DOE/EIS-0380
May 2008

Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico

Volume 1

Chapters 1 through 11

U.S. Department of Energy

National Nuclear Security Administration

Los Alamos Site Office

Availability of the Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico

To submit general questions regarding this EIS, or to request a copy, please contact:

Elizabeth Withers, EIS Document Manager
NNSA Service Center - Albuquerque
National Nuclear Security Administration
U.S. Department of Energy
P. O. Box 5400
KAFB East, SC-1
Albuquerque, NM 87185-5400
Telephone: 505-845-4984

Printed with soy ink on recycled paper

COVER SHEET

Responsible Agency: U.S. Department of Energy (DOE)
National Nuclear Security Administration (NNSA)

Title: *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (SWEIS) (DOE/EIS-0380)

Location: Los Alamos, New Mexico

For additional information or for copies of the SWEIS, contact:

Elizabeth Withers, EIS Document Manager
NNSA Service Center - Albuquerque
National Nuclear Security Administration
U.S. Department of Energy
P. O. Box 5400
KAFB East, SC-1
Albuquerque, NM 87185-5400
Telephone: 505-845-4984

For general information on the DOE National Environmental Policy Act (NEPA) process, contact:

Carol M. Borgstrom, Director
Office of NEPA Policy and Compliance
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585
Telephone: 202-586-4600, or leave a message at 1-800-472-2756

This document is available on the DOE NEPA website (www.eh.doe.gov/nepa) and the NNSA Los Alamos Site Office website (www.doeal.gov/laso/NEPASWEIS.aspx) for viewing and downloading.

Abstract**:** NNSA proposes to continue operating Los Alamos National Laboratory (LANL), which is located in Los Alamos County in north-central New Mexico. NNSA has identified and assessed three alternatives for continued operation of LANL: (1) No Action, (2) Reduced Operations, and (3) Expanded Operations. Under the No Action Alternative, NNSA would continue the historical mission support activities conducted at LANL at currently approved operational levels. Under the Reduced Operations Alternative, NNSA would eliminate some activities and limit the operations of other activities. Under the Expanded Operations Alternative, NNSA would operate LANL at the highest levels of activity currently foreseeable, including full implementation of mission assignments. Expanded Operations is NNSA's Preferred Alternative. NNSA intends to implement actions necessary to comply with the March 2005 Compliance Order on Consent (Consent Order) to address the investigation and remediation of environmental contamination at LANL, regardless of decisions it makes on other actions analyzed in the SWEIS. Under all of the alternatives, the affected environment is primarily within 50 miles (80 kilometers) of LANL. Analyses indicate little difference in the environmental impacts of the alternatives on many resource areas. The primary discriminators are public risk due to radiation exposure, collective worker risk due to radiation exposure, socioeconomic effects due to LANL employment changes, electrical power and water demand, waste management, and transportation. A classified appendix assesses the potential impacts of terrorist acts.

Public Comments: In preparing the Final SWEIS, NNSA considered comments received during the scoping period (January 19 to February 17, 2005) and during the public comment period on the Draft SWEIS (July 7 to September 20, 2006). Public hearings on the Draft SWEIS were held in Los Alamos, Española, and Santa Fe, New Mexico. Comments on the Draft SWEIS were requested during a period of 75 days following publication of the U.S. Environmental Protection Agency's (EPA's) Notice of Availability in the *Federal Register*. All comments, including any late comments, were considered during preparation of the Final SWEIS.

The Final SWEIS contains revisions and new information based in part on comments received on the Draft SWEIS. Vertical change bars in the margins indicate the locations of these revisions and new information. Volume 3 contains the comments received during the public comment period on the Draft SWEIS and NNSA's responses to the comments. NNSA will use the analysis presented in this Final SWEIS, as well as other information, in preparing the Record(s) of Decision (RODs) regarding the level of continued operations at LANL. NNSA will issue ROD(s) no sooner than 30 days after the EPA publishes a Notice of Availability of this Final SWEIS in the *Federal Register*.

TABLE OF CONTENTS
VOLUME 1

Table of Contents
Volume 1

Volume 1 – Chapters 1 through 11
Volume 2 Book 1 – Appendices A through H
Volume 2 Book 2 – Appendices I through M
Volume 3 Book 1 – Comment Response Document
Sections 1, 2, and 3 (pages 3-1 through 3-561)
Volume 3 Book 2 – Comment Response Document
Section 3 (pages 3-562 through 3-1089) and Section 4

Chapter 2
Los Alamos National Laboratory Activities and Facilities Update

Chapter 3
Alternatives for Continued Operation of Los Alamos National Laboratory

Chapter 4
Affected Environment

Chapter 5
Environmental Consequences

LIST OF FIGURES

Chapter 1

Chapter 2

Chapter 4

LIST OF TABLES

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ALARA	as low as reasonably achievable
ATSDR	Agency for Toxic Substances and Disease Registry
BCG	Biota Concentration Guide
CAP-88	Clean Air Act Assessment Package, 1988
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CMR	Chemistry and Metallurgy Research (Building)
CMRR	Chemistry and Metallurgy Research Building Replacement Project
CO	carbon monoxide
DARHT	Dual Axis Radiographic Hydrodynamic Test (Facility)
dB	decibel
dBA	decibel A-weighted
dBC	decibel C-weighted
DCG	derived concentration guideline
DD&D	decontamination, decommissioning, and demolition
DDT	dichlorodiphenyl-trichlorethane
DHS	U.S. Department of Homeland Security
DNA	deoxyribonucleic acid
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EA	environmental assessment
EIS	environmental impact statement
EOC	Emergency Operations Center
EPA	U.S. Environmental Protection Agency
ERPG	Emergency Response Planning Guideline
FFCA	Federal Facility Compliance Agreement
FONSI	Finding of No Significant Impact
FR	*Federal Register*
FY	fiscal year
HEPA	high-efficiency particulate air (filter)
HSWA	Hazardous and Solid Waste Amendments
ISCST3	Industrial Source Complex Short Term
LANL	Los Alamos National Laboratory
LANL SWEIS	*Site-Wide Environmental Impact Statement for the Continued Operation of the Los Alamos National Laboratory, Los Alamos, New Mexico*
LANSCE	Los Alamos Neutron Science Center
LASL	Los Alamos Scientific Laboratory (now LANL)

LCF	latent cancer fatality
LLW	low-level radioactive waste
MCL	maximum contaminant level
MDA	material disposal area
MEI	maximally exposed individual
MPF	modern pit facility
MSL	Materials Science Laboratory
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMSA	New Mexico Statutes Annotated
NMWQCC	New Mexico Water Quality Control Commission
NNSA	National Nuclear Security Administration
NOI	Notice of Intent
NO_x	nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NTS	Nevada Test Site
PC	performance category
petaflops	one quadrillion floating point operations per second
PM_n	particulate matter less than or equal to *n* microns in aerodynamic diameter
PRS	potential release site
R&D	research and development
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man
RLWTF	Radioactive Liquid Waste Treatment Facility
RNA	ribonucleic acid
ROD	Record of Decision
ROI	region of influence
SA	supplement analysis
SHEBA	Solution High-Energy Burst Assembly
SNM	special nuclear material
SO_2	sulfur dioxide
SST	safe secure transport
SWEIS	Site-Wide Environmental Impact Statement
SWMU	solid waste management unit
TA	technical area
TEDE	total effective dose equivalent
teraflops	one trillion floating point operations per second

TFF	Target Fabrication Facility
TRU	transuranic
TSCA	Toxic Substances Control Act
TSFF	Tritium Science and Fabrication Facility
TSP	total suspended particulate
TSTA	Tritium Systems Test Assembly
UCL	upper confidence limit
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geologic Survey
WETF	Weapons Engineering Tritium Facility
WIPP	Waste Isolation Pilot Plant
°C	degrees Celsius
°F	degrees Fahrenheit

CONVERSIONS

METRIC TO ENGLISH			ENGLISH TO METRIC		
Multiply	**by**	**To get**	**Multiply**	**by**	**To get**
Area					
Square meters	10.764	Square feet	Square feet	0.092903	Square meters
Square kilometers	247.1	Acres	Acres	0.0040469	Square kilometers
Square kilometers	0.3861	Square miles	Square miles	2.59	Square kilometers
Hectares	2.471	Acres	Acres	0.40469	Hectares
Concentration					
Kilograms/square meter	0.16667	Tons/acre	Tons/acre	0.5999	Kilograms/square meter
Milligrams/liter	1 [a]	Parts/million	Parts/million	1 [a]	Milligrams/liter
Micrograms/liter	1 [a]	Parts/billion	Parts/billion	1 [a]	Micrograms/liter
Micrograms/cubic meter	1 [a]	Parts/trillion	Parts/trillion	1 [a]	Micrograms/cubic meter
Density					
Grams/cubic centimeter	62.428	Pounds/cubic feet	Pounds/cubic feet	0.016018	Grams/cubic centimeter
Grams/cubic meter	0.0000624	Pounds/cubic feet	Pounds/cubic feet	16,025.6	Grams/cubic meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F - 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cubic meters/second	2118.9	Cubic feet/minute	Cubic feet/minute	0.00047195	Cubic meters/second
Grams/second	7.9366	Pounds/hour	Pounds/hour	0.126	Grams/second
Meters/second	2.237	Miles/hour	Miles/hour	0.44704	Meters/second
Volume					
Liters	0.26418	Gallons	Gallons	3.78533	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.314	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1233.49	Cubic meters
Weight/Mass					
Grams	0.035274	Ounces	Ounces	28.35	Grams
Kilograms	2.2046	Pounds	Pounds	0.45359	Kilograms
Kilograms	0.0011023	Tons (short)	Tons (short)	907.18	Kilograms
Metric tons	1.1023	Tons (short)	Tons (short)	0.90718	Metric tons
ENGLISH TO ENGLISH					
Acre-feet	325,850.7	Gallons	Gallons	0.000003046	Acre-feet
Acres	43,560	Square feet	Square feet	0.000022957	Acres
Square miles	640	Acres	Acres	0.0015625	Square miles

a. This conversion is only valid for concentrations of contaminants (or other materials) in water.

METRIC PREFIXES

Prefix	Symbol	Multiplication factor
exa-	E	1,000,000,000,000,000,000 = 10^{18}
peta-	P	1,000,000,000,000,000 = 10^{15}
tera-	T	1,000,000,000,000 = 10^{12}
giga-	G	1,000,000,000 = 10^{9}
mega-	M	1,000,000 = 10^{6}
kilo-	k	1,000 = 10^{3}
deca-	D	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	µ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}

CHAPTER 1
INTRODUCTION AND PURPOSE AND NEED FOR AGENCY ACTION

1.0 INTRODUCTION AND PURPOSE AND NEED FOR AGENCY ACTION

This chapter provides an introduction to the Los Alamos National Laboratory's (LANL) ongoing role in supporting the National Nuclear Security Administration's (NNSA) missions and compliance with the National Environmental Policy Act (NEPA), and how NEPA's requirements have been met through the preparation of Site-Wide Environmental Impact Statements (SWEISs). This chapter also includes a statement of the purpose and need for the continued operation of LANL and introduces the alternatives considered reasonable for meeting the purpose and need. A discussion of decisions to be made, descriptions of related NEPA compliance reviews, and a summary of the scope of this SWEIS analysis are also presented.

NNSA[1] proposes to continue managing LANL and its resources in a manner that meets evolving national security missions and that responds to the concerns of affected and interested individuals and agencies. This SWEIS describes the environmental impacts of three alternatives for the continued operation of LANL.[2]

NEPA Compliance

Site-wide NEPA documents are identified by the U.S. Department of Energy (DOE) as those broad-scoped environmental impact statements (EISs) or environmental assessments (EAs) that are programmatic in nature and that identify and assess the individual and cumulative impacts of ongoing and reasonably foreseeable actions at a DOE site. DOE NEPA Implementing Procedures (Title 10 *Code of Federal Regulations* [CFR] 1021.330(c)) require the preparation of SWEISs for certain large multiple-facility DOE sites. These procedures were amended in 1992 to specify that an evaluation of a DOE SWEIS be performed at least every 5 years by means of a Supplement Analysis (SA). Based on the Supplement Analysis, DOE determines whether an existing SWEIS remains adequate, or whether to prepare a new SWEIS or supplement the existing SWEIS, as appropriate. NNSA has prepared this SWEIS in accordance with NEPA, as amended (42 United States Code [U.S.C.] 4321 et seq.), and with Council on Environmental Quality (CEQ) regulations and DOE NEPA Implementing Procedures codified in the *Code of Federal Regulations* at 40 CFR Parts 1500 to 1508 and 10 CFR Part 1021, respectively.

In compliance with its NEPA Implementing Procedures, DOE issued the first SWEIS and Record of Decision (ROD) for the operation of LANL (then known as the Los Alamos Scientific Laboratory, or LASL) in 1979. That EIS was entitled *Final Environmental Impact Statement, Los Alamos Scientific Laboratory Site, Los Alamos, New Mexico* (DOE/EIS-0018). In 1999, DOE issued the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory, Los Alamos, New Mexico* (*1999 SWEIS*) (DOE/EIS-0238) (DOE 1999a) and its associated ROD. A full copy of the *1999 SWEIS* ROD is provided in

---

[1] NNSA is a semiautonomous agency within DOE (see the National Nuclear Security Administration Act [Title 32 of the Defense Authorization Act for fiscal year 2000, Public Law 106-65]).
[2] Vertical change bars in the margins indicate the locations of revisions and new information based in part on comments received on the Draft SWEIS.

Appendix A to this document. In early 2004, NNSA undertook the required 5-year evaluation of the continuing adequacy of the *1999 SWEIS* by initiating the preparation of an SA. In mid-2004, shortly into the process of preparing the SA, NNSA determined that the criteria for preparing at least a Supplemental SWEIS had been met. Criteria identified in DOE NEPA Implementing Procedures (10 CFR 1021.314) state that a Supplemental EIS shall be prepared if there are substantial changes to the proposal or significant new circumstances or information relevant to environmental concerns. The Implementing Procedures do not explicitly define criteria that would trigger the preparation of a new EIS. However, in this circumstance, the general procedural rationale for preparing a new SWEIS would apply.

NNSA discontinued preparation of the SA in late 2004, and initiated preparation of a supplement to the *1999 SWEIS*. In January 2005, DOE announced its intention to prepare a Supplemental SWEIS through a Notice of Intent (NOI) published in the *Federal Register* (FR) (70 FR 807) (see Appendix A of this SWEIS), and held a public scoping meeting (additional information regarding the public involvement process is presented in Section 1.6). Subsequently, NNSA made a determination that the changes in the LANL environment discussed below and the proposed new actions were significant enough to warrant preparation of a new SWEIS.

Since the issuance of the *1999 SWEIS* and its ROD, the LANL environment has been changed by the 2000 Cerro Grande Fire, which burned a part of LANL, the Los Alamos townsite, and the surrounding forested area; a regional drought; and a massive bark beetle evergreen tree infestation. Additional information about the LANL environmental setting has become available as various elements of this setting, in particular the hydrology, have undergone intense investigation over the past decade or longer. LANL security requirements also have evolved in response to changes in recognized threats to facilities and materials at LANL. In addition, since 1999, DOE and NNSA have issued several EISs and EAs for LANL operations and activities. These documents deal with implementing new or changed operations, replacing facilities, conveying or transferring land out of the administrative oversight of DOE (thereby reducing the size of the LANL site), and conducting emergency actions (specifically in response to the 2000 Cerro Grande Fire).

NNSA is considering new actions for initiation at LANL over about the next 5 years that could affect several areas of LANL operations originally analyzed in the *1999 SWEIS*. While consistent with the 1999 DOE decision for operating LANL according to the *1999 SWEIS* Preferred Alternative, these proposed activities represent potentially substantial changes to some operations. They include the refurbishment or replacement of existing infrastructure so that LANL operations can continue into the future.

Jointly, the activities analyzed through NEPA compliance documents completed since 1999, newly proposed activities for LANL, existing and developing changes to the LANL environmental setting, and changes in site security conditions have led NNSA to decide to update the *1999 SWEIS* by preparing a new SWEIS rather than a Supplemental SWEIS. Preparation of a new SWEIS also responds to comments received from the public during the scoping period. This new SWEIS impact analysis tiers from the *1999 SWEIS*, as appropriate, and incorporates information from that document by reference where the information presented in that earlier document remains valid.

One of the primary benefits of updating the environmental analysis is the reevaluation of cumulative impacts associated with LANL operations. When DOE issued the *1999 SWEIS* and its associated ROD, the analyses considered operational impacts to the northern New Mexico environment of actions that would likely occur over the next 10-year period (which was identified as the "foreseeable future" for the purposes of that analysis). This SWEIS considers cumulative impacts associated with activities at LANL on the changed environment in the region. For example, significant effort that was not anticipated in 1999 has been expended since the Cerro Grande Fire to implement forest thinning and watershed protection measures on the Pajarito Plateau.

1999 SWEIS Alternatives

Four alternatives were analyzed in the *1999 SWEIS* to support the Proposed Action of continuing to operate LANL: (1) the No Action Alternative, (2) the Reduced Operations Alternative, (3) the Greener Alternative, and (4) the Expanded Operations Alternative (identified as the Preferred Alternative) which, with certain modifications to weapons-related work regarding the level of nuclear weapons component manufacturing, was selected for implementation.

The *1999 SWEIS* also analyzed Action Alternatives as they could be anticipated at that time. The alternative selected by DOE for implementation at LANL was the Expanded Operations Alternative, with certain modifications to nuclear weapons-related production work regarding the level of nuclear weapons component manufacturing. This modified Expanded Operations Alternative is currently being implemented at LANL.

LANL Support of NNSA Missions

The *1999 SWEIS* assessed impacts to each area of the human and natural environment potentially affected by anticipated operations conducted in support of national security missions, including:

- National security as it relates to the safety and reliability of the nuclear weapons stockpile and its maintenance, the stemming of the international spread of nuclear weapons material and technologies, and the production of propulsion plants for the U.S. Navy;
- Energy resources, including research and development for energy efficiency, renewable energy, fossil energy, and nuclear energy;
- Environmental quality, including treatment, storage, and disposal of DOE wastes, pollution prevention, storage and disposal of civilian radioactive wastes, and development of technologies to reduce risks and reduce cleanup costs; and
- Science, including fundamental research in physics, material science, chemistry, nuclear medicine, basic energy sciences, computational sciences, environmental sciences, and biological sciences.

The President and the Congress created NNSA in early 2000 as a semiautonomous agency within DOE. The legislation that established NNSA assigned it the following mission:

- To enhance U.S. national security through the military application of nuclear energy;
- To maintain and enhance the safety, reliability, and performance of the U.S. nuclear weapons stockpile, including the ability to design, produce, and test in order to meet national security requirements;

- To provide the U.S. Navy with safe, militarily effective nuclear propulsion plants and to ensure the safe and reliable operation of those plants;
- To promote international nuclear safety and nonproliferation;
- To reduce global danger from weapons of mass destruction; and
- To support U.S. leadership in science and technology (50 U.S.C. Chapter 41, § 2401(b)).

The Congress identified LANL as one of three national security laboratories to be administered by NNSA for DOE. As the NNSA mission is a subset of DOE's original mission assignment, most of the work performed at LANL in support of NNSA has remained unchanged in character from that performed for DOE prior to the creation of NNSA.

In 2002, the Congress created the U.S. Department of Homeland Security (DHS) and assigned it a set of national security missions. At that time, some programs were transferred from DOE and other Federal agencies to DHS. However, no changes to the overall mission assignments of DOE and NNSA occurred. In most cases in which mission support activities were reassigned to DHS, programs have continued to be conducted at the facilities previously supporting them through interagency agreements between the hosting agency and DHS.

During testimony to the House Appropriations Subcommittee on Energy and Water on March 11, 2004, the Secretary of Energy agreed to conduct a comprehensive review of the nuclear weapons complex with consideration of changes in the nuclear weapons stockpile and the current national and international security situation, as well as limitations in available resources, including funding. In January 2005, the Secretary requested the Secretary of Energy Advisory Board to form the Nuclear Weapons Complex Infrastructure Task Force, a task force reporting to the Secretary of Energy Advisory Board. The objective of the Task Force was to assess the implications of Presidential decisions on the size

SWEIS Terminology

Missions. In this SWEIS, "missions" refers to the major responsibilities assigned to DOE and NNSA (described in this section). DOE and NNSA accomplish these major responsibilities by assigning groups or types of activities to DOE's system of security laboratories, production facilities, and other sites.

Programs. DOE and NNSA are organized into Program Offices, each of which has primary responsibilities within the set of DOE and NNSA missions. Funding and direction for activities at DOE facilities are provided through these Program Offices, and similar coordinated sets of activities to meet Program Office responsibilities are often referred to as programs. Programs are usually long-term efforts with broad goals or requirements.

Capabilities. This term refers to the combination of facilities, equipment, infrastructure, and expertise necessary to undertake types or groups of activities and to implement mission assignments. Capabilities at LANL have been established over time, principally through mission assignments and activities directed by Program Offices. Once capabilities are established to support a specific mission assignment or program activity, they are often used to meet other mission or program requirements (for example, the capability for advanced complex computation and modeling that was established to support NNSA's national security mission requirements may also be used to address needs under DOE's science mission).

Projects. This term is used to describe activities with a clear beginning and end that are undertaken to meet a specific goal or need. Projects can vary in scale from very small (such as a project to undertake one experiment or a series of small experiments) to major (such as a project to construct and start up a new nuclear facility). Projects are usually relatively short-term efforts, and they can cross multiple programs and missions, although they are usually "sponsored" by a primary Program Office. In this SWEIS, this term is usually used more narrowly to describe construction activities, including facility modifications (such as a project to build a new office building or to establish and demonstrate a new capability). Construction projects considered reasonably foreseeable at LANL over about the next 5 years are discussed and analyzed in this SWEIS.

and composition of the stockpile; the cost and operational impacts of the new nuclear facility Design Basis Threat; and the personnel, facilities, and budgetary resources required to support a smaller stockpile. This review was to entail evaluation of opportunities for the consolidation of special nuclear material, facilities, and operations across the complex so as to minimize security requirements and the environmental impacts of continuing operations.

On July 13, 2005, a Task Force of the Secretary of Energy Advisory Board issued its report, *Recommendations for the Nuclear Weapons Complex of the Future* (DOE 2005d). This report contains a comprehensive review of the nuclear weapons complex, which includes LANL, and a vision for a modern nuclear weapons complex of the future that would address the needs of the nuclear weapons stockpile. In 2006, NNSA outlined its comprehensive proposal for transforming to a smaller, more efficient nuclear weapons complex by the year 2030 that would be better able and more suited to respond to future national security challenges (NNSA 2006b). The proposal included significant dismantling of retired warheads, consolidating special nuclear materials, eliminating duplicative capabilities, consolidating operations, and implementing more efficient and uniform business practices throughout the complex. In an NOI published in the *Federal Register* on October 19, 2006 (71 FR 61731), NNSA announced its intent to prepare a *Supplement to the Stockpile Stewardship and Management Programmatic Environmental Impact Statement – Complex 2030* (now called the *Complex Transformation Supplemental Programmatic Environmental Impact Statement* [*Complex Transformation SPEIS*]). The NOI outlines alternatives for continued transformation of the nuclear weapons complex to better meet future national security requirements, including a proposal to construct and operate a consolidated plutonium center within the complex. Another proposal, to construct and operate a consolidated nuclear production center, was added as a result of scoping comments. Both of these proposals are analyzed in the Draft *Complex Transformation SPEIS* (DOE 2007b) (additional discussion regarding the *Complex Transformation SPEIS* is provided in Section 1.5 of this SWEIS). On January 31, 2007, NNSA submitted a *Report on the Plan for Transformation of the National Nuclear Security Administration Nuclear Weapons Complex* (NNSA 2007a) to the Congressional Defense Committees. The report provides additional discussion of the Complex Transformation vision and the associated transformation plan, including the consolidated nuclear production center.

The alternatives analyzed in the *Complex Transformation SPEIS* would result in changes to facilities and operations at LANL. In the short term, about the next 5 years, current LANL operations are not expected to change dramatically regardless of the strategy NNSA develops for continuing the transformation of the nuclear weapons complex. However, in recognition of the uncertainties associated with future work assignments to LANL, the "foreseeable future" for the purpose of the Proposed Action in this SWEIS has been changed from the 10 years of LANL operations considered in the *1999 SWEIS* to consideration of proposals regarding LANL operations over about the next 5 years.

As part of the evaluation process for Complex Transformation, NNSA will reconsider whether to construct and operate the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility. Pending completion of the *Complex Transformation SPEIS*, NNSA is deferring a decision on whether to construct the nuclear facility portion of the facility. NNSA is continuing with construction of the radiological laboratory, administrative offices and support function building of the new facility and with the design of the nuclear facility portion.

NNSA and DOE assign work to LANL based on the facilities and expertise of the staff located there, as well as other factors. LANL is a multidisciplinary, multipurpose institution primarily engaged in theoretical and experimental research and development activities with responsibility for some nuclear weapons component manufacturing activities. Detailed information regarding DOE missions and their supporting operations at LANL was included in the *1999 SWEIS*. Facilities and expertise at LANL are used to perform theoretical research (including analysis, mathematical modeling, and high-performance computing), experimental science and engineering, advanced and nuclear materials research and development, and applications (including weapons component fabrication, testing, stockpile assurance, replacement, surveillance, and maintenance). These capabilities allow research and development activities such as high explosives processing, chemical research, nuclear physics research, materials science research, systems analysis and engineering, human genome mapping, biotechnology applications, and remote sensing technologies, as applied to resource exploration and environmental surveillance, to be performed at LANL. The main roles of LANL staff in the fulfillment of NNSA mission objectives include a wide range of scientific and technological capabilities that support nuclear materials handling, processing, and fabrication; stockpile management; materials and manufacturing technologies; nonproliferation programs; and waste management activities.

Specific LANL assignments for the foreseeable future will continue to include production of war reserve products, assessment and certification of the nuclear weapons stockpile, surveillance of war reserve components and weapons systems, ensuring safe and secure storage of strategic materials, and management of excess plutonium inventories. Nuclear weapons pit[3] production work takes place at LANL on a limited scale in accordance with two RODs: the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE/EIS-0236) ROD (61 FR 68014) and the *1999 SWEIS* ROD (64 FR 50797).

In addition to work performed to support DOE and NNSA missions, work at LANL is also conducted for other Federal agencies such as the Department of Defense and the newly created DHS, as well as for various widely divergent university programs, institutions, and corporate entities such as those involved in the environmental restoration and automotive industries. All work performed by the management and operating contractor at LANL must be compatible with the DOE and NNSA mission support work assigned to LANL and must be work that cannot reasonably be performed by the private sector. The Work-for-Others Program is one such LANL program under which cost-reimbursable work is performed by the staff of the management and operating contractor. Under the terms of the LANL contract, LANL facilities, either in whole or in part, may be used for cost-reimbursable work by the management and operating contractor. About one-fourth (25 percent) of the work performed at LANL, representing about 13 percent of the total annual LANL budget, is currently performed as cost-reimbursable work.

The management and operating contract for LANL was openly competed in 2005 for the first time in the 63-year history of the LANL site. Through 2005, the University of California had been the sole management and operating contractor for the LANL site since its creation in 1943. The new management and operating contractor, Los Alamos National Security, LLC, began

[3] *Pits are the central core of a primary assembly in a nuclear weapon and are typically composed of plutonium-239 or highly enriched uranium, or both, and other materials.*

managing LANL in June 2006. The selection of a new management and operating contractor did not change the DOE and NNSA work performed at LANL.

1.1 Background

LANL is located in northern New Mexico, within the incorporated County of Los Alamos (also referred to as Los Alamos County) (see **Figure 1–1**). The two primary residential areas within the county are the Los Alamos townsite and the White Rock residential area. These two residential areas are home to about 18,400 people. About 13,500 people work at LANL, of which a little less than half reside within the county.

LANL occupies about 40 square miles (25,600 acres [10,360 hectares]) of land on the eastern flank of the Jemez Mountains along the area known as the Pajarito Plateau. The terrain in the LANL area consists of mesa tops and canyon bottoms that trend in a west-to-east manner, with the canyons intersecting the Rio Grande to the east of LANL. Elevations at LANL range from about 7,800 feet (2,380 meters) at the highest elevation on the western side of the site to about 6,200 feet (1,890 meters) at the lowest point along the eastern boundary at the Rio Grande. LANL operations are conducted within numerous facilities located in 48 designated technical areas (TAs) and at other leased properties situated near LANL. The leased properties in the town of Los Alamos are assigned the temporary designation of "TA-0." TA-57 is located about 20 miles (32 kilometers) west of LANL at Fenton Hill on land administered by the U.S. Department of Agriculture, Forest Service. The 47 contiguous TAs (which are not numbered sequentially) have been established so that together they comprise the entirety of the LANL site (see **Figure 1–2**).

> **Technical Area (TA)**
>
> Geographically distinct administrative unit established for the control of LANL operations. There are currently 49 active TAs; 47 in the 40 square miles of the LANL site, one at Fenton Hill, west of the main site, and one comprising leased properties in town.

Most of LANL is undeveloped grassland, shrubland, woodland, and forest that serve to provide a buffer for security and safety and space for future expansion. As of the end of 2005, LANL's facilities comprised 8.6 million square feet (800,000 square meters) of laboratory, production, administrative, storage, service, and miscellaneous space; the total space available for operational use changes frequently as structures are demolished or built at LANL. Fifteen facilities within LANL were identified in the *1999 SWEIS* as being Key Facilities for the purpose of facilitating a logical and comprehensive evaluation of the potential environmental impacts of LANL operations. The facilities identified as "Key" for the purposes of the *1999 SWEIS* and this new SWEIS are those that house activities that are critical to meeting work assignments given to LANL and also:

- house operations that could potentially cause significant environmental impacts,
- are of most interest or concern to the public based on scoping comments received, or
- would be most subject to change as a result of programmatic decisions.

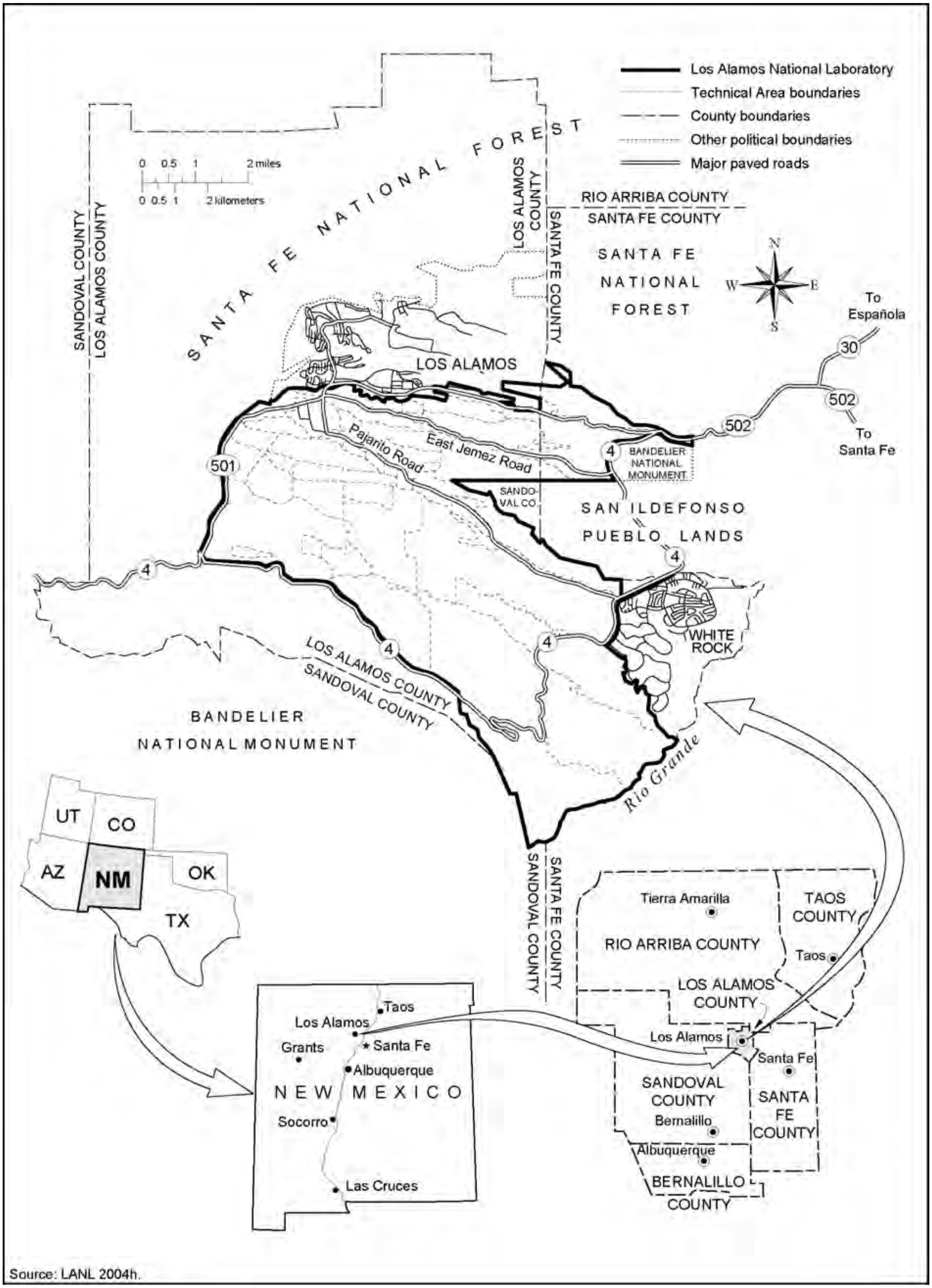


Figure 1–1 Location of Los Alamos National Laboratory Site

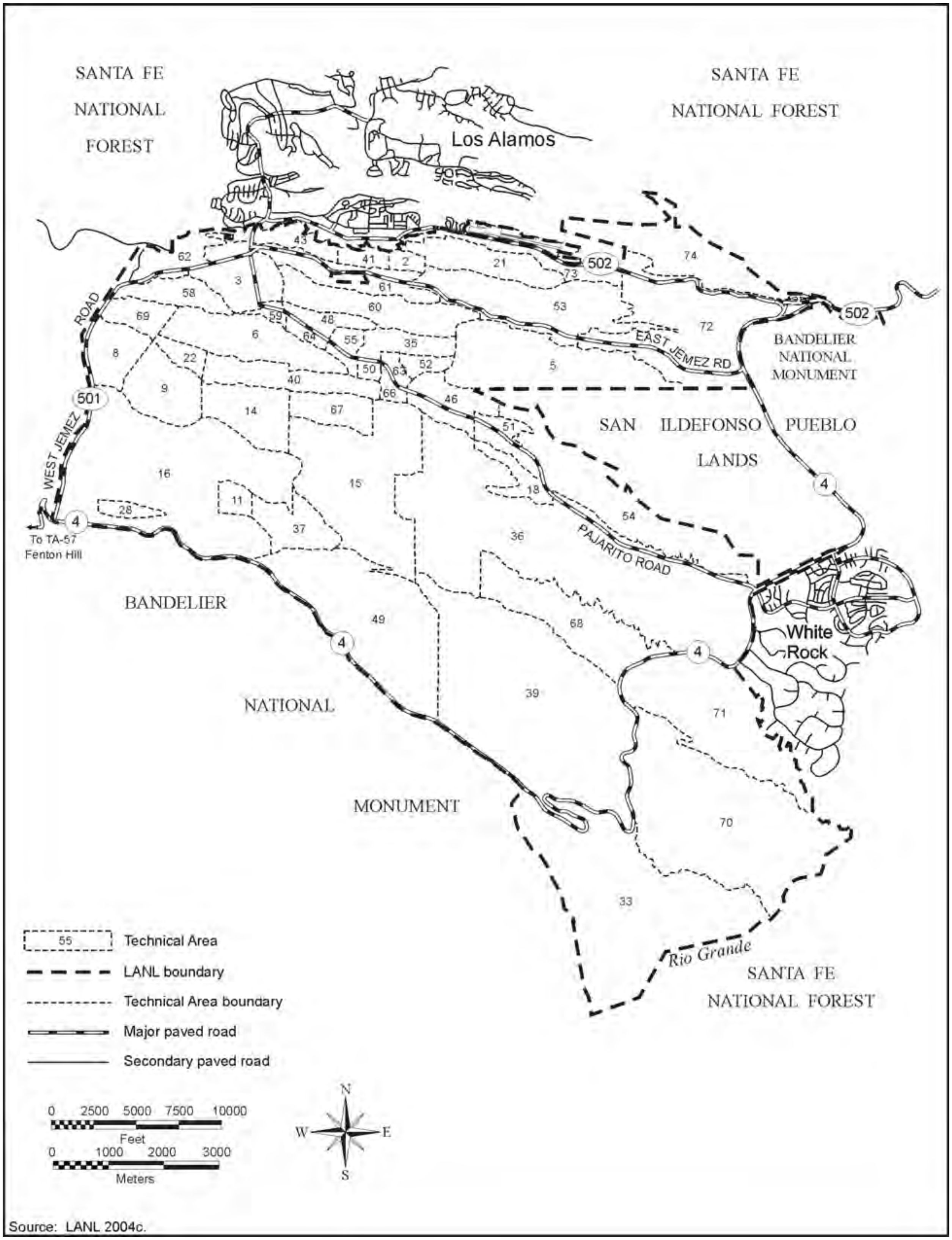


Figure 1–2 Identification and Location of Technical Areas Comprising Los Alamos National Laboratory

Taken together, the Key Facilities represent the majority of exposure risks associated with LANL operations. The operation of these 15 Key Facilities, together with functions conducted in other non-Key Facilities, formed the basis of the description of LANL facilities and operations analyzed for potential environmental impacts in the *1999 SWEIS*. For the purpose of the impact analysis provided by this new SWEIS, the identity of the LANL Key Facilities has been modified to reflect DOE decisions made after 1999 that resulted in changes to LANL facilities and operations. As seen in **Table 1–1**, most of the Key Facilities in the *1999 SWEIS* are Key Facilities in this SWEIS. The Nicholas C. Metropolis Center for Modeling and Simulation (Metropolis Center) has been added as a Key Facility because of the amounts of electricity and water it may use. Security Category I and II materials and operations have been moved from the TA-18 Pajarito Site. Under either of the Action Alternatives evaluated in this SWEIS, Security Category III and IV materials and operations also would be removed from the Pajarito Site, and it would be eliminated as a Key Facility. Under the No Action Alternative, the Pajarito Site would remain a Key Facility.

Security Categories

DOE uses a cost-effective, graded approach to provide special nuclear material safeguards and security. Quantities of special nuclear material stored at each DOE site are categorized into Security Categories I, II, III, and IV, with the greatest quantities included under Security Category I, and lesser quantities included in descending order under Security Categories II through IV.

Table 1–1 Comparison of Key Facilities between the *1999 Site-Wide Environmental Impact Statement* and this New Site-Wide Environmental Impact Statement

Technical Areas	*Key Facilities* [a]	*1999 SWEIS*	*New SWEIS*
3	Chemistry and Metallurgy Research Building	✓	✓
3	Sigma Complex	✓	✓
3	Machine Shops	✓	✓
3	Materials Science Laboratory	✓	✓
3	Nicholas C. Metropolis Center for Modeling and Simulation		✓
8, 9, 11, 16, 22, 37	High Explosives Processing Facilities	✓	✓
14, 15, 36, 39, 40	High Explosives Testing Facilities	✓	✓
16, 21	Tritium Facilities	✓	✓
18	Pajarito Site (Los Alamos Critical Experiments Facility)	✓	(b)
35	Target Fabrication Facility	✓	✓
43, 3, 16, 35, 46	Bioscience Facilities (formerly the Health Research Laboratory)	✓	✓
48	Radiochemistry Facility	✓	✓
50	Waste Management Operations: Radioactive Liquid Waste Treatment Facility	✓	✓
53	Los Alamos Neutron Science Center	✓	✓
54, 50	Waste Management Operations: Solid Radioactive and Chemical Waste Facilities	✓	✓
55	Plutonium Facility Complex	✓	✓

[a] The order of these Key Facilities has been changed from that presented in the *1999 SWEIS* to match the order used in this SWEIS, which is based on Technical Areas.

[b] The Pajarito Site remains a Key Facility under the No Action Alternative only.

Nuclear and radiological facilities at LANL are identified by hazard category in accordance with the potential consequences in the event of an accident (10 CFR Part 830). At LANL, there are no Hazard Category 1 nuclear facilities; the nuclear facilities at LANL are either Hazard Category 2 or Hazard Category 3 (DOE and LANL 2005). Facilities that handle less than Hazard Category 3 threshold quantities of radioactive materials, but require identification of "radiological areas" (10 CFR Part 835), are designated radiological facilities. All of the nuclear Hazard Category 2 and 3 facilities and most of the radiological facilities are accounted for in either the analyses of Key Facilities in this SWEIS or the project-specific analyses and evaluations of environmental restoration sites provided in Appendix I (see Chapter 2, Table 2–3, for a listing of Hazard Category 2 and 3 and radiological facilities).

Nuclear Facility Hazard Categories

Hazard Category 1: Hazard analysis shows the potential for significant offsite consequences.

Hazard Category 2: Hazard analysis shows the potential for significant onsite consequences.

Hazard Category 3: Hazard analysis shows the potential for only significant localized consequences.

(10 CFR Part 830)

1.2 Purpose and Need for Agency Action

DOE's purpose and need for agency action in the *1999 SWEIS* is presented in the text box to the right. The purpose and need for action with regard to the continued operation of LANL remains unchanged. With the creation of NNSA in 2000, the President and the Congress reaffirmed the Nation's need for ongoing operations at LANL by designating LANL as one of three national security laboratories. In 2002, the need for ongoing operations at LANL was reaffirmed with the creation of DHS and the subsequent assignment of many of its mission support activities to various Federal facilities, including assignments to each of NNSA's three national security laboratories. While uncertainty remains about the future work NNSA will assign to LANL to support the Nation's security missions, the overall need to continue operation of LANL is unlikely to change over the next several years.

Purpose and Need

The purpose of the continued operation of LANL is to provide support for DOE's core missions as directed by the Congress and the President. DOE's need to continue operating LANL is focused on its obligation to ensure a safe and reliable nuclear stockpile. For the foreseeable future, DOE, on behalf of the U.S. Government, will need to continue its nuclear weapons research and development, surveillance, computational analysis, components manufacturing, and nonnuclear aboveground experimentation. Currently, many of these activities are conducted solely at LANL. A cessation of these activities would run counter to national security policy as established by the Congress and the President (DOE 1999a).

1.3 Scope and Alternatives in this New Site-Wide Environmental Impact Statement for Los Alamos National Laboratory Operations

The Proposed Action analyzed in this SWEIS is the continued operation of LANL. As defined in 40 CFR 1508.28, this new SWEIS impact analysis is based on the *1999 SWEIS*. The *1999 SWEIS* covers broad general matters related to operation of LANL. This SWEIS considers more focused environmental impact analyses of three alternatives to implement the Proposed Action: a No Action Alternative (continued implementation of the *1999 SWEIS* Preferred Alternative together with other activities for which NEPA reviews have been completed); a Reduced Operations Alternative with newly proposed decreases in certain activities; and an

Expanded Operations Alternative with newly proposed additional activities. Consistent with the concept of tiering, pertinent information from the *1999 SWEIS* is summarized and incorporated by reference into this SWEIS. Impacts from all activities, including each of the alternatives analyzed in this SWEIS and in newly proposed projects that may be analyzed in separate NEPA impact reviews as interim actions[4], are considered in the cumulative impacts analyses for LANL operations in this SWEIS.

In March 2005, the State of New Mexico, DOE, and the LANL management and operating contractor entered into a "Compliance Order on Consent" (Consent Order) (NMED 2005) that is currently being implemented to address the investigation and remediation of environmental contamination at LANL. NNSA is including impacts associated with Consent Order implementation in order to facilitate its compliance with the Order. NNSA intends to implement actions necessary to comply with the Consent Order regardless of decisions it makes on other actions analyzed in this SWEIS. The activities and potential impacts of Consent Order-related activities are included under the Expanded Operations Alternative.

Implementing the Consent Order

NNSA intends to implement actions necessary to comply with the Compliance Order on Consent (Consent Order) regardless of decisions it makes on other actions analyzed in this SWEIS. Actions associated with implementing the Consent Order are included in the Expanded Operations Alternative; however, their implementation is not contingent on other actions that are part of the alternative. As explained in Chapter 1, Section 1.4, NNSA can implement individual parts of alternatives.

Due to unusual circumstances that have occurred at LANL since 1999, the environmental setting described in the *1999 SWEIS* has changed. In 2000, the Cerro Grande Fire burned 43,000 acres (17,400 hectares) of land in northern New Mexico. This fire burned about 7,700 acres (3,110 hectares) within the LANL boundaries and additional land in neighboring areas along the mountain flanks above and to the north of LANL (LANL 2004m). In total, about 40 structures at LANL were burned beyond reasonable repair or destroyed outright by the fire; an additional 200 structures suffered varying degrees of damage. Information about the Cerro Grande Fire and actions taken at LANL in direct response to the fire are detailed in the *Special Environmental Analysis for the Department of Energy, National Nuclear Security Administration, Actions Taken in Response to the Cerro Grande Fire at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/SEA-03) (DOE 2000f). A variety of facility changes occurred that were not anticipated before the fire or that were expedited directly or indirectly because of the fire. These include operations that have been moved or that are planned for removal from canyon locations, buildings that were destroyed by the fire or vacated and demolished after operations were relocated, and new structures that were built during the days after the fire as part of the recovery effort. Post-fire environmental effects included an alteration of watershed areas within LANL and a reduction in the forest fuel loading due to the fire and subsequent tree thinning activities. Additionally, the southwest region of the United States is experiencing a multiyear drought period. The drought, combined with a bark

[4] *CEQ's NEPA Implementing Regulations state that "agencies shall not undertake in the interim any major Federal action covered by the program that may significantly affect the quality of the human environment unless such action: (1) is justified independently of the program; (2) is itself accompanied by an adequate environmental impact statement; and (3) will not prejudice the ultimate decision on the program. Interim action prejudices the ultimate decision on the program when it tends to determine subsequent development or limit alternatives" (40 CFR 1506.1).*

beetle infestation, has resulted in a high mortality rate of evergreen tree species within LANL and surrounding areas.

Another alteration of the LANL environmental setting occurred through the conveyance and transfer of about 3.5 square miles (2,259 acres [914 hectares]) of land pursuant to Public Law 105-119 (Departments of Commerce, Justice, and State, the Judiciary, and Related Agencies Appropriations Act, 1998). Conveyance of land to Los Alamos County and transfer of land to the Department of the Interior in trust for the Pueblo of San Ildefonso has reduced the size of LANL to about 40 square miles (25,600 acres [10,360 hectares]). DOE anticipates conveying additional land before the end of 2012, the deadline for conveyance and transfer of lands established in the Defense Authorization Act, which extended the deadline initially established by Public Law 105-119.

The terrorist attacks that occurred in the United States on September 11, 2001, and subsequent world events have resulted in the implementation of enhanced security measures at LANL. Steps taken to protect LANL assets have resulted or will result in changes to some aspects of the LANL natural and cultural environments. Additionally, there have been changes to both the number of LANL workers and the population around LANL compared to those on which the *1999 SWEIS* socioeconomic and other impact analyses were based. To the extent that changes to, or new information about, the existing LANL environment will affect natural and cultural resource areas and the human environment originally considered in the *1999 SWEIS*, projected impacts from implementing the No Action Alternative and the Action Alternatives over about the next 5 years at LANL are analyzed in this SWEIS.

NNSA will use this SWEIS to consider the impacts of proposed modifications to LANL activities and the cumulative impacts associated with ongoing activities at LANL on the changed LANL environment and to make decisions regarding various proposed projects. Within about 5 years, detailed planning for these proposed projects, or in some cases, the proposed projects themselves, could be initiated. The decisions to be made on the basis of this new SWEIS are discussed in Section 1.4. The following sections provide summary descriptions of the alternatives analyzed in this SWEIS. Detailed descriptions of the SWEIS alternatives, as well as alternatives considered and dismissed, are presented in Chapter 3 of this SWEIS.

1.3.1 No Action Alternative

The No Action Alternative considered in this SWEIS consists of the continued implementation of decisions stated in the *1999 SWEIS* ROD (see Appendix A), together with decisions for other LANL actions based on completed NEPA reviews (see **Figure 1–3**). A list of NEPA EIS- and EA-level analyses completed since 1999 for LANL activities is included in Section 1.5.

The No Action Alternative reflects certain evolutions in the operation of LANL as a result of the implementation of the *1999 SWEIS* Preferred Alternative over the past 7 years. For example, the level of operations has decreased in some LANL facilities, and there have been changes in the amounts of materials at risk[5] in some facilities. Some materials have been transferred from one location to another at LANL, and some materials have been removed from the site to other

[5] *Material at risk is the amount of radioactive material in a facility that needs to be considered in evaluating the potential effects of accidents that could occur at the facility.*

locations around the complex. One former Key Facility identified in the *1999 SWEIS*, the TA-18 Pajarito Site, will be eliminated over the long term as an operating facility. In its 2002 *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory (TA-18 Relocation EIS)* (DOE/EIS-0319) (DOE 2002i) and associated ROD (67 FR 79906), NNSA decided to relocate TA-18 Pajarito Site Security Category I and II operations and associated nuclear materials to the Nevada Test Site. Implementation of the relocation decision was initiated in 2004 and will be carried out over a 5-year period. Security Category I and II operations and materials have recently been removed from the TA-18 Pajarito Site. Because Security Category III and IV materials remain, the TA-18 Pajarito Site has been retained under the No Action Alternative impact analysis as a Key Facility.

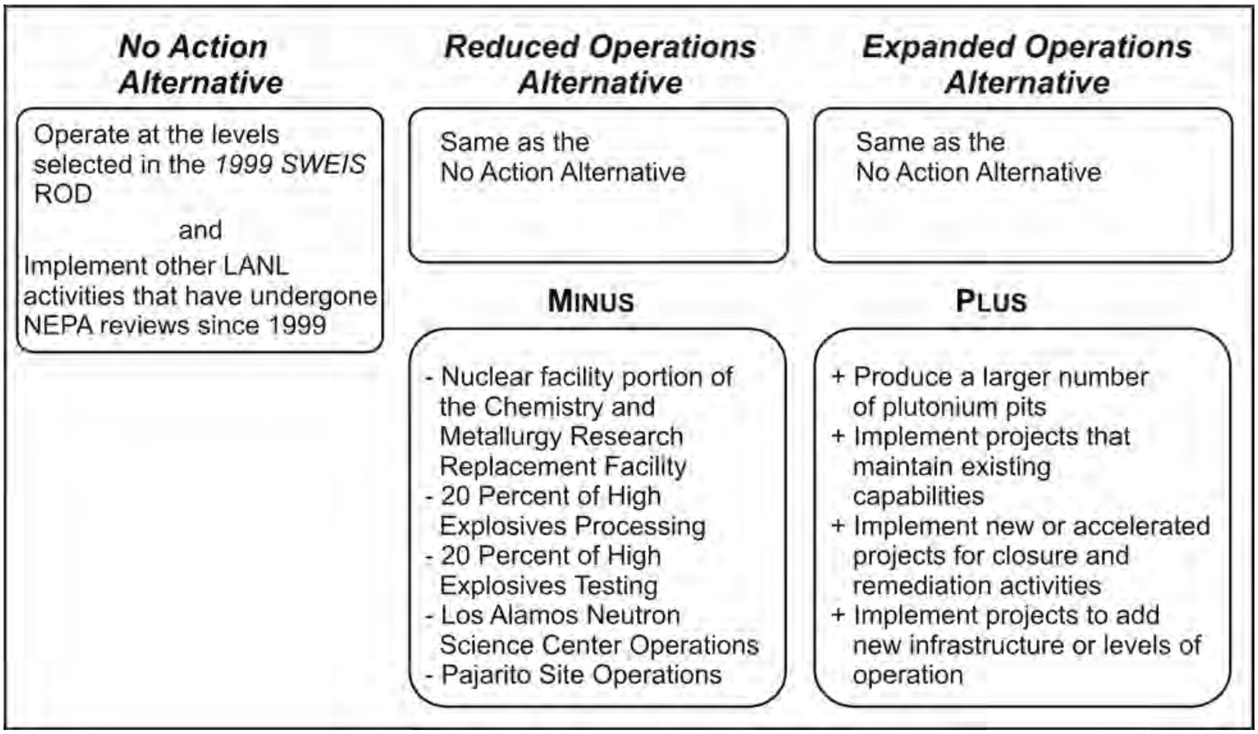


Figure 1–3 Summary Comparison of Alternatives Considered in this New Site-Wide Environmental Impact Statement

Another former Key Facility identified in the *1999 SWEIS*, the Chemistry and Metallurgy Research Building, will also be eliminated over the long term as an operating facility. In its 2004 ROD (69 FR 6967) for the *Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico (CMRR EIS)* (DOE/EIS-0350) (DOE 2003d), NNSA decided to construct and operate a new Chemistry and Metallurgy Research Replacement Facility at LANL's TA-55. Implementation of the construction phase began in 2004 with site construction planning for the two primary structures of the new facility proceeding on different schedules. Planning is complete and the radiological laboratory, administrative offices and support function building (collectively known as the "Radiological Laboratory") are currently under construction. The separate nuclear facility portion, a Hazard Category 2 nuclear laboratory, is still in the early planning stages and no building construction has begun. Planning for the nuclear facility portion of this project will continue (estimated planning completion is in 2008) and will either facilitate construction of the structure at LANL, or the planning process will facilitate the construction of a structure with the same capabilities as part of a consolidated plutonium center or as an integrated part of a consolidated nuclear production center. Both the consolidated plutonium center and the consolidated nuclear production center are subjects of the *Complex Transformation SPEIS* currently in preparation. (See discussions regarding Complex Transformation and the *Complex Transformation SPEIS*, and also the previously mentioned *CMRR EIS* elsewhere in this chapter. Additionally, see discussion of the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility in the following Action Alternatives discussion of the Reduced Operations Alternative).

Additional activities that are included in the No Action Alternative are those that may undergo a NEPA review and be categorically excluded from the need for preparation of either an EA or EIS. A list of DOE categorical exclusions is codified at 10 CFR 1021.410; activities conducted at LANL that are categorically excluded from further NEPA review are discussed further in Appendix L. Typically, several hundred proposed activities at LANL are categorically excluded from the need to prepare an EA or EIS each year.

Categorical Exclusions

DOE NEPA Implementing Procedures identify classes of actions that DOE has determined can be categorically excluded from the need to prepare an EA or EIS because they do not individually or cumulatively have a significant effect on the human environment. Examples of activities that could receive categorical exclusions include routine maintenance activities and shop operations; activities in support of environmental management including monitoring and small-scale remediation actions; and a broad range of research and development activities performed within existing LANL facilities.

Action Alternatives

In addition to the No Action Alternative, two Action Alternatives are analyzed in this SWEIS, both of which start with the No Action Alternative as their baseline. Newly proposed changes directed at reducing some operations conducted under the No Action Alternative at certain LANL facilities are analyzed under the Reduced Operations Alternative. Conversely, newly proposed changes reflecting expanded operations at certain LANL facilities, replacement of aging structures to accommodate ongoing operations, and actions associated with environmental cleanup above and beyond the operations included under the No Action Alternative are analyzed under the Expanded Operations Alternative.

1.3.2 Reduced Operations Alternative

The Reduced Operations Alternative analyzed in this SWEIS addresses new proposals that would reduce the overall operational level at LANL below that established for the No Action Alternative by reducing or eliminating certain operations at LANL. This Alternative includes new proposals for:

- Reducing the scope of the Chemistry and Metallurgy Research Replacement Facility Project. Construct and operate only the radiological laboratory, administrative office, and support functions building, and eliminate construction and operation of the proposed nuclear facility portion; operate the existing Chemistry and Metallurgy Research Building beyond its previously identified closure in 2010; upon cessation of operations, decommission, decontaminate, and demolish (DD&D) the building as previously decided;

- Discontinuing all accelerator operations, including all DOE and NNSA mission support work and all Work-for-Others-type operations, at the TA-53 Los Alamos Neutron Science Center (LANSCE) and placing the facility into an indefinite safe shutdown mode;

- Reducing High Explosives Processing Facilities operations conducted at TAs 8, 9, 11, 16, 22, and 37 by 20 percent from the No Action Alternative level of operations in this SWEIS;

- Reducing High Explosives Testing Facilities operations conducted at TAs 14, 15, 36, 39, and 40 by 20 percent from the No Action Alternative level of operations in this SWEIS, and eliminating all dynamic experiments using plutonium at the Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility; and

- Discontinuing all TA-18 Pajarito Site operations and placing the facility into a shutdown mode.

Each of these reductions in operations would occur at LANL Key Facilities described in the *1999 SWEIS*. Operations at the DARHT Facility were analyzed in the separate *Final Environmental Impact Statement, Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility (DARHT EIS)* (DOE/EIS-0228) (DOE 1995a), for which a ROD was issued. Project and environmental impact information provided through the *DARHT EIS* was included in the preparation of the *1999 SWEIS*. The *TA-18 Relocation EIS* (DOE 2002i) analyzed relocating TA-18, Pajarito Site materials and capabilities; however, the ROD deferred a decision on the Security Category III and IV materials and the Solution High-Energy Burst Assembly (SHEBA).

The 2004 ROD for the *CMRR EIS* announced NNSA's decision to build a two-building replacement facility and, after operations transitioned into the new buildings, to decommission, decontaminate, and demolish the aging Chemistry and Metallurgy Research Building. Construction and operation of the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility at LANL may not occur depending on programmatic decisions reached by NNSA regarding plutonium pit production and nuclear material consolidation that are being evaluated in the *Complex Transformation SPEIS*. In the event that NNSA decides to eliminate the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility, NNSA may select this reduction in LANL operations as one of its decisions informed by this SWEIS impact analysis. Not constructing and operating the new nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility would require NNSA to operate the existing Chemistry and Metallurgy Research Building beyond 2010. Continuing to restrict operations at the Chemistry and Metallurgy Research Building would result in the inability to meet the level of operations determined necessary for the foreseeable future at LANL in the *1999 SWEIS* ROD (NNSA 2007b).

1.3.3 Expanded Operations Alternative

The Expanded Operations Alternative analyzed in this new SWEIS reflects proposals to expand overall operational levels at LANL above those analyzed in the No Action Alternative. This alternative includes the expansion of operations at certain Key Facilities and the construction of new facilities.

The greatest operational change at a Key Facility would occur at the Plutonium Facility. The *1999 SWEIS* analyzed a production level of 50 pits per year in single-shift operations (or up to 80 pits per year in multiple-shift operations) as part of its Expanded Operations Alternative. However, DOE decided in 1999 to manufacture a nominal 20 pits per year, and announced that decision in the *1999 SWEIS* ROD. The annual production of 20 pits was identified in the Final *1999 SWEIS* as the Preferred Alternative, and the analysis of impacts for this Alternative was developed by scaling down the impacts identified for the *1999 SWEIS* Expanded Operations (which was based on an annual production rate of 80 pits) to a production rate of 20 pits per year.[6]

While recent studies suggest that the lifetime of the plutonium pit in the majority of nuclear weapons may be longer than originally thought, NNSA still needs to increase pit production. First, even with longer pit lifetimes, NNSA will need to replace considerable numbers of pits in stockpiled warheads as the stockpile ages. Second, at significantly smaller stockpile levels than today, NNSA must anticipate an adverse change in the geopolitical threat environment, or a technical problem with warheads in the operationally deployed force, either of which could require the United States to manufacture and deploy additional warheads in a relatively short time frame (NNSA 2006c, 2007a).

In this SWEIS, NNSA now proposes to increase the annual manufacturing rate from 20 pits (the rate assumed for the No Action Alternative in this SWEIS) to an annual rate that would produce up to 80 pits at LANL under the Expanded Operations Alternative. The production of pits includes the activities needed to fabricate new pits, to modify the internal features of existing pits, and to certify new pits or requalify pits. Some of the pits produced by these processes may not be certified or requalified. NNSA needs to produce about 50 certified pits annually to meet the immediate requirements of the Stockpile Stewardship Program (although the number of certified pits needed may change in the future), and may need to produce more than 50 pits in order to obtain the appropriate number of certified pits. The Expanded Operations Alternative for this SWEIS is based on an annual production rate of 80 pits per year in order to provide NNSA with some flexibility in obtaining the number of certified pits it requires each year. The annual production rate of 80 pits analyzed in the Expanded Operations Alternative is the upper limit of the annual production rate at LANL. Although NNSA has proposed further transformation of the nuclear weapons complex to meet future national security needs, NNSA has not completed the *Complex Transformation SPEIS* and therefore has not made a decision on the configuration of the future complex, including decisions regarding whether to increase its pit production capabilities above 80 pits per year at LANL or another NNSA site. Any decision to increase pit production beyond 20 pits per year would be made after NNSA issues the *Final Complex Transformation SPEIS*; such a decision would be based on the analyses in the *Complex Transformation SPEIS*, this SWEIS, and other information, including cost studies, budget projections, and national security requirements.

---

[6] *As part of this scaling process, the 1999 SWEIS provided quantitative adjustments of important impacts where possible to reflect the differences between an annual production rate of 80 pits (the rate used for that SWEIS's Expanded Operations Alternative) and an annual rate of 20 pits (the rate used for the Preferred Alternative and selected by the 1999 ROD) (64 FR 50797). Where quantitative adjustments were not possible, a qualitative discussion of the important differences in impacts was provided.*

A decision to increase pit production significantly above 20 pits annually would require NNSA to issue a new or revised ROD. Work continues toward implementing the decision to produce 20 pits per year announced in the *1999 SWEIS* ROD. NNSA's current proposal to produce up to 80 pits per year involves reorganizing operations within the Plutonium Facility such that no new building or other addition to the "footprint" of the facility would be required. Available production space within the facility would be used more efficiently and process efficiencies identified since 1999 would be employed. Some modifications to equipment arrangements in the Plutonium Facility might also be necessary. This approach – using only existing floor space – is not the same as the approaches analyzed in the *1999 SWEIS*, each of which would have required addition of floor space to the Plutonium Facility. In this SWEIS, NNSA is reanalyzing the potential environmental impacts of using this new approach to obtain up to 80 pits per year as outlined in the Expanded Operations Alternative. As was the case for the impact analysis used in the Expanded Operations Alternative in the *1999 SWEIS*, this SWEIS bases the analysis of impacts for its Expanded Operations Alternative on a maximum annual production rate of up to 80 pits. The No Action Alternative for this SWEIS uses the same scaling process used to develop the Preferred Alternative for the *1999 SWEIS*.

Three types of new projects are addressed in this SWEIS under the Expanded Operations Alternative, including:

- Projects that maintain existing capabilities at LANL;
- Projects that support the cleanup of LANL including the DD&D of excess buildings and implementation of the Consent Order[7] (NMED 2005); and
- Projects that add new or expand existing capabilities at LANL.

Decontamination, Decommissioning, and Demolition (DD&D)

DD&D are those actions taken at the end of the useful life of a building or structure to reduce or remove substances that pose a substantial hazard to human health or the environment, retire it from service, and ultimately eliminate all or a portion of the building or structure.

These newly proposed projects are described in the following paragraphs, and each is analyzed explicitly in the project-specific analyses included in Appendices G through J to this SWEIS.

Projects to Maintain Existing LANL Operations and Capabilities

The first type of proposed project analyzed under the Expanded Operations Alternative would continue operations at LANL at levels identical or very similar to those addressed in the *1999 SWEIS* Preferred Alternative or other LANL-specific NEPA compliance documents. Projects in the group would provide new structures for existing activities at LANL by replacing old and transportable buildings with new modern buildings. These projects include refurbishment of, and reinvestment in, certain existing buildings and structures, as well as construction of new buildings to replace aging buildings and temporary or portable structures. In cases involving new construction, the DD&D of older structures is included as part of the project

[7] NNSA is including impacts associated with Consent Order implementation in the SWEIS in order to more fully analyze the impacts resulting from Consent Order compliance. NNSA intends to implement actions necessary to comply with the Consent Order regardless of decisions it makes on other actions analyzed in the SWEIS.

for the purposes of the NEPA impact analysis and decisionmaking, although separate funding packages could be used to implement such activities.

Proposed projects of the first type include:

- Construction and operation of a new Physical Science Research Complex (formerly the Center for Weapons Physics Research) within TA-3;
- Construction of nine replacement office buildings within TA-3;
- Construction and operation of a new Radiological Sciences Institute at TA-48 for consolidating existing radiological operations including Security Category I and II nonproliferation activities, certain Security Category III and IV operations from the TA-18 Pajarito Site (SHEBA would not be included), and relocation of Wing 9 hot cell operations from the Chemistry and Metallurgy Research Building; the first phase would be construction and operation of the Institute for Nuclear Nonproliferation Science and Technology;
- Construction and operation of a Radioactive Liquid Waste Treatment Facility upgrade in TA-50;
- Refurbishment of the existing LANSCE in TA-53;
- Construction and operation of a new Radiography Facility at TA-55;
- Refurbishment of the existing Plutonium Facility Complex at TA-55;
- Construction and operation of a new Science Complex, including space for activities currently performed at the Bioscience Facilities (formerly the Health Research Laboratory); and
- Construction and operation of a new warehouse and truck inspection station in TA-72.

Buildings and structures constructed and occupied since the late 1940s often cannot adequately accommodate modern operations. Additionally, these buildings and structures were not built to current structural, health, safety, and security standards and cannot be easily or economically retrofitted to meet these standards. These older buildings also are ill-equipped to accommodate the modern office electronics and communications equipment and systems needed for workforce and equipment cooling and heating needs. NNSA is now in the process of replacing many of the old buildings and structures at LANL with modern buildings and structures.

The need to replace these aging structures provides NNSA with an opportunity to consolidate operations and eliminate underutilized and redundant structures and buildings. In general, the analyses of these new construction projects include the DD&D of a comparable amount of space in older buildings or portable structures that are no longer needed or are unsuitable for future use, in keeping with requirements established in the fiscal year 2002 Energy and Water Development Appropriations Act passed by the Congress. According to language included in that Act, space added by the construction of new facilities within the Complex must be offset by the elimination of an equal amount of excess space.

Projects for Closure and Remediation Actions

Proposed projects of the second type include various actions that would result in the DD&D of excess structures that are not directly connected to the proposed construction of new or replacement facilities or structures, and site remediation and closure. Projects also include replacements of waste management capabilities that would be displaced as a result of remediation activities. Proposed projects of the second type include:

- DD&D of TA-18 Pajarito Site buildings and structures, including relocation of operations;
- DD&D of TA-21 buildings and structures;
- Provision of waste management facilities necessitated by closure of the TA-54 Material Disposal Area[8] (MDA) G; and
- Remediation of major MDAs and other contaminated sites at LANL as required by NMED under the Consent Order.

Regarding relocation of TA-18 Pajarito Site operations, decisions for the future disposition of the Security Category III and IV materials and buildings and structures in the TA were not made following preparation of the *TA-18 Relocation EIS* (DOE 2002i). Additional planning has since been completed, and these buildings and structures are being considered for DD&D rather than reuse after current operations have been relocated. As already stated, Security Category III and IV operations would have to be moved to a new facility before certain DD&D actions could be undertaken.

TA-21 is one of the 10 land tracts identified in accordance with Public Law 105-119 for conveyance or transfer from DOE administrative control. Potential environmental impacts from contemplated reuses of TA-21 were analyzed in the *Final Environmental Impact Statement for the Conveyance and Transfer of Certain Land Tracts Administered by the U.S. Department of Energy and Located at Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico* (DOE/EIS-0293) (DOE 1999d). LANL tritium operations located at TA-21 are either already slated to be moved to other locations at LANL or offsite to other Complex facilities, or will be discontinued entirely. The buildings and structures at TA-21 are some of the oldest at LANL and would be difficult to retrofit for most proposed beneficial reuses. TA-21 buildings and structures also include about 100,000 square feet (9,300 square meters) of highly contaminated space. Additionally, most buildings and structures located at TA-21 are situated atop or adjacent to potential release sites in the form of buried distribution lines, contaminated soil, or waste disposal areas. The demolition of these buildings or structures is necessary before the potential release sites can be adequately investigated and remediated. Investigation and

[8] A material disposal area or MDA is an area used any time between the beginning of LANL operations in the early 1940s and the present for disposing of chemically, radioactively, or chemically and radioactively contaminated materials.

remediation of potential release sites at TA-21, if necessary, must be undertaken before the site can be conveyed, transferred, or otherwise reused for other purposes.

The Expanded Operations Alternative in this SWEIS considers the environmental impacts of actions associated with remediation decisions that would not be made entirely by DOE or NNSA. In the case of the MDAs and other potential release sites, remedial actions will be mainly decided in accordance with the Consent Order (NMED 2005) and the Atomic Energy Act. For potential release sites subject to the Consent Order, NNSA and the LANL management and operating contractor will recommend a preferred remediation, but the State of New Mexico will make the final decision on the remedy to be employed. These remediation actions will have associated support actions for which NNSA must make decisions. The remediation of LANL MDAs would require the construction and operation of various new temporary ancillary structures for such purposes as waste characterization, sorting, treatment, and packaging or overpacking operations; material lay-down and storage areas; and vehicle parking and equipment storage. Support of remediation activities could also require realignment of roads and alteration of traffic patterns. Additionally, new replacement buildings and structures would be required to house ongoing operations and capabilities associated with or collocated with certain MDAs requiring remediation. The construction and operation of the following replacement buildings and structures has been proposed and is analyzed in this SWEIS:

- A new TRU (Transuranic) Waste[9] Facility (previously named the Transuranic Waste Consolidation Facility) for all transuranic waste management activities currently conducted at TA-54;
- A new temporary remote-handled transuranic waste retrieval facility for all or a portion of the remote-handled transuranic waste currently stored underground at TA-54 so that it can be retrieved, processed, and shipped to the Waste Isolation Pilot Plant (WIPP) in New Mexico for disposal; and
- A new administrative and access control building, a new low-level radioactive waste compactor building, and a new low-level radioactive waste characterization and verification building at TA-54.

Projects Associated with New Infrastructure or Levels of Operation

The third type of proposed project considered under the Expanded Operations Alternative would establish new capabilities or expand existing capabilities beyond the type or level of capabilities analyzed in the *1999 SWEIS* Preferred Alternative or other completed NEPA compliance documentation. Proposed projects of the third type include:

[9] "Transuranic waste is radioactive waste containing more than 100 nanocuries (3,700 becquerels) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for: (1) high-level radioactive waste; (2) waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the Environmental Protection Agency, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations; or (3) waste that the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61" (DOE 1999b).

- Constructing new vehicle parking lots and roads, realignment of existing roads, and altering of traffic patterns at various locations at LANL in support of security requirements;
- Increasing the computational operating capacity of the Metropolis Center at TA-3; and
- Increasing the amount and type of sealed radioactive sources[10] (hereafter called sealed sources) received for long-term management at LANL.

These latter two projects involve Key Facilities as that term was defined in the *1999 SWEIS*. The Solid Radioactive and Chemical Waste Facilities in TA-54 and the Chemistry and Metallurgy Research Building were designated as Key Facilities in the *1999 SWEIS* and, together with other facilities such as the Radiological Sciences Institute, are proposed locations for managing sealed sources. The Metropolis Center in TA-3 is identified as a new Key Facility in this new SWEIS.

Environmental impacts of changes in physical security along Pajarito Road and in TA-3 were evaluated in the *Environmental Assessment for Proposed Access Control and Traffic Improvements at Los Alamos National Laboratory* (DOE/EA-1429) (DOE 2002k). As part of that Security Perimeter Project, the construction and activation of access control stations near each end of Pajarito Road has been completed. Another element of the Security Perimeter Project involving realignment of roads and changes to traffic patterns around TA-3, is also mostly complete. The proposed project in this SWEIS to construct new vehicle parking lots and roads, realign roads, and alter traffic patterns would provide additional security along the western section of Pajarito Road. Implementation of the project would allow restriction of certain vehicle traffic along Pajarito Road while ensuring employee access to work places in TA-35, TA-48, TA-50, TA-55, and TA-63 by means of shuttle buses, walkways, and bicycle paths. Auxiliary actions to the proposed project would also be considered. The first auxiliary action includes the construction of a bridge from TA-35 across Mortandad Canyon to TA-60 and connection to a road leading to TA-3. The second auxiliary action, which is dependent on the first auxiliary action, entails construction of a bridge across Sandia Canyon and extending the road to intersect with East Jemez Road. If implemented, these auxiliary actions would allow vehicles traveling from White Rock to TA-3 or the Los Alamos townsite to bypass the section of Pajarito Road that would have restrictions on certain vehicle traffic.

Construction and operation of the Metropolis Center were analyzed in the *Environmental Assessment for the Proposed Strategic Computing Complex, Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EA-1250) (DOE 1998) and its associated Finding of No Significant Impact (FONSI) (the Metropolis Center was formerly called the Strategic Computing Complex, and the impact analysis appears under that name), which considered impacts associated with operating the computation facility at an initial capacity of a 50-teraflops platform (a teraflop is a trillion floating point operations per second). The Metropolis Center has been constructed and is currently operating a 30-teraflops platform; however, NNSA is considering

[10] "Sealed radioactive source means a radioactive source manufactured, obtained, or retained for the purpose of utilizing the emitted radiation. The sealed radioactive source consists of a known or estimated quantity of radioactive material contained within a sealed capsule, sealed between layer(s) of nonradioactive material, or firmly fixed to a nonradioactive surface by electroplating or other means intended to prevent leakage or escape of the radioactive material. Sealed radioactive sources do not include reactor fuel elements, nuclear explosive devices, and radioisotope thermoelectric generators" (10 CFR Part 835).

increases to the facility's operational capacity that could consume additional amounts of water and electrical power resources. The Metropolis Center's performance platform could exceed 100 teraflops before 2009, with dramatic increases thereafter. The proposed increase in the operating platform beyond 50 teraflops is analyzed in this SWEIS; however, the exact level of operations supported would be unknown, as it has become clear over the past 5 years that the operating platform level cannot be directly correlated to a set amount of water or electrical power consumption. Each new generation of computing capability machinery continues to be designed with enhanced efficiency in terms of both electrical consumption and cooling requirements. Therefore, the operating level that can be supported by about 15 megawatts of electrical usage and 51 million gallons (193 million liters) per year of water has been used to project associated potential environmental impacts in this SWEIS.

The acceptance of certain sealed sources at LANL for radioactive material recovery was initiated after DOE prepared an EA in 1995 that supported a FONSI (DOE 1995b). Recovery of the radioactive material from the sealed sources at the Plutonium Facility Complex, as was originally proposed, never occurred; and in 2000, NNSA proposed that those sealed sources be managed and disposed of as waste. An SA to the *1999 SWEIS* was prepared to consider that action, and a finding was reached that the *1999 SWEIS* impact analysis adequately bounded the management and disposal of those particular waste items (DOE 2000d). Another type of source contained within radioisotope thermoelectric generators was subsequently considered for management within LANL's solid waste management capabilities in 2004, and the environmental impacts were considered through preparation of an SA to the *1999 SWEIS*. A finding was again reached that the *1999 SWEIS* impact analysis adequately bounded the anticipated impacts from that action (DOE 2004a). NNSA is now proposing to broaden the range of radionuclides in sealed sources to be managed at LANL. The new nuclides being considered include some that are not actinides.[11] Management of these sealed sources could require their indefinite storage at LANL until alternate storage or disposal facilities become available. In July 2007, DOE issued an NOI to prepare an EIS to support a decision regarding the disposal of Greater-Than-Class C waste[12] and DOE waste with similar characteristics (72 FR 40135). This waste includes some of the sealed sources managed at LANL.

1.3.4 Preferred Alternative

NNSA has selected the Expanded Operations Alternative as its Preferred Alternative for the continued operation of LANL (discussed in Chapter 3 of this SWEIS). This alternative includes fabrication of up to 80 pits per year at the Plutonium Facility Complex in TA-55, as well as increased activity levels at certain other Key Facilities (such as the Chemistry and Metallurgy Research Replacement Facility) to support this level of pit production. Under the Expanded Operations Alternative, NNSA would undertake activities to facilitate compliance with the

[11] Actinides are any of the elements in the series of elements beginning with actinium (atomic number 87) and ending with lawrencium (atomic number 103). This series includes thorium, uranium, neptunium, plutonium, and americium, among others. Nonactinides, therefore, are elements that are not included among the list of actinides.

[12] Greater-Than-Class C low-level radioactive waste is defined by the U.S. Nuclear Regulatory Commission (NRC) in 10 CFR 72.3 as "low-level radioactive waste that exceeds the concentration limits of radionuclides established for Class C waste in [10 CFR 61.55]." It is generated by NRC or Agreement State licensed activities. Such waste generally requires disposal technologies having greater confinement capability or protection than "normal" near surface disposal. Such improved technologies could involve better waste forms or packaging, or disposal by methods having additional barriers against intrusion.

Consent Order and remediation of the MDAs. Capabilities, activity levels, and projects identified under the No Action Alternative that remain unchanged under the Expanded Operations Alternative would continue as described. Proposed increases in activity levels would be implemented and new capabilities would be added to existing Key Facilities. The proposed projects discussed in the appendices to this SWEIS would proceed, commensurate with funding.

However, full implementation of the Preferred Alternative may be affected by future programmatic decisions. NNSA is reconsidering its decision regarding construction and operation of the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility at LANL pending completion of its NEPA analysis for transformation of the nuclear weapons complex. NNSA is deferring a decision on how to provide the necessary long-term analytical chemistry, materials characterization, and research and development capabilities that would be provided by the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility. Given the uncertainty regarding the nuclear weapons program work that will be assigned to LANL in the future, NNSA expects to issue two or more RODs to implement its decisions. As discussed later in Section 1.4 of this chapter, NNSA may ultimately choose to implement only part of the Expanded Operations Alternative depending on how it decides to transform the complex.

Decisions relating to site remediation and to DD&D of facilities are expected to be in the first ROD based on this SWEIS. Specifically, these include activities that would facilitate remediation of MDAs and other contaminated sites as required by the Consent Order; the Waste Management Facilities Transition Project, including construction and operation of a new TRU Waste Facility; closure of TA-18, including relocation of Security Category III and IV material from TA-18 to other LANL locations, cessation of SHEBA operations, and the DD&D of TA-18 structures, as appropriate; TA-21 DD&D; and any activities in support of the closure of the Los Alamos County Landfill. Another decision that might be announced in the first ROD is enhancement of the operating levels at the Metropolis Center in TA-3. Projects to maintain existing capabilities at LANL that may be included in the first ROD include construction and operation of replacement office buildings in TA-3; construction and operation of the TA-50 Radioactive Liquid Waste Treatment Facility upgrade; construction and operation of the new Science Complex in TA-62; the LANSCE Refurbishment Project; and construction and operation of the new Consolidated Warehouse and Truck Inspection Station in TA-72.

Decisions regarding operations and projects that might be made in subsequent ROD(s) are initiation of a new capability at the Radiochemistry Facility (atom trapping); Security-Driven Transportation Modifications; elevated operations at the High Explosives Processing Facilities; construction and operation of the TA-3 Physical Science Research Complex; construction and operation of the Institute for Nuclear Nonproliferation Science and Technology, the first component of the new Radiological Sciences Institute at TA-48; facility refurbishments that make up the TA-55 Plutonium Facility Complex Refurbishment Project; construction and operation of a radiography facility at TA-55; and an increase up to 80 in the number of nuclear weapons pits produced within the TA-55 Plutonium Facility Complex, along with increases in the levels of operations of associated activities such as the management of solid and liquid radioactive wastes. NNSA's implementation of its decisions is subject to annual congressional funding levels. Although the SWEIS ROD(s) would indicate NNSA's commitment to a project, capability, or operational level, the actions would be taken contingent upon the level of funding allocated.

1.4 Decisions the National Nuclear Security Administration May Make on the Basis of the Site-Wide Environmental Impact Statement

This SWEIS updates the *1999 SWEIS* analysis and evaluates the impacts of newly proposed projects. The RODs based on this new SWEIS may supersede previous decisions made in 1999 regarding the level at which LANL operations will be conducted over at least the next 5 years. Analyses in this SWEIS considered levels of operations and new projects proposed for the period 2007 through about 2011, but would equally apply to actions beyond 2011 as long as the actions are bounded by the analyses in the SWEIS. The impacts analyses provided in this SWEIS will allow NNSA to reassess the potential impacts of LANL operations on workers, the public, and the environment in light of changes in the environmental circumstances that have developed since 1999.

This SWEIS also represents an opportunity to update information regarding the current status of the regional, local, and LANL-specific environmental conditions. The Cerro Grande Fire of 2000 burned over 7,700 acres (3,110 hectares) of land at LANL, resulting in changes to area watershed functions, vegetation cover functions, wildlife use, and cultural resources present in the area. The physical environment at and around LANL has also been affected by a southwestern regional drought and the attendant bark beetle infestation of evergreen trees. The Cerro Grande Fire and the bark beetle infestation have resulted in widespread vegetation mortality, particularly of evergreen trees, which will cause long-term ecological changes to the LANL area.

In addition, the new SWEIS impacts analyses give NNSA the opportunity to reassess the potential impacts of LANL operations on the public in light of changes in the size and distribution of the population near LANL, the distance to the site boundaries (and therefore, to potential public receptors), and changes in assessment methodologies adopted by DOE. The impacts analyses consider the most recent census data on the number and location of people living near LANL. The analyses also consider changes that have occurred as a result of the conveyance and transfer of certain land tracts away from the LANL reservation. Conveyance and transfer of lands have reduced the land areas that provide distance buffering between LANL operations and the public, resulting in potential changes to the locations used to assess impacts to a hypothetical "maximally exposed individual" member of the public from normal operations and postulated accidents. Assessments of risk associated with radiation exposure also reflect changes to the guidance on dose-to-risk conversion factors that have occurred since 1999.

These changes, together with information regarding impacts analyses specific to newly proposed projects at LANL that could have overarching effects, will inform NNSA regarding decisions about the continued operation of LANL over about the next 5 years. At this time, a nominal 5-year period has been selected, recognizing that a meaningful level of detail is not possible when trying to project changes in operations over a long period of time. Focusing on LANL operations over about the next 5-year window of time allows NNSA to make decisions with a reasonable expectation of being able to implement those decisions and associated mitigative measures.

The analyses of potential environmental impacts that could occur if NNSA implemented the No Action Alternative, Reduced Operations Alternative, or Expanded Operations Alternative are evaluated in this SWEIS. NNSA could choose to implement the alternatives either in whole or in part; that is, NNSA could select the level of operations for a Key Facility or whether to implement individual projects. NNSA intends to implement actions necessary to comply with the Consent Order, regardless of decisions it makes on other actions analyzed in this SWEIS; the Expanded Operations Alternative includes the analysis of the actions needed to comply with that order. Similarly, NNSA plans to complete the design for the Chemistry and Metallurgy Research Replacement Facility, but is deferring a final decision on whether to construct the nuclear facility portion at LANL. NNSA could issue a ROD or RODs to document its decisions regarding the level of LANL operations or the implementation of a project no sooner than 30 days after the Environmental Protection Agency Notice of Availability of the Final SWEIS.

Decisions NNSA may make regarding the operation of LANL are:

- *Whether to implement the No Action Alternative for continued LANL operations, either in whole or in part*. NNSA may choose to implement the No Action Alternative in its entirety, thereby deciding to continue LANL operations for about the next 5 years at levels previously selected and to implement none of the specific projects or actions that are elements of the Expanded Operations Alternative; or NNSA may elect to implement the No Action Alternative in part by taking no action on certain specific projects or actions while electing to implement others. As explained previously, a decision to postpone an action decision results in a *de facto* decision to implement the No Action Alternative for that proposed project. That No Action Alternative decision could be changed later with the issuance of a subsequent ROD regarding selection of one of the Action Alternatives for implementation.

- *Whether to implement the Reduced Operations Alternative, either in whole or in part.* The Reduced Operations Alternative includes specific actions at separate existing facilities that could be implemented individually over about the next 5 years. Proposed projects considered under this Alternative include operations at facilities that are heavily engaged in experimental activities. Reducing high explosives testing operations by 20 percent, for example, could reduce all individual experiments, or it could entirely eliminate certain experiments and reduce other experiments from their full scope to achieve a 20 percent overall work reduction. The shutdown of LANSCE could be implemented separately from reductions to high explosives processing or testing operations although, to a certain extent, these two operations may be linked. Experimental operations at all LANL facilities receive funding from a variety of sources, and the level of operations at any time highly depends on the level of funding received for a particular year. Reductions due solely to a lack of funding could reach the level of reductions called for by this Alternative; however, choosing to implement this Alternative in whole or in part would permanently reduce the level of subject operations.

- *Whether to implement the Expanded Operations Alternative, either in whole or in part*. The Expanded Operations Alternative includes specific actions at separate existing facilities that could be implemented individually over about the next 5 years. Proposed projects considered under this Alternative include construction and demolition activities, as well as the expansion of certain operations at existing LANL facilities. Environmental remediation actions for potential release sites subject to cleanup under the Hazardous Waste Amendments to the Resource Conservation and Recovery Act will be determined by the State of New Mexico in accordance with the provisions of the Consent Order (NMED 2005). NNSA, however, will need to make decisions regarding how to implement the remediation actions selected by the State of New Mexico. This SWEIS provides environmental impact information about the methods of remediation to facilitate the State of New Mexico's decisionmaking process for those decisions that it will make, and for the benefit of the reader with regard to understanding potential remediation action options in context with the overall operation of LANL over the next 5 years and beyond. NNSA intends to implement actions necessary to comply with the Consent Order regardless of whether other actions in the Expanded Operations Alternative are implemented. Similarly, the County of Los Alamos has made a decision to close the municipal landfill located at LANL but operated by the county; however, accommodating further necessary actions associated with this decision, such as monitoring actions around the landfill site and down-canyon from the site within the LANL boundary, may require implementation decisions by NNSA.

In addition to the environmental impact information provided by this SWEIS, other considerations that are not evaluated through the NEPA compliance process will also influence NNSA's final project decisions. These considerations include cost estimate information, schedule considerations, safeguards and security concerns, and programmatic considerations of impacts. In accordance with CEQ NEPA Regulations §1500.1 (c), "Ultimately, of course, it is not better documents, but better decisions that count. NEPA's purpose is not to generate paperwork – even excellent paperwork – but to foster excellent action. The NEPA process is intended to help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment. These regulations provide the direction to achieve this purpose" (40 CFR Parts 1500 to 1508).

There are decisions related to the operation of LANL that NNSA will not make based on the Final SWEIS impact analyses. As already stated, decisions about the final remediation actions to be implemented at LANL MDAs and other potential release sites subject to the Consent Order will not be made by NNSA, but by the New Mexico Environment Department (NMED 2005). Similarly, the County of Los Alamos, as the landfill operator, has already made the decision to close the municipal solid waste landfill located at LANL.

NNSA will not make decisions to remove mission support assignments from LANL or alter the operational level of those capabilities that are ongoing at the site in favor of capabilities that have not been explicitly identified in the alternatives analyzed in this SWEIS. NNSA will not consider a LANL "shutdown" or "true No Action Alternative" or a "Greener Alternative" (alternatives considered but not evaluated further in this SWEIS are discussed in Chapter 3, Section 3.5). As noted previously, programmatic changes to the DOE nuclear weapons complex are the subject of a separate NEPA impact analysis. At this time, a shutdown alternative is not reasonable for NEPA analysis.

1.5 Relationships to Other Department of Energy National Environmental Policy Act Documents and Information Sources

Various NEPA compliance reviews undertaken since issuance of the *1999 SWEIS* and its associated ROD have resulted in decisions to implement proposed projects at LANL. Some of these actions have already been implemented, and some actions are proceeding through the detailed planning stages toward implementation in the near future. These NEPA compliance reviews were used to identify operational changes and environmental impacts for this new SWEIS impact analysis. Using the *1999 SWEIS* and its associated ROD as a starting point, these additional NEPA reviews include:

- *Supplement Analysis, Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Modification of Management Methods for Certain Unwanted Radioactive Sealed Sources at Los Alamos National Laboratory* (DOE/EIS-0238-SA-01) (2000). This SA was prepared to evaluate a proposal to modify the Off-Site Source Recovery Project from one that accepted the sealed sources and chemically reclaimed the radioactive material to one that accepted the sealed sources and managed them as radioactive waste.

- *Supplement Analysis, Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Modification of Management Methods for Transuranic Waste Characterization at Los Alamos National Laboratory* (DOE/EIS-0238-SA-02) (2002). This SA was prepared to evaluate a modification to the management methods for transuranic waste by installing and operating modular units for the characterization of this type of waste.

- *Supplement Analysis, Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Bolas Grande Project* (DOE/EIS-0238-SA-03) (2003). This SA was prepared to evaluate the cleanout and disposal of certain large containment vessels that were used for testing purposes. These vessels have been stored at TA-55 and would be taken to the Chemistry and Metallurgy Research Building for cleanout prior to being taken to TA-54 for disposal.

- *Supplement Analysis, Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Recovery and Storage of Strontium-90 (Sr-90) Fueled Radioisotope Thermal Electric Generators at Los Alamos National Laboratory* (DOE/EIS-0238-SA-04) (2004). This SA was prepared to evaluate a proposal to recover, store, and manage as waste certain radioisotope thermal electric generators containing sealed sources as part of the Off-Site Source Recovery Project.

- *Supplement Analysis, Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Proposed Horizontal Expansion of the Restricted Airspace up to 5,000 Feet at Los Alamos National Laboratory* (DOE/EIS-0238-SA-05) (2004). This SA was prepared to evaluate a proposal to slightly expand the horizontal extent of the restricted airspace up to 5,000 feet (1,500 meters) above LANL.

