collecting.

5.7.4.4 Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley. The irreversible and irretrievable commitment of resources resulting from the construction and operation of a Solar Enterprise Zone facility in Eldorado Valley, Dry Lake Valley, or Coyote Spring Valley would be the same and are presented in this section. Ecological productivity would be greatly reduced or completely stopped during the period of time in which the plant is operating. The ecosystem's contribution would be irretrievably lost for that period of time and would likely never return to its present status.

Some cultural resource site data recovery represents, to a degree, an irreversible and irretrievable commitment of the potential information resource represented. This is because the recovery in the future of some information would be precluded due to the limited capability of present technology to recover certain information. Construction of roads in areas proposed for solar-generating facilities is likely to result in a greater incidence of vandalism and illicit artifact collecting within archaeologically sensitive areas. This could result in an irreversible and irretrievable loss of their information value.

The use of materials for construction would be an irretrievable and irreversible long-term commitment of the resources.

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Chapter 6

CUMULATIVE IMPACTS

CHAPTER 6
CUMULATIVE IMPACTS

This chapter is comprised of five sections: (1) definition of cumulative impacts, methods of analysis, analytical baseline, and information sources; (2) inventory and characterization of past, present, and reasonably foreseeable actions (including federal and non-federal actions); (3) summary of impacts attributable to implementation of the Nevada Test Site (NTS) alternatives; (4) cumulative impact analysis by resource area; and (5) a summary of cumulative impacts.

The U.S. Department of Energy (DOE) is currently planning or conducting a variety of Programmatic Environmental Impact Statements (EISs) that have the potential for impacting activities at the NTS. These activities are discussed in Chapter 2, Purpose and Need. The impact of actions proposed by the DOE in these Programmatic EISs is accounted for in the assessment presented in Chapter 5, Environmental Consequences. Impacts experienced at the NTS attributable to activities contained in Programmatic EISs prepared by agencies other than the DOE are not individually identified and specifically addressed in Chapter 5.

6.1 Definition of Cumulative Impacts, Methods of Analysis, Analytical Baseline and Information Sources

The following subsections provide the definition of cumulative impacts, and description of methods used in the analysis. Also included is the analytical baselines and a summary of the information sources used.

6.1.1 Definition

In accordance with the Council on Environmental Quality regulations, a cumulative impact analysis within an EIS includes the anticipated impacts to the environment resulting from "the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time." (40 CFR Part 1508.7).

6.1.2 Methods of Analysis

A cumulative impact analysis is based on a number of assumptions. Cumulative impacts are examined by combining the impacts of the proposed program alternatives with the impacts of other past, present, and reasonably foreseeable activities in a region of influence. The extent of the region of influence can vary widely from one resource to another. For example, the region of influence for land use generally includes all impacts on land use in a broad region surrounding the area affected by the program alternatives. The region of influence for groundwater would generally be much smaller, encompassing only those groundwater-flow systems that are affected by the program alternatives, and by all past, present, and future actions that have or could affect these groundwater-flow systems. The region of influence for transportation could include an entire state, whereas the region of influence for socioeconomics could include all the cities and towns affected by the major economic activities in the region.

Public documents prepared by agencies of federal, state, and local government are the primary sources of information. It is assumed that actions undertaken by private persons and entities are captured in the information provided by such agencies.

The cumulative impacts methodology employs an approach that references resource management plans and economic and demographic projections as the sources of non-DOE-related baseline conditions. These plans provide an assessment of impacts to the environment associated with the implementation of these plans and scenarios. This approach is used rather than one that employs a compilation of specific future projects anticipated to occur in the respective regions of influence. In most cases the geographical areas in question are extensive and can also contain large populations, making it infeasible to achieve a project-by-project aggregation.

Because of the wide geographic scope of a cumulative assessment and the variety of activities assessed, cumulative impacts are commonly examined at a less detailed level than are direct and indirect impacts.

The resource management plans and economic and demographic projections developed by public agencies present a consolidated picture of activities that are projected to occur in their respective geographical areas. In general terms, the resource management plans apply to large areas of relatively undeveloped land (virtually all of which is in federal ownership), and the economic and demographic projections apply to Clark and Nye counties, respectively.

6.1.3 Analytical Baseline

Except for the Las Vegas metropolitan area, southern Nevada is sparsely populated with large tracts of uninhabited desert and forested mountains controlled by a few federal agencies. Other land owners control relatively little land area.

FEDERAL LAND—The U.S. Bureau of Land Management controls the largest amount of land in the region. The U.S. Bureau of Land Management's lands are open to the public and are used chiefly for grazing and dispersed recreation; mineral exploration and mining have affected small areas. The U.S. Bureau of Land Management manages the Red Rock Canyon National Recreation Area 10 miles west of Las Vegas. The U.S. Bureau of Land Management also manages a few dozen areas surrounding the NTS and Nellis Air Force Range (NAFR) Complex as Wilderness Study Areas. The U.S. Bureau of Land Management has recommended to the Secretary of the Interior that some of these areas be included in the National Wilderness Preservation System.

The NAFR Complex, controlled by the U.S. Air Force, is the next largest block of land in the region. It surrounds the NTS on the north and east sides, and most of the west side (public lands border the NTS on its southern and southwestern sides). The NAFR Complex is used for military training and is closed to public access. The NTS is the next largest block of land in the region and is closed to public access. Combined, the NAFR Complex and the NTS form a single northwest-trending block of land that contains approximately 4,000,000 acres.

The U.S. Fish and Wildlife Service manages a large block of land north of Las Vegas as the Desert National Wildlife Range, and a smaller block of land 24 kilometers (km) (15 miles [mi]) south of the NTS as Ash Meadows National Wildlife Refuge. These lands are managed for wildlife conservation, with an emphasis on bighorn sheep in the Desert National Wildlife Range and pupfish in the Ash Meadows National Wildlife Refuge.

The National Park Service manages a large block of land bordering Lake Mead and the Colorado River as part of the Lake Mead National Recreation Area, and another block of land west of Beatty, Nevada, as part of Death Valley National Park. Lands controlled by the National Park Service are managed for conservation and recreation.

The U.S. Forest Service manages a single segment of land west of Las Vegas as part of the Toiyabe National Forest. Other U.S. Forest Service lands are located just north of Tonopah. U.S. Forest Service lands are used chiefly for recreation.

AMERICAN INDIAN LAND—The Moapa River Indian Reservation is 48 km (30 mi) northeast of Las Vegas and is the largest reservation in the region. Other reservations include the Las Vegas Indian Reservation, which is located about 24 kilometers (15 miles) northwest of Las Vegas, and the Fort Mojave Indian Reservation at the southern tip of Clark County. Within this region, there also are several Indian reservation schools, tribal enterprises, tribally controlled schools, tribal police departments, and tribal emergency response units. The following reservations are located within the region: Duckwater Shoshone Tribe, Las Vegas Paiute Tribe, Moapa Paiute Tribe, and the Yomba Shoshone Tribe. In addition, there are tribes which are located geographically outside of the region, but are potentially impacted by NTS activities. (One of these tribes is the Timbisha Shoshone Tribe, based in Death Valley, California and is located closer to the Nevada Test Site than many towns in northern Nye County). As a consequence of this proximity, people from the Timbisha Shoshone Tribe, are a part of the social and economic region of influence of the NTS. For example, students from the Timbisha Shoshone Tribe attend public school in Beatty, Nevada, whereas many Shoshone students from Tacopa, California attend school in Pahrump, Nevada. Timbisha tribal members both work and shop in Clark and Nye counties.

The Pahrump Paiute Tribe, located in Pahrump Valley, is composed of Indian people who have been historically recognized by state and federal agencies as qualified to receive services as Indian people, and who as a group are currently seeking federal acknowledgment.

STATE LAND—The state of Nevada manages the Valley of Fire State Park. This park is used for recreational purposes and is located about 64 km (40 mi) northeast of Las Vegas. Other small parcels of undeveloped state lands are scattered throughout the region.

PRIVATE LANDS—The Las Vegas Valley and nearby Boulder City contain the single largest block of private land in the region. Pahrump Valley, located about 32 km (20 mi) south of the NTS, also contains large amounts of private land, but relatively little of this land has been developed. Large blocks of private land occur also in the Overton area at the north end of Lake Mead, in Coyote Spring Valley immediately east of the Desert National Wildlife Range, and in the Amargosa Desert, 16 km (10 mi) northwest of Ash Meadows National Wildlife Refuge. These lands are used chiefly for agriculture, with smaller amounts dedicated to residential and business development. Other small blocks of private agricultural lands are scattered around many of the small communities in the region.

6.1.4 Information Sources

Resource management plans, and EISs associated with their implementation, have been prepared by the U.S. Bureau of Land Management for the NAFR Complex (BLM, 1990) and the Stateline and Tonopah resource areas (BLM, 1994a; 1994b) near the NTS. A framework for a resource management plan has been prepared for the NTS and is included as Volume 2 of the NTS EIS. Such plans are designed to guide and control future management actions, including the development of limited and more detailed plans for specific resources and land uses. Resource management plans identify objectives for each resource area, management direction designed to attain these objectives, and restricted land-use designations associated with the management direction (where appropriate).

The resource categories commonly considered in resource management plans, include air, soils, water, vegetation, riparian, visual, fish and wildlife habitat, forestry, livestock grazing, wild horses and burros, cultural and paleontological, lands, natural areas, recreation, wild and scenic rivers, rights-of-way, minerals, fire management, and socioeconomic values.

The resource management plans and economic and demographic projections for the following geographic areas are:

- U.S. Bureau of Land Management Tonopah Resource Area
- U.S. Bureau of Land Management Stateline Resource Area
- Nellis Air Force Range
- Clark County Region Economic and Demographic Projections
- Nye County Economic and Demographic Projections.

6.2 Past, Present, and Reasonably Foreseeable Future Actions

In the following subsections, the past, present, and reasonably foreseeable future action of federal agencies, non-federal (public and private) entities, and American Indian Tribes, which contribute to the cumulative impacts, are presented.

6.2.1 Past and Present Actions

Past and present actions associated with activities of the DOE and other public and private entities are included in the baseline conditions described in Chapter 4, Affected Environments.

6.2.2 Reasonably Foreseeable Future Actions

Reasonably foreseeable future projects are presented below under the following three categories: federal, non-federal (public and private), and American Indian. Following the description of plans and programs, the relationships between their implementation and potential environmental impacts (by resource area) are presented.

FEDERAL ACTIONS—Actions of agencies of the federal government included in this section are those of the DOE, U.S. Air Force, Department of the Interior (U.S. Bureau of Land Management and U.S. Fish and Wildlife Service), and U.S. Navy.

U.S. DEPARTMENT OF ENERGY—Site characterization studies at Yucca Mountain in Nye County, Nevada, are ongoing and designed to determine whether the site is suitable for the storage and isolation of high-level radioactive waste and spent nuclear fuel. Activities being carried out include surface-based studies, underground studies, laboratory tests, modeling, and various associated analyses. The purpose of these studies and tests is to determine whether (1) a geologic repository can be constructed and operated at the site in such a way that the health and safety of the public and workers are protected and (2) nuclear waste emplaced in a repository will remain isolated from the accessible environment.

The DOE anticipates making a recommendation to the President on the suitability of Yucca Mountain for the disposal of spent nuclear fuel and high-level radioactive waste in 2001. If found suitable, a license application for construction of the repository would be submitted to the Nuclear Regulatory Commission in 2002. Construction of the repository would only begin after the Nuclear Regulatory Commission grants a construction license. It is anticipated that construction would be complete and the repository would start operations in 2010.

In support of the process that led to the recommendation of the Yucca Mountain site as the location where site characterization activities would be carried out, the DOE prepared a site-specific Environmental Assessment (DOE, 1986). This document concluded that no significant adverse environmental impacts were expected from site characterization activities carried out at the Yucca Mountain site. Environmental impacts associated with site characterization activities are monitored and outlined in detail in an annual Site Environmental Report. Such reports have been prepared for calendar years 1991, 1992, 1993, and 1994 (DOE, 1992a; 1993; 1994a; 1995f). Until 1994, with the positioning of the tunnel-boring machine in the starter tunnel, the main focus of site characterization was on surface activities. During the entire period covering site characterization activities, the DOE has complied with all environmental requirements and permit conditions. In addition, numerous monitoring activities have been carried out, especially in the areas of radiological field studies, air quality, meteorology, cultural resources (archaeological and American Indian), water resources, and terrestrial ecosystems.

No significant adverse impacts are anticipated as a result of site characterization activities. According to the 1986 Yucca Mountain Environmental Assessment, limited impacts are expected to occur in the following resource areas: approximately 704 acres of surface soils will be disturbed, wildlife habitat will be disturbed, air quality will be affected through the generation of particulate and gaseous emissions, noise effects will temporarily impact sensitive receptors (wildlife), impacts to aesthetics will result from the construction of access roads; and additional trips on U.S. Highway 95 will occur but are not expected to affect the current level of service.

Estimates of these impacts are described in the Environmental Assessment. Annual monitoring, as described in the Site Environmental Reports, is conducted to ensure that impacts associated with site characterization activities remain well within the levels projected in the Environmental Assessment. Certain mitigation actions, including reclamation of disturbed lands, studies of the desert tortoise and its habitat, and archaeological monitoring, have been implemented as part of the site characterization program. (Areas scheduled for ground disturbance are also surveyed in advance to determine the presence of cultural and biological resources and appropriate mitigation measures, such as avoidance or collection of resources). Mitigation activities required as part of applicable site permits, such as dust suppression in conformance with air quality permits, are also implemented.

The cumulative impacts from site characterization activities at Yucca Mountain, added to the impacts anticipated from implementation of program alternatives analyzed in this EIS, are expected to be minimal. Because most of these anticipated impacts will occur on the NTS, the cumulative contribution to off-site, regional conditions is expected to be negligible. In addition, given the recent reductions in weapons testing activity at the NTS, cumulative impacts would be expected to have declined during the period of site characterization activities. Further discussion regarding potential cumulative impacts to specific resource areas and the general population can be found in Section 6.4, and are summarized in Table 6-1.

U.S. AIR FORCE—The major land area associated with activities conducted at the Nellis Air Force Base is that of the NAFR Complex. The NAFR Complex comprises 3,035,326 acres (of which 826,000 acres are administered by the U.S. Fish and Wildlife Service as the Desert National Wildlife Range) located in south-central Nevada. Included in the NAFR Complex are about 123 acres of private land (patented mining claims).

Environmental concerns that could contribute to cumulative impacts in a resource region of influence are addressed in the *Nellis Air Force Range Proposed Resource Plan and Final Environmental Impact Statement* (BLM, 1990). Two alternatives were identified in the *Resource Management Plan* and selected for detailed analysis. They were (1) No Action Alternative, or a continuation of current management direction within the framework of present laws and regulations, and (2) Preferred Alternative which is designed to improve rangeland vegetation conditions and wildlife habitat by achieving and maintaining the appropriate management level of the wild horse population in the planning area. Four major issues were identified for consideration: (1) vegetation, (2) wildlife habitat, (3) wild horse and burro management, and (4) cultural resources.

In addition to operational activities associated with the NAFR Complex, other potential actions include return of approximately 7,200 to 7,500 acres of NAFR Complex lands to the U.S. Bureau of Land Management (Donegan, 1995). It is anticipated that property currently managed by the Nellis Air Force Base will be returned to the U.S. Bureau of Land Management. The property is comprised of approximately 4,800 acres within the old small arms range located west of the Nellis Air Force Base near Interstate 15 and less than 3,000 acres located west of the Indian Springs Auxiliary Airfield.

U.S. BUREAU OF LAND MANAGEMENT—Resource management plans, and EISs associated with their implementation, have been prepared by the U.S. Bureau of Land Management for the Stateline and Tonopah resource areas.

The Stateline resource area comprises 3.7 million acres of public land in Clark and Nye counties. The resource area is bordered by the Caliente resource area, the U.S. Fish and Wildlife Service, the Desert National Wildlife Range, the NAFR Complex, and the NTS.

Table 6-1 Population projections

County	Year 2000	Year 2005
Clark County		
NTS EIS	1,223,541	1,380,920
Clark County Regional Transportation Plan	1,130,000	1,289,000
Clark County Desert Conservation Plan	1,088,197	1,205,070
Nye County	33,966	38,516

The *Resource Management Plan* (BLM, 1992) provides a detailed characterization of five resource management plans (Alternatives A through D and the No Action Alternative). Alternative D is the Bureau of Land Management's Preferred Alternative. Following public and agency review of the draft version of the NTS EIS, an additional alternative was developed (Alternative E) and a Supplemental EIS was issued in 1994 (BLM, 1994a). The alternatives are as follows:

- No Action Alternative—This represents a continuation of current management direction within the framework of present laws and regulations, including existing Memoranda of Understanding and Cooperative Agreements. The No Action Alternative also provides a baseline against which the environmental effects of implementing other alternatives are compared.
- Alternative A—This Alternative is designed to provide for a full spectrum of public land uses in the traditional sense of multiple-use and sustained yield. Consumptive and non-consumptive uses would be balanced.
- Alternative B—This alternative attempts to provide maximum opportunities for land-based growth and development needs of the state of Nevada while continuing to provide for multiple-use and sustained yield of the public lands.
- Alternative C—This alternative provides for the management of the public lands on an ecosystemic basis, with an emphasis on biodiversity, nonconsumptive uses, and the protection and recovery of the desert tortoise.
- Alternative D—This alternative is the U.S. Bureau of Land Management's Preferred Alternative and would continue to allow for the multiple-use of the public lands, permit maximum flexibility in the disposal of public lands, and provide for the protection and recovery of the desert tortoise.
- Alternative E—This alternative proposes management direction to provide for public land uses on the basis of multiple-use and sustained yield, while emphasizing biodiversity and the protection and recovery of the threatened desert tortoise.

The *Resource Management Plan*/EIS focuses on 10 management issues, each of which is incorporated in the alternative plans under assessment. The identified issues are as follows:

1. Land Tenure
2. Desert Tortoise
3. Mineral Development
4. Off-Highway Vehicle Use
5. Special Management Areas and Areas of Critical Environmental Concern
6. Utility Corridors
7. Rangeland Classification
8. Utility Corridor Locations and Widths
9. Minerals Management and Post Congressional Non-designation of Wilderness Study Areas
10. Desert Tortoise Habitat Management in Conformance with the Recovery Plan for the Desert Tortoise (Mojave Population).

The potential environmental consequences in each of the resource areas are assessed from a number of perspectives. For example, effects on air resources are assessed from the perspective of land management, recreation management, and minerals management. The effects on soils are addressed from the perspectives of livestock grazing management, recreation management, rights-of-way management, and minerals management. The effects (quantified in terms of disturbed land area) attributable to reasonably foreseeable future actions are identified in the *Supplement to the Stateline Draft Resource Management Plan and EIS (BLM, 1994a).*

The total area potentially disturbed over the 10-year period could reach approximately 197,000 acres.

The Tonopah resource area encompasses 6.1 million acres of land in Nye and Esmeralda counties of central Nevada. Significant resources and program emphases include locatable minerals, livestock grazing, wild horses and burros, real estate, cultural resources, and wildlife.

Four detailed alternative management scenarios were analyzed in the NTS EIS (BLM, 1994b) which aim at resolving six major issues:

- Alternative 1 (No Action Alternative)— This alternative represents a continuation of management under existing planning guidance and also provides a baseline against which the potential environmental impacts associated with implementation of the other alternatives are compared.

- Alternative 2—This alternative provides management with an emphasis on private economic development and economic diversity through the use of a wide range of resources. Lands will be made available for expansion and development while protecting sensitive resources.

- Alternative 3—This alternative provides for private economic development and economic diversity which are constrained by environmental safeguards designed for the preservation and enhancement of environmental systems, and for species diversity.

- Alternative 4—This alternative is the preferred alternative and it provides for the development of renewable and nonrenewable resources while ensuring that the preservation and enhancement of fragile and unique resources will occur.

The issues addressed in the *Tonopah Resource Management Plan* and accompanying EIS are outlined below:

1. Wild horses and burros (determine what intensity of management should be implemented to ensure a thriving natural ecological balance)

2. Special management areas (determine if lands should be given special management to protect high resource values)

3. Off-highway vehicle use (determine if lands should be limited or closed)

4. Management of released wilderness study areas (determine what objectives should be established for areas now designated by Congress as nonwilderness)

5. Utility corridors (determine lands for preferred routes for utility corridors and to minimize conflicts)

6. Locatable and fluid minerals (determine lands for closure to leasing or location of minerals, and lands for special considerations).

The total area potentially disturbed over the 10-year period could reach approximately 26,800 acres.

U.S. FISH AND WILDLIFE SERVICE—Approximately 28 bighorn sheep were recently introduced into the Spotted Range of the Desert National Wildlife Range. Their introduction involved the construction of two water developments (wildlife guzzlers), and a third is planned for the future. These water developments comprise two or three water tanks (11.356 to 15.141 liters [3,000 to 4,000 gallons] each), a surface water collection apron, and a drinking device. Potential impacts to biological resources would be minor.

U.S. NAVY—The U.S. Navy proposes to withdraw 189,000 acres of U.S. Bureau of Land Management land in Churchill County around existing training ranges to accommodate increased levels of flight training activity at Naval Air Station Fallon. The action is referred to as the Master Land Withdrawal. The objectives of the proposed action are fourfold: (1) meet training requirements for national defense, (2) fulfill established operation and Range Air Installation Compatibility Use Zone safety guidelines, (3) facilitate protection of the public from off-range ordnance, and (4) provide for continued public access to and safety on public lands adjacent to the military withdrawals. The withdrawn land would be managed for military purposes for a proposed term of 20 years. A Resource Management Plan will be developed for the withdrawn lands to provide for public safety by defining public uses compatible with military training operations (McMillan, 1995).

A number of sensitive issues were identified prior to scoping. They include land use (including public recreational uses), public health and safety, cultural resources, and unexploded ordnance on withdrawn lands. The principal concern is the proposed withdrawal of land. This potential issue is of a statewide nature and is not directly related to NTS programs.

NON-FEDERAL ACTIONS—This section includes information from the following public entities: state of Nevada, Clark County, and Nye County. Activities that would likely take place within the incorporated places of both Clark and Nye counties are assumed under the economic and demographic growth projections presented for each of the counties.

STATE OF NEVADA—Virtually all state involvement in development activities in the region involve regional transportation. This area of concern, and others related to it, are addressed under county governmental entities.

CLARK COUNTY—The Regional Transportation Plan for Clark County (Regional Transportation Commission, 1994) documents an average annual rate of population growth over the period 1980 to 1990 of 5.2 percent, and 5.7 percent for employment. The respective growth rates over the period 1990 to 2000 are projected to be 3.9 percent for population and 4.6 percent for employment. Over the period 2000 to 2015, these growth rates fall to 2.5 percent for both population and employment.

A number of factors will influence the rate of future development in the Las Vegas Valley. They include, but are not limited to, the availability of water, air quality, the strength of the tourism industry (the gaming sector in particular), the cost of housing, and the disposal of public lands making areas available for urban development.

Population projections for Clark County anticipate a population of between 1.1 x 10^6 and 1.2 x 10^6 persons by the year 2000. Population is expected to rise to between 1.2 x 10^6 and 1.4 x 10^6 persons by the year 2005 (see Table 6-1). It is further projected that approximately 58,000 acres of undeveloped land, in the Las Vegas Valley, will be converted to urban uses between 1996 and the year 2005. (See Table 6-2).

CLARK COUNTY DESERT CONSERVATION PLAN—The Clark County Desert Conservation Plan (Regional Environmental Consultants, 1995) was prepared for two reasons: (1) support an application for a Section 10(a) incidental take permit under the Endangered Species Act applicable to the desert tortoise, and (2) outline a strategy that will allow Clark County (as well as state and federal resource managers) to address the conservation and protection of habitat necessary to preserve other plant and wildlife resources to avoid the need for listing those species.

The incidental take of desert tortoises applies to an area of approximately 525,000 acres which comprises all non-federal land in Clark County and on approximately 2,900 acres of desert tortoise habitat associated with the Nevada Department of Transportation activities (rights-of-way and material sites) in Clark, Esmeralda, Lincoln, and Nye counties.

Over the permit period (30 years), it is estimated that about 114,000 acres of land (111,000 acres in Clark County and 2,900 acres in Nevada Department of Transportation rights-of-way and material sites) will be developed, most of which is desert tortoise habitat. In order to offset this destruction of desert tortoise habitat, the Desert Tortoise Recovery Plan proposed six distinct population segments or recovery units within the range of the Mojave population of the desert tortoise. Each recovery unit includes one or more Desert Wildlife Management Areas. The Desert Wildlife Management Areas that fall primarily in Clark County are Paiute-Eldorado, Coyote Spring, Gold Butte, and Mormon Mesa. The recovery units are located in areas of prime desert tortoise habitat

Table 6-2. Land area disturbed (acres)

Locality	Disturbed Area
Stateline Resource Area	197,000
Tonopah Resource Area	26,800
Las Vegas Valley	58,000
Nye County	2,100
Total	283,900

and are subject to a number of land-use constraints designed to optimize the survival and recovery of the desert tortoise in these areas. Funding for the program is derived mainly from the imposition of a $500-per-acre mitigation fee on development projects in the permit area.

NYE COUNTY—Several key economic and demographic forces influence future activities and the character of Nye County and the communities contained in it. They include the NTS, Tonopah Test Range, mining activity, tourist activity, commuting, migration patterns, local service sector activity, and demographic factors.

Baseline population projections prepared for the county (Nye County Board of Commissioners, 1993) indicate an average annual compound growth rate of 4.6 percent for the entire county over the period 1990 to 2010. However, this population increase is highly localized and concentrated in the Pahrump area. It is projected that this area will experience a growth rate of 7.6 percent annually over the time period. The share of total county population located in Pahrump is projected to increase from 42 percent in 1990 to 74 percent in 2010. This urbanization trend will entail the conversion of land currently in an undeveloped state. It is anticipated that over 2,000 acres of land will be converted to urban uses by the year 2005 (see Table 6-2). The rapid urban development occurring in Pahrump is fueled by the low cost of land, proximity to the Las Vegas metropolitan region, and relocation of retirees. This residential activity, in turn, creates development and construction of service activities and infra-structural improvements.

AMERICAN INDIAN ACTIONS—The following American Indian tribal organizations and representatives have been contacted: Pahrump Paiute Tribe, Pahrump, Nevada; Las Vegas Paiute Tribe, Las Vegas, Nevada; Moapa Paiute Tribe, Moapa, Nevada; Kaibab Paiute Tribe, Glendale, Arizona; Las Vegas Indian Center, Las Vegas, Nevada; Owens Valley Paiute Tribe, Lone Pine, California; Yomba Shoshone Tribe, Austin, Nevada; and Duckwater Shoshone Tribe, Duckwater, Nevada.

Information regarding reasonably foreseeable future actions was received from the Las Vegas Paiute Tribe. Plans have been developed for the construction of a destination resort to be located on the east side of the reservation fronting U.S. Highway 95. The core of the resort area will encompass 150 acres and will include a 450-room hotel/casino and four championship golf courses. A 300-acre theme park will be built next to the resort area. On the west side of the reservation, a planned development includes 200 single-family homes for tribal members, a laundry plant, a 20-mw solar park, and a solar research center. The Bureau of Indian Affairs has prepared an Environmental Assessment for the construction of the four golf courses.

6.3 Nevada Test Site Program Alternatives

A summary of the anticipated impacts associated with implementing each of the program alternatives, on a resource-specific basis, is presented in Table 3-5. An inspection of this table reveals minimal impact from new programs or projects at the NTS over the 10-year period. In general, the level of intensity of impacts declines from those projected under Alternative 1 (No Action) for those under Alternative 2 (Discontinue Operations) and Alternative 4 (Alternative Use of Withdrawn Lands). The intensity of potential impacts associated with implementation of Alternative 3 (Expanded Use) is expected to be higher than under Alternative 1 (No Action). Potential impacts to the three areas associated with the Solar Enterprise Zone facility (Eldorado Valley, Dry Lake Valley, and Coyote Spring Valley) represent new rather than incremental potential impacts as is the case of the NTS, the fourth Solar Enterprise Zone facility area.

6.4 Cumulative Impact Analysis

Most of the land near the NTS is held in public ownership by the U.S. Bureau of Land Management (contained in the Stateline and Tonopah resource areas, respectively), the U.S. Air Force (NAFR Complex), and the U.S. Fish and Wildlife Service (Desert National Wildlife Range), while much of the land in the Las Vegas Valley is privately owned and undergoing widespread and rapid conversion to urban uses. The following assessment of cumulative impacts associated with reasonably foreseeable future actions is based on information presented in EISs prepared by the U.S. Bureau of Land Management for the Stateline and Tonopah resource areas, an EIS prepared for the Resource Plan at the NAFR Complex, a general development scenario applicable to private lands in the Las Vegas Valley section of Clark County, and economic and demographic projections prepared by both Clark and Nye counties.

It is likely that large areas of land will be disturbed throughout the entire region because of changes in use. These changes include urban development, development of mineral resources, the opening of areas for recreational use, and development of utility easements. The vast majority of the projected urban development will occur in areas adjacent to the Las Vegas urban area; additional rapid development will be localized in southern Nye County.

It is projected that approximately 284,000 acres of land could be disturbed within the region during the 10-year period. Of this total, about 58,000 acres would be located in the Las Vegas Valley. The general location of this disturbance is presented in Table 6-2. Much of the land disturbance in the Las Vegas Valley and southern Nye County is attributable to the conversion of land from non-urban to urban uses in the Las Vegas metropolitan area of Clark County and around Pahrump in Nye County. A series of population projections exist for Clark County as seen in Table 6-1. For purposes of this analysis, the higher projections are used.

6.4.1 Land Use

It is anticipated that the major land-use designations and land users within the region will remain unchanged through the foreseeable future. Under Alternative 4, some NTS land could be returned to the U.S. Bureau of Land Management. This action, along with the possible return of small tracts of U.S. Air Force land to the public, would increase the amount of public land in this area. However, the NTS (and the NAFR Complex) would continue to form a large, continuous block of land closed to the public.

It is likely that, over the next decade, Congress will designate some U.S. Bureau of Land Management lands in southern Nevada for inclusion in the National Wilderness Preservation System. Management and use of these wilderness areas would be similar to their current management and use as wilderness study areas. Wilderness study areas not included in the National Wilderness Preservation System will be released for general use, thereby increasing the types of activities that can be conducted by the public on thousands of acres of U.S. Bureau of Land Management land.

Rapid urbanization in Las Vegas and its vicinity, and the potential sale of U.S. Bureau of Land Management land to accommodate this growth, would reduce the acreage of public-owned lands in this area.

Under Alternative 3, defense-related aircraft operations within the DOE and NAFR Complex airspace would increase gradually over a 10-year period. This increase and the expected increases in civilian aviation activities would not have an adverse cumulative impact on airspace use in southern Nevada. The majority of DOE and the Department of Defense (DoD) aircraft transiting to and from the DOE and NAFR Complex airspace use corridors that do not conflict with those routes flown by commercial aircraft between Las Vegas and other key cities.

6.4.2 Transportation

An increase of 1,030 one-way vehicle trips generated by an additional 4,400 workers employed at the NTS in 2005 under Alternative 3 (Expanded Use Alternative) would contribute negligible amounts to approximately 4.0 x 10^6 daily vehicle trips projected for the year 2005 by the Regional Transportation Plan (Regional Transportation Commission, 1994). The Regional Transportation Commission of Clark County has been actively engaged in highway improvement programs to relieve traffic congestion and reduce traffic accidents in Clark County.

TRANSPORTATION OF RADIOACTIVE MATERIALS—The cumulative impacts of the transportation of radioactive material consist of impacts from (1) historical shipments of radioactive waste and spent nuclear fuel to the NTS, (2) other historical shipments, (3) contributions made by the alternatives evaluated in the NTS EIS, (4) reasonably foreseeable actions that include transportation of radioactive material, and (5) transportation of general radioactive materials that are not related to a particular action.

The Yucca Mountain Repository EIS will consider other relevant transportation information and analyses, including the NTS EIS and other EISs prepared by the DOE to address other proposed actions. The Yucca Mountain Repository EIS will incorporate information from the NTS EIS, as appropriate, in its description of the existing environment as well as in its analysis of cumulative impacts. In this way, the DOE will ensure that the cumulative effects from all activities taking place or contemplated at the NTS are considered in its decisionmaking process, along with the public's comments on these activities.

The assessment of cumulative transportation impacts concentrates on the cumulative impacts of off-site transportation, because off-site transportation yields potential radiation doses to a greater portion of the general population than does on-site transportation. The collective dose to the general population and workers is the measure used to quantify cumulative transportation impacts. This measure of impact was chosen because it may be directly related to latent cancer fatalities using a cancer risk coefficient and because of the difficulty in identifying a maximally exposed individual for shipments throughout the United States spanning the period 1951 (the year corresponding to the start of operations at the NTS) through 2005, a 55-year period.

1. Historical Shipments to NTS

Collective doses from historical shipments of spent nuclear fuel to the NTS were summarized in Jones and Maheras (1994). Data for these shipments were available for 1971 through 1993 and were linearly extrapolated back to 1951 because data prior to 1971 were not available. The results of this analysis are summarized in Table 6-3.

Other collective doses from historical shipments of low-level waste, low-level mixed waste, and transuranic waste to the NTS were also estimated. From 1974 through 1994, there were about 8,400 of these shipments. The results of this analysis are also summarized in Table 6-3.

2. Other Historical Shipments

Collective doses from other historical shipments of radioactive material were evaluated in DOE (1995a). These include historical shipments associated with the Idaho National Engineering Laboratory, the Savannah River Site, the Hanford Site, the Oak Ridge Reservation, and Naval spent nuclear fuel and test specimens. The results of these analyses are summarized in Table 6-3.

3. Shipments for NTS Alternatives

The collective doses for radioactive waste shipments associated with the alternatives evaluated in this EIS are summarized in Volume 1, Appendix I of the NTS EIS. The number of waste shipments from off-site generators ranges from none in Alternative 2, Discontinue Operations, to about 40,000 shipments in Alternative 3, Expanded Use. The range of collective doses estimated to result from these shipments is summarized in Table 6-3.

4. Reasonably Foreseeable Actions

Transportation impacts may also result from reasonably foreseeable projects taking place within

Table 6-3. Cumulative transportation-related radiological collective doses and latent cancer fatalities (1951 to 2005) (Page 1of 2)

Category	Collective occupational dose (person-rem)	Collective general population dose (person-rem)
1. Historical shipments to the NTS		
Spent nuclear fuel (Jones and Maheras, 1994)	1.4	0.70
Radioactive waste	82	100
2. Other historical shipments (DOE, 1995a)	250	130
3. Shipments for alternatives evaluated in the NTS EIS	d	0.0 to 154.0[d]
4. Reasonably foreseeable actions		
Spent nuclear fuel management (DOE, 1995a; 1996a)	360	810
Waste Isolation Pilot Plant (DOE, 1994b)	2,900	8,400
Molybdenum-99 production (DOE, 1996b)	240	520
Tritium supply and recycling (DOE, 1995b)	--	--
Waste Management Programmatic EIS (DOE, 1995c)[a]	16,000	20,000
Surplus highly enriched uranium disposition (DOE, 1995d)	1,100	1,200
Storage and Disposition of Fissile Materials (DOE, 1996c)	--	2,400.0[b]
Stockpile Stewardship (DOE, 1996d)	--	170.0[b]
Container system for Naval spent nuclear fuel (USN, 1996)	18	24
Pantex (DOE, 1996e)	250.0[c]	490.0[c]
West Valley (DOE, 1996f)	1,400	12,000
Submarine reactor compartment disposal (USN, 1984)	--	0.053
Return of Cs-137 capsules (DOE, 1994c)	0.42	5.7
Uranium billets (DOE, 1992b)	0.50	0.014
Nitric acid (DOE, 1995e)	0.43	3.1
5. General transportation		
1951 to 1982	180,000	130,000
1983 to 2005	39,000	42,000

Table 6-3. Cumulative transportation-related radiological collective doses and latent cancer fatalities (1951 to 2005) (Page 2of 2)

Summary		
Historical	330	230
Shipments for alternatives evaluated in the NTS EIS	d	154
Reasonably foreseeable actions	22,000	46,000
General transportation (1951 to 2005)	220,000	170,000
Total collective dose	240,000	220,000
Total latent cancer fatalities	96	110

[a] Includes low-level mixed waste and low-level waste; transuranic waste included in DOE (1995c)
[b] Includes public and occupational collective doses
[c] Includes all highly enriched uranium shipped to Y-12
[d] Collective occupational dose included in the total for collective general population dose.

the timeframe of the NTS EIS (1996 to 2005), such as the transportation impacts contained in other DOE National Environmental Policy Act analyses.

- Shipments associated with the DOE Tritium Supply and Recycling Program
- The shipment of radioactive and hazardous wastes associated with the DOE Waste Management Program
- Shipments associated with the disposition of surplus highly enriched uranium
- Shipments associated with the storage and disposition of weapons-usable fissile materials
- The shipment of Defense Program materials associated with the DOE Stockpile Stewardship and Management Program
- Shipments of spent nuclear fuel associated with a proposed container system for Naval spent nuclear fuel
- Shipments of Defense Program materials associated with continuous operation of the Pantex Plant
- Shipments of radioactive waste associated with the West Valley Demonstration Project.

The results of these analyses are summarized in Table 6-3. For many of these analyses, a preferred alternative was not identified nor has a Record of Decision been issued. In those cases, the alternative that was estimated to result in the largest transportation impact was included in Table 6-3. It should be noted that although the DOE is presently determining the suitability of Yucca Mountain, Nevada, as a site for a geologic repository for spent nuclear fuel and high-level waste, these shipments were not included in this analysis because they are scheduled to start in 2010, which is outside the timeframe evaluated in this EIS.