- *Final Supplement Analysis for Pit Manufacturing Facilities at Los Alamos National Laboratory, Stockpile Stewardship and Management Programmatic Environmental Impact Statement* (DOE/EIS-0236-SA/06) (2006). This SA was prepared to evaluate certain conditions and new information associated with proposed pit manufacturing at LANL.
- *Surplus Plutonium Disposition Final Environmental Impact Statement* (DOE/EIS-0283) (1999). This EIS was prepared to analyze environmental impacts with regard to disposition of surplus plutonium at locations around the DOE nuclear weapons complex, including LANL. Plutonium declared excess to national security needs could be stored and dispositioned in accordance with the strategy selected for implementation in the amended ROD for this EIS. LANL was identified as the site for fabrication of mixed oxide fuel to be used in testing.
- *Supplement Analysis, Fabrication of Mixed Oxide Fuel Lead Assemblies in Europe*, (DOE/EIS-0229-SA3) (2003). This SA evaluated the impacts of transporting plutonium oxide from LANL to France for fabrication into four mixed-oxide fuel lead assemblies for a nuclear reactor. The analysis also includes the return to LANL of excess mixed-oxide materials and out-of-specification materials loaded in fuel rods that are welded closed. These materials are to be stored at LANL until they are needed as feed for mixed-oxide fuel production in the United States.
- *Final Environmental Impact Statement for the Conveyance and Transfer of Certain Land Tracts Administered by the U.S. Department of Energy and Located at Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico* (DOE/EIS-0293) (1999). This EIS was prepared to analyze the environmental impacts associated with the future use of each of 10 tracts of land administered by DOE at LANL that were proposed for transfer to the Department of the Interior in trust for the Pueblo of San Ildefonso or conveyance to the County of Los Alamos in accordance with the provisions of Public Law 105-119.
- *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory* (DOE/EIS-0319) (2002). This EIS reviewed the environmental impacts expected from a proposal to relocate capabilities and materials from TA-18 at LANL to one of several locations around the Complex. The ROD issued as a result of this EIS was to transfer Security Category I and II nuclear equipment and related materials to the Device Assembly Facility at the Nevada Test Site. A decision on the disposition of Security Category III and IV materials was deferred and is addressed in the project-specific analyses of this SWEIS.
- *Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico (CMRR EIS)* (DOE/EIS-0350) (2003). This EIS examined the potential environmental impacts associated with the Proposed Action of consolidating and relocating the mission-critical chemistry and metallurgy research capabilities from an aging building to a new modern building (or buildings). The ROD (69 FR 6967) selected a location for a Chemistry and Metallurgy Research Replacement Facility adjacent to the

Plutonium Facility Complex in TA-55. Design and construction of the radiological laboratory, administrative office, and support portion of the new facility is proceeding; however, decisions to be made by NNSA that will be supported by the *Complex Transformation SPEIS* could result in changes to the Chemistry and Metallurgy Research Replacement Facility as described in the 2003 *CMRR EIS* and its associated 2004 ROD. Specifically, NNSA will decide whether to construct the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility at LANL or incorporate the capabilities into a consolidated plutonium center or a consolidated nuclear production center either at LANL or another DOE site. Decisions reached by NNSA on Complex Transformation are anticipated to take 10 to 20 years to fully implement. During that period there will remain a continuing need for analytical chemistry and material characterization, and actinide research and development support capabilities and capacities that are currently housed in the Chemistry and Metallurgy Research Building at LANL. NNSA is continuing design efforts for the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility, but actions to proceed beyond the design stage will not occur until programmatic decisions regarding Complex Transformation are made.

- *Supplement Analysis, Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico, Changes to the Location of the CMRR Facility Components* (DOE/EIS-0350-SA-01) (2005). This SA was prepared to evaluate placement of certain buildings related to the Chemistry and Metallurgy Research Building Replacement Project in the same vicinity, but at locations other than those detailed in the *CMRR EIS* ROD.

- *Special Environmental Analysis for the Department of Energy, National Nuclear Security Administration, Actions Taken in Response to the Cerro Grande Fire at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/SEA-03) (2000). This special environmental analysis (SEA) documented the impacts of actions take by NNSA (or on behalf of NNSA or with NNSA funding) to address the emergency situation caused by the 2000 Cerro Grande Fire. This SEA describes actions and their impacts, mitigation measures taken for actions that rendered their impacts not significant or that lessened the adverse effects, and provides an analysis of cumulative impacts.

- *Environmental Assessment for the Parallex Project Fuel Manufacture and Shipment* (DOE/EA-1216) (1999). This EA evaluated the activities necessary to fabricate 59.2 pounds (26.8 kilograms) of mixed-oxide fuel at TA-55 at LANL and ship it to the U.S.-Canada border. The mixed-oxide fuel would be used in a Canadian research reactor.

- *Environmental Assessment for the Proposed Construction and Operation of the Nonproliferation and International Security Center* (DOE/EA-1238) (1999). This EA analyzed construction and operation of a Nonproliferation and International Security Center at TA-3 at LANL that provides office and light laboratory space.

- *Environmental Assessment for Electrical Power System Upgrades at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EA-1247) (2000). This EA analyzed the effects of upgrading the LANL electrical power supply system to increase its reliability for meeting current and future needs.

- *Environmental Assessment for the Proposed Strategic Computing Complex, Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EA-1250) (1998). This EA analyzed the effects of the construction and operation of a three-story, 303,000-square foot (28,100-square meter) Strategic Computing Complex at TA-3 at LANL. Following construction, this building was renamed the Nicholas C. Metropolis Center for Modeling and Simulation.

- *Decontamination and Volume Reduction System for Transuranic Waste at Los Alamos National Laboratory, Los Alamos, New Mexico, Environmental Assessment* (DOE/EA-1269) (1999). This EA analyzed the environmental consequences of the construction and operation of a decontamination and volume reduction system for processing transuranic waste removed from underground storage at LANL.

- *Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EA-1329) (2000). This EA analyzed the environmental consequences resulting from implementation of a selected forest management practices program within the boundaries of LANL. Selected practices included mechanical and manual thinning of the forests. A subsequent FONSI added use of prescribed burns as a selected management practice.

- *Environmental Assessment for Leasing Land for the Siting, Construction, and Operation of a Commercial AM Radio Antenna at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EA-1332) (2000). This EA analyzed the environmental impacts of leasing approximately 3 acres (1.2 hectares) of land located in the southeastern portion of TA-54 for the siting, construction, and operation of a commercial AM radio broadcasting antenna.

- *Environmental Assessment for the Proposed Construction and Operation of a Biosafety Level 3 Facility at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EA-1364) (2002). This EA was prepared to assess environmental consequences resulting from construction and operation of a Biosafety Level 3 laboratory facility in TA-3 at LANL. Additional NEPA analysis is being performed to further evaluate the potential impacts of operating the facility.

- *Environmental Assessment for Construction and Operation of a New Office Building and Related Structures within TA-3 at Los Alamos National Laboratory* (NNSA/EA-1375) (2001). This EA was prepared to assess the environmental consequences resulting from construction and operation of a multistoried office building (the National Security Sciences Building) to house about 700 personnel who would move from Building 3-43; a one-story lecture hall; and a separate multilevel parking structure at TA-3 at LANL.

- *Environmental Assessment for the Proposed Construction and Operation of a New Interagency Emergency Operations Center at Los Alamos National Laboratory* (DOE/EA-1376) (2001). This EA was prepared to evaluate the impacts of the construction and operation of a new Interagency Emergency Operations Center at TA-69 at LANL. The new Center was designed to withstand, to the extent practical, any anticipated emergency such that emergency response actions would not be compromised by the emergency itself.

- *Environmental Assessment for Atlas Relocation and Operation at the Nevada Test Site* (DOE/EA-1381) (2001). This EA was prepared to assess the environmental consequences resulting from implementation of a proposal to relocate a hydrodynamic test machine, the Atlas Pulsed Power Machine, from LANL to the Nevada Test Site where it would be set up and operated.

- *Environmental Assessment for the Proposed TA-16 Engineering Complex Refurbishment and Consolidation at Los Alamos National Laboratory* (DOE/EA-1407) (2002). This EA was prepared to assess the environmental consequences of the proposed construction of new buildings and the remodeling of existing buildings to allow consolidation of the Engineering Sciences and Applications Division operations and offices in a "campus-like" cluster of facilities at TA-16. The Proposed Action also included infrastructure changes and the demolition or removal of older buildings and transportables.

- *Environmental Assessment for the Proposed Future Disposition of Certain Cerro Grande Fire Flood and Sediment Retention Structures at Los Alamos National Laboratory* (DOE/EA-1408) (2002). This EA was prepared to analyze the environmental impacts resulting from future disposition of certain flood and sediment retention structures built within the boundaries of LANL in the wake of the Cerro Grande Fire. Aboveground portions of these structures would be removed as the watersheds return to prefire conditions.

- *Environmental Assessment for the Proposed Issuance of an Easement to Public Service Company of New Mexico for the Construction and Operation of a 12-inch Natural Gas Pipeline within Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EA-1409) (2002). This EA was prepared to analyze the proposed issuance of an easement to the Public Service Company of New Mexico to construct, operate, and maintain approximately 15,000 feet (4,500 meters) of 12-inch (30-centimeter) coated steel natural gas transmission mainline on NNSA-administered land within LANL along Los Alamos Canyon.

- *Environmental Assessment of the Proposed Disposition of the Omega West Facility at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EA-1410) (2002). This EA was prepared to analyze the environmental consequences of removing the Omega West Facility, a research reactor, and the remaining support structures from Los Alamos Canyon in TA-2.

- *Environmental Assessment for Proposed Access Control and Traffic Improvements at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EA-1429) (2002). This EA was prepared to analyze the environmental consequences resulting from the construction of eastern and western bypass roads around the LANL TA-3 area and the installation of vehicle access controls and related improvements to enhance security along Pajarito Road and into the LANL TA-3 core area.

- *Environmental Assessment for the Installation and Operation of Combustion Turbine Generators at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EA-1430) (2002). This EA was prepared to evaluate the environmental impacts of installing and operating two new simple-cycle, gas-fired combustion turbine generators, each with an approximate output of 20 megawatts of electricity, as standalone structures within the Co-Generation Complex at TA-3 (TA-3 Power Plant).

- *Environmental Assessment for the Proposed Los Alamos National Laboratory Trails Management Program, Los Alamos, New Mexico* (DOE/EA-1431) (2003). This EA was prepared to assess the potential environmental consequences of initiating a LANL Trails Management Program that would maintain existing trails, develop new trails, and reclaim closed trails, making them available for public use.

- *Environmental Assessment for the Proposed Consolidation of Certain Dynamic Experimentation Activities at the Two-Mile Mesa Complex, Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EA-1447) (2003). This EA evaluated the environmental impacts of constructing and operating offices, laboratories, and shops within the Two-Mile Mesa Complex, located at the conjunction of TA-6, TA-22, and TA-40, where work would be consolidated from other locations at LANL.

- *Environmental Assessment for Proposed Corrective Measures at Material Disposal Area H within Technical Area 54 at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EA-1464) (2004). This EA was prepared to assess the potential environmental consequences of implementing corrective measures at MDA H. The corrective measure options analyzed in this EA addressed a range of potential containment and excavation options and provided a bounding analysis of the potential environmental effects of implementing any corrective measure at MDA H.

- *Environmental Assessment for the Proposed Closure of the Airport Landfills within Technical Area 73 at Los Alamos National Laboratory* (DOE/EA-1515) (2005). This EA was prepared to evaluate a proposal to conduct a voluntary corrective action involving the closure of two former solid waste disposal areas at the Los Alamos Airport within TA-73 at LANL.

- *Final Environmental Assessment for the Proposed Consolidation of Neutron Generator Tritium Target Loading Production* (DOE/EA-1532) (2005). This EA analyzed the potential effects of a proposal to consolidate tritium production operations by relocating to Sandia National Laboratories, New Mexico, the tritium target loading operations conducted at LANL.

As already stated, decisions to implement projects based on these impact analyses, together with the decision to implement the Preferred Alternative analyzed in the *1999 SWEIS*, form the basis of the No Action Alternative analyzed in this SWEIS. As such, the impacts projected for each action either implemented or to be implemented at LANL based on these NEPA compliance reviews are considered and incorporated by reference into this SWEIS impact analysis. Similarly, routine maintenance, construction, and support activities that are necessary to maintain the availability, viability, and safety of LANL, and that individually and cumulatively have negligible effects on the environment, are also incorporated into this SWEIS analysis.

Consideration of Future Projects and Emerging Actions Affecting Los Alamos National Laboratory

In addition to the actions for which NEPA analyses have been completed since 1999 and the project-specific actions that are analyzed in this SWEIS, there are interim actions that NNSA could implement for LANL during the time that this SWEIS is under development. In conformance with CEQ regulations regarding interim actions, these actions would be justified independently from the analyses in this SWEIS, would be supported by separate environmental analyses, and would not prejudice the decisions to be made regarding the level of operations at LANL by limiting alternatives (40 CFR 1506.1). Actions that are undergoing separate NEPA review while the SWEIS is being developed are summarized below. Additional actions that have not been sufficiently developed at this time could also be identified and would undergo the appropriate level of NEPA analysis.

- *Draft Environmental Impact Statement for the Operation of the Biosafety Level 3 (BSL-3) Facility at the Los Alamos National Laboratory* (DOE/EIS-0388D). In 2002, NNSA issued the *Environmental Assessment for the Proposed Construction and Operation of a Biosafety Level 3 Facility at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EA-1364), and reached a FONSI (DOE 2002c). The facility, containing two Biosafety Level 3 and one Biosafety Level 2 laboratories, was constructed in TA-3. Due to the need to consider new circumstances and information relevant to the actual construction of the Biosafety Level 3 Facility and its future operation, NNSA withdrew the 2002 FONSI as it applies to operating this facility. NNSA has since determined that an EIS should be prepared that reevaluates the proposed operations of the facility. The Draft BSL-3 EIS is currently being prepared. The outcome of that EIS would not affect NNSA's ability to implement any of the alternatives analyzed in this SWEIS.

- *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems (Consolidation EIS)* (DOE/EIS-0373D). This Draft EIS evaluates the environmental impacts of the Proposed Action and alternatives for consolidating radioisotope power system nuclear operations at a single site to reduce the security threat in a cost-effective manner, improve program flexibility, and to reduce interstate transportation of special nuclear material. The nuclear operations infrastructure required to produce radioisotope power systems currently exists, or is planned to exist, at three separate locations: Oak Ridge National Laboratory in Tennessee, LANL in New Mexico, and Idaho National Laboratory in Idaho. The Proposed Action would consolidate radioisotope power system nuclear operations at Idaho National Laboratory, thus eliminating safety, security, and transportation issues. The Proposed Action also would remove radioisotope power system nuclear operations work from TA-55; under the *Consolidation EIS* No Action Alternative, the operations would remain at TA-55. However, the elimination of radioisotope power systems operations would not be necessary to implement any of the alternatives analyzed in this SWEIS.

Future projects that could occur at multiple sites or throughout the complex may also undergo NEPA review during the timeframe of this analysis. Projects that could potentially affect activities at LANL include:

- *Complex Transformation Supplemental Programmatic Environmental Impact Statement (Complex Transformation SPEIS)* (DOE/EIS-0236-S4). On January 11, 2008, NNSA announced the availability of the Draft *Complex Transformation SPEIS* which analyzes the environmental impacts from the continued transformation of the United States' nuclear weapons complex over the next 10 to 20 years. NNSA's proposed action is to continue currently planned modernization activities: NNSA would select a site to consolidate plutonium research and development, surveillance, and pit manufacturing; consolidate special nuclear materials throughout the complex; consolidate, relocate, or eliminate duplicative facilities and programs and improve operating efficiencies; identify one or more sites for conducting NNSA flight test operations; and accelerate nuclear weapons dismantlement activities. With regard to future pit production at LANL, the *Complex Transformation SPEIS* assesses alternatives that could result in decisions to produce pits at LANL at higher levels than are assessed in the LANL SWEIS. Two options of an upgrade alternative for pit production are assessed: one that would produce 80 pits annually, and one that would produce 125 pits annually with a potential surge capacity of 200 pits annually. In addition, LANL is assessed as a potential location for a consolidated plutonium center or for a consolidated nuclear production center; either of which entails consolidation of special nuclear materials storage and production of 125 pits with a potential surge capacity of 200 pits annually. The impacts of constructing and operating a consolidated nuclear production center at LANL are included in the cumulative impacts section of this SWEIS.

  The *Complex Transformation SPEIS* also evaluates consolidating other activities that are currently part of the mission work assignments at LANL, including hydrotesting, high explosives research and development, tritium research and development, and major environmental testing. Depending upon decisions made for Complex Transformation, NNSA may decide to reduce certain operations at LANL, including its 2004 decision to construct and operate the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility at this site.

- *Global Nuclear Energy Partnership Programmatic Environmental Impact Statement* (*GNEP PEIS)* (DOE/EIS-0396). DOE issued a Notice of Intent for the *GNEP PEIS* on January 4, 2007 (72 FR 331). GNEP would encourage expansion of domestic and international nuclear energy production while reducing nuclear proliferation risks, and reduce the volume, thermal output, and radiotoxicity of spent nuclear fuel before disposal in a geologic repository. The PEIS includes evaluation of a proposed advanced fuel cycle facility that would support research and development associated with the GNEP program. LANL is one of the DOE sites being considered for the advanced fuel cycle facility. DOE held a scoping meeting for the *GNEP PEIS* on March 1, 2007, in Los Alamos, New Mexico. Another dozen scoping meetings were held across the country during the scoping period, which ended June 4, 2007. DOE intends to issue a *Draft GNEP PEIS* in 2008.

- *Environmental Impact Statement for the Disposal of Greater-Than-Class-C Low-Level Radioactive Waste* (*GTCC EIS*). In July 2007, DOE issued an NOI to prepare an EIS to address disposal of low-level radioactive waste generated by activities licensed by the Nuclear Regulatory Commission or an Agreement State that have radionuclides in concentrations exceeding 10 CFR 61 Class C limits (72 FR 40135). This EIS would also consider DOE waste having similar characteristics. Currently there is no location for disposal of Greater-Than-Class C waste and DOE is responsible for such disposal under the Low-Level Radioactive Waste Policy Amendments Act (Public Law 99-240). LANL is being considered as one of eight candidate DOE disposal sites for Greater-Than-Class C waste in the *GTCC EIS*, along with a generic commercial disposal facility option in arid and humid environments. DOE is evaluating several disposal technologies in the *GTCC EIS* including geologic repositories, intermediate depth boreholes, and enhanced near surface disposal facilities. Certain sealed sources managed by LANL under the Off-Site Source Recovery Project could be candidates for disposal in a site selected by DOE following completion of the EIS. The Off-Site Source Recovery Project would continue to collect and manage sealed sources independent of any decisions that would result from the *GTCC EIS*.

1.6 Public Involvement

The process of preparing an EIS provides opportunities for public involvement (see **Figure 1–4**). These opportunities include the scoping process and the public comment period for the EIS. The scoping process is required by 40 CFR 1501.7 while the public comment period is required by 40 CFR 1503.1. Section 1.6.1 summarizes the scoping process, major comments received from the public, and changes made by NNSA in response to the public comments. Section 1.6.2 summarizes the public comment period process, major comments raised by the public, and NNSA's responses to those comments.

1.6.1 Scoping Process

As a preliminary step in the development of an EIS, regulations established by the CEQ (40 CFR 1501.7) and DOE require "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a Proposed Action." The purpose of this scoping process is: (1) to inform the public about a Proposed Action and the Alternatives being considered, and (2) to identify and clarify issues relevant to the EIS by soliciting public comments.

On January 5, 2005, NNSA published an NOI to prepare a Supplemental SWEIS in the *Federal Register* (70 FR 807) (see Appendix A). NNSA provided the public an opportunity to participate in the scoping process through a public scoping meeting held on January 19, 2005, in Pojoaque, New Mexico, and through receipt of comments via the U.S. Postal Service, a special DOE Internet address, a toll-free phone line, and a facsimile phone line. The public scoping period ended February 17, 2005. Approximately 225 comments were received from citizens, interested groups, local officials, and representatives of Native American Pueblos in the vicinity of LANL during the scoping process. All comments received were reviewed for consideration by NNSA in proceeding with this NEPA analysis.

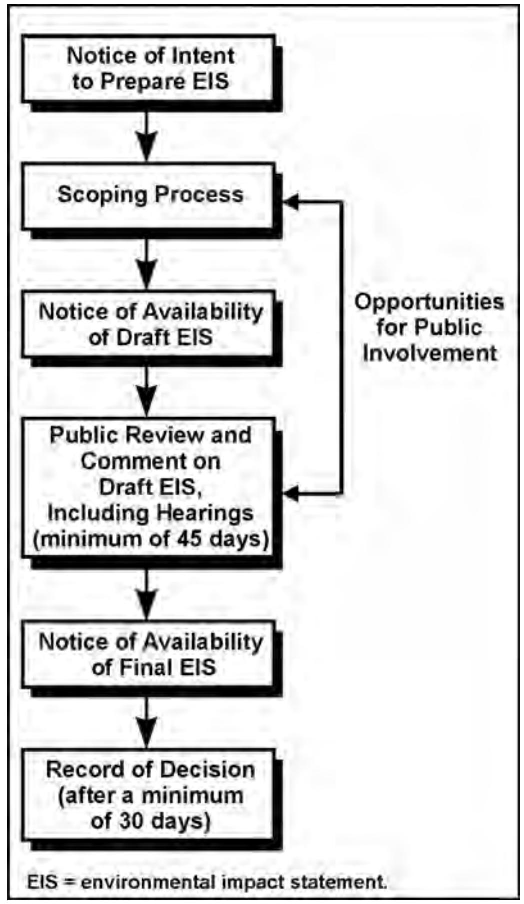


Figure 1–4 National Environmental Policy Act Process

Summary of Major Scoping Comments

Multiple comments were made regarding the type of NEPA document that NNSA should prepare. There were comments calling for development of a new SWEIS rather than a supplement to the *1999 SWEIS*. Justifications for a new SWEIS included changes in operations and the environment, issuance of the Consent Order (NMED 2005), concerns about inadequacies of the *1999 SWEIS*, contaminants in the environment, and others. Regarding the scope of the document, comments included the desire to see a Reduced Operations Alternative, a Greener Alternative, and a "true No Action Alternative". In response, NNSA prepared this SWEIS instead of a Supplemental SWEIS, as originally proposed. This SWEIS includes analysis of a Reduced Operations Alternative to assess the impacts of continued operation of LANL, with certain facilities operating at lower levels. Two alternatives that were suggested for inclusion in the new SWEIS are not analyzed. A "true No Action Alternative," understood to mean a cessation of LANL operations, is not included, nor is a distinct "Greener Alternative." The reasons these alternatives were considered and dismissed from further evaluation are discussed in Chapter 3, Section 3.5.

Other public comments focused on ensuring that certain facilities, processes, and activities at LANL were included in the SWEIS. In general, all facilities, processes, and other activities at LANL have been included. Operation of the Biosafety Level 3 Facility is being addressed in a separate EIS; however, a summary of the potential impacts is included in the cumulative impacts section of this SWEIS.

A range of comments on environmental changes since the release of the *1999 SWEIS* were also received, including general questions on New Mexico's drought and the impacts of the Cerro Grande Fire. Other comments stressed that the most recent environmental monitoring and hydrological data be incorporated and addressed. Chapter 4 summarizes the results of a number of studies performed following the Cerro Grande Fire to determine the impacts the fire had on the movement of contaminants. Appendix F presents a comparison of levels of environmental contamination based on composite samples of groundwater, stormwater runoff, sediments, and soil as measured over the years since the Cerro Grande Fire to similar sample results presented in the *1999 SWEIS*. In addition, the most recent publicly available environmental reports have been incorporated into the analyses of this SWEIS.

NNSA received comments from local Native American Tribes that reflected concerns related to LANL operations and human and environmental health problems in their communities. They believe health issues were not properly addressed in the *1999 SWEIS* or ROD and would like to see a more detailed analysis. NNSA believes this SWEIS conforms to the established NEPA requirements and practices for analyzing and presenting these impacts and made no specific changes in response to these comments.

Other concerns identified by commentors in the scoping process were related to analyzing the impacts of reduced air monitoring, improving the air quality and soil analysis, increasing the discussion of cleanup activities, addressing land conveyance and transfer, and questioning the scope of the accident analyses. NNSA addressed all of these topics in the Draft SWEIS and in this Final SWEIS.

Certain groups of comments from the scoping process were not included in the analysis of this SWEIS. These included comments regarding accountability of LANL management, the transfer of LANL management, worker turnover, and worker morale.

1.6.2 Public Comments on the Draft LANL SWEIS

Once the Draft EIS is completed, regulations require that it be issued publicly to obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved or which is authorized to develop and enforce environmental standards; appropriate State and local agencies; Native American Tribal Governments, when the effects may be on a reservation; and the public, which consists of those persons or organizations who may be interested or affected (40 CFR 1503.1).

NNSA issued a notice of availability for the Draft SWEIS in July 2006 (71 FR 38638). The formal public comment period, originally scheduled for 60 days, lasted 75 days, beginning on July 7, 2006 and ending on September 20, 2006. During this comment period, public hearings were held in Los Alamos, Española, and Santa Fe, New Mexico. In addition, Federal agencies, state and local governmental entities, Native American Tribal Governments, and the general public were encouraged to submit comments via the U.S. mail, e-mail, a toll-free telephone number, and a toll-free fax line. Approximately 1,600 comments were received. NNSA considered all comments, including those received after the comment period ended, in evaluating the accuracy and adequacy of the Draft SWEIS and to determine whether its text needed to be corrected, clarified, or otherwise revised.

Upon receipt, all comment documents (e-mail, letter, telefax, transcribed phone messages) are entered into a tracking system for management during the comment response process. The transcript from each public hearing is also entered into the system as a comment document. All comment documents are included in the Administrative Record. The text of each comment document is delineated into individual, sequentially numbered comments and responses are developed for each comment, as appropriate. A copy of each comment document, including transcripts, along with NNSA’s response to each comment, is included in Volume 3, *Comment Response Document*, Section 3, *Public Comments and NNSA Responses*, of the SWEIS.

Summary of Major Issues

Several topics raised by public comments on the Draft SWEIS are of broad interest or concern, or require a detailed response. The following discussion presents a summary of these major issues and NNSA's responses. Many of these issues are presented in more detail in the Comment Response Document, Section 2, *Major Issues*, of the SWEIS.

Opposition to Nuclear Weapons and Pit Production – *Commentors expressed general opposition to nuclear weapons and pit production. Nuclear weapons are seen as unnecessary, immoral, unethical, and violating international nonproliferation treaties, and should be eliminated. Some commentors also called into question the need for pit production because of the apparent long life of plutonium pits.*

NNSA acknowledges that there is wide-spread opposition to the production of nuclear weapons and their components; however, nuclear deterrence will continue to be an important element of national security policy for the foreseeable future. LANL's national security responsibilities are to support NNSA's core mission which includes ensuring a safe and reliable nuclear stockpile; a cessation of these activities would be counter to national security policy as established by the Congress and the President. Therefore, as discussed in Chapter 3, Section 3.5, ending these activities at LANL is not considered in the SWEIS. Maintaining an existing nuclear weapon stockpile for safety and security reasons is not in violation of any current nonproliferation treaty to which the United States is a signatory. Stockpile stewardship capabilities at LANL are currently viewed by the United States as a means to further the Nation's nonproliferation objectives. Continued confidence in the Nation's nuclear stockpile capabilities is likely to remain important in arms control negotiations as the size of the stockpile continues to be reduced in accordance with international treaties. Regarding pit lifetime, NNSA reviewed pit lifetime studies and concluded that the degradation of plutonium in the majority of nuclear weapons will not affect warhead reliability for a minimum of 85 years; however, the production rate of 80 pits per year analyzed in this SWEIS provides a bounding scenario and would, if implemented, give NNSA flexibility to meet current security needs.

NEPA Process – *Commentors expressed a variety of concerns related to the implementation of the NEPA process for the LANL SWEIS, including an inadequate scoping process, inadequate time to review the Draft SWEIS, inadequate timing and number of public hearings, lack of availability of references for public review, and the need to include not-yet completed technical studies.*

In implementing the NEPA process, NNSA provided reasonable opportunities for the public to provide input, including a scoping period following issuance of an NOI and a comment period following publication of the Draft SWEIS. NNSA announced a scoping period and scoping meeting based on the plans to prepare a supplement to the *1999 SWEIS*. Subsequently, NNSA determined that it would prepare a new SWEIS rather than a supplemental SWEIS, consistent with the sentiment expressed in some scoping comments. NNSA believes that the scoping comments apply equally to a supplement to the previous SWEIS or to a new SWEIS. For review of the Draft SWEIS, NNSA originally provided for a 60-day comment period; in response to requests for additional time, the comment period was extended by 15 days for a total of 75 days. The number and location of public hearings was consistent with prior public outreach for LANL

NEPA documents; in addition, all public announcements regarding the Draft SWEIS identified a number of other means by which the public could provide comments (U.S. mail, e-mail, fax, or toll-free phone message). References used in the Draft SWEIS were available to the public in reading rooms in Los Alamos, Santa Fe, and Albuquerque, New Mexico, also consistent with past practices. Commentors noted that the Draft SWEIS had referenced a draft public health assessment prepared by the Agency for Toxic Substances and Disease Registry; this study has since been finalized and is reflected in the Final SWEIS. Other concerns were that updates to seismic hazards analysis and the TA-54 Area G performance assessment should be included in the SWEIS. To the extent possible, the most recent technical documents, including an update to the seismic hazard analysis, completed in 2007, are considered in the Final SWEIS analyses. Information under development that is not available for use in the Final SWEIS, such as the updated Area G performance assessment, will be considered as it becomes available. In accordance with the NEPA process, the SWEIS impact analyses will be reviewed and supplemented as necessary in response to new information.

Alternative Missions *– Commentors suggested changing LANL's mission of supporting stockpile stewardship activities to another, non-weapons related mission. Examples of alternative missions suggested by commentors include development of renewable resources including solar, wind, and biomass; development of environmental cleanup technologies; addressing global climate change; development of the use of hydrogen fuel cells; and development of anti-terrorism and nonproliferation tools.*

As indicated above, the purpose of the continued operation of LANL is to provide support for NNSA's core mission as directed by the Congress and the President, which includes maintaining a safe and reliable nuclear weapons stockpile. A cessation of these activities would be counter to national security policy and therefore, is not considered in the SWEIS. Certain of the research areas identified by commentors are currently performed at LANL and therefore are part of the No Action Alternative. These research activities, including research related to national health issues, waste minimization, and environmental issues, and international nuclear safety, would continue to be conducted regardless of the alternative selected.

Modernization of the Nuclear Weapons Complex *– Commentors requested to delay completion of the LANL SWEIS until the Complex Transformation SPEIS is completed because it has a broader view of the need for, and level of, pit manufacturing. Comments also included requests to address environmental impacts from implementation of the Reliable Replacement Warhead Program in this SWEIS since reliable replacement warheads would be produced at TA-55 within the next 5 years. Commentors also requested the removal of references to a modern pit facility from the SWEIS.*

This LANL SWEIS focuses on continuing site-specific activities and new projects that may be initiated within about 5 years at LANL, whereas the *Complex Transformation SPEIS* addresses programmatic issues of modernization and consolidation of the nuclear weapons complex over a much longer timeframe and across the nuclear weapons complex. As such, the timing of and analyses in the LANL SWEIS are largely independent of the *Complex Transformation SPEIS*. An exception is the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility. In conjunction with its Complex Transformation planning, NNSA is reconsidering its previous decision to construct this facility. Regarding the analysis of environmental impacts from producing reliable replacement warheads, the alternatives analyzed in this SWEIS are independent of any decision to produce a reliable replacement warhead. Capabilities such as production of plutonium components are required regardless of such a decision. If a reliable replacement warhead is approved by the President and funded by the Congress as part of a national strategy for providing a nuclear deterrent, it would enable a shift to production that requires fewer hazardous operations. The environmental impacts analyzed in the LANL SWEIS are based on the existing stockpile stewardship program and corresponding life extension programs. Since the reliable replacement warhead design is expected to reduce the use of radioactive and hazardous materials, analysis of the current stockpile should reasonably bound the potential impacts of the reliable replacement warhead if it goes into production.

When NNSA announced its intent to prepare the *Complex Transformation SPEIS*, it also announced cancellation of proposals to construct a modern pit facility. Consequently, analyses in this SWEIS no longer include a modern pit facility in the cumulative impacts analysis.

Water Resources – *Commentors expressed concern about the impacts of LANL operations on groundwater in the regional aquifer and surface water in the Rio Grande, and consequently, the safety of the drinking water to local and downstream users.*

Monitoring of groundwater has been performed at LANL for many decades and at numerous locations within and around LANL. The locations include springs, drinking water supply wells, shallow monitoring wells, intermediate-depth monitoring wells, and a variety of different monitoring well types for the regional aquifer. LANL, in consultation with the New Mexico Environment Department, will continue a phased approach to determining which wells are needed and in what locations to satisfy long-term monitoring needs. The information presented in the SWEIS relies on the best information available, and primarily on data from the types of wells and screens that have high quality results. Some contaminants are present onsite at levels above applicable standards and guidelines. Elevated levels are investigated to confirm the validity of the results, determine the source and extent of the contamination, and evaluate needed control and cleanup technologies. Confusion regarding the presence of contaminants in samples caused by the presentation of data in Appendix F of this SWEIS has been addressed by better explaining the purpose, development, and use of the data and contrasting them with the data on detected contaminants reported in the annual LANL environmental surveillance reports. There have been concerns regarding neptunium-237 in the regional aquifer. The values of neptunium-237 listed in Appendix F reflect the conservative statistical interpretation of the analyses. The minimum detectable activity for this radioisotope was found to be greater than the reported values using laboratory gamma spectrometry analytical methods. This indicates that neptunium was not present, and that the results were an artifact of the analytical method. An alternate analytical method, alpha spectrometry, has been shown to have a significantly lower minimum detection level for neptunium-237 and was used to measure groundwater samples in and around LANL in 2006. The results of these environmental sample measurements to date have shown no neptunium-237 present in regional aquifer groundwater. Plutonium-239, plutonium-240, and strontium-90 have been detected in samples from Los Alamos water supply wells taken on only one or two dates, indicating an error by the analytical laboratory. This conclusion was confirmed by reanalysis of numerous samples and contradictory results from field and laboratory duplicate samples.

Remediation of water resources containing or potentially containing contaminants is carried out consistent with DOE and external regulatory requirements. For example, the 2005 Consent Order requires investigations to fully characterize the nature, extent, fate, and transport of contaminants subject to the Consent Order that have been released to surface water, groundwater, and other environmental media. Following the investigations, corrective measures are evaluated, proposed, authorized, and implemented as needed, to meet quantitative surface water and groundwater cleanup levels prescribed in Section VIII of the Consent Order.

Sampling in 2005 and 2006 indicates that chromium contamination is present in the regional aquifer in a limited area beneath Sandia and Mortandad Canyons and in perched groundwater beneath Mortandad Canyon. Chromium contamination was not detected in water-supply wells. The LANL contractor has prepared an *Interim Measures Work Plan for Chromium Contamination in Groundwater* (LANL 2006d). An interim measures investigation report prepared in 2006 provides a basis for follow-on work (LANL 2006k). The report found that the main source of hexavalent chromium was chromium-treated cooling water from a TA-3 power plant at the head of Sandia Canyon during its operations between 1956 and 1972. Additional data collection from other regional groundwater monitoring wells is needed to further assess the extent of LANL-derived chromium contamination. Recommendations included additional data collection on chromium and other chemicals for use in risk assessments and the selection of corrective action remedies.

Despite the detection of polychlorinated biphenyls in stormwater runoff within the LANL site boundaries, available data show no discernible impacts on polychlorinated biphenyls concentrations in the Rio Grande.

***Offsite Contamination** – Commentors expressed concern about offsite contamination from past and proposed LANL operations. Some commentors were concerned that increased activities would lead to new contamination. They questioned increasing pit production when LANL had not controlled releases in the past. Other commentors stated concerns that contaminants could appear outside the site boundaries and affect residents of nearby communities or those living down wind or down river from LANL, and others questioned the use of 50 miles as the range for evaluating offsite impacts.*

Chapter 6 of this SWEIS describes the environmental laws and regulations that apply to LANL operations. LANL operations do result in emissions to the air and discharges of surface water, but all of these emissions and discharges are in accordance with regulations established to protect public health and safety. The LANL contractor demonstrates compliance through environmental monitoring and reporting, which includes statistical analysis and other methods to determine which results are indicative of the actual presence of a contaminant. Chapter 4 describes the current environment and presents, for resource areas with annually measurable parameters, recent data that show compliance status with regulations and permits. Compliance status is based on data contained in the annual environmental surveillance reports that are required for DOE sites and are publicly available.

Contamination in Foodstuffs

Because ingestion of foodstuffs constitutes an important pathway by which radionuclides and other contaminants can be transferred to humans, a wide variety of domestically produced edible vegetables, fruits, grains, and animal products is sampled from the area surrounding LANL and analyzed for a variety of radionuclides. These samples are used to compare the levels of radioactive and nonradioactive contaminants in foodstuffs at onsite and perimeter locations to regional levels, to determine trends over time, and to estimate the radiation doses and chemical exposures to individuals who consume them. Foodstuff monitoring in the region regularly shows no contamination resulting from LANL operations.

LANL Impact on the Rio Grande

Waters and sediments along the Rio Grande historically have shown relatively small impacts from LANL operations. All base flow samples from the Rio Grande had pollutant concentrations below drinking water standards and standards for the protection of aquatic life, wildlife habitat, and irrigation. None of the radionuclides commonly associated with LANL operations was detected, except for uranium; uranium concentrations (0.5 to 2 milligrams per liter) were consistent with naturally occurring levels in regional waters and well below the Federal drinking water standard of 30 milligrams per liter. In 2005, radionuclide concentrations in bottom sediments from the Cochiti Reservoir, the first reservoir on the Rio Grande downstream from LANL, were lower than in other post-Cerro Grande Fire years. Plutonium-239, plutonium-240, and cesium-137 concentrations showed increases for 1 to 2 years following the Cerro Grande Fire, but concentrations in 2005 were comparable with pre-fire levels. Plutonium-239 and plutonium-240 concentrations in 2005 were near or below analytical detection limits. Metals concentrations in the bottom sediments were not sufficiently different from background concentrations to warrant discussion. The residual high-explosives organic compound 2, 4-dinitrotoluene was detected in Cochiti Reservoir bottom sediments at an estimated concentration of 2.8 milligrams per kilogram, considerably below the U.S. Environmental Protection Agency (EPA) Region VI soil screening level of 120 milligrams per kilogram. This compound was not detected in earlier analyses.

Use of 50-Mile (80-kilometer) Radius Region of Influence

A 50-mile (80-kilometer) radius is commonly used in EISs because this distance has been shown to encompass the significant impacts to the public. Samples measured at varying distances from emissions sources show that the concentration of radionuclides decreases with the distance from the source.

Waste Management – *Commentors were concerned about the large quantities of wastes projected in the SWEIS, particularly for the Expanded Operations Alternative. Commentors questioned the continued generation of waste, particularly when significant legacy waste remains onsite and remediation work is incomplete; where the ultimate disposition of the waste would occur; and the impacts associated with waste storage and disposal, including the impacts from potential accidents. Commentors also questioned the continued practice of onsite disposal of low-level radioactive waste in unlined trenches, citing its impacts on water resources and a general opposition to onsite disposal.*

Although LANL has instituted a pollution prevention and waste minimization program (see Chapter 4, Section 4.9), operation of LANL in support of DOE's core missions will generate radioactive and other wastes. NNSA will continue to manage waste in a manner that minimizes environmental and human health impacts and complies with regulatory requirements and DOE policies and procedures. Mixed low-level radioactive waste and solid and chemical wastes will be shipped to offsite treatment or disposal facilities. Disposal capacity is adequate for these wastes. Low-level radioactive waste may be disposed of onsite or at offsite commercial or DOE disposal facilities, while transuranic waste will be disposed of at WIPP. Increased pit production, as analyzed in the Expanded Operations Alternative, would not result in a significant increase in the volume of waste. The primary contribution to the large increase in waste volume under this alternative would be from environmental remediation involving complete removal of buried wastes located in MDAs and other contaminated media. In this case, the transuranic waste volume projected from postulated removal of all MDAs could increase the volume beyond that assumed to come from LANL in the WIPP Supplemental EIS. Decisions about disposal of this transuranic waste, if generated, would be made within the context of the needs of the entire DOE complex. Regarding the use of unlined pits, future use of lined pits rather than unlined pits for low-level radioactive waste disposal at LANL is being evaluated as part of the required review and update of the Area G performance assessment.

Some wastes would be managed at LANL that cannot be accepted at WIPP or other currently operating and authorized disposal facilities, including commercial sealed sources containing radionuclides in concentrations exceeding the Class C limits in 10 CFR Part 61 and DOE sealed sources containing non-defense transuranic isotopes with similar characteristics. These wastes would be safely stored until they can be disposed of pursuant to the Low-Level Radioactive Waste Policy Amendments Act of 1985 (Public Law 99-240). DOE has issued an NOI to prepare an *Environmental Impact Statement for the Disposal of Greater-Than-Class-C Low-Level Radioactive Waste* (72 FR 40135). Several options for disposal of this waste and other DOE waste having similar characteristics are being considered, including disposal at LANL.

***Water Use** – Commentors expressed concerns that implementation of the Expanded Operations Alternative would require the use of too much water and could exceed available water rights.*

Total and consumptive water use at LANL have actually decreased since 1999, in part due to water conservation efforts. DOE transferred 70 percent of its water rights for LANL, and leases the remaining 30 percent, to Los Alamos County. DOE is now a County water customer, and is billed and pays for the water it uses in accordance with a water service contract. LANL operational water demands would remain within DOE's water use target ceiling quantity. Water demands at LANL combined with the larger and growing demands of other Los Alamos County users could require up to 98 percent of the currently available water rights.

***Consent Order and Environmental Restoration** – Noting that activities to implement the March 2005 Compliance Order on Consent (Consent Order) were included only in the Expanded Operations Alternative, commentors were concerned that NNSA considered compliance with the Consent Order optional. Commentors doubted that cleanup was being addressed and thought that cleanup should be completed before NNSA contemplated increased pit production or generated additional waste at LANL.*

NNSA does not consider compliance with the Consent Order to be optional and is not linking Consent Order compliance with decisions about pit production, proposed new projects or activities, other increased operational levels, or waste generated from other LANL activities. NNSA could choose to implement the alternatives analyzed in this SWEIS either in whole, in part, or in combinations. NNSA intends to implement actions necessary to comply with the Consent Order regardless of decisions it makes on other actions analyzed in this SWEIS. Chapter 2, Section 2.2.6, summarizes the progress made in environmental restoration since 1999. Appendix I analyzes options related to future cleanup actions that could be undertaken.

Depleted Uranium and the Dual Axis Radiographic Hydrodynamic Test Facility – *Commentors expressed concern about open burning of uranium and the effects this would have on air, water, soil, and human health. Some commentors mentioned that large amounts of depleted uranium have been used in the past and might remain in the environment, and that a more comprehensive monitoring program to monitor open burning and detonation sites is needed. Others questioned the use of foam and its effect on emissions.*

There are no experiments or activities at LANL that would involve the burning of depleted uranium. High explosives and explosives-contaminated materials (not including depleted uranium) are burned or detonated in accordance with a Resource Conservation and Recovery Act (RCRA) permit as a hazardous waste treatment to render the materials safe for disposal. The State of New Mexico open burning permits that would allow a variety of experiments and testing have been withdrawn. Experiments at the Dual Axis Radiographic Hydrodynamic Test Facility are subject to specific monitoring requirements. Sampling is performed to better understand the levels of contamination at the firing sites, the success of decontamination efforts, and the success of mitigation techniques that are applied to specific experiments. LANL monitoring programs are regularly reviewed and adjusted to take into account the latest trends in results. Past emission levels analyzed through the existing LANL monitoring programs and those projected in this SWEIS would not be expected to cause adverse impacts on human health or the environment. The use of aqueous foam was implemented at the Dual Axis Radiographic Hydrodynamic Test Facility to reduce the amount of particulates released. The use of foam is estimated to reduce fine particulates by 50 to 95 percent depending on the individual shot. The foam breaks down and is rinsed to a sump from which it is pumped and sent to the Radioactive Liquid Waste Treatment Facility for treatment. This additional, non-hazardous waste was included in the waste analysis in this SWEIS.

Environmental Justice – *Commentors expressed concerns about the adequacy of the Environmental Justice analysis in the SWEIS, indicating that it does not meet the requirements of Executive Order 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations. They also were concerned that environmental justice was not properly addressed in cumulative impacts and that the special pathways were not adequately analyzed. Some commentors took exception to statements in the SWEIS that there are no disproportionately high and adverse impacts to low-income and minority populations.*

NNSA acknowledges that different approaches can be used to assess the environmental justice impacts from continuing to operate LANL. As discussed in Chapter 5, Section 5.11, Environmental Justice, NNSA has met the objectives of Executive Order 12898 to investigate environmental justice impacts that would be potentially high and adverse and would disproportionately affect one group over another. An analysis of the radiological doses from emissions associated with normal operations at LANL to minority and low income populations and individuals was added to the Environmental Justice impacts section of the SWEIS. Under all of the alternatives the doses to members of minority populations or low-income populations were slightly less than for the members of the population that do not belong to these groups. In response to comments on the Draft LANL SWEIS, NNSA added additional discussion to Chapter 5, Section 5.13, to address the potential for environmental justice cumulative impacts. As discussed in Chapter 5, Section 5.11, and Appendix C, NNSA looked at potential exposures through special pathways as part of its human health impacts analysis. The special pathways analysis considers ingestion of native vegetation (pinyon nuts and Indian Tea [Cota]), locally grown produce and farm products, groundwater, surface water, fish (game and non-game), game animals, other foodstuffs and incidental consumption of soils and sediments (on produce, in surface water, and ingestion of inhaled dust); adsorption of contaminants in sediments through the skin; and inhalation of plant materials. Even considering these special pathways, NNSA did not find disproportionately high and adverse health impacts to minority or low-income populations. While NNSA recognizes commentors objections to the conclusion that the analysis in this SWEIS has not identified any disproportionately high and adverse human health or environmental impacts on minority or low-income populations under any of the actions or alternatives analyzed in the SWEIS, NNSA believes this is the correct conclusion. Chapter 5, Section 5.11, has been expanded to include more detailed discussion of the environmental justice analysis.

Comparison to Rocky Flats Plant – *Commentors oppose continued or expanded levels of pit production and associated activities at LANL, concerned that these activities would result in health and safety problems. Commentors cited past performance at the Rocky Flats Plant as being indicative of NNSA's continued and future operations, inferring that similar activities at LANL would result in similar environmental contamination and human health effects.*

A number of factors including much lower pit production levels, a heightened awareness of safety and environmental issues, newer facilities and technologies, more stringent environmental and nuclear safety regulations, a higher level of scrutiny by regulators and independent oversight organizations, and more controlled operational and management practices support the conclusion that LANL operations are not comparable to operations at the Rocky Flats Plant. The Rocky Flats Plant produced thousands of pits per year until it ceased operation in 1989. Under the SWEIS Expanded Operations Alternative, LANL would produce a maximum of 80 pits per year.

The Plutonium Facility in TA-55 is a newer facility than those at the Rocky Flats Plant. The Plutonium Facility has increased safety margins, stronger structural components, firebreaks and automatic fire suppression systems, and more automatic alarms and process controls. Specifically with respect to filtration of process emissions and the problems with the Rocky Flats design, the Plutonium Facility has implemented structural designs for fire containments, multiple stages of high-efficiency particulate air (HEPA) filtration, and firebreaks to prevent, isolate, and confine potential fires from spreading through air filtration systems, thus minimizing potential releases to the environment. Additional upgrades, repairs, and replacements of equipment and components are proposed under the TA-55 Refurbishment Project as part of the SWEIS Expanded Operations Alternative to ensure the facility safety envelope is maintained as the facility and its systems and components age.

***Recommendations of the Defense Nuclear Facilities Safety Board (DNFSB)** – Commentors expressed their opinion that LANL is not in compliance with DOE and DNFSB safety regulations and recommendations; some commentors claimed that some LANL facilities are up to six years behind on preparing and submitting their safety documentation to DOE; and certain commentors stated that such lack of compliance poses an unacceptable risk to workers, the public and the environment. Commentors stated that the draft SWEIS should fully incorporate, analyze, consider, and resolve the serious safety issues raised by the DNFSB.*

The DNFSB was created by the Congress in 1988 as an independent oversight organization within the Executive Branch to provide advice and recommendations to the Secretary of Energy regarding protection of public health and safety at defense nuclear facilities. As such, the DNFSB independently oversees activities affecting nuclear safety within the nuclear weapons complex. DNFSB reviews safety issues and formally reports its findings and recommendations to the highest levels of NNSA regarding the safety of nuclear weapons complex facilities. Procedures are in place for NNSA to review and respond to DNFSB recommendations, and to implement recommendations at the sites as appropriate. NNSA and the LANL contractor have reviewed DNFSB reports and responded with commitments to update and improve safety basis documentation. The Los Alamos Site Office Safety Authorization Basis Team assures the development and approval of adequate controls to support operations at LANL in a safe manner. LANL nuclear facility operations are authorized and approved by NNSA based on its evaluation of the acceptability of existing relevant safety documentation.

The environmental impacts of potential accident scenarios, including accidents caused by human error during the performance of high hazard operations, as well as from other types of initiating events, are analyzed in the SWEIS. Safe operation is an intrinsic part of the activities proposed and analyzed in the SWEIS. Nonetheless, NNSA identifies possible operational accidents, natural events, or intentional destructive acts and analyzes their impacts of as part of the NEPA process so that this information is available to NNSA in deciding whether to proceed with a proposed action. NNSA has recently revised its oversight practices at LANL to increase the focus of its resources on nuclear safety and security.

***Plutonium Inventory Discrepancies** – During the scoping process and again during the review of the Draft LANL SWEIS, commentors contended that there were historical differences in plutonium inventories, leading to the conclusion that there was a loss of control of the plutonium materials and that inventory systems were inaccurate.*

The issue of historical differences in the plutonium inventories has been raised previously. DOE addressed this issue in a 1996 report that notes there are differences in the quantity of plutonium according to the accounting books and the quantity measured by a physical inventory.[13] The report explains that inventory differences are primarily due to various measurement uncertainties

[13] In 1996 DOE issued the report Plutonium: The First 50 Years (DOE 1996). This report notes that there are differences in the quantity of plutonium according to the accounting books and the quantity measured by a physical inventory. It explains that "inventory differences are not explained as losses but are explained as follows: (1) high measurement uncertainty of plant holdup (plutonium materials remaining in process tanks, piping, drains, ventilation ducts, and other locations); (2) measurement uncertainties because of the wide variations of material matrix; (3) measurement uncertainties due to statistical variations in the measurement; (4) lack of measurement technology to accurately measure material; (5) measurement uncertainties associated with waste due to material concentration and matrix factors; (6) unmeasured material associated with accidental spills; and (7) recording, reporting, and rounding errors."

(DOE 1996). More recently, NNSA addressed allegations of plutonium discrepancies at LANL. The letter responding to this issue states that "the apparent discrepancy is related to the different tracking and reporting procedures for site security and waste management organizations." The letter concludes that "because of the differences between the tracking and reporting of the site security and waste management organizations, comparisons of the information contained in these two systems cannot be used to draw conclusions concerning the control and accountability of special nuclear material" (NNSA 2006a).

1.7 Changes from the Draft Environmental Impact Statement

In preparing the Final LANL SWEIS, NNSA made revisions in response to comments received from other federal agencies, state and local government entities, Native American Pueblos, and the public. In addition, the SWEIS was changed to provide additional environmental baseline information, include additional analyses, correct inaccuracies and make editorial corrections, and clarify text. NNSA also updated information due to events or notifications made in other documents since the Draft SWEIS was provided for public comment in July 2006. The following summarizes the more important changes made to the SWEIS.

Incorporation of the Updated Environmental and Other Information

Information was updated in the Final SWEIS to reflect the most recent environmental data from *Environmental Surveillance at Los Alamos during 2005 (*LANL 2006h) and information from the 2005 SWEIS Yearbook (LANL 2006g). Data from these reports were incorporated into Chapters 2, 3, 4, and 5 as well as certain appendices. Resource areas most affected include air emissions and water discharges, human health, infrastructure (including electrical and water usage), and waste management. Other new information incorporated into the SWEIS analyses include a biological assessment, an update to the seismic hazard analysis, and new NMED stream water quality standards.

Appendix F was revised to more clearly indicate the purpose and use of the data included and how they relate to the information reported in annual environmental surveillance reports. The data analysis in Appendix F is for the purpose of providing perspective relative to similar data presented in the *1999 SWEIS* and for use in SWEIS impacts analyses. Affirmed detection of contaminants in the environment is presented in the LANL environmental surveillance reports. Appendix F was updated to include an additional year of radionuclide measurements in environmental media in and around LANL. In addition, Appendix F discusses the monitoring results for nonradiological chemicals that are part of the LANL environmental surveillance program. Information on nonradiological contaminants for the period of 2001 through 2005 has been provided for hexavalent chromium, 1,4-dioxane, and polychlorinated biphenyls. In addition, the perchlorate environmental surveillance information was updated to include the results from the most recent year of reporting.

Chapter 5, Section 5.8.2.3 was updated to include 2005 water use data in the trend analysis. The projected demand on available water rights administered by Los Alamos County decreased from 101 percent to 98 percent, leading to the conclusion in the Final SWEIS that the water rights would not be exceeded if the Expanded Operations Alternative were implemented. A more detailed discussion regarding water use is provided in Chapter 4, Section 4.8.2.3.

Presentation of Impacts from Consent Order Activities

The summary of impacts in Chapter 3 has been revised to more readily show the impacts associated with activities necessary to comply with the Consent Order. Under the Expanded Operations Alternative, in addition to showing the impacts for the entire alternative, where practical, the impacts from implementing the Consent Order have been shown separately and could be added to each alternative; the impacts for the balance of the Expanded Operations Alternative are also shown. This presentation of the impacts makes it possible for a reader to see how alternatives compare without the influence of Consent Order activities and reinforces the idea that the NNSA can select all or part of the Expanded Operations Alternative; however, NNSA does not consider compliance with the Consent Order to be optional.

Environmental Justice

The Environmental Justice analysis in Chapter 5 was expanded to include radiological doses from LANL operations for the following populations within 50 miles (80 kilometers) of LANL: white (non-Hispanic), all (total) minorities, American Indians, Hispanic of any race, and low-income populations. These data show that the total minority, American Indian, Hispanic, and low-income populations would not be subjected to disproportionately high and adverse dose impacts from operations at LANL.

Removal of References to a Modern Pit Facility

References to a modern pit facility in the Draft LANL SWEIS were made in the context of ensuring that reasonably foreseeable future actions were addressed in accordance with the CEQ NEPA regulations regarding cumulative impacts. In October 2006, NNSA issued an NOI to prepare the *Complex Transformation SPEIS*. In addition to announcing its intent to prepare an assessment of the environmental impacts from the continued transformation of the nuclear weapons complex, NNSA announced cancellation of the previously planned *Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility* (DOE/EIS-236-S2). Therefore, the Final LANL SWEIS does not include a modern pit facility in the discussion of cumulative impacts in Chapter 5, Section 5.13.

Accident Analyses

The accident analysis has been revised to account for 2006 updates to accident scenarios for certain nuclear facilities that resulted in higher consequences and risks than the previous scenarios. Revising the accident analysis also addressed a comment received regarding an accident scenario involving a fire in the Plutonium Facility Complex. Details of the revised scenarios are included in Appendix D. The new accident scenarios were for the Radioassay and Nondestructive Testing Facility, the Waste Characterization, Reduction, and Repackaging Facility, and the Plutonium Facility Complex. The new accident scenarios included one scenario for each of the individual facilities, two scenarios involving the Waste Characterization, Reduction, and Repackaging Facility and the Plutonium Facility Complex during a seismic event, and one scenario involving the Waste Characterization, Reduction, and Repackaging Facility in the event of a wildfire. Relevant results of these new accident scenarios are reported in Chapter 5, Section 5.12.

The discussion of the site-wide seismic accidents was revised to account for new information from the updated seismic hazard analysis (LANL 2007a). The new study indicates that the seismic hazard is higher than previously understood; that is, the likelihood of earthquakes capable of producing strong ground shaking at the LANL site is greater than previously estimated. This would result in changes to the maximum risks to the maximally exposed individual (MEI), the noninvolved worker and the offsite population under the two seismic accidents.

Terrorism

The SWEIS has been revised to more fully address the issue of terrorism. Chapter 4, Section 4.6 has been expanded to include a description of the safeguards and security that are in place at LANL to protect facilities and special nuclear materials from malevolent acts. Chapter 5, Section 5.12, has been revised to include a discussion of the process of assessing vulnerabilities of facilities to hostile acts. These vulnerability assessments guide the enhancement of safeguards and security at the site. A classified appendix to the SWEIS assesses the potential impacts of terrorist acts.

Transportation Analysis

The transportation analysis was revised to address three specific areas. Responding to comments expressing concerns regarding increased pit production, the SWEIS transportation analysis was revised to provide a clearer distinction between the shipment requirements for production rates of 20 and 80 pits per year. In addition, the impact analysis was revised to bound the impacts of transporting uranium-233 between Oak Ridge National Laboratory and LANL and between LANL and the Nevada Test Site in support of the criticality safety program. A unit basis transportation impacts assessment is also included in Appendix J to provide a basis for assessing impacts of the future transport of sealed sources to and from LANL in support of the Off-Site Source Recovery Project.

Alternatives for Upgrading the Radiography Facility

The Appendix G, Section G.6, project-specific analysis for providing a radiography facility in TA-55 has been revised to remove any options that considered use of all or part of the previous Nuclear Materials Storage Facility (Building 55-41). Based on evaluations of the structure of Building 55-41, a determination was made that extensive and costly structural upgrades to the building to bring it into compliance with requirements for managing special nuclear material would be needed – roof panel members would need to be replaced and other structural components would need to be repaired, replaced, or reconfigured. This structure was never used for storage of nuclear materials and a determination was made in 2006 to demolish the structure. As an uncontaminated structure, the resulting demolition debris could be reused as fill or sent to a solid waste landfill. In addition to the no action option, Section G.6 analyzes an option of constructing a new radiography facility in TA-55.

Location of the Proposed TRU Waste Facility

The impacts analysis included in Appendix H, Section H.3, Waste Management Facilities Transition, has been revised with respect to the TRU Waste Facility. The function of the facility would primarily be to support operations at the Plutonium Facility Complex, including managing transuranic waste from the Radioactive Liquid Waste Treatment Facility. Therefore, a number of locations along the west end of the Pajarito Road corridor near the waste-producing facilities are being considered. The analysis has been revised to evaluate the impacts of a range of locations in the TAs along Pajarito Road. For certain resource areas such as human health impacts, releases from normal operations, and facility accident impacts, analyses account for the largest impacts that would be expected. For other impacts that would be more site specific such as land use, visual impacts, and effects on ecology and cultural resources, the analyses distinguish among the group of TAs being considered.

Revision of the Reduced Operations Alternative

The Reduced Operations Alternative and impacts analyses were revised to include a possible reduction in scope of the Chemistry and Metallurgy Research Replacement Facility as described in the 2003 *CMRR EIS* and NNSA's subsequent 2004 ROD (69 FR 6967). The Chemistry and Metallurgy Research Replacement Facility would be limited to the construction and operation of the radiological laboratory, administrative offices, and support facility building. The decision whether to construct the nuclear facility portion will be postponed until completion of the *Complex Transformation SPEIS*. Under this scenario the existing Chemistry and Metallurgy Research Building would continue to operate beyond 2010 to provide analytical chemistry and materials characterization research and development activities.

1.8 Content of this New Site-Wide Environmental Impact Statement

As indicated in earlier sections of this chapter, the body of this SWEIS focuses on the rollup of past and future operational impacts and tiers from the *1999 SWEIS*. Information used in the SWEIS analyses also tiers from *LANL SWEIS Yearbooks* prepared for the years 1998 through 2005 to track LANL operational impacts. The *SWEIS Yearbooks* are published annually to compare impact projections from the *1999 SWEIS* with actual operations data. The purpose of the *Yearbooks* is to provide facilities and upper management at LANL with a guide for evaluating whether activities are expected to remain within the SWEIS operating envelope, and to facilitate the preparation of this SWEIS, subsequent 5-year review impact analyses, and other NEPA compliance reviews. Additional LANL documents and information sources identified and discussed in detail later in this SWEIS have also been used to support the review of LANL operational impacts. These data sources include *LANL Environmental Surveillance Reports*, LANL site planning processes, various studies and reports generated for the environmental restoration activities at LANL, information from the post-Cerro Grande Fire recovery efforts, and similar sources of information. Various NEPA reviews for proposed LANL actions that have been categorically excluded or were analyzed through EAs and EISs have resulted in actions undertaken since 1999 or in commitments for project implementation over about the next 5 years. These NEPA reviews were also used to identify past and projected operational changes and environmental impacts. A list of the pertinent EAs and EISs affecting LANL operations is provided in Section 1.5.

Chapter 2 of this SWEIS contains summary descriptions of changes at the site and its facilities and facility performance in implementing the 1999 ROD for continuing operations at LANL. Chapter 2 also includes updates and recharacterizes the status of the facilities and their activities that were first identified in the *1999 SWEIS* to establish a comprehensive LANL site operations baseline for the impact analyses presented later in this SWEIS. This chapter also sets the stage for the impacts analyses in this new SWEIS by comparing LANL operational impacts since 1999 to the projected operational impacts in the *1999 SWEIS*. This comparison of projected and actual impacts provides a benchmark for understanding the percentage of total impacts that have already occurred in those instances where impacts were aggregated for the full 10-year period of interest.

Chapter 3 presents the alternatives analyzed in this SWEIS along with projections of LANL operations for the No Action and Action Alternatives, thereby further defining the alternatives for the reader. A summary of the impacts associated with each alternative is also presented in this chapter.

Chapters 4 and 5, respectively, describe the affected environment at LANL as it appears today and the environmental consequences of continued LANL operations. Environmental consequences are addressed under natural and cultural resource topics for both the No Action and the Action Alternatives. They include the following resource areas:

- Land use and visual resources;
- Geology and soils, including paleontological resources;
- Water resources, including surface and groundwater – this includes updating information on the understanding of the groundwater regime;
- Air quality and noise;
- Ecological resources, including terrestrial resources, wetlands, aquatic resources, and threatened and endangered species;
- Radiological and hazardous chemical impacts on human health during routine normal operations and accidents;
- Cultural resources, including archaeological resources, historic buildings and structures, and traditional cultural properties;
- Socioeconomics, including regional economic characteristics, demographic characteristics, housing and community services, and local transportation;
- Site infrastructure;
- Waste management and pollution prevention;
- Transportation;
- Environmental justice.

In addition to these areas, Chapter 5 addresses cumulative impacts, mitigation, unavoidable impacts, irreversible and irretrievable commitment of resources, and impacts on long-term productivity.

The remaining chapters contain supporting information. Chapter 6 of this SWEIS updates information on applicable laws, regulations, other similar requirements and consultations. Chapters 7, 8, and 9 provide a list of references, the glossary, and an index, respectively. The list of preparers and the SWEIS distribution list are presented in Chapters 10 and 11.

As already discussed, Appendix A to this SWEIS contains the full text of the LANL SWEIS ROD issued in 1999 and the *Federal Register* NOI to prepare the Supplemental SWEIS; it also contains the Notice of Availability for the Draft LANL SWEIS, the notice of comment period extension, and the NOI for preparing the *Complex Transformation SPEIS* (then called the *Supplement to the Stockpile Stewardship and Management Programmatic Environmental Impact Statement – Complex 2030)*. Appendices B, C, and D, respectively, discuss the methodologies used to assess air quality impacts, human health impacts anticipated from normal operations, and projected impacts from facility accidents. Appendix E updates information on groundwater in the vicinity of LANL, and Appendix F updates information on environmental contamination in a manner that allows comparison to similar information in the *1999 SWEIS*. Appendices G through J provide detailed project-specific information and impact analyses for the projects listed previously as part of the Expanded Operations Alternative. Appendix K presents the methodology and results of the transportation analyses, and Appendix L describes types of activities that are routinely conducted at LANL and are categorically excluded from the need for an EA or EIS.

Volume 3 is the Comment Response Document for this LANL SWEIS. Section 1 of Volume 3 provides an overview of the Draft SWEIS public comment process. Section 2 identifies the major issues from the public comments and NNSA responses. Section 3 shows the public comment documents with the individual comments delineated and corresponding NNSA responses in a side-by-side format. Section 4 presents the references for this volume.

CHAPTER 2
LOS ALAMOS NATIONAL LABORATORY ACTIVITIES AND FACILITIES UPDATE

2.0 LOS ALAMOS NATIONAL LABORATORY ACTIVITIES AND FACILITIES UPDATE

This chapter provides an updated description of the activities and facilities at Los Alamos National Laboratory (LANL) and how they may have changed or been modified since publication of the *Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico (1999 SWEIS)* (DOE/EIS-0238) (DOE 1999a).

The *1999 SWEIS* described ongoing activities and facilities at LANL, focusing on 15 Key Facilities that housed operations which had a potential to cause significant environmental impacts, were of most interest or concern to the public, or were subject to change as a result of programmatic decisions. Since publication of the *1999 SWEIS*, several new facilities (including one new Key Facility) have been constructed, and a major wildfire (the Cerro Grande Fire of 2000, which burned approximately 7,700 acres [3,110 hectares] within LANL boundaries) has altered baseline environmental conditions at LANL, among other changes.

Chapter 2 describes the changes that have occurred at LANL since publication of the *1999 SWEIS*, highlighting the major physical and operational changes that have occurred to the overall LANL site, as well as the 49 individual Technical Areas (TAs), 15 Key Facilities, and several important non-Key Facilities. Discussions of changes to the Key and non-Key Facilities include addressing each facility's performance in implementing the *1999 SWEIS* Record of Decision (ROD) and other changes that have occurred since the publication of the *1999 SWEIS*.

Technical Area (TA)

Geographically distinct administrative unit established for the control of LANL operations. There are currently 49 active TAs; 47 in the 40 square miles of the LANL site, one at Fenton Hill, west of the main site, and one comprising leased properties in town.

Chapter 2 describes activities and notable changes at the site-wide level, TA level, and Key Facility level, as appropriate, and is organized as follows. At the site-wide level, Section 2.1 presents an overview of activities, and Section 2.2 describes site-wide changes that have occurred at LANL since publication of the *1999 SWEIS*. At the TA and Key Facility level, Sections 2.3 and 2.4 describe changes that have occurred within the 49 TAs and 15 Key and other important non-Key Facilities. Section 2.5 presents an overview and summary assessment of actual impacts compared to impact projections made in the *1999 SWEIS*. The chapter and this section conclude with a summary comparison table of actual impacts and performance changes by resource or impact area to projected modified Expanded Operations Alternative impacts that were presented in the *1999 SWEIS* (in the ROD, the U.S. Department of Energy [DOE] selected the Expanded Operations Alternative, but modified the level of plutonium pit production from 50 pits per year to 20 pits per year). The table also includes a brief performance assessment by each resource or impact area of whether actual impacts have exceeded or fallen within those projected in the *1999 SWEIS*.

This chapter also sets the stage for the impacts analysis included in this new Site-Wide Environmental Impact Statement (SWEIS) by comparing LANL's operational impacts since 1999 to the operational impacts projected in the *1999 SWEIS*. This comparison of projected and actual impacts provides a benchmark for understanding the percentage of total impacts that has already occurred in those instances where impacts were aggregated for the full 10-year period of interest. In addition, this chapter updates and recharacterizes the status of the Key Facilities and activities that were first identified in the *1999 SWEIS* to establish a comprehensive LANL site operations baseline for the impact analyses presented in Chapter 5 of this SWEIS.

2.1 Overview of Los Alamos National Laboratory Activities Since Publication of the *1999 SWEIS*

Research and development activities are dynamic by their very nature, and continual change within the limits of facility capabilities, authorizations, and operating procedures is normal. All facilities at LANL, including those that are proposed, under construction, preoperational, operational, or idle, have been categorized according to hazards inherent to their actual operations or planned use. The following sections examine how these activities and facilities have changed since publication of the *1999 SWEIS*, particularly their unique associated hazards.

LANL Facilities: A Framework for Analysis

As of September 2005, LANL had more than 2,000 structures with approximately 8.6 million square feet (800,000 square meters) under roof, spread over approximately 40 square miles (25,600 acres [10,360 hectares]) (104 square kilometers) of land owned by the U.S. Government and administered by DOE and the National Nuclear Security Administration (NNSA). Most of LANL is undeveloped to provide a buffer for security, safety, and expansion possibilities for future use. Approximately half of the square footage at LANL is considered laboratory or production space; the remaining square footage is considered administrative, storage, service, and other space.

An analysis of potential environmental impacts of future operations at LANL requires detailed knowledge of the specific activities occurring at specific sites over a known span of time. This knowledge enables a careful, detailed projection of the potential effects of these activities on the surrounding environment. In order to present a logical, comprehensive evaluation of the potential environmental impacts at LANL, the *1999 SWEIS* developed a framework for analyzing the types and levels of activities performed across the entire site. This framework assisted in analyzing the impacts of activities in specific locations (TAs) and the impacts related to specific programmatic operations (Key Facilities and capabilities). The following sections will use this framework to describe the current status of the LANL TAs and Key Facilities and to identify the capabilities existing within each Key Facility. The focal point for impact analysis throughout this new SWEIS is the level of operations related to each capability within the LANL Key Facilities. Fifteen Key Facilities were identified in the *1999 SWEIS* that were determined to be critical to meeting LANL's mission assignments and that: (1) housed operations that have a potential to cause significant environmental impacts, or (2) were of most interest or concern to the public (based on comments in the SWEIS public hearings), or (3) would be more subject to change than other LANL facilities because of (DOE) programmatic decisions. Subsequent chapters presented in this SWEIS will also use this framework to outline the differences among the three alternatives evaluated and their associated potential environmental impacts. The alternatives will be evaluated in terms of activity levels within the capabilities of each Key Facility. **Figure 2–1** provides a diagram of this conceptual framework.

As previously noted, this chapter describes activities and notable changes at the site-wide level; the TA level; or the Key Facility level, as appropriate. For Key Facilities, specific facility performance indicators are described, including radioactive air emissions, discharges to National Pollutant Discharge Elimination System (NPDES)-permitted outfalls, and volumes of radioactive liquid and solid wastes generated. To the greatest extent possible, projects, activities, and other changes are described in the context of Key Facilities to provide the greatest level of detail. A number of events or projects that have taken place at LANL since issuance of the *1999 SWEIS* are not tied to a Key Facility, however, and therefore are better described as either site-wide or TA-related. Projects or changes that were site-wide in nature are addressed in Section 2.2; changes that occurred in a specific TA are addressed in Section 2.3; and changes and performance indicators associated with specific Key Facilities are discussed in Section 2.4.

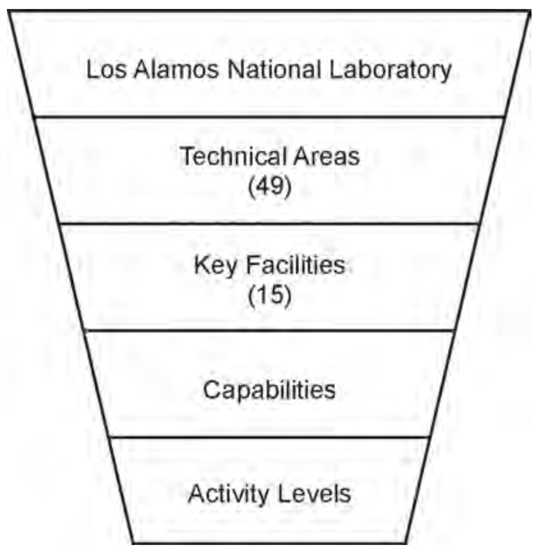


Figure 2–1 Conceptual Framework for Analysis

2.2 Site-Wide Changes at Los Alamos National Laboratory Since Publication of the *1999 SWEIS*

Major ongoing activities at LANL have been discussed in detail in *SWEIS Yearbooks* 1999 through 2005 and have been incorporated by reference. *SWEIS Yearbooks* from calendar years 1999 through 2005 provide detailed information on LANL site operations during each calendar year, and specifically address the following:

- Facility and process modifications or additions,
- Types and levels of operations during the calendar year,
- Operations data for the Key and non-Key Facilities, and
- Site-wide effects of operations for each calendar year.

The *SWEIS Yearbook – 2002* (LANL 2003h) is a special edition that was prepared to assist NNSA in evaluating the need for preparing a new SWEIS for LANL. The *SWEIS Yearbook – 2002* summarizes the data routinely collected from 1998 through 2002 and provides additional information, table summaries, and trend analyses. The *SWEIS Yearbook – 2002* also indicates LANL's programmatic progress in moving toward the projections provided in the *1999 SWEIS*.

The *1999 SWEIS* analyzed the potential environmental impacts of scenarios for future operations at LANL. The associated ROD (64 *Federal Register* [FR] 50797) was used not to predict specific operations, but to establish boundary conditions for operations. The ROD and the *1999 SWEIS* that supported it provided an environmental operating envelope both for specific facilities and for LANL as a whole. According to the ROD, if operations at LANL were to routinely exceed the operating envelope, DOE would evaluate the need for a new SWEIS. As long as overall LANL operations remain at or below the level analyzed in the *1999 SWEIS*, the environmental operating envelope remains valid. Thus, the levels of operation projected in the *1999 SWEIS* and the ROD should not be viewed as goals to be achieved, but rather as upper operational levels (LANL 2004f).

The *1999 SWEIS* and ROD projected a total of 38 facility construction and modification projects for LANL. Twenty-two projects have now been completed: six in 1998, eight in 1999, two in 2000, four in 2002, one in 2003, and one in 2004. The numbers of projects started or continued each year were 10 in 1999, 7 in 2000, and 6 in both 2001 and 2002.

A major modification project, the rerouting of effluents and elimination of NPDES outfalls, was completed in late 1999, bringing the total number of permitted outfalls down from the 55 identified in the *1999 SWEIS* to 20. During 2000, Outfall 03A-199, which serves the TA-3-1837 cooling towers, was included in the new NPDES permit issued by the U.S. Environmental Protection Agency (EPA) on December 29, 2000. This brings the total number of permitted outfalls up to 21. During 2005, only 17 of the 21 outfalls sustained effluent flows (LANL 2006g).

Each *SWEIS Yearbook* reports chemical usage and calculated emissions (expressed as kilograms per year) for the Key Facilities, based on an improved chemical reporting system. The 2004 chemical usage amounts were extracted from LANL's chemical inventory rather than from the Automated Chemical Inventory System used in the past. The quantities used represent chemicals procured or brought onsite from 1999 through 2004. Information regarding actual chemical use and estimated emissions for each Key Facility is presented in Appendix A of each *LANL SWEIS Yearbook* (LANL 2003h, 2004f, 2005f, 2006g). Additional chemical use and emissions reporting data can be found in the annual Emissions Inventory Report required by New Mexico. The most recent report is *Emissions Inventory Report Summary for Los Alamos National Laboratory for Calendar Year 2005* (LANL 2006i).

With a few exceptions, the capabilities identified in the *1999 SWEIS* for LANL have remained constant since 1999. These exceptions include:

- Movement of the Nonproliferation Training/Nuclear Measurement School, which was briefly located at TA-18 and returned to TA-3 (the Chemistry and Metallurgy Research Building) in 2004, where it will stay until the Chemistry and Metallurgy Research

Building is no longer available or until a new Security Category III and IV facility is built at TA-48 as part of the Radiological Sciences Institute's Institute for Nuclear Nonproliferation Science and Technology;

- Relocation of the Decontamination Operations Capability from the Radioactive Liquid Waste Treatment Facility to the Solid Radioactive and Chemical Waste Facilities in 2001;
- Redefinition of capabilities at the Bioscience Key Facility (formerly identified as the Health Research Laboratory Key Facility); and
- Loss of Cryogenic Separation Capability at the Tritium Key Facilities in 2001 (LANL 2004f).
- Transfer of neutron tube target loading from the Tritium Key Facilities to Sandia National Laboratories in 2006 (DOE 2003b).

In addition, following the events of September 11, 2001, the U.S. Department of Homeland Security (DHS) requested that LANL be used to support its missions. Activities undertaken at LANL for DHS are primarily the same actions that were performed for DOE prior to the reassignment of programs to DHS.

All currently operating capabilities are listed and described in detail as a part of the No Action Alternative discussed in Chapter 3 of this SWEIS. Since 1998, fewer than the 96 capabilities identified for LANL in the *1999 SWEIS* have been active. During 1998, only 87 capabilities were active. The nine capabilities with no activity were Manufacturing Plutonium Components at the Plutonium Complex; both Uranium Processing and Nonproliferation Training at the Chemistry and Metallurgy Research Building; Accelerator Transmutation of Wastes at the Los Alamos Neutron Science Center (LANSCE); Biologically Inspired Materials and Chemistry, Computational Biology, and Molecular and Cell Biology at the Bioscience Facilities; and both Size Reduction and Other Waste Processing at the Solid Radioactive and Chemical Waste Facilities (LANL 2003h).

During 1999, 91 capabilities were active. The five inactive capabilities were Fabrication and Metallography at the Chemistry and Metallurgy Research Building; both Accelerator Transmutation of Wastes and Medical Isotope Production at LANSCE; and both Size Reduction and Other Waste Processing at the Solid Radioactive and Chemical Waste Facilities (LANL 2003h).

During 2000, 88 capabilities were active. The eight inactive capabilities were Fabrication of Ceramic-Based Reactor Fuels at the Plutonium Complex; Diffusion and Membrane Purification at the Tritium Facilities;[1] both Destructive and Nondestructive Assay and Fabrication and Metallography at the Chemistry and Metallurgy Research Building; both Accelerator Transmutation of Wastes and Medical Isotope Production at LANSCE; and both Size Reduction and Other Waste Processing at the Solid Radioactive and Chemical Waste Facilities (LANL 2003h).

---

[1] *In these years, no research experiments were conducted on gaseous tritium movement and penetration through materials; however, the capability was used for effluent treatment.*

During 2001, 87 capabilities were active. The nine inactive capabilities were both Manufacturing Plutonium Components and Fabrication of Ceramic-Based Reactor Fuels at the Plutonium Complex; both Cryogenic Separation and Diffusion and Membrane Purification at the Tritium Facilities;[1] both Destructive and Nondestructive Assay and Fabrication and Metallography at the Chemistry and Metallurgy Research Building; both Accelerator Transmutation of Wastes and Medical Isotope Production at LANSCE; and Other Waste Processing at the Solid Radioactive and Chemical Waste Facilities (LANL 2003h).

During 2002 and 2003, 88 capabilities were active. The eight inactive capabilities were Manufacturing Plutonium Components at the Plutonium Complex; both Cryogenic Separation and Diffusion and Membrane Purification at the Tritium Facilities;[1] both Destructive and Nondestructive Assay and Fabrication and Metallography at the Chemistry and Metallurgy Research Building; both Accelerator Transmutation of Wastes and Medical Isotope Production capabilities at LANSCE; and Other Waste Processing at the Solid Radioactive and Chemical Waste Facilities (LANL 2003h, 2004f).

During 2004, 88 different capabilities remained active. The eight inactive capabilities were Cryogenic Separation at the Tritium Facilities; both Destructive and Nondestructive Assay and Fabrication and Metallography capabilities at the Chemistry and Metallurgy Research Building; Characterization of Materials at the Target Fabrication Facility; both Accelerator Transmutation of Wastes and Medical Isotope Production capabilities at LANSCE; and both Size Reduction and Other Waste Processing at the Solid Radioactive and Chemical Waste Facilities (LANL 2005f).

During 2005, 79 capabilities were active. The 17 inactive capabilities were Cryogenic Separation at the Tritium Facilities; both Destructive and Nondestructive Assay and Fabrication and Metallography at the Chemistry and Metallurgy Research Building; Characterization of Materials at the Target Fabrication Facility; Accelerator Transmutation of Wastes at LANSCE; Size Reduction and Other Waste Processing at the Solid Radioactive and Chemical Waste Facilities; Radioactive Liquid Waste Pretreatment at TA-21 or in Room 60 at TA-50; and all nine TA-18 capabilities (Dosimeter Assessment and Calibration, Detector Development, Materials Testing, Subcritical Measurements, Fast-Neutron Spectrum, Dynamic Measurements, Skyshine Measurements, Vaporization, and Irradiation) (LANL 2006g).

While there were activities under nearly all capabilities, the levels of these activities were mostly below the levels projected by the ROD. For example, the LANSCE linear accelerator generated an H-beam to the Lujan Center for 4,206 hours in 2005 at an average current of 125 microamps, compared to 6,400 hours at 200 microamps as projected by the ROD. Similarly, no criticality experiments were conducted at the Pajarito Site, compared to the 1,050 experiments projected by the ROD (LANL 2006g).

From 1999 through 2005, only three of LANL's facilities operated at levels approximating those projected in the *1999 SWEIS*: the Materials Science Laboratory, the Bioscience Facilities (formerly the Health Research Laboratory), and the non-Key Facilities. The two Key Facilities (the Materials Science Laboratory and the Bioscience Facilities) are more akin to the non-Key Facilities and represent the dynamic nature of research and development at LANL. More importantly, none of these facilities are major contributors to the parameters that lead to significant potential environmental impacts. The remaining 13 Key Facilities all conducted operations at or below projected activity levels for the modified Expanded Operations Alternative of the *1999 SWEIS* (LANL 2006g).

2.2.1 Cerro Grande Fire

The period between 1999 and 2005 saw environmental change on the Pajarito Plateau. Perhaps the most widespread and pervasive change in the region was drought. The first serious manifestation of the drought was an increase in wildfire activity in the region. The first of those wildfires was the 2000 Cerro Grande Fire, which affected buildings and the landscape at LANL. The fire burned north and east across LANL and onto San Ildefonso Pueblo property. By the time the fire was fully contained, it had consumed close to 43,000 acres (17,400 hectares), of which about 7,700 acres (3,110 hectares) (27 percent of LANL land) was on LANL property. The LANL response to the Cerro Grande Fire included burned area rehabilitation and monitoring efforts, enhanced vegetation and wildlife monitoring, and implementation of the *Wildfire Hazard Reduction Project Plan* (LANL 2001b). Additionally, several flood retention structures were constructed to minimize the danger of flooding due to the loss of vegetation and to allow the vegetation to regrow. In most areas, burned trees were removed and remaining forest was thinned to reduce the wildland fire potential and to make the forest viable and self-sustaining. The following is an overview of infrastructure changes and recovery efforts at LANL since the Cerro Grande Fire. More detailed facility-specific information is provided later in this chapter.

Across LANL, structures were destroyed by the Cerro Grande Fire or were rendered uninhabitable and needed to be replaced. Large amounts of construction and demolition debris required cleanup. High intensity fires often consume standing vegetation as well as the organic soil layers and associated seed bank. In addition, a common characteristic of high burn severity is a development of hydrophobic (water-repellent) soils. Together, these factors can lead to a potential for major runoff, soil erosion, downslope flooding, and degradation of water quality. All of these factors were considered in dealing with the effects of the Cerro Grande Fire. For further information on impacts from the Cerro Grande Fire, see Chapter 4.

The effects of the Cerro Grande Fire were minimal on the following Key Facilities: the Chemistry and Metallurgy Research Building (TA-3-29), Sigma Complex (TA-3-66), the Machine Shops (TA-3-102), Materials Science Laboratory (TA-3-1698), and the Tritium Facilities. No direct fire damage occurred, and recovery was limited to cleaning or replacement of air system filters. The Cerro Grande Fire caused notable effects on the other 11 Key Facilities. The effects of the fire on each of these Key Facilities are detailed in the facility performance portions of Section 2.4.

2.2.2 Land Conveyance and Transfer

Land use at LANL is a high-priority issue. Most of the undeveloped land is either required as buffer zones for operations or is unsuitable for development due to terrain restraints. Increases in available lands as a result of cleanup performed by environmental restoration activities and demolition of vacated buildings could affect strategic planning. To date, however, environmental restoration activities have not substantially added to the amount of land available for reuse (for further information, see Chapter 4, Section 4.1.1).

In 2002, the first congressionally mandated conveyances of land to Los Alamos County and transfer of land to the Department of the Interior (to be held in trust for the Pueblo of San Ildefonso) were accomplished. As of the end of 2006, 2,259 acres (914 hectares) have been effectively removed from LANL and made unavailable for LANL operations or use. Included are about 153 acres (62 hectares) conveyed to Los Alamos County and 2,106 acres (852 hectares) transferred to the Department of the Interior (in trust for the Pueblo of San Ildefonso). In addition, these conveyances and transfers changed LANL's boundaries (see Chapter 4, Figure 4–6). An assessment of the impacts of the boundary changes showed that the decrease in distances between postulated accident release sites and receptors would have little or no impact on the estimated public and worker doses presented in the *1999 SWEIS*. For further information on land conveyances and transfers, see Chapter 4.

2.2.3 LANL Security Enhancements

In response to the events of September 11, 2001, security at LANL was enhanced to protect personnel, property, and program projects. One security upgrade was installation of a temporary Truck Inspection Station located at the lower end of East Jemez Road. The purpose of the station is to screen all large vehicles coming into LANL to ensure they have the proper authority to be on DOE property. The station became operational in April 2002.

Another upgrade was construction of access control stations (called vehicle access portals) on Pajarito Road. Access to most of Pajarito Road is now restricted to DOE badge holders only; at least one occupant of a motor vehicle must present a valid DOE badge. Bicyclists without a valid DOE security badge are not allowed to use Pajarito Road. Walkers, joggers, work crews, and others on foot on Pajarito Road must display a valid security badge.

Under the Security Perimeter Project, access control stations were constructed on East Jemez and West Jemez Roads to screen vehicles entering TA-3. NNSA will enact a graded closure of the core area based on security levels in effect. Currently, the general public is allowed access via the East and West Jemez Road access control stations.

2.2.4 Operational Stand Down

During a July 7, 2004, special inventory associated with an upcoming experiment, two items of Classified Removable Electronic Media were discovered missing from the Weapons Physics Directorate. An immediate search did not locate the items. It was later determined that the "missing" Classified Removable Electronic Media may never have existed. In addition to these security incidents, several safety incidents also occurred at LANL, including one involving a student researcher who was injured in a laser experiment and another involving sulfuric acid. Two days later (July 16, 2004) the Director of LANL ordered a suspension of operations to allow the workforce to reaffirm its commitment to safety and security and compliance with all policies and procedures.

The resumption efforts included reviews (called management self-assessments), corrective action plans, and LANL readiness reviews. Resumption of Level 3 (high-risk) activities additionally included conduct of an independent review by NNSA. Level 1 activities (actions that present little risk to safety and security) were 100 percent resumed as of August 18, 2004. All Level 2 (moderate-risk) operations and more than 70 percent of all Level 3 (high-risk) work resumed by the end of 2004. Resumption of all activities was accomplished by the end of January 2005 (LANL 2004n).

2.2.5 Off-Site Source Recovery Project

The Off-Site Source Recovery Project has the responsibility to identify, recover, and store excess and unwanted sealed radiological sources on behalf of NNSA in cooperation with the U.S. Nuclear Regulatory Commission (NRC). From 1979 through 1999, DOE recovered excess and unwanted radioactive sealed sources containing plutonium-239 and beryllium on a case-by-case basis as requested by NRC. Since 1999, the Off-Site Source Recovery Project has assisted NNSA in managing actinide-bearing sealed sources that have been identified as potential threats to national security. Since the issuance of the *1999 SWEIS*, the Off-Site Source Recovery Project has been operating at various times at the following Key Facilities: the Chemistry and Metallurgy Research Building, the Pajarito Site, the Solid Radioactive and Chemical Waste Facility, and the Plutonium Facility Complex. DOE has determined that many of the actinide sources are eligible for disposal at the Waste Isolation Pilot Plant (WIPP) and is in the process of characterizing, packaging, and transporting them for disposal. As of February 2008, about 15,300 sources had been brought to LANL; about 3,500 of these were subsequently sent offsite for disposition.

2.2.6 Environmental Restoration Project

DOE established an environmental restoration project in 1989 to characterize and, if necessary, remediate over 2,100 potential release sites at LANL that were known or suspected to be contaminated from historical LANL operations. Many of the potential release sites remain under DOE control; however, some are located on lands that have been conveyed to Los Alamos County or transferred to private ownership. Remediation and cleanup efforts are regulated by and coordinated between the New Mexico Environment Department (NMED) and DOE. Environmental restoration activities include drafting and finalizing characterization and remediation reports, conducting characterization and remediation field work, and formal tracking of all work performed.

On May 2, 2002, NMED issued a Determination of Imminent and Substantial Endangerment to Health and the Environment, as well as a draft order compelling investigation and cleanup of environmental contamination at LANL. After receiving public comments, NMED revised its Determination and issued a final order on November 26, 2002. On behalf of DOE and the University of California (the LANL management and operating contractor at the time), the U.S. Justice Department filed a lawsuit challenging the final order. As the LANL management and operating contractor, the University of California filed a separate lawsuit. The DOE, the State of New Mexico, and the University of California subsequently negotiated a Compliance Order on Consent (Consent Order) (NMED 2005), which was issued for public comment on September 1, 2004.

The comment period for the Consent Order closed on October 1, 2004. NMED delayed finalizing the Consent Order until surface water and watershed issues were addressed in a separate Federal Facilities Compliance Act agreement under the Clean Water Act; that agreement was signed on February 3, 2005. The final Consent Order, approved by the three parties on March 1, 2005, is now the primary document recognized as defining the regulatory requirements and schedules for environmental remediation at LANL.

The Consent Order requires a site-wide investigation and cleanup to be conducted at LANL pursuant to stipulated procedures and schedules. The Consent Order also requires the installation of wells, piezometers, and other subsurface units to provide site characteristic or environmental information; the collection and investigation of sample data; and the preparation and submittal of investigative reports for various potential release sites. Following the investigation phase for a potential release site and upon a determination by NMED that corrective measures are needed to protect human health and the environment, a corrective measures evaluation report must be prepared. After NMED authorizes a corrective measure for a potential release site, the corrective measures must be implemented. Cleanup of soil, groundwater, and surface water throughout this process must meet standards documented in Section VIII of the Consent Order. Upon completing the remedy, a remedy completion report must be prepared and submitted to NMED for approval.