There are also reasonably foreseeable projects that involve limited transportation of radioactive material: (1) shipment of submarine reactor compartments from the Puget Sound Naval Shipyard to the Hanford Site for burial, (2) return of cesium-137 isotope capsules to the Hanford Site, (3) shipment of uranium billets from the Hanford Site to the United Kingdom, and (4) shipment of low specific activity nitric acid from the Hanford Site to the United Kingdom. The results of these analyses are summarized in Table 6-3. While this is not an exhaustive list of projects that may involve limited transportation of radioactive material, it does illustrate that the transportation impacts associated with these types of projects are extremely low when compared to major projects or general transportation.

5. General Transportation

General transportation activities also take place that are unrelated to the alternatives evaluated in the NTS EIS or to reasonably foreseeable actions. Examples of these activities are shipments of radiopharmaceuticals to nuclear medicine laboratories and shipments of commercial low-level waste to commercial disposal facilities. The U.S. Nuclear Regulatory Commission evaluated these types of shipments based on a survey of radioactive materials transportation published in 1975 (NRC, 1977). Categories of radioactive material evaluated in the U.S. Nuclear Regulatory Commission document (1977) included limited quantity shipments, medical, industrial, fuel cycle, and waste shipments.

Because comprehensive transportation doses were not available, collective dose estimates derived from transportation dose assessments in the U.S. Nuclear Regulatory Commission document (1977) were used to estimate transportation collective doses for 1951 through 1982 (32 years). These dose estimates included spent nuclear fuel and radioactive waste shipments made by truck and rail. The cumulative transportation collective doses for 1951 through 1982 are summarized in Table 6-3. The cumulative transportation doses for 1983 through 2005 are also summarized in Table 6-3.

The total worker and general population collective doses are summarized in Table 6-3. Total collective worker doses from all types of shipments (historical, the alternatives, reasonably foreseeable actions, and general transportation) were estimated to be 240,000 person-rem (96 latent cancer fatalities) for the period 1951 through 2005 (55 years). Total general population collective doses were estimated to be 220,000 person-rem (110 latent cancer fatalities). The majority of the collective dose for workers and the general population was because of general transportation of radioactive material. The total number of latent cancer fatalities over the period 1951 through 2005 was estimated to be 210. Over this same period (55 years), approximately 27,000,000 people would die from cancer, based on 510,000 latent cancer fatalities per year (U.S. Bureau of the Census, 1993). The estimated number of transportation-related latent cancer fatalities attributable to NTS alternatives would be indistinguishable from other latent cancer fatalities, and the transportation-related latent cancer fatalities attributable to NTS alternatives would be 0.0008 percent of the total number of latent cancer fatalities.

<u>VEHICULAR ACCIDENT IMPACTS</u>— Fatalities involving the shipment of radioactive materials were surveyed for 1971 through 1993 using the Radioactive Material Incident Report database. For 1971 through 1993, 21 vehicular accidents involving 36 fatalities occurred. These fatalities resulted from vehicular accidents and were not associated with the radioactive nature of the cargo. No radiological fatalities because of transportation accidents have ever occurred in the United States. During the same period, over 1,000,000 persons were killed in vehicular accidents in the United States.

For the alternatives evaluated in the NTS EIS, zero to eight vehicular accident fatalities are estimated to occur. During the 10-year period from 1996 through 2005, approximately 400,000 people would be killed in vehicular accidents in the United States. The vehicular accident fatalities associated with NTS radioactive waste shipment would be 0.002 percent of the total vehicular number accident fatalities. Activities related to the NTS would not measurably increase regional vehicular fatalities.

6.4.3 Socioeconomics

Cumulative socioeconomic impacts are defined as impacts generated by NTS activities under Alternative 3 (Expanded Use), which represents maximum impacts, added to the impacts generated by all economic activities projected for Clark and Nye counties in the year 2005. Employment and population projections embracing all economic activities including the continuation of current NTS-related activities as described under Alternative 1 were based on Economic Outlook (Schwer, 1995) and Draft Baseline Economic and Demographic Projections: 1990-2010 (Nye County Board of Commissioners, 1993). Impacts on selected socioeconomic indicators are presented in Table 6-4. Employment associated with activities at the NTS under Alternative 3 would contribute 2 percent of the projected employment level in

Table 6-4. Cumulative socioeconomic impacts

Socioeconomic Indicators	NTS Activities (Alternative 3) 2005	All Other Economic Activities 2005	Cumulative Impacts 2005	Percent Change (attributable to NTS activities)
Clark County				
Total Jobs	12,857.00	650,413.00	663,270.00	2.00
Personal Income ($million)	633.00	32,281.00	32,914.00	2.00
Population	10,020.00	1,380,920.00	1,390,940.00	0.70
Unemployment Rate (percent)	(1.10)	5.80	4.70	Not Applicable
Nye County				
Total Jobs	516.00	15,445.00	15,961.00	3.30
Personal Income ($million)	31.00	781.00	812.00	4.00
Population	656.00	38,516.00	39,172.00	1.70
Unemployment Rate (percent)	(0.50)	5.20	4.70	Not Applicable

Clark County in the year 2005 and reduce the projected unemployment rate by just over one percentage point. Although the total number of jobs held by residents of Nye County are significantly less than those held by Clark County residents, they correspond to 3.3 percent of the projected labor force in the year 2005. This NTS-related employment will reduce the unemployment rate by one half of one percentage point.

Under Alternative 2 there would be a reduction in employment at the NTS. There would be a reduction of almost 750 jobs held by Nye County residents which represents 5.5 percent of the projected labor force in 1997, the year when minimal site employment levels are reached.

Given the considerable growth of the economies of both Clark and Nye counties, it is estimated that increases or decreases of the magnitude referenced above will not severely impact the ability of county government to provide adequate public services to their residents. No fiscal impacts to cities and counties are anticipated.

6.4.4 Geology and Soils

Actions related to underground testing would add incrementally to the levels of subsurface contamination in underground nuclear zones. For tests conducted more than 100 m (328 ft) above the water tables, there would be an incremental increase in the deposition of radioactive materials in the subsurface and the activation of naturally occurring elements bound in the rock in the near test environments. Underground subcritical dynamic experiments would result in incremental increases in the deposition of radioactive material in the mined cavities of the Lyner Complex. The land surface would be unaffected by these experiments.

Excavation of contaminated soils during remediation will result in a substantial, but temporary, increase in disturbed areas. These areas will be regraded and revegetated, however, rendering the impacts temporary.

The continued restriction of the NTS to mining activities will result in the continued loss of some mineral resources and potential geothermal resources. The use of aggregate resources for construction will result in a cumulative impact to regional aggregate mining. However, aggregate resources are more than adequate to fill projected regional needs and the impact will not be significant.

Discontinuation of activities at the site would result in an increase in the areas of geological media and soils that are irretrievably lost as a resource.

6.4.5 Hydrology

Testing-related actions would add incrementally to the levels of subsurface contamination in underground testing areas if any tests are conducted under or within 100 m (328 ft) of the water table.

Groundwater withdrawals on the NTS in excess of historic pumping levels, in conjunction with existing water withdrawals, will decrease the water available for future appropriation in the Death Valley flow system. The only action that would cause water withdrawals to exceed past levels would be the construction and operation of a Solar Enterprise Zone facility. The impacts of water withdrawals for a Solar Enterprise Zone facility are expected to be limited to a lowering of water levels at the NTS. No incremental impacts to downgradient water levels or water quality are anticipated. The withdrawal of water for a Solar Enterprise Zone facility in Clark County would add incrementally to the overall demand for water and would decrease the water available for future appropriation in the Colorado River flow system.

If a Solar Enterprise Zone facility is located in Eldorado Valley, water supplies would come largely from existing allocations and there would be minimal or no cumulative impact on groundwater availability. The Las Vegas Valley Water District once planned to import water from rural areas; however, if this plan proceeds, actual development will not occur within the 10-year planning period covered by the NTS EIS. An incremental demand for water in the Las Vegas basin may occur in response to population increases attributable to the proposed actions. However, such increases are not expected to be large.

6.4.6 Biological Resources

Cumulative impacts to desert tortoises would occur throughout the region, although the intensity of the impact would vary from location to location depending on the habitat. Impacts in the Las Vegas Valley could be substantial. The Clark County Desert Conservation Plan is authorized to take all tortoises on 110,000 acres of non-federal land in the county, and on 2,900 acres disturbed by Nevada Department of Transportation activities in Clark County and adjacent counties. Because the Las Vegas Valley does not have large "islands" of habitat capable of sustaining viable populations, the loss of habitat is not expected to jeopardize the continued existence of the Mojave population of the desert tortoise.

The Biological Opinion for the Yucca Mountain Site Characterization Project authorizes the incidental killing or injury of 15 tortoises, but only 4 have been killed along roads in the 6 years since the opinion was issued. The number killed is expected to decline further because surface disturbing activities have been largely completed.

The Draft Biological Opinion for the NTS (U.S. Fish and Wildlife Service, 1996) authorizes incidental take of: three desert tortoises injured or killed per year as a result of project activities; ten tortoises taken through capture and displacement from project sites; an unknown number taken through predation by ravens; an unknown number of tortoise eggs destroyed during construction activities; an unknown number taken indirectly in the form of harm or harassment through increased noise associated with operation of heavy equipment; and a total of 3,015 acres of desert tortoise habitat disturbed. No tortoises were killed due to project activities and only four have been killed along roads in the four years since an earlier opinion for the NTS was issued (U.S. Fish and Wildlife Service, 1992). Because similar rates of mortality are predicted for the future, the most important consideration would be that given to desert tortoise habitat. Under the Expanded Use Alternative approximately 15,600 acres of habitat would be disturbed. The areal extent of these disturbances within desert tortoise habitat won't be known until project sites are selected. Even if all of the disturbances were in tortoise habitat, which is unlikely, the loss would represent a small amount of available habitat, and negative effects on the tortoise population would be unlikely..

Because the NTS is surrounded by federal lands that are managed in part for wildlife, it is also unlikely that the small amount of habitat disturbed would negatively affect other biological resources.

Since historic groundwater withdrawals, including those from Yucca Flat at rates beyond the perennial yield, have not resulted in any detectable impacts on water table levels, no cumulative impacts on flora and fauna associated with Devils Hole or Ash Meadows are anticipated.

6.4.7 Air Quality

For the NTS, it is projected that construction activities under Alternative 3 would generate about 600 tons of fugitive dust (PM_{10}) per year. This level of construction-related grading activity will extend over a period of three years. This quantity of fugitive dust (PM_{10}) would comprise just over 3 percent of the total of 177,660 tons associated with land disturbance activities throughout the region represented by the Stateline and Tonopah resource areas and the Las Vegas Valley.

Of the air sheds within which NTS-related activities are located, only the Las Vegas Valley metropolitan area is classed as a non-attainment area for carbon monoxide. Quantities of other criteria pollutants associated with activities proposed under Alternative 3 would not generate a measurable increase in the Las Vegas metropolitan area. It is projected that quantities of carbon monoxide generated by mobile sources associated with NTS activities in Clark County would contribute 90 tons per year to the projected 47,532 tons per year identified in the Regional Transportation Plan of Clark County (Regional Transportation Commission, 1994). Such an increment represents less than 0.2 percent of the Clark County pollutant burden. This contribution would not produce any additional violations of the carbon monoxide ambient air quality standard. The Regional Transportation Commission of Clark County, Nevada, has determined that the Regional Transportation Plan conforms with the applicable State Implementation Plan for the National Ambient Air Quality Standards. Project-related mobile source emissions distributed throughout Nye County would not increase ambient pollutant concentrations above ambient standards.

6.4.8 Noise

At the regional level, it is expected that ambient noise levels will increase, especially in areas undergoing urban development and those that are adjacent to industrial and mineral extraction activities. Noise impacts associated with activities at the NTS will be restricted to the geographical area contained therein and would not affect persons resident in adjacent areas or add measurably to regional noise levels.

6.4.9 Visual Resources

The visual character of the region will change in selected areas especially in those undergoing urban development and near mineral extraction activities. In such areas, natural landscapes will be modified by human activities. In those areas undergoing development, it is anticipated that activities associated with the implementation of program alternatives will have only a minor effect on visual resources. In the case of a Solar Enterprise Zone facility, implementation would have more noticeable effects.

6.4.10 Cultural Resources

As a result of DOE activities, 40,492 acres on the NTS have been surveyed for cultural resources. The area surveyed represents approximately 4.7 percent of the land surface of the site. A site density of 0.043 sites per acre is estimated for the NTS. This estimate is based on the recording of 1,764 sites for DOE projects. This site density represents an average based on all of the sites recorded on the NTS. However, it must be recognized that site density can vary significantly with location.

General site densities for surrounding areas have been estimated by the U.S. Bureau of Land Management. Based on data for the Tonopah resource area, site density is estimated to be approximately 0.024 sites per acre. Also, according to the State Historic Preservation Officer's (SHPO) records, approximately 12 percent of all sites identified in Nevada are found to be eligible.

For non-NTS programs and projects, it is estimated that approximately 284,000 acres of land are likely to be disturbed over the next decade. About 80 percent of this disturbed acreage is located on federal lands and is associated with federal or state actions, with the remaining 20 percent attributable to development on privately held land. Using a site density value derived from the NTS, over 12,000 sites may be located within the disturbed area of the region. Approximately 1,460 of these sites may be eligible for inclusion in the National Register of Historic Places.

Impacts to cultural resources will occur through ground-disturbing activities, unauthorized artifact collecting, and vandalism. This may result in a loss of over 12,000 sites, 1,460 of which may be eligible for the National Register of Historic Places. Cultural resources associated with federal and state projects will be subject to Section 106 of the National Historic Preservation Act. For these cultural resources, identification, evaluation, and data recovery are likely to occur resulting in increases of cultural resources information to the regional database. Cultural resources on about 20 percent of the acreage disturbed (located on privately held land) may be destroyed without data recovery, resulting in a serious loss of the information value inherent in these nonrenewable resources.

For the combination of NTS and non-NTS programs and projects, it is estimated that between 284,000 and 300,000 acres are likely to be disturbed in the next 10 years. NTS programs and projects account for between 3.5 to 5.5 percent of the overall disturbed acreage. Using a site density value derived from the NTS, ground-disturbing activities at the NTS could result in the potential loss of an additional 670 sites under Alternative 3. Of these, about 80 may be eligible for the National Register of Historic Places. The addition of these NTS-related impacts to those attributable to all other activities could raise the number of potentially lost sites to between 12,200 and 12,900. Of these sites, between 1,460 and 1,550 could be eligible for the National Register of Historic Places.

6.4.11 Occupational and Public Health and Safety

Based on occupational injury and fatality rates for construction and other industrial activities, NTS actions would result in up to 775 injuries and 9 fatalities over the 10-year period evaluated in the NTS EIS. The NTS actions should not elevate regional rates, which should remain unchanged. Occupational radiation exposure to the worker population could be about 380 person-rem over the 10-year period, resulting in 0.128 latent cancer fatalities and about 1 in 17 of any other detrimental health effects in the worker population. Over the same period, the worker population would receive about 9,000 person-rem from naturally occurring cosmic radiation and radon, airplane travel, and personal medical procedures (X-rays, radiodiagnostics).

The remote location of the NTS insulates the general public from NTS activities. Potential impacts to the public from routine airborne emissions of radioactivity and priority pollutants would be minimal. Over the same period, the population in the Las Vegas Metropolitan planning area would receive a radiation dose of about 3.0×10^6 person-rem from naturally occurring cosmic radiation and radon, airplane travel, and personal medical procedures (X-rays, radiodiagnostics). No impacts to the public from exposure to groundwater containing radioactivity from past activities would be expected during the 10-year period evaluated in the NTS EIS.

6.4.12 Environmental Justice

American Indian Environmental Justice concerns, as identified by the Consolidated Group of Tribes and Organizations, include holy land violations, perceived risks from radiation, and cultural survival. Increased land disturbance associated with all forms of development in the region of influence could result in a decrease in access to these areas for American Indians. Limiting access could reduce the traditional use of the area and affect its sacred nature. Increased development throughout the region of influence has the potential for greater disturbance and vandalism of American Indian cultural resources. Such impacts would be perceived, in the main, by American Indian groups who would comprise the population group experiencing disproportionate impacts as a result of project implementation.

6.5 Summary of Cumulative Impacts

A summary of cumulative impacts described on a resource-specific basis is presented in Table 6-5.

Table 6-5. Summary of cumulative impacts (Page 1 of 4)

Resource	Non-NTS Activity Impacts	NTS Program Alternative Impacts	NTS Contribution to Cumulative Impacts
Land Use	Over the period 1996-2005, it is likely that changes in ownership involving the disposal of public lands in the Las Vegas area will continue. As the Las Vegas metropolitan area continues to expand, land-use development and zoning regulations will extend over a larger geographical area. Where land-use zoning regulations are absent, as in Nye County, incompatible land-use patterns may evolve. The number of civilian aircraft operations in the region will increase as the levels of population and economic activity grow. Military aircraft operations associated with activities at Nellis Air Force Base and the NAFR Complex are expected to increase gradually over the next decade.	Activities at the NTS under all alternatives are not expected to effect land-use patterns or land ownership in measurable ways. The majority of DOE and DoD aircraft transiting to and from the NTS/NAFR Complex use existing corridors that are adequate to accommodate future use. These corridors do not conflict with routes flown by commercial aircraft.	Activities at the NTS are expected to have negligible effects on regional land-use patterns and land ownership. Activities at the NTS would have negligible effects on regional airspace and its use.
Transportation	Rapid urban development will continue to place pressure on existing transportation infrastructure. Level of service on key roads within the metropolitan Las Vegas region and on segments of I-15, U.S. Hwy.95, and U.S. Hwy.93 could deteriorate to unacceptable levels by the year 2000. Approximately 4.0×10^6 vehicle trips per day are projected for Clark County in the year 2005. Planned highway improvements over the next two decades are expected to meet the increased vehicle use. Impacts of transportation of radioactive materials consist of impacts from (1) historical shipments of radioactive waste and spent nuclear fuel to the NTS, (2) other historical shipments, (3) contributions made by the alternatives evaluated in the NTS EIS, (4) reasonably foreseeable actions that include transportation of radioactive material, and (5) transportation of general radioactive materials that are not related to a particular action.	Virtually all impacts to transportation would occur on site under all project alternatives. Maximum off-site impacts would occur under Alternative 3 as additional workers at the NTS commute over regional highways. Such impacts are expected to be negligible. In the year 2005, NTS-related activities would add approximately 1,030 one-way vehicle trips per day to approximately 4.0×10^6 occurring daily in Clark County. Trucks bringing radioactive wastes to NTS would increase from 2 under Alternative 1 to 11 under Alternative 3. The total number of waste shipments from off-site generators could reach 40,000 under Alternative 3. The collective general population dose (person-rem) could reach 154.0.	Impacts to regional transportation facilities associated with NTS activities will comprise a negligible increment. The estimated number of transportation-related latent cancer fatalities attributable to NTS Alternative 3 would be indistinguishable from other latent cancer fatalities. They would comprise 0.0008 percent of the total number of latent cancer fatalities.
Socioeconomics	Population in Clark County is projected to increase to approximately 1.2×10^6 persons by the year 2000 and 1.4×10^6 by the year 2005. This rapid growth could result in substantial increases in demand for housing, schools, and other public services. Additional expenses associated with construction of new facilities and personnel could produce adverse conditions in the area of public finances for local jurisdictions and service providers.	NTS-related activities under Alternative 3 would add only 10,000 persons to a projected population of approximately 1.4 million in Clark County in the year 2005. This minor (less than 1-percent) increase would not result in adverse socioeconomic impacts. Under Alternative 2, some out-migration of NTS workers and their families from the region could occur. Impacts would be negligible.	In- and out-migration potentially associated with Alternatives 3 and 2, respectively, would contribute only negligible impacts to regional socioeconomic effects.

Table 6-5. Summary of cumulative impacts (Page 2 of 4)

Resource	Non-NTS Activity Impacts	NTS Program Alternative Impacts	NTS Contribution to Cumulative Impacts
Geology and Soils	Geological resources include sand and gravel, mineral products, petroleum and natural gas, and geothermal resources. Continued urban development will influence the demand for sand and gravel with the demand for other resources related more to national and international market forces.	Types of activities at the NTS relate to subsurface contamination through underground testing. Restrictions placed on public access to the site adversely impact the use of mineral and geothermal resources.	It is not anticipated that continued inaccessibility of mineral and geothermal resources at the NTS will result in measurable adverse impacts. These resources are widespread in their occurrence and exist in adequate quantities to fulfill anticipated regional needs.
Hydrology	Rapid urban development in the Las Vegas area and southern Nye County has contributed to a state of groundwater overdraft. This condition is likely to be exacerbated as water made available through allocation from the Colorado River is committed.	Groundwater withdrawals on the NTS in excess of historic pumping levels will decrease the water available for future appropriation in the Death Valley flow system. Such increases in withdrawals would be associated with the location of the Solar Enterprise Zone on the NTS. The location of this proposed facility could lower water table levels on the NTS.	Any additional demand for water derived from groundwater sources could exacerbate an existing overdraft condition. Although the development of the Solar Enterprise Zone has the possibility of lowering the water table on the site (or at other potential locations offsite), water withdrawals associated with its operation are not expected to affect downgradient water levels or water quality.
Biological Resources	Development and implementation of the Desert Tortoise Recovery Plan is designed to ensure the sustainability of the species. It is unlikely, however, that the species will survive in large sections of the Las Vegas Valley. The Clark County Desert Conservation Plan authorizes the "take" of all tortoises on 110,000 acres of non-federal land in the county. The Plan designates several recovery units located in areas of prime desert tortoise habitat that are subject to a number of land-use constraints designed to optimize the survival and recovery of the species in these units.	The potential exists for disturbance to as much as 15,600 acres of land at the NTS under Alternative 3. Such a loss represents a small amount of the available habitat, and adverse effects to the desert tortoise are not anticipated.	Activities at the NTS will not add measurably to the loss of desert tortoise habitat.

Table 6-5. Summary of cumulative impacts (Page 3 of 4)

Resource	Non-NTS Activity Impacts	NTS Program Alternative Impacts	NTS Contribution to Cumulative Impacts
Air Quality	The Las Vegas metropolitan area is a nonattainment area for PM_{10} and carbon monoxide (CO). It is anticipated that continued rapid urban development will exacerbate these conditions. The Regional Transportation Commission of Clark County has prepared a Regional Transportation Plan which would allow the county to be in conformity with the State Implementation Plan for all National Ambient Air Quality Standards (NAAQS). Nye County is in attainment for all criteria pollutants.	Much of the local impact under Alternative 3 is associated with ground disturbance and the generation of fugitive dust (PM_{10}). The NTS is located in Nye County and, although activities would increase quantities of dust, it is not expected that State and national ambient air quality standards would be exceeded. Only a small portion of the pollutants associated with mobile sources would occur in Clark County. Although this would add approximately 90 tons per year of carbon monoxide (CO) to the projected CO emissions of 47,532 tons per year in Clark County by the year 2000, it would not create additional violations of the CO ambient air quality standard. Marginal improvements in air quality standards could be expected under Alternative 2.	With implementation of the Regional Transportation Plan in Clark County, it is expected that conformity with the State Implementation Plan for all National Ambient Air Quality Standards will be achieved. Effects associated with NTS activities are not expected to hinder this achievement of conformity. It is not expected that ambient air quality standards in Nye County would be exceeded in the near future.
Noise	In areas undergoing urban development, ambient noise levels can be expected to increase. In areas lacking land-use controls to guide development, incompatible land uses could occur.	Noise impacts associated with activities at the NTS have the potential to affect only an extremely small number of persons because of constraints that exist for access to the site by the general public.	Activities associated with implementation of Alternative 3 would not add measurably to regional noise levels.
Visual Resources	The visual character of areas would change as urban development and mineral extraction activities continue.	No significant changes are expected to occur to existing facilities at the NTS under Alternatives 1, 3, and 4. Under Alternative 2, deterioration of facilities could occur that would marginally degrade the visual environment.	Facilities at the NTS are not accessible to the general public, and impacts would have a negligible impact on regional visual resources
Cultural Resources	As a result of ground-disturbing activities and unauthorized artifact collecting, over 12,000 sites, 12 percent of which (1,460) may be eligible for the National Register of Historic Places, will be adversely affected. Cultural resources found on private lands may be destroyed without data recovery, resulting in a serious loss of the information value inherent in these nonrenewable resources.	Ground-disturbing activities at the NTS could result in the potential loss of an additional 670 sites under Alternative 3. Of these, about 80 may be eligible for the National Register of Historic Places.	The addition of these NTS-related impacts to those attributable to all other activities could raise the number of potentially lost sites to between 12,200 and 12,900. Of these sites, between 1,460 and 1,550 could be eligible for the National Register of Historic Places.

Table 6-5. Summary of cumulative impacts (Page 4 of 4)

Resource	Non-NTS Activity Impacts	NTS Program Alternative Impacts	NTS Contribution to Cumulative Impacts
Occupational and Public Health and Safety	With the number of persons residing and working in the region, the number of injuries and fatalities will increase. However, injury and mortality rates should remain unchanged, or decrease, assuming the continued enforcement of occupational and public health and safety regulations.	Activities at the NTS could result in up to 775 injuries and 9 fatalities over the period 1996-2005. Occupational radiation exposure to the worker population at the NTS could be 380 person-rem, resulting in 0.128 latent cancer fatalities and 0.096 other detrimental health effects in the worker population.	Activities at the NTS contribute extremely small increments to the risks to which the general population is exposed on a daily basis and should not increase injury and mortality rates in the region.
Environmental Justice	The non-NTS programs and projects account for approximately 284,000 acres of land disturbance. Land disturbance of this size could have adverse impacts on Americans Indians who have expressed concerns about holy land violations and the continued survival of their culture.	Concerns that representatives of American Indian groups have expressed relative to activities at the NTS include holy land violations, perceived risks from radiation, and the continued survival of their culture. Land disturbance at the site could have adverse impacts in these areas of concern.	Land disturbance in the region, attributable to changes in use away from an undeveloped state, could potentially raise environmental justice concerns. The increment to such land disturbance contributed by proposed actions at the NTS would be minimal and would not add measurably to the level of concern.

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Chapter 7

MITIGATION MEASURES

CHAPTER 7
MITIGATION MEASURES

This section presents the mitigation measures that would be implemented by the DOE to reduce potentially adverse impacts to the environment. The four alternatives analyzed in this EIS represent a wide range of projects and activities that have associated with them a corresponding range of potentially adverse environmental impacts. There are, therefore, a range of mitigation measures that would be implemented and that are designed to ameliorate the potentially adverse impacts associated with specific activities. The mitigation measures presented in this chapter comprise a series of actions which address the full range of potential impacts likely to occur under the identified alternatives. They are summarized below by resource category. Where impacts and mitigation measures vary across alternatives, measures specific to each alternative are described. Under Alternative 2, closure of the NTS would include the development and implementation of monitoring programs necessary to protect human health and the natural environment. Under all alternatives, DOE will continue to maintain the Waste Minimization/Pollution Prevention Program as described in Appendix C, Section 6.

Throughout the history of the NTS, the DOE, the State of Nevada, Nye, Esmeralda, Clark, and Lincoln counties, and local communities have contributed to the success of the NTS. As Nye County encompasses most of the NTS land area, DOE has worked closely with Nye County as activities have changed over the years. In accordance with 10 CFR Part 1021.331 and in the interest of continuing this relationship with the state, counties, and communities, the DOE will prepare a Mitigation Action Plan. This document will describe the actions to implement commitments made in this EIS and its associated Record of Decision (ROD) to mitigate adverse environmental impacts associated with the alternative adopted through the ROD. The Mitigation Action Plan will be as complete as possible commensurate with information available regarding the course of action directed by the ROD. The DOE may revise the plan as more specific and detailed information becomes available.

7.1 Land Use

Impacts to land use in areas surrounding the NTS under Alternatives 1, 2, and 3, and at the off-site locations under Alternatives 1 and 2 would be minimal and require no mitigation. Under Alternative 4, there is a possibility that a portion of currently withdrawn lands would be relinquished to the U.S. Bureau of Land Management. Should this land be found suitable for return to the public domain, the U.S. Bureau of Land Management would determine the ultimate land management and use policies. The land-use impact under this scenario would be an increase in lands available for use by the public, and mitigation measures appropriate to the use designation would be developed and implemented by the U.S. Bureau of Land Management.

Land-use impacts on the NTS under Alternative 1, the continuation of current activities, and Alternative 3, expanded use, would be generally consistent with existing site and zone designations. Although certain activities would intensify and others would expand under Alternative 3, additional mitigation measures beyond those presently employed would not be required. Under Alternative 2, all activities would cease at the NTS and no new activities would be allowed. Access to, and use of, the lands would be restricted. Minimal monitoring and security operations would continue, and no mitigation would be required under this non-use scenario.

Activities that would occur outside the NTS boundaries under Alternatives 3 and 4, e.g., Solar Enterprise Zone facility development, have the potential to result in land-use impacts. Projects that are located on federal land or are funded by agencies of the U.S. Government will be subject to additional review under provisions of the National Environmental Policy Act. This review will require the identification of significant environmental impacts, including land-use impacts, and the formulation of measures to mitigate these impacts to the extent practicable.

No adverse impacts to airspace are identified requiring mitigation under any of the alternatives at any project location.

7.2 Transportation

The following sections contain the discussion on the mitigation measures for transportation.

7.2.1 On-Site Traffic

It is anticipated that no on-site roadway segments would degrade to unacceptable levels of service under any of the alternatives at any project site; therefore, no mitigation measures would be required.

7.2.2 Off-Site Traffic

Should Alternatives 1, 2, or 4 be implemented, no substantial adverse impacts to traffic conditions are expected near the NTS at the access highway State Route 433, the ramp roadways at the Mercury Highway interchange, at U.S. Highway 95, or at any other project site; therefore, no mitigation measures, other than the continuing busing program, would be necessary.

Under Alternative 3, the highway that accesses the NTS (State Route 433) would drop to a level of service D (acceptable) between the years 2000 and 2005. The NTS-related traffic contributes minimally to the Las Vegas area traffic demands. Similarly, no mitigation measures would be necessary for roadways in the immediate vicinity of the NTS.

Ongoing and future development in the Las Vegas metropolitan area would result in an increase in traffic volumes and congestion on key roadway segments (namely, on Interstate 15, U.S. Highway 95, and U.S. Highway 93). These key segments already operate at an unacceptable level of service F at peak hours, and their conditions could continue to deteriorate even without the activities associated with all alternatives. Currently, roadway improvements are being undertaken along Interstate 15 in downtown Las Vegas and at other locations. With the improvements planned under the Regional Transportation Plan of Clark County, the highway conditions are expected to improve. No additional mitigation measures are needed.

7.2.3 Transportation of Materials and Waste

Under Alternatives 1, 3, and 4, the routes used for truck shipments would be chosen using U.S. Department of Transportation routing guidelines. These guidelines are designed to reduce the radiological risks associated with transportation. According to the guidelines, primary factors include (1) the radiation exposure from incident-free transport, (2) the risk to public health from an accidental release of radioactive material, and (3) the economic risk from an accidental release of radioactive material. Secondary factors, according to the guidelines, include (1) emergency response effectiveness, (2) evacuation capability, (3) location of special facilities such as schools or hospitals, and (4) traffic fatalities and injuries unrelated to the radioactive nature of the cargo.

The EPA has developed protective action guides and protective actions that are designed to limit doses in the event of a nuclear incident. Use of these guides and actions under Alternatives 1, 3, and 4 will minimize the impacts of transportation accidents involving radioactive material. In addition, the DOE will take the following actions:

- Conduct full government-to-government consultation with American Indian tribes that would be affected by the transportation of low-level waste and low-level mixed waste to the NTS
- Conduct a comprehensive study of the potential social and cultural effects of low-level waste and low-level mixed waste transportation on affected American Indian tribes
- Meet with the Transportation Protocol Working Group regularly to discuss low-level

waste and low-level mixed waste transportation issues

- Respond to transportation concerns between meetings by phone calls, faxes, or personal meetings

- Continue to provide First Response and other emergency response training to all Nevada emergency response personnel

- Allow low-level waste and mixed waste shipments arriving at the NTS during off-hours to park in a secure area inside the gate

- Work with local emergency response agencies to determine their needs with regard to responding to emergencies involving low-level waste and low-level mixed waste and to help fulfill those needs as far as practicable

- Provide information to stakeholders concerning waste shipments

- Distribute surplus federal equipment to local agencies to the extent possible under current regulations concerning federal surplus disposition.

7.2.4 Other Transportation

All other transportation modes will follow guidelines established by the Department of Transportation, the Federal Aviation Administration, and all federal, state, and local laws and regulations under each alternative.

7.3 Socioeconomics

No long-term adverse impacts are associated with implementation of any alternative over the 10-year period of this EIS for any socioeconomic issue: economic activity, population, housing, public finance, or public service. The loss of employment and personal income and the increase in unemployment associated with Alternative 2 would result in substantial short-term adverse effects to the regional economy; however, economic and natural growth in the region of influence is expected to compensate for these reductions over time. Reductions in employment at the NTS relative to historical NTS employment levels are also inherent in Alternatives 1 and 4. While no long-term mitigation measures are required, the following supportive measures could be undertaken to the level appropriate for the alternative selected:

- Continue to extend economic adjustment efforts to reduce the impact of NTS downsizing on workers and small and medium sized companies. The DOE economic adjustment efforts could include actions such as enhanced coordination of DOE downsizing actions and employee assistance programs with public agencies and small and medium-sized companies who are current suppliers of goods and services (Alternatives 1, 2, and 4)

- Sponsor a joint local, state, and federal conference to promote a national and international environmental technology development center (Alternative 4)

- Act as a catalyst to develop joint proposals for research activities (Alternatives 1, 3, and 4).

<u>American Indian Socioeconomics</u>—*This section describes the American Indian concerns associated with implementing Alternative 1, as summarized by the CGTO.*

When Indian people are hired, special problems emerge for themselves, families and reservation communities. The DOE can assist in mitigating these problems by recognizing the exact nature of the problems and developing a culturally responsible approach to mitigating the problem. For example, an Indian employee may be required to attend a ceremony back on the reservation. When this situation occurs, the DOE could grant special leave status to the employee to participate in the ceremony. The children of the Indian employee may go to non-Indian schools causing cross-cultural stresses. The DOE could potentially mitigate this situation by developing an American Indian outreach/educational program directed at the school system and the surrounding communities. Cultural awareness activities could be implemented similar to the Yucca Mountain Project's outreach program which incorporates knowledgeable Indian people who share various *aspects of their culture. The DOE could encourage other Indian employees to participate in the development and implementation of these culturally specific programs.*

Reservation problems resulting from the loss of tribal members to external employment with the DOE/NV, cannot be fully identified without a systematic study of these issues involving the tribes. It is recommended that this issue be mitigated by the DOE/NV, and be specifically addressed by the DOE/NV Diversity Council. The CGTO potentially can serve as a management consultant to the DOE for the development and implementation of culturally specific programs which address the unique issues that may arise due to off-reservation migration caused by the employment of Indian people.

7.4 Geology and Soils

Impacts to geologic media by activities under Alternatives 1 and 3 can be generally categorized as disturbance, contamination, excavation, or instability. The magnitude of these impacts largely depends on the nature of the activities resulting in these impacts.

Disturbance to surface and subsurface geologic media and radioactive contamination of subsurface geologic media resulting from testing of conventional or nuclear weapons are inherent with the tests. Surface disturbance and the dispersion of contamination are mitigated by implementing containment practices. Containment practices also mitigate radioactive contamination of surface geologic media.

- Contamination of surface and subsurface geologic media from release of radionuclides from disposed waste is mitigated by administrative and physical controls. Siting, design, operation, and monitoring of waste management facilities on the NTS and NAFR Complex are conducted in accordance with relevant regulations. Physical controls include the various disposal and closure configurations. Contamination of surface and subsurface geologic media resulting from accidental spills is also mitigated by administrative and physical controls. Administrative controls include occurrence reporting, emergency response plans, and training. Physical controls include secondary containment and response equipment

- Excavation includes boreholes and tunnels for testing of conventional and nuclear weapons, grading for roads and facilities, borrow pits, boreholes and trenches for waste disposal, and grading for environmental restoration. Excavation for other purposes is mitigated by minimizing the area disturbed

- Surface disturbances will be mitigated on a site-specific basis, depending on various factors such as the size of the area, future use, nature of soils, annual precipitation, slope aspect, and site location. Following the removal of soils and vegetation, the site will be immediately stabilized using water or commercial-available soil stabilizers, such as polymers. Options to be considered for mitigation include natural revegetation, gravel rearmoring, chemical stabilization, seeding, planting, and irrigating. Where intensive revegetation techniques are necessary, subsoils may be amended and irrigations may be used. At drier sites, irrigation could be used to encourage germination and plant establishment. Instability of slopes resulting from excavation is mitigated as necessary to protect the environment or to ensure employee health and safety. The mitigation measures include administrative controls and physical controls such as shoring, bolting, and grouting.

Adverse impacts that would result from nuclear testing under Alternatives 1 and 3, should testing be resumed, would be unavoidable and could not be mitigated. Adverse impacts that would result from underground subcritical experiments using special nuclear material would be unavoidable and could not be mitigated.

No adverse impacts to geological resources are anticipated under Alternatives 2 and 4, and no mitigation measures are suggested.

7.5 Hydrology

Discussions of mitigation actions for surface hydrology and groundwater are presented in the following sections.