During 2005, LANL drafted and finalized numerous characterization and remediation plans and reports for NMED in accordance with the Consent Order, including the Interim Facility-Wide Groundwater Monitoring Plan. In addition, accelerated characterization and remediation activities were implemented at sites that could be affected by upcoming infrastructure construction projects. For example, in 2005, LANL's Canyons Project focused on investigations in Mortandad and Pajarito Canyons to evaluate the nature and extent of contamination in sediment, biota, and groundwater (among other goals). Completed characterization and remediation plans and reports are listed in the *2005 SWEIS Yearbook*, as are ongoing field activities (LANL 2006g).

Environmental restoration may generate a large amount of waste during cleanup activities, which are scattered over the entire LANL site. The *1999 SWEIS* forecast that environmental restoration activities would contribute 60 percent of the chemical wastes, 35 percent of the low-level radioactive waste, and 75 percent of the mixed low-level radioactive waste generated at LANL over the 10-year period from 1996 through 2005. The LANL environmental restoration program originally identified 2,124 potential release sites, including 1,099 potential release sites which were subsequently listed in Model VIII of the LANL Hazardous Waste Facility Permit, which was issued by EPA in March 1990, and 1,025 potential release sites that were not listed in Module VIII. Based on prior "no further action" approvals and consolidation of sites, only 829 potential release sites remained at the end of 2005. Approximately 774 units have been approved for no further action, including 146 units that have been removed from LANL's Hazardous Waste Facility Permit (LANL 2006g). Some of the major completed remediation activities are shown in **Table 2–1**. In addition, during 2005, LANL received certificates of completion (which replace the former no further action determinations) from NMED for eight sites (LANL 2006g).

Table 2–1 Major Remediation Activities Completed Since the *1999 SWEIS*

Location	Decommissioning Activity	Year
TA-16-387	Cleanup of flash pad at TA-16	2000
TA-16-394	Closure of burn tray at TA-16	2000
TA-00	Cleanup of contaminated sediments in the South Fork of Acid Canyon	2001
TA-21, TA-51, and TA-54	Characterization and removal of inactive septic tanks	2002
TA-16	MDA P clean closure	2002
TA-53	Remediation of surface impoundment at TA-53	2002
TA-3	Support for several planned construction projects	2003, 2005
TA-21	"Cold dump" cleanup	2003
TA-21	Cleanup of contaminated soils and sediments below outfall in TA-21 (SWMU-21-011 [K])	2003
TA-61	Removal of French drain at Omega West	2003
TA-33	Cleanup of a former drum storage area (SWMU 33-013)	2005

TA = technical area, MDA = material disposal area, SWMU = solid waste management unit.
Sources: LANL 1999c, 2000f, 2001e, 2002e, 2003h, 2004f, 2005f, 2006g.

Waste quantities generated since issuance of the *1999 SWEIS* ROD generally have been below the projections made in the *1999 SWEIS*, with the exception of mixed low-level radioactive waste generated in 2000 and chemical wastes generated in 2000 and 2001. Projections were exceeded in those years due to recovery efforts from the Cerro Grande Fire. In addition, in 1999, the chemical waste projections were exceeded due to disposal of extensive amounts of soil during the cleanup of material disposal area (MDA) P.

The major concern following the Cerro Grande Fire pertaining to LANL's environmental restoration activities was the threat of erosion at burned-over potential release sites and the movement of contaminants downstream. The LANL environmental restoration organization began an assessment of the 600 potential release sites within the burn area to accomplish the following:

- *Evaluate and stabilize sites touched by fire*. The Potential Release Site Assessment Team determined that over 300 potential release sites were touched by fire. Assessments for these sites were completed by May 2000, and erosion control measures (called best management practices) were needed for 91 of the 300 potential release sites. These best management practice installations were completed in July 2000, and included contour raking, placement of water barriers (straw wattles), diversion of stream channels, and other measures to divert surface water from the potential release sites (LANL 2001g).

- *Conduct baseline sampling to characterize postfire, preflood conditions (before seasonal rains) in fire-impacted watersheds*. The Contaminant Transport Team completed a Baseline Characterization Sampling Plan in June 2000. Preflood fieldwork, including collection of sediment, surface water, and alluvial groundwater samples, was completed in July 2000. Postflood fieldwork was carried out in August and September 2000, as necessary.

- *Evaluate, stabilize, or remove sites subject to flooding*. The Accelerated Actions Team identified 77 potential release sites in fire-impacted canyons that were potentially vulnerable to postfire flooding. The majority of these sites were in Los Alamos Canyon (TA-2 and TA-41) and Pajarito Canyon (TA-18 and TA-27) and included outfalls, storm drains, septic systems, and other structures (including those associated with the Omega West Reactor at TA-2). Few of the sites assessed actually required corrective actions, except for several in TA-2 where excavation, soil removal, and site restoration activities were completed during July and August 2000.

Fire rehabilitation and flood mitigation efforts are ongoing at LANL and will continue until areas prone to erosion are stabilized. Sites that had controls installed continue to be inspected and maintained as part of the LANL stormwater program (LANL 2005c).

In 2004, LANL submitted the Los Alamos and Pueblo Canyons Investigation Report to NMED to address, among other things, the results of the Cerro Grande Fire on concentrations of contaminants of potential concern in canyon media. The report found that, for contaminants released from LANL solid waste management units and areas of concern, the human health risks were below NMED's and DOE's target levels for present and foreseeable future land uses, and that adverse ecological effects had not been observed in terrestrial and aquatic systems in the watershed (LANL 2006g).

2.3 Technical Areas Changes Since the *1999 SWEIS*

LANL is divided into 49 separate TAs, including TA-0 (which comprises leased space within the Los Alamos townsite) (see **Figure 2–2**) and TA-57 at Fenton Hill. These TAs compose the basic geographic configuration of LANL. While the number of structures changes with time (there is frequent addition or removal of temporary structures and miscellaneous buildings), the current breakdown is about 952 permanent buildings, 373 temporary structures (trailers and transportables), and 897 miscellaneous structures such as sheds and utility structures. Together, these structures contain approximately 8.6 million square feet (800,000 square meters). Collectively, between 2001 and 2004, 360,000 gross square feet were removed from all TAs through a variety of funding initiatives. Structures at LANL include such constructed items as meteorological towers, water tanks, manholes, small storage sheds, and electrical transformers. Portions of LANL's resources are specialized facilities that have been built and maintained at LANL over the last 50 years. **Table 2–2** provides a brief overview of current activities conducted at each of LANL's TAs.

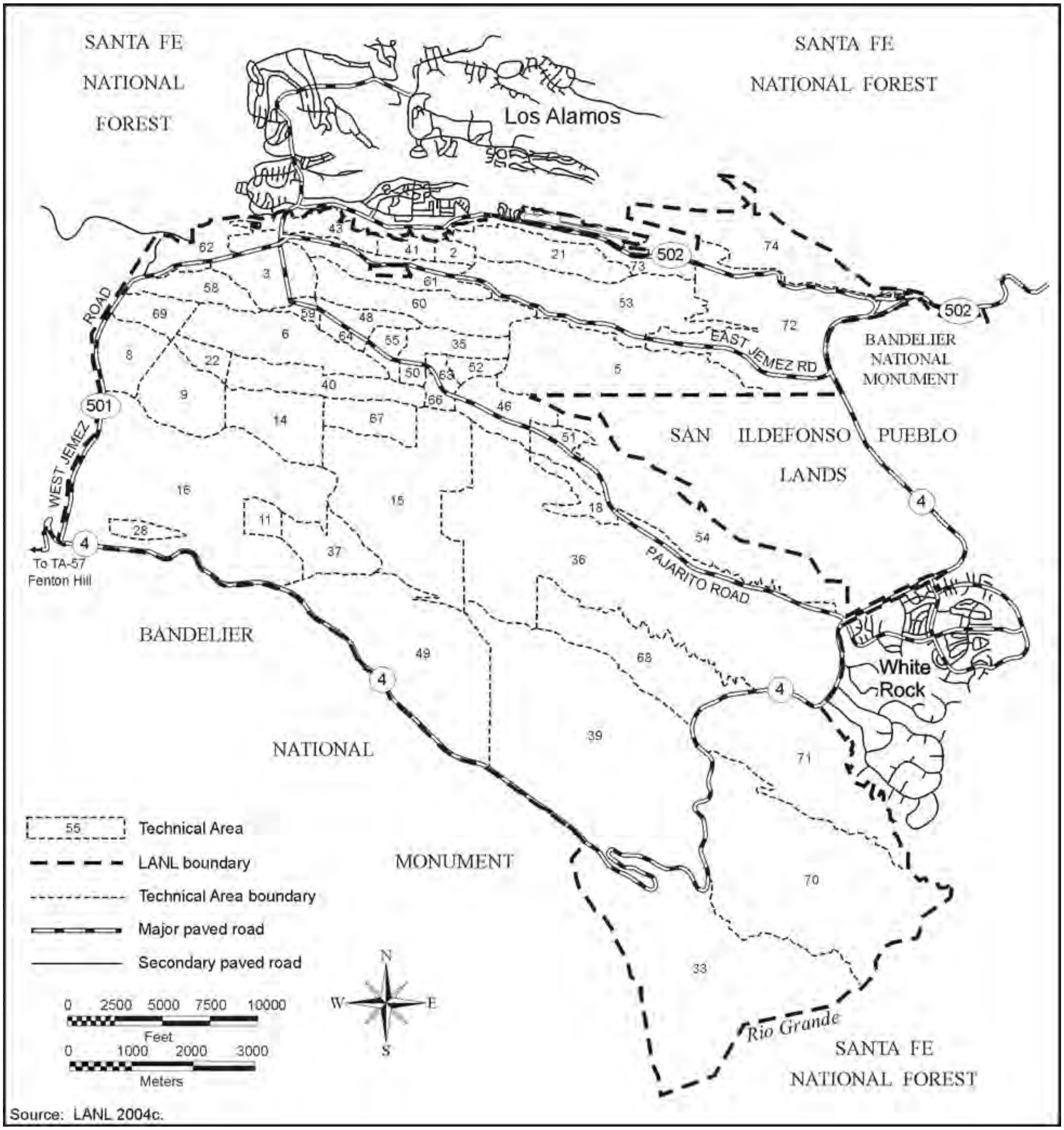


Figure 2–2 Technical Areas at Los Alamos National Laboratory

Table 2–2 Overview of Los Alamos National Laboratory Technical Areas and Activities [2]

Technical Area	*Activities*
TA-0 (Offsite Facilities)	This TA designation is assigned to structures leased by DOE and NNSA that are located outside LANL's boundaries. There are approximately 58 LANL facilities with this designation, with about 235,000 square feet (22,000 square meters) of space. The University of California and the Community Reading Room; the Bradbury Science Museum; the White Rock Environment, Safety, and Health Training Center; and other various office suites are located in the Los Alamos townsite and White Rock.
TA-2 (Omega Site or Omega West Reactor)	This TA encompasses approximately 4 acres (1.6 hectares) in Los Alamos Canyon. It once contained a building that housed an 8-megawatt nuclear research reactor, the Omega West Reactor. The reactor and all support buildings and ancillary structures have been demolished.
TA-3 (Core Area or South Mesa Site)	This TA is LANL's main TA, housing approximately half of LANL's employees and total floor space. It is the entry point to LANL, and is located on South Mesa. It houses most of the administrative and public access activities, as well as a mixture of laboratory activities including experimental sciences, biological work, work with special nuclear material, materials synthesis, metallic and ceramic processing and fabrication, theoretical and computational research and physical support operations. TA-3 contains major facilities such as the Chemistry and Metallurgy Research Building; the Sigma Complex; the Machine Shops; the Materials Science Laboratory; the Nicholas C. Metropolis Center for Modeling and Simulation (Metropolis Center); and the Los Alamos Research Park. The Chemistry and Metallurgy Research Building capabilities will be moved to TA-55 as a part of the Chemistry and Metallurgy Research Building Replacement Project. It is also the location proposed for operating the existing Biosafety Level 3 Facility.
TA-5 (Beta Site)	This largely uncleared TA is located between East Jemez Road and the San Ildefonso Pueblo and contains physical support facilities, an electrical substation, test wells, several archaeological sites, and environmental monitoring and buffer areas.
TA-6 (Two-Mile Mesa Site)	Located in the northwestern part of LANL, this TA is mostly undeveloped and contains a meteorological tower, gas cylinder staging buildings, and aging vacant buildings that are awaiting authorization for disposal.
TA-8 (GT-Site [Anchor Site West])	This TA, located between West Jemez Road and Anchor Ranch Road, is a testing site where all modern nondestructive dynamic testing techniques are maintained to ensure the quality of materials in items ranging from test weapons components to high-pressure dies and molds. The principal techniques used at this site include radiography (x-ray machines with a potential of up to 1,000,000 volts and a 24-megaelectronvolts betatron), radioisotope techniques, ultrasonic and penetrant testing, and electromagnetic test methods.
TA-9 (Anchor Site East)	This TA is located on the western edge of LANL. Fabrication feasibility and the physical properties of explosives are explored at this site, and new organic compounds are investigated for possible use as explosives. Storage and stability problems are also studied.
TA-11 (K-Site)	TA-11 is a remote TA. Facilities at this site are used for testing explosives components and systems, including vibration analysis and drop-testing materials and components under a variety of extreme physical environments. These facilities are arranged so that testing may be controlled and observed remotely, allowing devices that contain explosives, radioactive materials, and nonhazardous materials to be safely tested and observed.
TA-14 (Q-Site)	Located in the northwestern part of LANL, this TA is one of 14 firing areas. Most operations are remotely controlled and involve detonations, certain types of high explosives machining, and permitted burning. Tests are conducted on explosives charges to investigate fragmentation impact, explosives sensitivity, and thermal responses of new high explosives. This site is currently permitted to treat waste through open detonation or open burning under the Resource Conservation and Recovery Act (RCRA).

[2] *Names in parentheses are common or historical names that are sometimes used to refer to the Technical Areas.*

Technical Area	***Activities***
TA-15 (R-Site)	This TA, located in the central portion of LANL, is used for high explosives research, development, and testing, mainly through hydrodynamic testing and dynamic experimentation. TA-15 is the location of two firing sites, the Dual Axis Radiographic Hydrodynamic Test Facility, which has an intense high-resolution, dual-machine radiographic capability, and Building 306, a multipurpose facility where primary diagnostics are performed. The Pulsed High Energy Radiation Machine Emitting X-Rays Facility, a multiple-cavity electron accelerator capable of producing a very large flux of x-rays, was disabled in 2004. The machine was decommissioned in 2007, and decontamination and demolition will occur in the future. TA-15 is also used to investigate weapons functioning and systems behavior in nonnuclear testing.
TA-16 (S-Site)	TA-16, located in the western part of LANL, is the site of the Weapons Engineering Tritium Facility, which is a state-of-the-art tritium processing facility, and the High Explosives Wastewater Treatment Facility. The TA's high explosives research, development, and testing capabilities include high explosives processing; powder manufacturing; casting, machining, and pressing; inspection and radiography of high explosives components to guarantee integrity and ensure quality control; test device assembly; and chemical analysis. There are also some biological laboratories here.
TA-18 (Pajarito Site)	This TA is located in Pajarito Canyon about 4 miles (6 kilometers) southeast of TA-3. The Los Alamos Critical Experiment Facility, a general-purpose nuclear experiments facility, is housed on this site along with other experimental facilities. Currently, the primary focus of the Los Alamos Critical Experiment Facility is the design, construction, research, development, and application of critical experiments, as well as training related to criticality safety and radiation detection and instrumentation applications. In December 2002, NNSA decided to relocate all TA-18 Security Category I and II materials and activities to the Nevada Test Site; this transfer is in process.
TA-21 (DP-Site)	TA-21 is on the northern border of LANL, next to the Los Alamos townsite. The TA has two primary research areas: DP West and DP East. DP West is the former radioactive materials (including plutonium) processing facility that has been partially decontaminated, decommissioned, and demolished (DD&D). DP East consists of two tritium facilities. Current plans include closing TA-21 and consolidating tritium operations at the Weapons Engineering Tritium Facility in TA-16. The Tritium Systems Test Assembly has been deactivated and will undergo DD&D, and the Tritium Science and Fabrication Facility operations ended in 2006.
TA-22 (TD-Site)	This TA, located in the northwestern portion of LANL, houses the Los Alamos Detonator Facility. Construction of a new Detonator Production Facility began in 2003. Research, development, and fabrication of high-energy detonators and related devices are conducted at this facility.
TA-28 (Magazine Area A)	TA-28, located near the southern edge of TA-16, was an explosives storage area. The TA contains five empty storage magazines that are in the process of being decontaminated and decommissioned.
TA-33 (HP-Site)	TA-33 is remotely located at the southeastern boundary of LANL, where experiments that do not require daily oversight, but do require isolation, are located. The National Radioastronomy Observatory's Very Long Baseline Array telescope is located at this TA.
TA-35 (Ten Site)	This TA, located in the north central portion of LANL, is used for nuclear safeguards research and development, primarily in the areas of lasers, physics, fusion, materials development, and biochemistry and physical chemistry research and development. The Target Fabrication Facility, located at this TA, conducts precision machining and target fabrication, polymer synthesis, and chemical and physical vapor deposition. Additional activities at TA-35 include research in reactor safety, optical science, and pulsed-power systems, as well as metallurgy, ceramic technology, and chemical plating. This was formerly the site of the Atlas Project. The Atlas Removal Project has been completed at this site, and the building is now available as storage space. Additionally, there are some Biosafety Level 1 and 2 laboratories at TA-35.
TA-36 (Kappa-Site)	TA-36 is in a remotely located area in the eastern portion of LANL that is fenced and patrolled. It has four active firing sites that support explosives testing. The sites are used for a wide variety of nonnuclear ordnance tests pertaining to warhead designs, armor and armor-defeating mechanisms, explosives vulnerability to projectile and shaped-charge attack, warhead lethality, and determining the effects of shock waves on explosives and propellants.
TA-37 (Magazine Area C)	This TA is used as an explosives storage area. It is located at the eastern perimeter of TA-16.

Technical Area	***Activities***
TA-39 (Ancho Canyon Site)	TA-39 is located at the bottom of Ancho Canyon. The behavior of nonnuclear weapons is studied here, primarily by photographic techniques. Also studied are the various phenomenological aspects of explosives, interactions of explosives, explosions involving other materials, shock wave physics, equation-of-state measurements, and pulsed-power systems design.
TA-40 (DF-Site)	TA-40, centrally located within LANL, is used for general testing of explosives or other materials and development of special detonators for initiating high explosives systems. Fundamental and applied research includes investigating phenomena associated with the physics of high explosives and research in rapid-shock-induced reactions. This TA is also used for investigating the physics and chemistry of detonators and shock wave propagation.
TA-41 (W-Site)	TA-41, located in Los Alamos Canyon, is no longer used and many buildings have been decontaminated and decommissioned. Remaining structures include historic properties.
TA-43 (the Bioscience Facilities, formerly called the Health Research Laboratory)	TA-43 is adjacent to the Los Alamos Medical Center at the northern border of LANL. Two facilities are located within this TA: the Bioscience Facilities (formerly called the Health Research Laboratory) and NNSA's Los Alamos Site Office. The Bioscience Facilities have Biosafety Level 1 and 2 laboratories and are the focal point of bioscience and biotechnology at LANL. Research performed at the Bioscience Facilities includes structural, molecular, and cellular radiobiology; biophysics; radiobiology; biochemistry; and genetics.
TA-46 (WA-Site)	TA-46, located between Pajarito Road and the San Ildefonso Pueblo, is one of LANL's basic research sites. Activities have focused on applied photochemistry operations and have included development of technologies for laser isotope separation and laser enhancement of chemical processes. The Sanitary Wastewater Systems Plant is located within this TA.
TA-48 (Radiochemistry Site)	TA-48, located in the north-central portion of LANL, supports research and development in nuclear and radiochemistry, geochemistry, production of medical radioisotopes, and chemical synthesis.
TA-49 (Frijoles Mesa Site)	TA-49, located near Bandelier National Monument, is used as a training area and for outdoor tests on materials and equipment components that involve generating and receiving short bursts of high-energy, broad-spectrum microwaves. A fire support building located near the entrance to the TA, with an upgraded helipad, is operated by the U.S. Forest Service.
TA-50 (Waste Management Site)	TA-50 is located near the center of LANL. The site supports LANL's waste management activities for several types of waste, including storing solid and liquid low-level radioactive waste, low-level mixed waste, transuranic waste, and hazardous waste. Major facilities at TA-50 include the Radioactive Liquid Waste Treatment Facility; the Waste Characterization, Reduction, and Repackaging Facility; and the Actinide Research and Technology Instruction Center.
TA-51 (Environmental Research Site)	Located on Pajarito Road in the eastern portion of LANL, TA-51 is used for research and experimental studies on the long-term impacts of radioactive materials on the environment. Various types of waste storage and coverings are studied at this TA.
TA-52 (Reactor Development Site)	TA-52 is located in the north central portion of LANL. A wide variety of theoretical and computational research and development activities related to nuclear reactor performance and safety, as well as to several environmental, safety, and health activities, are carried out at this site.
TA-53 (Los Alamos Neutron Science Center)	TA-53 is located in the northern portion of LANL and includes LANSCE, which houses one of the largest research linear accelerators in the world and supports both basic and applied research programs. Basic research includes studies of subatomic and particle physics, atomic physics, neutrinos, and the chemistry of subatomic interactions. Applied research includes materials science studies that use neutron spallation and contribute to defense programs. LANSCE has also produced medical isotopes for the past 20 years.
TA-54 (Waste Disposal Site)	TA-54, located on the eastern border of LANL, is one of the largest TAs at LANL. Its primary function is management of solid radioactive and hazardous chemical wastes, including storage, treatment, decontamination, and disposal operations.
TA-55 (Plutonium Facility Complex Site)	TA-55, located just southeast of TA-3, includes the Plutonium Facility Complex and is the chosen location for the Chemistry and Metallurgy Research Building Replacement Project. This facility provides chemical and metallurgical processes for recovering, purifying, and converting plutonium and other actinides into many compounds and forms. Additional capabilities include the means to ship, receive, handle, and store nuclear materials, as well as to manage the wastes and residues produced by TA-55 operations. Relocated chemistry and metallurgy research, actinide chemistry, and materials characterization capabilities may be provided at the site through the Chemistry and Metallurgy Research Building Replacement Project currently under construction.

Technical Area	***Activities***
TA-57 (Fenton Hill Site)	TA-57 is located about 20 miles west (32 kilometers) of LANL on the southwest edge of the Valles Caldera in the Jemez Mountains. This TA lies within an area of land administered by the U.S. Forest Service. The primary purpose of the TA is observation of astronomical events. TA-57 houses the Milagro Gamma-Ray Observatory and a suite of optical telescopes. Drilling technology research is also performed in this TA.
TA-58 (Two-Mile North Site)	TA-58, located near LANL's northwest border on Two-Mile Mesa North, is a forested area reserved for future use because of its proximity to TA-3. The TA houses a few LANL-owned storage trailers and a temporary storage area.
TA-59 (Occupational Health Site)	This TA is located on the south side of Pajarito Road, adjacent to TA-3. TA-59 facilities provide LANL support services in the areas of health physics, risk management, industrial hygiene and safety, policy and program analysis, air quality, water quality and hydrology, hazardous and solid waste analysis, and radiation protection. The Medical Facility at TA-59 includes a clinical laboratory. Institutional-level analytical support for environmental samples and bioassay samples is also provided.
TA-60 (Sigma Mesa)	TA-60 lies between Mortandad Canyon and Sandia Canyon southeast of TA-3. The site is primarily used for physical support and infrastructure activities and includes the Nevada Test Site Test Fabrication Facility and a test tower. Because of the moratorium on testing, these buildings have been placed in indefinite safe shutdown mode.
TA-61 (East Jemez Site)	TA-61, located in the northern portion of LANL, contains physical support and infrastructure facilities, including a sanitary landfill operated by Los Alamos County and sewer pump stations.
TA-62 (Northwest Site)	TA-62, located next to TA-3 and West Jemez Road in the northwest corner of LANL, serves as a forested buffer zone. This TA is reserved for future use.
TA-63 (Pajarito Service Area)	TA-63, located in the north-central portion of LANL, contains physical support and infrastructure facilities. The facilities at this TA serve as localized storage and physical support office space.
TA-64 (Central Guard Site)	This TA is located in the north-central portion of LANL and provides offices and storage space.
TA-66 (Central Technical Support Site)	TA-66 is located on the southeast side of Pajarito Road in the center of LANL. The Advanced Technology Assessment Center, the only facility at this TA, provides office and technical space for technology transfer and other industrial partnership activities.
TA-67 (Pajarito Mesa Site)	TA-67 is a forested buffer zone located in the north central portion of LANL. No operations or facilities are currently located at the site.
TA-68 (Water Canyon Site)	TA-68, located in the southern portion of LANL, is a testing area for dynamic experiments and also contains environmental study areas.
TA-69 (Anchor North Site)	TA-69, located in the northwestern corner of LANL, serves as a forested buffer area. The new Emergency Operation Center, completed in 2003, is located here.
TA-70 (Rio Grande Site)	TA-70 is located on the southeastern boundary of LANL and borders the Santa Fe National Forest. It is a forested TA that serves as a buffer zone.
TA-71 (Southeast Site)	TA-71 is located on the southeastern boundary of LANL and is adjacent to White Rock to the northeast. It is an undeveloped TA that serves as a buffer zone for the High Explosives Test Area.
TA-72 (East Entry Site)	TA-72 is located along East Jemez Road on the northeastern boundary of LANL. The site contains LANL's small arms firing range, which is used by protective force personnel for required training and practice purposes.
TA-73 (Airport Site)	TA-73 is located along the northern boundary of LANL, adjacent to NM 502. Los Alamos County manages, operates, and maintains the community airport under a leasing arrangement with DOE. Use of the airport by private individuals is permitted with special restrictions.
TA-74 (Otowi Tract)	TA-74 was a forested area in the northeastern corner of LANL. Large parts of this TA have been either conveyed to Los Alamos County or transferred to the Department of the Interior (in trust for the Pueblo of San Ildefonso) and are no longer part of LANL.

TA = technical area, NNSA = National Nuclear Security Administration, NM = New Mexico.

Several TAs at LANL have experienced facility changes recently. Changes occurring at LANL TAs since publication of the *1999 SWEIS* include:

- **TA-2—**The 1940s-era Omega West Reactor Building has been completely decontaminated, decommissioned, and demolished (DD&D). The land has been reclaimed and revegetated.

- **TA-3—**New facilities have been constructed since the *1999 SWEIS*, including the Los Alamos Research Park, which was constructed on land leased from DOE to allow a wide range of companies to work within the same geographic location on projects that will benefit both private industry and LANL; the Metropolis Center, which houses one of the world's fastest supercomputers; and the Nonproliferation and International Security Center, which was built to increase the efficiency and effectiveness of support to the NNSA Office of Nonproliferation and International Security by consolidating personnel at a central LANL location.

  The Los Alamos Research Park was constructed on undeveloped land leased to Los Alamos County for 50 years in 1999. While located within TA-3, this Research Park is operated by the county and is not subject to the administrative control of DOE except as provided through the lease agreement. Currently, one building has been constructed (along with parking structures). Construction of the first building in the Los Alamos Research Park began in 2000 and was completed in March 2001. As described in the *Environmental Assessment for the Lease of Land for the Development of a Research Park at Los Alamos National Laboratory* (DOE 1997b), up to 10 structures may eventually be constructed, consuming an estimated 1.3 megawatts peak electric demand, 39 billion British Thermal Units of natural gas, and 17 million gallons (64,352,001 liters) of water annually.

  The Metropolis Center (formerly called the Strategic Computing Complex) and the Nonproliferation and International Security Center were constructed on previously disturbed land containing parking lots or other structures. As previously discussed, most other facility construction, modifications, and upgrades were conducted within existing facilities. The following sections describe major constructions at TA-3.

  Construction of the Metropolis Center (TA-3-2327) began in 1999 and was completed at the end of 2001. Occupancy by about 300 designers, computer scientists, code developers, and university and industrial scientists was completed in 2002. When expansion of the original facility is completed, it will require an estimated 51 million gallons (193 million liters) of cooling water per year and will have a maximum electricity load requirement of 15 megawatts. The impacts of this project were initially addressed in the *Environmental Assessment for the Proposed Strategic Computing Complex, Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 1998), which considered the construction and operation of this facility with an initial computing capacity of up to 50 teraflops (50 trillion floating point operations per second). NNSA has subsequently determined that a capability of at least 100 teraflops would be required to effectively support the mission requirements of this facility, and estimates that an operational level as high as 1,000 teraflops (1 petaflops) might be required in the future.

The Nonproliferation and International Security Center (left) and the Strategic Computing Complex at TA-3

Construction of the Nonproliferation and International Security Center (TA-3-2322) began in March 2001. Occupancy began in March 2003. The building houses laboratories, a machine shop for fabrication of satellite parts, a high-bay fabrication area, an area for the safe handling of sealed radioactive sources, and offices. Since workers have been relocated from other LANL buildings, there have been no increases in LANL's generation of sewage or solid or chemical wastes, or its overall demand for utilities. The impacts of this project were addressed in the *Environmental Assessment for the Proposed Construction and Operation of the Nonproliferation and International Security Center* (DOE 1999c).

Additional new construction at TA-3 since 1999 includes the Security Systems Support Facility; the Decision Applications Office Building; the new Materials Sciences and Technology Office Building; the LANL Center for Integrated Nanotechnologies; the new LANL Medical Facility; and the Biosafety Level 3 Facility, which is not yet operational. Construction is complete on the National Security Sciences Building, which will replace the old Administration Building. Two of three planned parking structures were constructed to complement the new office space in TA-3 (NNSA 2001). Several buildings were removed from TA-3, including the Sherwood Building, the Scyllac Building, the Assembly Rack Towers, and the old Environment, Safety, and Health Clinic, as well as a number of trailers. Access control stations have been constructed and operations have been initiated, allowing NNSA to control vehicle access into TA-3.

- **TA-16—**Several new facilities have been constructed in this TA, including the Tritium Science and Engineering Office Building, the Weapons Engineering Office Building, and the Weapons Plant Support Building. In addition, several major demolition projects totaling over 100,000 square feet (9,290 square meters) have taken place at TA-16, including the 220, 340, and 370 complexes and the old steam plant.

- **TA-18—**This TA has operated for many years as a major training facility for nuclear specialists in areas such as criticality management and safety, emergency response in support of counterterrorism activities, nonproliferation programs, and criticality experiments in support of stockpile stewardship. This TA is currently undergoing decommissioning consistent with the ROD for the *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory* (67 FR 79906). Efforts are underway to remove the majority of special nuclear material from this area and to relocate certain operations to the Nevada Test Site by 2008 (Security Category I and II nuclear materials have been removed from this TA).

- **TA-21—**In the past, this TA has supported tritium research, but this work is being consolidated at TA-16 or offsite at another NNSA facility. Part of TA-21 has been conveyed per Public Law 105-119 requirements.

- **TA-41—**This TA was previously used for a variety of administrative and technical activities, but is no longer used. Many buildings have been decontaminated and decommissioned.

- **TA-55—**The Plutonium Facility Complex is located in this TA. Security Category I and II nuclear materials removed from TA-18 are being stored here pending transfer to the Device Assembly Facility at the Nevada Test Site.

- **TA-61—**This TA is the location of the Los Alamos County Landfill, which currently handles municipal solid waste from both Los Alamos County and LANL. The landfill is scheduled to cease operation in 2008 under the direction of NMED.

2.4 Key Facilities and Non-Key Facilities Changes Since the *1999 SWEIS*

Taken together, the 15 Key Facilities at LANL represent the majority of environmental risks associated with LANL operations. Specifically, information in the *1999 SWEIS* projected that these Key Facilities would produce:

- More than 99 percent of all radiation doses to the public,
- More than 99 percent of all radiation doses to the LANL workforce,
- More than 90 percent of all radioactive liquid waste generated at LANL, and
- More than 90 percent of all radioactive solid waste generated at LANL.

This remains true for operations-related activities at LANL Key Facilities today (LANL 2005f). Facility cleanouts and DD&D, however, as well as environmental restoration activities, account for large quantities of waste requiring management. **Figure 2–3** shows the location of the 15 Key Facilities at LANL.

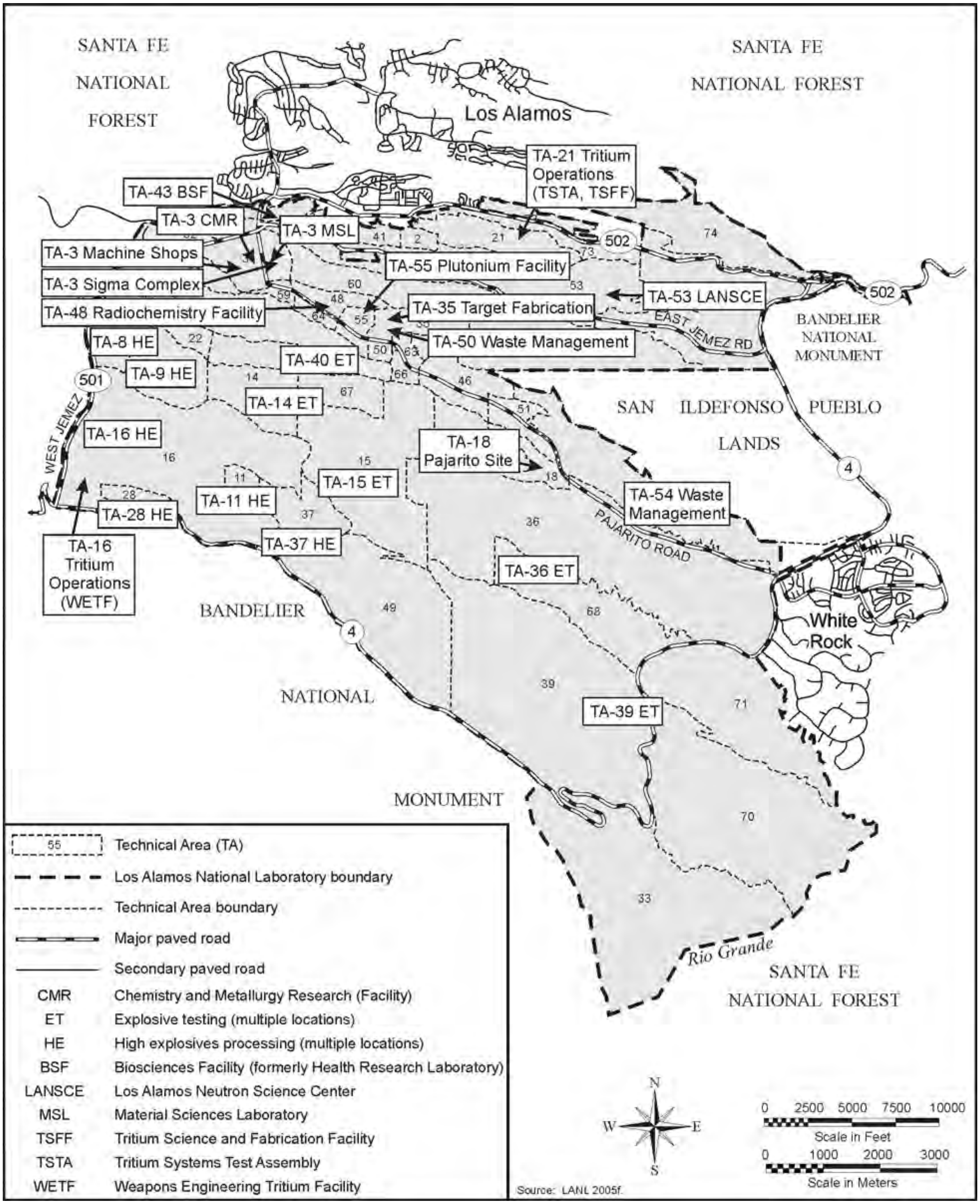


Figure 2–3 Los Alamos National Laboratory Key Facilities

Definition of a Key Facility

The definition of each Key Facility hinges upon operations,[3] capabilities, and location, and is not necessarily confined to a single structure, building, or TA. In fact, the number of structures[4] constituting a Key Facility ranges from one, such as the Metropolis Center, to more than 400 for LANSCE. Key Facilities may also exist in more than a single TA, as is the case with the High Explosives Testing and High Explosives Processing Key Facilities. *SWEIS Yearbooks* discuss each of the 15 Key Facilities from three aspects: substantial facility construction and modifications, types and levels of operations, and operations data by calendar year from publication of the *1999 SWEIS* through 2005. Each of these three aspects is given perspective by comparing them to projections made in the *1999 SWEIS*. This comparison provides an evaluation of whether or not data resulting from LANL operations continue to fall within the environmental envelope established in the *1999 SWEIS* ROD. The remainder of LANL facilities are called "non-Key," not because they are any less important to critical research and development activities, but because they did not fit the criteria of a Key Facility.

This SWEIS also describes changes that have occurred at non-Key Facilities. Although operations at non-Key Facilities do not individually contribute substantially to environmental impacts, non-Key Facilities represent a substantial fraction of LANL facilities. Non-Key Facilities comprise all or the majority of the facilities at 30 of the 49 TAs located on about 14,200 acres (5,750 hectares) of LANL's 25,600 acres (10,360 hectares) of land. Non-Key Facilities house about half the LANL workforce and include such important buildings and operations as the Center for Integrated Nanotechnology, the National Security Sciences Building and, the TA-46 Sanitary Wastewater System Plant.

Nuclear and Radiological Facility Designations

As previously noted in Chapter 1, Key Facilities in the *1999 SWEIS* included 42 of the 48 Hazard Category 2 and Category 3 nuclear structures at LANL.[5] Subsequently, DOE and LANL have reclassified some buildings so that there are now fewer Hazard Category 2 and 3 nuclear structures.

---

[3] *As used in the 1999 SWEIS and SWEIS Yearbooks, facility operations include three categories of activities: research, production, and services to other LANL organizations. Research is both theoretical and applied. Examples include modeling of the subatomic investigations and collaborative efforts with industry. Production involves delivery of a product to a customer, such as radioisotopes to hospitals and the medical industry. Examples of services provided to other LANL facilities include utilities and infrastructure support, analysis of samples, environmental surveys, and waste management.*

[4] *Structures may be buildings or any other engineered object such as test stations, manholes, and trailers.*

[5] *The identification of nuclear facilities is based upon the official list maintained by the Los Alamos Site Office; information in this SWEIS is as of October 2005 (DOE and LANL 2005).*

Table 2–3 presents the Key and non-Key Facilities identified in the *1999 SWEIS*, the structures currently listed as nuclear facilities, and their nuclear hazard categories (DOE and LANL 2005). There are now 15 structures or areas, 11 potential release sites, as well as the site-wide transportation capability, making a total of 27 nuclear facilities on the list. Many of the facilities that were classified as nuclear facilities in 1999 have been downgraded to radiological facilities[6] due to reductions in the amount of radioactive material in these facilities, or because the facilities have been decontaminated and decommissioned. Since the *1999 SWEIS*, the TA-54 Radioactive Materials, Research, Operations, and Demonstration Facility; the TA-48 Radiochemistry and Hot Cell Facility; the TA-21 Tritium Science Test Assembly; and the TA-3 Sigma Complex have been removed from the list. With these reductions in nuclear hazard categorizations, some facilities also have had their security hazard categorizations reduced. In addition, the new Decontamination and Volume Reduction System (TA-54) has been added to the list of nuclear facilities (June 2004) as a Hazard Category 2 nuclear facility. Several potential release sites, including MDAs, have also been added to the list of nuclear hazard facilities.

With the issuance of Nuclear Safety Management regulations (Title 10 *Code of Federal Regulations* [CFR] Part 830) on January 10, 2001, onsite transportation is also addressed relative to its nuclear hazard categorization. When the *1999 SWEIS* was published, onsite transportation was considered part of the affected environment. The onsite transportation of nuclear materials greater than or equal to Hazard Category 3 quantities is addressed in a NNSA-approved safety analysis (LANL 2003h).

Overview of Key Facility Capabilities and Changes

The following are brief descriptions of Key Facilities, their capabilities, and changes that have occurred since the publication of the *1999 SWEIS*. This discussion includes information on the location (TA) of each Key Facility, the building or buildings considered part of the Key Facility, and respective nuclear hazard categorizations. Emphasis is placed on the capabilities for which the facility maintains equipment and expertise and any changes that may have occurred since 1999. Subsequent chapters of this SWEIS will evaluate each alternative (No Action, Reduced, and Expanded) in terms of how it could impact the level of activity within each Key Facility capability, as well as major projects planned at any non-Key Facility.

---

[6] Radiological facilities are defined as areas or activities that contain or use less than Hazard Category 3 inventories as listed in Table A.1 DOE-STD-1027-92, but where the amount of radioactive material present is sufficient to create a "radiological area" as defined by 10 CFR Part 835. Sealed radioactive sources, material in U.S. Department of Transportation Type B containers, and structures whose only source of radiation is machine produced x-rays may be excluded. The identification of radiological facilities is based upon the official list maintained by the Los Alamos Site Office as of November 2002 (LANL 2002h).

Table 2–3 Los Alamos National Laboratory Key and Nuclear Facilities – *1999 SWEIS* and 2005 Listings

Key Facility and Location	*1999 SWEIS*		*2005 Listing*	
	Facility or Structure	*Nuclear Hazard Category*	*Facility or Structure*	*Nuclear Hazard Category*
Chemistry and Metallurgy Research Building (TA-3)	Chemistry and Metallurgy Research Building	2	Chemistry and Metallurgy Research Building	2
Machine Shops (TA-3)				
Materials Science Laboratory (TA-3)				
Sigma Complex (TA-3)	Sigma Building	3		
	Thorium Storage	3		
High Explosives Processing (TA-8 and TA-16)	Radiography Facility	2	Radiography Facility	Radiological
	Isotope Building	2		
	Experimental Science	2	Experimental Science	Radiological
	Intermediate Device Assembly	2	Intermediate Device Assembly	Radiological
High Explosive Testing (various TAs)				
Tritium Facilities (TA-16 and TA-21)	Weapons Engineering Tritium Facility	2	Weapons Engineering Tritium Facility	2
	Tritium System Test Assembly	2	Tritium Systems Test Assembly	Radiological
	Tritium Science and Fabrication Facility	2	Tritium Science and Fabrication Facility	Radiological
Pajarito Site (TA-18)	Critical Assembly and Storage Area 1	2	Los Alamos Critical Experiment Facility (whole facility)	2
	Hillside Vault	2		
	Critical Assembly and Storage Area 2	2		
	Critical Assembly and Storage Area 3	2		
Target Fabrication Facility (TA-35)				
Bioscience Facilities (various TAs)			Health Research Laboratory	Radiological
Radiochemistry Facility (TA-48)	Radiochemistry and Hot Cell Facility	3	Radiochemistry and Hot Cell Facility	Radiological
Radioactive Liquid Waste Treatment Facility (TA-50)	Main Treatment Plant	2	Main Treatment Plant, Pretreatment Plant	2
	Low-Level Waste Tank Farm		Low-level liquid influent tanks, treatment effluent tanks, low-level sludge tanks	2
	Acid and Caustic Tank Farm		Acid and caustic waste holding tanks	2
	Holding Tank		Holding Tank	2

Key Facility and Location	1999 SWEIS		2005 Listing	
	Facility or Structure	***Nuclear Hazard Category***	***Facility or Structure***	***Nuclear Hazard Category***
LANSCE (TA-53)	Experimental Science	3		
			1 L Target	3
			Lujan Center ER-1/2 Actinide	3
			Area A-East	3
Solid Radioactive and Chemical Waste Facilities (TA-50 and TA-54)	Radioactive Materials, Research, Operations, and Demonstration	2 [a]	Actinide Research Technology Instruction Center	
	Waste Characterization, Reduction, and Repackaging Facility Building	2	Waste Characterization, Reduction, and Repackaging Facility	3
	Nondestructive Analysis Mobile Activities		Nondestructive analysis mobile activities outside TA-50-69	2
	Drum Storage		Drum Staging, Storage, and Equilibration Pad outside TA-50-69	2
	Low-Level Radioactive Waste Storage and Disposal Area G	2	Waste Storage and Disposal Facility (Area G) [b]	2
	Transuranic Waste Inspectable Storage Project	2 [a]		
	Transuranic Storage Dome (Building)	2	Waste Assay Facility	2
	Transuranic Drum Preparation	2		
	Radioassay and Nondestructive Testing Facility	2	Radioassay and Nondestructive Testing Facility	2
	Transuranic Storage Domes (3)	2	Transuranic Waste Management Domes (12)	(c)
	Sheds (4)	2	Sheds (4)	(c)
	Temporary Retrieval Dome	2		
	Tension Support Domes (5)	2		
	Decontamination and Volume Reduction Glovebox		Decontamination and Volume Reduction System	2
	Storage Pad/Transuranic Storage	2	Pad 10 (previously pads 2 and 4)	2
	Storage Pad	2		

	1999 SWEIS		*2005 Listing*	
Key Facility and Location	***Facility or Structure***	***Nuclear Hazard Category***	***Facility or Structure***	***Nuclear Hazard Category***
Plutonium Facilities Complex (TA-55)	Plutonium Facility	2	Plutonium Facility	2
	Nuclear Material Storage	2		
			Staging Facility	2
			Safe Secure Transport Facility	2
Non-Key Facilities (TA-3, TA-33, and TA-35)	Physics Building	3	Physics Building	Radiological
	Source storage	2		
	Calibration Building	3		
	Former Tritium Research	3	Former Tritium Research	Radiological
	Nuclear Safeguards Research Facility	3	Nuclear Safeguards Research Facility	Radiological
Site-wide			Site-wide transportation of nuclear materials	2
Potential Release Sites (TA-10, TA-21, TA-35, TA-49, TA-50, TA-53, and TA-54)			Former liquid disposal complex	3
			Material Disposal Area A	2
			Material Disposal Area B	3
			Material Disposal Area T	2
			Material Disposal Area W Sodium Storage Tanks	3
			Wastewater Treatment Plant	3
			Wastewater Treatment Plant (Pratt Canyon)	3
			Material Disposal Area AB	2
			Material Disposal Area C	2
			Underground tank with spent resin	2
			Material Disposal Area H	3

TA = Technical Area, LANSCE = Los Alamos Neutron Science Center.

[a] Data indicate that this building was a nuclear Hazard Category 2 in 1998 and in 2000 so it is included here.

[b] This includes low-level radioactive waste (including mixed waste) storage and disposal in domes, pits, shafts, and trenches; transuranic waste storage in domes and shafts; transuranic legacy waste in pits and shafts; disposal of asbestos in pits and shafts; and operations building for transuranic waste storage.

[c] These structures are included as part of the Waste Storage and Disposal Facility (Area G).

Sources: LANL 2003a, 2004a, 2006g, DOE and LANL 2005.

Capabilities and Other Activities

In the Key Facility framework, a capability refers to the combination of buildings, equipment, infrastructure, and expertise necessary to undertake types or groups of activities and to implement mission assignments. The *1999 SWEIS* defined specific capabilities for each of the 15 Key Facilities based on projections of work (including production, research, and development) anticipated at each Key Facility. In some cases, capabilities at more than one Key Facility may have similar or identical names, but slightly different descriptions and operations. This is because several Key Facilities often work together to support a single mission or program, and work taking place in one area may complement efforts in another location. Unless otherwise noted, the capabilities described in this new SWEIS are the same as those previously defined in the *1999 SWEIS*. With a few exceptions, the capabilities identified in the *1999 SWEIS* ROD for LANL have remained constant since 1999. The exceptions are:

- Movement of the Nonproliferation Training and Nuclear Measurement School, which was briefly located at TA-18 and returned to TA-3 (the Chemistry and Metallurgy Research Building) in 2004, where it will stay until the Chemistry and Metallurgy Research Building is no longer available or until a new Security Category I and II facility is built at TA-48 as part of the Radiological Sciences Institute, of which Phase I is the Institute for Nuclear Nonproliferation Science and Technology (see Appendix G, Section G.3 for details);
- Relocation of the Decontamination Operations Capability from the Radioactive Liquid Waste Treatment Facility to the Solid Radioactive and Chemical Waste Facilities in 2001;
- Loss of Cryogenic Separation Capability at the Tritium Key Facilities in 2001 (LANL 2004f); and
- Transfer of thin film loading of neutron tube targets from the Tritium Key Facilities to Sandia National Laboratories in 2006.

Facility Performance and Other Changes Since the 1999 SWEIS

To evaluate the environmental impacts, the *1999 SWEIS* estimated the level of operations for each capability. If all of these capabilities were conducted at the estimated levels, they would be expected to result in a certain amount of emissions, liquid discharges, and waste. These projected parameters (emissions, liquid, and waste) set the limits for the operations levels. The *1999 SWEIS*, however, was not intended to set stringent limits on the level of activity for a particular capability. In most facilities, the operations levels for all capabilities would not be reached at one time because of the ebb-and-flow nature of the work at LANL. Thus, it is possible to exceed the projected operations level for one capability and still be within the operations limits for the facility.

The facility performance and changes sections of the following Key Facility descriptions summarize the operational performance levels within the defined facility capabilities for the period since the *1999 SWEIS* was published (through the end of 2005). Emphasis is placed on whether any capabilities have been gained or lost and whether the levels of activity have remained within the established environmental impact envelope. Operations data for air emissions, liquid releases (number of NPDES outfalls and effluent quality where applicable), and waste volumes (including transuranic waste, low-level radioactive waste, mixed low-level radioactive waste, and hazardous and chemical wastes) illustrate how the activity levels of each Key Facility have changed over the past 7 years. Quantified information about these changes is provided in **Table 2–5** at the end of this chapter.

2.4.1 Chemistry and Metallurgy Research Building (Technical Area 3)

The Chemistry and Metallurgy Research Building, (Building 3-29), located within TA-3, consists of seven wings that were constructed in 1952; a new wing (Wing 9) was added in 1960 for activities that must be performed in hot cells. The three-story building is a multiple-user facility in which specific wings are associated with different activities. It is the only LANL facility with full capabilities for performing special nuclear material analytical chemistry and materials science. This Key Facility is a Hazard Category 2 nuclear facility.


Chemistry and Metallurgy Research Building at TA-3

The principal capabilities and other activities at the Chemistry and Metallurgy Research Building include:

- Analytical chemistry capabilities involving the study, evaluation, and analysis of radioactive materials;
- Various operations considered essential for the stewardship of uranium products, including uranium processing and handling and storage of highly radioactive materials;
- Destructive and nondestructive analysis employing analytical chemistry, metallographic analysis, measurement of neutron or gamma radiation from an item, and other measurement techniques;
- Nonproliferation training utilizing measurement technologies and special nuclear material housed at the Chemistry and Metallurgy Research Building and other LANL facilities to train international inspection teams for the International Atomic Energy Agency;
- Actinide research and development that may include separation of medical isotopes from targets, processing of neutron sources, and research into the characteristics of materials, including the behavior or characteristics of materials in extreme environments; and
- Fabrication and processing of a variety of materials, including hazardous and nuclear materials, in support of highly enriched uranium processing and research and development on targets, weapons components, and other experimental tasks.

Chemistry and Metallurgy Research Building Performance and Changes Since the *1999 SWEIS*

As discussed in the *1999 SWEIS*, extensive upgrades originally planned for the Chemistry and Metallurgy Research Building would be much more expensive and time-consuming than originally anticipated and only marginally effective in providing the operational risk reduction and program capabilities required to support DOE mission assignments at LANL. As a result, DOE reduced the number of Chemistry and Metallurgy Research Building upgrade projects to those needed to ensure safe and reliable operations. Operations and capabilities are currently restricted due to safety and security constraints; the Chemistry and Metallurgy Research Building is not operational to the extent needed to meet the NNSA requirements established in the *1999 SWEIS* for the then-foreseeable future. In November 2003, NNSA issued an *Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2003d), which evaluated the potential environmental impacts resulting from activities associated with consolidating and relocating the mission-critical Chemistry and Metallurgy Research Building capabilities at LANL and replacement of the Chemistry and Metallurgy Research Building. In its ROD issued in February 2004, NNSA decided to replace the Chemistry and Metallurgy Research Building with a new Chemistry and Metallurgy Research Replacement Facility at TA-55 and to completely vacate and demolish the Chemistry and Metallurgy Research Building (69 FR 6967). The ROD stated that the new facility would be established as a Hazard Category 2 nuclear facility. NNSA is currently re-evaluating the need for this facility as part of its evolution of Complex Transformation, as discussed in Chapter 1, Section 1.5, of this SWEIS.

The principal capabilities and activities described for this Key Facility either operated within the bounds of the *1999 SWEIS* over the past 7 years or were inactive. The capability to evaluate secondary assemblies used in nuclear weapons through destructive and nondestructive analyses has not been used since 1999. Mechanical and chemical processing of sealed sources is no longer allowed in the Chemistry and Metallurgy Research Building per the Facility Authorization Basis, so there were no actinide processing operation activities. The research and development project related to spent nuclear fuel and long-term storage was completed in 1997 when the final shipment from Omega West was sent to the Savannah River Site. In addition, there were no activities related to the spent nuclear fuel capability and long-term storage research. Regarding the fabrication and metallography capability, the project to produce molybdenum-99 was terminated in 1999, the Ulysses Project was never initiated, and the equipment was removed in preparation for the Bolas Grande Project.

Modifications to Wing 9 were started in 1999 to support the Bolas Grande Project. This project would provide disposition of large vessels previously used to contain experimental explosive shots involving plutonium. The National Environmental Policy Act (NEPA) coverage for this project was provided by a *Supplemental Analysis Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Bolas Grande Project* (DOE/EIS-0238-SA-03) (DOE 2003c). As of the end of 2007, implementation of this project was pending approval.

Less than half the projected number of samples was analyzed annually in support of actinide research and processing activities. The Chemistry and Metallurgy Research Building's capability for metallurgical microstructural and chemical analysis and compatibility testing of actinides was used to analyze and test an average of 100 samples per year, equal to the projected *1999 SWEIS* rate. Demonstration of the actinide decontamination technology was completed in 2001.

Radiological air emissions remain below *1999 SWEIS* projections, except for technetium-99 and germanium-68, which were each present in 1 year, and strontium-90, which was present in 2 years in dosimetrically insignificant amounts and were not identified in the *1999 SWEIS*. The Chemistry and Metallurgy Research Building operated with one NPDES-permitted outfall, as projected in the *1999 SWEIS*. Except for 2001, the outfall discharge rates have regularly exceeded *1999 SWEIS* projections (500,000 gallons per year) by as much as 4 million gallons per year. In 2004, a dechlorination system was added to prevent NPDES permit noncompliances for chlorine at this outfall. Chemical waste, low-level radioactive waste, and mixed low-level radioactive waste were below their projected amounts. In 2002, mixed transuranic waste quantities were slightly higher (21 cubic yards or 16 cubic meters per year) than the *1999 SWEIS* projections (17 cubic yards or 13 cubic meters per year). In 2001, transuranic waste quantities generated were 66 percent higher than projected due to remodeling activities at the Chemistry and Metallurgy Research Building (17 cubic yards or 13 cubic meters per year). Quantities generated in all other years were below projections.

2.4.2 Sigma Complex (Technical Area 3)

The Sigma Complex Key Facility, also located in TA-3, consists of four principal buildings: the main Sigma Building (3-66), the Beryllium Technology Facility (3-141), the Press Building (3-35), and the Thorium Storage Building (3-159). The Sigma Complex supports a large, multidisciplinary technology base in materials fabrication science. This facility is used mainly for materials synthesis and processing, characterization, fabrication, joining, and coating of metallic and ceramic items. The Sigma Complex Key Facility had two Hazard Category 3 nuclear facilities identified in the *1999 SWEIS*, 3-66 and 3-159. However, in April 2000, Building 3-159 was downgraded from a Hazard Category 3 nuclear facility to a radiological facility and removed from the nuclear facilities list. In March 2001, Building 3-66 also was downgraded from a Hazard Category 3 nuclear facility and removed from the nuclear facilities list. In September 2001, the Sigma Building, the Press Building, and the Thorium Building were placed on the radiological facility list. The Beryllium Technology Facility is a nonnuclear moderate hazard facility.

Sigma Building at TA-3

The primary capabilities and activities conducted within the Sigma Complex are:

- Research and development on materials fabrication, coating, joining, and processing, including materials synthesis and processing work related to research and development on fabricating items from materials that are difficult to work with;
- Characterization of materials, which includes understanding the properties of metals, metal alloys, ceramic-coated metals, and other similar combinations, as well as the effects on these materials and their properties caused by aging, chemical attack, mechanical stresses, and other agents; and
- Fabrication of metallic and ceramic items, including fabricating and working with metallic and ceramic materials and various combinations.

Sigma Facility Performance and Changes Since the *1999 SWEIS*

The *1999 SWEIS* projected substantial facility changes for the Sigma Building itself. Three of five planned upgrades are complete; one is essentially complete; and one remains incomplete. They include:

- Replacement of graphite collection systems (completed in 1998);
- Modification of the industrial drain system (completed in 1999);
- Replacement of electrical components (essentially completed in 2000; however, add-on assignments will continue);
- Roof replacement (most of the roof was replaced in 1998 and 1999; however, additional work needs to be performed); and
- Seismic upgrades (not started).

In addition to the five planned upgrades, three additional upgrades were completed in 2003:

- Replacement of liquid nitrogen Dewar container,
- Painting the exterior of the Sigma Building, and
- Reinstallation of the utilities to activate the Press Building.

Construction of the Beryllium Technology Facility, formerly known as the Rolling Mill Building, was completed in 1999. This state-of-the-art beryllium processing facility has 16,000 square feet (1,490 square meters) of floor space, of which 13,000 square feet (1,210 square meters) are used for beryllium operations. The remaining 3,000 square feet (280 square meters) are for general metallurgical activities. The mission of the new facility is to maintain and enhance the beryllium technology base that exists at LANL and to establish the capability for fabrication of beryllium powder components. Research also will be conducted at the Beryllium Technology Facility, including research concerning the energy- and weapons-related use of beryllium metal and beryllium oxide. The beryllium equipment for this new facility was moved in stages from the

Machine Shops Key Facility into the Beryllium Technology Facility in 2000. The authorization to begin operations in the Beryllium Technology Facility was granted by NNSA in January 2001.

The research and development activity and the fabrication of metallic and ceramic items activity have operated below the levels projected in the *1999 SWEIS*. Parts of the characterization of materials activity operated above the levels projected in the *1999 SWEIS*. Other activities, including analysis of tritium reservoirs and development of a library of aged non-special nuclear material, operated below the levels projected in the *1999 SWEIS*.

Radiological air emissions were below projected levels identified in the *1999 SWEIS*. Thorium-230 and uranium-235 were not identified in the *1999 SWEIS* as contributors to the Sigma Building's overall air emission makeup, but have been present in dosimetrically insignificant amounts (less than a microcurie). In early 2000, stack monitoring was discontinued because potential emissions from the monitored stacks were sufficiently low that such monitoring was no longer warranted for compliance. Since 1994, the facility has operated with two NPDES-permitted outfalls, but only one outfall was used. Annual outfall discharge rates were within *1999 SWEIS* projections for 1999 through 2005, except for 2003, when the facility's effluent exceeded NPDES permit levels by 4 percent. A dechlorination system was installed in October 2003 to prevent further noncompliance events (LANL 2004d). Chemical wastes exceeded projections in 2002 by 49,400 pounds (22,400 kilograms) due to structure rehabilitation and disposal of equipment and other material debris resulting from bringing the Press Building back on line. In 2004, chemical waste projections were again exceeded because the graphite machine shop at Sigma generated a lot of graphite waste that could not be disposed of in the Los Alamos County Landfill. Over a 4-year period, the LANL Pollution Prevention office has searched unsuccessfully for a company to take the graphite powder for recycle. During this time, 115 55-gallon drums (about 24,400 kilograms) of nonhazardous graphite waste accumulated. As a last resort, all the drums were disposed of in June 2004. Currently, drums are being disposed of as they are filled, about five at a time. Also included in the chemical waste volume disposed of in 2004 were two 20-foot transportainers containing 32,000 pounds (about 14,500 kilograms) of beryllium waste from the Beryllium Technology Facility.

2.4.3 Machine Shops (Technical Area 3)

The main Machine Shops Complex, located in TA-3, consists of two buildings, the Nonhazardous Materials Machine Shop (3-39) and the Radiological Hazardous Materials Machine Shop (3-102). Both buildings are located within the same exclusion area in the southwestern quadrant of TA-3. A 125-foot-long (38-meter-long) corridor connects the two buildings. In September 2001, Building 3-102 was placed on the radiological facility list. Historically, LANL has maintained a prototype capability in support of research and development for nearly all of the nuclear weapons components (parts) designed at LANL.

The primary capabilities and activities conducted at the Machine Shops Complex include:

- Fabrication of specialty components including unique, unusual, or one-of-a-kind parts, fixtures, tools, or other equipment for use (1) in various applications for destructive testing, (2) as replacement parts for the Stockpile Stewardship Program, and (3) in gloveboxes;
- Fabrication using unique or exotic materials such as depleted uranium and lithium and its compounds; and
- Dimensional inspection of finished fabricated components including measurements to ensure correct size and shape.

Machine Shops Performance and Changes Since the *1999 SWEIS*

Although not projected in the *1999 SWEIS*, building maintenance and upgrades were performed on Buildings 3-39 and 3-102. The heat-treating capability of Building 3-66 was duplicated in Building 3-102. Beryllium equipment was moved to the Beryllium Technology Facility from Building 3-39. Depleted uranium was added to the materials compatibility study, and controlled storage areas were added to Building 3-39 in support of the weapons program. In 2004, additional electrical upgrades of Building 3-39 were completed. Also in 2004, one facility modification provided space to house a vault for classified work at the Secret Restricted Data level in support of the Security and Safeguards Division's Joint Conflict and Tactical Simulation System. The Joint Conflict and Tactical Simulation System Laboratory consists of a vault for internal communications, an office area, and a stand-alone classified computing system, all of which were installed in room 27 of Building 3-39. The project involved adding walls inside the existing structure.

In 2005, modular units were constructed on the north side of Building 3-39 to conduct upgrades of test equipment, tooling, computer numerical controlled programming, and controls for TA-55 activities; these units are prototypes for the Plutonium Facilities Complex. All manufacturing science and technology activities conducted in Building 3-39 are nonhazardous. Other minor activities conducted in this space include robotics testing, tensile testing, and welding activities.

The principal activities listed above operated below the levels projected in the *1999 SWEIS*, including fabrication of specialty components and fabrication with unique materials. Dimensional inspection was provided for the fabrication activities.

Since 1999, radiological air emissions from the Machine Shops have been below those projected in the *1999 SWEIS*. The following nuclides were not identified in the *1999 SWEIS*, but have been present in dosimetrically insignificant amounts (microcuries): americium-241, plutonium-239, thorium-228, thorium-230, thorium-232, uranium-234, and uranium-235. The facility has no NPDES-permitted outfalls. In the past 6 years, transuranic, low-level radioactive, and chemical wastes either were not produced or their production was less than predicted in the *1999 SWEIS*. Until 2001, small quantities (less than 1 cubic yard or 1 cubic meter per year) of mixed low-level radioactive waste were produced, although none was projected in the *1999 SWEIS*.

2.4.4 Materials Science Laboratory (Technical Area 3)

The Materials Science Laboratory, located on the southeastern edge of TA-3, is composed of several buildings containing 27 laboratories, 60 offices, 21 materials research areas, and various support areas. The main building (3-1698) is a two-story structure with approximately 55,000 square feet (5,110 square meters) of floor space. The building is designed to accommodate scientists and researchers, including participants from academia and industry whose focus is on materials science research. This building first opened in 1993. In September 2001, the Materials Science Laboratory was placed on the radiological facility list, where it remains today.

Materials Science Laboratory at TA-3

The principal capabilities and activities conducted at the Materials Science Laboratory include:

- Materials processing to support formulation of a wide range of useful materials through the development of materials fabrication and chemical processing technologies;
- Mechanical testing in laboratories where materials are subjected to a broad range of mechanical loadings study their fundamental properties and characterize their performance;
- Development of advanced materials for high-strength and high-temperature applications; and
- Characterization of materials utilizing x-ray, optical metallography, spectroscopy, and surface science chemistry to understand the properties and processing of these materials and to apply that understanding to materials development.

Materials Science Laboratory Performance and Changes Since the *1999 SWEIS*

The *1999 SWEIS* projected completion of the top floor of the Materials Science Laboratory. This project remains unscheduled and unfunded. Construction of the Material Science and Technology Office Building in the southeast quadrant of TA-3 was initiated in 2003 and completed in 2004. This new building provides materials science and technology staff with permanent offices in place of a cluster of temporary trailers and transportable structures.

The principal capabilities listed above have been maintained at the levels projected in the *1999 SWEIS* or, in some cases, the processes have been improved. Radiological air emissions from this Key Facility have been sufficiently small, so measurements of radionuclides have not been necessary to meet facility or regulatory requirements. The facility has no NPDES-permitted outfalls. All generated wastes have been maintained below levels identified in the *1999 SWEIS*, except during 2000, when chemical wastes exceeded projections by approximately 620 pounds (280 kilograms) due to the generation of industrial solid waste by routine maintenance activities.

2.4.5 High Explosives Processing (Technical Areas 8, 9, 11, 16, 22, and 37)

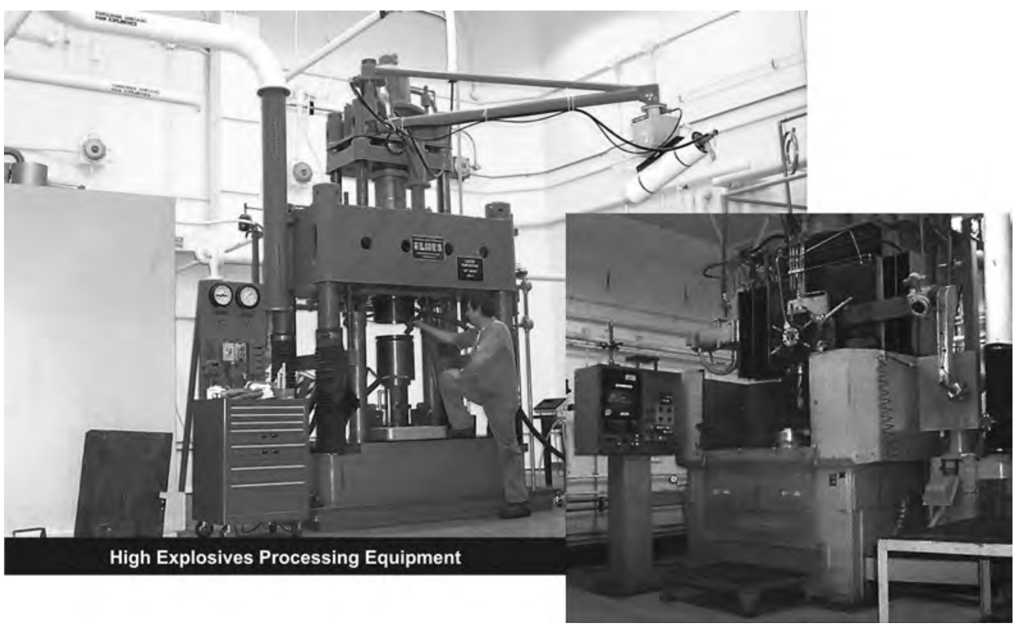
The High Explosives Research and Development and Processing Facilities are located in six TAs: TA-8, TA-9, TA-11, TA-16, TA-22, and TA-37. Most of these facilities were originally designed and built for production-scale operations during the early and mid-1950s and produced high explosives components for nuclear weapons in the U.S. stockpile reserve for several years. LANL has historically upgraded and modernized processing equipment in these facilities to provide prototype high explosives components to meet the needs of the Nevada Test Site Program, hydrodynamic tests at LANL, detonator design and production, and other high explosives activities.

Over the last few years, an average of 1,000 to 1,500 high explosives parts per year has been typically fabricated at LANL. Building types within this Key Facility consist of production and assembly facilities, analytical laboratories, explosives storage magazines, and a facility for treatment of explosive-contaminated wastewaters. At the time of the *1999 SWEIS*, this Key

Facility had one Hazard Category 2 nuclear building (the Radiography Facility) at TA-8. This building was downgraded to a radiological facility in 2005.

The primary capabilities and activities conducted at these facilities include:

- High explosives synthesis and production activities including explosive-manufacturing capabilities such as synthesizing new explosives and manufacturing pilot-plant quantities of raw explosives and plastic-bonded explosives;
- High explosives and plastics development and characterization for any explosives used in nuclear weapons technology;
- High explosives and plastics fabrication where high explosives powders are typically compacted into solid pieces and machined to final specified shapes;
- Assembly of test devices ranging from full-scale nuclear explosive-like assemblies (where fissile material has been replaced by inert material) to material characterization tests;
- Safety and mechanical testing of explosives samples, including tensile, compression, and creep properties; and
- Research, development, and fabrication of high-power detonators including detonator design; printed circuit manufacture; metal deposition and joining, plastic materials technology; explosives loading, initiation, and diagnostics; lasers; and safety of explosives systems design development and manufacturing activities.



High Explosives Processing Equipment

High Explosives Processing Facility Performance and Changes Since the *1999 SWEIS*

Although not projected in the *1999 SWEIS*, a real-time radiography capability was added to this Key Facility and became operational in 2001. Buildings 16-220, 16-222, 16-223, 16-224, 16-225, and 16-226 were vacated and demolished. Planning and modification work at TA-9 to consolidate high explosives formulation operations previously conducted at Building-16-340 continued. Explosives stored at TA-28 were moved to TA-37 for storage, and TA-28 is no longer used by the High Explosives Processing Key Facility. The Building-16-1409 incinerator associated with the burn operations of high explosives-contaminated combustible trash underwent Resource Conservation and Recovery Act (RCRA) clean-closure and was dismantled and scrapped. RCRA closure has also been obtained for TA-16-401 and TA-16-406, which are units at the TA-16 Burn Ground. Closure of MDA P, which began in 1997, was completed in 2002. An estimated total of about 20,800 cubic yards (15,900 cubic meters) of hazardous waste and 21,300 cubic yards (16,300 cubic meters) of other waste were excavated and shipped to a disposal facility. A total of 6,600 cubic yards (5,000 cubic meters) of material were shipped and used as clean fill at MDA J. The aboveground wastewater storage tank system was placed into service at TA-9 in 1998. The new High Explosives Wastewater Treatment Facility at TA-16 is a centralized treatment plant that became operational in 1997 and discharges approximately 35,000 gallons (132,000 liters) per year of treated effluent at an NPDES-permitted outfall. RCRA closure activities continued for the TA-16-387 flash pad and the TA-16-394 burn tray, resulting in removal of a total of about 860 cubic yards (660 cubic meters) of hazardous wastes. A burn unit was upgraded to improve capacity and efficiency and minimize environmental impacts. In 2000, the Cerro Grande Fire swept across TA-16, burning V-Site (an inoperable historic Manhattan Project era site), but all other buildings were placed into a safe closed condition, and fire personnel bulldozed a fire line around the Weapons Engineering Tritium Facility. No other High Explosives Processing facilities were destroyed, although some structures were damaged at TA-9, TA-11, and TA-37. All high explosives burning operations were consolidated at TA-16-388 and TA-16-399. Burning operations generally are limited to TA-16-388, although TA-16-399 is still available for burning of bulk high explosives.

In 2004, construction began on a new office building at the Hydrotest Design Facility, Building 22-120. Staff occupied the building in March 2005. In 2005, construction was completed on the new High-Power Detonator Production Facility, Building 22-115, and magazine 22-118. Use of the structures began in December 2005.

The principal activities at this Key Facility as described above were performed at levels equal to or less than those projected in the *1999 SWEIS*. No stacks have required monitoring for radiological air emissions. All non-point sources are measured using ambient monitoring. These facilities currently use 3 NPDES-permitted outfalls, compared to the 11 outfalls projected in the *1999 SWEIS*. Annual NPDES discharge rates since 1999 have remained below the levels projected in the *1999 SWEIS*. The quality of the NPDES effluent exceeded permit levels one time in March 2001 (LANL 2002d). Chemical wastes consistently exceeded *1999 SWEIS* projections for various reasons. Activities that caused these exceedances, some of which were covered by separate NEPA review, included: placement in storage of scrap metal for recycle due to the DOE radiological area release moratorium; cleanup of MDA R Legacy Material Action Project activities; and demolition and waste disposition of Buildings TA-16-220, -222, -223, -224, -225, and -226. Transuranic and mixed low-level radioactive waste generation has remained below the levels identified in the *1999 SWEIS*. Low-level radioactive waste quantities exceeded *1999 SWEIS* projections in 2003 by 12 cubic meters.

2.4.6 High Explosives Testing (Technical Areas 14, 15, 36, 39, and 40)

The High Explosives Testing Key Facility, located in five TAs (TA-14, TA-15, TA-36, TA-39, and TA-40), comprises more than one-half (22 of 40 square miles [14,080 of 25,600 acres (5,698 of 10,360 hectares)]) of the land area occupied by LANL and has 16 associated firing sites. The firing sites are in remote locations and canyons and specialize in experimental studies of the dynamic properties of materials under high-pressure and -temperature conditions. The facilities that make up the explosives testing operations are used primarily for research, development, test operations, and detonator development and testing related to the DOE Stockpile Stewardship Program. Major High Explosives Testing buildings are located at TA-15 and include the Dual Axis Radiographic Hydrodynamic Test Facility (TA-15-312) and the TA-15-306 firing site. Building types consist of preparation and assembly facilities, bunkers, analytical laboratories, high explosives storage magazines, and offices.


Typical Nonnuclear High Explosive Test

The major capabilities and categories of high explosives testing activities include:

- Hydrodynamic tests consisting of 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;
- Dynamic experiments to provide information regarding the basic physics of materials or to characterize the physical changes or motion of materials under the influence of high explosives detonations;
- Explosives research and testing activities conducted primarily to study the properties of the explosives themselves compared to explosive effects on other materials;
- Munitions experiment testing conducted to study the influence of external stimuli on explosives;
- High explosives pulsed-power experiment testing conducted to develop and study new concepts based on the use of explosively-driven electromagnetic power systems;

- Calibration, development, and maintenance testing conducted primarily to prepare for more elaborate tests, including tests to develop, evaluate, and calibrate diagnostic instrumentation or other systems; and
- Other explosives testing activities such as development of advanced high explosives and work to improve weapons evaluation techniques.

High Explosives Testing Facility Performance and Changes Since the *1999 SWEIS*

As projected in the *1999 SWEIS*, the Dual Axis Radiographic Hydrodynamic Test Facility was constructed. The first axis became operational in 2001 and the second axis was tested in late 2004. In 2005, failing accelerator cells at the Dual Axis Radiographic Hydrodynamic Test Facility Axis II were refurbished to bring them up to design specifications. Construction was also initiated on a concrete ramp and an access door into the Dual Axis Radiographic Hydrodynamic Test Facility Axis II; this access door will facilitate accelerator cell and equipment maintenance within the axis. As required by the *Dual Axis Radiographic Hydrodynamic Test Facility Final Environmental Impact Statement* (DOE 1995a), the Pulsed High Energy Radiation Machine Emitting X-Rays Facility (TA-15-184) was deactivated in March 2004. Although not projected, the Applied Research Optics Electronics Laboratory and adjacent parking lot were constructed. The outfall at TA-36 was eliminated from the NPDES permit.[7] Closeout of outfall 03A-028 located at the Pulsed High Energy Radiographic Machine Emitting X-rays Facility (Building 15-184) was initiated in 2005. Temporary closeout of aboveground storage tanks located at Buildings 15-306, 15-310, and 36-86 was initiated in 2005. These tanks (15-324, 15-325, 15-473, 15-474, 36-141, 36-142) previously contained dielectric mineral oil in support of radiographic experiments. Several structures within the High Explosives Testing Key Facilities were decommissioned and removed during 2005. These structures include TA-15-8, TA-15-46, TA-15-138, TA-15-141, TA-40-4, TA-40-19, and TA-40-43. Construction was also completed on the High Explosives Preparation Facility, the Camera Room at TA-36-12, the carpenter shop at TA-15, the X-Ray Calibration Facility at TA-15, and a warehouse at TA-15.

The 2000 Cerro Grande Fire destroyed or damaged equipment, materials, and storage structures within this Key Facility. Damaged buildings were subsequently decontaminated and demolished. As approximately 14 facilities were destroyed and approximately 28 additional facilities were damaged, the Cerro Grande Fire has had a long-term effect on the High Explosives Testing operations. Management has limited high explosives testing at TA-40 to tests that are contained because of adjacent steep canyon walls and excess forest fuels. All burned structures have been replaced.

As stated above, the principal activities have operated below the levels projected in the *1999 SWEIS*. During 2005, foam was used to reduce particulate emissions during dynamic experiments. Aqueous foam was used on explosive tests that included beryllium. Use of the foam continues for certain tests, but plans are to move these tests into containments.

[7] *This outfall was originally accounted for with the non-Key Facilities.*

No stacks require monitoring for radiological air emissions at this Key Facility; all non-point sources are measured using ambient monitoring. Chemical usage has been below that projected in the *1999 SWEIS*. This Key Facility has two functional NPDES-permitted outfalls, compared to 14 discussed in the *1999 SWEIS*. Total NPDES discharge volumes for these two outfalls were within *1999 SWEIS* projections for 2002 through 2005 and exceeded projected levels for 3 years (1999 through 2001). It should be noted that, prior to 2002, discharge rates were estimated and may have resulted in an overestimate of volume. A water meter was installed in 2002 to provide more accurate flow data. The quality of effluent from the Dual Axis Radiographic Hydrodynamic Test Facility exceeded NPDES permit levels one time during the period of interest in September 2001; changes were implemented and the effluent met requirements by the next sampling period (LANL 2002d). Chemical wastes produced were below *1999 SWEIS* projections, except in 2000, when chemical wastes exceeded projections due to cleanup performed following the Cerro Grande Fire. Construction and demolition debris accounted for an estimated 20,600 pounds (9,360 kilograms) of nonhazardous chemical waste that was disposed of in sanitary landfills. The remaining chemical waste was shipped offsite to approved hazardous waste facilities for treatment and disposal. Production of transuranic, low-level radioactive, and mixed low-level radioactive wastes was below the levels identified in the *1999 SWEIS* for years 1999 through 2005, with the exception of 2004, when mixed low-level radioactive wastes exceeded projections by approximately 18 cubic meters (640 cubic feet). The excess mixed low-level radioactive waste consisted mostly of lead bricks and plates used for shielding; the lead was contaminated with beryllium and depleted uranium. This was the result of an effort across the High Explosive Testing TAs to remove unwanted lead from the site.

2.4.7 Tritium Facilities (Technical Area 16 and Technical Area 21)

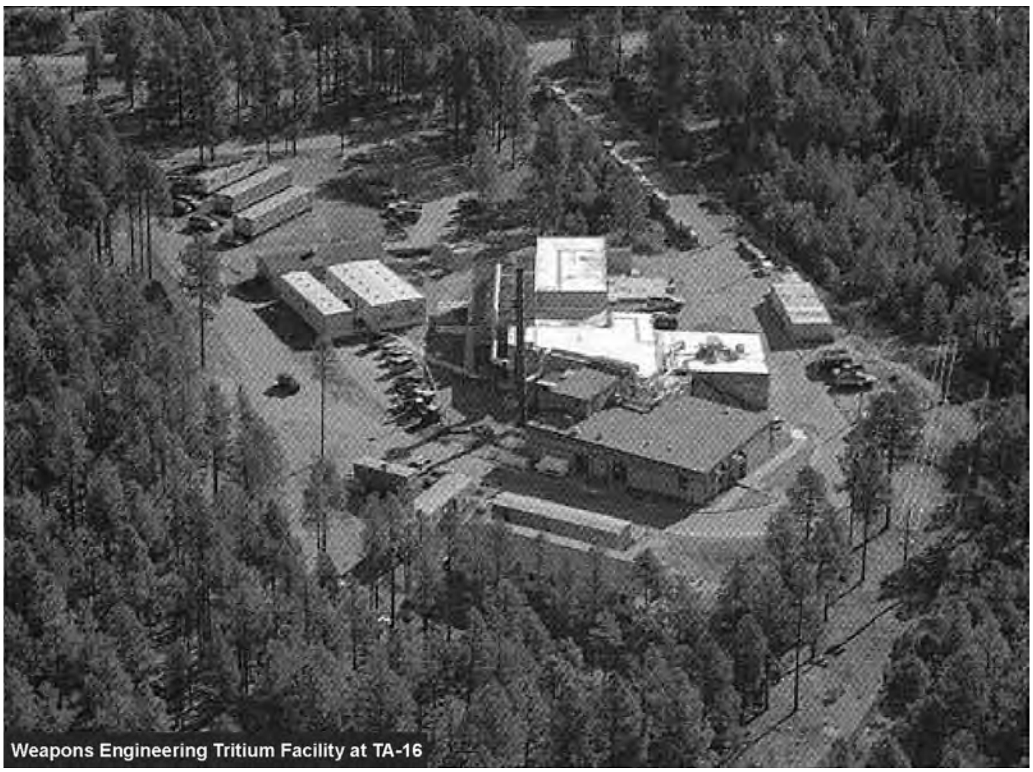
This Key Facility consists of tritium operations performed within TA-16 and TA-21. Tritium operations were conducted in three buildings over the past 7 years: the Weapons Engineering Tritium Facility (Building 16-205), the Tritium Science and Fabrication Facility (Building 21-209), and the Tritium Systems Test Assembly (Building 21-155N). These facilities support several tritium-related programs at LANL and play an important role in DOE energy research and nuclear weapons programs. The primary potential environmental impacts from tritium operations at LANL reside with these facilities.

The Weapons Engineering Tritium Facility at TA-16 is a Hazard Category 2 nuclear facility. It is a single-level structure with approximately 7,890 square feet (730 square meters) of floor area.

The Tritium Science and Fabrication Facility is a tritium research and development facility located in Building 21-209 at TA-21. This facility is located east of the Tritium Systems Test Assembly Facility at the DP East research area. During 2004, the tritium inventory at the Tritium Science and Fabrication Facility was reduced to less than 0.07 pounds (30 grams). This facility was then reclassified from a Hazard Category 2 to a Hazard Category 3 facility in August 2004. Programmatic activities at the Tritium Science and Fabrication Facility were reduced and moved to the Weapons Engineering Tritium Facility in 2005. The transition of the Tritium Science and Fabrication Facility to a radiological facility was completed in 2005. Neutron tube target loading activities at the Tritium Science and Fabrication Facility ended in March 2006 and the facility was placed in a surveillance and maintenance mode. NNSA prepared the *Environmental Assessment for the Proposed Consolidation of Neutron Generator Tritium Target Loading*

Production (DOE 2005b); this project relocated the neutron tube target loading operations from the Tritium Science and Fabrication Facility to Sandia National Laboratories in Albuquerque, New Mexico.

The Tritium Systems Test Assembly Facility includes the main experimental tritium area (3,700 square feet [344 square meters]) and two small laboratories. The facility is located at the DP East research area. During 2003, the tritium inventory at the Tritium Systems Test Assembly was reduced; as a result, the facility was reclassified to a radiological facility. In August 2003, the Tritium Systems Test Assembly was formally designated for surveillance and maintenance and limited equipment removal, as part of its decontamination, decommissioning, and ultimate demolition process.



Weapons Engineering Tritium Facility at TA-16

The principal capabilities and activities conducted at the Weapons Engineering Tritium Facility, the Tritium Systems Test Assembly, and the Tritium Science and Fabrication Facility included:

- High-pressure gas fills and processing operations for research and development and nuclear weapon systems;
- Function testing for highly specialized gas boost systems used in nuclear weapons and experimental equipment;
- Separation and purification of tritium from gaseous mixtures using diffusion and membrane purification techniques;
- Tritium-handling capabilities to accommodate a wide variety of metallurgical and material research activities;

- Gas analysis using spectrometry and other techniques such as beta scintillation counting to measure the composition and quantities of gas samples;
- Calorimetry used for measuring the amount of tritium in a container; and
- Storage of tritium gas and tritium oxide.

Tritium Facilities Performance and Changes Since the *1999 SWEIS*

Modifications at the Tritium Key Facility since 1999 have included remodeling and upgrading facility structures, as well as constructing a new office building. During 2005, there were major construction activities and building modifications at the Weapons Engineering Tritium Facility at TA-16, including addition of a new diesel generator and an upgraded uninterruptible power supply unit. Inclusion of Building 16-450 in the Weapons Engineering Tritium Facility nuclear boundary was postponed because of the LANL operations standdown and it has yet to be included. In addition, NNSA halted implementation of neutron tube target loading activities at the Weapons Engineering Tritium Facility and transferred these activities and associated programmatic hardware to Sandia National Laboratories in Albuquerque in 2005.

Between 1999 and 2005,[8] no new capabilities were added to the Tritium Key Facility, and one capability, cryogenic separation, was lost due to discontinuation of its operation in the Tritium Systems Test Assembly Facility where it was located. Among the continuing capabilities, operation levels have consistently been below the levels projected in the *1999 SWEIS* and have remained within the established environmental envelope. For example, in 2005, 22 high-pressure gas fill operations were conducted, compared to 65 fills projected by the *1999 SWEIS* ROD, and approximately 11 gas boost system tests and gas processing operations were performed, compared to 35 projected (LANL 2005f).

The following summaries of operations data over the period 1999 through 2005 illustrate how activity levels are affecting the surrounding environment. All three buildings are served by ventilation systems that exhaust to stacks. Between 1999 and 2005, tritium air emissions were below the *1999 SWEIS* projections, with two exceptions: a one-time release of elemental tritium in January 2001 at the Weapons Engineering Tritium Facility and an exceedance of tritium in water vapor released from the Tritium Systems Test Assembly during 2002, 2003, 2004, and 2005 (due to deactivation activities). This Key Facility has two NPDES-permitted outfalls, as projected in the *1999 SWEIS*.[9] Annual NPDES discharge rates exceeded *1999 SWEIS* projections 5 out of 7 years. The quality of the TA-21 effluent exceeded NPDES permit levels twice in 1999 (LANL 2000e). Chemical waste volumes exceeded *1999 SWEIS* projections in 2001 and 2002 due to refrigerant replacement at Building 16-450. Low-level radioactive waste, mixed low-level radioactive waste, and transuranic waste volumes were all below the projected amounts.

---

[8] The discussion of operations since 1999 includes operations at the TA-21 facilities, the Tritium Systems Test Assembly and Tritium Science and Fabrication Facility, as well as the TA-16 Weapons Engineering Tritium Facility operations.
[9] Although these outfalls were ascribed to the Tritium Key Facility in the 1999 SWEIS, the majority of the effluent comes from the TA-21 Steam Plant. For the sake of consistency, these outfalls continue to be accounted for with the Tritium Key Facility in this SWEIS.

2.4.8 Pajarito Site (Technical Area 18)

The Pajarito Site is located entirely at TA-18. As described in the *1999 SWEIS*, this Key Facility includes the Los Alamos Critical Experiments Facility and other experimental facilities, and consists of a main building, three outlying remote-controlled critical assembly buildings known as the Critical Assembly and Storage Area, and several smaller support buildings including a vault facility called the Hillside Vault. These facilities are 3 miles (4.8 kilometers) from the nearest residential area, White Rock, and 0.25 miles (400 meters) from the closest TA. The Pajarito Site is located in a canyon at the confluence of Pajarito Canyon and Threemile Canyon. The surrounding canyon walls rise approximately 200 feet (61 meters) on three sides of the site. DOE lists this entire Key Facility as a Hazard Category 2 nuclear facility and identifies seven buildings with nuclear hazard categorizations.


The Pajarito Site (TA-18)

This Key Facility studies both the static and dynamic behavior of multiplying assemblies of nuclear materials. In addition, the Pajarito Site provides the capability to perform hands-on training and experiments with special nuclear material in various configurations below critical mass.

The principal capabilities of and activities conducted at the Pajarito Site since 1999 include:

- Use of critical assemblies to evaluate the performance of personnel radiation dosimeters;
- Development of nuclear materials detection and monitoring instruments;
- Characterization and evaluation of materials, primarily by measuring the nuclear properties of these materials;
- Subcritical measurements performed on arrays of fissile materials that are below critical mass for material in a given form;
- Experiments using bare and reflected metal critical assemblies that operate on a fast-neutron spectrum;

- Dynamic measurements conducted with two fast-pulsed assemblies that produce controlled, reproducible pulses of neutron and gamma radiation from tens of microseconds to several tens of milliseconds in duration;
- Use of critical assemblies to study "skyshine" (radiation transported point-to-point without a direct line of sight) and to produce radiation fields to mimic those found around nuclear weapons production and dismantlement facilities, in storage areas, and in experimental areas;
- Use of fast-pulsed assemblies that have the capability to vaporize fissile materials used to test materials, measure the properties of fissile materials, and test reactor fuel materials in simulated accident conditions;
- Use of critical assemblies that have varying spectral characteristics in both steady-state and pulsed modes to irradiate fissile materials and other materials with energetic responses for the purposes of testing and verifying computer code calculations; and
- Storage of Security Category III quantities of special nuclear material in the form of sealed sources recovered by the Off-Site Source Recovery Project.

Pajarito Site Performance and Changes Since the *1999 SWEIS*

Since the publication of the *1999 SWEIS*, two office trailers (TA-18-300 and -301) were installed at the Pajarito Site, security enhancements were made, and a cable tray was relocated within this site. The *1999 SWEIS* ROD projected replacement of the portable linear accelerator; this has not been performed. Construction projects in 2005 consisted of security and safety enhancements. In 2002, NNSA prepared the *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory* (DOE 2002i). In the associated ROD (67 FR 79906), NNSA decided to relocate Security Category I and II capabilities and materials to the Device Assembly Facility at the Nevada Test Site, in effect initiating the closure of TA-18. Security Category I and II special nuclear materials were moved from this area to the Plutonium Facility Complex at TA-55 pending transfer to the Nevada Test Site. (Currently only Security Category IV material remains at TA-18). Implementation of the ROD was initiated in 2004 (for further information see Appendix H, Section H.1). The *1999 SWEIS* identified nine capabilities for this Key Facility, all of which are still operating. The Nuclear Measurements School, which had moved to the Chemistry and Metallurgy Research Building from the Pajarito Site before the *1999 SWEIS*, moved back to the Pajarito Site in 2000. The International Atomic Energy Agency Classroom returned to the Chemistry and Metallurgy Research Building in 2004, but the rest of the school remains at TA-18.