7.5.1 Surface Hydrology

Impacts to the surface hydrologic environment by activities under Alternatives 1 and 3 can be categorized generally as alteration of natural drainage, which potentially results in erosion or deposition of sediments, ponding of water, or inundation, and contamination. The extent of these impacts largely depends on the nature of the activities resulting in these impacts. Surface water quality impacts may result from the Environmental Restoration Program cleanup of plutonium-contaminated soils.

- The effects of altering natural drainage are mitigated by preactivity analysis of the flood potential and recommendations for minimizing direct and indirect flood hazards, followed by implementation of the recommendations. Typically, recommendations for minimizing direct and indirect flood hazards include construction of flood diversion structures

- Contamination may be mitigated by avoidance of surface water or groundwater contamination through lined storage/settlement ponds and environmental restoration of the affected area. Restoration typically might be excavation of contaminated geologic media, followed by grading and stabilization by revegetation

- With regard to the remediation of soils contaminated with plutonium, surface water controls will be implemented as part of the cleanup effort. However, there could be some breaching of control features resulting in the migration of contamination into downgradient areas. Such releases can be mitigated by expanding the soils media corrective action unit to include the area of release. The impacts would then be mitigated through the excavation of contaminated soils, removal of the plutonium, and return of the treated soils.

No adverse impacts to surface hydrology are anticipated under Alternatives 2 and 4, and no mitigation measures are proposed.

7.5.2 Groundwater

Potential adverse impacts on groundwater availability may be anticipated as a result of Alternatives 1, 3, and 4 actions. Large-scale groundwater withdrawals may be implemented to ensure there are no releases beyond the controlled NTS and NAFR Complex areas and other potentially affected areas via the flow of groundwater during Environmental Restoration Program activities. Any significant impacts on groundwater quality would be related to the underground testing program.

- Mitigation of groundwater availability impacts may be achieved through adjustments in the overall production of water from the well field and the drilling of new water supply wells, as required, and through the management of recharge and discharge areas in conjunction with the remedial action

- Under the Environmental Restoration Program, large-scale groundwater withdrawals may be implemented to ensure that no releases beyond the boundary of the site occur via the flow of groundwater. The potentially adverse impacts of such actions could be mitigated through the careful management of recharge and discharge areas in conjunction with the remedial action. These activities would occur as part of the underground test area corrective action unit.

The quantity and quality of groundwater resources could be substantially impacted under Alternative 3 if any of the following circumstances occur: (1) underground tests are conducted under or near the water table; (2) a Solar Enterprise Zone facility is located on the NTS; or (3) active groundwater controls are implemented under the Environmental Restoration Program.

Mitigation of the quantity of water available for appropriation in the affected basins surrounding a constructed Solar Enterprise Zone facility would not be required because the use of the water would be consistent with Nevada water laws. Although water use from Solar Enterprise Zone facility activities would be consistent with Nevada water laws, the private corporation implementing the technology would bear the responsibility of mitigating any adverse effects. The impacts of any water level declines can be mitigated through a number of potential actions: proper well field design and placement, moving the points of diversion farther away from potentially affected areas, optimizing water use, or importing water from adjacent areas.

7.6 Biology

The *Framework for the Resource Management Plan,* Volume 2 of this document, defines the ecosystem management principles which would be used to mitigate impacts related to biological resources:

- All reasonable and prudent measures required by the U.S. Fish and Wildlife Service to mitigate incidental taking of endangered or threatened species will be implemented
- Habitat disturbance may be partially mitigated by implementing a habitat reclamation program
- The DOE will conduct preactivity surveys to locate protected species such as candidates for listing under the Endangered Species Act, state-protected species, nests and eggs of migratory birds, individuals of a species that are locally rare (e.g. an isolated stand of Joshua trees on a bajada), references upon which these species may depend (e.g. free-standing water, burrows, nests), and other important biological resources such as Species of Concern. Project activities will be altered whenever possible to avoid harm.
- Migratory birds or other wildlife may drown or be exposed to drill-mud additives or could ingest chemicals in drill-fluid sumps, or evaporative tanks. These problems may be mitigated by placing flag lines that repel wildlife over the water sources, or by fencing or covering them.
- Impacts arising from military training exercises and other land-disturbing activities that have not yet been sited can be partially mitigated by developing and implementing a Resource Management Plan, which would be based on the principles of ecosystem management; identify sensitive areas, such as springs or habitats of rare species; and regulate harmful activities in those areas. This plan also would guide the collection of additional information needed to protect biological resources and the health and the ecosystem on the NTS. Volume 2 describes the DOE's framework for developing this *Resource Management Plan.*

Under Alternative 2, the following mitigation measure will be implemented:

- All reasonable and prudent measures required by the U.S. Fish and Wildlife Service to mitigate incidental taking of endangered or threatened species will be implemented.

7.7 Air Quality

Air quality mitigation measures under Alternatives 1, 3 and 4 at the NTS include the following:

- Continue the use of a central parking facility to transport workers to and from construction sites. Pooling the transportation of workers to remote sites from central parking localities would lower dust and carbon monoxide levels because fewer vehicle trips would be involved.
- Properly maintain construction vehicle engines requiring air pollution control equipment. Properly tuned equipment would emit fewer harmful pollutants. This measure is highly effective in minimizing local air degradation.
- Place speed restrictions for vehicles on unpaved roads. Dust levels generated by moving vehicles on unpaved roads are substantially reduced at low speeds. Imposing appropriate speed limits on these roads could effectively reduce fugitive dust.

- Continue to control fugitive dust by regularly watering the construction areas, as needed, thereby achieving a 50-percent reduction in emissions. This measure would be included in future construction contract specifications to minimize construction-phase emissions.

No air quality mitigation measures are required under Alternative 2 because there would be no adverse impacts.

7.8 Noise

No mitigation measures under any of the alternatives would be required at any of the project locations. However, should site activities exceed Occupational Safety and Health Administration noise level requirements, mandatory hearing protection for people working in the areas would be implemented.

7.9 Visual Resources

There would be no significant adverse impacts to visual resources under any of the alternatives. However, under those alternatives involving environmental restoration activities, areas would be revegetated with indigenous plants to return the sites to as natural an appearance as possible and to prevent excessive erosion and dust that could result in more serious, long-term adverse impacts. This measure would apply to all the project sites. Construction areas would be watered, as needed, to reduce dust.

7.10 Cultural Resources

Sites potentially eligible for listing in the National Register of Historic Places have been identified in numerous areas within which development associated with activities proposed under Alternatives 1, 3, and 4 may take place. Some of the prehistoric sites have the potential to provide information that will contribute to the understanding of hunter-gatherer settlement and subsistence patterns typical of the central Great Basin, while sites dating to the later historic period can contribute to a clearer understanding of the nuclear era (Cold War Era). Sites also have been identified on the NTS that are important to the economic or religious practices of American Indian people.

Section 106 of the National Historic Preservation Act of 1966, as amended, requires that federal agencies take into account the effects undertakings may have on historic properties (i.e., sites eligible for the National Register of Historic Places). The most effective mitigation measure is avoidance; however, avoidance is not always possible. Mitigation of adverse impacts to cultural resources would be handled on a case-by-case basis through consultation with the State Historic Preservation Office (SHPO) and through a programmatic agreement initiated by the SHPO and the DOE.

Any archaeological sites eligible for the National Register of Historic Places that cannot be avoided would be mitigated through the implementation of a data recovery plan formulated to address research goals important to an understanding of Nevada prehistory and history (Lyneis, 1982). Data recovery for prehistoric and historic archaeological sites may include, but not be limited to archival research, surface collection, photodocumentation, site evacuation, feature and artifact analyses, and specialized analysis such as radiocarbon dating, and obsidian sourcing and hydration.

Any historic or Cold War Era architectural sites eligible for the National Register of Historic Places that cannot be avoided would be mitigated through the implementation of data recovery plans formulated to address research goals important to understanding Nevada history and Cold War Era technology. Data recovery for historic and Cold War Era architectural sites may include, but not be limited to, archival research, photodocumentation, architectural recordation including the study of as-built plans, and implementing Historic American Building Survey/Historic American Engineering Record documentation standards. All mitigation measures for cultural resources including data recovery would be conducted within established health and safety guidelines.

Data recovery for prehistoric and historic archaeological sites may include, but not be limited to archival research, surface collection, photodocumentation, site excavation, feature and artifact analyses, and specialized analyses such as radiocarbon dating, and obsidian sourcing and hydration.

The CGTO recommends that mitigation programs implemented at the NTS fully incorporate the assistance of American Indian people so that adverse impacts on American Indian resources can be efficiently averted. American Indian people know the NTS landscape in great depth and thus can help scientists with the identification of plants, animals, geography, archaeological sites, and traditional cultural properties that have been or will be adversely impacted by NTS programs and activities.

The CGTO considers that the natural and spiritual balance of the NTS landscape has been profoundly upset by prolonged nuclear testing activities and that the land must be purified and the spirits appeased in order to fully restore the environment to its previous condition. Through ceremonies, prayers, and offerings, American Indian people will contribute to increase the benefits of mitigation and will aid in restoring the spiritual harmony of impacted landscapes.

There are a number of proposed NTS actions that are of great concern to Indian people because of their adverse impact on the American Indian landscape. To avert or mitigate such impacts, the CGTO recommends that the DOE/NV fund systematic American Indian studies to:

- *Identify those areas/resources that are irreparably damaged, as well as areas/resources that can be restored for human use*
- *Avoid further ground-disturbing activities*
- *Make mitigation of restorable areas a top priority*
- *Replace lost plant and animal species*
- *Avert or minimize damage to geological formations*
- *Implement environmental restoration techniques that require minimum ground-disturbing activities*
- *Develop systematic consultation with American Indians so that potentially impacted resources can be identified, alternative solutions discussed, and adverse impacts averted*
- *Give American Indian people access to adversely impacted areas so that they can contribute their knowledge, purification ceremonies, prayers, and offerings to the restoration of the natural and spiritual harmony of the NTS landscape.*

In addition to these recommendations that derive from analysis of potential action and alternative impacts to American Indian cultural resources, the CGTO made the following stipulations and recommendations at the first CGTO meeting with the DOE NTS EIS study team:

- *Consultation with the CGTO does not relieve the DOE/NV of its obligation to maintain a government-to-government relationship with American Indian tribes*
- *The DOE/NV must consult with all culturally affiliated tribes and organizations belonging to the CGTO*
- *The DOE/NV should incorporate other American Indian tribes and organizations when considering activities away from (i.e., outside the American Indian region of influence) the NTS*
- *The CGTO recommends that the DOE/NV incorporate wherever possible in the NTS EIS the "Final Tribal Recommendations to DOE" prepared at the second mitigation meeting, Nevada Test Site American Indian Religious Freedom Act, October 1-3, 1993*
- *The CGTO recommends that DOE/NV incorporate wherever possible in the NTS EIS all former American Indian recommendations made by the CGTO to the DOE*

- *The CGTO recommends the continuance and expansion of the American Indian consultation program*

- *The CGTO recommends that they be actively involved in the planning, developing, and monitoring of all future DOE/NV ground-disturbing activities*

- *Public meetings are not the proper way to consult with tribes and organizations. They should not be considered "stakeholders" as defined by the DOE.*

- *Responses to the various NTS EIS alternatives:*

  Alternative 1, (No Action, Continue Current Operations). The CGTO opposes Alternative 1 because of our strong cultural ties to the land.

  Alternative 2, (Discontinue Operations). The CGTO supports Alternative 2 with the inclusion of access and protection of all cultural resource sites.

  Alternative 3, (Expanded Use). The CGTO opposes Alternative 3 because of our strong cultural ties to the land.

  — *The CGTO recommends that lands set aside for exclusive Indian use continue to be kept free, secure, and monitored for contamination of radioactivity and hazardous waste.*

  — *The CGTO recommends that the Gold Meadow area be set aside for exclusive Indian use because the area contains a concentration of important cultural resources.*

  Alternative 4, (Alternate Use of Withdrawn Lands). The CGTO tentatively supports Alternative 4 with reservations regarding certain components of this alternative.

The following statements are specifically adapted from the first CGTO meeting by the AIWS to reflect new information compiled during the work of the AIWS. The recommendation of mitigation by the AIWS does not imply they support the alterative; it merely is the best way of responding to impacts on American Indian cultural resources.

If Alternative 1 is chosen, the following measures are recommended for DOE implementation: continue the American Indian Religious Freedom Act Compliance Program, expand American Indian ethnographic studies, provide access to the CGTO to culturally sensitive areas to conduct land restoration ceremonies, limit non-Native personnel access to culturally sensitive areas, continue to give access to American Indian monitors needed for cultural resources investigations, and provide for American Indian monitors needed for oversight of land and DOE activities.

If Alternative 2 is chosen, the following measures are recommended for DOE implementation: continue the American Indian Religious Freedom Act Compliance Program, turn back the land to the CGTO, provide for American Indian Monitors needed for oversight of the land and DOE activities, and provide access to the CGTO to conduct land restoration ceremonies.

If Alternative 3 is chosen, the measures recommended for this Alternative are the same as for Alternative 1.

If Alternative 4 is chosen, the following measures are recommended for DOE implementation: continue the American Indian Religious Freedom Act Compliance Program, limit non-Native personnel access to culturally sensitive areas, and designate joint-use areas for three ethnic groups.

Subject to funding, scheduling, and the requirements of existing agreements with state, federal, and local agencies, the DOE will continue to consult on a government-to-government basis and will evaluate study proposals to fund those studies which would:

- Identify those areas and resources that are irreparably damaged, as well as areas and resources that can be restored for human use

- To the extent practicable, avoid further ground disturbing activities
- Make mitigation of restorable areas a top priority
- Replace lost plant and animal species
- Avoid or minimize damage to geological formations
- Implement environment restoration techniques that require minimum ground disturbance.

Several of these study topics are consistent with the DOE/NV past and present restoration policies and would dovetail with remediation plans. The DOE will continue to coordinate with the Consolidated Group of Tribes and Organizations to develop formal consultation procedures as proposed in Appendix G, and will consider the steps for participation proposed by the American Indian Writers Subgroup in Volume 2, *Framework for a Resource Management Plan.* After approval and acceptance of such procedures, systematic consultation and coordination with American Indian tribes will be planned so that potentially impacted resources can be identified, alternative solutions discussed, and adverse impacts mitigated where possible.

For purposes of the contribution of knowledge, purification ceremonies, prayers, and offerings for the restoration of the natural and spiritual harmony of the NTS landscape, the DOE/NV will strive to give the American Indian people access to adversely impacted areas. Such access will be subject to reasonable times, health and safety restrictions, security requirements, and the agreement of the managing agency where sites are not on DOE-controlled lands. Reasonable efforts will be made to accommodate Indian people.

For sites not under their control, the DOE will consult and coordinate with tribes having cultural ties to sites in question, on a government-to-government basis. Through the consultation and coordination processes committed to heretofore, the Consolidated Group of Tribes and Organizations or other appropriate tribal organizations would be actively involved in the planning, developing, and monitoring of future ground disturbing activities. Such involvement would be subject to restrictions imposed by funding, scheduling, security, and agreements with the state of Nevada and federal agencies.

The DOE/NV acknowledges that consultation does not relieve the DOE/NV of its obligation to maintain a government-to-government relationship with American Indian tribes. The DOE will, to the extent practicable, incorporate wherever possible all previous Consolidated Group of Tribes and Organizations' recommendations. The DOE/NV acknowledges further that public meetings are not the appropriate way to consult with the Indian tribes and organizations, and does not consider the tribes and organizations to be "stakeholders."

7.11 Occupational and Public Health and Safety

The areas of concern are risks associated with occupational injuries and fatalities, traffic accidents resulting in injuries and fatalities, and exposures to ionizing radiation.

Implementation of activities proposed under Alternatives 1, 3, and 4 would not result in significant adverse impacts to the general public. Additionally, risks to which workers at the sites are exposed (attributable to both work-related activities and traffic activities) do not exceed those experienced by their respective occupational groups. No adverse impacts are anticipated with implementation of Alternative 2.

Hazards will be minimized by the best management practices and occupational and radiological safety programs operating under the same regulatory standards and limits that currently apply at the NTS.

Emergency response programs will be employed to mitigate impacts of accidents to workers and the public in accordance with the 5500 series of DOE orders. These programs typically involve emergency planning, emergency preparedness, and emergency response. Each plan uses resources specifically dedicated to assist the facility in emergency management. These include a warning communications center, fire departments, facility emergency command centers, a DOE emergency operations center, county and state emergency command centers, medical and industrial hygiene specialists, and protective clothing and equipment, such as respirators and breathing air supplies.

The radiation doses estimated in this EIS for the various radiological accident scenarios are the doses that would be received by the population if only limited protective actions were taken. The NTS has detailed plans for responding to accidents of the type described here, and the response activities would be closely coordinated with state and local officials. NTS personnel are trained and drilled in the protective actions to be taken if a release of radioactive or otherwise toxic materials occur. Even though this training may result in personnel receiving lower exposures should an accident occur, limited credit is taken for this training in estimating the exposure durations for workers.

For the off-site population, the need for any protective action would be based on the predicted radiation doses. The emergency response would be based on the guidance provided in the protective action guides developed by the EPA. The underlying principle for the protective action guides is that, under emergency conditions, all reasonable measures would be taken to minimize the radiation exposure to the general public and emergency workers. In the absence of significant constraints, protective actions may be implemented when projected doses are lower than the ranges given in the protective action guides.

7.12 Environmental Justice

The following supportive measures should be undertaken to mitigate Environmental Justice impacts:

- Continue to expand opportunities for low-income and minority communities to provide input within the public involvement process by seeking the constructive involvement of affected stakeholders
- Set in motion an Environmental Justice Strategy Implementation Plan, incorporating concerns expressed in Appendix G
- Continue to encourage the participation of the Consolidated Group of Tribes and Organizations in DOE-sponsored cultural resources investigations, including those associated with ground-disturbing activities such as environmental restoration
- Encourage Consolidated Group of Tribes and Organizations participation when developing educational programs, so that students and researchers receive proper guidance regarding how to interact with the physical environment and cultural landscape.

7.13 References

REGULATION, ORDER, LAW

10 CFR Part 1021.331	U.S. Department of Energy, "Energy: Mitigation Action Plans," *Code of Federal Regulations*, Office of Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC, 1995.

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Lyneis, 1982	Lyneis, M.M., *An Archaeological Element for the Nevada Historic Preservation Plan, Nevada Division of Historic Preservation and Archaeology*, University of Nevada, Las Vegas, NV, 1982.

Chapter 8

CONSULTATION AND COORDINATION

CHAPTER 8
CONSULTATION AND COORDINATION

The consultation and coordination efforts made by the DOE/NV during the preparation of this Final NTS EIS are summarized in this chapter. Meetings, briefings, and consultations were conducted with federal agencies and governments, state, county, tribal, and local. Some actions taken by the DOE/NV were mandated by regulations; other actions were initiated by the DOE/NV to further encourage participation in the National Environmental Policy Act process. Consulting and cooperating agencies have reviewed the Draft NTS EIS prior to and after its issuance, and provided comments which the DOE has addressed.