The Cerro Grande Fire damaged no facilities at TA-18; however, the fire destroyed much of the vegetation in and around the Pajarito Site. As TA-18 is located in a canyon bottom, postfire flooding became a major concern. A flood contingency plan and flood control structures were designed to protect personnel, infrastructure, and nuclear materials. Some portable structures, such as metal sheds used to store radioactive sources, were moved to higher ground.

The principal capabilities of this facility, as listed above, have operated below the levels projected in the *1999 SWEIS*, in part due to a safety stand-down in late 1998 to 1999 and operational downtime from August 2000 to February 2003. There have been no measurable radiological air emissions from the Pajarito Site since 1999. The facility has no NPDES-permitted outfalls. All wastes produced were below levels identified in the *1999 SWEIS*, except during 2000, when approximately 280 cubic feet (8 cubic meters) of mixed low-level radioactive waste were generated as a result of maintenance activities.

2.4.9 Target Fabrication Facility (Technical Area 35)

The Target Fabrication Facility, located at TA-35, comprises three buildings (35-213, 35-455, and 35-458). The main building is a two-story structure encompassing approximately 61,000 square feet (5,670 square meters) of floor space housing activities related to weapons production and laser fusion research. The Target Fabrication Facility is located immediately to the east of TA-55 and directly north of TA-50. This Key Facility is categorized as a low hazard nonnuclear facility. Exhaust air from process equipment is filtered prior to exhaust to the atmosphere. Sanitary waste is piped to the sanitary waste disposal plant located in TA-46. Radioactive liquid waste and liquid chemical waste are transported to the TA-50 Radioactive Liquid Waste Treatment Facility using a direct pipeline.

Inspection of target component (TA-35)

The principal capabilities and activities conducted at the Target Fabrication Facility include:

- Precision machining and target fabrication operations to produce sophisticated devices consisting of highly accurate part shapes and often optical-quality surface finishes;

- Polymer synthesis to formulate new polymers, study their structure and properties, and fabricate them into various devices and components;

- Chemical vapor deposition and chemical vapor infiltration to produce metallic and ceramic bulk coatings, various forms of carbon (including pyrolytic graphite, amorphous carbon, and diamond), nanocrystalline films, powder coatings, thin films, and a variety of shapes up to 3.5 inches (9 centimeters) in diameter and 0.5 inches (1.25 centimeters) in thickness; and
- Characterization of materials.

Target Fabrication Facility Performance and Changes Since the *1999 SWEIS*

No major additions or modifications have occurred at the Target Fabrication Facility since issuance of the *1999 SWEIS* ROD. The principal activities, as listed above, operated at or below the levels projected in the *1999 SWEIS*, including the precision machining and target fabrication, the polymer synthesis, and the chemical and physical vapor deposition capabilities. Material characterization for tritium reservoirs operated for 2 years.

Programs at the Target Fabrication Facility (TA-35) suffered substantial downtime and loss of productivity during and after the Cerro Grande Fire. No direct fire damage occurred; however, some equipment was damaged because of fluctuating power and loss of liquid nitrogen cooling. Additionally, smoke damage to work areas and air-handling systems was sufficient to prevent use of the Target Assembly Area.

The Target Fabrication Facility has no NPDES-permitted outfalls. Radiological air emissions since 1999 were below the levels projected in the *1999 SWEIS* or were sufficiently small that measurement systems were not deemed necessary to meet regulatory or facility requirements. Waste volumes were within the amounts projected in the *1999 SWEIS*, except chemical wastes, which exceeded projections in 2005 due to disposal of beryllium-contaminated waste from disposal of excess equipment from Rocky Flats, decommissioning of beryllium operations in Room A7, and removal and replacement of a beryllium-contaminated machine from the machine shop.

2.4.10 Bioscience Facilities (Technical Areas 43, 3, 16, 35, 46) (formerly called the Health Research Laboratory [Technical Area 43])

Since publication of the *1999 SWEIS*, the definition of this Key Facility has expanded to include a broader picture of bioscience research taking place across LANL. Some of the capabilities that were attributed to the Health Research Laboratory in the *1999 SWEIS* have become more visible as research and development in particular areas have increased, and some have become less visible as research and development in other areas have declined. These changes, which reflect the dynamic nature of a research laboratory, required an expanded definition of this Key Facility.

The Bioscience Facilities currently include the main Health Research Laboratory (TA-43), as well as additional offices and laboratories located at TA-3, TA-16, TA-35, and TA-46. The impacts of Bioscience Facilities activities at TA-3-1698, the Materials Science Laboratory, are accounted together with the potential impacts of that Key Facility and are not double-counted here. Operations at TA-35, TA-43, and TA-46 have chemical, laser, and limited radiological activities that maintain hazardous materials inventories and generate hazardous chemical wastes and very small amounts of low-level radioactive waste.

There are four biosafety levels consisting of protocols for laboratory practices, techniques, safety equipment, and laboratory facilities. Biosafety Level 1 and Biosafety Level 2 activities and laboratories are currently in operation at LANL and are covered by this SWEIS (these levels are defined in Appendix C, Section C.3). Work conducted in these areas is governed by safety and security requirements for biological agents as outlined in the document entitled, "Biosafety in Microbiological and Biomedical Laboratories," published by the Center for Disease Control, including biohazardous materials listed for each respective biosafety level (HHS 2007).

Operations at this Key Facility have evolved a great deal since 1999. At that time, the principal capabilities and activities were:

Health Research Laboratory (lower left) Adjacent to the Los Alamos Medical Center

- Research to characterize the extent of diversity in environmental microbes and to understand their functions and occurrences in the environment;
- Research using molecular and biochemical techniques to determine and analyze the sequence of genomes;
- Research using imaging and spectroscopy systems to analyze the structures and functions of subcellular systems and components;
- Research investigating the effects of natural and catastrophic cellular events like response to aging, harmful chemical and physical agents, and cancer;
- Capability to generate biometric organic materials and construct synthetic biomolecules;
- Research isolating and characterizing the properties and three-dimensional shapes of deoxyribonucleic acid (DNA) and protein molecules;
- Performance of whole-body scans as a service to the LANL Personnel Monitoring Program; and
- General biological work performed at Biosafety Levels 1 and 2, which were performed under safety and security requirements for biological materials, including biohazardous material that can be worked at these levels.

Bioscience Facilities Performance and Changes Since the *1999 SWEIS*

As discussed, major additions have been made to the definition of this Key Facility since the *1999 SWEIS*. Today, the principal capabilities and activities conducted at the Bioscience Facilities include:

- Biologically inspired materials research, including studies of how some materials mimic the functions of living systems based upon the relationships found between structure, function, and formation;
- Cell biology projects focused on understanding cellular responses to stress over a range of resolutions from molecular biochemistry to whole-cell studies and proceeding to multicellular and cell-environment interactions;
- Computational biology research focused on developing tools for managing, analyzing, and interpreting biological data and on modeling simple and complex biological systems;
- Environmental microbiology research focused on microbial systems and their environment, including the collection of environmental samples containing microbes, biochemical and genetic analysis of their distribution and functions in ecological systems, and growth and analysis of environmental isolates;
- Genomic studies using molecular and biochemical techniques to analyze the genes of humans, animals, plants, and fungi, as well as genetic material of microbes and viruses including the development of strategies to evaluate the specific sequence of individual genes and gene mapping;
- Bioscience research emphasizing the development and implementation of high-throughput tools and technologies for understanding biology at the systems level;
- Measurement science and diagnostics capabilities including a variety of spectroscopies for analysis of biomolecules and biomolecular complexes, flow cytometry-based analysis of materials, and mass spectrometry for proteomics, metabolomics, and structural biology;
- Molecular synthesis work focused on creating new, isotopically labeled molecules for observation of specific chemical groups and for use as standards in the detection of chemical agents and biological toxins;
- Structural biology using experimental techniques such as x-ray scattering and neutron diffraction, nuclear magnetic resonance, time-resolved vibrational spectroscopies, and state-of-the-art neutron protein crystallography;
- Biothreat reduction and bioforensics analyses, including DNA sequencing, single nucleotide polymorphism, and other molecular approaches to identify pathogen strain signatures for biodefense and national security purposes;
- Pathogenesis research involving genome-scale and computationally enhanced experimental studies to gain a quantitative understanding of various aspects of pathogen life cycles, with a focus on understanding infections in humans, animals, and plants and the epidemiology and life cycle of pathogens in the environment; and

- General biological work performed at Biosafety Levels 1 and 2, including select agent work at Biosafety Level 2 under the Center for Disease Control's "Biosafety in Microbiological and Biomedical Laboratories" guidelines.

The changes in the descriptions of the capabilities ascribed to the Bioscience Facilities have had negligible impacts on wastes and emissions. Most of the principal activities described above remained below *1999 SWEIS* projections and within the established environmental envelope.

Activity levels within the environmental microbiology and genomics capabilities exceeded *1999 SWEIS* projections 1 year out of 7. Research involving DNA exceeded *1999 SWEIS* projections 5 out of 7 years, and research involving protein molecules exceeded projections all 7 years. A number of projects involving work with viruses not specifically anticipated in the *1999 SWEIS* have been approved.

Two changes of note are that bioscience work with radioactive materials is continually decreasing and the animal colony was eliminated in 1999. Although the colony was eliminated, live animals including small animals, amphibians, and insects, are still kept for short periods of time at various locations at LANL, and wild animal handling is performed during environmental surveillance activities in the field and in field trailers.

A Biosafety Level 3 facility was constructed in 2004, but operational occupancy and operation has not occurred (as already stated). NNSA is preparing an EIS to analyze the potential impacts of its operation.

The effects of the Cerro Grande Fire on the Bioscience Facilities and operations included the loss of portable offices containing computers, intellectual property, and data at TA-46. Smoke damage occurred in several buildings at TA-43 and TA-46, requiring cleaning or replacement of an air-handling system and many replacement air filters, as well as replacement of laser optics (TA-46 and TA-3-1698).

Radiological air emissions are not measured for this Key Facility. The Bioscience Facilities currently have no NPDES-permitted outfalls. One outfall was projected in the *1999 SWEIS*, but was removed from service in 1999; no flow was discharged from the outfall during that year. Chemical and radioactive wastes generated were below the volumes projected in the *1999 SWEIS*.

2.4.11 Radiochemistry Facility (Technical Area 48)

The Radiochemistry Key Facility includes all of TA-48 (116 acres [50 hectares]). The facility has three roles: research, production of medical radioisotopes, and support services to other LANL organizations, primarily through radiological and chemical analyses of samples. TA-48 contains five major research buildings: the Radiochemistry Laboratory (48-1), the Assembly Checkout Building (48-17), the Diagnostic Instrumentation and Development Building (48-28), the Clean Chemistry/Mass Spectrometry Building (48-45), and the Weapons Analytical Chemistry Facility (48-107). There is also a Machine and Fabrication Shop (48-8). The Radiochemistry Laboratory (48-1) was downgraded to a radiological facility in 2003.

The principal capabilities and activities conducted at TA-48 include:

Radiochemistry Hot Cell (TA-48)

- Radionuclide transport studies including numerous chemical and geochemical investigations that address concerns about hydrologic flow and transport of radionuclides;
- Environmental remediation capabilities including characterization and remediation of soils contaminated with radionuclides and toxic metals, data analysis, and integrated site-wide assessment;
- Ultra-low-level measurements using isotopic tracers and high-sensitivity measurement technologies to support the nuclear weapons program;
- Development of radiation detectors, conduct of radiochemical separations, and performance of nuclear and radiochemistry for non-weapons-related work;
- Isotope production involving the chemical separation and distribution of isotopes to the medical and industrial communities;
- Actinide and transuranic chemistry using the special safe handling environment provided by the alpha wing of the Radiochemistry Laboratory;
- Reexamination of archive data and measurement of nuclear process parameters of interest;
- Inorganic chemistry work including synthesis, catalysis, and actinide chemistry, as well as the development of environmental technology;
- Synthesis, structural analysis, and x-ray diffraction analysis of actinide complexes in both single-crystal and powder form; and
- Sample counting involving measurement of the quantity of radioactivity present in each sample.

Radiochemistry Facility Performance and Changes Since the *1999 SWEIS*

No facility changes were projected for the Radiochemistry Facility in the *1999 SWEIS*. During 2005, the fire notification system was upgraded under the institutional program. The Building 48-1 roof was replaced in 2007, and heating, ventilation, and air conditioning upgrades are underway. Five structures at TA-48 suffered only minor direct effects from the Cerro Grande Fire; activities in these buildings were not affected. Building 48-45, the Clean Chemistry/Mass Spectrometry Building, however, suffered severe ash, dirt, and soot contamination and its interior was subsequently gutted and replaced.

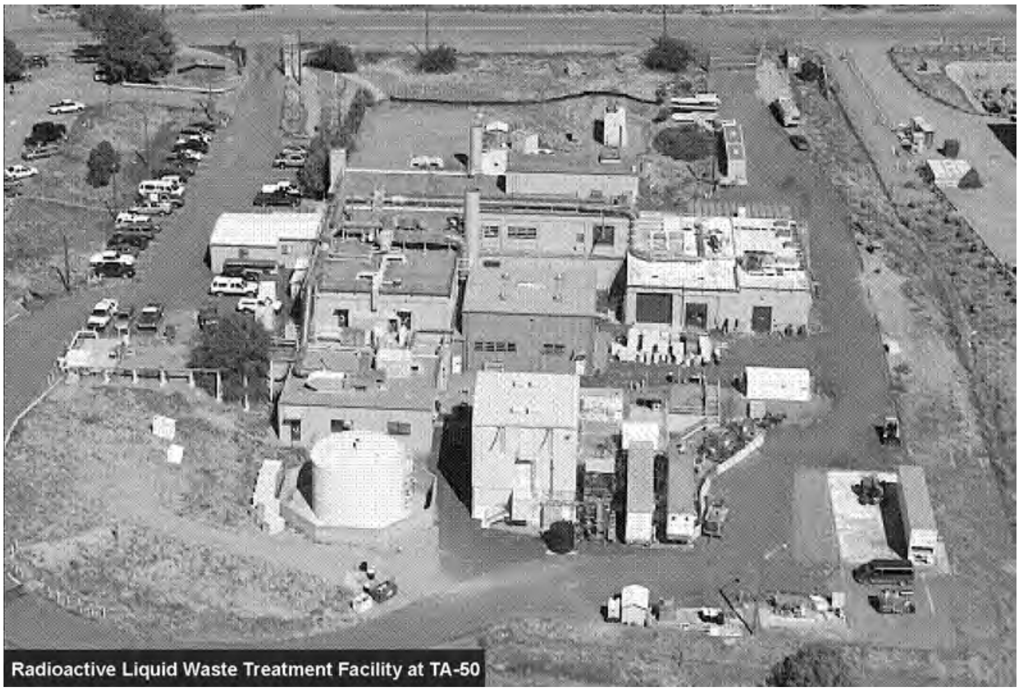
Many of the activities listed above operated at or below the levels projected in the *1999 SWEIS*. In 2005, the environmental remediation capability operations were approximately half the projected level, and the structural analysis capability level of operations was one-third of its projected level. The high-sensitivity measurement technologies level of operations was approximately the same as the level projected in the *1999 SWEIS*. Radiochemical operations levels were slightly lower than projected levels from 1999 to 2002 and substantially decreased in 2003, 2004, and 2005. Both the data analysis and actinide chemistry capabilities operated below the levels of activity projected in the *1999 SWEIS*.

Several other capabilities exceeded the *1999 SWEIS* projections. There was a slight increase in the level of operations for isotope production and sample counting from 1999 through 2005. In addition, radionuclide transport studies increased operations levels to approximately twice the levels projected in the *1999 SWEIS*. Radiochemical operations increased to twice the levels projected in the *1999 SWEIS* until 2002, when there was a substantial decrease in the operations levels.

Radiological air emissions were below *1999 SWEIS* projections for arsenic-72, beryllium-7, bromine-77, plutonium-239, and uranium-235 only. Release of several radionuclides exceeded projections at least 1 year out of 7 (1999 through 2005) including arsenic-73, arsenic-74, gallium-68, germanium-68, rubidium-86, and selenium-75. The nuclides plutonium-238, silicon-32, thorium-230, thorium-232, and uranium-238 were not identified in the *1999 SWEIS*, but were present at least once in the years 1999 through 2005 in microcurie quantities. The Radiochemistry Facility currently has no NPDES-permitted outfalls, although 2 outfalls were projected in the *1999 SWEIS* ROD. No discharges occurred after 1999 from these outfalls prior to their elimination. Chemical wastes from the Radiochemistry Facility exceeded *1999 SWEIS* projections in 2001 through 2004. Excess chemical waste volumes resulted in part from cleanup following the Cerro Grande Fire. Contaminated soil caused by a leaky pipe was subsequently removed from a fire recovery construction project after it was uncovered during excavation of trenches for new utilities. Several chemical clean-outs to dispose of unwanted chemicals were performed at this Key Facility as well. In 2003, transuranic and mixed low-level radioactive waste quantities were small, but exceeded *1999 SWEIS* projections. These wastes were generated by activities supporting the Building-48-1 reclassification from a nuclear facility to a radiological facility.

2.4.12 Radioactive Liquid Waste Treatment Facility (Technical Area 50)

The Radioactive Liquid Waste Treatment Facility is located in TA-50, near the center of LANL. It treats radioactive liquid wastes generated at other LANL facilities and houses analytical laboratories supporting waste treatment operations. This Key Facility consists of four primary structures: the Radioactive Liquid Waste Treatment Facility (50-01), the tank farm and pumping station (50-02), the acid and caustic solution tank farm (50-66), and a 100,000-gallon (380,000-liter) influent holding tank (50-90), as well as a number of ancillary structures. Presently, these four structures are considered one Hazard Category 2 nuclear facility.



Radioactive Liquid Waste Treatment Facility at TA-50

The principal capabilities and activities conducted at the Radioactive Liquid Waste Treatment Facility include:

- Waste characterization and packaging including identification and quantification of constituents of concern in waste streams and packaging and labeling waste according to U.S. Department of Transportation regulations;
- Waste transportation including inspection and cross-checking for acceptance;
- Liquid and solid chemical materials and radioactive waste storage;
- Waste pretreatment;
- Radiological liquid waste treatment using a number of treatment processes, including ultrafiltration and reverse osmosis; and
- Secondary waste treatment.

Radioactive Liquid Waste Treatment Facility Performance and Changes Since the *1999 SWEIS*

The decontamination capability was transferred to the Solid Radioactive and Chemical Waste Key Facility in 2000. Between 1999 and 2005, all liquid waste discharge volumes processed through this Key Facility were less than projected in the *1999 SWEIS* due to ongoing source reduction efforts and internal recycling by waste generators. Most of the process changes at the Radioactive Liquid Waste Treatment Facility have been aimed at further improving the quality of the effluent discharged by the facility. Nitrate reduction equipment was installed at the Radioactive Liquid Waste Treatment Facility in 1998 to improve effluent quality to meet new groundwater standards. In 2001, this equipment was taken out of service; currently, low-volume, high-nitrate liquid wastes are separated "upstream" by the waste generators and shipped to offsite commercial hazardous waste treatment facilities for treatment and disposal. An electrodialysis reversal unit and an evaporator were installed at the Radioactive Liquid Waste Treatment Facility in 1999 and 2000, respectively, to process the waste stream from the reverse osmosis unit. In 2002, a perchlorate removal system (using ion exchange resin columns) was added to the Radioactive Liquid Waste Treatment Facility to further improve the quality of effluent discharged.

The Radioactive Liquid Waste Treatment Facility was one of the very few facilities that operated during the Cerro Grande Fire. Operations were mandatory because radioactive liquid wastes continued to be generated. These flows would be expected from cooling systems and experiments that required cooling during the wildfire. Subsequent to the wildfire, radioactive liquid waste generation continued below typical rates because other LANL facilities required time to resume normal levels of operations.

Other changes that have taken place since issuance of the *1999 SWEIS* ROD largely have been the result of lowered incoming waste volumes, which have enabled changes in certain process steps and rendered others unnecessary. In 2000, the lead decontamination trailer was decommissioned because the quantity of lead needing decontamination had become so small that this operation was no longer cost-effective. In 2001, the transfer line that had carried liquid wastes from the TA-21 tritium facilities to the Radioactive Liquid Waste Treatment Facility was eliminated from service. Because of reduced waste volumes at the TA-21 facility, these materials are now transported by truck. During 2002, the Radioactive Liquid Waste Treatment Facility shop (Building 50-83) was relocated to TA-54 to make room for construction of a new 300,000-gallon (1,140,000-liter) influent storage facility funded by the Cerro Grande Rehabilitation Project. Construction of the new facility began in 2004.

The following radionuclides were not identified in the *1999 SWEIS* as potential radiological air pollutants, but were present in dosimetrically insignificant amounts (microcuries): americium-241, plutonium-238, plutonium-239, strontium-90, thorium-228, thorium-230, thorium-232, uranium-232, uranium-234, uranium-235, and uranium-238. The Radioactive Liquid Waste Treatment Facility has one NPDES-permitted outfall, as projected in the *1999 SWEIS*. Discharge flow rates have been consistently lower than projected in the *1999 SWEIS* and have steadily decreased. In 1999, the Radioactive Liquid Waste Treatment Facility effluent did not meet water quality discharge standards (the effluent exceeded NPDES permit quality standards nine times) and NMED issued a letter of noncompliance to LANL

(LANL 2002d). Since then, Radioactive Liquid Waste Treatment Facility has installed new or upgraded treatment processes to improve effluent quality. With these improvements, 2005 marked the sixth consecutive year that Radioactive Liquid Waste Treatment Facility effluent had zero violations of the NPDES permit limits and zero exceedances of the DOE Derived Concentration Guide for radioactive liquid wastes. Annual average nitrate discharges were reduced from 360 milligrams per liter in 1993 to less than 10 milligrams per liter in 2000 and have remained at that level through 2005. Another important improvement since the *1999 SWEIS* is that tritium-contaminated wastewater that was previously treated at TA-50 is now being treated at the TA-53 Radioactive Liquid Waste Treatment Plant, which has no environmental discharge of effluents. Transuranic waste generation levels have been below *1999 SWEIS* projections. Every year except 2001, the amount of chemical wastes generated at the Radioactive Liquid Waste Treatment Facility has been below projections. In 2001, however, chemical waste exceeded generation projections due to the replacement of storage tanks and some associated plumbing. Secondary wastes generated during the treatment of radioactive liquid waste and wastes resulting from decontamination operations at LANL, caused several waste streams to exceed projections. Solid low-level radioactive waste volumes exceeded generation projections in 1999, 2001, 2002, 2003, 2004, and 2005. In 2005, exceedance of the low-level radioactive waste volume projected in the *1999 SWEIS* resulted from about 75 cubic yards (58 cubic meters) of construction debris and soil generated from the Cerro Grande Rehabilitation Project to install additional influent storage tanks. Also included in the annual solid low-level radioactive waste volumes are the aqueous evaporator bottoms shipped offsite for treatment (about 96 cubic yards [73 cubic meters] in 2005). Solid mixed low-level radioactive waste generation at the Radioactive Liquid Waste Treatment Facility was not projected in the *1999 SWEIS*, but small quantities have been generated every year but one since 1999. More than 95 percent of these mixed wastes resulted from relocation of the lead contamination activities and attendant cleanup of the area; the balance were wastes from the analytical chemistry laboratory. Transuranic waste and mixed transuranic waste volumes have been below projections.

2.4.13 Los Alamos Neutron Science Center (Technical Area 53)

LANSCE lies entirely within TA-53 and comprises more than 400 structures. The majority of LANSCE operations are associated with the 800-million-electron-volt linear accelerator, a proton storage ring, and three major experimental areas: the Manuel Lujan Neutron Scattering Center (the Lujan Center), the Weapons Neutron Research Facility, and Experimental Area C. Experimental Area A, formerly used for materials irradiation experiments and isotope production, is currently inactive. Experimental Area C is the location of proton radiography experiments for the Stockpile Stewardship Program.

This Key Facility has three Hazard Category 3 and no Hazard Category 2 nuclear facilities. In September 2001, the radioactive liquid waste treatment facility and basins in TA-53 (53-945 and 53-954) were added to the LANL radiological facility list (LANL 2002h).

The principal capabilities and activities conducted at LANSCE include:

- Accelerator beam delivery, maintenance, and development of diagnostic instruments;

- Experimental area support including facility and plant operating and engineering services; environment, safety, and health services and oversight; site and building physical security; visitor control; and facility specific training;
- Neutron science and nuclear physics research;
- Accelerator transmutation of wastes experimentation;
- Subatomic physics research including proton radiography experiments;
- Production of medical radioisotopes; and
- High-power microwaves research and advanced accelerator development.

The Los Alamos Neutron Science Center at TA-53

LANSCE Performance and Changes Since the *1999 SWEIS*

The *1999 SWEIS* ROD projected that substantial facility changes and expansion would occur at LANSCE by December 2005. Three projects have been completed, and one has been started:

- The Low-Energy-Demonstration Accelerator became operational. The Low-Energy-Demonstration Accelerator started high-power conditioning of the radio frequency quadruple power supply in November 1998. The first proton beam was produced in March 1999, and maximum power was achieved in September 1999. It was designed for a maximum energy of 12 million electron volts, not the 40 million electron volts projected by the *1999 SWEIS* ROD. The Low-Energy-Demonstration Accelerator was shut down in December 2001 and will remain inactive. The current plan is to remove all support equipment and leave the building and the accelerator itself in place.

- Enhancements were made to the Short-Pulse Spallation Source. The Short-Pulse Spallation Source Project was completed in 2004. This project consisted of two components: Accelerator Enhancement and Spectrometer Enhancement. The Accelerator Enhancement portion completed in June 2003 provided a brighter H^- ion source and upgraded the Proton Storage Ring to handle the higher beam current. The Spectrometer Enhancement Subproject completed in January 2004 provided three new neutron-scattering spectrometers to the Lujan Center and upgraded the capability of one instrument.

- A new 100-megaelectronvolts Isotope Production Facility was constructed. Construction started in 2000 and the facility was completed in 2002. The Isotope Production Facility generated its first beam on December 23, 2003. Full production began in 2005.

- Closure of two sanitary lagoons was initiated. Characterization started in 1999 and continued into 2000. Cleanup at the south lagoon began in 2000 with removal of the sludge and liner. Data analysis and sampling continued through 2001 for both lagoons, and an Interim Action Plan was written for remediation of the north lagoon. Cleanup of the north lagoon was performed in 2002. The lagoons (Solid Waste Management Unit [SWMU] 53-002[a]-99) have been remediated, including complete removal of all contaminated sludge and liners; definition of the nature and extent of residual contamination; and determination that the residual contamination does not pose a potentially unacceptable risk to humans or the environment. Currently, the site is located within an industrial area under LANL (institutional) control and is expected to remain so for the reasonably foreseeable future. For these reasons, neither additional corrective action nor further characterization is warranted at the site. The closure report for the lagoons was reviewed and approved by NMED on July 25, 2006.

Projects that were anticipated to be completed by 2005 in the *1999 SWEIS*, but have not yet been started include the One-megawatt Target/Blanket; the Long-Pulse Spallation Source, including decontamination and renovation of Area A; the Los Alamos International Facility for Transmutation; the Exotic Isotope Production Facility; decontamination and renovation of Area A-East; and the Dynamic Experiment Laboratory. The Stockpile Stewardship Program is currently using Experimental Area C, Building 53-3P, for proton radiography and the Blue Room in Building 53-07 for neutron resonance spectroscopy.

In addition to these projected construction activities, several projects not anticipated in the *1999 SWEIS* have been implemented. A new warehouse was constructed in 1998 to store equipment and other materials formerly stored outside. A new waste treatment facility for radioactive liquids generated at LANSCE and two associated evaporation basins were constructed during 1999. Construction of a new cooling tower was completed in 2000. Construction of this and another cooling tower (structures 53-963 and 53-952) replace cooling towers 53-60, 53-62, and 53-64, which have been taken out of service. The new towers discharge through Outfall 03A-048, as did their predecessors. Construction of two new instruments on Flight Paths 12 and 13 at the Lujan Center started in 2002. The cold neutron Flight Path 12 was commissioned in February 2004, as was most of the NPD-Gamma experiment (NPD is a nuclear reaction in which a neutron impinges on a proton and emits a deuteron plus a gamma ray). The liquid hydrogen target was installed during fall 2005. Basic construction of

Flight Path 13 was completed in 2006. A new experimental facility for production of ultracold neutrons is nearing completion in Experimental Area B.

LANSCE was nearly untouched by the Cerro Grande Fire; a small portion of the roof of one building was damaged. The only impact to operations was evaluating and restoring the status of accelerator systems because site power was lost during the fire. Systems and equipment were returned to power sequentially instead of simultaneously, which required about a month to complete.

The *1999 SWEIS* identified seven capabilities for the LANSCE Key Facility. No new capabilities have been added, and none has been deleted. During 2001, LANSCE operated both accelerators and three of the five experimental areas. Area A has been idle for more than 2 years; Area B has been idle for several years, but as indicated above, a new Ultracold Neutron Facility is under construction (DOE 2002i).

All of the capabilities described above operated at activity levels below those projected in the *1999 SWEIS* or did not operate at all. Support of activities in the experimental areas was conducted as projected in the *1999 SWEIS*, including an increase in power for the LANSCE linear accelerator. Less than 10 percent of the projected number of neutron research experiments was conducted at the Lujan Center. Weapons-related experiments were conducted as well as experiments involving contained high explosives. Research and development was conducted on high-power microwaves and advanced accelerators.

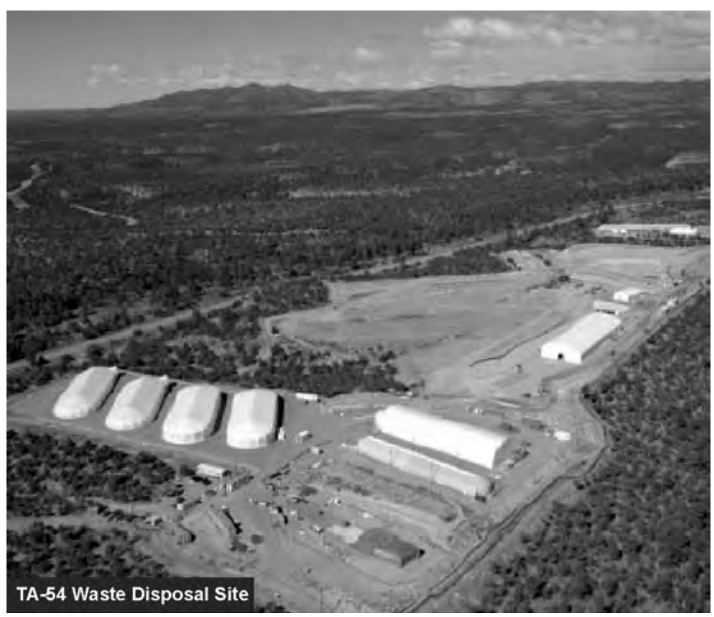
Because of the number of facilities that were not funded and therefore not completed, no accelerator waste transmutation tests were performed; no lead target tests were conducted; and no exotic, neutron-rich, and neutron-deficient isotopes were produced since issuance of the *1999 SWEIS* ROD. Ultra-cold neutron experiments ran only 3 of the 7 years.

The primary indicator of activity for LANSCE is production of the 800-million-electron-volt LANSCE proton beam. Between 1999 and 2005, production figures for the beam were all less than the 6,400 hours at 1,250 microamps projected by the *1999 SWEIS*. In fact, the delivery of an accelerator beam was successful one-third of the time projected in the *1999 SWEIS*. No medical isotopes were produced, except in 2005 when 64 targets for medical isotope production were irradiated, compared to 50 projected by the *1999 SWEIS*.

LANSCE accounts for more than 90 percent of all radioactive air emissions from LANL. These emissions come predominantly (greater than 95 percent) from stack ES–2, which ventilates Building 53-3, the linear accelerator, and adjacent experimental stations. Additional emissions come from stack ES–3, which exhausts the proton storage ring and experimental stations at the Manuel Lujan Center and the Weapons Neutron Research Facility buildings. Both ES–2 and ES–3 are equipped with continuous monitoring equipment. Emissions of activation products from LANSCE were higher in 2005 than in recent years due to the total hours of operation and the failure of one component of the emissions control system. The total point-source emissions were approximately 18,400 curies. As in recent years, the Area A beam stop did not operate during 2005; however, operations in Line D resulted in the majority of emissions reported for 2005. A corrective action implemented in late November 2005 returned emissions rates to their expected levels, and these reduced emissions rates are expected to continue in the future. The following nuclides were not projected as radiological air emissions in the *1999 SWEIS*, but have since been present in measured air emissions or occurred at levels above those projected (see Appendix B for additional information on air emissions): arsenic-72, arsenic-73, beryllium-7, bromine-76, bromine-77, bromine-82, carbon-11, cobalt-60, mercury-193, mercury-193m, mercury-195, mercury-195m, mercury-197, mercury-197m, mercury-203, nitrogen-16, osmium-191, oxygen-14, oxygen-15, selenium-75, sodium-24, sulfur-37, and tritium as water vapor. LANSCE currently has four NPDES-permitted outfalls, compared to five outfalls projected in the *1999 SWEIS*. These outfalls discharge cooling tower blowdown, and discharge rates were consistently below *1999 SWEIS* projections. While operational, the Low-Energy-Demonstration Accelerator (TA-53-952) cooling tower effluent exceeded NPDES permit levels twice in 1999, resulting in a shutdown of operations and an update of procedures (LANL 2000e). LANSCE generates both low-level radioactive liquid wastes and radioactive solid wastes such as beam line components and scrap metals, papers, and plastics. All chemical waste, low-level radioactive waste, mixed low-level radioactive waste, and transuranic waste generation amounts were below the *1999 SWEIS* projections, except for mixed low-level radioactive waste in 2000, which was above the 1999 waste generation projection.

2.4.14 Solid Radioactive and Chemical Waste Facilities (Technical Area 54 and Technical Area 50)

The majority of the structures associated with the Solid Radioactive and Chemical Waste Facilities are located at TA-54. There are over 200 structures within this TA, over 100 of which are dedicated to waste management. This waste management operation captures and tracks data for waste streams regardless of their points of origin and ultimate disposition. A variety of wastes are managed by the Solid Radioactive and Chemical Waste Facilities, including transuranic, low-level radioactive, industrial, toxic, hazardous, and mixtures of these waste types. Transuranic wastes are processed at the Waste Characterization Reduction and Repackaging Facility in TA-50 and transported to TA-54 for storage pending disposal. Most waste handled in TA-54 is of a solid physical state, although there are also small quantities of gaseous or liquid hazardous, toxic, and mixed wastes.


TA-54 Waste Disposal Site

The Hazard Category 2 nuclear facilities at this Key Facility include outdoor operations at the Waste Characterization, Reduction, and Repackaging Facility (50-69); waste storage and disposal facilities in Area G (including low-level waste disposal pits, shafts, and trenches, transuranic waste storage domes, sheds, and storage pads); the Waste Assay Facility (54-2); the Radioassay and Nondestructive Testing Facility (54-38); and the Decontamination and Volume Reduction System (54-412). The

Waste Characterization, Reduction, and Repackaging Facility (50-69) is a Hazard Category 3 nuclear facility.

The principal capabilities and activities conducted at the Solid Radioactive and Chemical Waste Key Facilities include:

- Waste characterization to ensure compliance with waste acceptance criteria for WIPP;
- Solid waste compaction to provide improved package integrity, minimize subsidence at the disposal pit, and conserve disposal space;
- Size reduction to reduce volume and repackage waste;
- Waste transport reception and acceptance, including visual inspection of vehicles and containers, cross-checking of container labels and shipping manifests, and radiation surveys of vehicle and containers;
- Waste storage, including storage of sealed sources for the Off-Site Source Recovery Project;
- Retrieval of transuranic wastes, including repackaging, characterization, and placement in aboveground storage domes;
- Solid low-level radioactive waste disposal in cells and shafts;
- Decontamination of items including personal respirators, air-proportional probes, vehicles, and portable instruments for reuse, as well as precious metals, scrap metals, and lead for resale; and
- Other waste processing such as storage of transuranic sludge (solidified and packaged by the Radioactive Liquid Waste Treatment Facility), stabilization of pyrophoric uranium chips and subsequent storage of the resulting gels, and electrochemical treatment of mixed low-level radioactive waste.

Solid Radioactive and Chemical Waste Facilities Performance and Changes Since the *1999 SWEIS*

Two construction projects were planned for the Solid Radioactive and Chemical Waste Facilities in the *1999 SWEIS*. Additional fabric domes for the storage of transuranic waste were completed in 1998. Execution of the other project, expansion of Area G, has not been completed. Design is underway; construction is scheduled to begin in 2009 with operation expected in 2010. The Radioactive Materials Research Operations and Demonstration Facility was transferred to the Plutonium Key Facility in 2003. A substantial fraction of TA-54's heavy earthmoving equipment was used for the Cerro Grande Fire and was not available for some time. The wildfire also impacted Solid Radioactive and Chemical Waste operations later in the year because fire-related debris was shipped to Area G for storage and disposal.

In 2003, volumes of transuranic waste and mixed transuranic waste processed by the Solid Chemical and Radioactive Waste Facility exceeded *1999 SWEIS* projections. In 2005, volumes of chemical waste, low-level radioactive waste, and mixed transuranic waste exceeded *1999 SWEIS* projections. These waste volumes exceeded projected amounts due to repackaging of legacy transuranic waste for shipment to WIPP. About 95 percent (1,300 drums) of the low-level radioactive wastes were empty drums wrapped in plastic resulting from repackaging of transuranic waste at the Waste Characterization, Reduction, and Repackaging Facility. These drums are typically sent to TA-54, Area G, for compaction and disposal. There are no NPDES-permitted outfalls. No stacks require monitoring for radiological air emissions; all non-point sources are measured using ambient monitoring. Thorium isotopes were identified in 2005 in dosimetrically insignificant quantities.

2.4.15 Plutonium Facility Complex (Technical Area 55)

The Plutonium Facility Complex consists of six primary buildings and a number of support, storage, security, and training structures located throughout the main complex at TA-55. The Plutonium Facility, Building 55-4, is categorized as a Hazard Category 2 nuclear facility, but was built to comply with the seismic standards for Hazard Category 1 buildings. In May 2005, a staging facility, PF-185 (55-185), was upgraded to Hazard Category 2. A third Category 2 nuclear facility, the Safe Secure Transport Facility (55-355), was constructed and became operational in November 2005. In addition, TA-55 includes two low hazard chemical facilities (Buildings 55-3 and 55-5) and one low hazard energy source facility (55-7). The *1999 SWEIS* also identified one potential Hazard Category 2 nuclear facility (the Nuclear Material Storage Facility, Building 55-41), which was slated for potential modification to bring it into operational status. The modifications were not performed, however, and a decision was made in 2006 to demolish the building.


Plutonium Complex at TA-55

The principal capabilities and activities conducted at the Plutonium Facility Complex include:

- Plutonium stabilization, including recovering, processing, and storing the existing inventory;
- Manufacturing plutonium components or other items for research and development or for the nuclear weapons stockpile;

- Surveillance and disassembly of weapons components using both nondestructive and destructive evaluation on pits removed from the stockpile and storage;
- Actinide materials research and development, which involves metallurgical and other characterization of materials and measurements of physical materials properties;
- Development of ceramic-based nuclear reactor fuel fabrication technologies;
- Research on providing a long-term reliable heat source for power systems to support space and terrestrial uses, as well as performing recovery, recycling, and blending of plutonium-238; and
- Storage, shipping, and receiving for the majority of the LANL special nuclear material inventory.

Plutonium Facility Complex Performance and Changes Since the *1999 SWEIS*

Several construction projects and upgrades were planned for the Plutonium Facility Complex and analyzed in the *1999 SWEIS*. A new administrative office building (called the Facility Infrastructure Technical Support Building) and upgrades to certain Plutonium Facility support systems have been completed. Construction of the Fire Safe Storage building (55-314) was completed in October 2004. Another office building, the Manufacturing Technical Support Facility (55-312), was completed in August 2003. As already stated, modifications to the Nuclear Material Storage Facility were halted and a decision was made to demolish the building. Security Category I and II and some Security Category III and IV materials, which are part of the TA-18 Relocation Project, have been relocated to secure facilities at the Plutonium Facility Complex at TA-55 while awaiting transfer to offsite facilities. Procurement and installation of a new uranium decontamination system was initiated in 2004 and was ongoing in 2005. Interim radiography capability also was ongoing in 2005. None of the buildings at TA-55 suffered serious damage from the 2000 Cerro Grande Fire, although the fire encroached on the fenced perimeter intrusion detection and assessment systems area.

The principal activities listed above operated well within the bounds of projections in the *1999 SWEIS*. One change, however, occurred in the plutonium stabilization operation and only the highest priority items have been stabilized. Recovery, processing, and storage of the remaining inventory are now scheduled to be completed by 2013.

All other processes at the Plutonium Facility Complex remained below *1999 SWEIS* projected operating levels. Manufacturing of plutonium components produced no quality-certified pits until 2003; production of fewer than 20 quality-certified pits each year has occurred since 2004. In addition, the surveillance and disassembly of weapons components operated below the projected number of pits. Plutonium-238 research has processed, evaluated, and tested below the 55 pounds (25 kilograms) of material per year projected in the *1999 SWEIS*. Because the Nuclear Material Storage Facility has not been available as a storage vault, NNSA has continued to store working inventory in the TA-55-4 vault. The number of items in the vault has remained relatively constant at levels identified in the *1999 SWEIS*.

Since 1999, the actinide research and development capability processed less than the 881 pounds (400 kilograms) per year projected in the *1999 SWEIS*, and the number of pits that were disassembled or converted also was below the projected amount. Research supporting actinide cleanup activities continued at low levels, and no plutonium residues originating from Rocky Flats were processed. Minimal study of nuclear fuels used in terrestrial and radioisotope power systems has occurred since 1999. In 2002, the Plutonium Facility Complex again began purifying and encapsulating plutonium fuels for this capability.

Radiological air emissions from this Key Facility were below *1999 SWEIS* projections in the years up to and including 2005, except for releases of elemental tritium that exceeded projections in 2002 and 2003 and the presence of actinides (isotopes of thorium and uranium) that were not projected in the *1999 SWEIS* in 2005. The facility has one NPDES-permitted outfall, which is consistent with the *1999 SWEIS* projections, and the NPDES discharge rate has been consistently below projected amounts. The quality of effluent exceeded NPDES permit levels only once in 2003 before being corrected (LANL 2004d). Transuranic, low-level radioactive, and mixed low-level radioactive wastes were all below the *1999 SWEIS* projections. Chemical wastes, however, exceeded projections in 2001 (generated by replacement of the hydraulic cylinders at the facility); in 2002 (generated by cleanup of soil contaminated with spilled transformer oil); and in 2003 (generated by cleanup of soil contaminated with diesel fuel).

2.4.16 Non-Key Facilities

The balance and majority of LANL buildings are referred to in the *1999 SWEIS* as non-Key Facilities. Non-Key Facilities house operations that are unlikely to cause significant environmental impacts. These buildings and structures are located in 30 of the 48 TAs over approximately 14,200 acres (5,750 hectares) of LANL's 25,600 acres (10,360 hectares) of land.

Some of the LANL non-Key Facilities are designated as radiological or moderate hazard facilities, but do not meet the criteria for Key Facilities. Some are currently operating, but several are designated as nonoperable surplus and are awaiting DD&D following removal of special nuclear material and other hazardous materials. At the present time, other than MDAs, there are no Hazard Category 2 or 3 nuclear facilities among the non-Key Facilities at LANL.

The following list provides information about physical changes to non-Key Facilities that have occurred since the issuance of the *1999 SWEIS*, including hazard category designation changes where appropriate:

- Various Chlorination Stations (Buildings 0-1109, 0-1110, 0-1113, 0-1114, 16-560, 54-1008, 72-3, 73-9) were designated moderate chemical hazard facilities in the *1999 SWEIS*. The quantity of chlorine stored at these facilities has been reduced or the stations no longer use gaseous chlorine for water treatment and are therefore no longer categorized as hazardous facilities. Ownership of certain of the chlorination stations was conveyed to Los Alamos County as part of the 1998 conveyance of the Los Alamos water distribution system and rights to surface water and water rights for subsurface water.

- The Omega West Building (2-1) and reactor were completely decontaminated and demolished in September 2003.

- The Ion Beam Building (3-16) houses an accelerator that is currently in safe-shutdown mode. All radioactive sources have been removed from that building.

- All cryogenics equipment has been removed from the Condensed Matter and Thermal Physics Laboratory (3-34) since 1999, and the Ion Beam M Laboratory now occupies the basement.

- The Health Physics Instrument Calibration facilities, located within the Physics Building (3-40), were designated in the *1999 SWEIS* as a Hazard Category 3 nuclear facility. Prior to 2002, the Health Physics Instrument Calibration facilities were relocated to Buildings 36-1 and 36-214, both of which are on the radiological facilities list. Building 3-40 also remains on the radiological facilities list.

- The Source Storage Building (3-65) was given a Nuclear Hazard Category 2 classification in the *1999 SWEIS*, but was downgraded and removed from the radiological facilities list. It is currently used for storage of materials and test kits.

- The Calibration Building (3-130) was designated in the *1999 SWEIS* as a Hazard Category 3 nuclear facility due to the radioactive source inventories stored in the building. The building is being converted into office space with some light-laboratory areas. All radioactive sources and special nuclear material have been removed, and the building is no longer on the radiological facilities list.

- The Liquid and Compressed Gas Facility (3-170) was reclassified to a low chemical hazard status. All toxic materials have been removed from this facility since 1999.

- Building 21-5, a laboratory, has been reclassified as a radiological facility since 1999.

- Building 21-150, Molecular Chemistry, has been removed from the radiological facilities list and is now identified as a surplus structure.

- The High Pressure Tritium Facility (33-86), a former high-pressure tritium-handling facility, was decommissioned in 2002 prior to its subsequent demolition.

- The Nuclear Safeguards Research Facilities (35-2 and 35-27) were classified as Hazard Category 3 nuclear facilities in the *1999 SWEIS* and were subsequently downgraded to radiological facilities in 2000 (DOE and LANL 2005).

- Central High Pressure Calibration Facility construction (36-214) was completed in October 2001. The facility has been categorized as a radiological facility. In addition, Building 36-1, a laboratory and office building, has been categorized as a radiological facility since 1999.

- The Laboratory Building (41-4) was categorized as a radiological facility in the *1999 SWEIS*. Building 41-30 was demolished along with a major portion of Building 41-4. Building 41-1, an underground storage vault known as the Ice House, is categorized as a radiological facility, although no special nuclear material is now stored there.

- The Sewage Treatment Plants (Building 46-340) were designated as moderate chemical hazard facilities prior to 1999. As these plants no longer use any chlorine gas for effluent disinfection, the hazard designation has recently been changed.

The *1999 SWEIS* identified just one major construction project (the Atlas Facility) for inclusion as a new future non-Key Facility. Construction of Atlas within existing buildings and a readiness review were completed in 2001. The Atlas conducted a series of 16 program experiments through October 2002 for the science-based Stockpile Stewardship Program before it was then disassembled and moved to the Nevada Test Site in 2003. After being reassembled, certified, and prepared for operation at the Nevada Test Site, Atlas was placed in standby, ready to support stockpile stewardship as a tri-laboratory (Lawrence Livermore National Laboratory, Sandia National Laboratories, and LANL) resource and a state-of-the-art research facility.

In addition to Atlas, DOE undertook several new construction projects since issuance of the *1999 SWEIS* that were not proposed at that time. These include the Nonproliferation and International Security Center, Center for Integrated Nanotechnologies, Emergency Operations Center, office buildings, LANL Medical Facility, and Live Fire Shoot House. Non-Key Facilities received substantial fire damage from the 2000 Cerro Grande Fire, which impacted 86 structures or buildings, damaged 31 and destroyed 10, including several temporary office facilities. A number of construction projects were undertaken in response to post-Cerro Grande Fire needs.

The following information describes additional non-Key Facility construction projects undertaken since 1999 and their current status:

- The Center for Integrated Nanotechnologies is based in Albuquerque, with facilities at LANL and Sandia National Laboratories. The Center provides open access to tools and the expertise needed to explore the scientific integration of nanostructures into the micro- and macro world. Operated by the DOE Office of Science's Nanoscale Science Research Center, the Center for Integrated Nanotechnologies is a national user facility devoted to establishing the scientific principles that govern the design, performance, and integration of nanoscale materials. In May 2004, groundbreaking took place for a new building that provides laboratory and office space for the LANL branch of the Center. Located northeast of the Materials Science Laboratory in TA-3, this two-story, 36,500-square-foot (3,390-square-meter) building will house approximately 50 workers, including LANL staff and collaborators from universities, other laboratories, and private industry. This building was completed in December 2005 and dedicated in August 2006.

- The Cerro Grande Fire showed that the existing Emergency Operations Center had outlived its useful life. Further research showed that upgrading it would be neither economical nor practical, and the decision was made to design and build a new Emergency

Operations Center. Construction began in early 2002, and the new Emergency Operations Center located at TA-69 became fully operational in December 2003.

- Five two-story office buildings were constructed after the Cerro Grande Fire to replace occupied space lost during the fire and afterwards as a result of postfire recovery efforts. These buildings house about 100 personnel each, consolidating functions and employees within physical proximity, and were occupied in 2003 and 2004.

- The Occupational Medicine Program occupies a new building (the LANL Medical Facility) at TA-3 that houses 60 medical personnel and supports approximately 2,500 LANL patients per month. Through the project, existing nonpermanent facilities were replaced because they had exceeded their life expectancy and were rapidly deteriorating to the point that their condition was impacting the delivery of medical programs. The readiness occupational assessment for the new Medical Facility was completed in December 2003 and the facility became functional in 2004.

- The newly constructed Live Fire Shoot House provides an environment for the safe and realistic conduct of advanced tactical security force training for the Protection Technology Los Alamos staff. Exterior and interior walls were designed to contain bullets and fragmentation from multiple impacts, and bullets traps were also constructed. The facility became operational in March 2003.

- Design of the Information Management Office Building was initiated. The building would consolidate various personnel into a centralized, more efficient office building within TA-3; however, issues have arisen over the size of the building and the planned location. Construction of this building is on hold.

- The National Security Sciences Building constructed in TA-3 provides approximately 275,000 square feet (25,550 square meters) of space for theoretical and applied physics, a Computation Science Program, and senior management office functions. This building is eight stories high and will house about 700 personnel and their functions. Current operations of these capabilities would move from the Administration Building (Building 3-43), which is scheduled to be demolished. The new building also includes a one-story, 600-seat lecture hall and a separate multilevel parking structure that provides 400 spaces near the site. The parking structure was constructed and opened in 2005; the main building was completed in 2006.

- Two new parking structures were constructed in the TA-3 area to ease the critical shortage of parking spaces. One is a precast concrete structure that is four stories tall and provides parking for 337 vehicles. Construction on this first structure began in July 2003 and was completed in April 2004. The second structure (see above) is near the National Security Sciences Building.

- Two staffed access control stations were constructed on Pajarito Road in 2003. The stations cover about 200 square feet (19 square meters) in floor space and an adjacent support building is equipped with various video systems, electric control devices, and fencing to preclude drive-around. They have been operational since April 2004. A temporary truck inspection station was also constructed at the intersection of NM 4 and East Jemez Road.

These non-Key Facilities occupy more than half of LANL and now provide space for about 70 percent of the workforce. In previous years, activities in these facilities have typically contributed less than 20 percent of most operational effects. In 2004, however, new construction and operational effects in the non-Key Facilities increased. For example, approximately 2 million pounds (930,000 kilograms) of chemical waste generated at the non-Key Facilities constituted about 84 percent of total LANL chemical waste volume in 2004 and exceeded the *1999 SWEIS* ROD projection by about 50 percent. Also in 2004, the non-Key Facilities generated about 87 percent of the total LANL low-level radioactive waste volume; about 30 percent of the mixed low-level radioactive waste volume; and about 54 percent of the transuranic waste volume. The combined flows of the Sanitary Wastewater Systems Plant and the TA-3 Steam Plant account for about 88 percent of the total discharge from non-Key Facilities and about 67 percent of all water discharged by LANL.

Measurement of radiological air emissions from stacks at two non-Key Facilities (Buildings 33-86 and 41-4) ceased in 2003. There were no plutonium or uranium emissions from non-Key Facilities between 1999 and 2004. Tritium emissions slightly exceeded *1999 SWEIS* projections in years 1999 to 2001 because of cleanup activities. These radioactive air emissions of approximately 1,000 curies per year represent off-gassing from inactive facilities and their cleanup activities and less than 5 percent of the total 21,700 curies of emissions from all of LANL that were projected by the *1999 SWEIS* ROD.

Non-Key Facilities currently operate five NPDES-permitted outfalls, compared to 22 outfalls identified in the *1999 SWEIS* for non-Key Facilities. Eighteen outfalls were removed from service since 1999 as a result of efforts to reroute and consolidate flows to eliminate outfalls. In 2001, one of those rerouted outfalls was reinstated in the NPDES permit to direct cooling tower effluent back to Sandia Canyon. The total amount of the effluent discharged by non-Key Facilities exceeded *1999 SWEIS* projections during 3 of the 5 years. Only three of these five NPDES-permitted outfalls have discharged effluent since 1999, because the Sanitary Wastewater Systems Plant effluent is pumped to TA-3 and combined with the Power Plant effluent, and the rerouted outfall just resumed discharging into Sandia Canyon in 2005. Since issuance of the *1999 SWEIS* ROD, non-Key Facilities have continued to discharge about 75 percent of the total NPDES effluent from LANL. Effluent discharged from non-Key Facilities had a 99.9 percent compliance rate during this period; only three events occurred where NPDES permit requirements were exceeded: effluent from the TA-3 Co-Generation Complex (TA-3 Power Plant) cooling towers exceeded permit limits once in 2001 and again in 2002, and effluent from the Metropolis Center cooling towers exceeded permit limits once in May of 2003.

Waste volumes generated by non-Key Facilities have exceeded *1999 SWEIS* projections in several categories. Projected chemical waste volumes were exceeded in 2001 due to the Cerro Grande Fire cleanup, and low-level radioactive waste generation projections were exceeded for the years 2000 through 2004 due to decontamination and decommissioning activities, heightened operational activities, and new construction.

2.5 Overview of Actual Impacts Compared to Site-Wide Environmental Impact Statement Projections

From 1999 through 2005, radioactive airborne emissions from point sources (stacks) have varied from a low of 1,900 curies during 1999 to a high of approximately 19,000 curies during 2005 (just under 90 percent of the 10-year average annual curies of 21,700 projected in the *1999 SWEIS*). The final maximally exposed individual dose over this same multiple-year period varied from a low of 0.32 millirem in 1999 to a high of 6.46 millirem during 2005 (compared to a 5.44 millirem projected dose for this period of time). This dose rate is below the EPA emissions limit of a 10 millirem per year dose rate for DOE facilities.

Calculated NPDES effluent discharges ranged from a low of 124 million gallons (469 million liters) per year in 2001 to a high of 317 million gallons (1.2 billion liters) per year in 1999, compared to a projected discharge volume of 278 million gallons (1.05 billion liters) per year. The apparent decrease in flows, however, is primarily due to the methodology by which the flows were measured and reported in the past. Historically, instantaneous flows were measured during field visits as required in the NPDES permit. These measurements were then extrapolated over a 24-hour day, 7 days per week. With implementation of the new NPDES permit on February 1, 2001, data began to be collected and reported using actual flows recorded by flow meters installed at most outfalls. At those outfalls that do not have meters, the flows are calculated as before (based on instantaneous flow).

Quantities of solid radioactive and chemical wastes generated have ranged from approximately 3.2 percent of the mixed low-level radioactive waste projections in the *1999 SWEIS* during both 1999 and 2002 to 852 percent and 849 percent of the chemical waste projections during 2000 and 2001, respectively. The extremely large quantities of chemical waste (61 million pounds [27.7 million kilograms] during 2000 and 60.8 million pounds [27.6 million kilograms] during 2001) are a result of environmental restoration activities. For example, the remediation of MDA P resulted in 47.4 million pounds (21.5 million kilograms), or 88 percent of the 53.8 million pounds (24.4 million kilograms) of chemical waste generated during 2001. Most chemical wastes are shipped offsite for disposal at commercial facilities (LANL 2003h, 2004f). In 2003, the quantity of mixed transuranic waste generated was 137 percent of the mixed transuranic waste projection. The larger-than-projected quantity of mixed transuranic waste was the result of the Decontamination and Volume Reduction System repackaging of legacy transuranic waste for shipment to WIPP (LANL 2005f). **Table 2–4** summarizes LANL emissions, doses, discharges, and radioactive waste generation and compares them to the *1999 SWEIS* projections.

The LANL workforce has been maintained above *1999 SWEIS* projections since 1999. The 13,504 employees recorded at the end of 2005 represent 1,953 more employees than projected. Since 1999, the peak electricity consumption by LANL operations was 421,413 megawatt-hours during 2005, and the peak demand was 70.9 megawatts during 2001 and 2003, compared to *1999 SWEIS* projections of 782,000 megawatt-hours with a peak demand of 113 megawatts. The peak water usage was 453 million gallons (1.71 billion liters) during 1999 (compared to 759 million gallons [2.87 billion liters] projected), and the peak natural gas consumption was 1.49 million decatherms (42.2 million cubic meters) during 2001 (compared to 1.84 million decatherms [52.1 million cubic meters] projected in the *1999 SWEIS*). Between 1999 and 2005, the highest collective total effective dose equivalent for the LANL workforce was 241 person-rem during 2003, which is considerably lower than the workforce dose of 704 person-rem projected by the *1999 SWEIS* (LANL 2004f).

Table 2–4 Los Alamos National Laboratory Emissions, Doses, Discharges, and Radioactive Waste Generation Since 1999 [a]

	SWEIS ROD	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
Radioactive Airborne Emissions from Point Sources								
- Total annual release in curies	21,700	1,900	3,100	15,400	6,150	2,060	5,230	19,100
Percent of 21,700 curies	–	*9*	*15*	*70*	*30*	*9*	*25*	*88*
- MEI dose in millirem per year	5.44	0.32	0.65	1.84	1.69	0.65	1.68	6.46
Percent of 5.44 millirem	–	*6*	*12*	*34*	*31*	*12*	*30*	*119*
NPDES discharges in million gallons per year	278	317	265	124	178	210	162	198
Percent of 278 million gallons per year	–	*114*	*95*	*45*	*64*	*76*	*58*	*71*
Low-level radioactive waste in cubic yards per year	16,000	2,190	5,530	3,400	9,560	7,640	19,400	7,080
Percent of 16,000 cubic yards per year	–	*13.7*	*34.6*	*21.3*	*59.8*	*47.8*	*121*	*44.3*
Mixed low-level radioactive waste in cubic yards per year	830	30	780	80	30	50	50	90
Percent of 830 cubic yards per year	–	*3.6*	*94.0*	*9.6*	*3.6*	*6.0*	*6.0*	*10.8*
Transuranic waste in cubic yards per year	440	190	160	150	160	530	50	100
Percent of 440 cubic yards per year	–	*43.2*	*36.4*	*34.1*	*36.4*	*120*	*11.4*	*22.7*
Mixed transuranic waste in cubic yards per year	150	110	120	60	110	210	30	130
Percent of 150 cubic yards per year	–	*73.3*	*80.0*	*40.0*	*73.3*	*140*	*13.3*	*86.7*
Chemical waste in 1,000 pounds per year	7,160	34,000	61,000	60,800	3,820	1,520	2,460	4,340
Percent of 71,000 pounds per year	–	*475*	*852*	*849*	*53*	*21*	*34*	*61*

[a] Values are rounded.
ROD = Record of Decision, MEI = maximally exposed individual, NPDES = National Pollutant Discharge Elimination System.
Note: To convert cubic yards to cubic meters, multiply by 0.76456; gallons to liters, multiply by 3.378533; pounds to kilograms, multiply by 0.4536.
Sources: LANL 2003h, 2004f, 2005f, 2006g.

Measured parameters for ecological resources and groundwater were similar to *1999 SWEIS* projections, and measured parameters for cultural resources and land resources were below projections. For land use, the *1999 SWEIS* projected the disturbance of 41 acres (17 hectares) of new land at TA-54 because of the need for additional disposal cells for low-level radioactive waste. This expansion is currently underway. In addition, construction of the Los Alamos Research Park was completed on 44 acres (18 hectares) of land along West Jemez Road.

Cultural resources remained protected, and no excavation of sites at TA-54 has occurred. (The *1999 SWEIS* projected that 15 prehistoric sites would be affected by the expansion of Area G into Zones 4 and 6 at TA-54.) Excavations did occur, however, at the Airport-1 East and White Rock-1 tracts from June 2002 through March 2003. These two land tracts were conveyed to the County of Los Alamos for future development (see Table 4-2). Eleven cultural sites also were excavated in Rendija Canyon in 2004 (LANL 2005f).

As projected in the *1999 SWEIS*, water levels in wells penetrating into the regional aquifer continue to decline in response to pumping, typically by several feet each year. In areas where pumping has been reduced, water levels show some recovery. No unexplained changes in patterns have occurred from 1999 through 2005 period, and water levels in the regional aquifer have continued a gradual decline that started in about 1977. Five additional characterization wells were completed in 2004 and, pursuant to the 2005 Consent Order, 21 additional characterization wells were installed in 2005. In addition, ecological resources are being sustained as a result of protection afforded by DOE ownership of LANL. These resources include biological resources such as protected sensitive species, ecological processes, and biodiversity. The recovery and response to the Cerro Grande Fire of May 2000 included a Wildfire Fuels Reduction Program, burned area rehabilitation and monitoring efforts, and enhanced vegetation and wildlife monitoring (LANL 2004f, 2005f).

For the most part, operations at LANL remained within the projections made in the *1999 SWEIS*. Operations that exceeded projections, such as the number of employees or the amount of chemical waste generated from cleanup activities, produced a neutral or beneficial impact on northern New Mexico. A larger number of employees increased the tax base and resulted in a higher level of economic activity. Although the amount of chemical waste generation was higher, thereby increasing the amount of offsite transportation, it was managed without adverse impact to the LANL waste management infrastructure and treatment and disposal of the waste was accomplished in accordance with applicable regulations. Overall, data on operations during the period from 1999 through 2005 indicate that LANL was still approaching the operation levels of the Expanded Operations Alternative in the *1999 SWEIS*, as modified for a lower level of pit production.

Table 2–5 summarizes the actual impacts and performance changes by resource or impact area from 1999 through 2005 compared to the projected impacts for the modified Expanded Operations Alternative in the *1999 SWEIS*. The first column lists the resource or environmental impact areas. For each resource or impact area, the next column provides a summary description of the projected impact for the Expanded Operations Alternative as presented in the *1999 SWEIS*. The third column summarizes the actual impacts for the years 1999 through 2005 as reported in the *LANL SWEIS Yearbooks*. The final column presents an assessment of performance at the site compared to the projected performance in the *1999 SWEIS*. This comparison shows that, in general, LANL operated within the bounds projected in the *1999 SWEIS*.

Table 2–5 Summary Comparison of *1999 SWEIS*[10] Projected Impacts and Actual Changes and Performance (1999 to 2005)

Resource or Impact Area	*1999 SWEIS Projected Impacts*	*Actual Impacts and Performance Changes (1999 to 2005)*	*Assessment*
Land Resources	LANL covered 43 square miles (111 square kilometers), with about 5 percent of the site developed. It was divided into 6 land use categories and contained 944 permanent buildings, 512 temporary structures, and 806 miscellaneous buildings. Changes to land use included TA-67, where 60 acres (24 hectares) of forested land would be cleared for a road and the land use category changed from "Explosives" to "Explosives and Waste Disposal." Area G expansion was estimated to disturb 41 acres (16.6 hectares) of approximately 72 acres designated for waste disposal. The *1999 SWEIS* predicted limited land disturbance (about 100 acres [40 hectares] of previously undisturbed land) from new construction.	LANL now covers 40 square miles (104 square kilometers). Land use categories have increased from 6 to 10. The number of structures, which change often, now includes 952 permanent buildings, 373 temporary structures, and 897 miscellaneous buildings. Major projects have occupied more land than predicted. Forty-four acres (18 hectares) were leased to Los Alamos County for a research park. Environmental restoration activities have not substantially added to available land. About 4,078 acres (1,650 hectares) have been designated for conveyance to Los Alamos County and the New Mexico Department of Transportation, and transfer to the Department of the Interior (to be held in trust for the Pueblo of San Ildefonso), of which 2,259 acres (914 hectares) have been turned over (as of the end of 2006), including all lands to be transferred to the Department of the Interior (in trust for the Pueblo of San Ildefonso). In 2000, the Cerro Grande Fire burned 43,000 acres (17,400 hectares), including about 7,700 acres (3,110 hectares) at LANL. Direct impacts on land use included damage to or loss of 332 structures. Fire mitigation work, such as flood retention structures, affected about 50 acres (20 hectares) of undeveloped land.	Land use changes were slightly greater than those projected in the *1999 SWEIS*. Actions undertaken at LANL that were either not addressed or predicted in the *1999 SWEIS* include the conveyance of land to Los Alamos County and the New Mexico Department of Transportation, and the transfer of land to the Pueblo of San Ildefonso; and several projects that could disturb up to 245 more acres (99 hectares) of greenfield sites than predicted in the *1999 SWEIS*. These actions, however, were addressed in separate NEPA review documents. Land use changes related to the number of buildings at LANL were within the range of impacts evaluated within the *1999 SWEIS*.
Visual Resources	LANL is primarily distinguishable in the daytime by views of its water storage towers, emission stacks, and occasional glimpses of older buildings. At elevations above LANL, the view is primarily of scattered austere buildings and groupings of several-storied buildings. LANL has relatively few nighttime security light sources compared to the nearby communities; the distinction between LANL and the nearby communities is lost to the casual observer.	In many cases, new construction has reduced visually incompatible building styles and allowed for the removal of some of the more austere buildings. One new building has been built at the Los Alamos Research Park. Radio towers have been erected, but have been painted to blend with the background. The water tower at the new Emergency Operations Center has also been painted to blend with the background. Two domes have been added at TA-54, which contrast with the natural landscape and can be seen from the Pueblo of San Ildefonso sacred area, the Nambe-Española area, and areas in western and southern Santa Fe County.	Visual impacts resulting from continuing operations at LANL slightly exceeded those projected in the *1999 SWEIS*. Actions undertaken at LANL that either were not fully addressed or occurred since the *1999 SWEIS* was published include the construction of domes at TA-54, construction of new facilities (especially those that extend above the tree line), and forest thinning. Activities associated with each of these areas were addressed in separate NEPA actions.

[10] *Based on the Expanded Operations Alternative as defined in the 1999 SWEIS and ROD (64 FR 50797).*

Resource or Impact Area	***1999 SWEIS Projected Impacts***	***Actual Impacts and Performance Changes (1999 to 2005)***	***Assessment***
	Projected temporary and minor impacts included changes resulting from construction and environmental restoration activities.	The Cerro Grande Fire altered views and made site facilities more visible. Since 2000, wildfire prevention activities, such as forest thinning, have reduced tree density on 7,700 acres (3,110 hectares) resulting in a more open, park-like forest, increasing the visibility of some facilities. Bark beetles have killed thousands of evergreen trees, opening the forest and making LANL facilities more visible.	The Cerro Grande Fire and bark beetle infestation altered the viewscape beyond that analyzed in the *1999 SWEIS* or other subsequent NEPA review documents.
Geology and Soils			
- Geology	The *1999 SWEIS* identified major seismic features at LANL. Some sections of faults at LANL constitute active and capable faults under the Nuclear Regulatory Commission nuclear facility criteria. Surface rupture from faulting in TA-3 was identified and concern regarding seismic risk to the Chemistry and Metallurgy Research Building was identified.	LANL operations have not affected seismicity concerns. Most construction was conducted at a distance from mapped faults and injection wells were not operated. Based on the seismic risk at TA-3 identified in the *1999 SWEIS*, LANL decided to move the Chemistry and Metallurgy Research Building operations to TA-55, an area of no observed seismic faulting (DOE 2003c).	Impacts at LANL were within those projected in the *1999 SWEIS*.
- Soils	The *1999 SWEIS* identified canyon walls as areas of potential slope instability and indicated that disturbed or unvegetated soils have a greater potential for erosion. Small quantities of contaminants from facility operations would impact LANL soils, and that contaminated soil would be excavated from LANL.	LANL operations have not substantially affected slope instability or soil erosion. Construction activities were set back from canyon walls, and although localized erosion due to disturbed soils occurred at construction sites, it was mitigated by standard construction best management practices such as silt fences and flow barriers. The Cerro Grande Fire increased soil erosion at LANL. Releases from facility operations causing soil contamination have been below *1999 SWEIS* projections due to improvements in facility operating procedures.	Impacts were fewer than those projected in the *1999 SWEIS*, in part due to the removal of contaminated soils through environmental restoration activities and continued use of engineering controls at construction sites. While the Cerro Grande Fire increased soil erosion, the overall effects were mitigated through various actions such that *1999 SWEIS* projections were not exceeded.
Surface Water			
- NPDES Outfall Volumes	Total of 55 NPDES-permitted outfalls. Total projected discharge volumes through permitted outfalls: • 278 million gallons per year (1,052 million liters per year). • 136 million gallons per year (515 million liters) from Key Facilities. • 142 million gallons (538 million liters) per year from non-Key Facilities.	NPDES-permitted outfalls decreased to 21 – including 20 industrial outfalls and 1 sanitary outfall. The total flow from all NPDES outfalls was below *1999 SWEIS* projections for 6 of 7 years; in 1999, the flow exceeded *1999 SWEIS* projections by 14 percent. Key facilities: Combined volumes have been less than *1999 SWEIS* projections; however, discharges from four Key Facilities exceeded their individual 1999 projections. • Tritium Facilities: discharges exceeded annual projections each year, ranging from 0.4 to 33 million gallons per year (1.5 to 125 million liters per year), compared to *1999 SWEIS* projection of 0.3 million gallons (1.1 million liters) per year.	The number of NPDES outfalls was within the *1999 SWEIS* projections. The number of permitted NPDES outfalls and the total flow were consistent with or below *1999 SWEIS* projections. The distribution of flow from individual Key and non-Key Facilities, however, has changed from that projected in the *1999 SWEIS*. Although there appears to be a decrease in total flow from NPDES outfalls, it is largely due to a change in how flow is measured and reported. The current method adopted in 2001 uses actual flow meters in many (but not all)

Resource or Impact Area	*1999 SWEIS Projected Impacts*	*Actual Impacts and Performance Changes (1999 to 2005)*	*Assessment*
		• Chemistry and Metallurgy Research Building discharges exceeded projections 6 of 7 years, ranging from 0.02 to 4.5 million gallons (0.08 to 17 million liters) per year, compared to *1999 SWEIS* projection of 0.5 million gallons (1.9 million liters) per year. • High Explosives Testing Facility discharges exceeded projections 3 years, ranging from 9 to 16.1 million gallons (34 to 61 million liters) per year in 1999 through 2001, compared to *1999 SWEIS* projection of 3.6 million gallons (14 million liters) per year. • Sigma Complex discharges exceeded projections in 2003, with 7.6 million gallons (29 million liters) compared to the *1999 SWEIS* projection of 7.3 million gallons (28 million liters) per year. Non-Key Facilities: Total flow exceeded *1999 SWEIS* projections 3 out of 7 years, in part due to extrapolation from instantaneous flow measurements.	outfalls and measuring stations, providing more accurate information.
- NPDES Outfall Quality	The implied measure of performance is compliance with NPDES permit levels, the New Mexico Water Quality Control Commission stream standards, and DOE Derived Concentration Guides for radionuclides. As described in the *1999 SWEIS*, RLWTF would be modified and the High Explosives Waste Treatment Facility would be constructed to improve effluent quality.	NPDES effluent quality met permitted levels for 99.75 percent of samples since 2000; number of events where permit levels were exceeded ranged from 0 to 14 (of about 1,100 samples) per year. Exceedances resulted in preparation and implementation of corrective action plans. RLWTF has improved the quality of effluent, reducing annual levels of nitrates and radionuclides. Since 1999, radionuclides activities have been well below the Derived Concentration Guides levels, and nitrates and fluorides concentrations were well below the standards. Volumes of effluent discharged from the High Explosives Wastewater Treatment Facility outfall have been below *1999 SWEIS* projections since 1999.	Surface water quality impacts are consistent with or less than those projected in the *1999 SWEIS*. Overall quality and volume of effluents were within the levels projected in the *1999 SWEIS*.
- Water Quality Impacts from Stormwater and Construction Sources	Water quality was projected to be similar or better than recent experience. The following LANL operations were identified in the *1999 SWEIS* as impacting surface water quality: • Stormwater discharges from industrial activities, with 76 industrial facilities identified on LANL site. • Construction activities disturbing greater than 5 acres (2 hectares). • Excavation or dredge and fill activities, which are permitted by the Corps of Engineers and the New Mexico	LANL still requires Stormwater Pollution Prevention Plans and best management practices to protect surface waters from pollutants from industrial stormwater sources and construction projects. The number of industrial activities requiring individual Stormwater Pollution Prevention Plans has ranged from 15 to 22. Stormwater Pollution Prevention Plans and best management practices are now required for all projects disturbing greater than 1 acre (0.4 hectares) of land. An increase in construction projects and dredge and fill projects was seen following the Cerro Grande Fire; however, each project was required to implement Stormwater Pollution Prevention Plans and meet 404 and 401 permit conditions to protect surface waters.	Impacts from storm flows and construction or excavation projects were within *1999 SWEIS* projections.

Resource or Impact Area	*1999 SWEIS Projected Impacts*	*Actual Impacts and Performance Changes (1999 to 2005)*	*Assessment*
	Environment Department (Section 404 and 401 permits).		
- Contaminant Transport	Small increases in outfall flows to watersheds were not expected to result in substantial contaminant transport offsite. Outfall discharge volumes per watershed were projected. Storm flow and sediment transport were identified as primary mechanisms for potential contaminant transport beyond LANL boundaries. The *1999 SWEIS* discussed watershed monitoring activities to track the extent of offsite contaminant movement in sediments and surface waters, including monitoring for radionuclides, metals, organics, polychlorinated biphenyls, and high explosives residue.	Several actions and best management practices were implemented to manage, control, and minimize stormwater and sediment transport. On average, outflows to individual watersheds have been within projections, and trends show that outfall flows per watershed have been declining, thereby reducing the potential for contaminant transport. The number of watersheds receiving outfall flow has been reduced from 8 to 5. The annual flow discharged to the individual watersheds exceeded *1999 SWEIS* projections 5 times from 1999 to 2000 and 1 time since 2000. While radionuclides at or above background levels have been detected in sediments on- and offsite, the overall pattern of radioactivity in sediments has not greatly changed since the *1999 SWEIS*. Concentrations of metals, radionuclides, polychlorinated biphenyls, and high explosives residue above water quality standards have been detected during storm flows; however, these events are infrequent and short-lived. As a direct result of the Cerro Grande Fire, stormwater runoff increased (2 to 4 times for average flow, and 10 to 1,000 times for peak flows), increasing the potential for contaminant transport. Storm events in 2001 and 2002 were found to accelerate the transport of legacy contamination (radionuclides) from Pueblo Canyon into lower watersheds and canyons.	Contaminant transport impacts were consistent with the *1999 SWEIS*, due to LANL programs and best management practices that manage and control storm flow and sediment transport. Increased or accelerated transport of contaminants that occurred from postfire storm flows are considered to be short-lived events that are being controlled and will diminish within the next few years.
Groundwater			
- Water Use	The projected effect of water use over the next 10 years (extracted from the main aquifer) is an average drop in DOE well fields of up to 15 feet (4.6 meters).	The drop in the Los Alamos County (previously DOE) well fields has continued to be 1 to 2 feet (0.3 to 0.6 meters) per year, per the Water Supply at Los Alamos 1998 to 2001 report (LANL 2003b).	Impacts of LANL water use on the regional aquifer continue to be bounded by the impacts analyzed in the *1999 SWEIS*.
- Quantity	No substantial changes to groundwater quantities were expected based on recent experience with LANL discharges that had little effect on groundwater quantities.	LANL discharges have had little effect on groundwater quantities in the last 6 years.	Impacts of LANL discharges on groundwater quantities continue to be bounded by the impacts analyzed in the *1999 SWEIS*.
- Quality	Because mechanisms for recharge to groundwater are highly uncertain, it is possible that discharges under any of the alternatives in the *1999 SWEIS* could result in contaminant transport in groundwater and off the site.	Regional groundwater samples taken in 2005 and 2006 show the presence of hexavalent chromium. Other contaminants detected included perchlorate in all groundwater zones in Mortandad Canyon, in the regional aquifer in Pueblo Canyon, and in alluvial groundwater in Cañon de Valle; and 1,4-dioxane in perched groundwater in Mortandad Canyon.	Hexavalent chromium has not been detected in offsite regional groundwater or in water supply wells. Production well Otowi-1 in Pueblo Canyon was taken permanently off-line because it had one tenth of the risk level of 24.5 micrograms per liter of perchlorate. There is no Federal or State standard for 1,4-dioxane.

Resource or Impact Area	*1999 SWEIS Projected Impacts*	*Actual Impacts and Performance Changes (1999 to 2005)*	*Assessment*
Air Quality			
- Nonradiological Criteria Pollutants	Ambient standards would be met. Annual emissions of criteria pollutants (tons per year): CO = 58 NO_x = 201 PM = 11 SO_2 = 0.98	Ambient standards have been met. Annual emissions for highest year, excluding years of the Cerro Grande Fire and fire mitigation activities (tons per year): CO = 35 NO_x = 93.8 PM = 5.5 SO_2 = 1.9	Annual emissions of criteria pollutants from LANL operations reported in the *Annual Emissions Inventories Through 2005* were within *1999 SWEIS* projections. As of 2004, revised reporting methods for the Title V Operating Permit Emissions Report include small exempt boilers and stand-by emergency generators in the emissions calculations; their inclusion results in SO_2 emissions higher than projected in the *1999 SWEIS*. Cerro Grande Fire and fire mitigation activities caused a temporary increase in CO, PM_{10} and SO_2 emissions above the levels analyzed in the *1999 SWEIS*.
- Other Nonradiological Pollutants	A screening analysis of toxic and hazardous pollutants indicated that levels of potential consequence to the public would not be exceeded for most air pollutants. Further detailed analysis demonstrated that concentrations of other pollutants would be below guideline values. For carcinogens, the combined lifetime incremental cancer risk due to all carcinogenic pollutants from all TAs was estimated. Major contributors to the combined cancer risk values included chloroform, formaldehyde, and trichloroethylene from TA-43 (Bioscience Facilities). The cancer risk to the public of less than 7.4×10^{-7} was dominated by the contribution from chloroform. Although annual emissions of chemical pollutants were not reported in detail for all facilities, the details presented for TA-3, for example, indicate emissions of 153 toxic pollutants. The *1999 SWEIS* did not address toxic and hazardous emissions from combustion sources.	Reported toxic and hazardous pollutant emissions generally have been less than guideline values. Carcinogenic emissions generally have been less than the *1999 SWEIS* projections. Chloroform emissions were less than 30 percent of the *1999 SWEIS* projections. TA-3 peak emissions data show that 21 additional pollutants were emitted and emissions of 39 pollutants exceeded *1999 SWEIS* projections. Seventy-five pollutants were not emitted that were projected.	The amounts of chemicals used and the amounts emitted to the air continue to show considerable variation. Although the actual quantities and chemicals vary from those analyzed in the *1999 SWEIS*, the concentrations to which the public is exposed continue to be below levels of potential consequence.

Resource or Impact Area	*1999 SWEIS Projected Impacts*		*Actual Impacts and Performance Changes (1999 to 2005)*		*Assessment*
- Nonradiological Construction Activities	Air quality impacts of construction activities were not quantified in the *1999 SWEIS*. The *1999 SWEIS*, however, indicated that construction activities were planned in various areas and would include land disturbance. These activities would result in emissions from disturbed areas and from equipment.		Construction of new facilities, demolition, and remediation activities have resulted in short-term increases in air pollutant concentrations. These activities were mitigated as appropriate to prevent exceedance of the ambient standards.		Construction at LANL is an ongoing activity with temporary and localized air quality impacts.
- Radiological		*Annual Average (curies per year)*	*Annual Average (curies per year)*	*Peak Year (curies)*	Annual average air emissions continue to be below levels projected in the *1999 SWEIS*. The exceptions for peak years were due to deactivation activities at TA-21 and a single event at the Weapons Engineering and Tritium Facility for tritium, as well as a failed valve and hours of operation at LANSCE for activation products.
	Actinides	0.000798	0.0000113	0.0000302	
	Fission Products	0.00014	Not reported	Not reported	
	Activation Products	16,000	5,070	18,900	
	Tritium (water vapor)	1,260	815	1,200	
	Tritium (gas)	1,920	1,770	8,740	
	Argon-41	870	22.7	49.8	
	Other Noble Gases	1,640	Not detected	Not detected	
	Uranium	0.152	0.00836	0.02	
Noise	There would be little change in noise impacts to the public from traffic or site activities, although sudden loud noises associated with explosives testing may occasionally startle members of the public and workers. There would be some increase in the frequency of impulsive noise, but these noises would be occasional and not prolonged or unusual to the community.		Construction activities at LANL are common and generally have not altered noise conditions to levels that annoy the public. The increase in workforce has not resulted in any noticeable increase in traffic noise.		Noise impacts from construction and operation were similar to those discussed in the *1999 SWEIS*.
Ecological Resources	Only 5 percent of LANL was determined to be unavailable to wildlife. There were 900 species of vascular plants and 294 species of animals in the area. There were 50 acres (20 hectares) of wetlands, 13 acres (5 hectares) of which were created or enhanced by wastewater from 38 outfalls. The site is home to 3 federally listed endangered species, 2 federally listed threatened species, 18 species of concern, and numerous state-listed species. Areas of Environmental Interest were established at LANL to protect threatened and endangered species.		In total, major projects used slightly less acreage of undeveloped land than predicted in the *1999 SWEIS*. About 5 acres (2 hectares) of the Los Alamos Research Park have been cleared, resulting in the loss of habitat. The reduction in permitted outfalls to 21 by 2003 has reduced the amount of wetlands supported by such flows. Approximately 34 acres (14 hectares) of wetlands occur at LANL. Impacts to ecological resources from land conveyance and transfer have resulted in a reduction in potential onsite habitat and the loss of DOE protection for threatened and endangered species, including areas of core and buffer zones within the Areas of Environmental Interests.		Impacts to biological resources were somewhat greater than those predicted in the *1999 SWEIS*. The *1999 SWEIS* did not account for certain events that occurred after 1999, including the land conveyance and transfer. Activities associated with each of these areas were addressed in separate NEPA documents. The Cerro Grande Fire and bark beetle infestation have altered the ecology of the site. The bark beetle infestation could impact runoff, herbaceous growth, and wildlife populations, as well as increase the potential fire hazard.

Resource or Impact Area	1999 SWEIS Projected Impacts	Actual Impacts and Performance Changes (1999 to 2005)	Assessment
	As discussed in the *1999 SWEIS*, about 100 acres (40 hectares) of undeveloped land at LANL were predicted to be disturbed by construction projects, resulting in some habitat loss. The closure of 27 outfalls was predicted to reduce wetland acreage by 8.6 acres (3.5 hectares). About 25 acres (10 hectares) of the core zone of the Areas of Environmental Interest and 38 acres (15 hectares) of buffer zone could be affected by new projects (some of which would be completed in the future).	The Cerro Grande Fire burned 43,000 acres (17,400 hectares), including about 7,700 acres (3,110 hectares) of LANL. Direct impacts to ecological resources included a reduction in habitat and the loss of wildlife. Fire mitigation work, such as flood retention structures, affected about 50 acres (20 hectares) of undeveloped land. Additionally, between 1997 and 2004, 8,233 acres (3,332 hectares) of forest were thinned to reduce potential wildfire. Thinning has both positive and negative effects on wildlife. An infestation of bark beetles resulted in a 12 to 100 percent mortality of pine and fir trees across LANL.	Forest thinning creates a forest that appears more park-like and increases the diversity of shrubs, herbs, and grasses in the understory.
Offsite Radiological Impacts			
- Offsite Population	Affected population within 50 miles (80 kilometers) of LANL.	Population within 50 miles (80 kilometers) of LANL grew by 14 percent between 1995 and 2000.	Lower emissions than those projected in the *1999 SWEIS* resulted in lower population dose and risk.
Dose (per year)	33.09 person-rem	2.5 person-rem in peak year (2005)	
Risk (per year)	0.0165 latent cancer fatalities	0.0015 latent cancer fatalities in peak year (2005)	
- MEI	LANL site MEI located north-northeast of LANSCE.	No change in location for the LANL site MEI.	Average dose to MEI continues to be bounded by projections in the *1999 SWEIS*. Higher emissions in 2005, resulting in a higher MEI dose, were due to a failed valve at LANSCE. The peak year dose is below the 10 millirem annual public exposure limit.
Dose (per year)	5.44 millirem	6.5 millirem in peak year (2005)	
Risk (per year)	2.72×10^{-6} latent cancer fatalities	3.9×10^{-6} latent cancer fatalities in peak year (2005)	
Worker Health			
- Average Measurable Dose			Average dose to workers continues to be bounded by projections in the *1999 SWEIS*.
Dose (per year)	198 millirem	149 millirem in peak year (2000)	
Risk (per year)	7.92×10^{-5} latent cancer fatalities	8.9×10^{-5} latent cancer fatalities in peak year (2000)	
- Collective Dose			Collective dose to the worker population continues to be bounded by projections in the *1999 SWEIS*.
Dose (per year)	704 person-rem	241 person-rem in peak year (2003)	
Risk (per year)	0.281 latent cancer fatalities	0.145 latent cancer fatalities in peak year (2003)	
	Factor used to estimate risk of latent cancer fatalities per rem was 0.0004 in 1999.	Dose-to-risk factor for workers increased from 0.0004 to 0.0006 latent cancer fatalities per rem.	

Resource or Impact Area	*1999 SWEIS Projected Impacts*	*Actual Impacts and Performance Changes (1999 to 2005)*	*Assessment*
Environmental Justice	There would be no disproportionately high and adverse impacts to minority or low-income populations from LANL activities. Consultations would continue to provide opportunities for avoiding or minimizing adverse impacts to traditional cultural properties at LANL. Human health impacts associated with special pathways would not present disproportionately high and adverse impacts to minority and low-income populations.	There were no disproportionately high and adverse impacts to minority or low-income populations from LANL activities during this period. Potential impacts to sacred lands adjacent to LANL from activities at TA-54 have been of concern to the San Ildefonso Pueblo. The amount of radiological material released to the environment (curies per year) has been well within the amount projected in the *1999 SWEIS*.	Impacts have not exceeded any health, safety, and environmental regulation, standard, or guideline; nor have they been high or adverse to minority and low-income populations. Ongoing consultations with representatives of the San Ildefonso Pueblo address concerns that activities at LANL and at TA-54 could affect sacred lands. Human health impacts associated with special pathways remained below the levels projected in the *1999 SWEIS*.
Cultural Resources	Cultural resources at LANL were categorized as prehistoric, historic, and traditional cultural properties. As discussed in the *1999 SWEIS*, about 75 percent of LANL was surveyed for cultural resources. Surveys identified 1,295 prehistoric sites, 2,319 historic sites, and 54 traditional cultural properties on or near LANL. As predicted in the *1999 SWEIS*, 15 prehistoric sites associated with the expansion of Area G could be impacted. No impacts to historic sites were expected. Impacts to traditional cultural properties were not fully predictable due to the lack of information on their specific locations and nature; however, impacts could result from changes in hydrology, explosives, hazardous materials, and security measures. It was noted that consultation with affected Pueblos would accompany any potential expansion in Area G or enhancement of pit manufacturing.	The percentage of LANL surveyed for cultural resources increased to 90 percent in 2005, and the number of known cultural resource sites increased as well. Conveyance and transfer of land resulted in the removal of cultural resources from the responsibility and protection of DOE, including resources eligible for listing on the National Register of Historic Places and American Indian sacred sites, remains, and traditional religious sites. A data recovery plan has been written to resolve adverse effects on tracts conveyed to the County of Los Alamos; transferred land would be held in trust by the Department of the Interior (to be held in trust for the Pueblo of San Ildefonso) and so would remain under Federal protection. Following the Cerro Grande Fire, an assessment determined that about 400 archaeological sites and historic buildings and structures were impacted by the fire. Impacts included direct loss, soot staining, spalling and cracking of stone masonry walls, and the exposure of artifacts from erosion. Additionally, the fire and the tree-thinning measures taken to reduce wildfire hazard resulted in the discovery of 447 new archaeological sites.	Impacts to cultural resources at LANL exceeded the level predicted in the *1999 SWEIS*, which did not account for events such as land conveyance and transfer. Certain activities associated with the development of new sites and land conveyance and transfer were addressed in separate NEPA documents. The Cerro Grande Fire caused extensive damage to cultural resources at LANL.
Socioeconomics	The *1999 SWEIS* projected the need for 11,351 full-time equivalent LANL-affiliated employees. Changes in employment at LANL would change regional population, employment, personal income, and other socioeconomic measures.	By 2005, there were 13,504 LANL-affiliated employees.	Socioeconomic impacts from continued operations at LANL between 1998 and 2005 have exceeded the socioeconomic impacts projected in the *1999 SWEIS* due to the larger number of employees.

Resource or Impact Area	*1999 SWEIS Projected Impacts*	*Actual Impacts and Performance Changes (1999 to 2005)*	*Assessment*
Infrastructure			
- Electricity	LANL was projected to require 782,000 megawatt-hours of electricity per year, with a peak load demand of 113 megawatts.	Average annual usage: 391,096 megawatt-hours per year, with peak usage of 421,413 megawatt-hours in 2005. Average peak load demand: 68.8 megawatts, with a peak of 70.9 megawatts in 2001 and 2003.	Annual electricity usage at LANL remained below the levels projected in the *1999 SWEIS*. Electrical usage has not exceeded the annual 963,600 megawatt-hour system capacity, or the physical transmission capability (thermal rating) of 110 megawatts.
- Fuel	LANL was projected to require 1.84 million decatherms (52.1 million cubic meters) of natural gas per year. Note: A decatherm is equivalent to 1,000 cubic feet.	Average annual usage: 1.32 million decatherms (37.4 million cubic meters) per year. Peak year usage: 1.49 billion cubic feet (42.2 million cubic meters) (2001).	Annual natural gas usage at LANL remained below the level projected in the *1999 SWEIS*. Demand for natural gas has not exceeded the contractually limited capacity of 8.07 million decatherms (229 million cubic meters) per year.
- Water	LANL was projected to require 759 million gallons (2.87 million liters) of water per year.	Average annual usage: 385 million gallons (1.46 billion liters) per year. Peak year usage: 453 million gallons (1.71 billion liters) (1999).	Annual water usage at LANL remained below the level projected in the *1999 SWEIS*. Demand for water has not exceeded the ceiling quantity of approximately 542 million gallons (2 billion liters) per year.
Environmental Restoration	The *1999 SWEIS* evaluated Environmental Restoration Program impacts in the ecological and human health risk assessments and in analyses related to the transport, treatment, storage, and disposal of waste. Other environmental restoration–related impacts addressed qualitatively in the *1999 SWEIS* included fugitive dust, surface runoff, soil and sediment erosion, and worker health and safety risks.	The environmental restoration project originally identified 2,124 potential release sites, including 1,099 regulated by the New Mexico Environment Department under RCRA and 1,025 regulated by DOE. At the end of 2005, 829 potential release sites remained to be investigated or remediated. Cleanup activities have been completed at many sites. No further action determinations have been made for 774 units, and 146 units have been removed from LANL's RCRA Permit. Major unplanned environmental restoration activities were undertaken in response to the Cerro Grande Fire that reduced long-term exposures to legacy contaminants. The large quantities of waste generated by cleanup were sent to offsite facilities.	The overall impacts of environmental restoration activities and waste generated by activities at LANL remained within the qualitative projections presented in the *1999 SWEIS*.

Resource or Impact Area	*1999 SWEIS Projected Impacts*	*Actual Impacts and Performance Changes (1999 to 2005)*	*Assessment*
Waste Management and Pollution Prevention	Waste management impacts were projected in the *1999 SWEIS* for five categories of waste (low-level radioactive waste, mixed low-level radioactive waste, transuranic waste, mixed transuranic waste, and chemical waste). Liquid radioactive wastes were evaluated separately and subcategory (sludge) quantities were projected. For low-level radioactive waste disposal at TA-54, the *1999 SWEIS* and ROD selected the preferred option of expansion into Zones 4 and 6, providing an additional 72 acres (29 hectares) of low-level radioactive waste disposal area, of which 41 acres (16.6 hectares) would actually be disturbed by waste disposal.	In general, quantities of radioactive waste were below *1999 SWEIS* projections for all categories. Overall low-level radioactive waste generation was well below the projected level up until 2004, when the projection was exceeded due to heightened activities and new construction at non-Key Facilities. Mixed low-level radioactive waste remained within the *1999 SWEIS* projection. For transuranic waste, the quantities were within the *1999 SWEIS* projection for 6 of the 7 years; in 2003, the transuranic waste projection was exceeded due to repackaging of legacy waste for shipment to WIPP and the receipt and storage of sealed sources by the Off-Site Source Recovery Program. Generation of mixed transuranic waste by the waste repackaging effort in 2003 exceeded the *1999 SWEIS* projection, the only exceedance for this category. The chemical waste projection was exceeded for the years 1999 through 2001 due to environmental restoration cleanups. Numerous facility-specific variances to the *1999 SWEIS* chemical waste projections occurred over the timeframe, mostly due to one-time events such as chemical cleanouts or maintenance activities. For liquid radioactive wastes, quantities treated were within *1999 SWEIS* projections; some sludge exceeded *1999 SWEIS* projections, but was within the low-level radioactive waste management capacity. Low-level radioactive waste operations at TA-54 were conducted within the existing footprint.	The amount of waste managed at LANL was within *1999 SWEIS* projections for all waste categories with a few exceptions. Although sporadic exceedances took place, the quantities generated were within the capacity of the existing LANL waste management infrastructure. Liquid radioactive waste treatment quantities remained within *1999 SWEIS* projections.
Emergency Preparedness and Security	LANL's Comprehensive Emergency Management and Response Program, which includes specialized response teams, specialized training, and response agreements in cooperation with local government response agencies was described in the *1999 SWEIS*. In addition, DOE was studying a variety of options for the renovation of the emergency preparedness and security infrastructure at LANL that included replacing a number of aging structures individually or as part of a multi-building effort.	Until 2003, the LANL Emergency Operations Center was located within TA-59. A new Emergency Operations Center located at TA-69 was completed and began operations in 2003.	Impacts were consistent with those described in the *1999 SWEIS*, except for measures taken in response to enhanced national security concerns after the attacks of September 11, 2001.

TA = technical area, NEPA = National Environmental Policy Act, NPDES = National Pollutant Discharge Elimination System, CO = carbon monoxide, NO_x = nitrogen oxide, PM = particulate matter, SO_2 = sulfur dioxide, rem = roentgen equivalent man, MEI = maximally exposed individual, RLWTF = Radioactive Liquid Waste Treatment Facility, LANSCE = Los Alamos Neutron Science Center, RCRA = Resource Conservation and Recovery Act, ROD = Record of Decision, WIPP = Waste Isolation Pilot Plant.

[a] Based on the Expanded Operations Alternative as defined in the *1999 SWEIS* and ROD (64 FR 50797).

CHAPTER 3
ALTERNATIVES FOR CONTINUED OPERATION OF LOS ALAMOS NATIONAL LABORATORY

3.0 ALTERNATIVES FOR CONTINUED OPERATION OF LOS ALAMOS NATIONAL LABORATORY

This chapter describes proposed alternatives for the continued operation of Los Alamos National Laboratory (LANL). These alternatives provide the basis for analysis of potential impacts in this environmental impact statement. Site-wide activities, activities that would occur in specific technical areas, and activities proposed to occur at each Key Facility are described for each alternative. Some activities are common to all alternatives; others vary among the alternatives.

This *Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (LANL SWEIS) evaluates potential environmental impacts associated with continued operation of LANL. The three alternatives described in this chapter, the No Action Alternative, a Reduced Operations Alternative, and an Expanded Operations Alternative, provide the basis for this evaluation. As the names of the alternatives imply, each considers operating LANL at different activity levels. Under the No Action Alternative, LANL would continue to be operated at currently approved levels (see Section 3.1 of this chapter), implementing those projects, including new construction, for which National Environmental Policy Act (NEPA) analyses have been completed. Under the Reduced Operations Alternative, many capabilities would remain unchanged, others would be eliminated or reduced in activity level, and most projects that have been approved based on completed NEPA analyses would go forward. The Expanded Operations Alternative, which NNSA has selected as its Preferred Alternative, proposes an increase in activity levels for some capabilities, as well as several new projects. These proposed activities and projects are evaluated in Appendices G, H, I, and J. Many capabilities would remain unchanged, even under the Expanded Operations Alternative.

Alternatives for Continued Operation of Los Alamos National Laboratory

No Action Alternative—Operations would continue at current levels consistent with previous decisions such as the *1999 LANL Site-Wide Environmental Impact Statement* Record of Decision (ROD), other RODs, and Findings of No Significant Impact.

Reduced Operations Alternative—Construction of the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility would be cancelled, thereby limiting pit production. Operations would be reduced at high explosives processing and testing facilities and eliminated at the Los Alamos Neutron Science Center and Pajarito Site.

Expanded Operations Alternative (Preferred Alternative)—Selected operations would increase, including plutonium pit production. Other projects proposed and analyzed in this SWEIS would be implemented.

The Expanded Operations Alternative in the 1999 *Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (*1999 SWEIS)* (DOE 1999a) is the basis for the No Action Alternative in this new Site-Wide Environmental Impact Statement (SWEIS). Under the *1999 SWEIS* Expanded Operations Alternative, the U.S. Department of Energy (DOE) anticipated expanding operations at LANL as the need arose to the highest reasonably foreseeable levels, including full implementation of pit manufacturing up to 50 pits per year under single-shift operations (80 pits per year using multiple shifts). As a result of constraints at the time the Record of Decision (ROD) was issued, however, including project delays and operational limitations for the Chemistry and Metallurgy Research Building (instituted to ensure that the operational risks [including seismic and human health risks] were maintained at an acceptable level), DOE determined that additional study of methods for implementing the 50 pits per year (or 80 pits per year) production capacity was warranted. In effect, DOE postponed a decision to expand pit manufacturing beyond a level of 20 pits per year. The impacts analysis in the *1999 SWEIS* Expanded Operations Alternative, however, is based on full implementation of pit production of 80 pits per year. That impacts analysis is also the basis for all of the alternatives analyzed in this SWEIS, although impacts in certain resource areas are distinguishable.

This chapter is organized by alternative; projects at the site-wide, technical area (TA), or Key Facility level are described within each alternative as appropriate. Key Facilities are described by their capabilities and the activity level at which each capability would be implemented. To the largest extent possible, projects and activities are evaluated at the Key Facility level because this is the most basic and descriptive level. A number of proposed projects described in the No Action and Expanded Operations Alternatives, however, are not tied to a Key Facility; instead, they are either site-wide or TA-related. Site-wide projects are described in Sections 3.1.1 and 3.3.1. Projects that would occur in a specific TA are described in Sections 3.1.2 and 3.3.2. Capabilities, activity levels, and proposed changes to Key Facilities are described in Sections 3.1.3, 3.2, and 3.3.3.

Technical Area (TA)

Geographically distinct administrative unit established for the control of LANL operations. There are currently 49 active TAs; 47 in the 40 square miles of the LANL site, one at Fenton Hill, west of the main site, and one comprising leased properties in town.

The No Action Alternative discussion in Section 3.1 contains complete descriptions of the capabilities of each Key Facility, as well as tables presenting the activity levels for each capability under each of the three alternatives. Discussions of the Reduced and Expanded Operations Alternatives in Sections 3.2 and 3.3, respectively, only discuss the changes from the No Action Alternative.

Evaluations and descriptions of each alternative implicitly include continued and evolving scientific, engineering, technology research and development (R&D), and support services throughout LANL, including those at the Key Facilities. Given the nature of R&D, specific activities are expected to vary and evolve over time; however, these changes can be sufficiently characterized to permit analysis of their consequences within the context of the alternatives. In addition, activity levels identified for each capability should be considered the maximum operating levels for which impacts are analyzed. Proposed new activities or increases in activity levels above those analyzed would require further NEPA compliance analysis.

In addition to operations associated with the capabilities described for each alternative, routine maintenance, construction, and support activities are required to maintain the availability and viability of LANL operations on an ongoing basis. DOE NEPA Implementing Procedures (Title 10 *Code of Federal Regulations* [CFR] Part 1021, Subpart D) list classes of actions called categorical exclusions that DOE has determined do not individually or collectively have a significant effect on the human environment and therefore do not require environmental assessments (EAs) or environmental impact statements (EISs). These actions include activities related to facility operations, safety and health, site characterization and environmental monitoring, and environmental remediation and waste management. Representative activities that can be categorically excluded, provided they meet certain criteria, include routine maintenance; facility repairs; plant rearrangements; building modifications; seismic upgrades; roof replacement and repairs; replacement or upgrading of pumps, piping, and electrical components; and exterior work on the facility and grounds. In addition, certain operations found to be associated with insignificant environmental impacts based on DOE experience may be categorically excluded. After documenting that a proposed activity or project meets the categorical exclusion criteria, any of these routine activities may be implemented without additional NEPA analysis. Categorically excluded activities would proceed regardless of decisions made about the level of LANL operations and are not detailed across the alternatives discussions. Appendix L includes summaries of activities routinely performed at LANL that typically receive categorical exclusions.

An updated probabilistic seismic hazard analysis providing an improved understanding of the seismic characteristics of LANL was completed in 2007 (LANL 2007a): this is discussed in more detail in Chapter 5, Section 5.12.3. LANL's *Engineering Standards Manual ISD 341-2* (LANL 2007c) was revised to incorporate natural phenomena hazard mitigation requirements for new structural designs and for renovation, replacement, modification, maintenance and rehabilitation projects. These requirements are applicable to construction projects under all alternatives.

3.1 No Action Alternative

The No Action Alternative reflects implementation of decisions made by DOE and the National Nuclear Security Administration (NNSA) based on the *1999 SWEIS* (DOE 1999a) and other analyses performed in accordance with DOE's NEPA process. In the *1999 SWEIS* ROD, DOE announced its decision to implement the Expanded Operations Alternative described in the *1999 SWEIS*, with a level of plutonium pit manufacturing of 20 pits per year. Therefore, the current No Action Alternative continues implementation of the *1999 SWEIS* Expanded Operations Alternative as modified in the ROD. The No Action Alternative also includes implementation of decisions made on actions evaluated in other EISs and EAs completed since 1999; these other NEPA implementing documents are summarized in Chapter 1, Section 1.5. For the purposes of this SWEIS, the construction and operation of the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility is included within the No Action Alternative in keeping with the bounding approach for impact analysis. However, NNSA is engaged in a programmatic review process that includes a reconsideration of its 2004 decision regarding that portion of the Chemistry and Metallurgy Research Replacement Facility through preparation of the *Complex Transformation Supplemental Programmatic Environmental Impact Statement* (*Complex Transformation SPEIS*) (see earlier discussion of this document in Chapter 1). In addition to other actions for which DOE has completed NEPA reviews, many actions have been implemented at LANL based on reviews and determinations that they met conditions in DOE NEPA Implementing Procedures for being categorically excluded from further NEPA compliance evaluation.

3.1.1 Site-Wide Projects

Proposed projects not associated with a specific TA or Key Facility are identified in **Table 3–1** and described in this section. Table 3–1 also shows site-wide actions associated with the Expanded Operations Alternatives that are discussed in Section 3.3.1. There are no new site-wide activities proposed under the Reduced Operation Alternative.

Table 3–1 Site-Wide Projects and Activities

Project	*No Action Alternative*	*Reduced Operations Alternative*	*Expanded Operations Alternative*
Security Needs	Security-Perimeter Project: - Build new access control stations at the intersection of Jemez Road and Diamond Drive and near the intersection of Camp May Road and West Jemez Road (mostly completed by the end of 2006). - Construct a road connecting West and Camp May Roads. Implement Nuclear Materials Safeguards and Security Upgrades Project Phase II to upgrade security systems at TA-55.	Same as No Action Alternative	Same as No Action Alternative, plus: - *Implement Security-Driven Transportation Modifications* (see Appendix J): – Construct traffic control stations and modify roadway to control access to Pajarito Road between TA-48 and TA-63. – Construct a vehicle and pedestrian bridge across Ten Site Canyon and a roadway from TA-63 to TA-35. – Construct commuter bus parking lots at TA-48 and TA-63. - Auxiliary Actions include: – Construct a vehicle bridge across Mortandad Canyon from TA-35 to TA-60; connect to paved road along the length of Sigma Mesa. – Construct a vehicle bridge across Sandia Canyon from TA-60 to TA-61; create intersection with East Jemez Road.
Remediation and Closure Activities	Continue remediation of potential release sites. Remediate and close MDA H.[a]	Same as No Action Alternative	Same as No Action Alternative, plus: - Implement *MDA Remediation, Canyon Cleanups and Other Consent Order Actions* [b, c] (see Appendix I). - Perform activities such as groundwater monitoring as necessary to support closure of the Los Alamos County Landfill.
Land Conveyance and Transfer	Convey or transfer previously identified parcels of LANL land to Los Alamos County, the New Mexico Department of Transportation, and the Department of the Interior in trust for the Pueblo of San Ildefonso.	Same as No Action Alternative	Same as No Action Alternative
Electrical Power System Upgrades	Construct new power line between Norton and new Southern TA Substations and from the Southern TA Substation to the new Western TA Substation. Construct new 115-kilovolt electrical substation along the Pajarito Corridor West. Upgrade Eastern TA Substation. Uncross Reeves and Norton-Los Alamos power lines.	Same as No Action Alternative	Same as No Action Alternative

Project	***No Action Alternative***	***Reduced Operations Alternative***	***Expanded Operations Alternative***
Wildfire Hazard Reduction	Implement ecosystem-based management program for approximately 10,000 acres (4,000 hectares) of LANL land. Includes prescribed fire, mechanical and manual forest thinning, access road construction, and fuel breaks.	Same as No Action Alternative	Same as No Action Alternative
Disposition of Flood and Sediment Retention Structures	Remove aboveground portion of Pajarito Canyon flood retention structure and stabilize sides. Grade streambed and reseed banks. Remove aboveground portions of steel diversion wall at TA-18.	Same as No Action Alternative	Same as No Action Alternative
Trails Management Program	Repair, maintain, improve, and close, as necessary, publicly used trails on the LANL site.	Same as No Action Alternative	Same as No Action Alternative
Off-Site Source Recovery Project	Continue to receive and store certain excess and unwanted sealed sources containing plutonium-239 and other actinides.	Same as No Action Alternative	Same as No Action Alternative, plus: - Implement *Increase in Type and Quantity of Sealed Sources Managed at LANL by the Off-Site Source Recovery Project*: – Increase scope of project to accept additional types and quantities of sealed sources, including nonactinide beta-gamma emitters (see Appendix J).
Management of Construction Fill	Transport and store up to 150,000 cubic yards per year of soil excavated from Chemistry and Metallurgy Research Replacement Facility, and other construction projects, at TA-16 or TA-61 borrow areas.	Same as No Action Alternative	Same as No Action Alternative

TA = technical area; MDA = material disposal area; Consent Order = Compliance Order on Consent entered into by DOE, the University of California as the management and operating contractor, and the State of New Mexico.

[a] Remediation of MDA H is discussed in Section 3.1.2.4 as a TA project.

[b] Activities required to comply with the Consent Order are evaluated under the Expanded Operations Alternative because they do not meet the No Action Alternative definition found in Section 3.1 of this SWEIS. As explained in Chapter 1, Section 1.4 of this SWEIS, the decisionmaker does not need to select an entire alternative, but can select among the proposed alternatives for each project or activity.

[c] NNSA is including impacts associated with Consent Order implementation in the SWEIS in order to more fully analyze the impacts resulting from Consent Order compliance. NNSA intends to implement actions necessary to comply with the Consent Order regardless of decisions it makes on other actions analyzed in the SWEIS.

Notes: Italicized entries indicate projects for which project-specific impact analyses are included in appendices to this SWEIS. To convert cubic yards to cubic meters, multiply by 0.76456.

3.1.1.1 Security Needs

Under the No Action Alternative, security operations and projects, including those initiated as a result of heightened security concerns related to the attacks of September 11, 2001, and the 2004 operational standdown at LANL, would continue. Projects approved and partially implemented include the Security Perimeter Project and Nuclear Materials Safeguards and Security Upgrades.

The Security Perimeter Project was first evaluated in the *Environmental Assessment for Proposed Access Control and Traffic Improvements at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2002k). Proposed changes to project implementation have been reviewed in subsequent NEPA documents: the *Supplement Analysis, Security Perimeter Project* (DOE 2003a), *the NEPA Compliance Review for Proposed Modifications to the Security Perimeter Project at Los Alamos National Laboratory* (NNSA 2004a), and most recently, the *NEPA Compliance Review Addendum for Proposed Modifications to the Security Perimeter Project at Los Alamos National Laboratory* (NNSA 2005a). This project initially proposed changes to traffic patterns around LANL, including the construction of bypass roads and the addition of access control stations to screen and limit access to LANL. Project modifications include not constructing the bypass roads and changing locations and designs for the access control stations. To date, four staffed access control stations have been completed, two along Pajarito Road, one at the intersection of Jemez Road and Diamond Drive (that intersection was redesigned to prevent vehicles from entering TA-3 without passing through the station), and another at the intersection of Camp May Road and West Jemez Road. West Jemez Road was redesigned at that point to facilitate vehicle screening and related activities. Together, these four access control stations will allow security personnel to restrict access to the site during times of heightened security; under normal security conditions, roads around the perimeter of LANL would remain open to the public. In addition, a road connecting West and Camp May roads will be constructed, largely following the route of an existing unpaved service road across TA-62.

The overall objective of the Nuclear Materials Safeguards and Security Upgrades Project is to upgrade and replace the existing physical security system to address new protection strategy requirements and the deteriorating physical security infrastructure. This project involves activities categorically excluded from further NEPA evaluation and is being implemented in two phases. In Phase I, which is already completed, the data and communications backbone for the central and secondary alarm stations security system was installed. In Phase II, the security system at TA-55 will be upgraded to provide an effective, responsive security system to address design-basis threats and other requirements. Phase II includes upgrades or replacements of existing exterior physical security systems and installation of interior intrusion detection, assessment, delay, access control, and security communications equipment to support the new protection strategy for TA-55. These systems will be integrated with the security control system installed in Phase I.

3.1.1.2 Remediation and Closure Activities

Remediation and cleanup efforts at LANL are regulated by and coordinated between NMED and DOE. Until recently, investigations and corrective measures in compliance with the Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act were carried out in accordance with LANL's Hazardous Waste Facility Permit. But on March 1, 2005, the corrective action program specified in the permit was replaced by a Compliance Order on Consent (Consent Order). For the No Action Alternative, environmental investigations and restoration efforts would be implemented as they were prior to the Consent Order. Although not included in the No Action Alternative, NNSA intends to implement actions necessary to comply with the Consent Order regardless of decisions it makes on other actions analyzed in this SWEIS.

3.1.1.3 Land Conveyance and Transfer

As discussed in Chapter 2 of this SWEIS, LANL began conveying land to Los Alamos County and transferring land to the Department of the Interior (to be held in trust for the Pueblo of San Ildefonso) in 2002, as directed by Public Law 105-119. DOE anticipates conveying or transferring additional land before the end of 2012, the deadline prescribed in the Defense Authorization Act, which extended the deadline from 2007 as originally established in Public Law 105-119. Tracts identified for future conveyance and transfer are (LANL 2006a):

- A-4, to be conveyed to Los Alamos County, is part of the airport along NM 501 located east of the Los Alamos townsite, close to the East Gate Business Park.
- A-8, A-10, and A-11 are tracts to be conveyed to Los Alamos County and are part of the DP Road tract, located between the western boundary of TA-21 and the major Los Alamos townsite commercial districts.
- A-13, to be conveyed to Los Alamos County, is currently the DOE Los Alamos Site Office location. This tract is located within the Los Alamos townsite between Los Alamos Canyon and Trinity Drive.
- A-14, the Rendija Canyon tract, to be conveyed to Los Alamos County, is located north of the Los Alamos townsite's Barranca Mesa residential subdivision.
- A-18, to be conveyed to Los Alamos County, and B-3, to be transferred to the U.S. Department of the Interior in trust for the San Ildefonso Pueblo, are located east of the Los Alamos townsite and include much of Pueblo Canyon.
- C-1, C-2, C-3, and C-4 are tracts to be conveyed to the State of New Mexico Department of Transportation and are part of the White Rock tract, a complex area that incorporates the alignments and intersections of NM 4 and NM 502 and the easternmost part of Jemez Road.

3.1.1.4 Electrical Power System Upgrades

The power systems at LANL are being upgraded to increase site infrastructure reliability to meet current and future needs. The *Environmental Assessment for Electrical Power System Upgrades at Los Alamos National Laboratory* (DOE 2000a) assesses proposed electrical power system upgrades, including construction and operation of a new 115-kilovolt power transmission line that would originate at the Norton Substation and terminate at a new DOE-administered Western TA Substation. The transmission line from the Norton Substation to the point where it reaches the new Southern TA Substation near NM 4 will be operated at 115 kilovolts, but will be built to 345-kilovolt specifications to provide redundant service to LANL and the Los Alamos townsite.

Construction of the new Southern TA switchyard and the portion of the new power line from the new Southern TA Substation to the Western TA Substation has been completed. Refurbishment of the Eastern TA Substation is complete. The project to uncross the two existing transmission lines is expected to be complete by 2010. Construction of the portion of the new power line from the Norton Substation to the Southern TA Substation is in the design phase. A new substation will also be installed along Pajarito Corridor West at TA-50. See Chapter 4, Section 4.8.2.1, for more detail about these upgrades.

3.1.1.5 Wildfire Hazard Reduction Project Plan

Five major wildfires have ignited in the local area outside the LANL boundaries over the past 50 years. Such wildfires pose a serious threat to LANL buildings, structures, and utilities. A Wildfire Hazard Reduction and Forest Health Improvement Program was proposed in late 2001 to protect LANL from wildfires. The proposed activities were evaluated in the *Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2000e). Initial fuel-reduction treatments were implemented through the Cerro Grande Rehabilitation Project using *Wildfire Hazard Reduction Project Plan* (LANL 2001b) guidance. About 10,000 acres (4,000 hectares), roughly 35 percent of LANL, were treated under this program from 2001 through 2005. Plans for future wildfire risk reduction activities such as monitoring for regrowth of fuel sources, tree thinning, and prescribed fire are described in the *Management Review Draft, LANL Wildland Fire Management Plan* (LANL 2005g).

3.1.1.6 Disposition of Flood and Sediment Retention Structures

The *Environmental Assessment for the Proposed Future Disposition of Certain Cerro Grande Fire Flood and Sediment Retention Structures at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2002j) evaluates removal of certain flood and sediment retention structures that were constructed as part of NNSA's emergency response actions for the Cerro Grande Fire of 2000. These structures were built to address changes in local watershed conditions that resulted from the fire. Watershed conditions are expected to return to a prefire status or approximate the prefire condition 3 to 8 years after the fire. After the watershed recovers, these structures would no longer be necessary to protect LANL facilities and the businesses and homes located downstream. This project will remove part of the aboveground portion of the Pajarito Canyon flood retention structure, including gabions installed along the downstream channel. The streambed will be graded, the remaining sides of the flood retention structure will be stabilized, and the banks will be reseeded. The area will be monitored and maintained to prevent slope erosion and damage to the floodplain and downstream wetlands. This project will also include removal of the aboveground portions of the steel diversion wall at TA-18. A Clean Water Act Section 404 Dredge and Fill Permit from the U.S. Army Corps of Engineers and a Section 401 Water Quality Certification from the New Mexico Environment Department will be required for removal of these structures. Any sediment removed will be characterized and either reused onsite, or if contaminated, disposed of in accordance with regulatory requirements. Best management practices involving stormwater controls will be implemented during removal activities as required by LANL's Construction Stormwater Permit Program.

3.1.1.7 Trails Management Program

NNSA and LANL staff recently began work on a Trails Management Program to address resource issues through improved and active stewardship. This program was evaluated in the *Environmental Assessment for the Proposed Los Alamos National Laboratory Trails Management Program, Los Alamos, New Mexico* (DOE 2003b). The program goal is to balance recreational trail use with environmental, cultural, safety, security, and social concerns. The program first established the Trails Assessment Working Group, which began meeting in December 2003 to formulate a plan for repair, construction, and implementation of environmental and cultural resources protection, safety, and security measures throughout the trail network. An inventory of all trails was started in 2005; further assessments would include end-state conditions and post-repair or post-construction assessments. The Working Group is also considering how community volunteers could contribute to the program.

3.1.1.8 Off-Site Source Recovery Project

The Off-Site Source Recovery Project has the responsibility to identify and as needed, to recover and store excess and unwanted sealed radiological sources on behalf of NNSA in cooperation with the U.S. Nuclear Regulatory Commission (NRC). From 1979 through 1999, DOE recovered excess and unwanted radioactive sealed sources containing plutonium-239 and beryllium on a case-by-case basis as requested by NRC. Since 1999, the Off-Site Source Recovery Project has assisted NNSA in managing actinide-bearing sealed sources and, in one case, strontium-90-bearing items that were recovered after being identified as potential threats to national security.

The LANL component of the current program disposes of recovered sources or places them in secure storage until a disposal path is available. Under the No Action Alternative, the Off-Site Source Recovery Project would continue to manage the same types and quantities of sealed sources as it has in the past. Sources containing actinide isotopes would be brought to LANL and safely stored if there were no other reasonable option to safely disposition the sources such as reuse or disposal. The Off-Site Source Recovery Project currently operates at the Chemistry and Metallurgy Research Building Key Facility, Pajarito Site Key Facility, Solid Radioactive and Chemical Waste Key Facilities, and Plutonium Facility Complex Key Facility. Activities related to this project are described as part of the specific capabilities of those Key Facilities.

3.1.1.9 Management of Construction Fill

Excavation during construction projects can result in large amounts of soil that cannot be immediately used for that project or in the immediate area. Uncontaminated construction fill is currently stored in two borrow areas at LANL, TA-61 and TA-16. This material can be used as backfill in other construction or remediation projects.

Excavation in TA-55 for the Chemistry and Metallurgy Research Replacement Facility (see Section 3.1.3.1) is expected to result in up to approximately 150,000 cubic yards of uncontaminated fill. The size of this excavation would bound excavation for other construction projects in this SWEIS. There is no capacity for storage of this amount of material at TA-55, and the fill would need to be transported by truck to the existing borrow areas or a similar to-be-determined location. At 10 cubic yards per truck load, there would be a total of 15,000 round trips between the TA-55 construction site and the destination borrow area over a period of 1 year.

Security concerns will determine the routing and timing of truck trips. One route would be west on Pajarito Road to Diamond Drive, and then either west on West Jemez Road to TA-16 or east on East Jemez Road to TA-61. An alternate route is east on Pajarito Road to NM 4, north to East Jemez Road, west on East Jemez either to TA-61 or to Diamond Drive and west on West Jemez Road to TA-16. The latter route would be the longest distance; from TA-55 to TA-16 would be approximately 20 miles.

3.1.2 Technical Area Projects

Under the No Action Alternative, changes will take place in a number of TAs. New facility construction; modification of existing structures; and facility or area upgrades would be undertaken to address security issues, building conditions, and increases or decreases in activities and personnel. These changes could result from programmatic initiatives, specific technical projects, implementation of corrective actions, or responses to environmental or other external concerns such as the Cerro Grande Fire.

Major changes anticipated for the TAs are identified in **Table 3–2** and described in this section.

3.1.2.1 Technical Area 3

TA-3 is the most populated area at LANL, with numerous buildings that support a variety of Key Facilities. As the center of technical, administrative, and physical support activities for LANL, TA-3 is the location of a number of new buildings and in-progress construction and office consolidation projects. The National Security Sciences Building, an eight-story building with approximately 275,000 square feet (25,500 square meters) of office, meeting, and light laboratory space, and its associated structures are under construction; the main building and parking structure have been completed and are in use. The existing building that was replaced by the National Security Sciences Building is planned to be demolished (NNSA 2001). Under the No Action Alternative, the Information Management Office Building, which would add approximately 15,000 to 18,000 square feet (1,400 to 1,700 square meters) of office space on two stories, was planned for the northeast corner of the intersection of Diamond Drive and Pajarito Road. Funding and location issues, however, have put this project on hold. Three additional two-story office buildings, each about 70 by 100 feet (21 by 30 meters) would provide about 15,000 to 17,000 gross square feet (1,400 to 1,600 square meters) of office space. Two of the buildings would be built due west of the existing Wellness Center; the third would be constructed near the northeast corner of the intersection of Mercury and Bikini Atoll Roads.

One general infrastructure project that would be completed at TA-3 under the No Action Alternative is the installation of two new combustion turbine generators, as evaluated in the *Environmental Assessment for the Installation and Operation of Combustion Turbine Generators at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2002l). This EA analyzed installation and operation of two new simple-cycle, gas-fired combustion turbine generators, each with an approximate output of 20 megawatts of electricity (rated at an elevation of 7,400 feet [2,220 meters]), as standalone structures within the Co-Generation Complex (Power Plant) at

TA-3. The installation site is immediately adjacent to existing structures and vehicle parking areas. No undeveloped areas would be involved. The first unit became operational in September 2007. There is presently no timetable for installing the second unit. See Chapter 4, Section 4.8.2.1 for more information about this project.

Table 3–2 Technical Area Projects and Activities

Activities	*No Action Alternative*	*Reduced Operations Alternative*	*Expanded Operations Alternative*
TA-3			
Installation of Combustion Turbine Generators	Install two 20-megawatt combustion turbine generators.	Same as No Action Alternative	Same as No Action Alternative
National Security Sciences Building	Demolish old building	Same as No Action Alternative	Same as No Action Alternative
Physical Science Research Complex Project	No activity	No activity	Construct the Physical Science Research Complex (see Appendix G).
Information Management Office Building Project	Construct Information Management Office Building	Same as No Action Alternative	Same as No Action Alternative
Replacement Office Buildings Project	Construct three office buildings.	Same as No Action Alternative	Construct up to 9 additional office buildings (see Appendix G).
TA-18			
TA-18 Closure Project, Including Remaining Operations Relocation and Structure DD&D	Continue certain Pajarito Site activities and store only Security Category III and IV materials. No DD&D activities would occur.	Remove all nuclear materials from the Pajarito Site. Shut the site down and place in surveillance and maintenance mode.	Remove all nuclear materials from the Pajarito Site. DD&D all buildings except a historic cabin and other historic properties from the Manhattan Project and Cold War eras that have been designated for long-term retention (see Appendix H).
TA-21			
TA-21 Structure DD&D Project	Deactivate tritium facilities and place in surveillance and maintenance mode.	Same as No Action Alternative	DD&D of structures located within the boundaries of TA-21 (see Appendix H).
TA-54			
MDA H Closure	Remediate and close MDA H in accordance with the Consent Order.	Same as No Action Alternative	Same as No Action Alternative
TA-62			
Science Complex Project	No activity	No activity	Construct and operate Science Complex (see Appendix G).
TA-72			
Remote Warehouse and Truck Inspection Station Project	No activity	No activity	Construct and operate Remote Warehouse and Truck Inspection Station (see Appendix G).

TA = technical area; DD&D = decontamination, decommissioning, and demolition; MDA = material disposal area; Consent Order = Compliance Order on Consent entered into by DOE, the University of California as the management and operating contractor, and the State of New Mexico.
Note: Italicized entries indicate projects for which project-specific impact analyses are included in appendices to this SWEIS.

3.1.2.2 Technical Area 18

Activities occurring in TA-18 are being discontinued in accordance with the ROD (67 *Federal Register* [FR] 79906) for the *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory (TA-18 EIS)* (DOE 2002i). TA-18 and the Pajarito Site Key Facility are used synonymously in this SWEIS because activities occurring in TA-18 are those assigned to the Pajarito Site Key Facility as defined in this SWEIS and because they are geographically identical. Closure of the Pajarito Site Key Facility is identified in this section because the Key Facility is within TA-18, but activities to implement closure are described in the Pajarito Site Key Facility sections of this Chapter (see Sections 3.1.3.9, 3.2.3, and 3.3.3.5).

3.1.2.3 Deactivation and Decontamination of Technical Area 21 Buildings

Historically, there have been two primary research areas in TA-21 – DP West and DP East. Buildings in DP West are primarily abandoned and deteriorating, with little process equipment present. DP West has been in LANL's decontamination and decommissioning program since 1992, and about half the facilities have been demolished. DP East still houses offices and some tritium facilities, but the remaining tritium work is moving to either the Weapons Engineering Tritium Facility in TA-16 or to Sandia National Laboratories in Albuquerque, New Mexico (*Final Environmental Assessment for the Proposed Consolidation of Neutron Generation Tritium Target Loading Production* [DOE 2005b]). The facilities will be deactivated as funding becomes available. Some buildings in DP East still contain equipment from current and recent operations that may contain accountable quantities of radioactive material. Most of this material would be removed during deactivation. Following deactivation, the tritium buildings will be placed in surveillance and maintenance mode along with the DP West buildings.

> **Decontamination, Decommissioning, and Demolition (DD&D)**
>
> Actions taken at the end of the useful life of a building or structure to reduce or remove substances that pose a substantial hazard to human health or the environment, retire it from service, and ultimately eliminate all or a portion of the structure.

3.1.2.4 Technical Area 54 Material Disposal Area H Closure

Material disposal area (MDA) H, located within TA-54, is a fenced site about 0.3 acres (0.12 hectares) in size that consists of nine inactive vertical inground shafts. Between 1960 and 1986, the site was used for burial of classified containerized and noncontainerized solid wastes, some of which were contaminated with radioactive, hazardous, and high explosives constituents. MDA H subsurface shafts contain primarily radioactive metal, most of which is either known or presumed to be depleted uranium. Investigations and studies for remediation of MDA H have been completed, and now NNSA needs to implement a corrective measure to comply with the legal requirements of the Atomic Energy Act of 1954, as amended, and the Compliance Order on Consent (Consent Order) entered into by DOE, the University of California as the management and operating contractor, and the State of New Mexico. As discussed in the following paragraphs, NNSA has completed its evaluations and is awaiting a decision from the New Mexico Environment Department.

The *Environmental Assessment for the Proposed Corrective Measures at Material Disposal Area H within Technical Area 54 at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2004e) evaluated five corrective measure options—three containment options and two excavation and removal options. For options involving in-place containment of wastes, physical controls (engineered barriers such as caps and containment barriers) and institutional controls (such as access restrictions) would be required for generations to come. As a result, long-term environmental stewardship requirements would be incorporated into any containment option.

The corrective measure option preferred by NNSA and recommended to the State of New Mexico for implementation in the *Corrective Measures Study Report for Material Disposal Area H, Solid Waste Management Unit 54-004, at Technical Area 54* (LANL 2003d) was replacement of the existing surface with an engineered evapotranspiration cover. Final selection of a corrective measure option was made by the New Mexico Environment Department in November 2007.

3.1.3 Key Facilities

3.1.3.1 Chemistry and Metallurgy Research Building

The Chemistry and Metallurgy Research Building, located within TA-3, is an actinide chemistry and metallurgy research facility. The only building currently in this Key Facility is the Chemistry and Metallurgy Research Building, a three-story, multiple-user facility in which specific wings are associated with different activities. It is the only LANL facility with full capabilities for performing special nuclear material analytical chemistry, materials characterization, and actinide R&D.

Although most capabilities and operating levels projected in the *1999 SWEIS* ROD (see Appendix A) for the Chemistry and Metallurgy Research Building are being retained as capabilities in this SWEIS, two important issues affect the capabilities and activity levels for this Key Facility. First, because of seismic concerns, DOE has administratively restricted operations and reduced the amount of nuclear material that can be used and stored in the building to levels lower than those projected in the *1999 SWEIS* ROD. Therefore, several capabilities are either operating at reduced levels or are not active. Second, as discussed later in this section, the Chemistry and Metallurgy Research Building has been identified for replacement and demolition. The impact analyses in this SWEIS are based on capabilities, activities, and operating levels presented in this section, regardless of whether they are administratively reduced or restricted and whether those activities would occur in the Chemistry and Metallurgy Research Building, its replacement facility, or both during a transition period.

The following paragraphs describe the capabilities of this Key Facility. **Table 3–3** indicates activity types and levels proposed under all three alternatives for each capability.

Table 3–3 Chemistry and Metallurgy Research Building Capabilities and Activity Levels [a]

Capability	*No Action Alternative* [b]	*Reduced Operations Alternative*	*Expanded Operations Alternative* [c]
Analytical Chemistry	Support actinide research and processing activities by processing approximately 7,000 samples per year.	Same as No Action Alternative	Support actinide research and processing activities by processing approximately 11,000 samples per year.[a]
Uranium Processing	Recover, process, and store LANL's highly enriched uranium inventory.	Same as No Action Alternative	Same as No Action Alternative
Destructive and Nondestructive Analysis	Evaluate up to 10 secondary assemblies per year through destructive and nondestructive analysis and disassembly.	Same as No Action Alternative	Same as No Action Alternative
Nonproliferation Training	Conduct nonproliferation training using special nuclear material.	Same as No Action Alternative	Same as No Action Alternative
Actinide Research and Development (Actinide Research and Processing in the *1999 SWEIS*)	Characterize approximately 100 samples per year using microstructural and chemical metallurgical analysis. Perform compatibility testing of actinides and other metals to study long-term aging and other material effects. Analyze transuranic waste disposal related to validation of WIPP performance assessment models. Perform transuranic waste characterization. Analyze gas generation such as could occur in transuranic waste during transportation to WIPP. Demonstrate actinide decontamination technology for soils and materials. Develop actinide precipitation method to reduce mixed wastes in LANL effluents. Process up to 900 pounds (400 kilograms) of actinides per year between TA-55 and the CMR Building.	Same as No Action Alternative	Same as No Action Alternative, plus: - Receive, disassemble, and analyze assemblies and components used to measure radiological effects on different materials. - Conduct Performance Demonstration Program to test nondestructive analysis and nondestructive examination equipment. - Develop small-scale (less than 2 pounds [1 kilogram] per year) actinide processing capability. - Perform gas-solid interfacial studies using surface-science instrumentation and associated techniques. - Investigate physical and mechanical properties of plutonium metal alloys.
Fabrication and Processing (Fabrication and Metallography in the *1999 SWEIS*)	Process up to 5,000 curies of neutron sources per year (both plutonium-238 and beryllium and americium-241 and beryllium sources). Process neutron sources other than sealed sources. Stage a total of up to 1,000 plutonium-238 and beryllium and americium-241 and beryllium neutron sources in Wing 9 floor holes. Produce 1,320 targets per year for isotope production. Separate fission products from irradiated targets. Support fabrication of metal shapes using highly enriched uranium (as well as related uranium processing activities), with an annual throughput of approximately 2,200 pounds (1,000 kilograms).	Same as No Action Alternative	Same as No Action Alternative, plus: - As a part of the Isotope Production Program, produce up to 100 curies per year of industrial or medical radioisotopes. - Produce up to 9 pounds (4 kilograms) per year of americium oxide. - Fabricate metal alloys. - Study and perform fabrication methods and effects of actinide materials thermomechanical processing. - *Increase types and quantities of sealed sources stored for the Off-Site Source Recovery Project* (see Appendix J).

Capability	***No Action Alternative*** [b]	***Reduced Operations Alternative***	***Expanded Operations Alternative*** [c]
Large Vessel Handling	Process up to two large vessels from the Dynamic Experiments Program annually.	Same as No Action Alternative	Same as No Action Alternative
Construction/Upgrades/DD&D			
Replacement of CMR Building	Construct and operate a CMRR Facility in TA-55 and conduct DD&D of the CMR Building. Wing 9 hot cell operations and certain other capabilities would be eliminated. The CMRR Facility would replace the CMR Building as the Key Facility.	Construct and operate only the radiological laboratory, administrative and support facility portion of the CMRR Facility; continue to down scope and consolidate operations within the existing CMR Building in performance of minimal mission support work.	Same as No Action Alternative, plus: - Reconstruct Wing 9 hot cell capabilities in proposed new *Radiological Sciences Institute* in TA-48 (see Section 3.3.3.7 and Appendix G).

WIPP = Waste Isolation Pilot Plant; TA = technical area; DD&D = decontamination, decommissioning, and demolition; CMR = Chemistry and Metallurgy Research, CMRR = Chemistry and Metallurgy Research Replacement Facility.

[a] Activity levels shown cannot be met while work is performed in the Chemistry and Metallurgy Research Building due to seismic concerns that restrict the level of operations and limit the allowable amount of nuclear materials. Full operations would be achievable upon movement of all activities into the new Chemistry and Metallurgy Research Replacement Facility.

[b] DOE 1999a.

[c] LANL 2004c, 2006a.

Note: Italicized entries indicate projects for which project-specific impact analyses are included in appendices to this SWEIS.

Analytical Chemistry. Analytical chemistry capabilities involve the study, evaluation, and analysis of radioactive materials. These activities support R&D associated with various nuclear materials programs, many of which are performed at other LANL locations on behalf of, or in support of, other sites across the DOE complex (such as the Hanford Site, Savannah River Site, and Sandia National Laboratories). Sample characterization activities include assay and determination of isotopic ratios of plutonium, uranium, and other radioactive elements; major and trace elements in materials; the content of gases; constituents at the surface of various materials; and methods to characterize waste constituents in hazardous and radioactive materials.

Uranium Processing. Uranium processing capabilities encompass many types of operations that are essential for uranium product stewardship, including uranium processing (casting, machining, and reprocessing operations, including R&D of process improvements and uranium and uranium compounds characteristics) and highly enriched uranium handling and storage. The Chemistry and Metallurgy Research Building also provides limited backup to support nuclear materials management needs for TA-55 activities, as well as pilot-scale unit operations to back up uranium technology activities at the Sigma Complex (described in Section 3.1.3.2), other LANL facilities, and other DOE sites.

Destructive and Nondestructive Analysis. Destructive and nondestructive analysis involves analytical chemistry, metallographic analysis, neutron- or gamma-radiation-based measurement, and other measurement techniques. These activities support weapons quality component surveillance, nuclear materials control and accountability, special nuclear material standards development, R&D, environmental restoration, and waste treatment and disposal.

Nonproliferation Training. Measurement technologies are used at the Chemistry and Metallurgy Research Building and other LANL facilities to train international inspection teams for the International Atomic Energy Agency. Such training might use special nuclear material.

Actinide Research and Development. Actinide research and processing at the Chemistry and Metallurgy Research Building typically involves solids or small quantities of solution. Research involving highly radioactive materials or remote handling, however, may use the hot cells in Wing 9 of the Chemistry and Metallurgy Research Building to minimize personnel exposure to radiation or other hazardous materials. Actinide research and processing can include separation of medical isotopes from targets, neutron source processing, and material characteristics research, including the behavior or characteristics of materials in extreme environments such as high temperatures or pressures.

The primary mission to study long-term aging and other material effects is achieved through microstructural and chemical metallurgical analysis and compatibility testing of actinides and other metals. This R&D is conducted in hot cells on pits exposed to high temperatures.

Fabrication and Processing. The Chemistry and Metallurgy Research Building has facilities to fabricate and analyze a variety of parts, including targets and weapons components used for various research and experimental tasks. Fabrication and processing at this building involve a variety of materials, including hazardous and nuclear materials. Much of the work is performed to support highly enriched uranium processing, R&D, pilot operations, and casting. Some metal recycling is conducted through these processes. In addition, materials to support these activities and the Off-Site Source Recovery Project are stored in the Wing 9 hot cell areas.

Large Vessel Handling. This capability would not begin until the Chemistry and Metallurgy Research Replacement Facility is operating. Large (6 to 8 feet [1.8 to 2.4 meters] in diameter) experimental vessels from the Dynamic Experiments Program would be cleaned and materials would be recovered for reuse or disposal. Large-vessel handling operations would begin with unloading and opening the vessel. The vessels would then be emptied and the contents would be sorted and packaged. Depending on the condition and quality of the special nuclear material recovered from the vessels, the material could be processed for reuse or prepared for disposal as transuranic waste. Other vessel contents would be disposed of as either low-level radioactive waste or transuranic waste. The empty vessel would be cleaned for disposal as low-level radioactive waste.

Replacement of Chemistry and Metallurgy Research Building. Because of the age and condition of the Chemistry and Metallurgy Research Building, NNSA decided to replace the building rather than upgrade it to meet structural requirements to address seismic concerns and code requirements for operation as a nuclear facility. As part of its decisionmaking process, NNSA prepared the *Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico* (*CMRR EIS*) (DOE 2003d). The *CMRR EIS* evaluates potential impacts of the proposed relocation of analytical chemistry and materials characterization activities and associated R&D

capabilities that currently exist primarily at the Chemistry and Metallurgy Research Building to a newly constructed Chemistry and Metallurgy Research Replacement Facility, as well as the continued performance of those operations and activities at the new facility for the next 50 years. The *CMRR EIS* ROD (69 FR 6967) announced NNSA's decision to replace the Chemistry and Metallurgy Research Building with a new facility in TA-55, the Chemistry and Metallurgy Research Replacement Facility, followed by decontamination, decommissioning, and demolition (DD&D) of the existing Chemistry and Metallurgy Research Building. The replacement facility will comprise a nuclear facility portion (a Nuclear Hazard Category 2 laboratory building) and a separate radiological laboratory, administrative office, and support building.

Phased construction began in 2006. The radiological laboratory, administrative office, and support building will be constructed first and will house office space, training facilities, utility equipment, and laboratory space designed to handle small amounts of special nuclear material. Construction of the nuclear facility portion, capable of handling larger quantities of special nuclear material has been delayed until NNSA completes reconsideration of its 2004 decision to construct this facility at LANL. If located at LANL, the transition of capabilities and operations to the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility would begin at construction completion. Not all Chemistry and Metallurgy Research Building capabilities would be moved to the new facility: Wing 9 hot cell operations, medical isotope production, uranium production, surveillance activities, and other capabilities would be eliminated.

Transition of operations from one facility to the other is anticipated to occur in stages and is expected to take about 4 years to complete. During the transition period, both facilities would be operating, although at reduced levels. Activities would decrease at the Chemistry and Metallurgy Research Building while increasing at the new replacement facility. Routine onsite shipments of analytical chemistry and materials characterization samples would continue during the transition period.

The Key Facility would comprise both the Chemistry and Metallurgy Research Building and its replacement during the transition period. After the transition period, the Chemistry and Metallurgy Research Replacement Facility would become the Key Facility.

3.1.3.2 Sigma Complex

The Sigma Complex Key Facility, located in TA-3, consists of the main Sigma Building and its associated support structures, including the Beryllium Technology Facility, the Press Building, and the Thorium Storage Building. The Sigma Building contains four levels and approximately 200,000 square feet (60,960 square meters) of space.

The Sigma Complex supports a large multidisciplinary technology base in materials fabrication science. Primary activities are materials synthesis and processing, characterization of materials, and fabrication of metallic and ceramic items, including depleted uranium items used in the Stockpile Stewardship Program. Bulk depleted uranium is stored in the Sigma Building as supply and feed stock. Current activities in the Sigma Building focus on test hardware, prototype fabrication, and materials research for the DOE Nuclear Weapons Program, but also include activities related to energy, environment, industrial competitiveness, and strategic research.

Sigma Complex Key Facility capabilities include R&D on materials fabrication, coating, joining, and processing; characterization of materials; and fabrication of metallic and ceramic items. The following paragraphs describe the capabilities of this Key Facility. **Table 3–4** indicates activity types and levels proposed under all three alternatives for each capability.

Table 3–4 Sigma Complex Capabilities and Activity Levels

Capability	***No Action Alternative*** [a]	***Reduced Operations Alternative***	***Expanded Operations Alternative*** [b]
Research and Development on Materials Fabrication, Coating, Joining, and Processing	Fabricate items from metals, ceramics, salts, beryllium, enriched and depleted uranium, and other uranium isotope mixtures. Fabrication techniques would include casting, forming, machining, polishing, coating, and joining.	Same as No Action Alternative	Same as No Action Alternative
Characterization of Materials	Perform research and development on properties of ceramics, oxides, silicides, composites, and high-temperature materials. Analyze up to 36 tritium reservoirs per year. Develop a library of aged nonspecial nuclear material from stockpiled weapons and develop techniques to test and predict changes. Characterize and store up to 2,500 nonspecial nuclear material samples per year, including uranium.	Same as No Action Alternative	Same as No Action Alternative
Fabrication of Metallic and Ceramic Items	Fabricate stainless steel and beryllium components for up to 80 pits per year. Fabricate up to 200 reservoirs for tritium per year. Fabricate components for up to 50 secondary assemblies (of depleted uranium, depleted uranium alloy, enriched uranium, deuterium, and lithium) per year. Fabricate nonnuclear components for research and development: 100 major hydrotests and 50 joint test assemblies per year. Fabricate beryllium targets. Fabricate targets and other components for accelerator production of tritium research. Fabricate test storage containers for nuclear materials stabilization.	Same as No Action Alternative	Same as No Action Alternative
Construction/Upgrades/DD&D			
	No activity	No activity	No activity

DD&D = decontamination, decommissioning, and demolition.
[a] DOE 1999a.
[b] LANL 2004c, 2006a.

Research and Development on Materials Fabrication, Coating, Joining, and Processing. Materials synthesis and processing work includes R&D related to making items out of difficult-to-work-with materials. Processes include applying coatings and joining materials using plasma arc welding and other techniques. Other activities include casting, forming, machining, and polishing. Materials used in fabrication are also reprocessed (separated into pure forms for reuse or storage).

Characterization of Materials. Materials characterization work conducted at the Sigma Complex includes activities to enhance understanding of the properties of metals, metal alloys, ceramic-coated metals, and other similar combinations. Materials characterization also includes activities to improve understanding of the effects of aging, chemical attack, mechanical stresses, and other agents on these materials and their properties.

Fabrication of Metallic and Ceramic Items. Materials fabrication at the Sigma Complex includes work with metallic and ceramic materials and combinations thereof. Items are fabricated as one-of-a-kind and prototype pieces, as well as on a limited-production basis. One specific set of applications for this technology is fabrication of nonnuclear weapons components.

3.1.3.3 Machine Shops

The Machine Shops Key Facility consists of two buildings, a Nonhazardous Materials Machine Shop and a Radiological Hazardous Materials Machine Shop. These buildings are located in TA-3 and are connected to each other by a 125-foot-long (38-meter-long) corridor. The Nonhazardous Materials Machine Shop is approximately 138,000 square feet (42,060 square meters), including a 13,500-square-foot (4,120-square-meter) administrative office area. This building contains a variety of lathes, mills, and other metal-forming equipment and also houses the old beryllium shop, which is ventilated through a high-efficiency particulate air filtration system. Equipment from the beryllium shop was moved to the Sigma Complex in 2000, and beryllium operations ceased in 2001. A number of modular units have been constructed on the north side of the Nonhazardous Materials Machine Shop to provide space in which to conduct prototype mockup operations for TA-55, PF-4 Building.

The Radiological Hazardous Materials Machine Shop has a total floor space of approximately 12,500 square feet (1,160 square meters) and contains a variety of metal fabrication machines. Depleted uranium represents the bulk of the materials used in this facility, although many other potentially hazardous materials, such as lithium compounds, are used.

Activities conducted at the machine shops include machining, welding, and assembly of various materials in support of major LANL programs and projects, principally those related to weapons manufacturing.

The following paragraphs describe the capabilities of this Key Facility. **Table 3–5** indicates activity types and levels proposed under all three alternatives for each capability.

Fabrication of Specialty Components. The primary purpose of the Machine Shops Key Facility is fabrication of specialty components. Specialty components are unique, unusual, or one-of-a-kind parts, fixtures, tools, or other equipment.

Fabrication Utilizing Unique Materials. Parts and components are fabricated using unique or exotic materials at the machine shops. Components are fabricated from depleted uranium or lithium in support of NNSA programs, for example.

Table 3–5 Machine Shops Capabilities and Activity Levels

Capability	*No Action Alternative* [a]	*Reduced Operations Alternative*	*Expanded Operations Alternative* [b]
Fabrication of Specialty Components	Provide fabrication support for the Dynamic Experiments Program and explosives research studies. Support up to 100 hydrodynamic tests annually. Manufacture 50 joint test assembly sets annually. Provide general laboratory fabrication support as requested.	Same as No Action Alternative	Same as No Action Alternative
Fabrication Using Unique Materials	Fabricate items using unique and unusual materials such as depleted uranium and lithium.	Same as No Action Alternative	Same as No Action Alternative
Dimensional Inspection of Fabricated Components	Perform dimensional inspections of finished components. Perform other types of measurements and inspections.	Same as No Action Alternative	Same as No Action Alternative
Construction/Upgrades/DD&D			
	No activity	No activity	No activity

DD&D = decontamination, decommissioning, and demolition.
[a] DOE 1999a.
[b] LANL 2004c, 2006a.

Dimensional Inspection of Fabricated Components. Dimensional inspection of the finished component is a standard step in the fabrication process. It involves numerous measurements to ensure that the component is the correct size and shape to fit into its allotted space and perform its intended function.

3.1.3.4 Material Sciences Laboratory

This Key Facility comprises several buildings in TA-3 (3-32, 3-34, 3-1698, 3-1819, and 3-2002). The main Material Sciences Laboratory (Building-3-1698), a two-story, approximately 55,000-square-foot (5,100-square-meter) laboratory building, contains 27 laboratories, 60 offices, and 21 materials research and support areas. This Key Facility supports four major types of experimentation: materials processing, mechanical behavior in extreme environments, advanced materials development, and materials characterization. These four areas contain operational capabilities that support materials research activities related to energy, environment, nuclear weapons, and industrial competitiveness. Collaboration with private industry is also an important feature of much of the work performed at the Material Sciences Laboratory. Given the dynamic nature of research, the types and number of experiments will continue to evolve. These changes, however, can be sufficiently characterized to allow analysis of their consequences within the context of this SWEIS.

The following paragraphs describe the capabilities of this Key Facility. **Table 3–6** indicates activity types and levels proposed under all three alternatives for each capability.

Table 3–6 Material Sciences Laboratory Capabilities and Activity Levels

Capability	*No Action Alternative* [a]	*Reduced Operations Alternative*	*Expanded Operations Alternative* [b]
Materials Processing	Support development and improvement of technologies for materials formulation. Support development of chemical processing technologies, including recycling and reprocessing techniques to solve environmental problems.	Same as No Action Alternative	Same as No Action Alternative
Mechanical Behavior in Extreme Environments	Study fundamental properties of materials and characterize their performance, including research on the aging of weapons. Develop and improve techniques for these and other types of studies.	Same as No Action Alternative	Same as No Action Alternative
Advanced Materials Development	Synthesize and characterize single crystals and nanophase and amorphous materials. Perform ceramics research, including solid-state, inorganic chemical studies involving materials synthesis. A substantial amount of effort in this area would be dedicated to producing new high-temperature superconducting materials. Provide facilities for synthesis and mechanical characterization of materials systems for bulk conductor applications. Develop and improve techniques for development of advanced materials.	Same as No Action Alternative	Same as No Action Alternative
Materials Characterization	Perform materials characterization activities to support materials development.	Same as No Action Alternative	Same as No Action Alternative
Construction/Upgrades/DD&D			
	No activity	No activity	No activity

DD&D = decontamination, decommissioning, and demolition.
[a] DOE 1999a.
[b] LANL 2004c, 2006a.

Materials Processing. Materials processing supports formulation of a wide range of useful materials through development of materials fabrication and chemical processing technologies. Wet chemistry, thermomechanical processing, microwave processing, heavy-equipment materials processing, single-crystal growth, amorphous alloys, and powder processing are synthesis and processing techniques that represent some of the capabilities available for this research area.

Some of the laboratories housing heavy equipment for novel mechanical processing of powders and nondense materials are configured to explore net shape and zero-waste manufacturing processes. Several laboratories are dedicated to development of chemical processing technologies, including recycling and reprocessing techniques to solve current environmental problems.

Mechanical Behavior in Extreme Environments. These laboratories contain equipment for mechanical testing of materials subjected to a broad range of mechanical loadings to study their fundamental properties and characterize their performance. Laboratories utilized for this major area of materials science include dedicated space for mechanical testing; mechanical fabrication, assembly, and machining research; metallography; and dynamic testing.

The mechanical testing laboratory offers capabilities to study multi-axial, high-temperature, and high-load behaviors of materials. Assembly areas consist of metalworking and experimental assembly areas that house a variety of electrically or hydraulically powered machines that twist, pull, or compress samples. The most energetic of these is a gas launcher, which projects a sample against an anvil at very high velocities. The Material Sciences Laboratory's dynamic materials behavior laboratory is used by researchers to study high-deformation-rate behaviors. The dynamic testing equipment allows materials to be subjected to high-rate loadings, including impact up to 1.2 miles (2 kilometers) per second. The metallography area contains equipment for sectioning, mounting, polishing, and photographing samples.

Advanced Materials Development. The various laboratories are configured for development of advanced materials for high-strength and high-temperature applications. Capabilities involve research in synthesis and characterization using ceramics, superconductors, and new materials.

Materials Characterization. The materials characterization capability aids researchers in understanding the properties and processing of materials and applying that understanding to materials development. Capabilities at these laboratories include x-ray, optical metallography, spectroscopy, and surface-science chemistry.

The x-ray laboratory allows for the study of samples at temperatures up to 4,892 degrees Fahrenheit (°F) (2,700 degrees Celsius [°C]) and pressures up to 80 kilobars. Optical characterization is conducted with the latest equipment in the metallography and ceramography support laboratory. Subnanometer to micrometer structures are characterized using electron microscopy, including chemical analysis and high-resolution electron holography. The optical spectroscopy laboratory performs ultrafast and continuous-wave, tunable-resonance Raman scattering spectroscopy; high-resolution Fourier Transform infrared absorption; and ultraviolet-visible to near-infrared absorption spectroscopy. Surface-science studies and corrosion characterization of materials are carried out in additional laboratories.

3.1.3.5 Nicholas C. Metropolis Center for Modeling and Simulation

The Nicholas C. Metropolis Center for Modeling and Simulation (Metropolis Center) is a new Key Facility and an integral part of the tri-laboratory (LANL, Lawrence Livermore National Laboratory, and Sandia National Laboratories) mission to maintain, monitor, and ensure the Nation's nuclear weapons performance through the Advanced Simulation and Computing Program. The facility is housed in a three-story, 303,000-square-foot (28,200-square-meter) structure in TA-3 and has been in operation since 2002. High-performance, complex computing operations are performed at this facility. Together with the Laboratory Data Communication Center, Central Computing Facility, and Advanced Computing Laboratory, the Metropolis Center forms the center for high-performance computing at LANL.

Under the No Action Alternative, the Metropolis Center computing platform would operate at up to 50 teraflops.[1] Computer operations are performed 24 hours a day, with personnel occupying

[1] *A teraflop is a trillion floating point operations per second.*

the control room to support computer operation activities during prime business hours and other times as necessary. Operations consist of office-type activities, light laboratory work such as computer and support equipment assembly and disassembly, and computer operations and maintenance. The Metropolis Center has capabilities to enable remote-site users access to the computing platform, and its co-laboratories and theaters are equipped for distance operations to allow collaboration between weapons designers and engineers across the DOE weapons complex.

The following paragraph describes the capabilities of this Key Facility. **Table 3–7** indicates activity levels proposed under all three alternatives.

Computer Simulations. Computer simulations have become the only means of integrating the many complex processes that occur in the nuclear weapon lifespan. Large-scale calculations are now the primary tools for estimating nuclear yield and evaluating the safety of aging weapons in the nuclear stockpile. Continued certification of aging stockpile safety and reliability depends upon the ability to perform highly complex, three-dimensional computer simulations.

Table 3–7 Nicholas C. Metropolis Center for Modeling and Simulation Capabilities and Activity Levels

Capability	*No Action Alternative*	*Reduced Operations Alternative*	*Expanded Operations Alternative*
Computer Simulations	Perform complex three-dimensional computer simulations to estimate nuclear yield and aging effects to demonstrate nuclear stockpile safety. Apply computing capability to solve other large-scale, complex problems.	Same as No Action Alternative	Same as No Action Alternative, plus: Operate computing platform at higher computational capabilities.
Construction/Upgrades/DD&D			
Metropolis Center Increased Level of Operations	No activity	No activity	Install additional processors to increase functional capability. This expansion would involve addition of mechanical and electrical equipment, including chillers, cooling towers, and air-conditioning units (see Appendix J).

DD&D = decontamination, decommissioning, and demolition.
Note: Italicized entries indicate projects for which project-specific impact analyses are included in appendices to this SWEIS.

3.1.3.6 High Explosives Processing Facilities

High Explosives Processing Facilities are located in six TAs: TA-8, TA-9, TA-11, TA-16, TA-22, and TA-37. This Key Facility includes production and assembly buildings, analytical laboratories, explosives storage magazines, and a building to treat wastewater contaminated with explosives. Activities under the No Action Alternative would require an estimated 82,700 pounds (37,500 kilograms) of explosives and 2,910 pounds (1,320 kilograms) of mock explosives annually (this is an indicator of overall activity levels in this Key Facility).

The following paragraphs describe the capabilities of this Key Facility. **Table 3–8** indicates activity types and levels proposed under all three alternatives for each capability.

Table 3–8 High Explosives Processing Facilities Capabilities and Activity Levels

Capability	*No Action Alternative* [a]	*Reduced Operations Alternative*	*Expanded Operations Alternative*
Volume of Explosives Required (indicator of overall activity levels)	High-explosives processing activities would use approximately 82,700 pounds (37,500 kilograms) of explosives and 2,910 pounds (1,320 kilograms) of mock explosives annually.	High-explosives processing activities would use approximately 66,160 pounds (30,000 kilograms) of explosives and 2,330 pounds (1,060 kilograms) of mock explosives annually, a 20 percent reduction in activity levels from the No Action Alternative.	Same quantity of explosives as the No Action Alternative, plus: Increase to 5,000 pounds (2,270 kilograms) of mock explosives.[b]
High Explosives Synthesis and Production	Perform high explosives synthesis and production research and development. Produce new materials for research, stockpile, military, security-interest, and other applications. Formulate, process test, and evaluate explosives.	Reduce activity levels by 20 percent from the No Action Alternative.	Same as No Action Alternative
High Explosives and Plastics Development and Characterization	Evaluate stockpile returns and materials of specific interest. Develop and characterize new plastics and high explosives for stockpile, military, and security interest improvements. Improve predictive capabilities. Research high explosives waste treatment methods.	Reduce activity levels by 20 percent from the No Action Alternative.	Same as No Action Alternative
High Explosives and Plastics Fabrication	Perform stockpile surveillance and process development. Supply parts to the Pantex Plant for surveillance and stockpile rebuilds and joint test assemblies. Fabricate materials for specific military, security-interest, hydrodynamic, and environmental testing.	Reduce activity levels by 20 percent from the No Action Alternative.	Same as No Action Alternative
Test Device Assembly	Assemble test devices. Perform radiographic examination of assembled devices to support stockpile-related hydrodynamic tests, joint test assemblies, environmental and safety tests, and R&D activities. Support up to 100 major hydrodynamic test device assemblies annually.	Reduce activity levels by 20 percent from the No Action Alternative, including supporting up to 80 major hydrodynamic test device assemblies annually.	Same as No Action Alternative
Safety and Mechanical Testing	Conduct safety and environmental testing related to stockpile assurance and new materials development. Conduct up to 15 safety and mechanical tests annually.	Reduce activity levels by 20 percent from the No Action Alternative, including conducting up to 12 safety and mechanical tests annually.	Same activities as No Action Alternative, plus: Increase up to 500 safety and mechanical tests conducted annually.[c]

Capability	No Action Alternative [a]	Reduced Operations Alternative	Expanded Operations Alternative
Research, Development, and Fabrication of High-Power Detonators	Continue to support stockpile stewardship and management activities. Manufacture up to 40 major product lines per year. Support DOE-wide packaging and transport of electro-explosive devices.	Reduce activity levels by 20 percent from the No Action Alternative, including manufacturing up to 32 major product lines per year.	Same as No Action Alternative
Construction/Upgrades/DD&D			
Engineering and Science Applications Consolidation Project	Complete construction of TA-16 Engineering Complex. Remove or demolish vacated structures that are no longer needed.	Same as No Action Alternative	Same as No Action Alternative

R&D = research and development; DD&D = decontamination, decommissioning, and demolition; TA = technical area.
[a] DOE 1999a.
[b] LANL 2004c.
[c] LANL 2006a.

High Explosives Synthesis and Production. Activities under this capability include explosive manufacturing capacity such as synthesizing new explosives and manufacturing pilot-plant quantities of raw and plastic-bonded explosives. These operations allow the LANL contractor to develop and maintain expertise in explosive materials and processes that is essential for long-term maintenance of stockpile weapons and materials.

High Explosives and Plastics Development and Characterization. Activities included in this capability provide characterization data for explosives applications in nuclear weapons technology. Information on the initiation and detonation properties of high explosives coupled with non-high explosives component information for modeling is essential to weapons design and safety analysis. A wide range of plastic and composite materials is used in nuclear weapons such as adhesives, potting materials, flexible cushions and pads, thermoplastics, and elastomers. A thorough understanding of the chemical and physical properties of these materials is necessary to effectively model weapons behavior.

High Explosives and Plastics Fabrication. High explosives powders are typically compacted into solid pieces and machined to final specified shapes. Some small pieces are pressed into final shapes, and some powders, based upon their properties, are melted into stock pieces. Fabrication of plastic materials and components is a core capability associated with high explosives processing, and a wide variety of plastic and composite materials may be fabricated.

Test Device Assembly. This capability provides the capacity to assemble test devices ranging from full-scale nuclear-explosive-like assemblies (where fissile material has been replaced by inert material) to materials characterization tests. In addition to assembly operations, this Key Facility conducts explosives testing support and radiography examinations of the final assemblies.

Safety and Mechanical Testing. Capabilities exist for measuring mechanical properties of explosives samples, including tensile, compression, and creep properties (change of materials shapes over time). Test assemblies can be instrumented with strain or pressure gauges or other diagnostic equipment.

Research, Development, and Fabrication of High-Power Detonators. This capability includes activities such as detonator design; printed circuit manufacture; metal deposition and joining; plastic materials technology development; explosives loading, initiation, and diagnostics; laser production; and explosives systems design, development, and manufacture safety. Detonators, cables, and firing systems for tests are built as part of this capability.

Construction, Upgrades, and DD&D. Under all three alternatives, the Engineering and Science Applications Consolidation would be completed. This consolidation was evaluated in the *Environmental Assessment for the Proposed TA-16 Engineering Complex Refurbishment and Consolidation at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2002e), and involves constructing or remodeling TA-16 Engineering Complex offices, laboratories, and shops. Operations and personnel would be consolidated from facilities in TA-3, TA-8, TA-11, TA-50, and other areas of TA-16. Six new buildings (two office buildings, two machine shops, a crafts support building, and a calibration laboratory) would be constructed, and two other existing TA-16 Engineering Complex buildings would be remodeled. Some vacated structures would be removed or demolished. Existing Engineering Complex roads, parking, fencing, and utilities would be modified or upgraded. Proposed construction sites are located in areas that were once occupied by buildings or structures, are within existing paved parking areas, or are in areas immediately adjacent to existing buildings and parking areas.

3.1.3.7 High Explosives Testing Facilities

The major High Explosives Testing Facilities buildings are located in TA-15 and include the Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility. These buildings are used primarily for R&D, test operations, and detonator development and testing related to the DOE Stockpile Stewardship Program. Building types include preparation and assembly facilities, bunkers, analytical laboratories, high explosives storage magazines, and office areas. Firing sites are located in five TAs (TA-14, TA-15, TA-36, TA-39, and TA-40). All of the firing sites are in remote locations within canyons and specialize in experimental studies of the dynamic properties of materials under high-pressure and -temperature conditions. The firing sites, which occupy approximately 22 square miles (57 square kilometers) of land area, represent more than half of LANL's total 40 square miles (104 square kilometers).

The No Action Alternative includes about 1,800 experiments per year, 100 of which would be characterized as major hydrodynamic tests. Up to 6,900 pounds (3,130 kilograms) of depleted uranium would be expended in experiments annually. Firing site activities would include expenditures of materials that are considered to be useful indicators of overall test activity.

The following paragraphs describe the capabilities of this Key Facility. **Table 3–9** indicates activity types and levels proposed under all three alternatives for each capability.

Hydrodynamic Tests. Hydrodynamic tests are dynamic integrated systems tests of mockup nuclear packages during which high explosives are detonated and resulting motions and reactions of materials and components are observed and measured. Explosively generated pressures and temperatures cause some materials to behave hydraulically (like a fluid). Surrogate materials such as depleted uranium replace actual weapons materials in the mockup nuclear weapons package to ensure there is no potential for a nuclear explosion. Most hydrodynamic tests are conducted at TA-15; others are conducted at TA-36.

Table 3–9 High Explosives Testing Facilities Capabilities and Activity Levels

Capability	*No Action Alternative* [a]	*Reduced Operations Alternative*	*Expanded Operations Alternative* [b]
Volume of Materials Required (indicator of overall activity levels)	Conduct about 1,800 experiments per year. Use up to 6,900 pounds (3,130 kilograms) of depleted uranium in experiments annually.	Reduce activity levels by 20 percent from the No Action Alternative: - Conduct about 1,440 experiments per year. - Use up to 5,500 pounds (2,500 kilograms) of depleted uranium in experiments annually.	Same as No Action Alternative
Hydrodynamic Tests	Develop containment technology. Conduct baseline and code development tests of weapons configurations. Conduct 100 major hydrodynamic tests per year.	Reduce activity levels by 20 percent from the No Action Alternative. Conduct approximately 80 major hydrodynamic tests per year.	Same as No Action Alternative
Dynamic Experiments	Conduct dynamic experiments to study properties and enhance understanding of the basic physics and equation of state and motion for nuclear weapons materials, including some special nuclear material experiments.	Reduce activity levels by 20 percent from the No Action Alternative: No experiments would use special nuclear material.	Same as No Action Alternative
Explosives Research and Testing	Conduct tests to characterize explosive materials.	Reduce activity levels by 20 percent from the No Action Alternative.	Same as No Action Alternative
Munitions Experiments	Support the U.S. Department of Defense with R&D on conventional munitions. Conduct experiments to study external-stimuli effects on munitions.	Reduce activity levels by 20 percent from the No Action Alternative.	Same as No Action Alternative
High Explosives Pulsed-Power Experiments	Conduct experiments using explosively driven electromagnetic power systems.	Reduce activity levels by 20 percent from the No Action Alternative.	Same as No Action Alternative
Calibration, Development, and Maintenance Testing	Perform experiments to develop and improve techniques to prepare for more involved tests.	Reduce activity levels by 20 percent from the No Action Alternative.	Same as No Action Alternative
Other Explosives Testing	Conduct advanced high explosives or weapons evaluation studies.	Reduce activity levels by 20 percent from the No Action Alternative.	Same as No Action Alternative
Construction/Upgrades/DD&D			
Dynamic Experimentation Consolidation Project [c]	Complete construction of 15 to 25 new structures (offices, laboratories, and shops) within the Two-Mile Mesa Complex to replace about 59 structures currently used for dynamic experimentation operations. Remove or demolish vacated structures.	Same as No Action Alternative	Same as No Action Alternative
DARHT EIS [d]	Install dynamic experimentation structure at TA-15.	Same as No Action Alternative	Same as No Action Alternative

R&D = research and development; DD&D = decontamination, decommissioning, and demolition; DARHT = Dual Axis Radiographic Hydrodynamic Test Facility; EIS = environmental impact statement; TA = technical area.
[a] DOE 1999a.
[b] LANL 2004c, 2006a.
[c] DOE 2003e.
[d] DOE 1995a.

Dynamic Experiments. A dynamic experiment is an experiment that provides information regarding basic physics of materials or characterizes physical changes or motion of materials under influence of high explosives detonations. Most dynamic experiments are conducted at TA-15 and TA-36; some are conducted at TA-39 and TA-40. DOE could perform dynamic experiments using plutonium in the future at DARHT and other facilities. Dynamic experiments involving plutonium would be conducted inside containment vessels.

Explosives Research and Testing. Explosives research and testing activities would be conducted primarily to study properties of the explosives themselves as opposed to explosive effects on other materials. Examples include tests to determine effects of aging on explosives, safety and reliability of explosives from a quality assurance point of view, and fire resistance of explosives. Explosives research and testing activities could be performed at any of the High Explosives Testing sites.

Munitions Experiments. Munitions experiments study the influence of external stimuli, for example, projectiles or other impacts on explosives. These studies include work on conventional munitions for the U.S. Department of Defense. Most of the munitions experiments are performed at TA-36 and TA-39, but any of the firing sites could be used as required.

High Explosives Pulsed-Power Experiments. High explosives pulsed-power experiments are conducted to develop and study new concepts based on explosively driven electromagnetic power systems. These experiments are conducted primarily at TA-39.

Calibration, Development, and Maintenance Testing. This testing involves experiments conducted primarily to prepare for more elaborate tests and includes tests to develop, evaluate, and calibrate diagnostic instrumentation or other systems. Calibration, development, and maintenance testing activities are concentrated at TA-15 and TA-36, but could involve any of the High Explosives Testing sites. Activities within this capability also include image processing capability maintenance.

Other Explosives Testing. This capability includes activities such as advanced high explosives development and work to improve weapons evaluation techniques.

Construction, Upgrades, and DD&D. Under all three alternatives, portions of this Key Facility would be relocated to one centralized area, as analyzed in the *Final Environmental Assessment for the Proposed Consolidation of Certain Dynamic Experimentation Activities at the Two-Mile Mesa Complex, Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2003e). This project would consolidate operations of the LANL organization responsible for dynamic experimentation within the Two-Mile Mesa Complex (portions of TA-6, TA-22, and TA-40). The project includes constructing 15 to 25 new structures over a 10-year timeframe to replace about 59 structures in a number of TAs. These new structures would consist of two to five combination office and laboratory buildings, a Characterization of Highly Energetic Materials Laboratory, an Engineering Diagnostic Facility, five Contained Firing Capability buildings and associated support structures, a High-Bay Laboratory, a Detonator Qualification Laboratory, two to four Gas Gun Facility buildings, a machine shop, a Classified High Explosives Storage Building, and a lecture hall. This project would also involve upgrading or constructing new roads, parking, fencing, and utilities within the Two-Mile Mesa Complex, including construction of a new road and security gate to provide access to the Dynamic Experimentation Facility. In addition, the project provides for removal or demolition of some of the vacated structures.

Another project for this Key Facility would be the possible assembly, installation, and operation of a containment structure for assembling components into test assemblies for dynamic experimentation. Currently, test components are assembled in TA-16. Completed test assemblies are then transported to TA-8 for radiographic examination, after which they are transported to the firing site in TA-15. The proposed structure, to be located at TA-15, is designed to contain any explosions that could occur during test component assembly. The *Final Environmental Impact Statement*, *Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility* (*DARHT EIS*) (DOE 1995a) evaluates containment options for dynamic experiments at the DARHT facility, including containment vessels and a building addition.

Assembly and radiography operations would be collocated in this containment structure at the DARHT firing site, which would reduce test assembly transportation. This would reduce security risks and the risk of vibration-induced explosions during transport. Risks to the environment and collocated workers would also be substantially reduced compared to those associated with facilities currently used for these activities. The containment structure would be brought to the LANL site in sections for assembly adjacent to the DARHT firing site in TA-15, and could be used to support other DARHT tests.

3.1.3.8 Tritium Facilities

The Weapons Engineering Tritium Facility in TA-16 is the principal building in this Key Facility. The Tritium Science and Fabrication Facility in TA-21 had been part of this Key Facility, but operations in this building have ceased and those operations have been moved to the Weapons Engineering Tritium Facility and another DOE site as discussed in Section 3.1.2.3. In the past, tritium operations were conducted in the Tritium Systems Test Assembly Facility in TA-21, but that building is no longer used and is also no longer part of the Tritium Facilities Key Facility. Some equipment is being removed from the building, and the building is in surveillance and maintenance mode. Residual tritium is present in the Tritium Systems Test Assembly and will remain until completion of decontamination activities.

The following paragraphs describe the capabilities of this Key Facility. **Table 3–10** indicates activity types and levels proposed under all three alternatives for each capability. The activity levels shown in the table may not be possible during the entire period covered by this SWEIS. An updated probabilistic seismic hazard analysis (LANL 2007a) was completed in 2007 which indicated a greater seismic risk than previously recognized. To mitigate the accident risk associated with the increased seismic risk, a limitation on the amount of tritium used in the Weapons Engineering Test Facility was imposed pending completion of a facility-specific seismic analysis (LANL 2007b, NNSA 2007c).

Table 3–10 Tritium Facilities Capabilities and Activity Levels [a]

Capability	*No Action Alternative* [b]	*Reduced Operations Alternative*	*Expanded Operations Alternative*
High-Pressure Gas Fills and Processing	Handle and process tritium gas in quantities of about 3.5 ounces (100 grams) approximately 65 times per year at the Weapons Engineering Tritium Facility.	Same as No Action Alternative	Same as No Action Alternative
Gas-Boost System Testing and Development	Conduct gas-boost system R&D and testing and gas processing operations at the Weapons Engineering Tritium Facility approximately 35 times per year using quantities of about 3.5 ounces (100 grams) of tritium.	Same as No Action Alternative	Same as No Action Alternative
Diffusion and Membrane Purification	Conduct research on gaseous tritium movement and penetration through materials—perform up to 100 major experiments per year. Use this capability for effluent treatment.	Same as No Action Alternative	Same as No Action Alternative
Metallurgical and Material Research	Conduct metallurgical and materials research and application studies, and tritium effects and properties R&D. Small amounts of tritium would be used for these studies.	Same as No Action Alternative	Same as No Action Alternative
Gas Analysis	Measure the composition and quantities of gases (in support of tritium operations).	Same as No Action Alternative	Same as No Action Alternative
Calorimetry	Perform calorimetry measurements in support of tritium operations.	Same as No Action Alternative	Same as No Action Alternative
Solid Material and Container Storage	Store about 35 ounces (1,000 grams) of tritium inventory in process systems and samples, inventory for use, and waste.	Same as No Action Alternative	Same as No Action Alternative for TA-16 operations. Eliminate TA-21 activities.
Hydrogen Isotopic Separation	Perform R&D of tritium gas purification and processing in quantities of about 7 ounces (200 grams) of tritium per test.	Same as No Action Alternative	Same as No Action Alternative
Radioactive Liquid Waste Pretreatment	Pretreat liquid low-level radioactive waste at TA-21 prior to transport for treatment. Activity ends with decommissioning of TA-21 tritium buildings.	Same as No Action Alternative	Same as No Action Alternative
Construction/Upgrades /DD&D			
TA-21 Structure DD&D Project	No activity	No activity	Implement *TA-21 Structure DD&D Project (see Section 3.3.2.2)*: - DD&D of TA-21 buildings. - Eliminate TA-21 buildings from Tritium Key Facilities.

R&D = research and development; DD&D = decontamination, decommissioning, and demolition; TA = technical area.

[a] Activity levels shown may not be met while there are restrictions on operations instituted due to seismic concerns related to the updated probabilistic seismic hazard analysis (LANL 2007a). Pending evaluation of the need for and implementation of corrective actions, limitations have been imposed on the amount of tritium allowed in the Weapons Engineering Test Facility (LANL 2007b, NNSA 2007c).

[b] DOE 1999a, LANL 2006a.

Note: Italicized entries indicate projects for which project-specific impact analyses are included in appendices to this SWEIS.

High-Pressure Gas Fills and Processing. High-pressure gas fills and processing operations for R&D and nuclear weapons systems are performed at the Weapons Engineering Tritium Facility. High-pressure gas containers (reservoirs) are filled with tritium or deuterium gas mixtures, or both, to specified pressures in excess of 10,000 pounds per square inch (6,900 newtons per square meter). This capability is also used for filling experimental devices (for example, filling small inertial confinement fusion targets that require high-pressure tritium gas).

Gas-Boost System Testing and Development. Modern nuclear weapons are equipped with gas-boost systems that use hydrogen isotopes, including tritium. These systems and their components need ongoing maintenance, testing, development, gas replacement, and modifications to maintain safety and reliability. The Weapons Engineering Tritium Facility provides highly specialized system function testing and experimental equipment for conducting gas-boost system R&D and testing for existing systems, new gas-boost systems development and testing, and gas processing operations.

Diffusion and Membrane Purification. The Weapons Engineering Tritium Facility has the operational capability to separate and purify tritium from gaseous mixtures using diffusion and membrane purification techniques. The facility conducts research on gaseous tritium penetration of, and movement through, materials. This capability could also be used on a continuing basis for effluent treatment.

Metallurgical and Material Research. Tritium-handling capabilities at the Weapons Engineering Tritium Facility accommodate a wide variety of metallurgical and material research activities, such as studying methods to remove hydrogen isotopes (including tritium) from a flowing stream of nitrogen and other inert gases. Metallurgical and materials research, including metal getter research and application studies, and tritium effects and properties R&D, is conducted at the Weapons Engineering Tritium Facility.

Gas Analysis. Spectrometry and other techniques, such as beta scintillation counting, are used to measure composition and quantities of gas samples on a real-time or batch basis.

Calorimetry. This nondestructive method is used for measuring the amount of tritium in containers. No tritium leaves the container during these measurements.

Solid Material and Container Storage. Tritium gas may be stored in either specially designed dual-wall containers or certified shipping containers, and tritium oxide (tritiated water) can be stored in solid form when it is adsorbed (gathered on a surface in a condensed layer) on molecular sieves. Tritium is also present in process systems and samples, inventory for use, and waste. Most tritium would be stored in the Weapons Engineering Tritium Facility, which has an administrative limit of 35 ounces (1,000 grams) of tritium inventory.

Hydrogen Isotopic Separation. Tritium gas purification R&D activities are an important capability of this Key Facility. Methods such as hydrogen isotopic separation are used at the Weapons Engineering Tritium Facility.

Radioactive Liquid Waste Pretreatment. Tritium-contaminated liquid low-level radioactive waste is collected in storage tanks. As needed, it is pretreated by adjusting the acidity prior to transfer to TA-50 for treatment in the Radioactive Liquid Waste Treatment Facility or to TA-53 for solar evaporation.

3.1.3.9 Pajarito Site

The Pajarito Site Key Facility is located entirely within TA-18 and contains the Los Alamos Critical Experiments Facility and other experimental facilities. This Key Facility consists of a main building, three outlying remote-controlled critical assembly and storage areas, and several smaller support buildings. In 2002, NNSA prepared the *TA-18 EIS* (DOE 2002i) to evaluate relocating the Pajarito Site Key Facility capabilities and materials. In the ROD, NNSA announced its decision to relocate Security Category I and II capabilities and related materials to the Device Assembly Facility at the Nevada Test Site, in effect initiating Pajarito Site Key Facility closure. No decisions were made, however, about relocation of Security Category III and IV materials and activities or the Solution High-Energy Burst Assembly (SHEBA). The ROD indicated that additional NEPA analysis would be required to support those decisions, and this SWEIS provides that NEPA analysis. Implementation of the ROD for Security Category I and II removal activities was initiated in 2004.

Under the No Action Alternative, only Security Category III and IV nuclear materials would be stored at TA-18. The only critical assembly remaining at TA-18 would be SHEBA, which would be operated in its Security Category III configuration. To ensure that specific programs continue uninterrupted, certain activities would occur intermittently at TA-18. These activities could involve temporary use of Security Category I or II materials that would be transported to TA-18 for the day and afterwards returned to storage elsewhere at LANL. Sealed sources retrieved from other locations under the Off-Site Source Recovery Project would continue to be received at TA-3 and repackaged as necessary for storage at LANL locations, including the Pajarito Site, pending shipment to the Waste Isolation Pilot Plant (WIPP) or other offsite locations for final disposition. Experiments and activities to support NNSA's Second Line of Defense Program, Nuclear Nonproliferation Research and Development Testing, and Emergency Response Program activities would continue. Training activities, including nuclear criticality training courses, would also continue.

The following paragraphs describe the capabilities of this Key Facility. **Table 3–11** indicates activity types and levels proposed under all three alternatives for each capability. Although the ability to perform some of these activities would be reduced or eliminated as the Pajarito Site is being closed, these capabilities are included in the No Action Alternative for evaluation of potential impacts.

Dosimeter Assessment and Calibration. Nuclear accident dosimetry studies are conducted using critical assembly radiation to simulate criticality accident radiation.

Detector Development. The Pajarito Site offers the capability to configure nuclear materials to develop and validate instruments and methods used in nuclear nonproliferation programs, assess potential threats from terrorist organizations, and train nuclear emergency search team personnel to use these instruments.

Table 3–11 Pajarito Site Capabilities and Activity Levels

Capability	*No Action Alternative* [a]	*Reduced Operations Alternative*	*Expanded Operations Alternative* [b]
Dosimeter Assessment and Calibration	Perform criticality experiments.	No activity	No activity
Detector Development	Develop safeguards instrumentation and perform R&D for nuclear materials and materials processing.	No activity	No activity
Materials Testing	Perform criticality experiments. Develop safeguards instrumentation and perform R&D for nuclear materials and materials processing.	No activity	No activity
Subcritical Measurements	Perform criticality experiments. Develop safeguards instrumentation and perform R&D for nuclear materials and materials processing.	No activity	No activity
Fast-Neutron Spectrum	Perform criticality experiments. Develop safeguards instrumentation and perform R&D for nuclear materials and materials processing.	No activity	No activity
Dynamic Measurements	Perform criticality experiments. Develop safeguards instrumentation and perform R&D for nuclear materials and materials processing.	No activity	No activity
Skyshine Measurements	Perform criticality experiments.	No activity	No activity
Vaporization	Perform criticality experiments.	No activity	No activity
Irradiation	Perform criticality experiments. Develop safeguards instrumentation and perform R&D for nuclear materials and materials processing.	No activity	No activity
Other Activities	Continue Security Category III and IV nuclear activities at TA-18. Operate SHEBA in its Security Category III configuration. Receive and store sealed radioactive sources retrieved under the Off-Site Source Recovery Project. These would be repackaged as necessary for storage at LANL pending shipment to WIPP or other offsite locations for final disposition. Support experiments and activities for: - NNSA Second Line of Defense Program - Nuclear Nonproliferation Research and Development Testing - Emergency Response Program activities Continue training activities, including nuclear criticality training courses.	No activity	Cease operations at Pajarito Site. Move Security Category III and IV materials to other LANL facilities (see Appendix H).
Construction/Upgrades/DD&D			
DD&D of TA-18 Structures	No activity	Cease operations at Pajarito Site. Place in surveillance and maintenance mode. Eliminate Pajarito Site as a Key Facility.	Implement *TA-18 Closure Project*: - Shut down Pajarito Site. - DD&D Pajarito Site buildings as appropriate. Eliminate Pajarito Site as a Key Facility.

R&D = research and development; TA = technical area; SHEBA = Solution High-Energy Burst Assembly; NNSA = National Nuclear Security Administration; DD&D = decontamination, decommissioning, and demolition.

[a] DOE 1999a, 2002i; LANL 2004c.

[b] DOE 2002i.

Note: Italicized entries indicate projects for which project-specific impact analyses are included in appendices to this SWEIS.

Materials Testing. The primary purpose of the Pajarito Key Facility is to characterize and evaluate materials, primarily by measuring their nuclear properties. Materials evaluated are typically structural materials or those used for shielding or neutron absorbers. Materials testing typically involves use of radiation sources or critical assemblies as radiation generators and measurement of radiation levels under a variety of conditions.