8.1 Cooperating Agencies

Four federal agencies and one county government served as cooperating agencies with the DOE/NV in accordance with Title 40 CFR Parts 1501.5 and 1501.6. The DOE/NV sought their cooperation to identify potential impacts to lands owned, administered, or managed by these agencies as a result of implementing its alternatives. Furthermore, the DOE/NV did not want its alternatives to be in conflict with the programs and policies of other agencies. And finally, specific areas of expertise within these agencies were critical to the DOE/NV for the evaluation of its alternatives. General functions applicable to all cooperating agencies were to:

- Provide land-use plans, National Environmental Policy Act documents, and other reference documents which could assist in the analysis
- Coordinate internal reviews and provide one set of comments for rough draft portions and all of the NTS EIS to assure consistency
- Ensure that ecosystem management concepts were applied to land-use impact analysis, where appropriate
- Attend and participate in periodic meetings of the technical working group, executive management group, and other appropriate groups; EIS scoping meetings, public meetings and hearings, and interagency meetings related to the NTS EIS; and assist, where applicable, with response to public comments.

The following briefly describes the specific contributions of the five cooperating agencies:

1. DoD, U.S. Air Force, Nellis Air Force Base: Provide noise analysis for the NTS EIS, as necessary, and serve as the subject matter expert for aircraft and airspace issues. Assist with impact analysis of remediation and monitoring activities of contaminated or potentially contaminated surface or groundwater as it might affect portions of the NAFR Complex.

2. DoD, Defense Nuclear Agency: Provide information on current and planned projects that are managed by the Defense Nuclear Agency, and assist with impact analysis.

3. Department of the Interior, U.S. Fish and Wildlife Service: To fulfill its obligations under the Endangered Species Act, the DOE/NV requested threatened and endangered species lists for the Central Nevada Test Area, Project Shoal Area, Tonopah Test Range/ Double Tracks and the Nevada Test Site at the beginning of the NTS EIS process. These lists are valid for 90 days and were periodically reauthorized throughout the NTS EIS process.

   In November 1995, the DOE/NV initiated formal Section 7 consultation with the U.S. Fish and Wildlife Service regarding effects of activities and programs proposed in the Draft NTS EIS on listed species. The U.S. Fish and Wildlife Service provided a Draft Biological Opinion on May 5, 1996, that concluded that the proposed activities were not likely to jeopardize the continued existence of the threatened Mojave population of the desert tortoise. No critical habitat will be destroyed or adversely modified. The U.S. Fish and Wildlife Service concurred with the DOE/NV that the programs will not affect the bald eagle or peregrine falcon. The DOE/NV has asked the U.S. Fish and Wildlife Service for a similar concurrence in the Final Biological Opinion that the programs will not affect Ash Meadows or Devils Hole.

4. Department of the Interior, Bureau of Land Management: Assist the DOE/NV in evaluating the adequacy of the existing DOE land withdrawals as they relate to the NTS EIS alternatives.

5. Nye County: Provide information regarding planning objectives and other information on long-term objectives of future Nye County planning initiatives. Provide information to assist in the evaluation of socioeconomic impacts of the NTS EIS alternatives.

8.2 American Indians

During the week of March 17, 1995, the DOE/NV met with the Consolidated Group of Tribes and Organizations to discuss American Indian involvement in the preparation of this EIS. The Consolidated Group of Tribes and Organizations recommended that two representatives from the Owens Valley Paiute, Western Shoshone, and Southern Paiute tribes be appointed to write an American Indian perspective for the NTS EIS. It was also recommended that the DOE/NV provide these representatives with funding and technical assistance. The DOE/NV agreed, and the American Indian Writers Subgroup (AIWS) was formed.

The Subgroup held its first meeting the week of May 1, 1995, in Las Vegas, Nevada, to develop a writing strategy, draft an outline of writing tasks, and begin preparing draft text. Subsequent meetings were held the week of May 22, 1995, and from June 9 through 12, 1995, to continue preparation and to finalize the draft text. At the June meeting, the development of the *Resource Management Plan* was outlined and continued American Indian involvement was discussed. A draft of American Indian Comments for the NTS EIS (Appendix G) was received by the DOE/NV June 15, 1995. The appendix provided an overview of the cultural basis for the viewpoints presented by the Consolidated Group of Tribes and Organizations' members in the Draft NTS EIS.

Two subgroup meetings were held in Las Vegas, Nevada, after the public review period for the Draft NTS EIS. The purpose of these meetings was to review and edit the Draft American Indian Comments, to respond to the public comments on the Draft document, and to prepare additional text for inclusion in the NTS EIS. On March 20 and 21, 1996, the Subgroup met with DOE/NV management officials to discuss the current American Indian involvement in the NTS EIS as well as other consultation issues. A brief presentation of the *Resource Management Plan* was also given by the DOE/NV.

On April 15 through 17, 1996, DOE/NV again consulted with Consolidated Group of Tribes and Organizations' representatives to update them on the changes, final schedule, and public comments for the NTS EIS. This meeting was held at the NTS. The AIWS presented a report of activities and a status of writing tasks completed. The Consolidated Group of Tribes and Organizations reviewed and commented on the additional text developed by the Subgroup and provided suggestions for expanding sections of the text.

On April 18 through 21, 1996, the Subgroup met in Las Vegas to incorporate the Consolidated Group of Tribes and Organizations' comments, to complete and edit the additional text, to focus writing efforts on the Transportation Study and the *Resource Management Plan*, and to complete an expanded inventory of American Indian traditional-use plants and animals. On April 21, 1996, the Subgroup completed all additional text for Appendix G as well as sections to be incorporated into Volumes 1 and 2 of the NTS EIS. The final additions for the American Indian Assessments for the NTS EIS (Appendix G) were submitted to DOE/NV.

8.2.1 American Indian Consultation Procedures

American Indian tribes are sovereign nations that acknowledge the U.S. Government and expect that, *in return, the U.S. Government recognize tribal sovereignty. In a memorandum dated April 29, 1994, President William J. Clinton wrote, "I am strongly committed to building a more effective day-to-day working relationship reflecting respect for the rights of self-government due the sovereign tribal rights." American Indian governments expect that federal agencies and state officials will honor President Clinton's explicit commitment to building such a relationship and following his mandate (Executive Orders 12875 and 12866). Accordingly, government officials must implement comprehensive consultation policies that take into consideration the vast cultural, social, and political diversity of American Indians as well as the needs, concerns, and impacts that are shared by our nations.*

American Indian tribes are not considered as, nor do they fit the definition of, businesses or stakeholders. Formal government-to-government consultation with tribal governments require diplomacy. U.S. Government officials that are in charge of maintaining friendly and productive day-to-day relationships with foreign countries, such as Japan, Mexico, or Germany, must acquire knowledge on the languages, culture, and politics of those countries in order to best represent the interests of the United States, and to achieve success in international, economic, and political negotiations. Yet, there is little or no interest among government officials to educate themselves as to how American Indians living in their own country organize themselves culturally and politically. How, we ask, are federal agencies and state officials going to succeed in following President Clinton's mandate, if they do not work at improving their knowledge of American Indian life ways?

The American Indian Writers Subgroup (AIWS), which represents the concerns of the CGTO for the Nevada Test Site Environmental Impact Statement would like to suggest a series of procedures for implementing a comprehensive day-to-day consultation relationship with the U.S. Department of Energy (DOE). The Environmental Protection Division of the U.S. Department of Energy, Nevada Operations Office (DOE/NV) has maintained its commitment to consultation and established a working relationship with culturally affiliated American Indian tribes regarding cultural resources at Yucca Mountain and the NTS since 1985. There are, however, numerous other areas of great concern for tribal governments that are currently addressed in the NTS EIS but have not been explored nor systematically subjected to consultation with tribal governments. Some of these areas are:

- *Land use*
- *Risk assessment*
- *Socioeconomic issues*
- *Nuclear waste transportation*
- *Environmental justice and equity*
- *Environmental restoration*
- *Mitigation.*

The AIWS is aware that presently there are programmatic EISs taking place without the direct involvement of Indian people. This lack of involvement is a source of great concern for culturally affiliated tribes. The gravity of past and proposed future nuclear and defense-related programs and activities at the NTS and other areas withdrawn by the DOE calls for a broadening of the scope of American Indian consultation programs. As stated in the American Indian Policy (April 29, 1994), the DOE must identify and seek to remove impediments to working directly and effectively with tribal governments on DOE programs and activities. The DOE has already recognized that there may be certain procedural impediments which limit or restrict the ability to work effectively and consistently with American Indian tribes. In keeping with the American Indian Policy, which requires government-to-government consultation, this federal agency must make every effort to remove such impediments.

The AIWS reviewed and edited the Consultation Model produced for the DOE Legacy Project (Stoffle et al., 1994). A detailed version of this American Indian Consultation Model, which has *been tailored to meet current DOE/NV consultation procedures, is included in Attachment C of Appendix G.*

The consultation procedures are drawn both from past and current consultation relationships between DOE/NV and the CGTO. Furthermore, these procedures reflect the need for adjustments on consultation strategies for future DOE programs and activities that may potentially impact the traditional culture and contemporary well-being of Indian people. Therefore, discussions presented in Appendix G not only highlight the accomplishments of DOE/NV consultation with tribal governments, but also points out procedures that have yet to be developed and implemented in the future. Because the NTS EIS will be read by government officials from sister DOE facilities and perhaps by other federal and state agencies as well, the AIWS expects that the consultation procedures will serve as a model for future interaction between tribal governments and federal and state agencies.

It is important to note that specific consultation procedures should be approved by tribal governments at the onset of each consultation process.

8.3 Other Meetings

Additional meetings were held with local governments, advisory boards, the Nevada State Clearinghouse, the DOE/NV Operations Office Environmental Management Community Advisory Board, affected units of local government, and the South-Central Nevada Federal Complex Advisory Board. Several work-group meetings with local and county governments took place, many of which were specific to transportation issues. These meetings are summarized in Table 8-1.

Table 8-1. Summary of meetings held on the NTS EIS and Transportation Study (Page 1 of 5)

Host Organization	Date	Location
Environmental Impact Statement Transportation Study Meetings		
Local or County Government	August 22, 1994	U.S. Department of Energy Nevada Operations Office 2753 S. Highland Las Vegas, NV 89109
University of Nevada, Las Vegas	November 15, 1994	University of Nevada, Las Vegas Harry Reid Center 4505 S. Maryland Parkway Las Vegas, NV 89154
Transportation Risk Working Group Meetings		
DOE Nevada Operations Office	May 16, 1995	U.S. Department of Energy Nevada Operations Office 2753 S. Highland Las Vegas, NV 89109
DOE Nevada Operations Office	June 15, 1995	IT Corporation 4330 S. Valley View, #114 Las Vegas, NV 89103

Table 8-1. Summary of meetings held on the NTS EIS and Transportation Study (Page 2 of 5)

Host Organization	Date	Location
Draft Implementation Plan Meetings		
Community Advisory Board for the NTS Programs	February 1, 1995	Holiday Inn Crowne Plaza 4225 Paradise Road Las Vegas, NV 89109
DOE Nevada Operations Office	February 7, 1995	University of Nevada, Las Vegas 4505 S. Maryland Parkway Las Vegas, NV 89154
DOE Nevada Operations Office	February 9, 1995	University of Nevada 9th and N. Virginia Reno, NV 89557
DOE Nevada Operations Office	March 7, 1995	U.S. Department of Energy Nevada Operations Office 2753 S. Highland Las Vegas, NV 89109
DOE Nevada Operations Office	March 9, 1995	Reno-Sparks Convention and Visitors Authority 4590 S. Virginia St. Reno, NV 89501
Scoping Period Meetings		
DOE Nevada Operations Office	September 7, 1994	Fallon Convention Center 100 Campus Way Fallon, NV 89046
DOE Nevada Operations Office	September 8, 1994	Carson City Community Center 851 E. Williams Street Carson City, NV 89701
DOE Nevada Operations Office	September 13, 1994	Dixie Center Convention Facilities 425 South 700 East St. George, UT 84770
DOE Nevada Operations Office	September 15, 1994	Tonopah Convention Center 301 Brougher Tonopah, NV 89049
DOE Nevada Operations Office	September 20, 1994	Cashman Field Convention Center 850 Las Vegas Boulevard No. Las Vegas, NV 89101

Table 8-1. Summary of meetings held on the NTS EIS and Transportation Study (Page 3 of 5)

Host Organization	Date	Location
DOE Nevada Operations Office	September 21, 1994	Bob Ruud Community Center Highway 93 Caliente, NV 89008
DOE Nevada Operations Office	October 4, 1994	Henderson Convention Center 200 S. Water Street Henderson, NV 89015
Other Information Meetings		
State of Nevada Clearinghouse	August 30, 1994	State Clearinghouse II Capitol Complex Carson City, NV 89710
Environmental Management Community Advisory Board	October 5, 1994	Holiday Inn Crowne Plaza 4225 Paradise Road Las Vegas, NV 89109
Affected Units of Local Government	October 21, 1994	White Pine County Convention Center 150 6th Street Ely, NV 89301
South-Central Nevada Federal Complex Advisory Board	October 28, 1994	Tonopah Convention Center 301 Brougher Tonopah, NV 89049
Air and Waste Management Association	December 14, 1994	Palace Station Hotel & Casino 2411 West Sahara Las Vegas, NV 89102
State of Nevada Clearinghouse	December 19, 1994	Nevada State Library Capitol Complex Carson City, NV 89710
Affected Units of Local Government	February 24, 1995	Tonopah, NV 89049
CGTO	March 17 - 19, 1995	Nevada Test Site Mercury, NV 89023
State of Nevada Clearinghouse	April 19, 1995	Nevada State Library Capitol Complex Carson City, NV 89710
Affected Units of Local Government	May 25, 1995	Pioche Fire Department Pioche, NV 89043
Community Technical Representative Program	July 31 - August 4, 1995	Brian Head Hotel 223 W. Hunter Ridge Drive Brian Head, UT 84719

Table 8-1. Summary of meetings held on the NTS EIS and Transportation Study (Page 4 of 5)

Host Organization	Date	Location
Environmental Management Community Advisory Board	August 2, 1995	Community College of Southern Nevada Cheyenne Campus North Las Vegas, NV 89030
Transportation Study Group	August 9, 1995	Desert Research Institute 755 E. Flamingo Road Las Vegas, NV 89119
State of Nevada Clearinghouse	August 29, 1995	Nevada State Library Capitol Complex Carson City, NV 89710
Environmental Management Community Advisory Board	October 8, 1995	Community College of Southern Nevada Cheyenne Campus North Las Vegas, NV 89030
Public Hearings, Workshops, and Other Meetings		
Environmental Management Community Advisory Board	February 7, 1996	Durango High School 7100 W. Dewey Drive Las Vegas, NV
NTS EIS Public Hearing	March 5, 1996	Dixie College Smith Convention Center 425 South 700 East St. George, UT 84770
NTS EIS Public Hearing	March 13, 1996	Town of Pahrump Bob Rudd Community Center 50 North Highway 160 Pahrump, NV 89041
NTS EIS Public Hearing	March 19, 1996	University of Nevada ASUN Auditorium Reno, NV 89557-0089
NTS EIS Public Hearing	March 26, 1996	Cashman Field Center 850 Las Vegas Blvd. No. Las Vegas, NV 89101
NV State Clearinghouse Meeting	April 10, 1996	Nevada State Library 100 Stewart Avenue Carson City, NV 89710

Table 8-1. Summary of meetings held on the NTS EIS and Transportation Study (Page 5 of 5)

Host Organization	Date	Location
NTS Transportation Big Group	April 11, 1996	Bechtel Nevada Facilities Bldg. C-1, Auditorium 2621 Losee Road North Las Vegas, NV 89030
Public Hearings, Workshops, and Other Meetings		
NTS EIS CORE Workshops	April 8, 1996	Boulder City Hall Bldg. 401 California Avenue Boulder City, NV 89005
NTS EIS CORE Workshops	April 16, 1996	Caliente Train Station 100 Depot Avenue Caliente, NV 89008
NTS EIS CORE Workshops	April 23, 1996	Tonopah Courthouse Commissioners Chambers W. P. Beko Justice Chambers 101 Radar Road Tonopah, NV 89049
NTS EIS CORE Workshops	April 25, 1996	West Las Vegas Arts Center 947 W. Lake Mead North Las Vegas, NV

8.4 References

REGULATION, ORDER, LAW

40 CFR Part 1501.5	U.S. Environmental Protection Agency (EPA), "Protection of the Environment: Lead Agencies," *Code of Federal Regulations,* Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC, 1995.
40 CFR Part 1501.6	EPA, "Protection of the Environment: Cooperating Agencies," *Code of Federal Regulations,* Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC, 1995.
EO 12866	Executive Order, "*Regulatory Planning and Review*," Office of the President, Washington, DC, 1993.
EO 12875	Executive Order, "*Enhancing the Intergovernmental Partnership,*" Office of the President, Washington, DC, 1993.

GENERAL

Stoffle, et al., 1994	Stoffle, R.W., M.J. Evans, D.B. Halmo, M.E. Dufort, and B.K. Fulfrost, *Native American Cultural Resources on Pahute and Rainier Mesas, Nevada Test Site*, Desert Research Institute Technical Report No. 84, Bureau of Applied Research in Anthropology (BARA), University of Arizona, Tucson, AZ, 1994.

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Chapter 9

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GLOSSARY

100-year flood. A flood event of such magnitude that it occurs, on average, every 100 years. This equates to a 1-percent probability of occurring in any given year.

A-weighted decibel (dBA). See Decibel, A-weighted.

Absorbed dose. The energy imparted to matter by ionizing radiation per unit mass of irradiated material. The unit of absorbed dose is the rad, which equals 100 ergs per gram.

Ad valorem taxes. A Latin term meaning "according to value" and referring to taxes levied on the assessed valuation of real and personal property, including automobiles.

Air Traffic Control Assigned Airspace. Airspace of defined vertical/lateral limits assigned by Air Traffic Control, for the purpose of providing air traffic separation between the specified activities being conducted within assigned airspace and other instrumental flight rules air traffic. Procedure governing operations within these areas shall be specified in letters of agreement between local military authorities and the air traffic control facility.

Aircraft operation. Air traffic control-related air activity that is counted as follows: (1) count an arrival as one operation; (2) count a departure as one operation; (3) count aircraft touch and go landings as two operations; (4) count an approach followed by a waveoff as two operations; (5) count aircraft that transit the control area of jurisdiction and are provided air traffic control service as one operation (count formation flights in this category as one operation except as provided in 6; (6) count individual aircraft in a formation as one operation when that formation is operating to/from/within an airport traffic area or within special-use airspace.

Alluvial fan. A pattern of sediment deposit caused by running water.

Alluvium. Any stream-laid sediment deposit.

Alpha activity. The emission of alpha particles by fissionable material (uranium or plutonium).

Alpha particle. A positively charged particle, consisting of two protons and two neutrons, that is emitted during radioactive decay from the nucleus of certain nuclides. It is the least penetrating of the three types of radiation (alpha, beta, and gamma).