Subcritical Measurements. Subcritical measurements are those performed on arrays of fissile material that are below the critical mass for material in a given form. Subcritical experiments can vary any or all factors that influence criticality (mass, density, shape, volume, concentration, moderation, reflection, neutron absorption, enrichment, and interactions). Associated measurement techniques involve measuring some aspect of the neutron or gamma population in the material to assess its criticality state.

Fast-Neutron Spectrum. There are bare and reflected metal critical assemblies that operate on a fast-neutron spectrum. These assemblies typically have irradiation cavities in which flux foils, small replacement samples, or small experiments can be inserted. Typical experiments include evaluation of material reactivity, irradiation of novel neutron and gamma measuring instrumentation, and testing and calibrating radiation dosimeters.

Dynamic Measurements. Two fast-pulsed assemblies produce controlled, reproducible pulses of neutron and gamma radiation from tens of microseconds to several tens of milliseconds in duration. These pulses are useful for applications such as neutron physics measurements, instrumentation development, dosimetry, and materials testing.

Skyshine Measurements. The study of skyshine (radiation transported point-to-point without a direct line of sight) is a component of dosimetry that is primarily applicable to neutron-producing processes and facilities. Critical assemblies can be used to produce radiation fields to mimic those found around nuclear weapons production and dismantlement facilities and in storage and experimental areas.

Vaporization. Fast-pulsed assemblies have the capability of vaporizing fissile materials placed in a thermalizing material next to the assembly or in an internal cavity. These vessels are placed inside multiple containment vessels to prevent leakage of vaporized materials and fission products. This capability is useful for testing materials, measuring fissile materials properties, and testing reactor fuel materials in simulated accident conditions.

Irradiation. Several critical assemblies can have varying spectral characteristics in both steady-state and pulsed modes. These assemblies are typically used for irradiating fissile materials and other energetic-response materials to test and verify computer code calculations.

3.1.3.10 Target Fabrication Facility

The Target Fabrication Key Facility comprises three main buildings (35-213, 35-455, and 35-458). The main building is a two-story structure with approximately 61,000 square feet (5,700 square meters) of floor space located in TA-35. Laboratories and offices are located on both floors. Approximately 48,000 square feet (4,500 square meters) is laboratory space; the remainder is used for offices. The Target Fabrication Key Facility houses activities related to weapons production and laser fusion research. These activities are accomplished through high-technology material science, effects testing, characterization, and technology development.

The following paragraphs describe the capabilities of this Key Facility. **Table 3–12** indicates activity types and levels proposed under all three alternatives for each capability.

Table 3–12 Target Fabrication Facility Capabilities and Activity Levels

Capability	*No Action Alternative* [a]	*Reduced Operations Alternative*	*Expanded Operations Alternative* [b]
Precision Machining and Target Fabrication	Provide targets and specialized components for approximately 12,400 laser and physics tests per year. Perform approximately 100 high-energy density physics tests per year. Analyze up to 36 tritium reservoirs annually.	Same as No Action Alternative	Same as No Action Alternative
Polymer Synthesis	Produce polymers for targets and specialized components for approximately 12,400 laser and physics tests per year. Perform approximately 100 high-energy density physics tests per year.	Same as No Action Alternative	Same as No Action Alternative
Chemical and Physical Vapor Deposition	Coat targets and specialized components for approximately 12,400 laser and physics tests per year. Support approximately 100 high-energy density physics tests per year. Support plutonium pit rebuild operations.	Same as No Action Alternative	Same as No Action Alternative
Construction/Upgrades/DD&D			
	No activity	No activity	No activity

DD&D = decontamination, decommissioning, and demolition.
[a] DOE 1999a, LANL 2006a.
[b] LANL 2006a.

Precision Machining and Target Fabrication. Considered the primary measurement of activity for this Key Facility, precision machining operations produce sophisticated devices consisting of very accurate part shapes and often optical-quality surface finishes. A variety of processes are used to produce the final parts, which include conventional machining, ultraprecision machining, lapping, and electron discharge machining. Dimensional inspections are performed during part production using a variety of mechanically and optically based inspection techniques. Tritium reservoirs are analyzed at the Target Fabrication Facility.

Polymer Synthesis. Polymer synthesis science formulates new polymers, studies their structure and properties, and fabricates them into various devices and components. Capabilities exist at the Target Fabrication Facility for developing and producing polymer foams by organic synthesis, liquid crystalline polymers, polymer host dye laser rods, microfoams and composite foams, high-energy density polymers, electrically conducting polymers, chemical sensors, resins and membranes for actinide and metal separations, thermosetting polymers, and organic coatings. The materials and devices are typically prepared using solvents at temperatures ranging from 70 to 302 °F (20 to 150 °C) or by melt-processing at temperatures from room temperature up to

572 °F (300 °C). A wide variety of analytical techniques are used to determine the structure and behavior of polymers, including spectroscopy, microscopy, x-ray scattering, thermal analysis, chromatography, rheology, and mechanical testing.

Chemical and Physical Vapor Deposition. Chemical vapor deposition and infiltration are processes used to produce metallic and ceramic bulk coatings, various forms of carbon (including pyrolytic graphite, amorphous carbon, and diamond), nanocrystalline films, powder coatings, thin films, and a variety of shapes up to 3.5 inches (9 centimeters) in diameter and 0.5 inches (1.25 centimeters) in thickness. Chemical vapor deposition and infiltration coating processes are routine operations that use a variety of methods such as thermal hot wall, cold wall, and fluidized bed techniques; laser-assisted, laser ablation, radiofrequency and microwave plasma techniques; direct-current glow discharge and hollow cathode techniques; and organometallic chemical vapor deposition techniques. Polymer processing and extensive characterization is performed in conjunction with this work.

Physical vapor deposition capabilities can be used to apply layers of various materials on sophisticated devices with high precision. These layers, applied by various coating techniques, include a wide range of metals and metal oxides, as well as some organic materials.

3.1.3.11 Bioscience Facilities (formerly Health Research Laboratory)

Major Bioscience Facilities buildings include the main Health Research Laboratory; four buildings in TA-43; and additional offices and laboratories located in three buildings in TA-35, several buildings in TA-3, and six buildings in TA-46. There is also some activity in TA-16. This Key Facility focuses on the study of intact cells, cellular components (ribonucleic acid [RNA], deoxyribonucleic acid [DNA], and proteins), instrument analysis (laser and mass spectroscopy), and cellular systems (repair, growth, and response to stressors). Activities other than theoretical or paper studies are subject to review and approval by internal organizations such as the LANL Bioscience Oversight Review Board. External organizations such as the Centers for Disease Control and Prevention and the National Institutes of Health also review and approve projects for which they provide funding. Work with biohazardous agents is reviewed and approved by the LANL Institutional Biosafety Committee, which includes members that are both internal and external to LANL organizations.

Work with biological materials at LANL is governed by LANL Biosafety Program requirements, which are based on the document *Biosafety in Microbiological and Biomedical Laboratories* (HHS 2007) published by the Centers for Disease Control and Prevention. This document establishes requirements for workplace safety by biosafety level, of which there are four. These biosafety levels consist of progressively more stringent protocols for laboratory practices, techniques, safety equipment, and laboratory facilities. LANL has laboratories that operate at Biosafety Level 1 and Biosafety Level 2. (These levels are defined in Appendix C, Section C.3.3.) Work with select agents, specifically regulated pathogens and toxins defined in 42 CFR Part 73, is limited at LANL to Biosafety Level 2 activities. A new facility intended for work requiring Biosafety Level 3 conditions was constructed in 2004, but the building has not been occupied or used for this purpose. NNSA is currently preparing the *Environmental Impact Statement for the Operation of the Biosafety Level 3 Facility at the Los Alamos National Laboratory* to analyze potential impacts of operating this facility.

The following paragraphs describe the capabilities of this Key Facility. **Table 3–13** indicates activity types and levels proposed under all three alternatives for each capability.

Table 3–13 Bioscience Facilities Capabilities and Activity Levels

Capability	*No Action Alternative* [a]	*Reduced Operations Alternative*	*Expanded Operations Alternative*
Biologically Inspired Materials and Chemistry (Biomaterials and Chemistry in the *1999 SWEIS*)	Determine formation and structure of biomaterials. Synthesize biomaterials. Characterize biomaterials.	Same as No Action Alternative	Same as No Action Alternative
Cell Biology	Study stress-induced effects and responses on cells. Study host-pathogen interactions. Determine effects of beryllium exposure.	Same as No Action Alternative	Same as No Action Alternative
Computational Biology	Collect, organize, and manage information on biological systems. Develop computational theory to analyze and model biological systems.	Same as No Action Alternative	Same as No Action Alternative
Environmental Microbiology	Study microbial diversity in the environment. Collect and analyze environmental samples. Study biochemical and genetic processes in microbial systems.	Same as No Action Alternative	Same as No Action Alternative
Genomic Studies	Analyze genes of living organisms such as humans, animals, microbes, viruses, plants, and fungi.	Same as No Action Alternative	Same as No Action Alternative
Genomic and Proteomic Science	Develop and implement high-throughput tools. Perform genomic and proteomic analysis. Study pathogenic and nonpathogenic systems.	Same as No Action Alternative	Same as No Action Alternative
Measurement Science and Diagnostics	Develop and use spectroscopic tools to study molecules and molecular systems. Perform genomic, proteomic and metabolomic studies.	Same as No Action Alternative	Same as No Action Alternative
Molecular Synthesis	Synthesize molecules and materials. Perform spectroscopic characterization of molecules and materials. Develop new molecules that incorporate stable isotopes. Develop chem-bio sensors and assay procedures. Synthesize polymers and develop applications for them. Utilize stable isotopes in quantum computing systems.	Same as No Action Alternative	Same as No Action Alternative
Structural Biology	Research three-dimensional structure and dynamics of macromolecules and complexes. Use various spectroscopy techniques. Perform neutron scattering. Perform x-ray scattering and diffraction.	Same as No Action Alternative	Same as No Action Alternative

Capability	***No Action Alternative*** [a]	***Reduced Operations Alternative***	***Expanded Operations Alternative***
Pathogenesis	Perform genome-scale, focused and computationally enhanced experimental studies on pathogenic organisms.	Same as No Action Alternative	Same as No Action Alternative
Biothreat Reduction and Bioforensics	Analyze samples for biodefense and national security purposes. Identify pathogen strain signatures using DNA sequencing and other molecular approaches.	Same as No Action Alternative	Same as No Action Alternative
Construction/Upgrades/DD&D			
New *Science Complex* in TA-62	No activity	No activity	Move most Bioscience operations to proposed *Science Complex* (see Appendix G). This new space would replace buildings vacated by Bioscience staff as the major component of the Bioscience Facilities.

DD&D = decontamination, decommissioning, and demolition; TA = technical area.
[a] LANL 2004c, 2006a.
Note: Italicized entries indicate projects for which project-specific impact analyses are included in appendices to this SWEIS.

Biologically Inspired Materials and Chemistry. This capability is used primarily to determine formation-structure-function relationships in biological and biologically relevant materials at macroscopic, microscopic, and molecular scales, with the goal of using this knowledge to create new biologically inspired materials with novel functionalities for a variety of applications. Synthesis and characterization of biological and biologically relevant materials at scales from the molecular to macroscopic are an integral part of this capability. Characterization tools include spectroscopy with laser sources, microscopy, spectral imaging, electrochemistry, mass spectrometry, and nuclear magnetic resonance spectroscopy. Stable isotopes are used to enable many of these characterization measurements.

Cell Biology. This research area focuses on understanding stress responses at the molecular level, within the whole cell, and in multicellular and cell environment systems. Historically, cellular response to ionizing radiation has been the primary focus. New focus areas include host-pathogen interactions, the human health effects of exposure to beryllium, and the regulation of plant growth for applications in carbon management and energy. Specific capabilities include culture and biochemical analysis of a variety of cell types, including nonpathogenic environmental microbes, infectious microbes (including viruses) under controlled conditions, and plant and mammalian cells.

Computational Biology. This capability is purely theoretical and does not involve any experimental, operational, or production activities. This capability includes collection, organization, and management of biological data and development of computational tools to analyze, interpret, and model biological information. Certain activities involve partnering with computational scientists to develop computation-based biological theory and to analyze and model biological systems.

Environmental Microbiology. This work focuses on gaining a better understanding of microbial systems and their environment. This capability underpins the ability of LANL scientists to achieve its goals in biothreat reduction and is key to work related to climate change, bioremediation, bioenergy, and environmental monitoring. Activities include collection of environmental samples containing microbes (including viruses), biochemical and genetic analysis of their distribution and functions in ecological systems, and growth and analysis of environmental isolates.

Genomic Studies. This capability involves conducting research using molecular and biochemical techniques to analyze the genetics of living organisms such as animals (particularly humans), microbes (including viruses), plants, fungi, and other species. Specifically, personnel develop strategies to analyze the nucleotide sequence of individual genes, especially those associated with genetic disorders, and to identify these genes and map the genetic diseases to locations on individual chromosomes. Part of this work is to map each nucleotide, in sequence, of each gene in all 46 chromosomes of the human genome.

Genomic and Proteomic Science. This capability emphasizes development and implementation of high-throughput tools and technologies for understanding biology at the systems level. Researchers perform production sequencing, finishing, clone selection, quality assurance, and bioinformatics and are involved in development of high-throughput technologies for high-affinity, high-specificity ligand generation, expression arrays, and proteomics. This capability focuses on pathogen and environmental microbial sequencing and comparative genomics and on affinity tag production for detection and sensing applications in support of biothreat reduction work.

Measurement Science and Diagnostics. These activities encompass a broad set of technologies including spectroscopy for understanding molecular dynamics and structure and for biomedical applications; imaging microscopy for exploring molecular events using ultrafast time resolution measurements, at times as short as 10 to 13 seconds; and flow-based analyses using flow cytometry methods for measuring everything from single molecules to multicellular spheroids, spanning a size range from 10 Angstroms to 100 microns. A developing area is mass spectrometry for proteomics and structural biology. These technologies provide the platforms and data that can lead to new strategies for detection and sensing technologies. Capabilities include a variety of spectroscopies for analysis of biomolecules and biomolecular complexes; flow-cytometry-based analysis of materials spanning the range from single molecules to intact chromosomes to single cells to multicellular spheroids; and mass spectrometry for proteomics, metabolomics, and structural biology.

Molecular Synthesis. Work in this area includes synthesis, materials preparation, and spectroscopic characterization of a variety of compounds. Current work is focused on creating new molecules using natural and enriched stable isotopes for biomolecular structure analysis, for observation of specific chemical groups, and for use as standards in detection of chemical agents and biological toxins. Additional work in this area includes linking antibodies to biomimetic surfaces, creating chemical and biological microsensors for detection and sensing, developing polymers to protect soldiers' eyes from laser light, and using stable isotopes to demonstrate the feasibility of quantum information processing.

Structural Biology. This research focuses on determination and analysis of three-dimensional structures and dynamics of macromolecules and the complexes that they form. Experimental techniques include x-ray scattering and neutron diffraction, nuclear magnetic resonance, and time-resolved vibrational spectroscopies. State-of-the-art neutron protein crystallography capabilities provided as part of the Manuel Lujan Neutron-Scattering Center are accessed on a national level.

Pathogenesis. This work involves performing genome-scale, focused, and computationally enhanced experimental studies to gain a quantitative understanding of various aspects of pathogen lifecycle. The focus is on infections in humans, animals, and plants, as well as understanding the epidemiology and life cycle of pathogens in the environment.

Biothreat Reduction and Bioforensics. This capability, a collection of forensic and molecular biological capabilities, is used to analyze samples for biodefense and national security purposes. Analyses include DNA sequencing and other molecular approaches to identify pathogen strain signatures. This capability also includes the ability to undertake classified laboratory and information processing and analysis projects.

3.1.3.12 Radiochemistry Facility

The Radiochemistry Key Facility includes all of TA-48 (116 acres [47 hectares]), although the main research buildings are located together in an area of only 8.6 acres (3.5 hectares). These buildings include the Radiochemistry Laboratory, Machine and Fabrication Shop, Diagnostic Instrumentation and Development Building, Clean Chemistry/Mass Spectrometry Building, and Weapons Analytical Chemistry Facility. The Radiochemistry Facility fills three roles: research, production of medical radioisotopes, and support services to other LANL organizations, primarily through radiological and chemical analyses of samples. Research supports environmental management projects such as the Yucca Mountain Project, plutonium stabilization, catalysis, basic energy, and other scientific efforts. Chemistry research is performed in the areas of inorganic, actinide, organometallic, environmental, geochemistry, and nuclear chemistry. Production activities use a hot cell located in the Radiochemistry Laboratory Building to separate and package radioisotopes for medical research and clinical uses.

The following paragraphs describe the capabilities of this Key Facility. **Table 3–14** indicates activity types and levels proposed under all three alternatives for each capability.

Radionuclide Transport. Chemical and geochemical investigations address concerns about hydrologic flow and transport of radionuclides. Areas of study include the sorption (binding) of actinides, fission products, and activation products in minerals and rocks and the solubility and speciation of actinides in various chemical environments such as those associated with waste disposal. Paired with model development, these studies are used to evaluate various activities and phenomena such as parameters for performance assessment of mined geologic disposal systems.

Table 3–14 Radiochemistry Facility Capabilities and Activity Levels

Capability	*No Action Alternative* [a]	*Reduced Operations Alternative*	*Expanded Operations Alternative* [b]
Radionuclide Transport Studies	Conduct 80 to 160 actinide transport, sorption, and bacterial interaction studies annually. Develop models for evaluation of groundwater. Assess performance or risk of release for radionuclide sources at proposed waste disposal sites.	Same as No Action Alternative	Same as No Action Alternative
Environmental Remediation and Risk Mitigation	Conduct background contamination characterization pilot studies. Conduct performance assessments, soil remediation research and development, and field support. Support environmental remediation activities.	Same as No Action Alternative	Same as No Action Alternative, plus: - Perform beryllium dispersion and mitigation assessments.
Ultra-Low-Level Measurements	Perform chemical isotope separation and mass spectrometry at current levels.	Same as No Action Alternative	Same as No Action Alternative
Nuclear and Radiochemistry Separations	Conduct radiochemical operations involving quantities of alpha-, beta-, and gamma-emitting radionuclides at current levels for nonweapons and weapons work.	Same as No Action Alternative	Same as No Action Alternative
Isotope Production	Conduct target preparation, irradiation, and processing to recover medical and industrial application isotopes to support approximately 150 offsite shipments annually.	Same as No Action Alternative	Same as No Action Alternative
Actinide and Transuranic Chemistry	Perform radiochemical separations involving alpha-emitting radionuclides.	Same as No Action Alternative	Same as No Action Alternative
Data Analysis	Reexamine archive data and measure nuclear process parameters of interest to weapons radiochemists.	Same as No Action Alternative	Same as No Action Alternative
Inorganic Chemistry	Conduct synthesis, catalysis, and actinide chemistry activities: - Conduct chemical synthesis of organo-metallic complexes. - Conduct structural and reactivity analysis, organic product analysis, and reactivity and mechanistic studies. - Conduct synthesis of new ligands for radiopharmaceuticals. - Conduct environmental technology development activities: – Ligand design and synthesis for selective extraction of metals, – Soil washing, – Membrane separator development, and – Ultrafiltration.	Same as No Action Alternative	Same as No Action Alternative
Structural Analysis	Perform synthesis and structural analysis of actinide complexes at current levels. Conduct x-ray diffraction analysis of powders and single crystals.	Same as No Action Alternative	Same as No Action Alternative

Capability	***No Action Alternative*** [a]	***Reduced Operations Alternative***	***Expanded Operations Alternative*** [b]
Sample Counting	Measure the quantity of radioactivity in samples using alpha-, beta-, and gamma-ray counting systems.	Same as No Action Alternative	Same as No Action Alternative
Hydrotest Sample Analysis	Measure beryllium contamination from simulated nuclear weapons hydrotesting.	Reduce activity levels consistent with High Explosive Processing and Testing	Same as No Action Alternative
Atom Trapping	No activity	No activity	Implement atom trapping capability for fundamental and applied research.
Construction/Upgrades/DD&D			
Radiological Sciences Institute	No activity	No activity	Construct and operate the new *Radiological Sciences Institute*. Construct and operate the Institute for Nuclear Nonproliferation Science and Technology (see Appendix G). Relocate Security Category III and IV capabilities and materials that would remain at LANL from TA-18 to the Institute for Nuclear Nonproliferation Science and Technology. Reconstruct CMR Building Wing 9 hot cell capabilities in the Radiological Sciences Institute.

DD&D = decontamination, decommissioning, and demolition; TA = technical area, CMR = Chemistry and Metallurgy Research.
[a] DOE 1999a.
[b] LANL 2006a.
Note: Italicized entries indicate projects for which project-specific impact analyses are included in appendices to this SWEIS.

Environmental Remediation and Risk Mitigation. Characterization and remediation of soils contaminated with radionuclides and toxic metals and data analysis and integrated site-wide assessment are the two functions provided by this capability. A major objective of characterizing and remediating soils is to minimize generation of large volumes of metal- and radionuclide-contaminated soils. The objective of data analysis and integrated site-wide assessment is to accelerate remediation through improved sampling schemes, clearer and more efficient evaluation of characterization data, and more effective tools for assigning priority to cleanup targets.

Ultra-Low-Level Measurements. Isotopic tracers and high-sensitivity measurement technologies have been developed to support the U.S. nuclear weapons program. Isotopic tracers can include both radioactive and nonradioactive isotopes, although this capability emphasizes nonradioactive tracers. Specialty applications include developing analytical techniques for a variety of problems in nuclear, environmental, and biological sciences. Typical analyses include determining the origin of radioactive contamination in an environmental sample (for example, whether the contamination results from a nearby nuclear facility or from radioactive fallout from global weapons testing). This capability can also be used to trace the migration of radioactive contamination through the environment.

Nuclear and Radiochemistry Separations. Activities under this capability include developing radiation detectors, conducting radiochemical separations, and performing nuclear chemistry. Development, calibration, and use of radiation detectors include the use of off-the-shelf systems for routine measurement of radioactivity and development of new radiation detection systems for a number of special applications. LANL personnel conduct both routine and special separations of radioactive materials from other radioactive species and stable impurities. These experiments have provided support to Hanford waste tank treatment activities and production of medical isotopes. Separations are based on traditional approaches that use commercially available ion-exchange media and chemical reagents. LANL staff have also developed new separations techniques based on experimental chemical systems, using radioactive tracers to synthesize the chemicals and to characterize their performance. In addition, nuclear chemistry-related activities use exotic laser-based atom traps to probe the interactions of energy and atoms in energy regimes that are not easily accessed by other techniques. This work requires conducting extensive laser spectroscopy, handling of radioactive materials, and interpreting the resulting data. Other nuclear chemistry-related activities include irradiating targets at the Los Alamos Neutron Science Center (LANSCE) or at offsite reactors to produce specific radioactive isotopes. These isotopes are then separated from impurities, and their neutron-capture cross sections are measured at the Radiochemistry Laboratory.

Isotope Production. Activities under this capability include the production, chemical separation, and distribution of isotopes to medical and industrial users. Activities also include preparing the target packages to be irradiated using the LANSCE accelerator, processing in the Radiochemistry Laboratory hot cell to recover the desired isotopes, and packaging the isotopes for offsite shipment.

Actinide and Transuranic Chemistry. Activities in the Alpha wing of the Radiochemistry Laboratory are essentially the same as the radiochemical separations carried out in the rest of the building, but with different materials. The materials handled are actinides and transuranics that require the special safe handling environment provided in this wing.

Data Analysis. Data analysis is the evaluation of experimental data to interpret results of experiments, measurements, and other activities. This capability includes evaluation of archived data in support of weapons programs.

Inorganic Chemistry. Inorganic chemistry work includes two main categories of activities: (1) synthesis, catalysis, and actinide chemistry; and (2) development of environmental technology. The former category includes chemical synthesis of new organometallic complexes, structural and reactivity analysis, organic product analysis, reactivity and mechanistic studies, and synthesis of new ligands for radiopharmaceuticals. Development of environmental technology includes designing and synthesizing ligands for selective extraction of metals, soil washing, development of membrane separators, photochemical processing, and ultrafiltration.

Other work involves oxidation-reduction studies on uranium and other metals for both environmental restoration and advanced processing.

Structural Analysis. Structural analysis includes the synthesis, structural analysis, and x-ray diffraction analysis of actinide complexes in both single-crystal and powder form. This capability supports programs in basic energy sciences, materials characterization, stockpile stewardship, and environmental management.

Sample Counting. Sample counting, the measurement of the quantity of radioactivity present in a sample, is accomplished with a variety of radiation detectors, each customized to the type of radiation being counted and the expected levels of radioactivity. All samples counted in the counting facility are sealed items placed inside appropriate detectors for specified periods of time. Data are automatically processed through the computer system and results are presented to the users.

Hydrotest Sample Analysis. This capability involves the measurement of beryllium contamination from hydrotesting simulated nuclear weapons. This work includes analysis, ligand binding, materials characterization, field sampling, fundamental beryllium chemistry, and beryllium mitigation (LANL 2006g).

3.1.3.13 Waste Management Operations: Radioactive Liquid Waste Treatment Facility

The Radioactive Liquid Waste Treatment Key Facility is located in TA-50 and consists of four primary structures: the Radioactive Liquid Waste Treatment Facility Building, the Pump House and Influent Storage Building, the acid and caustic solution tank farm, and a 100,000-gallon (380,000-liter) influent holding tank. The Radioactive Liquid Waste Treatment Facility treats radioactive liquid waste generated by other LANL facilities and houses analytical laboratories to support waste treatment operations. The Radioactive Liquid Waste Treatment Facility Building is the largest structure in TA-50, with 40,000 square feet (3,720 square meters) under roof. Construction of a new 300,000-gallon (1,100,000-liter) influent storage facility is complete, but it is not yet operational.

The following paragraphs describe the capabilities of this Key Facility. **Table 3–15** indicates activity levels proposed under all three alternatives for each capability.

Waste Transport, Receipt, and Acceptance. Most radioactive liquid waste is conveyed directly to the Radioactive Liquid Waste Treatment Facility through an underground pipeline system. Pipelines for liquid radioactive waste exist in TA-3, TA-35, TA-48, TA-50, TA-55, and TA-59.[2] Waste from generators not connected by the underground pipeline system is transferred by tanker truck to the Radioactive Liquid Waste Treatment Facility. Generators of small quantities of radioactive liquid waste collect their waste in drums, which are then trucked to TA-50.

[2] The pipelines in TA-53 move waste only within that TA (as part of LANSCE), and do not connect to or pump radioactive liquid waste to the Radioactive Liquid Waste Treatment Facility.

Table 3–15 Waste Management Operations: Radioactive Liquid Waste Treatment Facility Capabilities and Activity Levels

Capability	*No Action Alternative* [a]	*Reduced Operations Alternative*	*Expanded Operations Alternative* [b]
Waste Transport, Receipt, and Acceptance	Collect radioactive liquid waste from generators and transport it to RLWTF in TA-50. Support, certify, and audit generator characterization programs. Maintain the waste acceptance criteria for RLWTF. Send approximately 66,000 gallons (250,000 liters) of evaporator bottoms to an offsite commercial facility for solidification annually. (Approximately 25 cubic yards [20 cubic meters] of solidified evaporator bottoms would be returned annually for disposal as low-level radioactive waste at TA-54 Area G.) Transport annually to TA-54 for storage or disposal: - 330 cubic yards (250 cubic meters) of low-level radioactive waste; - 3 cubic yards (2 cubic meters) of mixed low-level radioactive waste; - 13 cubic yards (10 cubic meters) of transuranic waste; and - 880 pounds (400 kilograms) of hazardous waste.	Same as No Action Alternative	Same as No Action Alternative, except: - Send approximately 80,000 gallons (300,000 liters) of evaporator bottoms to an offsite commercial facility for solidification annually. (Approximately 30 cubic yards [23 cubic meters] of solidified evaporator bottoms would be returned annually for disposal as low-level radioactive waste at TA-54 Area G.) - Transport annually to TA-54 for storage or disposal: – 390 cubic yards (300 cubic meters) of low-level radioactive waste; – 3 cubic yards (2 cubic meters) of mixed low-level radioactive waste; – 18 cubic yards (14 cubic meters) of transuranic waste; and – 1,100 pounds (500 kilograms) of hazardous waste.
Radioactive Liquid Waste Treatment	Pretreat 30,000 gallons (110,000 liters) of liquid transuranic waste annually. Solidify, characterize, and package 16 cubic yards (12 cubic meters) of transuranic waste sludge annually. Treat 4 million gallons (15 million liters) of liquid low-level radioactive waste annually. Dewater, characterize, and package 70 cubic yards (50 cubic meters) of low-level radioactive waste sludge annually. Process 260,000 gallons (1 million liters) of secondary liquid waste generated by RLWTF treatment processes through the RLWTF evaporator annually. Discharge treated liquids through an NPDES outfall.	Same as No Action Alternative	Same as No Action Alternative, except: - Pretreat 50,000 gallons (190,000 liters) of liquid transuranic waste annually. - Solidify, characterize, and package 22 cubic yards (17 cubic meters) of transuranic waste sludge annually. - Treat 5 million gallons (20 million liters) of liquid low-level radioactive waste annually. - Dewater, characterize, and package 80 cubic yards (60 cubic meters) of low-level radioactive waste sludge annually. - Process 320,000 gallons (1,200,000 liters) of secondary liquid waste generated by RLWTF treatment processes through the RLWTF evaporator annually.

Capability	*No Action Alternative* [a]	*Reduced Operations Alternative*	*Expanded Operations Alternative* [b]
Construction/Upgrades/DD&D			
RLWTF Upgrade	Construction of a new 300,000-gallon (1.1 million-liter) influent storage facility is complete.	Same as No Action Alternative	Same as No Action Alternative, plus: - Implement *RLWTF Upgrade Project* (see Appendix G): – Construct and operate a replacement for the existing RLWTF at TA-50. Start-up estimated in 2012. – Construct and operate evaporation tanks in TA-52 for treated effluent from RLWTF – DD&D portions of existing RLWTF.

RLWTF = Radioactive Liquid Waste Treatment Facility; TA = technical area; NPDES = National Pollutant Discharge Elimination System; DD&D = decontamination, decommissioning, and demolition.
[a] DOE 1999a, LANL 2006a.
[b] LANL 2006a.
Note: Italicized entries indicate projects for which project-specific impact analyses are included in appendices to this SWEIS.

In addition to receiving and accepting radioactive liquid waste trucked to the TA-50 facility from other LANL locations, some radioactive liquid waste is trucked to the TA-53 facility for evaporation, and other radioactive liquid waste is shipped to an offsite commercial facility for solidification. Returned solidified waste and other solid wastes are sent from the Radioactive Liquid Waste Treatment Facility to waste management facilities in TA-54 for storage or disposal.

Radioactive Liquid Waste Treatment. Liquid transuranic waste and low-level radioactive waste are treated in sequential steps to remove and reduce the radioactive components of the liquid waste stream. Neutralization, precipitation, filtration, ion exchange, and reverse osmosis are among the treatment steps that can be used, depending on individual waste stream characteristics. Liquid effluents are discharged through a permitted National Pollutant Discharge Elimination System outfall. To meet discharge limits, liquids with higher concentrations of tritium are transported to TA-53, where they are treated in solar evaporation basins. Resultant low-level radioactive waste sludges are drummed and transferred to TA-54 for disposal. Transuranic waste sludges are cemented and transferred to TA-54 for storage until they are certified and sent to WIPP for disposal.

3.1.3.14 Los Alamos Neutron Science Center

LANSCE is located on a 750-acre (303-hectare) mesa top at TA-53 and contains approximately 400 structures. LANSCE is LANL's major accelerator R&D complex, consisting of a high-power 800-million-electron-volt proton linear accelerator, a proton storage ring, production targets at the Manuel Lujan Neutron-Scattering Center and the Weapons Neutron Research Facility, and a variety of associated experimental areas and spectrometers. Particle beams are used to conduct basic and applied research in the areas of condensed-matter science, materials science, nuclear physics, particle physics, nuclear chemistry, atomic physics, and defense-related experiments. LANSCE also produces medical radioisotopes.

The following paragraphs describe the capabilities of this Key Facility. **Table 3–16** indicates activity types and levels proposed under all three alternatives for each capability.

Table 3–16 Los Alamos Neutron Science Center Capabilities and Activity Levels

Capability	*No Action Alternative* [a]	*Reduced Operations Alternative*	*Expanded Operations Alternative* [b]
Accelerator Beam Delivery, Maintenance, and Development	Operate 800-million-electron-volt linear accelerator and deliver accelerator beam to Areas A, B, and C; Weapons Neutron Research Facility; Lujan Center; Dynamic Test Facility; and Isotope Production Facility for 10 months each year (6,400 hours). The H^+ beam current would be 1,250 microamps; the H^- beam current would be 200 microamps. Reconfigure beam delivery and support equipment to support new facilities, upgrades, and experiments.	LANSCE would be shut down, and all capabilities would cease except radioactive liquid waste treatment. Systems would be maintained in a condition to support future restart. LANSCE would be eliminated as a Key Facility.	Same as No Action Alternative
Experimental Area Support	Provide support to ensure availability of the beam lines, beam line components, handling and transport systems, and shielding, as well as radiofrequency power sources. Perform remote handling and packaging of radioactive materials and waste, as needed.	No activity	Same as No Action Alternative
Neutron Research and Technology	Conduct 1,000 to 2,000 different experiments annually, using neutrons from the Lujan Center and Weapons Neutron Research Facility. Support contained weapons-related experiments using small to moderate quantities of high explosives, including: - Approximately 200 experiments per year using nonhazardous materials and small quantities of high explosives; - Approximately 60 experiments per year using up to 10 pounds (4.54 kilograms) of high explosives and depleted uranium; - Approximately 80 experiments per year using small quantities of actinides, high explosives, and sources; - Shockwave experiments involving small amounts, up to nominally 1.8 ounces (50 grams) of plutonium; and - Support for static stockpile surveillance technology research and development.	No activity	Same as No Action Alternative

Capability	***No Action Alternative*** [a]	***Reduced Operations Alternative***	***Expanded Operations Alternative*** [b]
Materials Test Station	Irradiate materials and fuels in a fast-neutron spectrum and in a prototypic temperature and coolant environment.	No activity	Same as No Action Alternative
Subatomic Physics Research	Conduct 5 to 10 physics experiments annually at the Manuel Lujan Center and Weapons Neutron Research Facility. Conduct up to 100 proton radiography experiments, including using small to moderate quantities of high explosives, including: - Dynamic experiments in containment vessels with up to 10 pounds (4.5 kilograms) of high explosives and 100 pounds (45 kilograms) of depleted uranium; and - Dynamic experiments in powder launcher with up to 10 ounces (300 grams) of Class 1.3 explosives (gun powder). Conduct research using ultracold neutrons; operate up to 10 microamperes per year of negative beam current.	No activity	Same as No Action Alternative
Medical Isotope Production	Irradiate up to 120 targets per year for medical isotope production at the Isotope Production Facility.	No activity	Same as No Action Alternative
High-Power Microwaves and Advanced Accelerators	Conduct R&D in high-power microwave and advanced accelerators in areas including microwave research for industrial and environmental applications.	No activity	Same as No Action Alternative
Radioactive Liquid Waste Treatment (Solar Evaporation at TA-53)	Treat about 140,000 gallons (520,000 liters) per year of radioactive liquid waste.	Treat about 5,000 gallons (20,000 liters) per year of radioactive liquid waste brought to TA-53 from other locations (not generated by LANSCE activities).	Same as No Action Alternative
Construction/Upgrades/DD&D			
	Install Material Test Station equipment in Experimental Area A. Construct Neutron Spectroscopy Facility within existing buildings (under High-Powered Microwaves and Advanced Accelerators Capability).	Shut LANSCE down. Cease capabilities except radioactive liquid waste treatment. Maintain systems in a condition to support future restart.	Same as No Action Alternative, plus: - Implement *LANSCE Refurbishment Project* to extend reliable operation of facility for the future (see Appendix G).

Lujan Center = Manuel Lujan Neutron-Scattering Center; LANSCE = Los Alamos Neutron Science Center; R&D = research and development; TA = technical area; DD&D = decontamination, decommissioning, and demolition.

[a] DOE 1999a; LANL 2004c, 2004f.

[b] LANL 2006a.

Note: Italicized entries indicate projects for which project-specific impact analyses are included in appendices to this SWEIS.

Accelerator Beam Delivery, Maintenance, and Development. The heart of the LANSCE Key Facility is the linear accelerator itself. The building housing the accelerator is more than 0.5 miles (0.8 kilometers) long, and has 316,000 square feet (29,400 square meters) of floor space. The building contains equipment to form hydrogen ion beams (protons and negative hydrogen ions) and to accelerate them to 84 percent of the speed of light. The beam tunnel itself is located 35 feet (11 meters) below ground level to provide shielding from the radiation. Above-surface structures house radiofrequency power sources used to accelerate the beam. Ancillary equipment is used to transport the ion beams, maintain vacuum conditions in the beam transport system, and provide ventilation and cooling. Creating and directing the ion beam requires large amounts of power, much of which is ultimately removed as excess heat.

This capability is responsible for development, configuration, and maintenance of components and support systems needed to deliver proton ion beams and for delivery of those beams. Generation and delivery of the proton ion beams require considerable development and maintenance capabilities for all components of the linear accelerator, including the ion sources and injectors, the mechanical systems in the accelerator (including cooling water), all systems for the proton storage ring and its associated transfer lines, and beam diagnostics in the accelerator and transfer lines. Beam development activities include beam dynamics studies and design and implementation of new capabilities. This activity requires the coordination of many disciplines, including accelerator physics, high-voltage and pulsed-power engineering, mechanical engineering, materials science, radiation shielding design, digital and analog electronics, high-vacuum technology, mechanical and electronics design, mechanical alignment, hydrogen furnace brazing, machining, and mechanical fabrication.

Experimental Area Support. Beam users (LANL organizations and external users such as scientists from universities, other laboratories, and the international scientific community) require support from TA-53 personnel, whether they are preparing for, performing, or closing out their experiments. This support capability focuses on the maintenance, improvement, and operational readiness of beam lines and experimental areas at LANSCE.

Support also includes the design, operation, and maintenance of remote-handling systems for highly activated components; the handling and transportation (usually for disposal) of highly activated components; and the specification, engineering, design, and installation of radiation shielding.

The linear accelerator requires large power sources and is supplied at TA-53 by radiofrequency power sources. The capability to design, fabricate, operate, and maintain radiofrequency systems for accelerators and other applications is an important support function for LANSCE operations. Radiofrequency technology development also supports microwave materials processing and radiofrequency system design.

Neutron Research and Technology. Fundamental research is conducted on the interaction of neutrons with various materials, molecules, and nuclei to advance condensed matter science (including material science and engineering and aspects of bioscience), nuclear physics, and the study of dynamic phenomena in materials. Applied neutron research is conducted to provide scientific and engineering support to weapons stockpile stewardship and nonproliferation surveillance. Efforts include resonance neutron spectroscopy and neutron radiography. Research is also performed to develop instrumentation and diagnostic devices by scientists from universities, other Federal laboratories, and industry.

Neutrons from the Manuel Lujan Neutron-Scattering Center and the Weapons Neutron Research Facility are used to conduct experiments at LANL. In addition, LANL continues to support contained weapons-related experiments using small-to-moderate quantities of high explosives and would provide support for static stockpile surveillance technology R&D.

Material Test Station. The Material Test Station capability would replace the Accelerator Transmutation of Waste capability analyzed in the *1999 SWEIS*. Similar to Accelerator Transmutation of Waste, the Material Test Station would provide the capability to safely irradiate materials and fuels in a fast-neutron spectrum and in a prototypic temperature and coolant environment. Two existing target locations would be replaced, and a spallation neutron source would be installed in an existing experimental area (Area A) at LANSCE. A fast-neutron irradiation environment would be produced by interaction of the proton beam with a tungsten target. The neutrons would be used to irradiate small samples of materials and fuels to conduct proof of performance experiments to prove the practicality of transmuting plutonium and high-level radioactive wastes into other elements or isotopes. This capability is anticipated to become operational in the 2009 to 2010 timeframe.

Subatomic Physics Research. This capability supports the conduct of physics experiments at the Manuel Lujan Center and the Weapons Neutron Research Facility, as well as the conduct of proton radiography experiments. Proton radiography experiments include contained experiments using small-to-moderate quantities of high explosives.

Medical Isotope Production. Radioisotopes used by the medical community for diagnostic procedures, therapeutic treatment, clinical trials, and biomedical research are produced at LANSCE. A new 100-million-electron-volt Medical Isotope Production Facility became fully operational in 2004. This new facility provides the ability to perform more selective and efficient isotope production while generating fewer byproduct isotopes than was previously possible.

In addition, an Isotope Production Facility would be established in an existing building. This facility would complement the 100-million-electron-volt Isotope Production Facility by using the 800-million-electron-volt proton beam available at the end of the linear accelerator to fabricate radioisotopes used by the medical community for diagnostic and other procedures.

Area A East would be stripped of existing contaminated and uncontaminated items for use as a staging area for shipments, receipts, equipment storage, and limited maintenance activities. Removal of existing items would generate an estimated 1,700 tons (1,540 metric tons) of waste for disposal, as detailed in Chapter 3, Section 3.2.11, of the *1999 SWEIS* (DOE 1999a).

High-Power Microwaves and Advanced Accelerators. R&D is conducted for advanced accelerator concepts, high-powered microwaves, room-temperature and superconducting linear accelerator structures, as well as in microwave chemistry for industrial and environmental applications. A neutron spectroscopy facility would be added under this capability for use in neutron research and technology. This facility would be constructed within existing buildings and would house photographic equipment and experiments contained within closed vessels.

Radioactive Liquid Waste Treatment. Wastes from LANSCE activities and certain wastes from TA-21 and TA-50 are treated in facilities at TA-53. Treatment includes wastewater storage to allow for short-lived radioisotope decay followed by solar evaporation. Radioactive liquid waste comes primarily from floor drains and accelerator magnet cooling water. Water flows by gravity into lift stations constructed adjacent to Experimental Area A and the Manuel Lujan Neutron-Scattering Center and is pumped from the lift stations through double-walled piping to one of three 30,000-gallon (113,562-liter) horizontal fiberglass tanks located in a building at the east end of TA-53. After allowing for decay, the radioactive liquid waste is pumped to one of two aboveground concrete evaporation basins. Each of the basins can hold 125,000 gallons (470,000 liters) of liquid and has impermeable liners and leak detection instrumentation.

3.1.3.15 Waste Management Operations: Solid Radioactive and Chemical Waste Facilities

The Solid Radioactive and Chemical Waste Facilities occupy over 200 structures in an area of 943 acres (382 hectares) in TA-54 and TA-50. This Key Facility processes, temporarily stores, and disposes of solid waste generated throughout LANL. A variety of wastes are managed, including toxic, hazardous, low-level radioactive, transuranic, and mixtures of these waste types. Most waste managed in TA-54 is in a solid physical state, although there are also small quantities of gaseous or liquid hazardous, toxic, and mixed wastes. Most low-level radioactive waste generated by LANL operations is disposed of onsite in TA-54. As evaluated in the *1999 SWEIS* and documented in the ROD, as disposal capacity in the currently active portion of Area G is used up, Zone 4 is being developed for continued low-level radioactive waste disposal. In addition to the operations at TA-54, transuranic waste is processed in the Waste Characterization, Reduction, and Repackaging Facility in TA-50 and is transported to TA-54 for assay and storage. Transuranic waste is stored onsite until it is transported to WIPP for disposal. Chemical and mixed radioactive wastes are transported to other offsite facilities for treatment and disposal.

The following paragraphs describe the capabilities of this Key Facility. **Table 3–17** indicates activity types and levels proposed under all three alternatives for each capability.

Waste Characterization, Packaging, and Labeling. LANL supports, certifies, and audits generator characterization programs and maintains the waste acceptance criteria for LANL waste management facilities. LANL also manages compliance with the waste acceptance criteria for offsite treatment, storage, and disposal facilities. Deteriorating drums are overpacked, and small waste items are bulked (packaged together) to facilitate their management.

Capabilities include coring and visual inspection of a percentage of transuranic waste packages, ventilating packages of transuranic waste retrieved from below grade, maintaining compliance with the current version of the WIPP waste acceptance criteria, and coordinating with WIPP operations for disposal of LANL transuranic waste.

Table 3–17 Waste Management Operations: Solid Radioactive and Chemical Waste Facilities Capabilities and Activity Levels

Capability	*No Action Alternative* [a, b]	*Reduced Operations Alternative*	*Expanded Operations Alternative* [b]
Waste Characterization, Packaging, and Labeling	Characterize 420 cubic yards (320 cubic meters) of newly generated transuranic waste annually. Characterize 11,000 cubic yards (8,400 cubic meters) of legacy transuranic waste. Characterize low-level radioactive, mixed low-level radioactive, and chemical waste, including waste from DD&D and remediation activities. Ventilate transuranic waste retrieved from belowground storage. Perform coring and visual inspection of a percentage of transuranic waste packages. Overpack and bulk small waste items as required. Support, certify, and audit generator characterization programs. Maintain waste acceptance criteria for LANL waste management facilities. Maintain waste acceptance criteria for offsite treatment, storage, and disposal facilities. Maintain WIPP waste acceptance criteria compliance and liaison with WIPP operations.	Same as No Action Alternative	Same as No Action Alternative, plus: - Characterize an additional 290 cubic yards (220 cubic meters) of newly generated transuranic waste annually. - Characterize approximately 3,100 cubic yards (2,400 cubic meters) of contact-handled and 130 cubic yards (100 cubic meters) of remote-handled legacy transuranic waste retrieved from belowground storage. - Characterize additional low-level radioactive, mixed low-level radioactive, and chemical waste, including waste from DD&D and remediation activities.
Waste Transport, Receipt, and Acceptance	Ship 420 cubic yards (320 cubic meters) of newly generated transuranic waste to WIPP annually. Ship 11,000 cubic yards (8,400 cubic meters) of legacy transuranic waste to WIPP. Ship low-level radioactive wastes to offsite disposal facilities. Ship 70 cubic yards (55 cubic meters) of mixed low-level radioactive waste for offsite treatment and disposal in accordance with EPA land disposal restrictions annually. Ship 7,100 tons (6,400 metric tons) of chemical wastes for offsite treatment and disposal in accordance with EPA land disposal restrictions annually. Ship low-level radioactive, mixed low-level radioactive, and chemical waste from DD&D and remediation activities. Collect chemical and mixed wastes from LANL generators and transport them to Consolidated Remote Storage Sites and TA-54. Receive, on average, 5 to 10 shipments annually of low-level radioactive waste and transuranic waste from offsite locations.	Same as No Action Alternative	Same as No Action Alternative, plus: - Ship 290 cubic yards (220 cubic meters) of additional transuranic waste to WIPP annually. - Ship approximately 3,000 cubic yards (2,340 cubic meters) of contact-handled and 130 cubic yards (100 cubic meters) of remote-handled legacy transuranic waste to WIPP. - Ship additional low-level radioactive, mixed low-level radioactive, and chemical waste from DD&D and remediation activities.

Capability	***No Action Alternative*** [a, b]	***Reduced Operations Alternative***	***Expanded Operations Alternative*** [b]
Waste Retrieval	No activity	No activity	Retrieve remaining legacy transuranic waste (approximately 3,100 cubic yards [2,400 cubic meters] of contact-handled and 130 cubic yards [100 cubic meters] of remote-handled) from belowground storage in TA-54 Area G, including: Pit 9, above Pit 29, Trenches A–D, and Shafts 200-232, 235-243, 246-253, 262-266, and 302-306 (see Appendix H). [c]
Waste Treatment	Compact up to 3,000 cubic yards (2,540 cubic meters) of low-level radioactive waste annually. Process 3,000 cubic yards (2,400 cubic meters) of transuranic waste through size reduction at the Decontamination and Volume Reduction System. Demonstrate treatment (e.g., electrochemical) of liquid mixed low-level radioactive waste. Stabilize 1,100 cubic yards (870 cubic meters) of uranium chips.	Same as No Action Alternative	Same as No Action Alternative, plus: - Process newly generated transuranic waste through new TRU Waste Facility (formerly called the Transuranic Waste Consolidation Facility).
Waste Storage	Stage chemical and mixed wastes prior to shipment to offsite treatment, storage, and disposal facilities. Store transuranic waste until it is shipped to WIPP. Store mixed low-level radioactive waste pending shipment to a treatment facility. Store low-level radioactive waste uranium chips until sufficient quantities are accumulated for stabilization campaigns. Manage and store sealed sources for the Off-Site Source Recovery Project.	Same as No Action Alternative	Same as No Action Alternative, plus: - *Increase types and quantities of sealed sourced stored for the Off-Site Source Recovery Project* (see Appendix J). - Store transuranic waste generated by DD&D and remediation activities.
Waste Disposal	Dispose 110 cubic yards (84 cubic meters) of low-level radioactive waste in shafts, 30,000 cubic yards (23,000 cubic meters) of low-level radioactive waste in pits, and small quantities of radioactively contaminated polychlorinated biphenyls in shafts in Area G annually. Migrate operations in Area G to Zones 4 and 6 as necessary to allow continued onsite disposal of low-level radioactive waste.	Same as No Action Alternative	Same as No Action Alternative, plus: - Dispose additional low-level radioactive waste generated by DD&D and remediation activities.

Capability	No Action Alternative [a, b]	Reduced Operations Alternative	Expanded Operations Alternative [b]
Decontamination Operations (Part of RLWTF operations in the *1999 SWEIS*)	Decontaminate approximately 700 personal respirators and 300 air-proportional probes per month for reuse. Decontaminate vehicles and portable instruments for reuse as required. Decontaminate precious metals for resale using an acid bath. Decontaminate scrap metals for resale by sand-blasting the metals. Decontaminate 260 cubic yards (200 cubic meters) of lead for reuse by grit-blasting.	Same as No Action Alternative	Same as No Action Alternative
Construction/Upgrade/DD&D			
Waste Management Facilities Transition Project	No activity	No activity	As described in Appendix H: - Construct and operate equipment and facilities for retrieval, characterization, and packaging of stored remote-handled transuranic waste. - Procure additional and upgraded equipment and facilities to increase throughput of stored transuranic waste drums being processed for shipment to WIPP. - Construct and operate a new *TRU Waste Facility*. - Construct and operate new access control station, low-level radioactive waste compactor building, and low-level radioactive waste certification building. - Relocate hazardous and mixed low-level radioactive waste storage facilities within TA-54, Area L, or move to other LANL locations.

WIPP = Waste Isolation Pilot Plant; TA = technical area; EPA = U.S. Environmental Protection Agency; RLWTF = Radioactive Liquid Waste Treatment Facility; TRU = transuranic; DD&D = decontamination, decommissioning, and demolition.

[a] DOE 1999a.

[b] LANL 2006a.

[c] LANL 2005e.

Note: Italicized entries indicate projects for which project-specific impact analyses are included in appendices to this SWEIS.

Waste Transport, Receipt, and Acceptance. Hazardous and mixed wastes are collected from LANL generators, transported to the consolidated remote storage sites and TA-54, and shipped offsite for treatment and disposal in accordance with U.S. Environmental Protection Agency (EPA) land disposal restrictions. Legacy and newly generated transuranic wastes are prepared for disposal and shipped to WIPP. Fewer than 10 shipments a year of low-level radioactive waste and transuranic waste are received from offsite locations. Receipt of offsite waste is not routine and must be approved by NNSA. Once received, the wastes are managed along with similar wastes generated at LANL. These wastes are generated by LANL activities at other locations and by other DOE facilities that do not have the capability to manage the wastes.

Waste Retrieval. This capability involves the retrieval and management of waste stored in pits, shafts, and trenches in TA-54 Area G so that the waste can be processed for eventual disposition.

Waste Treatment. This capability involves a variety of activities to prepare different waste types for storage and disposal: compaction, size reduction, and special treatment of wastes on an as-needed basis. Low-level radioactive waste generated onsite is compacted to reduce its volume prior to disposal.

Larger pieces of transuranic waste are reduced in size at the Decontamination and Volume Reduction System to make them suitable to be packaged for shipment to WIPP. This system is intended to handle large metal items. Processes include decontamination to low-level radioactive waste levels, as well as cutting and compacting so waste fits in containers accepted at WIPP.

On an as-needed basis, Waste Management Operations demonstrates treatment of liquid mixed low-level radioactive waste, stabilizes uranium chips, and accepts environmental restoration soils for disposal at Area G as low-level radioactive waste.

Waste Storage. LANL stores chemical and mixed wastes prior to shipment to offsite treatment, storage, and disposal facilities; legacy transuranic waste until it is shipped to WIPP; mixed low-level radioactive waste until it is transported to a treatment facility; sealed sources from the Off-Site Source Recovery Project until a disposition path is available; and low-level radioactive waste uranium chips until sufficient quantities are accumulated for stabilization campaigns.

Waste Disposal. Solid low-level radioactive waste is disposed of in cells, pits, and shafts in TA-54 Area G. The Consent Order requires investigation and remediation of environmental contamination at LANL, including certain subsurface units in MDA G in Area G. For this reason, and because the currently active portion of Area G is reaching the limit of its disposal capacity, the existing disposal units will be closed and disposal operations will be moved to Zone 4 in TA-54 to provide new disposal capacity and facilitate closure of MDA G. Zone 6 in TA-54 is also available for future expansion.

Decontamination Operations. This capability was relocated from the Radioactive Liquid Waste Treatment Facility in 2000. Decontamination is performed either to enable reuse or to reduce the contamination of materials before disposal. Items generally decontaminated include respirators, vehicles, portable equipment, scrap and precious metals, and lead shielding.

3.1.3.16 Plutonium Facility Complex

The Plutonium Facility Complex Key Facility is located on 40 acres (16 hectares) in TA-55 and consists of six primary buildings and a number of support, storage, security, and training structures located throughout the TA. The Plutonium Facility, a two-story laboratory of approximately 151,000 square feet (14,000 square meters), is the major R&D facility in the complex. The Plutonium Facility Complex has the capability to process and perform research on actinide materials, although plutonium is the principal actinide used in the facility.

The following paragraphs describe the capabilities of this Key Facility. **Table 3–18** indicates activity types and levels proposed under all three alternatives for each capability.

Plutonium Stabilization. This capability employs a variety of plutonium and other actinide recovery operations to improve the storage condition of legacy plutonium in the LANL inventory. Cleaning metallic plutonium, converting metal to oxide, reprocessing scrap material, and high-firing oxides are among the routine Plutonium Complex chemical processing capabilities.

Manufacturing Plutonium Components. This capability involves the manufacture of plutonium pits and parts, and fabrication of samples for R&D activities. This capability also includes fabrication of parts for dynamic and subcritical experiments.

Surveillance and Disassembly of Weapons Components. This capability provides for the disassembly of plutonium pits for examination. Destructive and nondestructive techniques are used for examination.

Actinide Materials Science and Processing Research and Development. Research would be conducted on plutonium (and other actinide) materials, including metallurgical and other characterization of samples and measurements of mechanical and physical properties. This includes continued operation of the 40-millimeter Impact Test Facility and other apparatus. Research is also conducted to develop new techniques that are useful for such research or for enhanced surveillance. In addition, research is performed to support development and assessment of technology for manufacturing and fabrication of components, including activities in areas such as welding; bonding; fire resistance; and casting, machining, and other forming technologies.

Special recovery processes are performed, including demonstration of the disassembly and conversion of plutonium pits using hydride-dehydride processes and development of expanded disassembly capacity. Neutron sources (plutonium and beryllium, and americium-241 and beryllium) can be processed at TA-55. Included in this capability is the technology to process neutron sources other than sealed sources, process items through the Special Recovery Line (tritium separation), and perform oralloy decontamination of uranium components.

Table 3–18 Plutonium Facility Complex Capabilities and Activity Levels

Capability	*No Action Alternative* [a]	*Reduced Operations Alternative*	*Expanded Operations Alternative* [b]
Plutonium Stabilization	Recover, process, and store existing plutonium residue inventory.	Same as No Action Alternative	Same as No Action Alternative
Manufacturing Plutonium Components	Produce up to 20 plutonium pits per year. Fabricate parts and samples for research and development activities, including parts for dynamic and subcritical experiments.	Same as No Action Alternative, except: - Produce less than 20 plutonium pits per year.	Same as No Action Alternative except: - Produce up to 80 pits per year.
Surveillance and Disassembly of Weapons Components	Disassemble, surveil, and examine up to 65 plutonium pits per year.	Same as No Action Alternative	Same as No Action Alternative
Actinide Materials Science and Processing Research and Development	Perform plutonium (and other actinide) materials research, including metallurgical and other characterization of samples and measurements of mechanical and physical properties. Operate the 40-millimeter Impact Test Facility and other test apparatus. Develop expanded disassembly capacity and disassemble up to 200 pits per year. Process up to 5,000 curies of neutron sources (including plutonium and beryllium and americium-241 and beryllium). Process neutron sources other than sealed sources. Process up to 900 pounds (400 kilograms) of actinides per year between TA-55 and the CMR Building. Process pits through the Special Recovery Line (tritium separation). Perform oralloy decontamination of 28 to 48 uranium components per month. Conduct research in support of DOE actinide cleanup activities and on actinide processing and waste activities at DOE sites. Stabilize specialty items and residues from other DOE sites. Fabricate and study nuclear fuels used in terrestrial and space reactors. Fabricate and study prototype fuel for lead test assemblies. Develop safeguards instrumentation for plutonium assay. Analyze samples.	Same as No Action Alternative	Same as No Action Alternative, except (some of these are higher activity levels; some are additional activities): - Develop expanded disassembly capacity and disassemble up to 500 pits per year. - Process up to 1,800 pounds (800 kilograms) of actinides, including polishing up to 460 pounds (210 kilograms) of plutonium oxide, annually. - Provide support for dynamic experiments. - Conduct plutonium research, development, and support: prepare, measure, and characterize samples for fundamental research and development in areas such as aging, welding and bonding, coatings, and fire resistance.
Fabrication of Ceramic-Based Reactor Fuels	Make prototype mixed oxide fuel. Build test reactor fuel assemblies. Continue R&D on other fuels.	Same as No Action Alternative	Same as No Action Alternative

Capability	*No Action Alternative* [a]	*Reduced Operations Alternative*	*Expanded Operations Alternative* [b]
Plutonium-238 Research, Development, and Applications [c]	Process, evaluate, and test up to 55 pounds (25 kilograms) of plutonium-238 per year in production of materials and parts to support space and terrestrial uses. Recover, recycle, and blend up to 40 pounds (18 kilograms) per year of plutonium-238.	Same as No Action Alternative	Same as No Action Alternative
Storage, Shipping, and Receiving	Provide interim storage of up to 7.3 tons (6.6 metric tons) of the LANL special nuclear material inventory, mainly plutonium. Store working inventory in the vault in Building 55-4; ship and receive as needed to support LANL activities. Provide temporary storage of Security Category I and II materials removed in support of TA-18 closure, pending shipment to the Nevada Test Site and other DOE complex locations. Store sealed sources collected under DOE's Off-Site Source Recovery Project. Store mixed oxide fuel rods and fuel rods containing archive and scrap material from mixed oxide fuel lead assembly fabrication.	Same as No Action Alternative	Same as No Action Alternative, plus: - Conduct nondestructive assay on special nuclear material at TA-55-4 to identify and verify the content of stored containers. - Cut mixed oxide fuel rods and fuel rods containing archive and scrap materials from mixed oxide fuel lead assembly fabrication into smaller pieces, repackage, and continue to store.
Construction/Upgrades/DD&D			
Plutonium Facility Complex Refurbishment Project	No activity	No activity	Implement *Plutonium Facility Complex Refurbishment Project*, involving major systems repairs and replacements to extend reliable operation of facility for the future (see Appendix G).
TA-55 Radiography Facility Project	No activity	No activity	Construct and operate TA-55 Radiography Facility (see Appendix G).

R&D = research and development; TA = technical area; CMR = Chemistry and Metallurgy Research; DD&D = decontamination, decommissioning, and demolition.

[a] DOE 1999a.

[b] LANL 2006a.

[c] The *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems* (DOE 2005c) evaluates consolidation of radioisotope power system nuclear operations, including those currently performed at the Plutonium Facility at LANL, at a single site. The Proposed Action would consolidate these activities at Idaho National Laboratory. Should DOE decide to implement consolidation, associated operations would cease at LANL and be transferred. However, other activities involving plutonium-238, such as the plutonium-238 fuel aging studies and plutonium-238 calibration standards activities would remain at LANL.

Note: Italicized entries indicate projects for which project-specific impact analyses are included in appendices to this SWEIS.

Research in support of DOE's actinide cleanup activities and on actinide processing and waste activities at DOE sites is conducted. In addition, LANL staff would stabilize specialty items and residues from other DOE sites; fabricate and study nuclear fuels used in terrestrial and space reactors; fabricate and study prototype fuel for lead test assemblies; develop safeguards instrumentation for plutonium assay; and analyze samples.

Fabrication of Ceramic-Based Reactor Fuels. Development and demonstration of ceramic fuel fabrication technologies is conducted. R&D continues on other fuels.

Plutonium-238 Research, Development, and Applications. Radioisotope thermoelectric generators and milliwatt generators using plutonium-238 as an energy source are developed and fabricated under this capability. As part of R&D and testing, plutonium-238 is processed, recovered, recycled, and blended. Materials and parts are fabricated and units are tested in support of space and terrestrial uses.

Storage, Shipping, and Receiving. The Plutonium Facility provides storage, shipping, and receiving activities for the majority of the LANL special nuclear material inventory, mainly plutonium. This includes temporary storage of Security Category I and II materials removed from TA-18 in support of TA-18 closure until these materials are shipped to the Nevada Test Site and other DOE sites. In addition, sealed sources collected under DOE's Off-Site Source Recovery Project are stored at TA-55 or sent to other LANL locations for storage pending final disposition. When appropriate, mixed oxide fuel materials stored at TA-55 would be transported to other DOE sites.

3.2 Reduced Operations Alternative

At the site-wide and TA levels, the Reduced Operations Alternative is the same as the No Action Alternative. Differences between the Reduced and No Action Alternatives occur only within Key Facilities as described in this section.

Under the Reduced Operations Alternative, the following Key Facilities would maintain the same capabilities and operate at the same activity levels as under the No Action Alternative (see Section 3.1 of this SWEIS):

- Sigma Complex
- Machine Shops
- Material Sciences Laboratory
- Nicholas C. Metropolis Center for Modeling and Simulation
- Tritium Facilities
- Target Fabrication Facility
- Bioscience Facilities
- Radiochemistry Facility

- Waste Management Operations: Radioactive Liquid Waste Treatment Facility
- Waste Management Operations: Solid Radioactive and Chemical Waste Facilities

The six Key Facilities discussed in the following paragraphs would operate at levels reduced from those described for the No Action Alternative.

3.2.1 Chemistry and Metallurgy Research Replacement Facility

Under the Reduced Operations Alternative, NNSA would not construct and operate the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility. Operations at the Chemistry and Metallurgy Research Building would continue to provide LANL's analytical chemistry and materials characterization research and mission support capabilities beyond 2010, while most administrative offices and support functions would move to TA-55 once construction of the new Chemistry and Metallurgy Research Replacement radiological laboratory, administrative office, and support building was completed. Operations remaining at the Chemistry and Metallurgy Research Building would likely be reduced and consolidated from Wings 3, 5 and 7 (operations have already been halted within Wings 2 and 4); ultimately Wing 7 might become the last remaining operable wing of the building before its total shutdown and closure. Operations overall within the Chemistry and Metallurgy Research Building would be reduced and nuclear materials stored within the building would also be reduced. Overall support to production activities would not be adequate to support a 20 pit-per-year rate.

3.2.2 High Explosives Processing Facilities

Under the Reduced Operations Alternative, capabilities described in the No Action Alternative for the High Explosives Processing Facilities Key Facility would remain the same, but their activity levels would be reduced by 20 percent (see Section 3.1.3.6). These activities would require an estimated 66,200 pounds (30,000 kilograms) of explosives and 2,300 pounds (1,100 kilograms) of mock explosives annually. Table 3–8 presents activity levels proposed under this alternative for each capability.

Construction of the TA-16 Engineering Complex would be completed as under the No Action Alternative, including removing or demolishing unneeded vacated structures.

3.2.3 High Explosives Testing Facilities

Under the Reduced Operations Alternative, capabilities for the High Explosives Testing Facilities would remain the same as those described in the No Action Alternative, but their activity levels would be reduced by 20 percent (see Section 3.1.3.7). Further, no special nuclear material would be used in dynamic experiments. Table 3–9 indicates activity levels proposed under all three alternatives for each capability. Under this alternative, up to 5,500 pounds (2,500 kilograms) of depleted uranium would be expended in experiments annually.

The same construction projects would be implemented as under the No Action Alternative: 15 to 25 new structures (new offices, laboratories, and shops) would be built within the Two-Mile Mesa Complex to consolidate activities currently conducted in various locations around LANL. Vacated structures would be removed or demolished as appropriate, and the dynamic experimentation assembly structure would be installed at TA-15.

3.2.4 Pajarito Site

Under the Reduced Operations Alternative, operations at the Pajarito Site would cease. The Pajarito Site would be placed in surveillance and maintenance mode and would be eliminated as a Key Facility. Table 3–11 identifies differences between the three alternatives for the Pajarito Site Key Facility.

3.2.5 Los Alamos Neutron Science Center

Under the Reduced Operations Alternative, LANSCE would be closed, placed into safe shutdown mode, and eliminated as a Key Facility. Systems would be maintained in a condition to support future restart. This shutdown would be a major change at LANL because LANSCE accounts for more than 90 percent of all radioactive air emissions from LANL and provides a source of neutron and proton beams that is not readily available elsewhere in the DOE complex. Radioactive liquid waste treatment would continue at TA-53, with approximately 5,000 gallons (20,000 liters) per year transported from TA-50 for solar evaporation. Table 3–16 identifies differences between the three proposed alternatives for LANSCE.

3.2.6 Plutonium Facility Complex

Under the Reduced Operations Alternative, the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility would not be constructed and analytical chemistry and materials characterization research would continue at the Chemistry and Metallurgy Research Building. As discussed in Chapter 1, Section 1.3.2, and in Section 3.2.1, overall support to pit production activities would not be adequate to support a 20 pit-per-year production rate.

3.3 Expanded Operations Alternative

This alternative considers LANL operations at a higher level than the No Action Alternative, as well as implementation of additional projects at the site-wide, TA, and Key Facility levels. Many capabilities would remain unchanged. Some projects that would be implemented, such as for the Pajarito Site Key Facility, would result in closure and demolition of facilities and loss of capabilities at LANL. Each proposed new construction project or major modification to existing facilities is described and the potential impacts are evaluated in an appendix to this SWEIS. Each of these appendices includes a proposed timeline for construction and operation.

3.3.1 Los Alamos National Laboratory Site-Wide Projects

Under the Expanded Operations Alternative, three major site-wide projects would be undertaken. The Security-Driven Transportation Modifications Project, remedial activities required to comply with the Consent Order, and an increase in the types and quantities of sealed sources managed at LANL by the Off-Site Source Recovery Project are described in this section.

3.3.1.1 Security Needs

As part of its ongoing security improvement effort, NNSA has determined there is a continuing need to upgrade physical protection in the area of the Pajarito Corridor West. Under the Expanded Operations Alternative, additional Security-Driven Transportation Modifications involving extensive changes to general traffic flow patterns and site infrastructure identified in Table 3–1 would be implemented.

Under this approach, vehicular traffic in the Pajarito Corridor West between TA-48 and TA-63 could be limited, according to the security level, to only Government vehicles and physically inspected service vehicles. Access for staff and visitors to this controlled area would be provided by an internal shuttle system linked to large parking areas at TA-48 and TA-63. Surface parking lots for both private vehicles and commuter buses would be constructed at these two termini. A shuttle bus system would be deployed within the restricted area.

Modifications to certain existing roads and construction of new roads would be required. Retaining walls and security barriers would be constructed as needed to provide physical separation of the security-controlled portion of the Pajarito Corridor West from the parking areas and other roadways. A pedestrian and bicycle pathway system including shelters and related amenities would be provided at various locations within the project area. Pedestrian and vehicular crossings would be constructed between TA-63 and TA-35 over a branch of Mortandad Canyon (known locally as Ten Site Canyon).

Two auxiliary actions could also be implemented. Auxiliary Action A involves the construction of a two-lane bridge crossing Mortandad Canyon between TA-35 and Sigma Mesa (in TA-60) with a new road proceeding west through TA-60 to TA-3. Auxiliary Action B, which would be dependent on implementation of Auxiliary Action A, involves constructing a two-lane bridge over Sandia Canyon between TA-60 and TA-61, and a new road proceeding northward to East Jemez Road. The proposed project and an evaluation of the potential impacts are presented in Appendix J.

3.3.1.2 Remediation and Closure Activities

For several years, LANL personnel have conducted an environmental restoration program to identify locations where hazardous constituents may have been released into the environment and to carry out corrective measures in compliance with the Atomic Energy Act and the Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA). Under RCRA and related legislation, corrective action is enforced nationally by EPA and locally by the New Mexico Environment Department pursuant to the New Mexico Hazardous Waste Act. Since 1990, LANL personnel have conducted investigations and corrective actions at sites subject to HSWA in accordance with the LANL Hazardous Waste Facility Permit. The Consent Order signed on March 1, 2005, however, stipulates a more specific program of studies and corrective measures and requires cleanup to be completed by 2015.

The Consent Order establishes requirements for investigation and remediation of a large number of potential release sites, including several former MDAs, and specifies both the set of investigations and the schedule for their completion. Investigations by LANL staff would include installation of wells at the MDAs and in adjoining canyons, collection of soil and rock samples at the MDAs, collection of vapor samples from the MDAs, collection of alluvial sediment and groundwater samples in the adjoining canyons, and other related activities. These investigations would involve similar, if not identical, technologies that have been used for many years at LANL with few, if any, environmental impacts. If, at the conclusion of the investigation process, the New Mexico Environment Department determines that corrective measures are needed to protect human health or the environment, LANL staff would evaluate a set of remedial options and recommend to the New Mexico Environment Department a preferred corrective measure. The New Mexico Environment Department would decide, however, which method should be implemented and is not obligated to select the preferred corrective measure.

Two scenarios for environmental restoration have been evaluated to bound the range of possible consequences of implementing corrective measures required by the Consent Order.[3] A Capping Option, a Removal Option, and a No Action Option are assumed and evaluated in Appendix I of this SWEIS. The No Action Option is the base case in which remedial investigations and cleanup activities would continue at a level comparable to that of recent years. Briefly, the Capping Option reflects the assumption that the waste and contamination within the MDAs would be left in-place and stabilized by installation of evapotranspiration caps as a mitigation measure. The Removal Option reflects the assumption that the waste and contamination within the MDAs covered by the Consent Order would be removed. For both the Capping and Removal Options, several additional potential release sites such as firing sites and outfalls would be remediated annually. These options are intended to bound the range of possible corrective measures and do not represent the preferred action NNSA would propose to the New Mexico Environment Department.

The Los Alamos County Solid Waste Landfill is an unlined facility that does not meet current regulatory standards. In lieu of bringing the landfill up to required standards, Los Alamos County will close the landfill, but has proposed to the New Mexico Environment Department that the landfill remain open through 2008 to achieve final waste grade (LAC 2007). Following closure, any remaining requirements would be addressed under the Consent Order as part of investigating and remediating the Upper Sandia Canyon Aggregate Area. The Investigation Work Plan for Upper Sandia Canyon Aggregate Area, including proposed groundwater monitoring, is due to the New Mexico Environment Department in 2008.

3.3.1.3 Increase in the Type and Quantity of Sealed Sources Managed at Los Alamos National Laboratory by the Off-Site Source Recovery Project

Under the Expanded Operations Alternative, the types and quantities of sealed sources accepted under the Off-Site Source Recovery Project would increase. In 2004, the scope of the Off-Site Source Recovery Project was expanded to include:

- all concentrations of the sources in the original scope commonly found in sealed sources;
- additional isotopes such as cobalt-60, cesium-137, iridium-192, radium-226, and californium-252, all of which are commonly found in sealed sources; and strontium-90, which is used in radioisotope thermoelectric generators (DOE 2004c).

[3] NNSA is including impacts associated with Consent Order implementation in the SWEIS in order to more fully analyze the impacts resulting from Consent Order compliance. NNSA intends to implement actions necessary to comply with the Consent Order regardless of decisions it makes on other actions analyzed in the SWEIS.

The Off-Site Source Recovery Project would use the same approach to manage these additional sealed sources as it does for those already managed under the No Action Alternative. The sealed sources would be brought to LANL for safe storage when other reasonable disposition options such as reuse or commercial disposal were not available. The potential impacts of the increased scope of the Off-Site Source Recovery Project at LANL are analyzed in Appendix J of this SWEIS.

3.3.2 Technical Area Projects

LANL activities discussed in this section would occur at TA-3, TA-21, TA-62, and TA-72. Proposed activities for TA-18, the Pajarito Site Key Facility, are discussed in Section 3.3.3.5.

3.3.2.1 Technical Area 3

Physical Science Research Complex Project

The Physical Science Research Complex Project (formerly the Center for Weapons Physics Research) would provide a new modern facility in which to consolidate staff currently located in TA-3 and other LANL locations in temporary structures or aging permanent buildings in poor condition. The new complex would collocate approximately 750 weapons scientists from various LANL organizations and disciplines to facilitate stockpile stewardship and certification activities. Security would be enhanced with construction of the Physical Science Research Complex, which would enable efficient conduct of classified work in a properly engineered security environment. Productivity is expected to be enhanced by collocating similar functions and organizations.

Under the Expanded Operations Alternative, the new Physical Science Research Complex would be constructed in a currently developed area of TA-3. The preliminary proposal is for a complex of four buildings, with a total floor space of approximately 350,000 square feet (32,500 square meters). Approximately 30 percent of the floor space would be laboratories (primarily laser). These laboratories would have an improved heating, ventilation, and air conditioning system; special flooring to limit vibration; extensive electrical grounding; and the use of pressurized air, helium, and nitrogen gas. The gases would be provided from a central location. No wet chemistry is expected to be performed. The complex would include both classified and unclassified workspace, a clean room, and vault space for classified weapons designers. A substantial amount of electrical power would be required to operate equipment.

Approximately 74,000 square feet (6,900 square meters) of existing structures at TA-3 would be removed to accommodate construction of the proposed new facility. Additionally, an undetermined number of other facilities could be demolished when the Physical Science Research Complex is complete. The potential impacts of this proposed project are evaluated in Appendix G.

Replacement Office Buildings Project

A complex of replacement office buildings and associated structures has been proposed for TA-3. The buildings would provide new modern structures to allow consolidation of staff currently located throughout TA-3 or other parts of LANL in temporary structures or aging permanent buildings in failing and poor condition. The office complex would be located partially on undeveloped land south of West Jemez Road and partially in developed areas of the existing Wellness Center building. The project would consist of nine new buildings (one of which would be available to house DOE's Los Alamos Site Office) and two new parking structures, one located north of Mercury Road and one located south of West Jemez Road. The existing Wellness Center would be demolished to accommodate later phases of this project. Three new office buildings already under construction would become part of this complex through connecting parking and siting proximity.

The proposed Los Alamos Site Office Building would be a 45,500-square-foot (4,200-square-meter) building housing approximately 150 staff. The remaining office complex buildings would be two-story structures, each with a footprint of 8,000 to 9,000 square feet (740 to 840 square meters). These new buildings would provide approximately 15,000 to 17,500 gross square feet (1,400 to 1,600 square meters) of office space and house approximately 50 to 70 staff each. Staff would be transferred from other offices at LANL. Appendix G provides an analysis of the potential impacts of this project. Construction of the Los Alamos Site Office Building has begun.

3.3.2.2 Technical Area 21 Structure Decontamination, Decommissioning, and Demolition Project

Under the Expanded Operations Alternative, all or some of the structures located within the boundaries of TA-21 would undergo DD&D. Structures involved could range from only those that interfere with site investigations and remediation to all existing TA-21 structures: process buildings, administrative and logistics buildings, and support facilities. Infrastructure such as gas, water, and waste piping; electrical and communication lines; and fences that cross TA-21 en route to other LANL facilities would also be removed as necessary.

The Consent Order requires investigation and remediation of environmental contamination at LANL, including areas in TA-21. In many cases, these investigations and remedial actions would be hampered by buildings that are above or adjacent to proposed investigation areas. To facilitate investigation of these areas, decommissioning and decontamination of many of the structures is planned. Decommissioning and decontamination of the structures would be optimized by grouping structures with similar contaminant profiles, interrelated systems, and construction types. The composition of those groups is identified in Appendix H, which evaluates the potential impacts of DD&D of structures in TA-21.

Field activities include preparation work and establishment of waste staging areas, utility management, removal of internal equipment, abatement or decontamination, removal of roofing and exterior equipment, above- and below-grade structural demolition, limited removal of underlying soil and structures, verification sampling, and site restoration. Many buildings are extensively contaminated and have residual radiological material in systems and on surfaces. Drainage, ventilation, and other utility systems also could contain residual hazardous materials.

Heavy equipment, specialty equipment, safety systems, and waste processing systems could be used in the decommissioning and decontamination effort. This equipment would be operated inside and adjacent to the structures. Removal of the foundation, substructures, and underlying soil would be limited to a depth of about 5 feet (1.5 meters) adjacent to and 2 feet (0.6 meters) below structure footprints. Remedial investigations and cleanup of the contaminated areas would be addressed by environmental restoration efforts as described in Section 3.3.1.2 and Appendix I of this SWEIS.

Actions would be taken on a schedule to support the investigation and corrective actions required under the Consent Order. DD&D of buildings and structures that might have an interim use, such as the steam plant and piping and administrative and logistics facilities, might be deferred. Appendix H lists buildings and structures identified for DD&D under this alternative and evaluates the potential impacts of these proposed activities.

3.3.2.3 Science Complex Project in Technical Area 62

The Science Complex is proposed to be built in TA-62; other siting options include the Research Park and south TA-3. The complex would consist of two buildings providing approximately 402,000 gross square feet (37,300 square meters) of office and light laboratory space along with the necessary supporting infrastructure and an auditorium, and would replace an equal amount of outdated and inefficient space that would be retired from service and eventually demolished. A parking structure of 504,000 square feet (46,800 square meters) would also be constructed. The complex would provide space for scientific staff involved in research in biosciences, computer and computational sciences, earth and environmental sciences, theoretical research, nonlinear studies, and geophysics and planetary physics.

Construction of the Science Complex would provide NNSA an opportunity to improve the quality of facilities that would be used to carry out current and future research programs in support of NNSA's Defense Program mission and to decrease and control operational and maintenance costs for LANL facilities. In addition, by providing consolidated space for staff performing work in related areas, peer groups would have frequent interactions that could contribute to collaborations and creative innovation and achieve efficiency.

NNSA's goal is to retain as much of the natural setting, vegetation, and overall environmental integrity of the site as practical. Potential environmental impacts of the construction and operation of the new Science Complex are analyzed in Appendix G.

3.3.2.4 Remote Warehouse and Truck Inspection Station Project in Technical Area 72

The proposed warehouse and truck inspection station in TA-72 would allow consolidation of truck inspections and warehousing operations at a location that is remote from core areas at LANL. The remote location would provide enhanced security because commercial vehicle shipments would be received and inspected before entering the more densely populated areas of LANL. The new Remote Warehouse and Truck Inspection Station would be sited on the southwest side of East Jemez Road, approximately 1 mile (1.6 kilometers) west of NM 4. Shipments would be offloaded and searched at the warehouse, then shipped to their onsite destinations.

The new facility would consolidate current distribution center activities into a modern facility that is safe, secure, cost-efficient, and environmentally compliant. The facility would replace existing LANL warehouse facilities that are over 50 years old and in poor condition and would solve existing operational problems. The new Truck Inspection Station would replace the temporary station located on the north side of East Jemez Road.

This complex would include an 85,000-square-foot (7,900-square-meter) distribution warehouse building, a 12,000-square-foot (1,100-square-meter) office building, a 400-square-foot (37-square-meter) rest area, and a 600-square-foot (55-square-meter) guardhouse and dog kennel. The warehouse would contain a vault, loading docks, leveling ramps, conveyor belts, and a materials handling area. The office building would house support personnel for the warehouse and truck inspection station operations. In addition, there would be approximately 50,000 square feet (4,600 square meters) of paved area for the Truck Inspection Station.

After the proposed facility is in operation, the temporary truck inspection station would be demolished and the area would be returned to a natural condition. Potential impacts of the construction and operation of this new Remote Warehouse and Truck Inspection Station are evaluated in Appendix G.

3.3.3 Key Facilities

The following Key Facilities would maintain the same capabilities and operate at the same activity levels under the Expanded Operations Alternative as under the No Action Alternative (see Section 3.1 of this SWEIS):

- Sigma Complex
- Machine Shops
- Material Sciences Laboratory
- High Explosives Testing Facilities
- Target Fabrication Facility

Changes to the other Key Facilities are described in the following paragraphs.

3.3.3.1 Chemistry and Metallurgy Research Building

Under the Expanded Operations Alternative, activities and anticipated construction would proceed as under the No Action Alternative described in Section 3.1.3.1, with a few additions. The Actinide Research and Development capability and the Fabrication and Processing capability would include several new or expanded activities, as outlined in Table 3–3. Under the Expanded Operations Alternative, Chemistry and Metallurgy Research Building Wing 9 hot cell operations would be moved to the Radiological Sciences Institute proposed for TA-48 rather than being eliminated, and operations would be overseen by Radiochemistry Laboratory personnel. Potential impacts of construction and operation of the new Radiological Sciences Institute are evaluated in Appendix G.

3.3.3.2 Nicholas C. Metropolis Center for Modeling and Simulation

Operations levels for the Metropolis Center are described in Table 3–7. Under the Expanded Operations Alternative, the computing platform would operate at higher computational levels, initially estimated to be up to 100 teraflops, and could approach 1,000 teraflops (1 petaflops). The level to which operations could increase would be limited by the amount of electricity and water needed to support the increased capabilities. Increases in operational levels requiring more than 15 megawatts of electricity or 51 million gallons (193 million liters) of water per year would require additional NEPA analysis before implementation. Expansion of computational capabilities would be supported by installation of additional processors and mechanical and electrical equipment. Potential impacts of increasing the level of operation at the Metropolis Center are evaluated in Appendix J.

3.3.3.3 High Explosives Processing Facilities

Activity levels for the High Explosives Processing Facilities are shown in Table 3–8. Activities under the Expanded Operations Alternative would require an estimated 82,700 pounds (37,500 kilograms) of explosives and an increase to 5,000 pounds (2,300 kilograms) of mock explosives annually. In addition, the Safety and Mechanical Testing capability would operate at a higher level; the number of safety and mechanical tests conducted annually would increase from approximately 15 per year up to 500 tests per year. The remaining capabilities would operate at the same levels described for the No Action Alternative (see Section 3.1.3.6).

3.3.3.4 Tritium Facilities

Tritium Facilities capabilities and activity levels are described in Table 3–10. Under the Expanded Operations Alternative, activity levels would be the same as described for the No Action Alternative (see Section 3.1.3.8). Once all tritium operations are finished at the Tritium Systems Test Assembly and the Tritium Science and Fabrication Facility, however, the buildings would undergo DD&D as part of the TA-21 structure DD&D (see Section 3.3.2.2).

3.3.3.5 Pajarito Site

The Pajarito Site capabilities and activity levels are described in Table 3–11. Under the Expanded Operations Alternative, Security Category III and IV materials would be relocated to the proposed Institute for Nuclear Nonproliferation Science and Technology, which is part of the proposed Radiological Sciences Complex at TA-48, or to another location at LANL as evaluated in Appendices G and H. Sealed sources managed under the Off-Site Source Recovery Project would be moved to other LANL storage locations, and the remaining operations at the Pajarito Site would be discontinued. Buildings would be decontaminated and decommissioned, as appropriate. Except for a cabin structure and other historic properties from the Manhattan Project and Cold War eras that would be preserved, buildings at TA-18 would be demolished and the Pajarito Site would be eliminated as a Key Facility.

3.3.3.6 Bioscience Facilities

Under the Expanded Operations Alternative, most of the Bioscience Facilities operations would move to the proposed Science Complex described in Section 3.3.2.3 and evaluated in

Appendix G. Moving Bioscience Facilities operations to the Science Complex would facilitate eventual replacement of the Health Research Laboratory in TA-43.

3.3.3.7 Radiochemistry Facility

Under the Expanded Operations Alternative, most capabilities would operate at the same levels as under the No Action Alternative, as described in Table 3–14. In addition, there would be one new activity under an existing capability and one new capability. Beryllium dispersion and mitigation assessments would be performed as part of the Environmental Remediation and Risk Mitigation capability. The new capability, Atom Trapping, would use a high-efficiency magneto-optical trap coupled to an offline mass separator to efficiently trap radioactive atoms for fundamental and applied research efforts.

The Expanded Operations Alternative would also include construction of the first component of the new consolidated and integrated Radiological Sciences Institute. The new institute would be constructed over about 20 years in a phased approach. Construction would begin on the first phase, the Institute for Nuclear Nonproliferation Science and Technology, during the timeframe analyzed in this SWEIS. The Institute for Nuclear Nonproliferation Science and Technology would include a Security Category I and II training center with a Security Category I vault, several Security Category III and IV laboratories, a field security test laboratory, a secure radiochemistry facility, and associated office and support facilities. Security Category III and IV capabilities and materials from TA-18 remaining at LANL would be relocated to the Institute for Nuclear Nonproliferation Science and Technology.

Once the new complex is completed, existing Radiochemistry Facility capabilities, as well as those from several other buildings, would be relocated to the new Radiological Sciences Institute and the old buildings currently housing those operations would undergo DD&D. In addition, capabilities from the Chemistry and Metallurgy Research Building Wing 9 hot cell would be reconstructed in the new Radiological Sciences Institute, and responsibility for those operations would transfer to the Radiochemistry Key Facility. Potential impacts of construction and operation of the new Radiological Sciences Institute are evaluated in Appendix G.

3.3.3.8 Waste Management Operations: Radioactive Liquid Waste Treatment Facility

Radioactive Liquid Waste Treatment Facility capabilities and activity levels are described in Table 3–15. Under the Expanded Operations Alternative, the Waste Transport, Receipt, and Acceptance capability and the Radioactive Liquid Waste Treatment capability would operate at increased levels. In addition to operating the new influent storage facility, a replacement for the existing Radioactive Liquid Waste Treatment Facility Building would be constructed in TA-50, with an estimated start of operations in 2012. New low-level radioactive waste and transuranic waste treatment facilities would be constructed, and low-level radioactive waste and transuranic waste processes would be modified to achieve greater reliability, redundancy, and flexibility. Portions of the existing facility would be demolished. New equipment would be purchased; some existing equipment might be used to supplement the new equipment. Evaporation tanks would be installed in TA-52 to minimize the discharge of treated liquid effluent from the Radioactive Liquid Treatment Waste Facility to the environment. Treated effluent would be conveyed to the evaporation tanks through a pipeline installed between TA-50 and TA-52. Potential impacts of this project are evaluated in Appendix G.

3.3.3.9 Los Alamos Neutron Science Center

Under the Expanded Operations Alternative, there would be no change in activity levels from the No Action Alternative, described in Table 3–16. The LANSCE Refurbishment Project, however, would be implemented. This project, which would include renovations and improvements to the existing facility to increase its reliability and extend its operation into the future, is described in Appendix G.

3.3.3.10 Waste Management Operations: Solid Radioactive and Chemical Waste Facilities

Under the Expanded Operations Alternative, most capabilities would continue to operate at the same activity levels described for the No Action Alternative in Table 3–17. Activity levels for the Waste Characterization, Packaging, and Labeling; and the Waste Transport, Receipt, and Acceptance capabilities would increase to accommodate additional transuranic waste resulting from increased pit production at the Plutonium Facility Complex. Storage and shipment of transuranic waste and disposal of low-level radioactive waste from DD&D and remediation activities would increase. In addition, the Waste Retrieval capability would be restarted to retrieve the transuranic waste stored in pits, shafts, and trenches in TA-54, Area G, as described in Table 3–17.

Within the Waste Storage capability, efforts to support the Off-Site Source Recovery Project would be expanded to accommodate expansion of the project to include additional types and concentrations of sealed sources. This project, which involves recovery of radioactive sources and devices (primarily sealed sources) that pose a potential risk to health, safety or national security, is evaluated in Appendix J.

Several new construction and upgrade projects would be implemented at the Solid Chemical and Radioactive Waste Facilities under the Expanded Operations Alternative. These projects would include construction and operation of a facility and equipment to retrieve and process remote-handled transuranic waste; procurement of additional and upgraded equipment for transuranic waste processing; construction and operation of a new TRU (Transuranic) Waste Facility (formerly the Transuranic Waste Consolidation Facility) in a TA along the Pajarito Road corridor; and construction and operation of a new access control station, low-level radioactive waste compactor building, and low-level radioactive waste certification building in TA-54. Potential impacts of construction and operation of these projects are analyzed in Appendix H.

3.3.3.11 Plutonium Facility Complex

Under the Expanded Operations Alternative, the Plutonium Facility Complex at TA-55 would increase pit production to up to 80 pits per year to meet the near-term needs of the Stockpile Stewardship Program. Increased pit production would impact all capabilities at the Plutonium Facility Complex, as shown in Table 3–18, and would also cause changes in activity levels at other Key Facilities. For example, a portion of the increased levels of transuranic waste processing that would occur at the Solid Radioactive and Chemical Waste Facilities under this alternative would result from increased pit production.

In addition, under the Expanded Operations Alternative, activities in support of mixed oxide fuel fabrication would increase. Up to 500 pits would be disassembled and up to 460 pounds (210 kilograms) of plutonium oxide would be polished annually and stored pending shipment to the Savannah River Site for use at the Mixed Oxide Fuel Fabrication Facility. Also, mixed oxide fuel stored in TA-55 would be reconfigured for more compact storage and eventual transportation offsite. Two containers with approximately 1,455 pounds (660 kilograms) of mixed oxide fuel in the form of ceramic pellets enclosed in fuel rods are stored at the Plutonium Facility Complex in their Type B shipping containers. Under this alternative, the pellets would be removed from the fuel rods and repackaged into smaller containers for storage in the special nuclear material vault pending transport to other DOE sites in Type B containers.