Ambient. Surrounding or background conditions in the absence of an identifiable source.

Ambient air. That portion of the atmosphere, outside of buildings, to which the general public has access.

Ambient Air Quality Standards. Standards established on a state or federal level that define the limits for airborne concentrations of designated criteria pollutants (nitrogen dioxide, sulfur dioxide, carbon monoxide, particulate matter with aerodynamic diameters less than 10 microns (PM_{10})., ozone, and lead) to protect public health with an adequate margin of safety (primary standards) and to protect public welfare, including plant and animal life, visibility, and materials (secondary standards). See Criteria Pollutants.

Apron. An outwash plain composed of sediments washed out from the ice.

Aquifer. A body of rock that contains enough saturated permeable material to transmit groundwater and to yield significant quantities of groundwater to wells and springs.

Area of potential effect. In the context of Section 106 of the National Historic Preservation Act, the area in which planned development may directly or indirectly affect a cultural resource.

Areal. The measure of a planar region or of the surface of a solid.

As low as reasonably achievable (ALARA). An approach to radiation protection designed to manage and control individual and collective radiation doses to the workforce and the general public and to ensure that exposure is kept to the lowest level reasonably achievable. The ALARA approach considers aspects of the social, technical, economic, practical, and public impacts.

Assessed valuation. A valuation set upon real estate or other property by a government as a basis for levying taxes. For example, in most municipal jurisdictions in Clark and Nye counties, 35 percent of the taxable value placed upon real and personal property by the chief appraiser of the appraisal district is used as the basis for levying property taxes.

Attainment area. A region that meets the National Ambient Air Quality Standards for a criteria pollutant under the Clean Air Act.

Attenuation. Weakening, reducing the severity.

Average annual daily traffic. For a one-year period, the total volume passing a point or segment of a highway facility in both directions, divided by the number of days in the year.

Background radiation. Radiation from cosmic sources and from radioactive materials that are naturally occurring in the environment. Background radiation due to cosmic rays and natural radioactivity is always present.

Baseline. The initial environmental conditions against which the environmental consequences of various alternatives are evaluated.

Beta activity. The emission of beta particles by radioisotopes.

Beta particle. An elementary particle emitted from a nucleus during radioactive decay; it is negatively or positively charged, identical in mass to an electron, and in most cases easily stopped, as by a thin sheet of metal.

Biocide. A substance that is hazardous to many different organisms.

Biome. A major ecological community.

Byproduct waste. Tailings or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.

Caches. A hole or similar hiding place used for concealment or safekeeping.

Caliche. A desert soil formation consisting of near-surface crystallization of calcite or other soluble minerals by upward movement of solutions.

Candidate species. Species for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threat(s) to support the issuance of a proposed rule to list but issuance of the proposed rule is precluded.

Capacity (traffic). The maximum rate of flow at which vehicles can be reasonably expected to traverse a point or uniform segment of a lane or roadway during a specified time period under prevailing roadway, traffic, and control conditions.

Capital projects fund. A fund used to account for financial resources for the acquisition or construction of major capital facilities.

Carbon-14. An isotope of carbon that occurs both naturally and from the decay of certain radioactive isotopes. Carbon-14 is a well-known tool used to date archaeological finds. Carbon-14 can be generated from wastes as a gas and can rise upward to the surface if precautions are not taken.

Carbon monoxide. A colorless, odorless, poisonous gas produced by incomplete fossil-fuel combustion. One of the six pollutants for which there is a national ambient standard.

Cavity. An underground void created in the rock by the shock wave and heat from an underground nuclear detonation.

Census blocks. Cluster of blocks within the same census tract. Census blocks do not cross county or census tract boundaries and generally contain between 250 and 550 housing units.

Chimney. A tall, roughly cylindrical volume of broken rock and rubble formed underground by the collapse of the overlying medium (overburden) into the cavity.

Class I, II, and III areas. Under the Clean Air Act, clean air areas are divided into three classes. Very little pollution increase is allowed in Class I areas, some increase in Class II areas, and more in Class III areas. National parks and wilderness areas receive mandatory Class I protection. All other areas start out as Class II. States can reclassify Class II areas up or down, subject to federal requirements.

Classified waste. Weapons components and assemblies designated by the U.S. Government, pursuant to Executive Order, statute, or regulation, that require protection against unauthorized information or material disclosure for reasons of national security. Additional security and safeguards management activities are required in the handling of these materials.

Clastic. Pertaining to a rock or sediment composed principally of broken fragments that are derived from preexisting rocks or minerals and that have been transported some distance from their place of origin.

Coefficient. A numerical factor of an elementary algebraic term, as "4" in the term "4x."

Collective effective dose equivalent (person-rem). A summation of the radiation doses received by individuals in an exposed population dose. See population dose.

Colluvium. A general term applied to loose and incoherent deposits, usually at the foot of a slope or cliff and brought there chiefly by gravity, e.g., talus material or cliff debris.

Corrective Action Unit. A Resource Conservation and Recovery Act (RCRA) controlled cleanup unit for which owners and operators are required to perform corrective actions to address release of hazardous wastes.

Corridor. A strip of land of various widths on both sides of a particular linear facility, such as a highway, rail line, or utility line.

Council manager. A form of government whereby a full-time appointed manager oversees the day-to-day operations of the government. The nonpartisan elected council provides policy and direction to the manager.

Counterproliferation. Efforts taken by the U.S. government to combat the international proliferation of weapons that can cause mass destruction.

Criteria pollutants. The Clean Air Act required the U.S. Environmental Protection Agency to set air quality standards for common and widespread pollutants after preparing criteria documents summarizing scientific knowledge on their health effects. Today there are standards for six criteria pollutants: sulfur dioxide, carbon monoxide, particulate matter less than 10 micrometers in diameter (PM_{10}), nitrogen dioxide, ozone, and lead.

Cumulative impact. The impact on the environment that results from the incremental impact of the action when added to 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.

Curie (ci). A unit of radiation that describes the number of atoms undergoing nuclear transformations per unit time, i.e., 3.7×10^{10} disintegrations per second.

Daughter products. Nuclides resulting from the radioactive disintegration of a radionuclide, formed either directly or as the result of successive transformations in a radioactive series. A daughter product may be either radioactive or stable.

Day-night average sound level. A-weighted sound-pressure levels averaged over a 24-hour period with 10 dBA added for events occurring between 10 p.m. and 7 a.m.

Debt service fund. A fund accounting for the accumulation of resources for, and the payment of, interest and principal on general long-term debt.

Decibel. A standard unit for measuring sound-pressure levels based on a reference sound pressure of 0.0002 dynes per square centimeter. This is the smallest sound a human can hear.

Decibel, A-weighted (dBA). Adjusted unit of sound measurement that corresponds to the relative sensitivity of the human ear at specified frequency levels. This represents the loudness as perceived by humans.

Decontamination and decommissioning. The actions taken to reduce or remove substances that pose a substantial present or potential hazard to human health or the environment, such as radioactive contamination from facilities, soil, or equipment by washing, chemical action, mechanical cleaning, or other techniques, and then removing such from operation.

Diagnostic canister. A canister used in a nuclear test that contains the instrumentation necessary to receive data from the explosion.

Dipole hail. Defense Nuclear Agency program which consists of a series of high explosive experiments in different media to determine levels of disruption to underground facilities.

Direct impact. Effects resulting solely from the proposed program.

Direct effects. Beneficial or deleterious impacts that are caused by an action and occur at the same time and place.

Dose equivalent. The product of the absorbed dose in the tissue or organ of interest, the applicable quality factor(s), and all other necessary modifying factors at the point of interest.

Dynamic experiment. An experiment to provide information regarding changes in materials under conditions caused by the detonation of high explosives. Dynamic experiments are used to gain information on the physical properties and dynamic behavior of materials used in nuclear weapons, including changes due to aging.

Effective dose equivalent. The sum of the products of the dose equivalent to a tissue or organ and the weighting factor applicable to that tissue or organ for all tissues and organs irradiated.

Effluent. A gas or fluid discharged into the environment.

Endangered species. A plant or animal species that is threatened with extinction or serious depletion in its range and is formally listed as such by the U.S. Fish and Wildlife Service.

Environmental Impact Statement. A detailed written statement that helps public officials make decisions that are based on understanding of environmental consequences and to take actions that protect, restore, and enhance the environment.

Eolian. Applied to deposits arranged by the wind. Wind blown.

Ephemeral. Lasting only a brief period of time.

Equivalent sound level (L_{eq}). A single-number representing the fluctuating sound level in decibels over a specified period of time. The average of a fluctuating level of sound energy.

Escarpment. A long cliff or steep slope.

Evapotranspiration. The loss of water from the soil both by evaporation and by transpiration from the plants growing there.

Exclusion zone. The area around ground zero where there is a potential for subsidence.

Fiscal year. A 12-month period of time to which the annual budget applies and at the end of which its financial position and the result of its operations are determined. Clark County, the city of Las Vegas, the city of North Las Vegas, Nye County, the towns of Tonopah and Pahrump, and the Clark County School District and Nye County School District fiscal years run from July 1 through the following June 30. Federal fiscal years are from October 1 through the following September 30.

Fissile. Capable of undergoing fission by interaction with thermal (slow) neutrons. The three primary fissile materials are uranium-233, uranium-235, and plutonium-239.

Fission. A nuclear transformation characterized by the splitting of a nucleus and the simultaneous release of energy.

Fission products. A complex mixture of radioactive nuclides produced as a result of nuclear fission.

FORTRAN. A computer programming language for problems that can be expressed in algebraic terms.

Friable. Easily crumbled or pulverized.

Fugitive dust. Particulate matter composed of soil. Fugitive dust may include emissions from haul roads, wind erosion of exposed soil surfaces, and other activities in which soil is either removed or redistributed.

Fugitive emissions. Emissions released directly into the atmosphere that could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening.

Future baseline. As used in the socioeconomic sections of this document, the future baseline of economic indicators and population are provided by the Alternative 1 and projected to the year 2005. Economic indicators and population for all other alternatives are compared against this future baseline to determine the specific impact of the alternative. In other words, the economic growth of an alternative in a certain year can be determined, and the future baseline for that year is subtracted, leaving the economic impact specifically associated with the alterative.

Gabion. Large cage.

Gamma ray. Short wavelength electromagnetic radiation, with no mass, that is emitted from the nucleus.

General aviation. All aircraft that are not commercial or military aircraft.

Geologic. Any natural process acting as a dynamic physical force on the Earth; i.e. faulting, erosion, and mountain-building resulting in rock formations.

Geologic media. Refers to the characteristics of the rock or soil type at a specific site.

Grant. A contribution by a government or other organization to support a particular function. Grants may be classified as either categorical or block, depending upon the amount of discretion allowed the grantee.

Greater-Than-Class C waste. Low-level waste that is generated by the commercial sector and that exceeds U.S. Nuclear Regulatory Commission concentration limits for Class-C low-level waste as specified in 10 CFR Part 61. DOE is responsible for the disposal of greater-than-Class-C wastes from the DOE nondefense program.

Groundshine. The irradiation caused by the radioactivity which is deposited on the ground.

Groundwater. Subsurface water within the zone of saturation.

Groundwater recharge. Water that infiltrates the land surface and is not lost to evaporation or consumed by plants can percolate downward and replenish the groundwater aquifers. This deep percolation is called recharge. Much of the recharge at the NTS is from mountainous areas as much as 48 km (30 mi) away.

Grubbing. To clear of roots and stumps by digging.

Hazardous waste. Wastes that are designated as hazardous by the Environmental Protection Agency (EPA) or State of Nevada regulations. Hazardous waste, defined under the Resource Conservation and Recovery Act, is waste from production or operation activities that poses a potential hazard to human health or the environment when improperly treated, stored, or disposed. Hazardous wastes that appear on special EPA lists or possess at least one of the four following characteristics: (1) ignitability, (2) corrosivity, (3) reactivity, and (4) toxicity.

HEAST. Acronym for Health Effects Assessment Summary Tables.

Highly enriched uranium. Uranium in which the abundance of the isotope uranium-235 is increased well above the normal (naturally occurring) levels.

High-level waste. The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing of and any solid waste derived from the liquid, that contains a combination of transuranic waste and fission products in concentrations requiring permanent isolation.

Human environment. The natural and physical environment and the relationship of people with the environment.

Human intruder. A hypothetical individual (in a future scenario) who unknowingly contacts the waste(s) in a disposal unit(s) after the loss of institutional control and with no prior knowledge of the waste disposal activities at the site. Intrusion scenarios include, but are not limited to, drilling into the waste or farming on or near the waste disposal facility.

Hydrocarbons. Any of a vast family of compounds containing hydrogen and carbon. Used loosely to include many organic compounds in various combinations. Most fossil fuels are composed predominately of hydrocarbons.

Hydrodynamic test. A dynamic, integrated systems test of a mock-up nuclear package during which the high explosives are detonated and the resulting motions and reactions of materials and components are observed and measured. The explosively generated high pressures and temperatures cause some of the materials to behave hydraulically (like a fluid). Hydrodynamic tests are used to obtain diagnostic information on the behavior of a nuclear weapon's primary assembly (using simulant materials for the fissile materials in an actual weapon) and to evaluate the effects of aging on the nuclear weapons remaining in the greatly reduced stockpile.

Hydrology. A science dealing with the properties, distribution, and circulation of water on and below the earth's surface and in the atmosphere.

Hydronuclear experiment. Very low-yield experiment (less than a few pounds of nuclear energy released) to assess primary performance and safety with normal detonation.

Impoundment. To accumulate, as water in a reservoir.

Inertia. That property of a body by virtue of which it offers resistance to a change of its motion of translation.

Infiltration. Water that falls on the land surface that does not runoff but percolates into the ground. Some of this water evaporates, some is used by plants, and some percolates downward to the groundwater.

Infrastructure. Utilities and other physical support systems needed to operate a laboratory or test facility. Included are electric distribution systems, water supply systems, sewage disposal systems, roads, and so on.

Intergovernmental revenues. Revenues received from federal, state, and local sources, such as grants and taxes.

Intermodal. Involving more than one form of carrier during a single transport.

Inertial confinement fusion. A laser initiated nuclear fusion using the inertial properties of the reactants as a confinement mechanism.

IRIS. Acronym for Integrated Risk Information System.

Isopleth. A line, on a map or chart, drawn through points of equal size or abundance.

Isotope. Nuclides having the same number of protons in their nuclei, and hence the same atomic number, but differing in the number of neutrons, and therefore in the mass number. Almost identical chemical properties exist between isotopes of a particular element. The term should not be used as a synonym for nuclide.

Iterative. To say or do repeatedly; involving repetition.

Level of service (public services). A measure describing the amount of public services (e.g., fire protection and law enforcement services) available to community residents, generally expressed as the number of personnel providing the services per 1,000 population.

Level of service (traffic). A qualitative measure describing operational conditions within a traffic stream and how they are perceived by motorists and/or passengers.

Limiting concentrations. The radioactivity that remains in a waste after treatment that poses a limitation or bounding condition to disposal options. The radionuclide that tends to be most mobile, or has the highest potential to affect human health and the environment, becomes the limiting factor for the disposal facility.

Lithic. Made of or related to stone.

Logarithm. The exponent indicating the power to which a fixed number, the base, must be raised to produce a given number.

Low-enriched uranium. Naturally occurring uranium contains only about 0.7 percent U-235 and almost all of the rest is U-238. Low-enriched uranium is enriched in the isotopic content of U-235, greater than 0.7 percent but less than 20 percent of the total mass, for use as light water reactor fuel.

Low-level mixed waste. Low-level waste that also includes hazardous components, as identified in Title 40 CFR Part 261, Subparts C and D.

Low-level waste. Radioactive waste not classified as high-level waste, transuranic waste, or spent nuclear fuel, or the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level waste, provided the concentration of transuranic elements is less than 100 nCi per gram.

Maximum individual dose. A radiation dose received by a hypothetical individual whose location and habits are such that the dose received is the maximum expected to result from some given operation or accident.

Military training route. A route developed for the high-speed (greater than 250 knots) low-altitude training of tactical aircrews. Instrument flight rules military training routes are mutually developed by the Federal Aviation Administration and the U.S. Department of Defense (DoD). Visual flight rules military training routes are developed by DoD. Military training routes are published on aeronautical charts. Each military training route has its own unique number consisting of either three or four digits. Three digits indicate that at least one segment of the route is 1,500 feet above ground level, and four digits indicate that the entire route is at or below 1,500 feet above ground level. The number is preceded by either IR or VR, specifying instrument flight rules or visual flight rules, respectively. Since routes are one way, the same route flown the opposite direction will have a separate, distinct number.

Mitigation. Actions and decisions that (1) avoid impacts altogether by not taking a certain action or parts of an action, (2) minimize impacts by limiting the degree or magnitude of an action, (3) rectify the impact by repairing, rehabilitating, or restoring the affected environment, (4) reduce or eliminate the impact over time by preservation and maintenance operations during the life of the action, or (5) compensate for an impact by replacing or providing substitute resources or environments.

Mixed waste. Waste containing both radioactive and hazardous components, as defined by the Atomic Energy Act and the Resource Conservation and Recovery Act, respectively. Mixed waste intended for disposal must meet the Land Disposal Restrictions as listed in Title 40 CFR Part 268. Mixed waste is a generic term for specific types of mixed waste such as low-level mixed waste, and transuranic mixed waste.

Moratorium. A waiting period set by an authority—a suspension of activity.

Moving average. A method consisting of computing an average of the most recent "n" data values in the time series. This average is then used as a forecast for the next period.

National Priority List. A list of sites (federal and state) that contain hazardous materials that may cause an unreasonable risk to the health and safety of individuals, property, or the environment.

National Ambient Air Quality Standards. Section 109 of the Clean Air Act requires the Environmental Protection Agency to set nationwide standards, the National Ambient Air Quality Standards, for widespread air pollutants. Currently, six pollutants are regulated: sulfur dioxide, carbon monoxide, particulate matter less than 10 micrometers in diameter (PM_{10}), nitrogen dioxide, ozone, and lead.

Neutron activation product. The absorption of one or more neutrons into the nucleus of an atom resulting in a new isotope.

Nitrogen dioxide. Gas formed primarily from atmospheric nitrogen and oxygen when combustion takes place at high temperature. Nitrogen dioxide emissions contribute to acid deposition and formation of atmospheric ozone. See Criteria Pollutants.

Nitrogen oxides. Gases formed primarily by fuel combustion, which contribute to the formation of acid rain. Hydrocarbons and nitrogen oxides combine in the presence of sunlight to form ozone, a major constituent of smog.

Noise. Any sound that is undesirable because it interferes with speech and hearing or is intense enough to damage hearing.

Nonattainment area. An area that has been designated by the U.S. Environmental Protection Agency or the appropriate state air quality agency as exceeding one or more national or state Ambient Air Quality Standards.

Nondispersible. Cannot be scattered or spread.

Nonpotable. Water that is unsafe or unpalatable to drink because it contains pollutants, contaminants, minerals, or infective agents.

Nonproliferation. The use of political, economic, and military means to prevent the spread of weapons that cause mass destruction or protect the United States' interests against countries with such weapons.

Nonstochastic. Not random, not involving chance.

Notice of Intent. A notice that an environmental impact statement will be prepared and considered.

Nuclear testing. An underground nuclear weapons test of either a single underground nuclear explosion or two or more underground nuclear explosions conducted at the NTS within an area delineated by a circle having a diameter of two kilometers and conducted within a total period of 0.1 second. The yield of a test shall be the aggregate yield of all explosions in the test.

Operable unit. Division of cleanup of a release site into discrete action units that eliminate or mitigate a release, a threat of a release, or an exposure pathway.

Ozone (ground level). A major ingredient of smog. Ozone is produced from reactions of hydrocarbons and nitrogen oxides in the presence of sunlight and heat.

Paleontological resources. Fossils.

Parabolic. Having the form of a conic section taken parallel to an element of the intersected cone.

Particulate. Fine liquid or solid particles such as dust, smoke, mist, fumes, or smog, found in air or emissions.

Pathogenic. Causing or capable of causing disease.

Peak hour (traffic). The hour of highest traffic volume on a given section of roadway.

Percutaneous. Absorbed through the skin.

Piedmont. Lying or formed at the base of the mountains.

Platform. The area of thinner sediments adjoining a geosynclinal wedge of thicker equivalent beds.

Pathway. The route by which a contaminant reaches a human receptor. Common pathways considered in performance assessments include, but are not limited to, air, groundwater, and surface water.

Playa. A dry, vegetation-free, flat area at the lowest point of an undrained basin.

Population dose (person-rem). A summation of the radiation doses received by individuals in an exposed population. Equivalent to collective dose.

Porosity. The percentage of the volume of rock that is occupied by pore spaces.

Primary roads. A consolidated system of connected main roads important to regional, statewide, and interstate travel. They consist of rural arterial routes and their extensions into and through urban areas of 5,000 or more population.

Protective levels. Those levels which would meet acceptable human health and risk factors based on future land uses, as established through the Federal Facility Agreement and Consent Order process.

Quality factor. A factor which is used to account for the difference in biological effectiveness for different types of radiation. The quality factor is directly related to the energy deposited per unit path length by radiation in traversing a tissue or organ.

Radiation. The emissions, either electromagnetic or particulate, resulting from the transformation of an unstable atom or nucleus.

Radioactive decay. The process in which a nucleus emits radiation and undergoes spontaneous transformation into one or more different nuclei.

Radioactive source-term. Initial quantity of radionuclides at a release point from which dose rate and total dose as a function of distance from the release point may be calculated after accounting for radioactive decay and atmospheric dispersal.

Radioactive waste. Solid, liquid, or gaseous material that contains radioactive nuclides regulated under the Atomic Energy Act of 1954, as amended, and of negligible economic value considering costs of recovery.

Radioactive Waste Management Site. Designated location where radioactive waste handling, storage, or disposal operations are conducted under management control.

Radioisotopes. Radioactive nuclides of the same element (same number or protons in their nuclei) that differ in the same number of neutrons.

Radionuclide. Radioactive particle, man-made or natural, with a distinct atomic weight number. Can have a long life as soil or water pollutants.

RADTRAN. A computer code combining user-determined meteorological, demographic, transportation, packaging, and material factors with health physics data to calculate the expected radiological consequences and accident risk of transporting radioactive material.

Receptors. Plants, animals, and people that may be exposed to contamination. A receptor can be exposed via the air and soil pathways (for example, by inhalation, ingestion, and contact), and the surface and groundwater pathways (by contact and ingestion).

Record of decision. A public document that explains which cleanup alternative will be selected for the area of concern.

Rem. A unit of dose equivalent or effective dose equivalent equal to the product of the absorbed dose in rad, the applicable quality factor(s), all other necessary modifying factors, and the applicable weighting factors as appropriate.

Remediate. The process, or a phase in the process, of rendering radioactive, hazardous, or mixed waste environmentally safe, whether through processing, entombment, or other methods.

Render-safe mission. A means to make a nuclear weapon secure from unwanted detonation.

Repository. A mined, deep geologic disposal facility for spent nuclear fuel and high-level radioactive waste.

Residuals. The composition and form of a waste after treatment. For example, solidified incineration ash would be a residual.

Restricted area (airspace). Airspace designated under Federal Acquisition Requirements Part 73 within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Restricted areas are designated when determined necessary to confine or segregate activities considered to be hazardous to nonparticipating aircraft.

Retrofit (facility). Addition of a pollution control device on an existing facility without making major changes to the generating plant.

Retrofit (weapon). Modification of the components of an existing weapon without making major changes to the basic design.

Riparian. The banks of a body of water.

Riprap. A loose assemblage of stones or other materials used in water or soft ground to prevent erosion.

Rod claddings. An external layer of material applied directly to nuclear fuel rods or other material to provide protection from a chemically reactive environment, to provide containment of radioactive products produced during the irradiation of the composite, or to provide structural support.

Roentgen (R). A unit of the amount of exposure to electromagnetic, ionizing radiation. One R is the amount of electromagnetic, ionizing radiation necessary to generate 2.58×10^{-4} coulombs of electric charge in one kilogram of dry air at standard temperature and pressure.

Scope. The range of actions, alternatives, and impacts to be considered in an environmental impact statement.

Significant. The common meaning of significant is; "having or likely to have considerable influence or effect." As it pertains to the National Environmental Policy Act, "significant" requires that both context and intensity be considered in evaluating impacts (40 CFR Part 1508). Context could include surrounding circumstances such as society as a whole, the affected region, the affected interests, and the locality. Intensity refers to the severity of the impact, and requires that several factors be evaluated. These factors may include the degree to which public health and safety are affected, unique characteristics of the geographic area, and others.

Skarn. Metamorphic rock rich in iron.

Source Material. Initial quantity of any material released into the environment.

Source-term. An initial quantity of any material released into the environment from which concentrations are a function of distance and may be estimated from calculational models which account for radiological/chemical decay and atmospheric dispersal.

Special nuclear materials. As defined in Section 11 of the Atomic Energy Act of 1954, special nuclear material means (1) plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Nuclear Regulatory Commission determines to be special nuclear material or (2) any material artificially enriched by any of the foregoing.

Special revenue fund. A fund that accounts for the proceeds of specific revenue sources that are legally restricted to expenditures for specified purposes.

Specific activity. The concentration of radioactivity, given as the number of Becquerels (Bq) or curies (Ci) per unit mass or volume.

Spent fuel. Nuclear reactor fuel that, through nuclear reactions, has been sufficiently depleted of fissile material to require its removal from the reactor.

Stakeholder(s). Interested and/or affected people or groups.

Stockpile stewardship. The science and technology aspects of ensuring the safety, security, and reliability of the United States' stockpile of nuclear weapons, including research and development to provide the technologies required for stockpile management. This includes a program of activities to maintain confidence in the safety, reliability, and performance of the stockpile.

Storage. The collection and containment of waste or spent nuclear fuel in such a manner as not to constitute disposal of the waste or spent nuclear fuel for the purposes of awaiting treatment or disposal capacity.

Stratigraphic. Division of geology dealing with the definition and description of rocks and soils, especially sedimentary rocks.

Subcritical experiment. A dynamic experiment that involves the use of special nuclear material and does not achieve a condition of criticality, i.e., no self-sustaining nuclear reaction.

Subsidence. A depression formed at the surface of the ground by an underground nuclear explosion. The dimensions of the subsidence are a function of explosive yield, depth of burial, and geologic site characteristics.

Subsurface. A zone below the surface of the Earth whose geologic features are principally layers of rock that have been tilted or faulted and are interpreted on the basis of drill hole records and geophysical (seismic or rock vibration) evidence. Generally, it is all rock and solid materials lying beneath the Earth's surface.

Sulfur dioxide. A toxic gas that is produced when fossil fuels are burned. Sulfur dioxide is the main pollutant involved in the formation of acid rain. The major source of sulfur dioxide in the United States is coal-burning electric utilities.

Surface ground zero. The location at ground level where the emplacement hole is drilled.

Surficial soils. Soils which occur on the Earth's surface, specifically, the upper 12 to 20 cm of tilled soil.

Tectonic. Of, pertaining to, or designating the rock structure and external forms resulting from the deformation of the earth's crust. As applied to earthquakes, it is used to describe shocks not due to volcanic action or to collapse of caverns or landslides.

Temporal. Limited or finite; related to time rather than space.

Threat-Nuclear-Device Simulants. Radioactive sources which simulate the radioactive character of an unexploded nuclear device.

Threatened species. A species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Transmissivity. The rate at which water is passed through a unit width of rock under a unit hydraulic gradient.

Transuranic mixed waste. Waste containing both transuranic and hazardous components, as identified in Title 40 CFR Part 261, Subparts C and D.

Transuranic waste. Radioactive waste containing alpha-emitting radionuclides having an atomic number greater than 92 and half-lives greater than 20 years, in concentrations greater than 100 nanocuries (nCi) per gram.

Transuranic radionuclide. Any radionuclide having an atomic number greater than 92.

Trip generation. A determination of the quantity of trip ends associated with a parcel of land.

Tritium. A radioactive isotope of the element hydrogen, with two neutrons and one proton in its nucleus. Common symbols for the isotope are H^3 and H-3.

Unemployment rate. The number of civilians, as a percentage of the total civilian labor force, without jobs but actively seeking employment.

Unsaturated Zone. The subsurface zone between the land surface and the top of the groundwater. The unsaturated zone at the NTS is thick, ranging from 106 m (525 ft) to almost 909 m (3,000 ft) in some areas.

Use tax. A tax incurred in those instances when articles purchased in an area where no sales tax is levied are brought back for use in an area where the sales tax is imposed.

Vitrification. A waste treatment process that uses glass (e.g., borosilicate glass) to encapsulate or immobilize radioactive wastes to prevent them from reacting in disposal sites.

Volume (traffic). The total number of vehicles that pass over a given point or section of a roadway during a given time interval. Volumes may be expressed in terms of annual, daily, hourly, or subhourly periods.

Waste acceptance criteria. The requirements specifying the characteristics of waste and waste packaging acceptable to a waste receiving facility and the documents and processes the generator needs to certify that waste meets applicable requirements.

Waste management. The planning, coordination, and direction of those functions related to generation, handling, treatment, storage, transportation, and disposal of waste, as well as associated surveillance and maintenance activities.

- Site - Made up of units that accommodate specific types of waste. The Radioactive Waste Management Sites at Areas 3 and 5 are sites.
- Unit - The seven craters at Area 3, the 20 trench Mixed Waste Disposal Unit, and the low-level waste pits and trenches in the 92 acre active portion of Area 5 are units.
- Crater - An individual disposal cell similar to a trench or pit as U3ah or U3ah/at.
- Trench - The individual disposal cells in the Mixed Waste Disposal Unit, the individual cells for such as TO3U, are trenches.
- Pit - As in Pit 3 (PO3U) is an individual disposal cell similar to a trench.
- Cell - Trenches, Pits, and Craters are all waste management cells.

Waste management facility. All contiguous land, structures, other appurtenances, and improvements on the land, used for treating, storing, or disposing of waste.

Watershed. The land area that drains into a stream or river.

Wetlands. An area that is regularly saturated by surface water or groundwater and subsequently supports vegetation that is adopted for life in saturated soil conditions.

Wickiup. A frame hut covered with matting, bark, brush, or the like and used by the nomadic Indians of North America.

Work-for-Others-Program. Reimbursable programs (work) funded by other than DOE Defense Programs, i.e. Department of Defense and Defense Nuclear Agency.

X-ray. Ionizing, electromagnetic radiation emitted from the electron field of an unstable atom. X-rays are similar in nature, but generally lower in energy than gamma rays.

Zeolitized rocks. Various hydrous silicates occurring as secondary minerals in lava matrices and cavities within lavas.

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LIST OF ACRONYMS

AIWS	American Indian Writers Subgroup
amp	ampere
Bd	baud
Bq	Becquerel
Bq/L	Becquerels per liter
BREN	Bare Reactor Experiment Nevada Tower
°C	degree Celsius
C	Coulomb
C/kg	coulomb per kilogram
CFR	Code of Federal Regulations
CGTO	Consolidated Group of Tribes and Organizations
Ci	curie
Ci/yr	curies per year
cm	centimeter
cm^2	square centimeter
dB	decibel
dBA	A-weighted sound levels
DEIS	Draft Environmental Impact Statement
DoD	Department of Defense
DOE/NV	U.S. Department of Energy, Nevada Operations Office
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
°F	degree Fahrenheit
FEIS	Final Environmental Impact Statement
ft	feet
ft^2	square feet
ft^3	cubic feet
ft/sec	feet per second
ft/yr	feet per year
g	local acceleration due to gravity
gal	gallon

gal/hr	gallon per hour
gal/s	gallons per second
gal/yr	gallons per year
gpm	gallon per minute
HE	high explosive
HF	high frequency
Hz	hertz
in.	inch
in^2	square inches
in^3	cubic inch
J	joule
kg	kilogram
kg/yr	kilograms per year
km	kilometer
km^2	square kilometer
kph	kilometers per hour
kt	kilotons
kV	kilovolt
kw	kilowatt
L	liter
L/min	liters per minute
L/s	liters per second
lb	pound
lb/yr	pounds per year
m	meter
m^2	square meter
m^3	cubic meter
m/sec	meters per second
m/yr	meters per year
MEI	maximally exposed individuals
MHz	megahertz
μCi	microcurie
μg	microgram
mg	milligram

mg/L	milligram per liter
mg/yr	milligram per year
mi	mile
mi^2	square mile
mm	millimeters
mph	miles per hour
mR	milliroentgen
mrem/hr	millirem per hour
mrem/yr	millirem per year
mW	milliwatt
MW	megawatt
NAFR	Nellis Air Force Range
nCi	nanocurie
ns	nanosecond
NTS	Nevada Test Site
NV/ERP	Nevada Environmental Restoration Program
OCC	Operation Coordinator Center
ppm	parts per million
PCB	polychlorinated biphenyl
pCi/L	picocurie per liter
PEIS	Programmatic Environmental Impact Statement
PM_{10}	airborne particulate matter smaller than 10 micrometers (microns)
R	roentgen
rem	roentgen equivalent man
SHPO	State Historic Preservation Officer
tons/yr	tons per year
TNT	trinitrotoluene
TRU	transuranic
UHF	ultra high frequency
V	volt
w	watt
yd	yard
yd^2	square yard
yd^3	cubic yard

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Measurements and Conversions

The following information is provided to assist the reader in understanding certain concepts in this NTS Environmental Impact Statement (EIS). Definitions of technical terms can be found in the Glossary and names and symbols for units of measure can be found in the Acronym List.

The primary units used in this report are metric units with English equivalents enclosed in parenthesis. DOE Order 5900.2A, "Use of the Metric System of Measurement," prescribes the use of this system in DOE documents.

To signify decimal multiples and submultiples, the following prefixes may be used:

Submultiple	Prefix	Symbol	Multiple	Prefix	Symbol
10^{-2}	centi	c	10^{2}	hecto	h
10^{-3}	milli	m	10^{3}	kilo	k
10^{-6}	micro	μ	10^{6}	mega	M
10^{-9}	nano	n	10^{9}	giga	G
10^{-12}	pico	p	10^{12}	tera	T

The following Conversion Table lists the mathematical values or formulas needed for conversion between metric and English units:

Conversion Table

Multiply	By	To Obtain	Multiply	By	To Obtain
cm	0.3937	in	in	2.5400	cm
m	3.2808	ft	ft	0.3048	m
km	0.6214	mi	mi	1.6093	km
g	0.0353	oz	oz	28.3286	g
kg	2.2046	lb	lb	0.4536	kg
ac-ft	1233.4818	m^3	m^3	0.00081	ac-ft
ac-ft	1612.9032	yd^3	yd^3	0.00062	ac-ft
L	0.2642	gal	gal	3.7853	L
m^2	10.7639	ft^2	ft^2	0.0929	m^2

Multiply	By	To Obtain	Multiply	By	To Obtain
km^2	0.3861	mi^2	mi^2	2.5900	km^2
m^3	35.3145	ft^3	ft^3	0.0283	m^3
m^3	263.1579	gal	gal	0.0038	m^3
pCi	1,000	nCi	nCi	0.001	pCi
μCi/mL	10^9	pCi/L	pCi/L	10^{-9}	μCi/mL
Ci/m^3	10^{12}	pCi/m^3	pCi/m^3	10^{-12}	Ci/m^3
mCi/cm^3	10^{15}	pCi/m^3	pCi/m^3	10^{-15}	mCi/cm^3
nCi/m^2	1.0	mCi/km^2	mCi/km^2	1.0	nCi/m^2
ppm	1,000	ppb	ppb	0.001	ppm
R	2.58×10^{-4}	C/kg	C/kg	3876.0	R
mR	1,000	R	R	0.001	mR
Bq	2.703×10^{-11}	Ci	Ci	3.7×10^{10}	Bq
Bq	1.0	dps	dps	1.0	Bq
Gy	100	rad	rad	0.01	Gy
Sv	100	rem	rem	0.01	Sv
°C	(°C x 9/5) +32	°F	°F	(°F - 32) x 5/9	°C

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About NEPA

The National Environmental Policy Act (NEPA) was enacted to ensure that Federal decisionmakers considered the effects of proposed actions on the human environment and to lay their decisionmaking process open for public scrutiny. NEPA also created the President's Council on Environmental Quality (CEQ) to establish a NEPA review process. DOE's NEPA regulations (10 CFR 1021) augment the CEQ regulations (40 CFR 1500- 1508).

An environmental impact statement (EIS) documents a Federal agency's analysis of the environmental consequences that might be caused by major Federal actions, defined as those proposed actions that might result in a significant impact to the environment. An EIS:

- Explains the purpose and need for the agency to take action
- Describes the proposed action and the reasonable alternative courses of action that the agency could take to meet the need
- Describes what would happen if the proposed action were not implemented — the "No Action" (or Status Quo) Alternative
- Describes what aspects of the human environment would be affected if the proposed action or any alternative were implemented
- Analyzes the changes, or impacts, to the environment that would be expected to take place if the proposed action or an alternative were implemented, compared to the expected condition of the environment if no action were taken.

The DOE EIS process follows these steps:

- Notice of Intent, published in the *Federal Register*, identifies potential EIS issues and alternatives and asks for public comment on the scope of the analysis
- Public scoping period, with at least one public meeting
- Implementation Plan, which gives the results of public scoping and provides a "roadmap" of how the EIS will be prepared
- Draft EIS, issued for public review and comment, with at least one public hearing
- Final EIS, which incorporates the results of the public comment period on the draft EIS
- Record of Decision, which states:
  - — The decision
  - — The alternatives that were considered in the EIS, and the environmentally preferable alternative
  - — All decision factors, such as cost and technical considerations, that were considered by the agency along with environmental consequences
  - — Mitigation measures designed to alleviate adverse environmental impacts.
- Mitigation Action Plan, which explains how the mitigation measures will be implemented and monitored.