The Plutonium Facility Complex Refurbishment Project has been proposed to modernize and upgrade existing facilities and infrastructure at the TA-55 complex. This project is part of a comprehensive, long-term strategy to extend the life of TA-55 so that it can continue to operate safely, securely, and effectively for at least another 25 years. The project would be executed through a series of subprojects at TA-55; 21 high-priority subprojects and other less-critical subprojects have been proposed. The subprojects focus on high-priority facility systems and components that would improve overall Plutonium Facility reliability and are critical to facility and program operations. Proposed upgrades and renovations are described and potential impacts evaluated in Appendix G.

Another proposed project is construction and operation of a high-energy x-ray radiography facility in TA-55 to relocate this capability from TA-8. Examination of nuclear items and components through radiography is a key process in verifying the safety and reliability of the U.S. nuclear weapons stockpile. Movement of these nuclear items and components between TA-55 and TA-8, a distance of 4.5 miles (7.2 kilometers), was difficult prior to September 11, 2001, but was stopped after that date because increased demands on security personnel impacted the availability of security resources. The capability for high-energy x-ray radiography that eliminates the need for transporting nuclear items and components outside the security perimeter of TA-55 is needed to meet mission milestones and deadlines.

The proposed new facility in TA-55 would have between 5,000 to 8,500 square feet (460 to 790 square meters) of floor space and would be no more than two stories high, with the second floor below ground level. Constructing and operating this facility in TA-55 would eliminate the need to move nuclear components and items from TA-55 and would allow this type of nondestructive examination to resume at LANL. The proposed facility is described and potential impacts evaluated in Appendix G.

3.4 Preferred Alternative

NNSA's Preferred Alternative for continued operation of LANL is the Expanded Operations Alternative. This alternative includes fabrication of up to 80 pits per year at the Plutonium Facility Complex in TA-55, as well as increased activity levels at certain other Key Facilities (such as the Chemistry and Metallurgy Research Replacement Facility) to support this level of pit production. Proposed increases in activity levels would be implemented and new capabilities would be added to existing Key Facilities. Capabilities, activity levels, and projects identified under the No Action Alternative that remain unchanged under the Expanded Operations Alternative would continue as described. NNSA would undertake activities to facilitate compliance with the Consent Order and remediation of the MDAs, as well as other closure and DD&D projects. The proposed projects discussed in the appendices to this SWEIS would proceed, commensurate with funding.

However, full implementation of the Preferred Alternative may be affected by future programmatic decisions. NNSA is reconsidering its 2004 decision (69 FR 6967) to construct and operate the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility, pending evaluations and decisions related to Complex Transformation. NNSA may decide to proceed with construction and operation of the nuclear facility portion at LANL, as announced in the 2004 ROD, or to establish these capabilities as part of a consolidated plutonium center or an integrated part of a consolidated nuclear production center. Both the consolidated plutonium center and the consolidated nuclear production center are analyzed in the *Complex Transformation SPEIS*. A ROD for the *Complex Transformation SPEIS* is expected in late 2008.

3.5 Alternatives Considered but Not Analyzed in Detail in the Site-Wide Environmental Impact Statement

Among the comments received during the scoping process were suggestions for additional alternatives that should be considered in the SWEIS, including a "Greener Alternative" and a "true No Action Alternative" (or shutdown alternative).

A Greener Alternative was evaluated in the *1999 SWEIS*. The name and general description of the alternative were provided by interested citizens as a result of the scoping process for that SWEIS. This alternative included LANL capabilities existing at that time with an emphasis on work performed in support of basic science, waste minimization and treatment, nuclear weapons dismantlement, nonproliferation, and other areas of national and international importance. While the Greener Alternative contained components of both the No Action and the Expanded Operations Alternatives evaluated in the *1999 SWEIS*, the operational focus was on science, waste management, and nuclear weapons dismantlement. NNSA is not evaluating a similar alternative in this SWEIS because, as stated in the *1999 SWEIS* ROD (see Appendix A), a Greener Alternative would not support the nuclear weapons mission assigned to LANL. It should be noted, however, that important aspects of the Greener Alternative evaluated in the *1999 SWEIS*, specifically optimization of work in the field of nonproliferation of weapons of mass destruction, as well as enhanced weapons dismantlement work, have been incorporated into the No Action Alternative analyzed in this new SWEIS. Other aspects of the Greener Alternative in the *1999 SWEIS* also incorporated into the No Action Alternative of this SWEIS include enhanced research related to national health issues, waste minimization and environmental restoration technologies, and international nuclear safety.

The alternative characterized as a "true No Action Alternative," in which all operations at LANL, including production and testing in support of stockpile stewardship would cease, is not a reasonable alternative. Thus, NNSA is not analyzing it in this SWEIS. Ceasing operations would result in a loss of support to nonproliferation efforts and research aiding the fight against terrorism. Because these activities are vital to national security and are among the major components of the mission assigned to LANL by NNSA, this alternative is not considered a reasonable alternative. This SWEIS updates previous EISs that have provided information supporting a number of decisions about operations at LANL. In such situations, an alternative that assumes LANL would cease all mission-related work is not reasonable.

3.6 Summary of Environmental Consequences

This section summarizes the impacts analyses performed for this SWEIS to provide an understanding of the overall consequences of each of the proposed alternatives and how the alternatives compare to each other. Chapter 5 of this SWEIS contains the detailed environmental analyses. Section 3.6.1 presents an overview for each of the resource areas, highlighting issues, concerns, or positive impacts. **Table 3–19** (located at the end of Section 3.6.1) summarizes the potential consequences of each alternative by resource area. Section 3.6.2 is a summary of the cumulative impacts analyses that considers operating LANL in the context of other past, present, and reasonably foreseeable actions.

The Expanded Operations Alternative includes implementation of specific projects evaluated in the appendices to this SWEIS. As discussed in Chapter 1, however, NNSA may make decisions on individual projects or proposed activities rather than making a single decision to implement an entire alternative. While Section 3.6.1 summarizes the impacts from these projects as part of the Expanded Operations Alternative, Section 3.6.3 summarizes the environmental consequences of each of the individual proposed projects evaluated in Appendices G, H, I, and J. This individual treatment is intended to facilitate the decision process by providing an understanding of how each of the proposed projects could affect the overall impacts of continued operations at LANL. Implementing the proposed projects may result in impacts to potential release sites covered under the Consent Order. As needed, these impacts would be addressed through the accelerated cleanup process described in Section VII.F of the Consent Order. NNSA intends to implement the actions necessary to comply with the Consent Order regardless of whether it implements decisions it makes on other actions analyzed in this SWEIS.

3.6.1 Comparison of Potential Consequences of Alternatives for Continued Operation at Los Alamos National Laboratory

This section focuses on the overall LANL site, providing an overview of impacts for each SWEIS alternative and resource area to provide an understanding of the total potential impacts of each alternative. Table 3–19, located at the end of this section, compares the environmental consequences of the three SWEIS alternatives.

Land Use

Under the No Action Alternative, the conveyance of land from LANL to Los Alamos County and the New Mexico Department of Transportation, and transfer of land to the Department of the Interior (to be held in trust for the Pueblo of San Ildefonso) would continue. Of the 4,078 acres (1,650 hectares) identified under Public Law 105-119 (Departments of Commerce, Justice, and State, the Judiciary, and Related Agencies Appropriations Act, 1998), about 1,820 acres (737 hectares) remain to be transferred. This land conveyance and transfer, and the Power Grid

Upgrades Project, could impact site and regional land use. Effects of these actions include reduction in the size of LANL, possible changes in offsite land use from development following transfer, loss of recreational opportunities, and changes in site land use. Impacts would be similar under the Reduced Operations Alternative. Under the Expanded Operations Alternative, in addition to the impacts of the No Action Alternative, changes to land use could occur as the result of projects such as the Replacement Office Buildings Project, Radiological Sciences Institute Project, TA-18 Closure Project, MDA Remediation Project,[4] Radioactive Liquid Waste Treatment Facility Upgrade Project, Waste Management Transition Project, Science Complex Project, Remote Warehouse and Truck Inspection Station Project, and Security-Driven Transportation Modifications Project. While actions associated with these projects would in many cases be compatible with existing land use plans, there is no provision in the current plans for the new bridge that could be constructed over Sandia Canyon under Auxiliary Action B of the Security-Driven Transportation Modifications Project. Although no major changes in land use would occur in most cases, environmental remediation occurring for all alternatives could lead to fewer restrictions on land use. The fewest restrictions on land use would occur under the Removal Option for the MDA Remediation Project upon completion of remedial actions.

Visual Environment

Under the No Action Alternative, possible development following conveyance and transfer of land could degrade the views of presently undeveloped areas. For many projects, impacts to the visual environment would be limited to the construction phase. Once complete, most projects would be minimally visible from offsite locations, but more noticeable from closer vantage points; however, near views are often restricted to LANL employees. Under all alternatives, environmental remediation activities at some potential release sites could be publicly visible while remediation occurs. Power grid upgrades could adversely impact the views in previously undisturbed areas. Impacts under the Reduced Operations Alternative would be similar to those identified for the No Action Alternative.

Although in many cases impacts to the visual environment from implementation of the Expanded Operations Alternative would be similar those associated with the No Action Alternative, a number of proposed projects would cause noticeable changes to the visual environment. Capping or removing MDAs under the MDA Remediation Project would temporarily disturb areas or involve the use of temporary enclosures that could be visible in some cases. MDA Remediation Project activities would increase the visibility of the borrow pit in TA-61; and the Security-Driven Transportation Modifications Project would cause the construction of roads, parking lots, and new bridges over a site canyon. Additional visible bridges could be constructed over site canyons if the auxiliary actions were selected. In addition, new buildings associated with the Replacement Office Buildings and Science Complex Projects would be readily visible from West Jemez or Pajarito Roads. The new building associated with the Remote Warehouse and Truck Inspection Station would be visible from East Jemez Road. Establishment of evaporation tanks for final treatment of effluent from the Radioactive Liquid Waste Treatment Facility would cause a permanent change to the visual environment in the area near the border of TA-52 and TA-5. There would be a break in forest cover that could be seen from areas west of

[4] *The phrase MDA Remediation Project is used in this SWEIS as a general term for environmental remediation activities under the Consent Order, addressing MDAs and other potential release sites.*

LANL. The removal of old buildings would enhance the visual environment at both TA-18 and TA-21, and the visual environment at TA-21 could further change in the longer term if development takes place. Also, removal of the domes in TA-54 as part of the Waste Management Facilities Transition Project would have a beneficial impact on views of the site from both near (including the Pueblo of San Ildefonso) and far. Construction of the TRU Waste Facility, however, has the potential to impact the visual environment, including views from San Ildefonso Pueblo lands, depending on its location.

Geology and Soils

There is little difference in the impacts on geologic resources for the No Action and Reduced Operations Alternatives; however, the impacts from the Expanded Operations Alternative would be distinctly different. Under the Expanded Operations Alternative, facility construction and DD&D for the following projects would impact geologic materials: Physical Science Research Complex, Replacement Office Buildings, Radiological Sciences Institute, Radioactive Liquid Waste Treatment Facility Upgrade, TA-55 Radiography Facility, Science Complex, Remote Warehouse and Truck Inspection Station, TA-21 DD&D, Waste Management Facilities Transition, and the Security-Driven Transportation Modifications. A total of approximately 3.2 million cubic yards (2.5 million cubic meters) of soil and rock would be disturbed if all of these projects were implemented.

In addition, MDA remediation in compliance with the Consent Order would have a major impact on geologic resources. MDA remediation would require 1.2 million to 2.5 million cubic yards (0.9 million to 1.9 million cubic meters) of crushed tuff and other materials for evapotranspiration covers under the Capping Option, or up to 2.2 million cubic yards (1.7 million cubic meters) of backfill and surface materials under the Removal Option. These geologic resources would be available either at LANL or from nearby offsite sources.

Under all three alternatives, remediation of potential release sites would continue to remove existing contaminants from soils and shallow bedrock at LANL. This impact would be greatest under the Expanded Operations Alternative because the largest area and volume of contaminated soil would be remediated. The use of standard construction methods and best management practices would minimize the potential for erosion and release of soils during construction and decrease the potential for erosion, slope failure, and contaminant releases after remediation is complete.

Water Resources

There would be only minor adverse impacts on surface water quality and quantity from the No Action Alternative. There could be significant beneficial impacts on Sandia Canyon if the effluent from the Sanitary Wastewater Systems Plant is used as cooling water at the Metropolis Center for Modeling and Simulation. Under the Reduced Operations Alternative, the elimination of cooling tower effluent from LANSCE would result in a significant reduction of effluent discharge to Los Alamos Canyon. The Expanded Operations Alternative could have beneficial impacts on surface water quality due to the installation of new treatment technologies associated with the Radioactive Liquid Waste Treatment Facility Upgrade Project, and the possible elimination of the Radioactive Liquid Waste Treatment Facility discharge to Mortandad Canyon if the auxiliary action to evaporate treated effluents were implemented. Complete DD&D of TA-21 under the Expanded Operations Alternative would eliminate two industrial effluent outfalls, which would have a minor beneficial impact on Los Alamos Canyon. Environmental remediation under all alternatives would have positive impacts on surface water quality; implementation of the MDA Remediation Project under the Expanded Operations Alternative would have additional beneficial impacts on surface water quality due to the potential removal or stabilization of contaminants at the MDAs. Removal of the flood retention structure in Pajarito Canyon under all the alternatives could impact floodplains downstream immediately following removal. None of the alternatives would likely have any other impacts on floodplains.

There would be no changes in the flow of contaminants to the alluvial or regional groundwater as a result of the No Action Alternative, except for that achieved from continuing the environmental remediation program that existed before the Consent Order. Most impacts to groundwater resources identified as occurring under the No Action Alternative would also occur under the Reduced Operations Alternative. Long-term impacts might be reduced by elimination of some of the canyon-outfalls and reduction of water use. Direct and indirect impacts to groundwater as a result of proposed construction and operations under the Expanded Operations Alternative would also be similar to those described for the No Action Alternative. Under the Expanded Operations Alternative, water usage would be greater than the range of LANL's water use over the last 7 years, but within the range of use over the last 14 years. Therefore, impacts to the water levels in the regional aquifer from withdrawals to supply LANL would be within historical levels. The effects of either an MDA Capping or Removal Option under the Expanded Operations Alternative would not appreciably affect the rate of transport of contaminants presently in the vadose zone in the near term, but would likely reduce very long-term migration of contaminants and corresponding impacts on the environment from wastes present in the MDAs.

Air Quality

Nonradiological air pollutant emissions from operations at LANL would continue within the limits of the operating air permit under all the alternatives. Reductions in emissions would occur under the Reduced Operations Alternative from reduced high explosives processing and testing, shutdown of LANSCE and the Pajarito Site (TA-18), and a smaller construction scope. A minor increase in operations emissions could occur under the Expanded Operations Alternative, but emissions would remain within the limits of the operating permit. Increased employment under the Expanded Operations Alternative could result in an increase in air pollutant emissions from additional vehicles of employees commuting from Santa Fe and Rio Arriba County and other locations and waste and materials shipments. Temporary localized increases in air pollutant emissions from construction, DD&D, and remediation activities would occur under all alternatives, but under the Expanded Operations Alternative the emissions would be larger. These activities could result in exceedances of short-term ambient standards for nitrogen oxides and carbon monoxide for some projects where activities are near the site boundary or public roads unless these activities are properly controlled. Appropriate management controls and scheduling would be used to minimize impacts on the public and to meet regulatory requirements. Development by others of lands conveyed and transferred could result in air quality impacts.

Radiological air emissions from normal operations under the No Action Alternative would be dominated by short-lived gaseous mixed activation products emitted from LANSCE (TA-53). Under the Reduced Operations Alternative, a reduction in the activity levels of some Key Facilities (including the continued use of the Chemistry and Metallurgy Research Building), and the shutdown of LANSCE and the Pajarito Site (TA-18) would greatly reduce the amount of radiological air emissions. Under the Expanded Operations Alternative, some small increases in radiological air emissions compared to the No Action Alternative would result from increased LANL activities and the operation of new facilities. These emissions would be dominated by operations at LANSCE. There could be temporary additions to radiological air emissions if the New Mexico Environment Department selects exhumation as the corrective measure for any of the MDAs.

Noise

Under the No Action Alternative, noise impacts from operations at LANL would be similar to the impacts from recent operations, including noise from explosives testing and traffic. Construction, DD&D, and remediation activities would result in a minor increase in offsite noise impacts to the public from equipment use and traffic under the No Action and Reduced Operations Alternatives. Under the Reduced Operations Alternative, however, a minor reduction in explosives testing noise would occur, as well as a minor decrease in construction and DD&D noise impacts compared to the No Action Alternative. Under the Expanded Operations Alternative, minor to moderate increases in traffic noise could occur from changes in traffic patterns due to increased construction, MDA remediation, DD&D activities, and increased employment at LANL. In addition, increased equipment-related noise impacts would occur from additional construction, DD&D, and MDA remediation activities. Activities near the site boundary or increases in truck traffic noise under various MDA remediation options could result in some public annoyance. Development by others of lands conveyed and transferred could also result in noise impacts.

Ecological Resources

Under the No Action Alternative, a number of actions would result in impacts on ecological resources. For example, conveyance of land to the county could result in the loss of 770 acres (312 hectares) of habitat through possible future development. Therefore, impacts such as loss and displacement of wildlife would take place. The Wildfire Hazard Reduction Program would have short-term adverse impacts on wildlife due to activities such as tree trimming, but would produce long-term benefits from returning the forest to a condition similar to that which existed in the past. Increased forest health could also benefit the Mexican spotted owl at LANL and across the region. Impacts from the Reduced Operations Alternative generally would be similar to the No Action Alternative.

Under the Expanded Operations Alternative, however, impacts on ecological resources would be larger than those of the No Action Alternative. A number of projects could impact habitat and wildlife. Those impacts mostly would be temporary disturbances during construction and demolition; however, if all of the proposed projects were implemented, up to about 170 acres (69 hectares) of habitat would be lost; borrow pit expansion, if required, would disturb some additional acreage. Most habitat loss would be associated with the Security-Driven

Transportation Modifications Project (30 acres [12 hectares] and its two auxiliary actions (91 acres [37 hectares]). Temporary disturbances to habitat and displacement of wildlife could occur from environmental remediation under all alternatives; however, because material disposal areas are mostly grassy, open areas, temporary habitat disturbances associated with the MDA Remediation Project under the Expanded Operations Alternative would be mostly associated with remediation support activities such as operation of temporary storage areas for capping materials. Withdrawal of crushed tuff from the TA-61 borrow pit to support MDA remediation may cause loss of habitat at the borrow pit for the Mexican spotted owl; Section 7 consultation with the U.S. Fish and Wildlife Service would be required.

Impacts to the Mexican spotted owl, bald eagle, and southwestern willow flycatcher were evaluated in a biological assessment prepared by DOE (LANL 2006b). This biological assessment determined that activities associated with many projects may affect, but were not likely to adversely affect, these species. Regarding the Security-Driven Transportation Modifications Project, the U.S. Fish and Wildlife Service determined that provided that reasonable and prudent measures are taken, construction of a span bridge over Ten Site Canyon would not result in adverse affects to the Mexican spotted owl. Further consultation would be needed, however, if a land bridge was to be used. A determination of potential impacts from construction of the auxiliary action bridges associated with the Security-Driven Transportation Modifications Project could not be made because bridge locations and final designs were not known. Thus, further consultation with the U.S. Fish and Wildlife Service would be required prior to bridge construction. Depending on where the TRU Waste Facility would be located, consultation could be required prior to building this facility since construction could affect both core and buffer habitat of the Mexican spotted owl.

Human Health

None of the alternatives would result in an increase in latent cancer fatalities (LCFs) in the population; and all doses estimated for the maximally exposed individual (MEI), a hypothetical individual located at the site boundary, would meet the regulatory limit of 10 millirem per year (40 CFR 61.92). Under the No Action Alternative, radiological air emissions from LANSCE (TA-53) would be responsible for over 70 percent of the estimated population dose of 30 person-rem per year; emissions from the firing sites (TA-15 and TA-36) would contribute approximately 20 percent. Under the No Action Alternative, the dose to the MEI would be about 7.8 millirem per year, with 7.5 millirem attributable to emissions from LANSCE.[5] Under the Reduced Operations Alternative, estimated annual doses to the population and the MEI would be reduced by approximately 80 percent and 90 percent, respectively, compared to the No Action Alternative. This reduction would largely be due to the shutdown of LANSCE, along with minor reductions from termination of operations at the Pajarito Site, lower levels of high explosives processing and testing, and continued use of the Chemistry and Metallurgy Research Building. Under the Expanded Operations Alternative, there would be small increases in emissions from the Plutonium Facility Complex from increased pit manufacturing activity and reduced emissions from the Pajarito Site and TA-21, which would result in slight increases in the estimated doses to

[5] *Administrative controls established at LANSCE to regulate beam operations as emissions levels increase require operational changes to prevent the generation of excessive radioactive air emissions, so that the maximum dose to the LANL site-wide MEI from air emissions at LANSCE is 7.5 millirem per year or less.*

the public and the MEI from routine operations compared to the No Action Alternative. In addition, there could be temporary increases in offsite doses if the Removal Option were implemented for MDA cleanup. The annual population dose could increase by about 20 percent to approximately 36 person-rem per year, and the MEI dose could increase by about 5 percent to approximately 8.2 millirem per year.

On an individual worker basis, impacts to worker health would be the same across all alternatives. Application of procedures designed to ensure safe worker environments would control exposure to radiation, chemicals, and biohazardous material. Individual radiation doses would be maintained below the DOE limit of 5 rem per year, with a goal of limiting the dose to 2 rem per year from external exposure. Under normal operating conditions, no adverse effects from chemical or biological exposures would be expected.

The collective dose for workers would be about 280 person-rem per year under the No Action Alternative. Under the Reduced Operations Alternative, the dose would drop to 257 person-rem annually due to the cessation of TA-18 activities and the shutdown of LANSCE. Under the Expanded Operations Alternative, collective doses would differ depending on the actions taken to remediate the MDAs. If the MDA Capping Option were implemented, the collective dose would be about 407 person-rem per year. This increase in dose over the No Action Alternative is primarily associated with manufacturing up to 80 pits per year at the Plutonium Facility Complex. If the MDA Removal Option were implemented, waste in the MDAs would be removed rather than capped in place. In this case, the collective dose would be about 543 person-rem annually. The average annual dose to the worker population contributed by the MDA Remediation Project alone would range from about 1 (MDA capping) to 137 (MDA removal) person-rem.

Cultural Resources

Under the No Action Alternative, potential impacts to cultural resources include conveyance or transfer of lands containing cultural resources from DOE. Further, there is potential for damage to these resources from development and for adverse effects on historic buildings from demolition and remodeling. From a positive standpoint, the Trails Management Program could enhance cultural resource protection by limiting public access to certain trails or trail segments. Documentation could be required to resolve possible adverse effects from demolishing and remodeling historic buildings involved in high explosives processing and testing. Impacts from the Reduced Operations Alternative generally would be similar to those described for the No Action Alternative.

Under the Expanded Operations Alternative, many impacts would also be similar to those that would occur under the No Action Alternative. In general, individual projects would have a minimal potential for impacting archaeological resources because most projects would not be located in the immediate area of archaeological sites; however, the proposed TRU Waste Facility has the potential to directly impact archaeological resources depending on its location, which has yet to be determined. Potentially affected resources would be protected by LANL requirements for protecting sensitive areas. Additionally, the implementation of LANL requirements would ensure that any proposed demolition or modification of existing historic buildings and structures would be in keeping with *A Plan for the Management of Cultural Heritage at Los Alamos*

National Laboratory, New Mexico (LANL 2006f). If the auxiliary actions to build bridges across canyons as part of the Security-Driven Transportation Modifications Project were implemented, certain traditional cultural properties could be adversely affected. Also, the proposed TRU Waste Facility has the potential to impact the view from traditional cultural properties if constructed within certain locations of the Pajarito Road corridor. Removal of the domes from Area G of TA-54 as part of the Waste Management Facilities Transition Project, however, would have a positive effect on views from Pueblo of San Ildefonso lands.

Possible impacts to cultural resources from environmental restoration would be reviewed for all potential release sites and protective measures taken as needed. There would be no direct impacts to cultural resources from either capping or removing material disposal areas under the Expanded Operations Alternative. Any temporary support areas needed for MDA remediation would be located and operated to be protective of cultural resources.

Socioeconomics

Under the No Action Alternative, no change in the socioeconomic impacts on the region from those currently being observed would be expected. As a major employer, LANL provides large socioeconomic contributions to the region. Impacts from the Reduced Operations Alternative would be similar to those associated with the No Action Alternative. Under the Reduced Operations Alternative, however, direct employment at LANL would be expected to decrease by about 3.7 percent (500 jobs) due to the closure of LANSCE, the reduction in high explosives processing and testing, and the cessation of TA-18 activities. This decrease in LANL employment would also be expected to indirectly result in additional job losses in the region. The combined loss of employment due to both direct and indirect job losses would be approximately 1,030 positions, but these losses are not expected to have a major adverse impact on the regional economy because the losses would be small in comparison to the total employment base for the region (less than 1 percent).

Under the Expanded Operations Alternative, jobs would be added at LANL to support the increased workload. It is projected that, compared to the 2005 level, up to 600 jobs by 2007 and 1,890 jobs by 2011 would be added at LANL, in addition to 640 indirect jobs by 2007 and 2,000 indirect jobs by 2011. Although the addition of these positions would be beneficial from an economic standpoint, the influx of workers would place demands on the regional infrastructure in terms of additional housing needs, schools, and community services. There is currently a housing shortage in Los Alamos County, although the county is planning for additional housing that could allow more employees to live within its borders. Rio Arriba and Santa Fe counties also would be expected to grow as a result of LANL employment increases. Considering that LANL positions are some of the highest paying positions in the region, the benefits associated with these positions in terms of increased revenues and taxes should more than offset any drawbacks. This is especially true in light of regional growth projections that show the region growing at a rate in line with LANL's projected growth rate under the Expanded Operations Alternative.

Infrastructure

Utility infrastructure demands for electricity, natural gas, and water are projected to increase in the LANL region of influence through 2011 regardless of the alternative selected in this SWEIS, mainly due to increasing demands among other Los Alamos County users who rely upon the same utility systems as LANL. Total projected utility infrastructure requirements are summarized for LANL operations and for other Los Alamos County users in Table 3–19. Under the No Action Alternative, the total energy and peak load requirements would be about 49 percent and 74 percent, respectively, of the capacity of the power pool serving the Los Alamos area. Natural gas requirements and water requirements respectively would be about 27 percent and 90 percent of system capacity. For the Reduced and Expanded Operations Alternatives, respectively, projected electricity requirements would be about 39 and 63 percent of capacity, peak load demand would be about 54 percent and 96 percent of capacity, natural gas requirements would be about 27 percent and 29 percent of capacity, and water requirements would be about 85 percent and 98 percent of capacity. Projections for natural gas demand show less variation across the alternatives because the demand is controlled mainly by space heating requirements, which are affected less than other utilities by operational levels. LANSCE operations have a major effect on LANL's demand for water and electricity. LANSCE has historically accounted for as much as 25 percent of total water demand and 50 percent of electrical demand at LANL.

Under the Expanded Operations Alternative, peak load demand would approach the capacity of the Los Alamos Power Pool. Similarly, the water demand under the Expanded Operations Alternative could approach the Los Alamos Water Supply System's available water rights. This potential exists because of the projected infrastructure requirements for increased operations at LANL and the forecasted demands of other non-LANL users in Los Alamos County. Completion of a new transmission line and other upgrades, however, would reduce any concerns about peak load capacity. Also there are plans to install a second new combustion turbine generator at the TA-3 Co-Generation Complex, if needed. The second generator would add an additional 20 megawatts (175,200 megawatt-hours) of generating capacity. As for future water needs, Los Alamos County, as owner and operator of the Los Alamos Water Supply System, is currently pursuing use of the San Juan-Chama Transmountain Diversion Project to secure additional water for its customers, including LANL. This would supply the Los Alamos area with up to an additional 391 million gallons (1,500 million liters) of water per year, an increase in capacity of approximately 20 percent.

Waste Management

Under the No Action Alternative, waste management impacts from LANL operations would remain within the capacity of LANL's infrastructure. Most wastes, with the exception of low-level radioactive waste, would be disposed of offsite at facilities designed for specific categories of wastes. The expansion into TA-54, Area G, Zones 4 and 6, as necessary, would provide onsite disposal capacity for low-level radioactive waste from operations through 2016 and beyond. Due to the uncertainties of predicting environmental remediation wastes, variances from projections are likely in future years. The waste management infrastructure at LANL would be adequate, in terms of staffing and facilities, to manage the quantities of waste expected to be generated under the No Action Alternative.

Under the Reduced Operations Alternative, waste management impacts from LANL operations would be similar to those under the No Action Alternative, with some reductions in waste quantities from operations due to the closure of LANSCE and the Pajarito Site, reduced operational levels at the high explosives facilities, and a smaller construction scope. Although some reductions in operational waste volumes are expected, continued generation of low-level radioactive waste would be expected to result in the expansion of future disposal operations into Zone 4. Wastes generated by environmental restoration and DD&D activities would be expected to be the same as those generated under the No Action Alternative. The LANL waste management infrastructure would be capable of managing the projected quantities.

The Expanded Operations Alternative includes implementing a large number of projects involving major construction and DD&D, as well as increases in operation levels at a number of Key Facilities, so larger volumes of all waste types would be generated than under the other alternatives. Retrieval and processing of transuranic waste stored below grade in Area G of TA-54 would also generate additional volumes of transuranic and low-level radioactive waste. To accommodate the processing and storage of legacy and newly generated transuranic waste from LANL operations, NNSA is proposing to install and operate additional waste management equipment and facilities, and upgrade existing processes, as identified in Appendix H, Section H.3.

Full implementation of the MDA Removal Option is conservatively estimated to generate about 1.1 million cubic yards (840,000 cubic meters) of low-level radioactive waste and 22,000 cubic yards (17,000 cubic meters) of transuranic waste, most of which DOE buried before 1970. Final waste volumes may be smaller than the maximum volumes analyzed in this SWEIS because waste generation is dependent on future regulatory decisions by the New Mexico Environment Department. In addition, the estimates are based on the volume of waste as excavated (including soil) and the removal of all major MDAs; no credit has been taken for waste volume reduction techniques such as sorting.

Onsite disposal capacity for low-level radioactive wastes may be sufficient, depending upon the actual volumes generated by remediation; disposal capacity would be supplemented by offsite facilities if needed. The transportation analysis includes the impacts of shipping all low-level radioactive waste offsite. In this SWEIS, it is assumed that the transuranic waste would be disposed of at WIPP. WIPP disposal capacity is expected to be sufficient for disposal of all retrievably stored waste and all newly generated transuranic waste from the DOE complex over the next few decades, but not sufficient for this waste plus all transuranic waste buried before 1970 across the DOE complex (63 FR 3624). Decisions about disposal of transuranic waste from full removal of LANL MDAs, if generated, would be based on the needs of the entire DOE complex. Any transuranic waste that may be generated at LANL without a disposal pathway would be safely stored until disposal capacity becomes available.

Transportation

Under all alternatives, radioactive, hazardous, and commercial materials would be transported onsite and to and from various offsite locations. The evaluation of impacts in this SWEIS focuses on repeated shipments of materials to and from offsite locations. The specific locations analyzed were the Pantex Plant in Texas, the Y-12 Complex and Oak Ridge National Laboratory in Tennessee, the Lawrence Livermore National Laboratory in California, the Nevada Test Site in Nevada, and the Savannah River Site in South Carolina for transport of special nuclear material (such as plutonium, highly enriched uranium [mainly uranium-235], and uranium-233); WIPP in New Mexico for the transport of transuranic wastes; the Nevada Test Site and a commercial disposal site for low-level radioactive wastes; and multiple locations for disposal of hazardous and nonhazardous waste materials.

It is unlikely that transportation of radioactive materials under any of the alternatives would cause a fatality as a result of radiation either from incident-free operations or postulated accidents. The highest risks to the public would result from the Expanded Operations Alternative if all of the large MDAs were exhumed under the MDA Remediation Project and the Nevada Test Site was the main option for disposal of low-level radioactive waste. This alternative could result in about 122,440 shipments of radioactive materials (both special nuclear material and radioactive waste). It is estimated that there could be about three fatalities from nonradiological traffic accidents associated with the transportation activities required to implement this alternative.

All trucks carrying radioactive materials to or from LANL would travel the section of road from LANL to Pojoaque; many of these trucks would also travel the section of road from Pojoaque to Santa Fe. The radiological risks to the population along these two sections of road are very small under all alternatives. The nonradiological accident risks (the potential for fatalities as a direct result of traffic accidents) are greater than the radiological risks; however, even under the scenario involving the largest amount of transportation, the Expanded Operations Alternative with the MDA Removal Option, no fatalities would be expected along these routes.

Local traffic flows would be expected to remain at current levels under the No Action Alternative because employment would stay at current levels. Under the Reduced Operations Alternative, traffic through LANL would decline by about 4 percent, mainly as a result of the projected decrease in employment. Under the Expanded Operations Alternative, traffic would be expected to increase by up to 18 percent (averaged across all LANL entrances) due to the projected increases in employment and construction, DD&D, and remediation activities. Transportation of waste and fill material by truck for DD&D and MDA remediation could accelerate wear on local roads and exacerbate traffic problems.

Environmental Justice

Executive Order 12898 (*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*) requires every Federal agency to analyze whether its Proposed Actions and alternatives would have disproportionately high and adverse impacts on minority or low-income populations. Based on the analysis of impacts for other resource areas, NNSA expects no high and adverse impacts from the continued operation of LANL under any of the alternatives. For all alternatives the radiological dose from emissions associated with normal operations are slightly lower for members of Hispanic, Native American, total minority, and low-income populations than for the members of the population that are not in these groups. The maximum annual dose for the average member of any of the minority or low-income populations was 0.092 millirem compared to a dose of 0.10 millirem for a member of the general population and a dose of 0.11 millirem for a member of the population that does not belong to a minority or low-income group.

NNSA also analyzed human health impacts from exposure through special pathways, including subsistence consumption of native vegetation (pinyon nuts and Indian Tea [Cota]), locally grown produce and farm products, groundwater, surface waters, fish (game and nongame), game animals, other foodstuffs, and incidental consumption of soils and sediments (on produce, in surface water, and ingestion of inhaled dust). The special pathways could be important to the environmental justice analysis because some of these pathways may be more important or viable for the traditional or cultural practices of members of minority populations in the area. Analyses, however, show that the human health impacts associated with these special pathways would not present disproportionately high and adverse impacts on minority or low-income populations.

Facility Accidents

There is little difference among the alternatives for the maximum potential wildfire, seismic, or facility accident at LANL because actions under each alternative do not, for the most part, affect the location, frequency, scenario, or material at risk of the postulated accidents. Facility accident impacts are presented in terms of consequences and risks. Reported consequences assume that the accident occurs and do not account for how probable the accident is. The risk associated with an accident reflects the probability of the accident occurring; it is calculated by multiplying the consequences times the probability of occurrence.

In 2000, the Cerro Grande Fire burned a heavily forested canyon area to within about 0.75 miles (1.2 kilometers) of the waste storage domes in TA-54, but none were burned and there were no radiological releases from domes. Additional fuel reduction has been conducted since the Cerro Grande Fire, both to the vegetation surrounding the TA-54 area and within the domes themselves (for example, wooden pallets have been replaced with metal pallets), to further decrease the potential for a waste storage dome fire occurring as a result of a site wildfire. In the event of a wildfire that impacted LANL, burned the waste storage domes at TA-54, and caused their contents to be released to the environment, the radiological releases from those waste storage domes would dominate the potential impacts to LANL workers and to the public from the fire. Should such an accident scenario occur in which the contents of the waste storage domes actually caught on fire and burned, the MEI would likely develop a fatal cancer during his or her lifetime and an additional 55 LCFs could be expected in the general area population. Any onsite worker located within 110 yards (100 meters) of the facility during such an accident would likely develop a fatal cancer during his or her lifetime. Taking into account the probability of occurrence, the annual risks are estimated to be about 1 chance in 20 of an LCF for the MEI or for an onsite worker and an additional 3 (calculated value of 2.7) LCFs in the offsite population. These risks assume that workers and members of the public do not take evasive action in the event of a wildfire. It is likely that workers and members of the public would be evacuated, as happened during the Cerro Grande Fire. These risks would decrease as transuranic waste is removed from the domes and transported to WIPP for disposal. In terms of chemical risks from a wildfire, the accidental release of formaldehyde from the Bioscience Facilities in TA-43 would expose the public and noninvolved workers to the greatest risks, similar to those associated with a seismic event, as discussed below.

The seismic event that presents the largest risk to the public would be a postulated Performance Category 3 earthquake (Seismic 2 scenario). If this accident were to occur, there would be widespread damage at LANL and across the region resulting in a large number of fatalities and injuries unrelated to LANL operations. Facilities at LANL would be affected and the public and workers at the site would be exposed to increased risks from both radiological and chemical releases. The consequences of such a seismic accident would be an increased lifetime risk of an LCF of 0.55 (1 chance in 1.8) for the MEI and an additional 22 LCFs could be expected in the population; a noninvolved worker 110 feet (100 meters) from certain failed buildings would likely develop an LCF.

The seismic accident scenarios (Seismic 1 and 2) analyzed in the SWEIS are based on the *Seismic Hazards Evaluation of the Los Alamos National Laboratory (February 24, 1995)*. The 1995 study concluded that a seismic event characterized by a peak horizontal ground acceleration of 0.22g (0.22 times the acceleration due to gravity) had an estimated annual probability of exceedance (probability of occurrence when calculating risk) of 0.001 (1 in 1,000). The study also showed that the more severe seismic event characterized by a peak ground acceleration of 0.31g had an estimated annual probability of exceedance of 0.0005 (1 in 2,000). An updated probabilistic seismic hazard analysis that provides an improved understanding of the seismic characteristics of LANL was completed in 2007 (LANL 2007a). The new study indicates that the seismic hazard is higher than previously understood; that is, the likelihood of earthquakes capable of producing strong ground shaking at the LANL site is greater than previously estimated. For example, the annual probabilities of exceedance for the previously analyzed peak ground accelerations are now estimated to be about 1 in 700 rather than 1 in 1,000 and 1 in 1,250 rather than 1 in 2,000. Using the assumptions inherent in the accident source terms developed for the SWEIS Seismic 1 (Performance Category 2 earthquake) and Seismic 2 (Performance Category 3 earthquake) accident scenarios, the most conservative effect on accident risks would be an increase of 50 percent and 60 percent, respectively. Although the greater probability of exceedance results in a higher risk from seismic events, these risks remain lower than those associated with other postulated accidents.

Taking into account the probability of occurrence, the annual risks from a Seismic 2 accident are estimated to be an increase of 1 chance in 2,200 of the MEI developing an LCF and no additional LCFs (a calculated risk much less than 1) in the offsite population. The largest chemical risk from such an event would result from a formaldehyde release from the Biosciences Facilities in TA-43, leading to life-threatening concentrations at the locations of the noninvolved worker and the MEI. The seismic event that presents the largest risk to a noninvolved worker is the Seismic 1 accident (a Performance Category 2 earthquake) with a frequency of once every 700 years. The annual increased risk of a LCF to the noninvolved worker would be about 0.0015 or 1 in 700.

Just as the updated probabilistic seismic hazards analysis used new data and advanced methods to calculate LANL seismic hazards, revised structural analysis tied to damage states credited in the safety assessments will be used to update the seismic structural integrity evaluation of LANL facilities. The effect of the higher values of peak horizontal ground acceleration on calculated seismic accident consequences and risks will be analyzed in future LANL facility safety analyses and incorporated as appropriate into future LANL NEPA documents. NNSA and the LANL contractor will undertake an evaluation of LANL facility performance in terms of the updated seismic hazard information. Until a revised analysis is completed, facility operations are authorized based on NNSA approval of a contractor-prepared justification for continued operation.

Under all alternatives, the facility accident with the highest radiological risk to the offsite population would be a lightning strike fire at the Radioassay and Nondestructive Testing Facility. If this accident were to occur, there could be six additional LCFs in the offsite population. Under the Expanded Operations Alternative, if the Chemistry and Metallurgy Research Building fire involving sealed sources were to occur, the consequence to the offsite population would be greater (seven LCFs) than that of the Radioassay and Nondestructive Testing Facility lightning strike fire; however, the estimated frequency is much less. Also, the consequences of that accident are based on a conservative assumption that the entire inventory of radiological material allowed in the Chemistry and Metallurgy Research Building is dedicated to a single isotope contained in sealed sources.

Under all alternatives, the individual facility accident with the highest estimated consequences to the MEI and noninvolved workers would be a fire at a waste storage dome in TA-54. If this accident were to occur as modeled, the noninvolved worker and the MEI would receive large radiation doses. Depending on the specific radionuclides released and the route of human exposure, radiation doses of this magnitude would result in near-term health effects or even death from causes other than cancer. In some cases, medical intervention may be effective in reducing the dose to the exposed individual, mitigating health impacts, or both. In addition to the conservative assumptions used to develop the source term (amount of radioactive material released) for this accident, the calculated doses are based on the assumptions that no protective action is taken during the entire time of exposure and that no subsequent medical intervention occurs.

Taking into account the frequency of the postulated accidents, the estimated highest risk accident would be a lightning strike fire at the Radioassay and Nondestructive Testing Facility. The relatively large risk of the accident is due to the conservative assumption that any lightning strike at the Radioassay and Nondestructive Testing Facility has sufficient energy and occurs at a location that results in a building fire and concomitant source term. The increased risk of an LCF for this accident would be 0.06 (about 1 chance in 16) for the MEI, 0.12 (about 1 chance in 8) for the noninvolved worker,[6] and 0.8 for the offsite population (a risk of 1 LCF occurring in the population over approximately 1.3 years of operation).

For chemical accident risks, the individual facility accident with the largest risk to the public is a selenium hexafluoride release from TA-54. There is an annual risk of about 1 chance in 240 that members of the public could receive life-threatening exposures from this accident. For a chlorine gas release outside of TA-55, there is an annual risk of about 1 chance in 15 that noninvolved workers could receive a life-threatening exposure to this chemical from this accident. There is a great deal of uncertainty regarding how much and which chemicals were disposed of in the MDAs. The MDA closest to the public (and thus with the potentially greatest impacts on the public), MDA B, was chosen to bound the chemical accident impacts for MDA cleanup. Two chemicals, sulfur dioxide (a gas) and beryllium (assumed to be in powder form), were chosen based on their respective hazards to bound the impacts of chemicals possibly disposed of in the MDAs. Both of these chemicals, if present in the quantities assumed, would dissipate to below life-threatening concentrations very close to the release point, but would continue to present a risk to the public due to the short distance to the nearest public access point for MDA B.

Substantive details of terrorist attack scenarios and security countermeasures are not released to the public because disclosure of this information could be exploited by terrorists to plan attacks. Depending on the malevolent, terrorist, or intentionally destructive acts, impacts may be similar to or would exceed bounding accident impact analyses prepared for the SWEIS. A separate classified appendix to this Final SWEIS has been prepared that evaluates the underlying facility threat assumptions with regard to malevolent, terrorist, or intentionally destructive acts. These data provide NNSA with information upon which to base, in part, decisions supported by this SWEIS.

[6] The lightning strike fire at the Waste Characterization, Reduction, and Repackaging Facility has a slightly higher risk for the noninvolved worker; an increased risk of an LCF of 0.14 (1 chance in 7) per year.

Table 3–19 Summary of Environmental Consequences by Resource Area

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative (Preferred Alternative)*
Land Use			
	Land Conveyance and Transfer - The remaining 1,820 acres (737 hectares) of the 4,078 acres (1,650 hectares) of land identified per Public Law 105-119 would be conveyed or transferred. - Development may occur on up to 826 acres (334 hectares). - Potential introduction of incompatible land uses. - Loss of recreational opportunities. *Electrical Power System Upgrades* - 473 acres (191 hectares) affected by upgrades. - Project generally compatible with existing land use.	Same as No Action Alternative.	Same as No Action Alternative, plus: *MDA Remediation Project* - Fewer restrictions on land use for Removal Option than for the Capping Option. - No major changes in land use designations in most cases because surrounding land uses would retain their current classification. *Security-Driven Transportation Modifications Project* - Most development would not conflict with current land use designations. - Auxiliary Action A - Within scope of current land use plans. - Auxiliary Action B - Partially within scope of current land use plans. Current plans, however, contain no provision for a bridge over Sandia Canyon. *Replacement Office Buildings Project* - 13 acres (5.3 hectares) of undeveloped land in TA-3 would be developed consistent with a change in future land use from Reserve to Physical/Technical Support. *TA-18 Closure Project* - Possible change in land use designation of TA-18 to Reserve after DD&D of the Pajarito Site. *TA-21 Structure DD&D Project* - Future LANL development could negate the proposed change in land use from the current designation to Reserve. *Radiological Sciences Institute Project* - 12.6 acres (5.1 hectares) of undeveloped land at or near TA-48 would be developed consistent with land use plans. *RLWTF Upgrade Project* - Up to 4 acres (1.6 hectares) of undeveloped land near the border of TA-5 and TA-52 could be developed for evaporation tanks. *Science Complex Project* - 5 acres (2 hectares) of undeveloped land at or near TA-62 would be developed; 15.6 acres (6.3 hectares) could undergo a change in land use plans to Experimental Science.

	No Action Alternative	Reduced Operations Alternative	Expanded Operations Alternative (Preferred Alternative)
			Remote Warehouse and Truck Inspection Station Project - 4 acres (1.6 hectares) of undeveloped land in TA-72 would be developed with a change in land use plans to Physical/Technical Support. *Waste Management Facilities Transition Project* - Up to 7 acres (2.8 hectares) of undeveloped land could be disturbed that could result in a change in land use designation.
Visual Environment			
	Land Conveyance and Transfer - Development could degrade views of presently undeveloped tracts. *Electrical Power System Upgrades* - Short-term visual impacts during construction. - Adverse visual impact in undisturbed areas. - No overall change in view from Bandelier National Monument. *Wildfire Hazard Reduction Program* - Forest would appear more park-like. - Some LANL facilities would be more visible. *Disposition of Flood Retention Structures* - Temporary impacts during removal if staging areas are located near Pajarito Road. Temporary impacts during construction of the CMRR Facility at TA-55. Temporary impacts during construction of replacement or new buildings and long-term enhancement of visual environment from removal of old buildings for the following projects: - High Explosives Processing Facilities, and - High Explosives Testing Facilities.	Same as No Action Alternative.	Same as No Action Alternative, plus: *MDA Remediation Project* - Temporary visual impacts during MDA capping or removal. - Borrow pit in TA-61 would become more visible due to the large quantities of material needed under both options. *Security-Driven Transportation Modifications Project* - Temporary impacts during construction. - Pronounced impacts due to parking lots, as well as vehicle and pedestrian bridges, especially for auxiliary actions involving bridges across canyons. *Physical Science Research Complex* - Temporary impacts during construction. - New structures would blend with other TA-3 construction. - Appearance of TA-3, TA-35, and TA-53 would improve with demolition of vacated structures. *Replacement Office Buildings Project* - Temporary impacts during construction. - New buildings and parking lot would be visible from West Jemez Road and Pajarito Road. *TA-18 Closure Project* - Temporary impact from demolition of Pajarito Site facilities at TA-18. - Long-term enhancement of visual environment as area is restored to more natural appearance. *TA-21 Structure DD&D Project* - Enhancement of visual environment from the removal of old structures from TA. Both conveyed and nonconveyed lands could undergo development which could change visual environment.

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative (Preferred Alternative)*
			Radiological Sciences Institute Project - Temporary impacts during demolition and construction. *RLWTF Upgrade Project* - Short-term impact from construction of new treatment building in TA-50. - Permanent change to the visual environment if evaporation tanks are built near the border of TA-5 and TA-52. *Waste Management Facilities Transition Project* - Beneficial impact on near and distant views from removal of domes in TA-54. - Minimal visual impact of the TRU Waste Facility to the public; possible impact on views from San Ildefonso Pueblo lands, depending on its location. - Temporary impacts during construction of structures at TA-54 and another location in the Pajarito Road corridor. *Science Complex Project* - Under Options 1 and 2, the new facility would be readily visible from West Jemez Road and forested buffer between LANL and Los Alamos Canyon would be lost; potential impacts to Los Alamos Canyon from night lighting. - Negligible impacts for Option 3. *Remote Warehouse and Truck Inspection Station Project* - 4 acres (1.6 hectares) would be cleared making the site readily visible from East Jemez Road; lighting could be visible from Tsankawi Unit of Bandelier National Monument.
Geology and Soils			
	Overall level of legacy contamination in soil should continue to decrease as a result of ongoing remediation projects including cleanup of suspected contamination at TA-21.	Same as No Action Alternative, except that the potential impact of LANL operations on soil could decrease because of the 20 percent reduction in high explosives testing activities.	Same as No Action Alternative, except: *MDA Remediation Project* - Use of large amounts of soil and rock for backfill or closure caps (up to 2.5 million cubic yards) (1.9 million cubic meters). - Positive impact from removal or containment of legacy waste. - TA-61 borrow pit would be expanded to provide additional soil and rock; other sources may be required. Temporary adverse impacts from excavation of large amounts of rock and soil during construction and DD&D, and positive impacts from removal of legacy contamination for the following projects: - *Physical Science Research Complex,* - *Replacement Office Buildings,* - *TA-18 Closure,*

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative (Preferred Alternative)*
			- TA-21 Structure DD&D, *- Radiological Sciences Institute* *- RLWTF Upgrade,* *- Waste Management Facilities Transition,* *- TA-55 Radiography Facility,* *- Science Complex,* *- Remote Warehouse and Truck Inspection Station, and* *- Security-Driven Transportation Modifications.*
Water Resources – Surface Water			
	Only minor impact on surface water quality or quantity, or floodplains from activities other than the project to remove flood retention structures. Removal of flood retention structures could result in potential impacts on Pajarito floodplains. Restoration of normal flow would cause sediments to alter channel and readjust floodplains.	Same as No Action Alternative, except shutdown of LANSCE operations would result in significant reductions of NPDES-permitted cooling tower discharges, particularly to Los Alamos Canyon.	Same as No Action Alternative, and: Potentially long-term positive impact from MDA remediation because water quality would be protected by removal or stabilization of waste or contaminants in soil. DD&D of TA-18 structures would eliminate potential contaminant sources, thereby enhancing protection of surface water quality. Complete Removal Option for DD&D of TA-21 would eliminate two NPDES-permitted outfalls reducing discharges to Los Alamos Canyon. Although increased pit production would increase RLWTF outfall volumes by 25 percent, this would have a negligible effect on surface water volumes in Mortandad Canyon because other facilities contribute 90 percent of the outfall flow in that canyon. Implementing the zero discharge option at the RLWTF (evaporation tanks) would have a minor effect on surface water volume, but would improve surface water quality by reducing the uptake of historical contaminations in the sediments downstream of that outfall.
Water Resources – Groundwater			
	Construction and DD&D activities are unlikely to affect groundwater resources. Operations-related impacts to groundwater are not likely to be significant in nature.	Same as No Action Alternative, except long-term impacts as a result of operations might be reduced by elimination of additional outfalls and reduction of water use.	Same as No Action Alternative, except impacts from water supply well withdrawals could increase and positive long-term impacts could occur from MDA remediation and the reduced potential for contaminant migration.

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative (Preferred Alternative)*
Nonradiological Air Quality			
	Minor temporary localized increases in air emissions from construction and demolition activities. Minor increases in air emissions from operations and remediation activities, including operation of new combustion turbine generators.	Same as No Action Alternative, except for reductions in emissions from reduced high explosives processing and testing activities and shutdown of LANSCE and the Pajarito Site (TA-18).	- Higher level of emissions from increased operations and proposed construction, demolition, and remediation including increases in emissions from commuter vehicles, and waste and materials shipments. - Hazardous air pollutants could increase by up to 2.5 percent from the High Explosives Processing Facilities resulting from the increased use of mock explosives. - Temporary construction-type releases of criteria pollutants would occur from MDA remediation, DD&D, and construction of new facilities. - Minor to moderate air quality impacts would result from remediating MDAs, and other PRSs, particularly for MDA removal.
Radiological Air Quality			
Curies per year:			
Tritium [a]	2,400	2,400	2,400 [b]
Americium-241	4.2×10^{-6}	4.2×10^{-6}	4.2×10^{-6} [c]
Plutonium [d]	0.00082	0.000092	0.00084 [c]
Uranium [e]	0.15	0.12	0.15
Particulate and vapor activation products	30	0.014	30
Gaseous mixed activation products	30,600	100 [f]	30,600 [f]
Mixed Fission Products [g]	1,650	1,650	1,650
Emissions from remediation	Not applicable	Not applicable	Variable [h]

[a] Includes both gaseous and oxide forms of tritium.
[b] Tritium emissions would decrease to 1,850 curies per year after about 2009 following decontamination, decommissioning, and demolition of TA-21.
[c] Americium-241 emissions could increase to 1.1×10^{-5} curies per year and plutonium emissions to 0.00089 curies per year if the Decontamination and Volume Reduction System, the new TRU Waste Facility, and remote-handled transuranic waste retrieval activities operated simultaneously (estimated to occur from 2012 through 2015).
[d] Includes plutonium-238, plutonium-239, and plutonium-240.
[e] Includes uranium-234, uranium-235, and uranium-238.
[f] Gaseous mixed activation products emissions would decrease by 100 curies per year after about 2009 due to the permanent shutdown of TA-18, resulting in zero emissions of gaseous mixed activation products in the Reduced Operations Alternative and 30,500 curies per year in the Expanded Operations Alternative.
[g] Mixed fission products include krypton-85, xenon-131m, xenon-133, and strontium-90.
[h] There would be additional emissions from the remediation of the larger MDAs. These emissions would depend on radionuclides present, whether an MDA is being capped or removed, the number of MDAs being remediated at one time, and whether exhumation occurs under an enclosure (see Appendix I).

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative (Preferred Alternative)*
Noise			
	Operations noise levels would have little impact on the public with the exception of sporadic noise from explosives detonations and traffic noise. Temporary localized increases in noise levels would occur from construction, demolition, and remediation activities that would be expected to have little impact on the public.	Same as No Action Alternative, except minor reductions in noise levels from reduced high explosives testing activities and shutdown of LANSCE and Pajarito Site (TA-18).	Higher noise levels than the No Action Alternative from increased operations, construction, DD&D, and remediation activities. Increase in truck and personal vehicle traffic noise, some of which could occur during nighttime, could result in public annoyance: - Up to a 32 percent increase in traffic along DP Road affecting nearby businesses and residents. - Up to a 13 percent increase in traffic along East Jemez Road affecting residents.
Ecological Resources			
	Land Conveyance and Transfer - 770 acres (312 hectares) of habitat could be lost through development. - Transfer of resource protection responsibility could result in a less rigorous environmental protection review process. *Electrical Power System Upgrades* - Temporary displacement of wildlife due to construction-related activities. - Potentially positive impact by providing perching sites for larger birds. *Wildfire Hazard Reduction Program* - Short-term disturbance of wildlife due to forest thinning activities. - Increased forest health could benefit the Mexican spotted owl and other species. *Disposition of Flood Retention Structures* - Temporary displacement of wildlife due to construction-related activities. - Potentially minor impacts on downstream wetlands *Trails Management Program* - Temporary disturbance of wildlife during implementation activities. Clearing of some ponderosa pine forest in TA-48 and TA-55 for construction of CMRR Facility would cause loss or displacement of associated wildlife.	Same as No Action Alternative, plus: - Reduction in high explosives testing activities would reduce the number of times animals would be subjected to stress resulting from high explosives testing.	Same as No Action Alternative, plus: *MDA Remediation Project* - Short-term disturbance and displacement of wildlife during capping or waste removal. - Loss of habitat at borrow pit in TA-61, including buffer and core habitat for the Mexican spotted owl. Section 7 consultation with the U.S. Fish and Wildlife Service would be required. - Remediation activities may affect, but are not likely to adversely affect the Mexican Spotted Owl, bald eagle, and southwestern willow flycatcher. *Security-Driven Transportation Modifications Project* - Parking lot construction and placement of pedestrian and vehicle bridges would destroy up to 30 acres (12 hectares) of natural habitat. Construction of a span bridge over Ten Site Canyon would be unlikely to adversely affect the Mexican spotted owl. - Auxiliary Action A would disturb up to 25.4 acres (10.6 hectares) of undeveloped core and buffer Mexican spotted owl habitat. Auxiliary Action B would disturb up to 67.1 acres (27.2 hectares) of undeveloped core and buffer habitat. - Under both auxiliary actions, bridge traffic over the core zone of the Sandia-Mortandad Canyon Mexican spotted owl Area of Environmental Interest could cause long-term impacts. Section 7 consultation with the U.S. Fish and Wildlife Service would be needed. *Replacement Office Buildings Project* - Temporary displacement of wildlife due to construction-related activities.

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative (Preferred Alternative)*
	Short-term impacts in TA-6, TA-22, and TA-40 from construction of new High Explosives Test Facility buildings and demolition of old structures would cause loss or displacement of wildlife.		- Clearing 13 acres (5.3 hectares) of mixed conifer forest in TA-3 would result in loss or permanent displacement of wildlife. - Construction may affect, but is not likely to adversely affect, the Mexican spotted owl and bald eagle. *TA-18 Closure Project* - Minor impact on wildlife during demolition of Pajarito Site structures in TA-18. DD&D activities may affect, but is not likely to adversely affect, the Mexican spotted owl and southwestern willow flycatcher. - Restoration of TA-18 (Pajarito Site) would create a more natural habitat and benefit wildlife, potentially including the Mexican spotted owl. *TA-21 Structure DD&D Project* - Minor disturbance of wildlife on adjacent land during demolition of structures. DD&D activities may affect, but is not likely to adversely affect, the Mexican spotted owl. *Radiological Sciences Institute Project* - Temporary disturbance of wildlife during demolition of structures and construction in TA-48. - Clearing of 12.6 acres (5 hectares) of ponderosa pine forest would cause loss or displacement of associated wildlife. - Construction may affect, but is not likely to adversely affect, the Mexican spotted owl and bald eagle. - DD&D activities may affect, but are not likely to adversely affect, the Mexican spotted owl. *RLWTF Upgrade Project* - Loss of up to 5.4 acres (2.2 hectares) of habitat if the evaporation tanks and pipeline are constructed. - Implementation of the evaporation tank option would reduce wetlands and riparian habitat in Mortandad Canyon and the abundance and diversity of Mexican spotted owl prey species, requiring Section 7 consultation with the U.S. Fish and Wildlife Service. - Construction may affect, but is not likely to adversely affect, the Mexican spotted owl and bald eagle. *Waste Management Facilities Transition Project* - Short-term impacts on wildlife in the vicinity of TA-54 and the TRU Waste Facility site from new construction and demolition activities. - TRU Waste Facility construction could result in the loss of 2.5 to 7 acres (1.0 to 2.8 hectares) of ponderosa pine forest or open field.

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative (Preferred Alternative)*
			- Construction at TA-54 may affect, but is not likely to adversely affect, the southwestern willow flycatcher. - A TRU Waste Facility could be built in portions of the Mexican spotted owl Area of Environmental Interest which would require Section 7 consultation with the U.S. Fish and Wildlife Service.
			Science Complex Project - Temporary displacement of wildlife due to construction-related activities. - Options 1 and 2 would remove 5 acres (2 hectares) of ponderosa pine forest. - Under Option 3, less than 5 acres (2 hectares) of grassland and forest would be cleared. - Construction may affect, but is not likely to adversely affect, the Mexican spotted owl and bald eagle. *Remote Warehouse and Truck Inspection Station Project* - Temporary displacement of wildlife due to construction-related activities. - 4 acres (1.6 hectares) of ponderosa pine forest and pinyon-juniper woodland would be cleared. - Construction may affect, but is not likely to adversely affect, the bald eagle.
Human Health			
Offsite Population Dose (person-rem per year) Risk (LCFs per year)	 30 0.018	 6.1 [i] 0.0037	 Less than 36 [j, k] 0.022
MEI [l] Dose (millirem per year) Risk (LCFs per year)	 7.8 4.7×10^{-6}	 0.78 [i] 4.7×10^{-7}	 Less than 8.2 [j, k] 4.9×10^{-6}
Workers Dose (person-rem per year) Risk (LCFs per year)	 280 0.17	 257 0.15	 407 to 543 [m] 0.24 to 0.33 [m]

[i] After about 2009, TA-18 (Pajarito Site) would no longer be able to contribute to radiological air emissions, thereby reducing the MEI and population doses.

[j] Population dose and MEI dose include 6.2 person-rem and 0.42 millirem respectively, attributable to the assumed removal of all MDAs (LCF risk of 3.7×10^{-3} and 2.5×10^{-7}, respectively). This dose could be smaller depending on the MDAs being remediated, whether an MDA is capped rather than removed, the number of MDAs being remediated at one time, and other factors.

[k] After about 2009, TA-18 (Pajarito Site) and TA-21 would not contribute to radiological air emissions, thereby reducing the MEI and population doses.

[l] Under the No Action Alternative and the Expanded Operations Alternative, the LANL site-wide MEI would be located near LANSCE. Under the Reduced Operations Alternative, the LANL site-wide MEI would be located near the firing sites at TA-36.

[m] The range for the Expanded Operations Alternative reflects the contribution from the two MDA Remediation Project options. The lower value is for the Capping Option, the higher value is for the Removal Option. The annual average worker doses contributed by the MDA Remediation Project alone would range from about 1 (MDA capping) to 137 (MDA removal) person-rem per year (0.0006 to 0.082 LCF per year).

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative (Preferred Alternative)*
Cultural Resources			
	Land Conveyance and Transfer - Potential damage to cultural resources and impacts on protection of and accessibility to Native American sacred sites from conveyance or transfer of cultural resources out of the responsibility and protection of DOE. Potential damage on conveyed or transferred parcels due to future development. *Trails Management Program* - Enhanced protection of cultural resources. Potentially adverse effects from demolition and remodeling of historic buildings in High Explosive Processing and Testing Facilities. Documentation would be required to resolve adverse effect.	Same as No Action Alternative.	Same as No Action Alternative plus: *Waste Management Facilities Transition Project* Removal of domes would have a positive impact on views from traditional cultural properties. Potential impact to cultural resources from construction of the TRU Waste Facility. Also, this facility could be visible from lands of the Pueblo of San Ildefonso, depending on its location. *MDA Remediation Project* No direct impacts are expected for either option of the MDA Remediation Project, although the potential for indirect impacts from temporary remediation support activities in the vicinities of the MDAs and PRSs would require review and protective measures taken as needed. To varying degrees, impacts on archaeological sites or historic structures eligible or potentially eligible for listing on the National Register of Historic Places could result from the following projects. These resources would be protected as appropriate and documentation would be developed as required to resolve adverse effects. - *Security-Driven Transportation Modifications,* - *Physical Science Research Complex,* - *Replacement Office Buildings,* - *Radiological Sciences Institute (including the Institute for Nuclear Nonproliferation Science and Technology),* - *RLWTF Upgrade,* - *LANSCE Refurbishment,* - *Waste Management Facilities Transition,* - *TA-55 Radiography Facility,* - *Science Complex* - *Remote Warehouse and Truck Inspection Station.* - *TA-18 Closure Project* - *TA-21 Structure DD&D*

	No Action Alternative	Reduced Operations Alternative	Expanded Operations Alternative (Preferred Alternative)
Socioeconomics			
	LANL Employment		
	2005 levels of employment assumed to remain steady at 13,504 employees.	A decrease of 500 employees from 2005 levels would be expected to result in the loss of 530 indirect jobs in the region (total 1,030 jobs lost).	An employment increase of 2.2 percent per year from 2007 to 2011 would result in an additional 600 to 1,890 employees working at LANL and creation of another 640 to 2,000 indirect jobs. This growth rate is consistent with the projected regional growth rate.
	Housing		
	No new housing units needed specific to changes in LANL employment level.	Additional housing units could become available in the tri-county area as a result of the projected decrease in LANL's employment level. These could be expected to offset the need for additional housing units in the region because the population would still be expected to grow, although at a slower rate (about 1.5 percent versus 2.3 percent).	Additional housing units would be required in the tri-county area due to the projected increase in LANL's employment level along with the projected increase in the region's population. More LANL employees could be expected over time to reside in Rio Arriba, Santa Fe, or other surrounding counties, compared to Los Alamos County, where a shortage of available housing would likely continue. The number of housing units needed would depend on the number of workers relocating from outside the area. Overall, the number of units needed would likely be small compared to overall needs in the tri-county area.
	Construction		
	Completion of previously approved construction projects is expected to draw workers already in the region who historically work from job-to-job.	Same as the No Action Alternative for construction projects.	An increase in the number of construction projects would be expected to draw workers already in the region who historically work from job-to-job.
	Local Government Finance		
	Annual gross receipts tax yields would be expected to remain at current levels in real terms.	Annual gross receipts tax yields directly and indirectly associated with LANL employment could decrease by about 1.1 percent.	Annual gross receipts tax yields directly and indirectly associated with LANL employment are projected to increase by between 1.3 and 3.9 percent from 2007 through 2011 over 2005 levels in real terms.
	Services		
	The demand for services such as police, fire, and hospital beds would be expected to remain at current levels in proportion to LANL employment. Regional population is projected to increase even if LANL employment remains flat, so there would be an increase in the demand for regional services but the increased demand would not be driven by LANL employment growth.	Demand for services would be expected to decrease in proportion to the number of out-of-work LANL-related employees leaving the region. However, regional population would still be projected to increase even if LANL employment was to decrease by the small levels envisioned in this alternative compared to the No Action Alternative. Demand for services would likely increase as well.	Demand for services would be expected to increase in proportion to the number of additional LANL-related jobs added to the region. The associated number of additional school age children would be between 440 and 1,400 in the tri-county area, resulting in an estimated increase in needed public school funding from the State of $3.2 million in 2007 to $11 million in 2011. Most of the additional services would be required in Rio Arriba, Santa Fe, and other surrounding counties.

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative (Preferred Alternative)*
Site Infrastructure			
LANL Site and Other Los Alamos County Users Total Per Alternative (annual)	Electricity requirements: 645,000 megawatt-hours total (495,000 megawatt-hours for LANL); 49 percent of system capacity.	Electricity Requirements: 516,000 megawatt-hours total (366,000 megawatt-hours for LANL); 39 percent of system capacity.	Electricity Requirements: 827,000 megawatt-hours total (677,000 megawatt-hours for LANL); 63 percent of system capacity.
	Electric Peak Load: 111 megawatts total (91.2 megawatts for LANL); 74 percent of system capacity.	Electric Peak Load: 80.6 megawatts total (60.4 megawatts for LANL); 54 percent of system capacity.	Electric Peak Load: 144 megawatts total (124 megawatts for LANL); 96 percent of system capacity.
	Natural Gas Demand: 2,215,000 decatherms total (1,197,000 decatherms for LANL); 27 percent of system contract capacity supply.	Natural Gas Demand: 2,181,000 decatherms total (1,163,000 decatherms for LANL); 27 percent of system contract supply capacity.	Natural Gas Demand: 2,331,000 decatherms total (1,313,000 decatherms for LANL); 29 percent of system contract supply capacity.
	Water Demand: 1,621 million gallons total (380 million gallons for LANL); 90 percent of system available water rights.	Water Demand: 1,544 million gallons total (303 million gallons for LANL); 85 percent of system available water rights.	Water Demand: 1,763 million gallons total (522 million gallons for LANL); 98 percent of system available water rights.
	Project Effects: - Ongoing electrical power system upgrades would have a positive incremental impact onsite electrical energy and peak load capacity. - Potential for increased natural gas consumption from increased capacity at the TA-3 Co-Generation Complex. Note: Values are rounded.	*Project Effects:* Same as the No Action Alternative.	*Project Effects:* - Increases in electrical energy, peak load, and water demands over the No Action Alternative due to increased operational levels at the Metropolis Center and LANSCE (see above).
MDA Remediation (total over 10 years)	No change in utility demands.	Same as No Action Alternative.	Annual average of up to 70 million gallons of liquid fuels and 58 million gallons of water for remediation activities.

Waste Type	*No Action Alternative*	*Reduced Operations Alternative*	*Expanded Operations Alternative (Preferred Alternative)*		
			Total Including MDA Remediation Project	*Total Excluding MDA Remediation Project*	*MDA Remediation [n] Project Only*
Waste Management (10-Year Total)					
Transuranic Waste					
Contact-handled [o] (cubic yards)	3,500 to 5,900	3,500 to 5,900	5,300 to 33,000	5,200 to 11,000	68 to 22,000
Remote-handled [p] (cubic yards)	–	–	11 to 61	11	0 to 50
Low-Level Radioactive Waste [p, q]					
Bulk low-level radioactive waste (cubic yards)	39,000	39,000	196,000 to 884,000	186,000	11,000 to 698,000
Packaged low-level radioactive waste (cubic yards)	33,000 to 128,000	33,000 to 110,000	80,000 to 183,000	80,000 to 183,000	–
High activity low-level [p] radioactive waste (cubic yards)	–	–	0 to 347,000	–	0 to 347,000
Remote-handled low-level [p] radioactive waste (cubic yards)	–	–	480 to 1,700	480	0 to 1,200
Mixed low-level radioactive waste (cubic yards)	1,800 to 2,800	1,800 to 2,800	3,900 to 183,000	3,200 to 4,400	710 to 178,000
Construction/Demolition Debris [r] (cubic yards)	198,000	197,000	642,000 to 722,000	595,000	47,000 to 126,000
Chemical waste [s] (pounds)	19,000,000 to 37,000,000	19,000,000 to 36,000,000	64,000,000 to 129,000,000	22,000,000 to 39,000,000	42,000,000 to 90,000,000
Liquid Radioactive Wastes					
Liquid transuranic waste (gallons)	300,000	300,000	500,000	500,000	(t)
Liquid low-level radioactive waste (at TA-50) (gallons)	40,000,000	40,000,000	50,000,000	50,000,000	(t)
Liquid low-level radioactive waste (at TA-53) (gallons)	1,400,000	50,000 [u]	1,400,000	1,400,000	(t)

[n] Waste volumes are the incremental increase over remediation waste projections from the No Action Alternative.
[o] Operations waste volumes are assumed to be contact-handled transuranic waste and packaged low-level radioactive waste; small volumes of remote-handled or high-activity waste may be generated.
[p] These waste types are generated during retrieval of waste from MDAs under the Expanded Operations Alternative. Nominal volumes generated under other alternatives are accounted for in other waste categories.
[q] The subcategories of low-level radioactive waste do not necessarily meet precise definitions, but are used to assist in the analysis of transportation and disposal options and impacts.
- Bulk low-level radioactive waste = wastes that can be transported in large volumes in soft-sided containers.
- Packaged low-level radioactive waste = typical low-level radioactive waste packaged in drums or boxes.
- High activity low-level radioactive waste = waste exceeding 10 CFR 61.55 Class A concentrations (greater than 10 nanocuries per gram of transuranic nuclides) and therefore not accepted at certain facilities.
- Remote-handled low-level radioactive waste = waste with a dose rate exceeding 200 millirem per hour at the surface of the container.

[r] Demolition waste includes uncontaminated wastes such as steel, brick, concrete, pipes and vegetative matter from land clearing.
[s] Chemical waste includes wastes regulated under the Resource Conservation and Recovery Act, Toxic Substances Control Act, or state hazardous waste regulations. The large increase under the Expanded Operations Alternative is primarily due to high volumes of waste associated with MDA remediation.
[t] MDA remediation is projected to generate roughly 10,000 to 24,000 gallons (38,000 to 91,000 liters) of industrial, hazardous, low-level, and mixed low-level liquid wastes.
[u] Under the Reduced Operations Alternative, operations at the LANSCE facility would cease. Approximately 5,000 gallons (20,000 liters) of radioactive liquid waste per year from TA-50 would continue to be treated at TA-53.

Note: Because values have been rounded to the nearest hundred, thousand, or million, totals may not equal the sum of individual contributions.
To convert cubic yards to cubic meters, multiply by 0.76456; pounds to kilograms, multiply by 0.45359; gallons to liters, multiply by 3.78533.

	No Action Alternative	Reduced Operation Alternative	Expanded Operations Alternative (Preferred Alternative)				
			Total Including MDA Remediation Project		Excluding MDA Remediation Project	MDA Remediation Project Only	
			Capping	Removal		Capping	Removal
Transportation (for 10-Year Period 2007-2016)							
Incident Free							
Public Radiation Exposure *Dose (person-rem) / Risk (LCFs):*							
Total	58.4/0.035	53.1/0.032	89.1/0.053	286.8/0.17	88.6/0.053	0.49/0.0003	198.2/0.12
LANL to Pojoaque	1.8/0.0011	1.7/0.0010	2.8/0.0017	8.1/0.0049	2.8/0.0017	0.01/0.000006	5.3/0.0032
Pojoaque to Santa Fe	3.3/0.0020	3.1/0.0019	4.6/0.0028	13.3/0.0080	4.6/0.0028	0.02/0.00001	8.7/0.0052
Worker Radiation Exposure: (transport drivers) *Dose (person-rem) / Risk (LCFs):*	163.8/0.098	147.2/0.088	255.9/0.15	910.3/0.55	254.0/0.15	1.9/0.0012	656.4/0.40
Transportation Accidents							
Population: - *Radiological Risk (LCFs)*	0.00017	0.00015	0.00025	0.0016	0.00024	0.00001	0.0013
- *Nonradiological Traffic Fatalities* [v]	0 (0.37)	0 (0.34)	1 (0.95)	3 (3.23)	1 (0.90)	0 (0.02)	2 (2.3)

[v] Nonradiological traffic fatalities include all traffic accidents involving both radioactive and nonradioactive materials and waste shipments. Values presented are the nearest whole number.

	No Action Alternative	Reduced Operation Alternative	Expanded Operations Alternative (Preferred Alternative)
Local Traffic			
Average Daily Traffic at Entry Points	42,300	40,600	up to 49,800
Environmental Justice			
	No disproportionately high and adverse impacts on minority or low-income populations. Radiological doses to minority and low-income populations would be lower than those to sectors of the population that are not members of these groups. Human health impacts from exposure through special pathways (including subsistence consumption of fish and wildlife) would not present disproportionately high and adverse impacts to minority or low-income populations.	Same as No Action Alternative.	While there would be small, but not significant, increases in radiological and chemical risks to the public (0.004 LCFs), increased levels of operations and implementation of proposed projects are not expected to have any disproportionately high and adverse impacts on minority or low-income populations. Radiological doses to minority and low-income populations would be lower than those to sectors of the population that are not members of these groups.

	No Action Alternative	*Reduced Operation Alternative*	*Expanded Operations Alternative (Preferred Alternative)*
Facility Accidents (highest risk and MDA removal accidents presented)			
Wildfire – Radiological (Waste Storage Domes at TA-54 – assumed frequency 1 in 20 years)			
Offsite Population			
Dose (person-rem)	91,000	Same as No Action Alternative.	Same as No Action Alternative.
Risk (LCFs per year)	2.7		
MEI			
Dose (rem)	1,900 [w]		
Risk (LCFs per year)	0.05 [x]		
Noninvolved Worker			
Dose (rem)	8,700 [w]		
Risk (LCF per year)	0.05 [x]		
Wildfire – Chemical (Releases formaldehyde at TA-43 – assumed frequency 1 in 20 years)			
- Concentrations above which life-threatening health effects could result (ERPG-3 [y] limit)	25 parts per million	Same as No Action Alternative	Same as No Action Alternative.
- ERPG-3 distance	97 yards		
- Distance to the site boundary	13 yards		
Site-Wide Seismic Event – Radiological (PC-3 seismic event – assumed frequency 1 in 1,250 years) [z]			
Offsite Population			
Total Dose (person-rem)	36,000	Same as No Action Alternative	Same as No Action Alternative
Risk (LCF per year)	0.014		
MEI			
Maximum Dose (rem)	460 [w]		
Risk (LCF per year)	0.00045		
Noninvolved Worker [aa]			
Maximum Dose (rem)	2,000 [w]		
Risk (LCF per year)	0.0008		
Site-Wide Seismic Event – Chemical (PC-3 seismic event releases formaldehyde at TA-43 – assumed frequency 1 in 1,250 years) [z]			
- Concentrations above which life-threatening health effects could result (ERPG-3 [y] limit)	25 parts per million	Same as No Action Alternative	Same as No Action Alternative.
- ERPG-3 distance	120 yards		
- Distance to the site boundary	13 yards		
Facility Accident (RANT lightning strike fire – assumed frequency 1 in 8 years)			
Offsite Population			
Dose (person-rem)	11,000	Same as No Action Alternative	Same as No Action Alternative
Risk (LCF per year)	0.8		
MEI			
Dose (rem)	410 [w]		
Risk (LCF per year)	0.06		
Noninvolved Worker [bb]			
Dose (rem)	1,900 [w]		
Risk (LCF per year)	0.12 [x]		

	No Action Alternative	*Reduced Operation Alternative*	*Expanded Operations Alternative (Preferred Alternative)*
Facility Chemical Release (Selenium hexafluoride at TA-54 – assumed frequency 1 in 240 years)			
- Concentrations above which life-threatening health effects could result (ERPG-3 [y] limit)	5 parts per million	Same as No Action Alternative	Same as No Action Alternative.
- ERPG-3 distance	962 yards		
- Distance to the site boundary	537 yards		
MDA G Removal Accident – Radiological (explosion – assumed frequency 1 in 100 years)			
Offsite Population	Not applicable	Not applicable	
Dose (person-rem)			770
Risk (LCF per year)			0.005
MEI			
Dose (rem)			55
Risk (LCF per year)			0.0007
Noninvolved Worker			
Dose (rem)			410
Risk (LCF per year)			0.005
MDA B Removal Accident (sulfur dioxide – frequency not assumed)			
- Concentrations above which life-threatening health effects could result (ERPG-3 [y] limit)	Not applicable	Not applicable	15 parts per million
- ERPG-3 distance			37 yards
- Distance to the site boundary			49 yards

[w] Individual radiation doses in excess of a few hundred rem would result in acute (near-term) health effects or even death from causes other than cancer. In some cases, medical intervention may be effective in reducing the dose, mitigating health impacts, or both. The listed doses are calculated assuming that the exposed individual takes no protective action during the period of exposure and that no subsequent medical intervention occurs.

[x] The risk to any individual would not exceed the risk of the accident scenario.

[y] ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects (DOE 2005b).

[z] Based on the 2007 update of the probabilistic seismic hazard analysis (LANL 2007a).

[aa] The maximum risk (considering consequence and probability) to the noninvolved worker comes from the PC-2 seismic event which has a frequency of 1 in 700 (LANL 2007).

[bb] The maximum risk (considering consequence and probability) to the noninvolved worker comes from the Waste Characterization, Reduction, and Repackaging Facility lightning strike fire which has a frequency of 1 in 7.

TA = technical area; DD&D = decontamination, decommissioning, and demolition; MDA = material disposal area; LANSCE = Los Alamos Neutron Science Center; NPDES = National Pollutant Discharge Elimination System; RLWTF = Radioactive Liquid Waste Treatment Facility; CMRR = Chemistry and Metallurgy Research Replacement Facility; LCF = latent cancer fatality; MEI = maximally exposed individual; ERPG = Emergency Response Planning Guideline; PC = performance category; RANT = Radioassay and Nondestructive Testing; ROI = region of influence.

Note: To convert gallons to liters, multiply by 3.7854; cubic yards to cubic meters, multiply by 0.76456; pounds to kilograms, multiply by 0.45359.

3.6.2 Summary of Cumulative Impacts

In accordance with Council on Environmental Quality regulations, a cumulative impact analysis includes "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" (40 CFR 1508.7). The cumulative impact analysis for this SWEIS includes (1) an examination of cumulative impacts presented in the *1999 SWEIS*; (2) impacts since the *1999 SWEIS* was issued (presented in this SWEIS in Chapter 5); and (3) a review of the environmental impacts of past, present, and reasonably foreseeable actions for other Federal and non-Federal agencies in the region.

Reasonably foreseeable actions that are likely to occur at LANL are described in Section 3.3 under the Expanded Operations Alternative. Additional DOE or NNSA actions that could impact LANL include the possible consolidation of nuclear operations related to production of radioisotope power systems (DOE/EIS-0373D) (DOE 2005c); proposed operation of a Biosafety Level 3 facility; a proposed advanced fuel cycle facility for research and development associated with the Global Nuclear Energy Partnership (GNEP) initiative; the potential implementation of Complex Transformation; and a potential disposal facility for Greater-Than-Class C waste.

Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems – As proposed in the *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems* (DOE/EIS-0373D) (*Consolidation EIS*) (DOE 2005c), consolidation of DOE plutonium-238 activities at the Idaho National Laboratory would reduce plutonium-238 operations at LANL. But regardless of the decision on the *Consolidation EIS,* some plutonium-238 operations would continue at LANL. Therefore, very small changes in the impacts from plutonium-238 activities at LANL would occur.

If current plutonium-238 operations were to continue at the LANL Plutonium Facility Complex, as described under the *Consolidation EIS* No Action Alternative, manufacturing of up to 80 pits per year could still be accomplished within the LANL Plutonium Facility Complex. This would be accommodated by consolidating a number of plutonium processing and support activities (such as analytical chemistry and materials characterization at the Chemistry and Metallurgy Research Replacement Facility). The impacts of the 80-pit-per-year production rate and plutonium-238 processing (at levels far above the level of plutonium-238 processing identified in the *Consolidation EIS*) have been evaluated in both the LANL *1999 SWEIS* and this new SWEIS. Therefore, there would be no additional cumulative effects from these activities.

Biosafety Level 3 Facility – NNSA is preparing an *Environmental Impact Statement for the Operation of a Biosafety Level 3 Facility at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EIS-0388D) to analyze the potential environmental impacts of operating a Biosafety Level 3 Facility. Operation of the facility would be consistent with the land use designation of Research & Development for Experimental Science. The facility is visually compatible with surrounding structures; therefore, there would be no impacts to visual resources. There would be no impacts to geology and soils and water resources from operations. Air emissions from the facility's laboratories are HEPA-filtered, resulting in very minor air quality effects. Noise impacts would be restricted to noise from heating, ventilation, and air conditioning system operations, consistent with other buildings in the area. Facility operations would have no effect upon ecological resources in the area. There would be no effect on prehistoric, historic, traditional, or paleontological resources. Facility personnel would come primarily from the existing LANL workforce, leading to no socioeconomic impacts. Operations would be well within LANL infrastructure capability to provide utilities such as electricity, water, and natural gas. There would be no discernable effects on local traffic conditions. There have been no reported cases of illnesses in the United States due to the release of diagnostic specimens during transport (Cummings 2007).

There would be a low potential risk of illness to site workers or visitors and no public human health effect from routine operations involving biohazardous material. Accident conditions would result in minimal or no impact to the public primarily because there would be severely limited opportunity for transport of an infectious dose of a biohazardous material to the public. Biohazardous material in open cultures would be handled only in biosafety cabinets where a spill would be contained. In addition, biohazardous material would be handled in a liquid or solid culture container that would release very few organisms to the air if dropped or spilled. This means that one of the most critical risk factors, public exposure to an infectious dose from a biohazardous material, is greatly minimized, and therefore, the potential risk of disease would be very low. The EIS will address slope stability at the Biosafety Level 3 Facility based on the recent update to the LANL probabilistic seismic hazard analysis (Cummings 2007, LANL 2007a).

Advanced Fuel Cycle Facility – On January 4, 2007, DOE issued an NOI (72 FR 331) to prepare a Programmatic EIS for the GNEP initiative. GNEP would encourage expansion of domestic and international nuclear energy production while reducing nuclear proliferation risks, and reduce the volume, thermal output, and radiotoxicity of spent nuclear fuel before disposal in a geologic repository. LANL is one of the DOE sites being considered for an advanced fuel cycle facility. The advanced fuel cycle facility would be a large shielded facility (approximately 1 million square feet [92,900 square meters] (DOE 2008). Potential cumulative impacts at LANL associated with the proposed advanced fuel cycle facility are based on preliminary data and could change prior to the public release of the Draft *GNEP PEIS*.

Complex Transformation – On January 11, 2008, NNSA announced the availability of the Draft *Complex Transformation SPEIS* (73 FR 2023), which evaluates NNSA's proposal for a smaller, more efficient nuclear weapons complex that would be better able and more suited to respond to future national security challenges. The Preferred Alternative in the Draft *Complex Transformation SPEIS* is to pursue distributed centers of excellence. LANL would be the center of excellence for plutonium manufacturing and research and development, with a production capacity of up to 80 pits per year. This alternative would be based on the use of the existing and planned infrastructure already described in the SWEIS Expanded Operations Alternative (DOE 2007b). Among other alternatives for LANL that are evaluated in the *Complex Transformation SPEIS*, the one that would have the largest potential cumulative impacts is the consolidated nuclear production center. The SWEIS cumulative impacts analysis addresses the impacts of construction and operation of a consolidated nuclear production center at LANL.

Disposal of Greater-Than-Class-C Low-Level Radioactive Waste (GTCC EIS). On July 23, 2007, DOE issued an NOI to prepare an *Environmental Impact Statement for the Disposal of*

Greater-Than-Class-C Low-Level Radioactive Waste (GTCC EIS) (72 FR 40135). The *GTCC EIS* will address the disposal of low-level radioactive waste generated by activities licensed by the Nuclear Regulatory Commission or an Agreement State that contain radionuclides in concentrations exceeding 10 CFR 61 Class C limits, as well as DOE waste having similar characteristics. LANL is being considered as one of eight candidate DOE disposal sites for Greater-Than-Class C waste, along with a generic commercial disposal facility option in arid and humid environments. In addition, DOE is evaluating several disposal technologies in the *GTCC EIS* including geologic repositories, intermediate depth boreholes, and enhanced near-surface disposal facilities. The alternatives in the *GTCC EIS* could result in changes to facilities or operations at LANL, but because the changes have yet to be developed, quantitative data are not available for the cumulative impacts analysis.

Reasonably foreseeable actions for the region surrounding LANL were also reviewed for the cumulative impacts analysis. Interviews were conducted with personnel in planning departments in the surrounding counties, as well as from the regional Bureau of Land Management and Santa Fe National Forest offices, to collect information on activities that might affect cumulative impacts. Available documentation was reviewed for activities that could contribute to cumulative impacts.

Each resource area in this SWEIS was reviewed for potential cumulative impacts; the analyses are summarized in the following paragraphs. The level of detail provided for each resource area is commensurate with the extent of the potential cumulative impacts. Some resources were not provided with a detailed analysis based on minimal or very localized impacts from LANL operations and a judgment that, cumulatively, there would be no appreciable impacts on these resources.

The following paragraphs summarize cumulative impacts for LANL and the surrounding region of influence. The maximum cumulative impacts for all resource areas would occur if a decision was made to implement the SWEIS Expanded Operations Alternative in its totality.

Land Use, Visual Environment, Ecological Resources, and Cultural Resources

Impacts on land use, visual environment, ecological resources, and cultural resources from LANL operations have been discussed previously. Additional impacts could arise from the conveyance and transfer of land as required under Public Law 105-119. Up to 826 acres (334 hectares) of land could be developed after transfer or conveyance. For example, Los Alamos County has indicated there are proposals to develop approximately 1,000 new residences on land adjacent to LANL and to develop land for light industry, retail, and residential development along the Los Alamos Canyon rim across from the airport. This could change the current land use and increase cumulative impacts on visual, ecological, and cultural resources. In addition, the *Complex Transformation SPEIS* consolidated nuclear production center facilities, if constructed at LANL, could result in disturbance of up to 545 acres (221 hectares) of land. The total land area required for the GNEP advanced fuel cycle facility would be approximately 373 acres (151 hectares) with 144 acres (58 hectares) inside a property protection fence, including approximately 62 acres (25 hectares) within a perimeter intrusion, detection, and assessment system (DOE 2008).

Impacts associated with construction of the consolidated nuclear production center or the GNEP advanced fuel cycle facility at LANL would include the loss of habitat and of less mobile wildlife, such as reptiles and small mammals. Best management practices and implementation measures set forth in the LANL *Threatened and Endangered Species Habitat Management Plan* would be used to minimize the potential for any adverse effects to plant and animal communities and on threatened and endanger or special interest species. After construction, temporary structures would be removed and the sites reclaimed.

Proposed sites for the *Complex Transformation SPEIS* consolidated nuclear production center in TA-16 or TA-55 and the GNEP advanced fuel cycle facility in TA-36 that involve undisturbed lands are likely to contain archaeological resources due to the high density of these resources in the region. Identification, evaluation, determination of impact, and implementation of mitigative measures would be conducted in consultation with the New Mexico State Historical Preservation Office (SHPO), interested Native American tribes, and in accordance with *A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico*.

Geology and Soils

For geology and soils, the primary impacts are due to proposed closure of the MDAs under the Expanded Operations Alternative in compliance with the Consent Order. If the waste at the MDAs is contained in place (MDA Capping Option), the final covers would require up to 2.5 million cubic yards (1.9 million cubic meters) of bulk materials including crushed tuff, rock, gravel, topsoil, and other materials for surface grading and erosion control. Construction of the consolidated nuclear production center or the GNEP advanced fuel cycle facility would also require the use of bulk geologic materials. These materials would be obtained from LANL resources and from quarries and mines in the surrounding counties. While the quantity of materials would be large, there would be sufficient resources in the region to meet the demand.

Water Resources

Reasonably foreseeable activities in the region could affect surface water and groundwater in combination with past and present activities, as well as those proposed at LANL in this SWEIS. Mitigation measures implemented by Federal agencies during fire and vegetation management projects and modification of water control structures installed after the Cerro Grande Fire would minimize impacts on surface water quality and quantity. Use of facilities to evaporate treated effluent from the Radioactive Liquid Waste Treatment Facility would improve surface water resources in Mortandad Canyon. Additional groundwater depletion projected as a result of potential new residential development within Los Alamos County could be somewhat offset by reduced depletion of the regional aquifer following implementation of the city of Santa Fe's water diversion project and reduced pumping of the Buckman Well Field. Monitoring of the quality and quantity of the regional aquifer would be needed to evaluate the rate and direction of contaminant movements and to track the amount of water available for use. The North Railroad Avenue groundwater contamination plume located over 12 miles (19 kilometers) from the LANL boundary is undergoing remediation, and is not expected to migrate into groundwater and surface water impacted by past or present LANL operations.

Air Quality

Under the Expanded Operations Alternative, construction, excavation, and remediation activities could result in temporary increases in air pollutant concentrations at the site boundary and along publicly accessible roads. These impacts would be similar to those that would occur during construction of a housing project or a commercial complex. Emissions of fugitive dust from these activities would be controlled with water sprays and other engineering and management practices as appropriate. The maximum ground level concentrations offsite and along publicly accessible roads would be below ambient air quality standards, except for possible short-term concentrations of nitrogen oxides and carbon monoxide for certain projects that could occur near the site boundary. Appropriate management controls and scheduling would be used to minimize impacts on the public and to meet regulatory requirements. The impacts on the public would be minor.

The projected increase in LANL employees and vicinity populations would cause an increase in vehicles and an associated increase in vehicle emissions along the routes used to access the site. However, cumulative concentrations of all criteria pollutants are expected to remain compliant with Federal and State ambient air quality standards.

The 24-hour standard for nitrogen dioxide and total suspended particulates could be exceeded if the Complex Transformation consolidated nuclear production center operated at LANL along with implementation of the Expanded Operations Alternative. Based on these potential exceedances, more detailed site-specific analyses would need to be performed if LANL were selected as the site for the consolidated nuclear production center. Preliminary data available for the GNEP advanced fuel cycle facility do not include emissions.

The contribution to cumulative air quality impacts from offsite construction and operation activities was also evaluated. The maximum impacts from construction activities (including fugitive dust) for oil and gas development in the region are evaluated in the *Farmington Proposed Resource Management Plan and Final EIS* and were shown to occur very close to the source, with concentrations decreasing rapidly with distance (BLM 2003b). Therefore, it is expected that offsite air emissions from disturbance and construction would not contribute substantially to cumulative impacts at LANL.

Impacts of inert pollutants (pollutants other than ozone and its precursors) generally were found to be limited to a few miles downwind from the source. For emissions from the oil and natural gas well fields, the distance where the nitrogen dioxide concentrations dropped below their significance levels was 15.6 to 24.9 miles (25 to 40 kilometers). Therefore, it is expected that emissions from the operation of offsite facilities would not contribute substantially to cumulative impacts at LANL.

In contrast, the maximum effects of volatile organic compounds and nitrogen oxide emissions on ozone levels usually occurs several hours after these compounds are emitted and many miles from their sources (BLM 2003b). A number of mitigation measures for activities occurring in the region are designed to reduce the cumulative air quality impacts from gas and oil wells and pipelines. One of the more successful mitigation measures requires that new and replacement wellhead compressors limit their nitrogen oxide emissions to less than 10 grams per horsepower-hour, and each pipeline compressor station limit its total nitrogen oxide emissions to less than 1.5 grams per horsepower-hour. This measure is intended to substantially reduce the level and extent of emissions that form ozone throughout the region and to reduce visibility impacts on Class I Areas such as Bandelier National Monument.

Human Health

For human health, the dose to the general public from all anticipated airborne emissions at LANL (Expanded Operations Alternative) could be as much as 36 person-rem per year. The dose to the offsite MEI from all anticipated airborne emissions at LANL could be as much as 8.2 millirem per year. The Clean Air Act regulations limit airborne radiation doses to 10 millirem per year for any individual member of the public. No additional LCFs would be expected at these dose levels. If the consolidated nuclear production center facilities were sited at LANL, the offsite radiological impacts would be essentially unchanged due to closure of facilities whose functions would be included in the new center. Preliminary data available for the GNEP advanced fuel cycle facility do not include estimates of offsite dose impacts.

Collective worker doses would increase if the MDA Removal Option was implemented. Collective worker dose would increase from about 280 person-rem per year under the No Action Alternative to an average of up to about 540 person-rem per year due to the number of workers involved. At the maximum dose, the annual risk of a LCF in the worker population would be about 0.3 (or for each 3 years of operation, 1 chance of an LCF in the worker population). Worker dose would decrease by about 140 person-rem annually after the MDA remediation work was complete. Worker doses would be expected to increase from operation of the consolidated nuclear production center facilities at LANL. The net increase in collective worker doses would be approximately 105 person-rem per year. The increased annual risk of an LCF in the worker population would be 0.06 (or for each 17 years of operation, an additional LCF might be expected in the worker population). Preliminary data for the GNEP advanced fuel cycle facility do not include a worker population dose estimate. Individual worker doses would be maintained as low as reasonably achievable (ALARA) and within applicable regulatory limits.

Environmental surveillance results for radioisotopes and chemicals, monitoring of LANL radiological emissions and radiation dose data, and cancer mortality and incidence rates in New Mexico and all counties surrounding LANL are presented in this SWEIS. These data, along with the final LANL Public Health Assessment, issued on August 31, 2006, by the U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, show that "there is no evidence of contamination from LANL that might be expected to result in ill health to the community" and "[o]verall, cancer rates in the Los Alamos area are similar to cancer rates found in other communities" (CDC 2006). Additionally, there is currently a Center for Disease Control and Prevention dose reconstruction project at LANL in the initial information gathering phase (CDC 2006). Therefore, this information is not available to include in the cumulative impacts analysis.

Socioeconomics

By 2011, LANL operations under the No Action Alternative could account for approximately 20 percent of employment in the tri-county area (Los Alamos, Rio Arriba, and Santa Fe

Counties) and an even higher percentage of wages due to the large difference in average wages for LANL employees versus the county averages. Under the Expanded Operations Alternative, direct employment at LANL could increase by another 14 percent by 2011. Of the 1,890 direct and 2,000 indirect jobs thus created, about 1,600 and 1,700 jobs, respectively, would be held by those in the tri-county area. This would increase the estimated percentage of the population employed in the tri-county area as a result of LANL operations activities to 22 percent.

If the maximum number of jobs estimated for operation of the Los Alamos Research Park and the conveyance and transfer of land were also created by 2011, there could be additional socioeconomic impacts in the region of influence. Cumulatively, the Expanded Operations Alternative and these activities could result in nearly 21,000 direct and 22,000 indirect jobs in the region. This scenario would increase the estimated percentage of the population employed by LANL-related activities or actions to 31 percent of the region of influence.

Increases in employment related to the proposed *Complex Transformation SPEIS* consolidated nuclear production center facilities would add approximately 1,500 direct and 1,600 indirect jobs for a total of 3,100 additional employees living in the tri-county region of influence. The addition of the GNEP advanced fuel cycle facility could add about 1,100 direct jobs in the tri-county region of influence, generating approximately 1,200 indirect jobs for a total 2,300 additional employees living in the tri-county region of influence. Combined with the other initiatives discussed above and LANL's continuing operations under the Expanded Operations Alternative, this scenario could increase the estimated percentage of the population employed by LANL-related activities to 33 percent of the region of influence.

The rate of population growth in the region would likely exceed current rates, placing additional strain on regional infrastructure and social services. For example, additional demand would be placed on regional water and electrical systems, roads would be more heavily traveled, additional housing would need to be constructed, and there may be demands for additional schools and hospitals. There would also be beneficial gains in terms of average wages and benefits flowing into the local economy because many of these jobs should be relatively higher paying jobs (for example, research jobs), and the unemployment rate would likely fall.

Infrastructure

Under the SWEIS Expanded Operations Alternative, the cumulative peak electrical load would approach, but not exceed, the system capacity; and the water use would approach, but not exceed, the system available water rights. Planned upgrades to the electrical system should enhance peak load capacity and ensure that electric energy is available for future operations. For water use, Los Alamos County is currently pursuing additional water rights to supply its water customers, including LANL. LANL water requirements have been decreasing compared to the demand in 1999, and are far below projections included in the *1999 SWEIS*. In the near term, no infrastructure capacity constraints are expected, and LANL demands on infrastructure resources are below projected levels and within site capacities. Potential shortfalls in available capacity would need to be addressed if increased site requirements are larger than those analyzed in this SWEIS.

If the proposed Complex Transformation consolidated nuclear production center, the GNEP advanced fuel cycle facility, or both were located at LANL, the system capacities for electricity and water could be exceeded and additional resources might need to be identified to satisfy the projected demand. It is likely that significant modifications would be required and LANL would need to obtain greater water resources, or significantly reduce its potable water use through mitigative measures. Overall LANL work assignments might have to be revamped, reduced, or eliminated so that existing potable water supplies would be adequate to support the assigned LANL work load.

Waste Management

Cumulative generation of all waste types is expected to be substantial, largely due to future remediation of MDAs and DD&D of facilities. Although this would be the case under all alternatives, the quantities of wastes projected under the Expanded Operations Alternative would be significantly larger than those projected under the other alternatives. Sufficient disposal capacity, both on- and offsite, for all waste types would be available except possibly under the Expanded Operations Alternative. Up to 1.4 million cubic yards (1.1 million cubic meters) of low-level radioactive waste and 33,000 cubic yards (25,000 cubic meters) of transuranic waste are projected. About two-thirds of the transuranic waste volume is associated with postulated complete removal of all waste from the MDAs – including transuranic waste buried before 1970. Final waste volumes from MDA remediation may be smaller because waste generation is dependent on future regulatory decisions by the New Mexico Environment Department and on waste volume reduction techniques such as sorting. Additional resources, including new storage and handling facilities, could be required to augment existing and proposed waste management capabilities.

Onsite disposal capacity for low-level radioactive wastes may be sufficient, depending on the actual volumes generated by remediation; disposal capacity can be supplemented by offsite facilities if needed. It is assumed that the transuranic waste would be disposed of at WIPP. WIPP disposal capacity is expected to be sufficient for disposal of all retrievably stored waste and all newly generated transuranic waste from the DOE complex over the next few decades, but not sufficient for this waste and all of the transuranic waste buried before 1970 across the complex (63 FR 3624). Decisions about disposal of transuranic waste from full removal of LANL MDAs would be based on the needs of the entire DOE complex. Any transuranic waste that may be generated at LANL without a disposal pathway would be safely stored until disposal capacity becomes available.

Operation of the proposed Complex Transformation consolidated nuclear production center would result in additional radioactive waste being generated. Up to 1,160 cubic yards (890 cubic meters) of transuranic waste, 12,000 cubic yards (9,000 cubic meters) of low-level radioactive waste, and 72 cubic yards (55 cubic meters) of mixed low-level radioactive waste would be generated annually. Operations would also generate up to 8,900 gallons (33,800 liters) of liquid low-level waste and up to 3,600 gallons (13,700 liters) of mixed low-level liquid waste annually. These wastes would be treated and packaged for disposal in accordance with their characteristics and applicable requirements in existing facilities or new facilities. Low-level waste would be disposed of onsite, mixed low-level waste would be disposed of at a permitted offsite facility, and transuranic waste would be disposed of at WIPP.

The volumes of low-level radioactive waste (up to 3,450 cubic yards [2,640 cubic meters]) and mixed low-level radioactive waste (up to 4.4 cubic yards [3.4 cubic meters]) projected to be generated annually by the GNEP advanced fuel cycle facility (DOE 2008) would be managed within the current waste management program. In addition, the project could generate up to 928 cubic yards (710 cubic meters) of nondefense transuranic waste annually (DOE 2008), which is not eligible for disposal at WIPP. Transuranic waste without a disposal pathway would be safely stored until a disposal facility became available. The project could also generate 34 cubic yards (26 cubic meters) of high-level radioactive waste annually (DOE 2008). Facilities to safely manage high-level radioactive waste until it could be sent to a geologic repository would have to be provided by the project since no high-level radioactive waste is currently managed at LANL.

Transportation

The total cumulative worker dose from 130 years of radioactive materials shipments (general transportation, historical DOE shipments, and reasonably foreseeable actions as estimated in the *Draft Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, (DOE/EIS-0250F-S1D) (DOE 2007a), as well as shipments associated with the LANL SWEIS alternatives, would be a maximum of 382,400 person-rem, which could result in 229 LCFs. The total cumulative dose to the general public would be a maximum of 343,900 person-rem, which could result in 206 excess LCFs. The total estimated traffic fatalities associated with accidents involving radioactive material and waste transports would be a maximum of 119.

Implementing the Expanded Operation Alternative would result in no more than three additional traffic fatalities and zero worker or public cancer deaths (LCFs); therefore, they would not contribute substantially to cumulative impacts. For perspective, in 2004, there were 522 traffic fatalities in New Mexico, 58 of which occurred in the three counties neighboring LANL (Los Alamos, Rio Arriba, and Santa Fe Counties) (see Chapter 4, Table 4–56).

Daily traffic could increase on county roads by up to 18 percent (averaged across all LANL entrances) due to (1) increased development of both housing and light industry, as a result of the conveyance and transfer of lands; (2) increased truck shipments under the Expanded Operations Alternative; (3) projected increases in the LANL workforce under the Expanded Operations Alternative; and (4) increased employment at the Los Alamos Research Park. Development of land transferred under the *Land Conveyance and Transfer EIS* (DOE/EIS-0293) (DOE 1999d) could increase traffic in the vicinity of the airport and TA-21 based on current Los Alamos County plans to develop light industry, retail, and residential units on these tracts. This action, combined with the increased traffic associated with DD&D activities at TA-21, could cause excessive traffic loads on NM 502.

The major radiological transportation actions involving Category I/II special nuclear material related to the proposal to consolidate activities at LANL would be transportation of pits currently stored at Pantex and highly enriched uranium currently stored at Y-12 to LANL. After these one-time shipments were completed, there would be no annual shipment of pits and highly enriched uranium from these sites. The estimated radiological health impacts of the one-time transportation of pits and highly enriched uranium to LANL would not result in any additional

LCFs in the general public. Non-radiological impacts would be expected to result in zero fatalities as a result of accidents. Workers handling the movement of pits and highly enriched uranium would receive a collective dose of approximately 5,500 person-rem, resulting in an estimated 3.3 LCFs. It should be noted that in accordance with DOE regulations, the maximum annual dose to a radiation worker would be administratively controlled to 2 rem per year; therefore, an individual worker would not be expected to develop a lifetime latent fatal cancer from exposures during these activities.

The major transportation actions involving radioactive materials related to the *GNEP PEIS* advanced fuel cycle facility at LANL would involve the receipt of shipments of spent reactor fuel, shipments of transmutation fuel, shipments of spent fast reactor fuel, and radioactive waste shipments associated with operation of the advanced fuel cycle facility (DOE 2008).

The addition of proposed facilities and an increased number of workers for the consolidated nuclear production center in TA-16 would likely result in increased traffic along NM 4 from White Rock to West Jemez Road and on West Jemez Rd to the center of the site. The consolidation of facilities in TA-16 would somewhat alleviate current concerns related to increased traffic along Pajarito Road under the Expanded Operations Alternative, because there could be a corresponding decrease in traffic along Pajarito Road from NM 4 to TA-55 if the activities at the Plutonium Facilities Complex were relocated to TA-16. Conversely, the GNEP advanced fuel cycle facility is proposed to be built in TA-36 which would lead to increased traffic along Pajarito Road from NM 4 to the center of LANL, if approved.

Environmental Justice

No disproportionately high adverse human and environmental effects to minority or low-income populations would be expected as a result of implementing any of the three alternatives considered in this SWEIS, constructing and operating the *Complex Transformation SPEIS* consolidated nuclear production center or the GNEP advanced fuel cycle facility. Employment at LANL and in the surrounding region would be expected to increase, thus creating additional employment opportunities for local individuals. As additional funding flows into the regional economy, increased opportunities for low-income and minority populations should be realized. Also, the conveyance and transfer of land to the Department of the Interior that has occurred benefits people inhabiting the Pueblo of San Ildefonso. A consultation process is in place to address possible impacts to traditional cultural properties from LANL activities.

3.6.3 Summaries of Potential Consequences from Project-Specific Analyses

Appendices G, H, I, and J of this SWEIS contain evaluations of the environmental impacts of projects proposed for implementation under the Expanded Operations Alternative. They include projects to replace or refurbish existing structures and their related capabilities, DD&D of old structures and remediation of environmental contamination, modifications to site infrastructure, and expansion of site capabilities. This section summarizes the potential consequences of implementing each of the proposed projects.

The sliding-scale approach is used in this SWEIS to evaluate environmental consequences. This approach implements the Council on Environmental Quality instruction to “focus on significant environmental issues" (40 CFR 1502.1) and to discuss impacts "in proportion to their significance" (40 CFR 1502.2[b]). For some of the project-specific analyses it was determined that there would be no or only minor impacts for some resource areas. Consequently, these resource areas are not analyzed in detail. In the following tables, these resource areas are identified as having "no or negligible impacts."

General temporary construction-related impacts would be expected to occur for most of the projects summarized in this section during construction and DD&D activities. After project completion, these impacts would cease and the area would return to normal. These impacts are not discussed in detail in the project summaries:

- Physical disturbances to areas under or in the vicinity of construction and DD&D projects would disrupt land use, affect the visual environment, and disturb the soils and geology, the latter primarily from excavation activities.
- Water resources, primarily surface water quality, could be temporarily affected by runoff and increased sediment loads from construction and DD&D sites. Stormwater Pollution Prevention Plans describing best management practices would be required and would mitigate most of these impacts. A Construction General Permit, a U.S. Army Corps of Engineers Section 404 Dredge and Fill Permit, and a Section 401 New Mexico Water Quality Certification would be obtained, if needed, for projects that may affect surface water.
- Air quality impacts would be increased by emissions of criteria air pollutants, primarily carbon monoxide and nitrogen oxides from vehicles and heavy equipment, as well as particulate matter from soil disturbance.
- Noise levels could rise from the increased number of personal vehicles, trucks hauling materials and waste to and from construction sites, and heavy equipment involved in the activities. Most noise would be localized, but if a project were near a LANL site boundary, offsite populations could be disturbed.
- Loss of habitat from land disturbance and increased noise and light are potentially adverse ecological impacts from construction and DD&D activities. Impacts could be minimized by avoiding working during nesting seasons for sensitive species, using special lighting, protecting areas of concern, and working only during certain times of the day or year.
- Construction workers would be subject to accidents typical of any construction site. Adverse effects could range from relatively minor (such as lung irritation, cuts, or sprains) to major (such as lung damage, broken bones, or fatalities). To prevent serious exposures and injuries, all site construction contractors would be required to submit and adhere to a Construction Safety and Health Plan and undergo site-specific hazard training. Appropriate personal protection measures would be a routine part of construction activities, including use of personal protection equipment such as coveralls, respirators, gloves, hard hats, steel-toed boots, eye shields, and earplugs or covers. Workers also would be protected by other engineered and administrative controls.
- Increased consumption of fuels, water, and electricity would occur during construction and DD&D.

- Implementing the projects addressed in this section may result in impacts to potential release sites covered under the Consent Order. As needed, these potential impacts would be addressed through the accelerated cleanup process described in Section VII.F of the Consent Order.

Summary of Impacts for the Physical Science Research Complex Project

The Physical Science Research Complex would be a complex of four buildings in TA-3 with approximately 350,000 square feet (32,500 square meters) of floor space, approximately 30 percent of which would be laboratory space (primarily laser). This complex would be available to consolidate staff currently located in TA-3 and other LANL locations in newer, more efficient and modern space. A number of structures would be demolished to make room for the Physical Science Research Complex, and a number of buildings vacated by staff moving to the new facility would also undergo DD&D. A building potentially eligible for listing on the National Register of Historic Places could be impacted, as well as the Administration Building which has been determined to be eligible. Proposed activities would require documentation to resolve adverse effects. Only minor impacts would be expected from construction and operation of this facility. There would be some improvement in the overall appearance of areas in which aging buildings and temporary structures would be demolished. **Table 3–20** summarizes the potential impacts of implementing this project.

Table 3–20 Summary of Impacts for the Physical Science Research Complex Project

Resource Area	*Impact Summary*
Land Resources	*Land Use* – No or negligible impact. *Visual Environment* – Demolition of vacated structures would improve the overall appearance of TA-3, TA-35, and TA-53.
Geology and Soils	Temporary construction- and DD&D-related impacts. Approximately 499,000 cubic yards of rock and soil would be disturbed during construction.
Water Resources	No or negligible impact.
Air Quality and Noise	*Air Quality* – Temporary construction- and DD&D-related impacts. Little or no change in emissions from operations. *Noise* – Temporary construction- and DD&D-related impacts.
Ecological Resources	No or negligible impact.
Human Health	Temporary construction-related impacts and accident potential for workers. Potential worker exposure to radiological contamination and asbestos during DD&D. Impacts would be mitigated through safe work practices, procedures, and personal protective equipment. Positive impact on relocated staff from improved working conditions.
Cultural Resources	Possible impact on a building potentially eligible for listing on the National Register of Historic Places and the Administration Building, which has been determined to be eligible. Proposed activities would require documentation to resolve adverse effects.
Socioeconomics and Infrastructure	*Socioeconomics* – No or negligible impact. *Infrastructure* – No more than negligible impact on LANL utility capacity; requirements would be similar to or less than the facilities being replaced.
Waste Management	*Construction* – 1,600 cubic yards of construction debris. *DD&D* – 17,000 cubic yards of low-level radioactive waste; 177,000 cubic yards of solid waste including demolition debris; and 314,000 pounds of chemical waste.
Transportation	Transportation of construction materials and wastes and demolition wastes (some radioactive) would not be expected to result in any fatalities or excess LCFs.
Environmental Justice	No or negligible impact.
Facility Accidents	No or negligible impact.

TA = technical area; DD&D = decontamination, decommissioning, and demolition; LCF = latent cancer fatality.
Note: To convert cubic yards to cubic meters, multiply by 0.76456; pounds to kilograms, multiply by 0.45359.

There would be no major environmental impacts from construction, operation, and DD&D of existing buildings for the Replacement Office Buildings Project. Most construction would be in a developed portion of TA-3; however, a portion of the project area would require use of about 13 acres (5.3 hectares) of currently undeveloped land. Protection of cultural resources and potential accommodation for the Mexican spotted owl during construction could be required. **Table 3–21** summarizes the potential impacts of implementing this project.

Table 3–21 Summary of Impacts for the Replacement Office Buildings Project

Resource Area	*Impact Summary*
Land Resources	*Land Use* – Consistent with future land use plans; about 13 acres of undeveloped land would be disturbed. *Visual Environment* – New buildings and parking lot could be visible from West Jemez Road and Pajarito Road.
Geology and Soils	Temporary construction- and DD&D-related impacts. Approximately 369,000 cubic yards of rock and soil would be disturbed during construction.
Water Resources	Temporary construction- and DD&D-related impacts.
Air Quality and Noise	*Air Quality* – Temporary construction-and DD&D-related impacts. No change in emissions from operations. *Noise* – Temporary construction- and DD&D-related impacts.
Ecological Resources	Temporary construction-related impacts. Loss of 13 acres of habitat. Construction may affect, but is not likely to adversely affect, the Mexican spotted owl and bald eagle.
Human Health	Temporary construction- and DD&D-related impacts and accident potential for workers. Impacts would be mitigated through safe work practices, procedures, and personal protective equipment.
Cultural Resources	Possible impact on a historic trail potentially eligible for listing on the National Register of Historic Places. Proposed activities could require documentation to resolve adverse effects.
Socioeconomics and Infrastructure	*Socioeconomics* – No or negligible impact. *Infrastructure* – No more than negligible impact on LANL utility capacity; requirements would be similar to or less than the facilities being replaced.
Waste Management	*Construction* – 1,700 cubic yards of construction waste. *DD&D* – 31 cubic yards of low-level radioactive waste and 6,900 cubic yards of demolition debris.
Transportation	No or negligible impact.
Environmental Justice	No or negligible impact.
Facility Accidents	No or negligible impact.

TA = technical area; DD&D = decontamination, decommissioning, and demolition.
Note: To convert cubic yards to cubic meters, multiply by 0.76456; acres to hectares, multiply by 0.40469.

Summary of Impacts for the Radiological Sciences Institute Project, Including Phase I – the Institute for Nuclear Nonproliferation Science and Technology

The proposed project would involve the DD&D of 52 obsolete structures scattered over 6 TAs, and the construction of the Radiological Sciences Institute in TA-48, which would include as many as 13 new facilities. Phase I would include construction of five buildings associated with the Institute for Nuclear Nonproliferation Science and Technology. This facility would include Security Category I and II laboratories and vaults, other laboratory space, a secure radiochemistry laboratory, and associated offices and support facilities.

DD&D activities and transportation would result in the largest potential impacts. DD&D activities are expected to generate large quantities of debris, including some radioactively-contaminated debris. With the exception of low-level radioactive waste, most DD&D waste would be transported to appropriate offsite facilities. Transportation impacts would include temporary disruption of traffic on Pajarito Road during construction; increased local traffic during operations; and movement of large amounts of DD&D waste. **Table 3–22** summarizes the potential impacts of implementing this project.

Table 3–22 Summary of Impacts for the Radiological Sciences Institute Project, Including Phase I – the Institute for Nuclear Nonproliferation Science and Technology

Resource Area	***Impact Summary***
Land Resources	*Land Use* – Some currently designated Reserve and Experimental Science areas would be redesignated in the future as Nuclear Materials Research and Development; 12.6 acres of undeveloped land would be disturbed. *Visual Environment* – Minor impact from new development in TA-48 west of existing buildings.
Geology and Soils	Temporary construction-related impacts. Approximately 802,000 cubic yards of rock and soil would be disturbed during construction. Excavation of welded tuff could necessitate blasting. Negligible impacts anticipated from DD&D activities.
Water Resources	Temporary construction-related impacts. DD&D of older contaminated structures could reduce the potential for future surface water and groundwater contamination.
Air Quality and Noise	*Air Quality* – Temporary construction- and DD&D-related nonradiological impacts and potential for release of radionuclides in contaminated soils in the vicinity of the proposed building location. Little or no change in emissions from operations. *Noise* – Temporary construction- and DD&D-related impacts could include blasting.
Ecological Resources	Temporary construction-related impacts. Loss of 12.6 acres of habitat. Construction may affect, but is not likely to adversely affect, the Mexican spotted owl and bald eagle. DD&D activities may affect, but are not likely to adversely affect, the Mexican spotted owl.
Human Health	Temporary construction-related impacts and accident potential for workers. Impacts would be mitigated through safe work practices, procedures, and personal protective equipment. No additional LCFs in general population or to the MEI from radiological doses from facility construction or operation and associated DD&D.
Cultural Resources	Possible impact on two archaeological sites determined to be eligible for the National Register of Historic Places and on potentially eligible historic buildings, including the Radiochemistry Building. Documentation to resolve adverse effects on the archaeological sites would be required before beginning construction of the Radiological Sciences Institute and could be required before demolition of any of the potentially important historic structures.
Socioeconomics and Infrastructure	*Socioeconomics* – No or negligible impact. *Infrastructure* – No more than negligible impact on LANL utility capacity, requirements would be similar to or less than the facilities being replaced.
Waste Management	*Construction* – 2,800 cubic yards of construction debris and associated solid waste. *DD&D* – 1,100 cubic yards of transuranic waste; 96,000 cubic yards of low-level radioactive waste; 1,000 cubic yards of mixed low-level radioactive waste; 77,000 cubic yards of demolition debris; and 988,000 pounds of chemical waste.
Transportation	Transportation of construction materials and wastes, and demolition wastes (some of which would be radioactive) would not be expected to result in any fatalities or excess LCFs.
Environmental Justice	No or negligible impact.
Facility Accidents	Postulated facility accident with the highest impacts would result in an LCF risk of 1 in 12,000 for a noninvolved worker and 1 in 77,000 for the MEI; there would be no excess LCFs expected in the exposed population.

TA = technical area; DD&D = decontamination, decommissioning, and demolition; LCF = latent cancer fatality; MEI = maximally exposed individual.
Note: To convert cubic yards to cubic meters, multiply by 0.76456; pounds to kilograms, multiply by 0.45359; acres to hectares, multiply by 0.40469.

Summary of Impacts for Radioactive Liquid Waste Treatment Facility Upgrade Project

This project has been proposed to improve the operation and reliability of the Radioactive Liquid Waste Treatment Facility in TA-50. Three options have been proposed to upgrade the facility, each involving DD&D of part of the existing facility. Under Option 1, a new building for treating liquid low-level radioactive and transuranic wastes would be constructed west of the existing facility in a parking area, along with a central utilities building. The East Annex would be demolished. Under Option 2, the Radioactive Liquid Waste Treatment Facility treatment capabilities would be housed in two or more separate structures to the west and north of the existing facility (for example, one or more structures for low-level radioactive liquid waste and one or more structures for transuranic liquid waste). The East Annex, the North Annex, and a transformer located on the north side of the existing facility would be demolished to accommodate the new construction. Option 3 is identical to Option 2, except that the existing facility would be renovated for reuse; the most DD&D would be required under this option. An auxiliary action of installing a pipeline and constructing evaporation tanks to treat effluent could occur with any of the options, including the No Action Option (not upgrading the facility).

Potential impacts from each of the action options would be similar. Demolition of the East Annex and the transuranic influent storage tanks would likely produce considerable low-level radioactive waste and some transuranic waste. There is also the potential for releasing radioactive or other hazardous constituents from contaminated soils and contaminated structural materials, but proper procedures would be followed to minimize their release. **Table 3–23** summarizes the potential impacts of implementing this project.

Implementing the auxiliary action to construct evaporation tanks and a pipeline would result in a change in the land use category and the loss of habitat of up to 5.4 acres (2.2 hectares) of currently undeveloped land. Tank construction would cause a break in the forest cover that would be noticeable from areas west of LANL. Use of the evaporation tanks would improve surface water quality by eliminating a discharge that could contribute to movement of existing environmental contamination.

Table 3–23 Summary of Impacts for the Radioactive Liquid Waste Treatment Facility Upgrade Project

Resource Area	*Impact Summary*
Land Resources	*Land Use* – If the option to construct evaporation tanks and pipeline were implemented, the land use designation of up to 5.4 acres of land for the area of the tanks would change from Reserve to Waste Management. *Visual Environment* – The new treatment buildings would not result in a change to the overall visual character of the area within TA-50, but the area proposed for construction of the evaporation tanks is currently undeveloped and wooded, and a break in the forest cover would be noticeable from areas west of LANL.
Geology and Soils	Temporary construction- and DD&D-related impacts. Construction may affect, but is not likely to adversely affect, the Mexican spotted owl and bald eagle. Permanent removal of contaminated soil to accommodate new facilities. Up to 164,000 cubic yards of rock and soil could be disturbed, assuming construction of the evaporation tanks and pipeline.
Water Resources	Potential positive impact on effluent water quality and quantity due to more stringent discharge requirements and improved processing.
Air Quality and Noise	*Air Quality* – Temporary construction-related impacts. Potential for increased radioactive emissions during DD&D. Minimal impact expected from operation. *Noise* – Minor construction equipment and traffic noise impact to workers.
Ecological Resources	Temporary construction- and DD&D-related impact. Loss of up to 5.4 acres of habitat if the evaporation tanks and a pipeline are built. May affect, but is not likely to adversely affect, the Mexican Spotted Owl and bald eagle.
Human Health	Temporary construction-related impacts and accident potential for workers. Potential worker exposure to radiological contamination during DD&D. Impacts would be mitigated through safe work practices, procedures, and personal protective equipment. During operations, worker health and safety would be improved because of improved reliability and design and less maintenance on new systems. RLWTF emissions do not have a distinguishable effect on the projected dose to the public.
Cultural Resources	Possible impact on several historic properties, including the RLWTF, potentially eligible for listing on the National Register of Historic Places. Proposed activities could require documentation or excavation to resolve adverse effects.
Socioeconomics and Infrastructure	*Socioeconomics* – No or negligible impact. *Infrastructure* – Utility requirements are expected to increase but to stay within LANL utility capacity.
Waste Management	*Construction* – Up to 1,150 cubic yards of construction debris. *DD&D* – Up to 230 cubic yards of transuranic waste; 10,300 cubic yards of low-level radioactive waste; 150 cubic yards of mixed low-level radioactive waste; 1,800 cubic yards of demolition debris; and 212,000 pounds of chemical waste.
Transportation	Temporary disruption of local traffic during construction and DD&D. Transportation of construction materials and wastes and demolition wastes (some of which would be radioactive) would not be expected to result in any fatalities or excess LCFs.
Environmental Justice	No or negligible impact.
Facility Accidents	No or negligible impact.

TA = technical area; DD&D = decontamination, decommissioning, and demolition; LCF = latent cancer fatality; RLWTF = Radioactive Liquid Waste Treatment Facility.
Note: To convert cubic yards to cubic meters, multiply by 0.76456; gallons to liters, multiply by 3.7854; pounds to kilograms, multiply by 0.45359; acres to hectares, multiply by 0.40469.

Summary of Impacts for Los Alamos Neutron Science Center Refurbishment Project

The LANSCE Refurbishment Project would include renovations and improvements to the existing facility in TA-53 to increase its reliability and extend its operating life. Impacts from implementation would be minimal. There could be minimal indirect effects on utility usage and air emissions from increased usage of the facilities after the project was complete. **Table 3–24** summarizes the potential impacts of LANSCE Refurbishment Project activities.

Table 3–24 Summary of Impacts for the Los Alamos Neutron Science Center Refurbishment Project

Resource Area	*Impact Summary*
Land Resources	*Land Use* – No or negligible impact. *Visual Environment* – No or negligible impact.
Geology and Soils	No or negligible impact.
Water Resources	Project implementation may result in a small increase in nonradiological cooling water discharge from increased facility usage.
Air Quality and Noise	*Air Quality* – Negligible to minor impacts during refurbishment. Operations may result in increased nonradiological air emissions from increased facility usage. *Noise* – Potential temporary increase in onsite noise levels during refurbishment.
Ecological Resources	No or negligible impact.
Human Health	Temporary construction-related impacts and accident potential for workers. Impacts would be mitigated through safe work practices, procedures, and use of personal protective equipment. Operations impacts may increase as a result of increased accelerator usage. The maximum dose to the MEI as a result of emissions, however, would be limited to 7.5 millirem per year.
Cultural Resources	Possible impact on several historic buildings potentially eligible for listing on the National Register of Historic Places and the LANSCE accelerator building, which has been determined to be eligible. Documentation to resolve adverse effects would be required before making modifications to the accelerator building and could be required before modifications or demolition of any of the other potentially important historic structures.
Socioeconomics and Infrastructure	*Socioeconomics* – No impacts identified. *Infrastructure* – Negligible utility requirements during refurbishment. Project implementation could result in increased utility demands from increased facility usage. Peak load demand could approach current capacity but ongoing improvements to LANL's electric power infrastructure should alleviate this concern.
Waste Management	Small quantities of low-level radioactive waste, mixed low-level radioactive waste, chemical waste, and nonhazardous solid waste would be generated during refurbishment.
Transportation	No or negligible impact.
Environmental Justice	No or negligible impact.
Facility Accidents	No or negligible impact.

MEI = maximally exposed individual; LANSCE = Los Alamos Neutron Science Center.

Summary of Impacts for the Radiography Facility Project

The proposed Radiography Facility would be constructed at TA-55 to eliminate the need for transporting nuclear items to different locations at LANL during the examination process. Minor impacts from construction would be expected. Radiography operations would use engineering and administrative controls to ensure workers would not be exposed to high radiation fields. Implementation of the project would reduce the number of onsite trips for nuclear components, resulting in fewer road closures and improved traffic flow. **Table 3–25** summarizes the potential impacts of the proposed TA-55 Radiography Facility Project.

Table 3–25 Summary of Impacts for the Technical Area 55 Radiography Facility Project

Resource Area	*Impact Summary*
Land Resources	*Land Use* – No or negligible impact. *Visual Environment* – No or negligible impact.
Geology and Soils	Temporary construction-related impacts. Up to 8,000 cubic yards of soil and rock would be disturbed.
Water Resources	No or negligible impact.
Air Quality and Noise	*Air Quality* – Temporary construction-related impacts. *Noise* – Temporary construction-related impacts.
Ecological Resources	No or negligible impact.
Human Health	*Construction* – Temporary construction-related impacts and accident potential for workers. Impacts would be mitigated through safe work practices, procedures, and personal protective equipment. *Operations* – Operations would involve high radiation fields. Worker health would be protected by facility design, radiation control procedures, and personal protective equipment.
Cultural Resources	No or negligible impact.
Socioeconomics and Infrastructure	*Socioeconomics* – No or negligible impact. *Infrastructure* – No more than negligible impact on LANL utility capacity.
Waste Management	*Construction* – Up to 24 cubic yards of solid waste would be generated during construction of the new building.
Transportation	Implementation of project would reduce onsite nuclear material transport.
Environmental Justice	No or negligible impact.
Facility Accidents	Accident impacts are bounded by those analyzed for the TA-55 Plutonium Facility Complex.

TA = technical area.
Note: To convert cubic yards to cubic meters, multiply by 0.76456.

Summary of Impacts for Plutonium Facility Complex Refurbishment Project

The TA-55 Plutonium Facility Complex Refurbishment Project would upgrade the electrical, mechanical, safety, and other selected facility systems to improve overall reliability to ensure continued operations. The project would be implemented in phases as a series of subprojects. All work would be performed inside the existing TA-55 complex. Several subprojects could have positive impacts on the environment, including replacement of the chiller, which would result in fewer emissions of ozone-depleting substances; implementation of the Steam System Subproject, which would reduce emissions of criteria pollutants; several subprojects that would improve the safety basis of the complex; and improvement in stack mixing and emissions monitoring resulting from implementation of the Stack Upgrade and Replacement Subproject. Implementation of the project would result in small amounts of radioactive and chemical waste that would be accommodated by the LANL waste management infrastructure. **Table 3–26** summarizes the potential impacts for the Plutonium Facility Complex Refurbishment Project.

Table 3–26 Summary of Impacts for the Plutonium Facility Complex Refurbishment Project

Resource Area	***Impact Summary***
Land Resources	*Land Use* – Temporary construction-related impacts of previously disturbed areas. *Visual Environment* – No impacts identified.
Geology and Soils	Temporary construction-related impacts.
Water Resources	No impacts identified.
Air Quality and Noise	*Air Quality* – Temporary construction-related impacts. Potential reduction in air emissions from upgrades and installation of new equipment. *Noise* – Temporary construction-related impacts confined to LANL site in and near TA-55, except for a very small potential increase in traffic noise.
Ecological Resources	No or negligible impact.
Human Health	Temporary construction-related impacts and accident potential for workers. Potential worker exposure to radiological contamination during refurbishment activities. Impacts would be mitigated through safe work practices, procedures, and personal protective equipment. No radiological risks to members of the public identified from construction or normal operations.
Cultural Resources	No or negligible impact.
Socioeconomics and Infrastructure	*Socioeconomics* – No impacts identified. *Infrastructure* – No more than negligible impact on LANL utility capacity.
Waste Management	*Construction and DD&D* – 340 cubic yards of transuranic waste; 1,300 cubic yards of low-level radioactive waste; 220 cubic yards of mixed low-level radioactive waste; 2,700 cubic yards of demolition debris; and 2,000 pounds of chemical waste.
Transportation	Transportation of construction materials and wastes and demolition wastes (some of which would be radioactive) would not be expected to result in any fatalities or excess LCFs.
Environmental Justice	No or negligible impact.
Facility Accidents	A number of the higher-priority subprojects involve upgrades that would substantially improve the safety basis of the Plutonium Facility Complex.

TA = technical area; DD&D = decontamination, decommissioning, and demolition; LCF = latent cancer fatality.
Note: To convert cubic yards to cubic meters, multiply by 0.76456; pounds to kilograms, multiply by 0.4536.

Summary of Impacts for the Science Complex Project

The proposed Science Complex, a state-of-the-art multidisciplinary facility used for light laboratory and offices, would consist of two buildings and one supporting parking structure. The Science Complex would be constructed at one of three proposed sites: in TA-62, west of the Research Park area; in the Research Park in the northwest portion TA-3; or in the southeast portion of TA-3.

Construction of the Science Complex at the TA-62 site or the Research Park site would disturb about 5 acres (2 hectares) of undeveloped land. Each of the locations would require some modification of site infrastructure such as extending natural gas pipelines. The Research Park option would likely require rerouting of additional utilities currently located in or near the project area. **Table 3–27** summarizes the potential impacts of Science Complex Project activities.

Table 3–27 Summary of Impacts for the Science Complex Project

Resource Area	Impact Summary		
	Northwest TA-62 Option	***Research Park Option***	***South TA-3 Option***
Land Resources	*Land Use* – 5 acres of undeveloped land would be permanently disturbed; the land use plans for 15.6 acres would be changed. *Visual Environment* – Views from neighboring properties and roadways would be altered by construction of the proposed structures and from night lighting. Forested buffer between LANL and Los Alamos Canyon would be lost.	*Land Use* – Impacts similar to Northwest TA-62 Site. *Visual Environment* – Impacts similar to Northwest TA-62 Site.	*Land Use* – Negligible impacts identified. *Visual Environment* – No impacts identified.
Geology and Soils	Temporary construction-related impacts. Approximately 840,000 cubic yards of soil and rock would be disturbed.		
Water Resources	Temporary construction-related impacts.		
Air Quality and Noise	*Air Quality* – Temporary construction-related impacts. *Noise* – Temporary construction-related impacts. Minor increased noise levels from operation.		
Ecological Resources	Temporary construction-related impacts; loss of up to 5 acres of habitat. Under the TA-62 option, construction may affect, but is not likely to adversely affect, the Mexican spotted owl and bald eagle.		
Human Health	Temporary construction-related impacts and accident potential for workers. Impacts would be mitigated through safe work practices, procedures, and personal protective equipment.		
Cultural Resources	Possible impact on two archaeological sites determined to be eligible for the National Register of Historic Places. Proposed activities would require documentation to resolve adverse effects.	No impacts identified.	No impacts identified.
Socioeconomics and Infrastructure	*Socioeconomics* – No or negligible impact. *Infrastructure* – Addition of a natural gas line and tie-in to sanitary sewage system would be required. No more than negligible impact on LANL utility capacity.	*Socioeconomics* – No or negligible impact. *Infrastructure* – Would likely require rerouting of many utilities currently located on the site and extension of a sewer trunk line.	*Socioeconomics* – No or negligible impact. *Infrastructure* – Addition of a natural gas line and tie-in to sanitary sewage system would be required.
Waste Management	*Construction* – Approximately 3,300 cubic yards of construction debris would be generated.		
Transportation	Once complete, impacts would include an estimated 5,790 vehicle trips on the average weekday (2,895 vehicles entering and exiting in a 24-hour period).	Impacts similar to Northwest TA-62 Site.	Impacts would be greater than those for the Northwest TA-62 site due to the site location within the planned Security Perimeter Road and higher traffic flows on Diamond Drive relative to those on West Jemez Road. Construction traffic impacts would also be greater due to travel on Diamond Drive.
Environmental Justice	No or negligible impact.		
Facility Accidents	Risk of an LCF for a Science Complex occupant from a CMR Building accident: 1 chance in 560,000 per year.	Risk of an LCF for a Science Complex occupant from a CMR Building accident: 1 chance in 240,000 per year.	Risk of an LCF for a Science Complex occupant from a CMR Building accident: 1 chance in 60,000 per year.

TA = technical area; LCF = latent cancer fatality; CMR = Chemistry and Metallurgy Research.
Note: To convert cubic yards to cubic meters, multiply by 0.76456; acres to hectares, multiply by 0.40469.

Summary of Impacts for Remote Warehouse and Truck Inspection Station Project

The Remote Warehouse and Truck Inspection Station Project would relocate shipment receiving, warehousing, and distribution functions from TA-3 to a site in TA-72. In addition, the Truck Inspection Station would be relocated from its current location on the northwest corner of NM 4 and East Jemez Road to the new location. Impacts resulting from this project would be minor, although the proposed facilities would be constructed in a relatively undeveloped area with desirable aesthetic qualities. Some screening of the proposed facilities would be possible using selective tree cutting and strategic placement of the facilities, but the view would be permanently altered to one that is typical of a more developed area. Nearby sensitive archaeological sites and National Historic Landmarks would be protected from construction and operation activities and increased visitation by installing fencing around the perimeter of the Remote Warehouse and Truck Inspection Station. **Table 3–28** summarizes the potential impacts for this project.

Table 3–28 Summary of Impacts for the Remote Warehouse and Truck Inspection Station Project

Resource Area	***Impact Summary***
Land Resources	*Land Use* –Land use designation would change from Reserve to Physical/Technical Support; 4 acres of undeveloped land would be disturbed. *Visual Environmental* – Views would change from primarily natural landscape to include developed area. Lighting could be visible from Tsankawi Unit of Bandelier National Monument.
Geology and Soils	Temporary construction-related impacts. Approximately 90,000 cubic yards of soil and rock would be disturbed during construction.
Water Resources	Temporary construction-related impacts.
Air Quality and Noise	*Air Quality* – Temporary construction-related impacts. *Noise* – Temporary construction-related impacts. Possible noticeable noise along East Jemez Road during operations.
Ecological Resources	Temporary construction-related impacts; loss of 4 acres of habitat. Construction may affect, but is not likely to adversely affect, the bald eagle.
Human Health	Temporary construction-related impacts and accident potential for workers. Impacts would be mitigated through safe work practices, procedures, and personal protective equipment.
Cultural Resources	Possible impact on three nearby archaeological sites potentially eligible for listing on the National Register of Historic Places and two National Historic Landmarks. Proposed activities could require documentation to resolve adverse effects. Fencing around perimeter of project site would aid in protecting these sensitive sites.
Socioeconomics and Infrastructure	*Socioeconomics* – No or negligible impact. *Infrastructure* – Addition of a natural gas line and means of sanitary sewage treatment, conveyance, or disposal would be required. No more than negligible impact on LANL utility capacity.
Waste Management	Approximately 610 cubic yards of construction debris would be generated.
Transportation	Changes to geometry of East Jemez Road. Potential reduction of traffic in and around TA-3.
Environmental Justice	No or negligible impact.
Facility Accidents	No or negligible impact.

TA = technical area.
Note: To convert cubic yards to cubic meters, multiply by 0.76456; acres to hectares, multiply by 0.40469.

Summary of Impacts for TA-18 Closure Project, Including Remaining Operations Relocation, and Structure Decontamination, Decommissioning, and Demolition

This proposed project would relocate the Security Category III and IV capabilities and materials remaining in TA-18, and would conduct DD&D of the buildings and structures at TA-18. The removal of buildings and structures at TA-18 (Pajarito Site) would provide positive local visual impacts, as would the eventual return of the area to its natural state, which would blend with other undisturbed portions of LANL. Buildings of historic importance and other cultural sites are located in TA-18. These cultural resources would be protected during DD&D activities as required. **Table 3–29** summarizes the potential impacts of these activities.

Table 3–29 Summary of Impacts for the Technical Area 18 Closure Project, Including Remaining Operations Relocation and Structure Decontamination, Decommissioning, and Demolition

Resource Area	*Impact Summary*
Land Resources	*Land Use* – DD&D could result in an overall change in the land use designation from Nuclear Materials Research and Development to Reserve. *Visual Environmental* – Potentially positive impact from removal of old buildings.
Geology and Soils	Temporary DD&D-related impacts.
Water Resources	DD&D would remove facilities from a floodplain, thereby enhancing protection of surface water quality.
Air Quality and Noise	*Air Quality* – Temporary DD&D-related impacts. *Noise* – Temporary DD&D-related impacts.
Ecological Resources	Temporary DD&D-related impacts. DD&D activities may affect, but are not likely to adversely affect, the Mexican spotted owl and southwestern willow flycatcher. Restoration of the site could create a more natural habitat and benefit wildlife.
Human Health	The primary source of potential impacts on workers and members of the public would be associated with the release of radiological contaminants during DD&D. Potential impacts would be much less than during past operations and would be mitigated using confinement and filtration methods.
Cultural Resources	Three archaeological resources sites found at TA-18 (a rock shelter, a cavate complex, and the Ashley Pond cabin) have been determined to be eligible for listing on the National Register of Historic Places, and there are other eligible and potentially eligible buildings within the TA. Proposed activities would require documentation to resolve adverse effects, and these buildings would be protected during DD&D activities as required. Several historic properties at TA-18 have been identified for permanent retention, including the Pond Cabin, the Slotin Accident Building (TA-18-1), and other properties that represent the history of the TA and LANL.
Socioeconomics and Infrastructure	*Socioeconomics* – No or negligible impact. *Infrastructure* – No or negligible impact.
Waste Management	Waste generated from the disposition of the buildings and structures is estimated to be 4,700 cubic yards of low-level radioactive waste; 5 cubic yards of mixed low-level radioactive waste; 17,000 cubic yards of demolition debris; and 75,000 pounds of chemical waste.
Transportation	Transportation of wastes would not be expected to result in any fatalities or excess LCFs.
Environmental Justice	No or negligible impact.
Facility Accidents	No or negligible impact.

TA = technical area; DD&D = decontamination, decommissioning, and demolition; LCF = latent cancer fatality.
Note: To convert cubic yards to cubic meters, multiply by 0.76456; pounds to kilograms, multiply by 0.45359.

Summary of Impacts for the TA-21 Structure Decontamination, Decommissioning, and Demolition Project

All or a portion of the buildings and structures at TA-21 would undergo DD&D under this project. Two options are proposed: the Complete DD&D Option would remove essentially all structures within TA-21; the Compliance Support Option would remove only those structures necessary to support remediation activities.

Onsite and offsite visual impacts would be improved by removal of some or all of the buildings and structures at TA-21. DD&D activities would affect buildings and structures potentially eligible for listing on the National Register of Historic Places, so documentation to resolve adverse effects could be required. Implementation of this project at the same time that TA-21 MDA remediation is underway would result in local traffic impacts along DP Road and in the Los Alamos townsite. **Table 3–30** summarizes the potential impacts of these activities.

Table 3–30 Summary of Impacts for Technical Area 21 Structure Decontamination, Decommissioning, and Demolition Project

Resource Area	***Impact Summary***	
	Complete DD&D Option	***Compliance Support Option***
Land Resources	*Land Use* – The remainder of the western portion of the area would be available for conveyance to Los Alamos County. The eastern part of the TA would remain a part of LANL for the foreseeable future. *Visual Resources* – Temporary DD&D-related impacts. Long-term impacts would be positive with the removal of old industrial buildings.	*Land Use* – Currently unconveyed portions of TA-21 would remain under DOE control. Land use designations would remain unchanged. *Visual Environment* – Temporary construction- and DD&D-related impacts. Over the long-term, the view of the TA from NM 502 and from higher elevations to the west would still include portions of the current mix of 50-year-old structures.
Geology and Soils	Temporary DD&D-related impacts.	Temporary DD&D-related impacts.
Water Resources	Improvement in overall water resources from discontinuing processes and associated water use and eliminating two outfalls.	Little or no impact on water resources.
Air Quality and Noise	*Air Quality* – Temporary DD&D impacts. Operational emissions would be relocated or cease. *Noise* – Temporary DD&D-related impacts.	*Air Quality* – Nonradioactive air pollutant emissions from the three natural gas-fired boilers in Building 21-0357 and the vehicle exhaust and emissions from activities in the maintenance facilities would remain. *Noise* – Temporary DD&D-related impacts.
Ecological Resources	Temporary DD&D-related impacts. Activities may affect, but are not likely to adversely affect, the Mexican spotted owl.	
Human Health	East Gate MEI would receive 2×10^{-4} millirem over the life of the project.	
Cultural Resources	DD&D of buildings and structures at TA-21 would have direct effects on 15 NRHP-eligible historic buildings and structures (and 1 potentially eligible building) associated with the Manhattan Project and Cold War years at LANL.	
Socioeconomics and Infrastructure	*Socioeconomics* – Temporary modest increase in employment due to DD&D activities. *Infrastructure* – No or negligible impact.	
Waste Management	DD&D would generate 1 cubic yard of transuranic waste; 34,000 cubic yards of low-level radioactive waste, 65 cubic yards of mixed low-level radioactive waste; 47,000 cubic yards of solid waste; and 420,000 pounds of chemical waste.	The volume of solid waste and debris generated under this Option would be about 29,000 cubic yards less than that under the Complete DD&D Option.
Transportation	Transportation of construction materials and wastes and demolition wastes (some radioactive) would not be expected to result in any fatalities or excess LCFs. Local traffic impacts associated with DD&D activities would be exacerbated by MDA remediation occurring at the same time.	
Environmental Justice	No or negligible impact.	
Facility Accidents	No or negligible impact.	

TA = technical area; DD&D = decontamination, decommissioning, and demolition; MEI = maximally exposed individual; NRHP = National Register for Historic Places; LCF = latent cancer fatality; MDA = material disposal area.
Note: To convert cubic yards to cubic meters, multiply by 0.76456; pounds to kilograms, multiply by 0.45359.

Summary of Impacts for Waste Management Facilities Transition Project

This project involves DD&D of certain aboveground facilities in TA-54, Areas G and L, to facilitate closure of those areas; construction of additional waste management facilities; removal of waste stored underground in pits and shafts in Area G; and preparation and shipment of this waste for disposal. New waste management facilities would include a retrieval facility to assist in removal of high-activity remote-handled transuranic waste from certain shafts, new low-level radioactive waste facilities in TA-54, and a new TRU Waste Facility in the Pajarito Road Corridor to store and process transuranic waste.

The waste storage domes in Area G would be removed as part of this project, which would have a beneficial impact on both near and distant views. Because these domes are visible from the lands of the Pueblo of San Ildefonso, their removal would improve the views from that vantage point. Construction at TA-54 may affect, but is not likely to adversely affect, the southwestern willow flycatcher. Construction of the TRU Waste Facility, which could require up to 7 acres (2.8 hectares), could occur within Mexican spotted owl Areas of Environment Interest which would require consultation with the U.S. Fish and Wildlife Service. (The location of the TRU Waste Facility has not been finalized, so land resource, ecological, and cultural resource impacts could vary.) Eventual removal of stored wastes in Area G would reduce the dose to the facility-specific MEI. Worker doses could also decrease after 2015, once waste management activities in Area G are completed. **Table 3–31** summarizes the potential impacts of these activities.

Summary of Impacts for Major Material Disposal Area Remediation, Canyon Cleanups, and Other Consent Order Actions[7]

The environmental impacts that could result from implementation of the Consent Order depend on decisions yet to be made by the New Mexico Environment Department. To bound the range of possible consequences of implementing different corrective measures, two action options have been evaluated: (1) a Capping Option, in which specific MDAs are stabilized in-place, and (2) a Removal Option, in which the waste and contamination within the MDAs are removed. These options are for analytical purposes only and do not necessarily represent the corrective measures that NNSA would propose to the New Mexico Environment Department. Remediation of other potential release sites would also occur at LANL. The impacts of remediating other potential release sites would be small relative to those for MDA remediation.

The Removal Option would result in larger near-term impacts than the Capping Option. Both options would involve major ground-disturbing activities that would require use of heavy equipment and hauling of materials and wastes. Temporary construction impacts such as increases in noise levels and emissions of criteria pollutants and particulate matter would be expected. Because these activities would be widespread and would continue over a number of years, MDA remediation activities would have a larger impact than other proposed projects. Under the Removal Option, large quantities of wastes would be generated including low-level radioactive waste and transuranic waste buried at LANL before 1970. Onsite disposal capacity

Table 3–31 Summary of Impacts for the Waste Management Facilities Transition Project

Resource Area	Impact Summary
Land Resources	*Land Use* – Temporary construction-related impacts. The TRU Waste Facility could require up to 7 acres (2.8 hectares) of undeveloped land and could result in a change in land use designation, depending on its location. *Visual Environment* – Positive impact due to removal of the domes in TA-54. The TRU Waste Facility could be visible from San Ildefonso Pueblo lands, depending on its location.
Geology and Soils	Temporary construction- and DD&D-related impacts would occur in previously disturbed areas; impacts would be minor. Up to 169,000 cubic yards of soil and rock would be disturbed.
Water Resources	Minor impacts to surface water and groundwater. New facilities would use mitigative techniques to minimize impacts of spills.
Air Quality and Noise	*Air Quality* – Temporary construction impacts. Operational emissions would be mitigated using engineering controls, such as filtration systems, and monitored. Emissions from new facilities would not exceed those currently measured at the Decontamination and Volume Reduction System. Point source and area emissions in Area G would decrease by the end of 2015. *Noise* – Temporary construction-related impacts.
Ecological Resources	Temporary construction-related impacts at TA-54 may affect, but is not likely to adversely affect, the southwestern willow flycatcher. Construction of the TRU Waste Facility could disturb up to 7 acres (2.8 hectares) of ponderosa pine forest and open field. Consultation with the U.S. Fish and Wildlife Service could be required since construction could take place within Mexican spotted owl Areas of Environmental Interest.
Human Health	Minimal radiological impacts to offsite population. Reduced impacts to the MEI. Removal of transuranic waste would reduce area sources of occupational radiological exposure in Area G, potentially decreasing worker exposures after 2015.
Cultural Resources	Removal of the domes at TA-54 would reduce visual impacts on nearby traditional cultural properties. Potential impact to cultural resources could occur from construction of the TRU Waste Facility, depending on its location.
Socioeconomics and Infrastructure	*Socioeconomics* – No or negligible impact. *Infrastructure* – Infrastructure demands would not exceed current LANL site capabilities.
Waste Management	Construction waste would include 500 cubic yards of construction debris. DD&D waste would include 30,000 cubic yards of low-level radioactive waste; 8 cubic yards of mixed low-level radioactive waste; 54,000 cubic yards of solid waste including demolition debris; and 566,000 pounds of chemical waste.
Transportation	Transportation of construction materials and wastes and demolition wastes (some radioactive) would not be expected to result in any fatalities or excess LCFs.
Environmental Justice	No or negligible impact.
Facility Accidents	The postulated facility accident having the highest impacts would result in an LCF risk of 1 in 900 for a noninvolved worker, 1 in 12,000 for the MEI, and 1 in 500 to the exposed population.

TA = technical area; DD&D = decontamination, decommissioning, and demolition; MEI = maximally exposed individual; LCF = latent cancer fatality.
Note: To convert cubic yards to cubic meters, multiply by 0.76456, pounds to kilograms, multiply by 0.45359.

for low-level radioactive wastes may be sufficient, depending on the actual volumes generated by remediation; disposal capacity can be supplemented by offsite facilities if needed. WIPP's disposal capacity is expected to be sufficient for disposal of all retrievably stored waste and all newly generated transuranic waste from the DOE complex over the next few decades, but not sufficient for this waste plus all transuranic waste buried before 1970 across the DOE complex (63 FR 3624). Decisions about disposal of transuranic waste from full removal of LANL MDAs, if generated, would be based on the needs of the entire DOE complex. Any transuranic waste

[7] NNSA is including impacts associated with Consent Order implementation in the SWEIS in order to more fully analyze the impacts resulting from Consent Order compliance. NNSA intends to implement actions necessary to comply with the Consent Order regardless of decisions it makes on other actions analyzed in the SWEIS.

generated at LANL without a disposal pathway would be safely stored until disposal capacity becomes available.

The Removal Option would result in over 100,000 shipments of radioactive and nonradioactive wastes that could require transport to offsite disposal facilities. These shipments could lead to two to three traffic fatalities over a 10-year period from nonradiological (truck collision) accidents. In addition, both the Capping or Removal Option would require the use of large quantities of soil, rock, and other bulk materials that would be obtained from LANL or local sources including the borrow pit in TA-61. Transporting this material to the MDAs could increase traffic congestion on LANL and local roads. Acquisition of large quantities of material from the TA-61 borrow pit could result in local visual impacts and some elimination of wildlife habitat.

Operational accidents postulated for the Removal Option could result in radiological or chemical exposures and risks to noninvolved workers, the MEI, and the population within a 50-mile (80-kilometer) radius. Although sulfur dioxide is not known to be present in MDA B, an accident was postulated in which a quantity of the gas would be released. This postulated accident could result in concentrations of sulfur dioxide in excess of the Emergency Response Planning Guideline (ERPG)-3 out to 111 feet (34 meters) (DOE 2005e). The MDA B MEI distance is 148 feet (45 meters). The ERPG-2 distance would be approximately 270 feet (80 meters). **Table 3–32** summarizes the potential impacts of the options for remediation, cleanup, and Consent Order actions.

Table 3–32 Summary of Impacts for Major Material Disposal Area Remediation, Canyon Cleanups, and Other Consent Order Actions

Resource Area	*Capping Option*	*Removal Option*
Land Resources	*Land Use* – Temporary commitment of land may be required to support remediation. Future use of the MDAs would remain restricted because capping would stabilize rather than remove existing contamination. *Visual Environment* – Temporary adverse impacts would result from capping activities. Borrow pit in TA-61 would become more visible.	*Land Use* – Temporary commitment of land may be required to support remediation. Decontamination would provide expanded opportunities for future use of some lands. *Visual Environment* – Temporary adverse impacts would result from removal activities. Borrow pit in TA-61 would become more visible.
Geology and Soils	Up to 2.5 million cubic yards of soil and rock would be required for capping; most material would be available from LANL sources. Covers for the MDAs would be contoured and provided with run-on and run-off control measures. Contamination within the subsurface of the MDAs and in the immediate vicinities would be fixed in-place except for contaminated gases or vapors.	Up to 2.2 million cubic yards of soil and rock would be required for fill and cover material; most would be available from LANL sources. Complete removal of the MDAs would eliminate the susceptibility of buried materials to erosional or other geological processes. Existing soil contamination in the vicinity of the MDAs would be greatly reduced, and contaminated soil or gas would be largely eliminated.
Water Resources	Few, if any impacts to surface water or groundwater from site investigations. Final MDA covers would minimize surface water run-on, runoff, erosion, and could protect surface and groundwater resources.	Few, if any, impacts to surface or groundwater from site investigations. There would be much less contamination in soils and sediments that could present a risk to water quality.

Resource Area	***Capping Option***	***Removal Option***
Air Quality and Noise	*Air Quality* – Minor to moderate impacts from releases of airborne pollutants caused by heavy equipment used in remediation and trucks hauling materials. Increased potential for particulate matter release from TA-61 borrow pit. *Noise* – Minor to moderate increase in traffic noise associated with remediation.	*Air Quality* – Larger releases of airborne pollutants than Capping Option from additional vehicles and heavy equipment. Comparable particulate matter release. The potential for long-term release of volatile organic compounds from the MDAs would be greatly reduced, if not eliminated. *Noise* – Temporary increase in noise in vicinity of remediation. Minor to moderate increase in traffic noise associated with remediation.
Ecological Resources	Temporary localized, construction-type impacts during site investigations and remediation. In a few cases, remediation activities may affect, but are not likely to adversely affect, the Mexican spotted owl, bald eagle, and southwestern willow flycatcher. Possible loss of habitat at the TA-61 borrow pit, including undeveloped buffer and core habitat for the Mexican spotted owl. Expansion of the borrow pit would require consultation with the U.S. Fish and Wildlife Service.	
Human Health	Radiological and nonradiological risks to workers would be minor. There would be no risk to the public during MDA capping, while future risks would be reduced.	Radiological and nonradiological risks to workers would be increased. There would be small risk to the public during MDA removal, while future risks would be greatly reduced.
Cultural Resources	No archaeological resources are located within any of the MDAs. Few or no risks to cultural resources at potential release sites. All work would be coordinated with LANL personnel responsible for preservation of cultural resources.	
Socioeconomics and Infrastructure	*Socioeconomics* – Marginal increases in employment, personal income, and other economic measures. *Infrastructure* – Marginal increases in utility usage.	*Socioeconomics* –Increases anticipated in employment, personal income, and other economic measures. *Infrastructure* – Increases in utility infrastructure demands.
Waste Management	280 cubic yards of transuranic waste; 20,000 cubic yards of low-level radioactive waste; 1,800 cubic yards of mixed low-level radioactive waste; 47,000 cubic yards of solid waste; and 50 million pounds of chemical waste. Sufficient capacity would exist at LANL to dispose of the low-level radioactive waste.	22,000 cubic yards of transuranic waste; 1,000,000 cubic yards of low-level radioactive waste; 180,000 cubic yards of mixed low-level radioactive waste; 130,000 cubic yards of solid waste; and 97 million pounds of chemical waste. This volume of low-level radioactive waste may require use of some offsite disposal capacity.
Transportation	Increase in shipments of waste and bulk materials on onsite and offsite roads would not be expected to result in any LCFs among workers or the public from radiation exposure during waste transport, nor traffic fatalities from accidents.	Large increase in shipments of waste and bulk materials on onsite and offsite roads would not be expected to result in any LCFs among workers or the public from radiation exposure during waste transport, but could result in traffic fatalities.
Environmental Justice	No disproportionately high and adverse impacts on minority or low-income populations.	
Facility Accidents	Low risks of accidents involving radioactive or hazardous materials.	Postulated facility accident with the highest radiological impacts would result in an LCF risk of 1 in 210 for a noninvolved worker; 1 in 1,500 for the MEI; and 1 in 220 for the population within a 50-mile radius. Postulated facility accident with the highest chemical impacts would result in concentrations of sulfur dioxide exceeding ERPG-3 out to 111 feet; ERPG-2 out to 270 feet.

MDA = material disposal area; TA = technical area; LCF = latent cancer fatality; MEI = maximally exposed individual.
ERPG = Emergency Response Planning Guideline.
Note: To convert cubic yards to cubic meters, multiply by 0.76456; feet to meters, multiply by 0.3048; miles to kilometers, multiply by 1.6093; pounds to kilograms, multiply by 0.45359.

Summary of Impacts for Security-Driven Transportation Modifications Project

This proposed project would restrict privately owned vehicles (according to their security level) along portions of Pajarito Corridor West between TA-48 and TA-63. The project would involve constructing new roadways, parking lots, pedestrian and vehicle bridges across Ten Site Canyon, and security check points. Auxiliary actions are also being considered that would construct bridges across Mortandad and Sandia Canyons. **Table 3–33** summarizes the potential impacts of these activities.

Table 3–33 Summary of Impacts for the Security-Driven Transportation Modifications Project

Resource Area	*Impact Summary*	
	Proposed Action	***Auxiliary Actions***
Land Resources	*Land Use* – Development of portions of the Pajarito Corridor West would be within current land use plans. *Visual Environment* – Temporary construction impacts. Permanent, pronounced changes to views from parking lots and pedestrian and vehicle bridges across Ten Site Canyon.	*Land Use* – The route for Auxiliary Action A would represent a change in land use but would be within the scope of the LANL Comprehensive Site Plan. The route for Auxiliary Action B would be partially within current land use plans. *Visual Environment* – Permanent, pronounced changes to views from proposed bridges over Mortandad and Sandia Canyons.
Geology and Soils	Temporary construction-related impacts. Approximately 238,000 cubic yards of soil and rock would be disturbed during construction. Up to 26,000 cubic yards of soil and rock would be disturbed if both auxiliary actions are implemented.	
Water Resources	Temporary construction-related impacts.	
Air Quality and Noise	*Air Quality* – Temporary construction-related impacts. Minor increase in vehicle emissions during operation. *Noise* – Temporary construction-related impacts. Minor increase in traffic noise in vicinity of new roads and bus routes during operation.	*Air Quality* – Temporary construction-related impacts. Minor increase in vehicle emissions during operation. *Noise* – Temporary construction-related impacts. Minor increase in traffic noise in vicinity of new roads and bus routes during operation.
Ecological Resources	Temporary construction-related impacts. Up to 30 acres of habitat loss from parking lot and bridge construction. Construction of a span bridge across Ten Site Canyon would be unlikely to cause adverse affects to the Mexican spotted owl.	Temporary construction-related impacts. Proposed Auxiliary Action A construction falls within Areas of Environmental Interest core and buffer zones for the Mexican spotted owl, and would disturb up to 25.4 acres of habitat. Proposed Auxiliary Action B construction falls within Areas of Environmental Interest buffer zone for the Mexican spotted owl, and would disturb 67.1 acres of habitat. Potentially adverse impacts on owls from traffic noise and light. Implementation of either Auxiliary Action would necessitate consultation with the U.S. Fish and Wildlife Service.
Human Health	No or negligible impact.	
Cultural Resources	Proposed bridges could adversely affect views of Ten Site Canyon from nearby Traditional Cultural Properties.	Further detailed analysis would be required once the exact bridge locations are determined to ensure protection of prehistoric and historic sites located to the east and west of the proposed bridge corridor. Proposed bridges could adversely affect views of Mortandad and Sandia Canyons from nearby Traditional Cultural Properties.
Socioeconomics and Infrastructure	*Socioeconomics* – No impacts identified. *Infrastructure* – Temporary construction-related impacts. Some existing utilities might require relocation or rerouting.	
Waste Management	Approximately 1,260 cubic yards of construction debris.	Approximately 160 cubic yards under Auxiliary Action A, and 110 cubic yards under Auxiliary Action B, of construction debris.
Transportation	Some temporary and intermittent disruption of traffic during construction of new roads and bridges. Traffic patterns would be permanently altered, but impacts would be minor.	
Environmental Justice	No or negligible impact.	

Note: To convert cubic yards to cubic meters, multiply by 0.76456; acres to hectares, multiply by 0.40469.

The most consequential impacts from implementing this project would be on the visual environment and the Mexican spotted owl. The removal of open and forested land under the Proposed Action would add to the overall developed appearance of the Pajarito Corridor West as viewed from nearby and higher elevations to the west. The construction of both vehicle and pedestrian bridges across Ten Site Canyon under the Proposed Action, and Mortandad and Sandia Canyons under the auxiliary actions, would be major changes to the landscape. While careful site selection and bridge design would help mitigate visual impacts, the bridges would nevertheless alter the natural appearance of the canyons as viewed from both nearby and distant locations. The proposed bridges could adversely affect views of the three canyons from nearby traditional cultural properties. Bridges constructed across Mortandad and Sandia Canyons would pass through Areas of Environmental Interest for the Mexican spotted owl. Habitat would be lost as a result of the proposed and auxiliary actions, and the light and noise from traffic could create adverse effects. The U.S. Fish and Wildlife Service has determined that, provided reasonable and prudent measures are taken, construction of a span bridge over Ten Site Canyon would be unlikely to cause adverse affects to the Mexican spotted owl. Additional consultation with the U.S. Fish and Wildlife Service would be needed for the proposed action if a land rather than span bridge was to be used, and for the auxiliary actions once the exact locations and designs of the optional bridges over Mortandad and Sandia Canyons are better known.

Summary of Impacts for Nicholas C. Metropolis Center for Modeling and Simulation Increase in Level of Operations

This project would expand the computing capabilities of the Metropolis Center to support a 100-teraflops capability at a minimum, and could approach 1,000 teraflops (1 petaflops). This action would add mechanical and electrical equipment, including chillers, cooling towers, and air-conditioning units. **Table 3–34** summarizes the potential impacts of these activities.

The level to which operations could increase would be limited by the amount of electricity (15 megawatts) and water (51 million gallons [193 million liters] per year) needed to support the increased capabilities. Because each new generation of computing capability machinery continues to be designed with increased computational speed and enhanced efficiency in cooling water and electrical requirements, it is anticipated that higher computing capabilities could be achieved within these limitations. Planned improvements to the Sanitary Effluent Recycling Facility should increase its effectiveness in supplying the Metropolis Center with cooling water. Accordingly, the Metropolis Center's reliance on groundwater is expected to diminish substantially.

Table 3–34 Summary of Impacts for Nicholas C. Metropolis Center for Modeling and Simulation Increase in Level of Operations

Resource Area	*Impact Summary*
Land Resources	*Land Use* – No or negligible impact. *Visual Environment* – No or negligible impact.
Geology and Soils	No or negligible impact.
Water Resources	Discussed in infrastructure.
Air Quality and Noise	No or negligible impact.
Ecological Resources	No or negligible impact.
Human Health	No or negligible impact.
Cultural Resources	No or negligible impact.
Socioeconomics and Infrastructure	*Socioeconomics* – No or negligible impact. *Infrastructure* – Water usage would expand to 51 million gallons per year, which would not exceed available water supply capacities. Electrical demand would increase to 15 megawatts, which would not exceed available electrical supply capacities.
Waste Management	No or negligible impact.
Transportation	No or negligible impact
Environmental Justice	No or negligible impact.
Facility Accidents	No or negligible impact.

Note: To convert gallons to liters, multiply by 3.7854.

Summary of Impacts for Increase in Type and Quantity of Sealed Sources Managed at LANL by the Off-Site Source Recovery Project

This proposed project would expand the types and quantities of sealed sources that could be managed at LANL by the Off-Site Source Recovery Project. The proposed project would continue the current approach of providing safe storage of sealed sources at LANL when other reasonable options for disposition, such as reuse or commercial disposal, are not available. The only impacts resulting from these activities would result from exposure to the radioactive sources during normal operations and postulated accidents. Under normal conditions, the sealed sources would be completely contained and would contribute only to external radiation exposure. Proper shielding and radiation control procedures would minimize worker exposure. Noninvolved workers and the public would not be expected to receive any measurable dose during normal operations.

For purposes of analysis, potential bounding accident scenarios were assessed for an aircraft crash with fire at Area G at TA-54, as well as a seismic event with fire at Wing 9 of the Chemistry and Metallurgy Research Building. Consequences of the Wing 9 event also were calculated for a release emanating from TA-48 because the Radiological Sciences Institute that would be built in TA-48 would provide a replacement for the Chemistry and Metallurgy Research Building Wing 9 hot cell. None of these accidents would result in a fatal dose to the noninvolved worker, the MEI, or the population within a 50-mile (80-kilometer) radius. The highest LCF risk to the population would result from an accident at Wing 9 of the Chemistry and Metallurgy Research Building with consequences calculated at TA-3. This postulated accident could result in an increase in LCF risk of approximately 1 chance in 6 million for the noninvolved worker, 1 chance in 70 million for the MEI, and 1 chance in 600 for the population within a 50-mile (80-kilometer) radius.

Potential mitigation measures could include placing sealed sources at locations where they would not be susceptible to damage from an aircraft crash, fire, or seismic event (kept underground); or instituting lower limits for maximum allowable source radioisotope activity in shipping containers, the TA-54 dome, and Wing 9 of the Chemistry and Metallurgy Research Building. **Table 3–35** summarizes the potential impacts from increasing the scope of the Off-Site Source Recovery Project at LANL.

Table 3–35 Summary of Impacts for Increase in Type and Quantity of Sealed Sources Managed at Los Alamos National Laboratory by the Off-Site Source Recovery Project

Resource Area	***Impact Summary***
Land Resources	*Land Use* – No or negligible impact. *Visual Environment* – No or negligible impact.
Geology and Soils	No or negligible impact.
Water Resources	No or negligible impact.
Air Quality and Noise	*Air Quality* – No or negligible impact. *Noise* – Temporary construction-related impacts from construction and burial activities.
Ecological Resources	No or negligible impact.
Human Health	Involved worker doses would be maintained below their regulatory and administrative limits through use of shielding, safe work practices, procedures, and personal protective equipment. Noninvolved workers and the public would not be expected to receive any measurable doses during normal operations.
Cultural Resources	No or negligible impact.
Socioeconomics and Infrastructure	*Socioeconomics* – No or negligible impact. *Infrastructure* – No impacts identified.
Waste Management	No impacts identified.
Transportation	No or negligible impact.
Environmental Justice	No or negligible impact.
Facility Accidents	Postulated accidents could result in an increase in LCF risk to the noninvolved worker, the MEI, and population within 50-mile radius. Highest LCF risk to population would be from a CMR Building Wing 9 accident.

LCF = latent cancer fatality; MEI = maximally exposed individual; CMR = Chemistry and Metallurgy Research.
Note: To convert miles to kilometers, multiply by 1.6093.

CHAPTER 4
AFFECTED ENVIRONMENT

4.0 AFFECTED ENVIRONMENT

This chapter describes the environmental setting and existing conditions associated with Los Alamos National Laboratory (LANL) and the U.S. Department of Energy's (DOE) operations at the site. This chapter also provides baseline descriptions for use in evaluating the environmental impacts of the reasonable alternatives identified in Chapter 3. Since existing conditions at the site were described in detail in the *Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico (1999 SWEIS)* (DOE 1999a), information presented in that document is incorporated here by reference. The present chapter summarizes each resource area for context, based on the *1999 SWEIS*, but emphasizes the differences that have occurred in the environmental setting since its publication. Resource areas addressed include land resources, geology and soils, water resources, air quality and noise, ecological resources, human health, cultural resources, socioeconomics and infrastructure, waste management and pollution prevention, transportation, environmental justice, and environmental restoration.

LANL is located in north-central New Mexico, 60 miles (97 kilometers) north-northeast of Albuquerque, 25 miles (40 kilometers) northwest of Santa Fe, and 20 miles (32 kilometers) southwest of Española in Los Alamos and Santa Fe Counties (see **Figure 4–1**). LANL and the surrounding region are characterized by forested areas with mountains, canyons, and valleys, as well as diverse cultures and ecosystems. The area is dominated by the Jemez Mountains to the west and the Sangre de Cristo Mountains to the east. These two mountain ranges are divided north to south by the Rio Grande. LANL is located on the Pajarito Plateau, which is cut by 13 steeply sloped and deeply eroded canyons that have formed isolated finger-like mesas running west to east. Most structures at LANL are located on these mesas (DOE 1999a).

DOE evaluated the environmental impacts within defined regions of influence for each resource area. The regions of influence are specific to the type of effect evaluated, and encompass geographic areas within which any significant impact would be expected to occur. For example, human health risks to the general public from exposure to airborne contaminant emissions were assessed for an area within an 80-kilometer (50-mile) radius of the proposed facilities. Economic effects were evaluated within a socioeconomic region of influence that include the county in which the site is located and nearby counties in which substantial portions of the site's workforce reside. Brief descriptions of the regions of influence are given in **Table 4–1**.

This chapter presents information about the LANL environment to serve as a baseline against which impacts can be compared. Depending on the resource area being discussed, data are presented in different ways. For resource areas with annually quantifiable metrics (such as effluent discharges or radiological doses) data for a number of years are shown, generally for the years since the issuance of the *1999 SWEIS* through 2005. For other resource areas (such as land use, noise, ecology, and cultural resources), the data are current as of the end of 2005 unless otherwise noted.

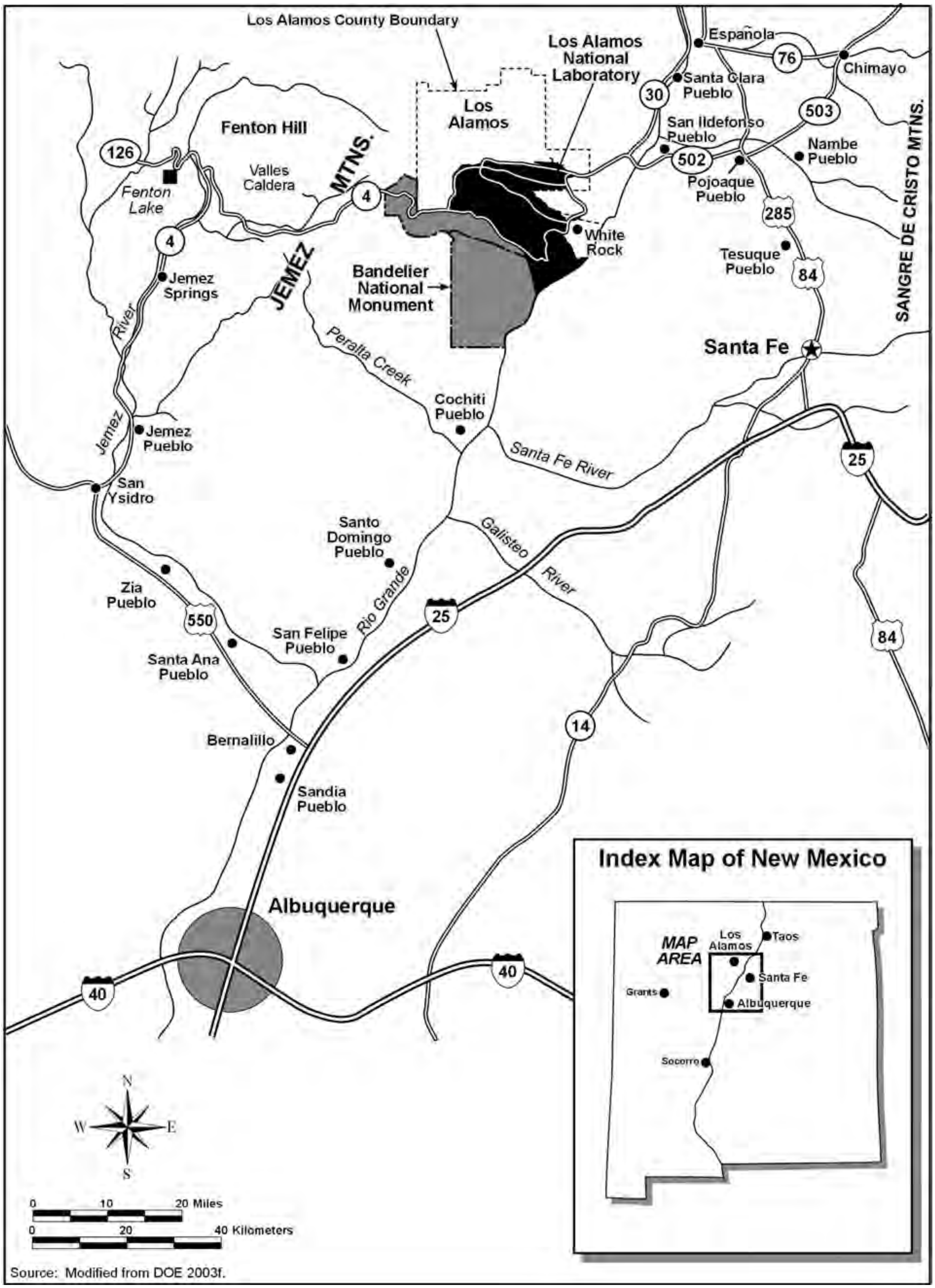


Figure 4–1 Location of Los Alamos National Laboratory

Table 4–1 General Regions of Influence for the Affected Environment

Environmental Resources	*Region of Influence*
Land Resources	The site and the areas immediately adjacent to the site
Geology and Soils	Geologic and soil resources within the site and nearby offsite areas
Water Resources	Surface water bodies and groundwater located onsite, on adjacent properties, and extending to northern New Mexico and southern Colorado
Air Quality and Noise	The site, nearby offsite areas within local air quality control regions, where significant air quality impacts may occur (air quality); the site, nearby offsite areas and access routes to the site (noise)
Ecological Resources	The site and adjacent areas
Human Health	The site and offsite areas within 50 miles of the site where worker and general population radiation, and hazardous chemical exposures may occur
Cultural Resources	The area within the site and adjacent to the site boundary
Socioeconomics and Infrastructure	The counties where approximately 90 percent of site employees reside (socioeconomics); the site (infrastructure)
Waste Management and Pollution Prevention	The site
Transportation	Local area and transportation corridors to offsite locations
Environmental Justice	The minority and low-income populations within 50 miles of the site
Environmental Restoration	The site

Note: To convert miles to kilometers, multiply by 1.6093.

4.1 Land Resources

Land resources include land use and visual resources. Land use is defined as the way land is developed and used in terms of the kinds of anthropogenic activities that occur (such as agriculture, residential areas, industrial areas) (EPA 2006a). Natural resource attributes and other environmental characteristics could make a site more suitable for some land uses than for others. Changes in land use may have both beneficial and adverse effects on other resources such as geological, atmospheric, ecological, and cultural resources. Visual resources are natural and manmade features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape (BLM 1986).

4.1.1 Land Use

Land use in the LANL region is linked to the economy of northern New Mexico, which depends heavily on tourism, recreation, agriculture, and Federal and state government employment for its economic base. Area communities generally are small and primarily support urban uses including residential, commercial, light industrial, and recreational facilities. The region also includes Native American communities; lands of the Pueblo of San Ildefonso share LANL's eastern border, and six other Pueblos are clustered nearby. Entities that serve as land stewards and determine land uses within the LANL region are depicted in **Figure 4–2**. These include DOE, the U.S. Forest Service, Native American pueblos, the U.S. National Park Service, the County of Los Alamos, private land-owners, the State of New Mexico, and the Bureau of Land Management.

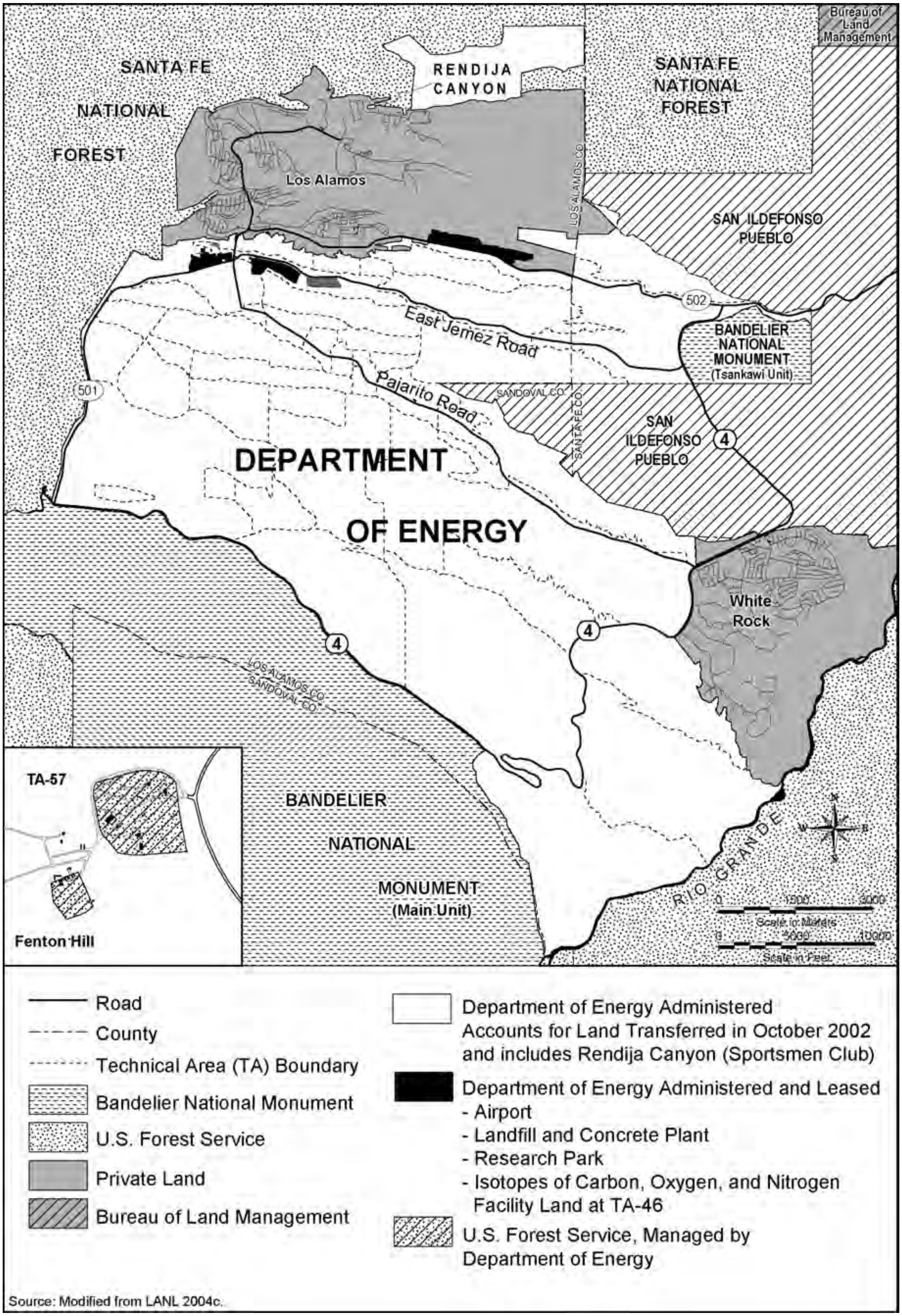


Figure 4–2 Land Management and Ownership

LANL is divided into 48 technical areas (TAs) (not including TA-0, which comprises leased space within the Los Alamos townsite) covering 25,600 acres (10,360 hectares) with locations and spacing that reflect the site's historical development patterns, regional topography, and functional relationships (see **Figure 4–3**). In 1943, development of LANL began with the construction of a little more than 93,000 gross square feet (8,640 gross square meters) of space. At the end of 2005, LANL had approximately 8,600,000 gross square feet (800,000 gross square meters) of space. While the number of structures changes with time (due to frequent addition or removal of temporary structures and miscellaneous buildings), the current breakdown of structures is 952 permanent structures; 373 temporary structures (such as trailers, transportables, and transportainers); and 897 miscellaneous structures (such as sheds and utility structures) (LANL 2006a).

Only about 2,400,000 gross square feet (223,000 gross square meters) of space in 409 buildings are designed to house personnel in an office environment. In addition to onsite office space, 450,000 gross square feet (42,000 gross square meters) of space are leased within the Los Alamos townsite and White Rock community to provide workspace for an additional 1,683 people (LANL 2006a).

Overall, 43 percent of the structures at LANL (not including leased or rented space) are more than 40 years old, and 52 percent are more than 30 years old. A recent condition assessment survey determined the conditions of the facilities are: 23 percent in excellent condition; 17 percent in good; 11 percent in adequate; 17 percent in fair; 18 percent in poor; and 11 percent in failing condition. Condition assessment requirements cover a wide range of criteria and standards (such as safety, severity, and seismic) (LANL 2006a). This represents an improvement in both building age and condition since the *1999 SWEIS* was published.

Although developed areas play a vital role at LANL, they make up only a small part of the site. Most of the site is undeveloped to provide security, safety, and expansion possibilities for future mission-support requirements. There are no agricultural activities present on the LANL site, nor are there any prime farmlands in the vicinity. In 1977, DOE designated LANL as a National Environmental Research Park; in 1999, the White Rock Canyon Reserve was dedicated. The Reserve is about 1,000 acres (405 hectares) in size and is located on the southeast perimeter of LANL. It is managed jointly by DOE and the National Park Service for its significant ecological and cultural resources and research potential (DOE 2003d).

LANL is separated into the following internal land use categories: service and support, experimental science, high explosives research and development, high explosives testing, nuclear materials research and development, physical and technical support, public and corporate interface, reserve, theoretical and computational science, and waste management (see **Figure 4–4**) (LANL 2003h). Previously, a hazard-based system based on the most hazardous activity in each TA was used to characterize land use. Six land use categories were delineated under this system (DOE 1999a).

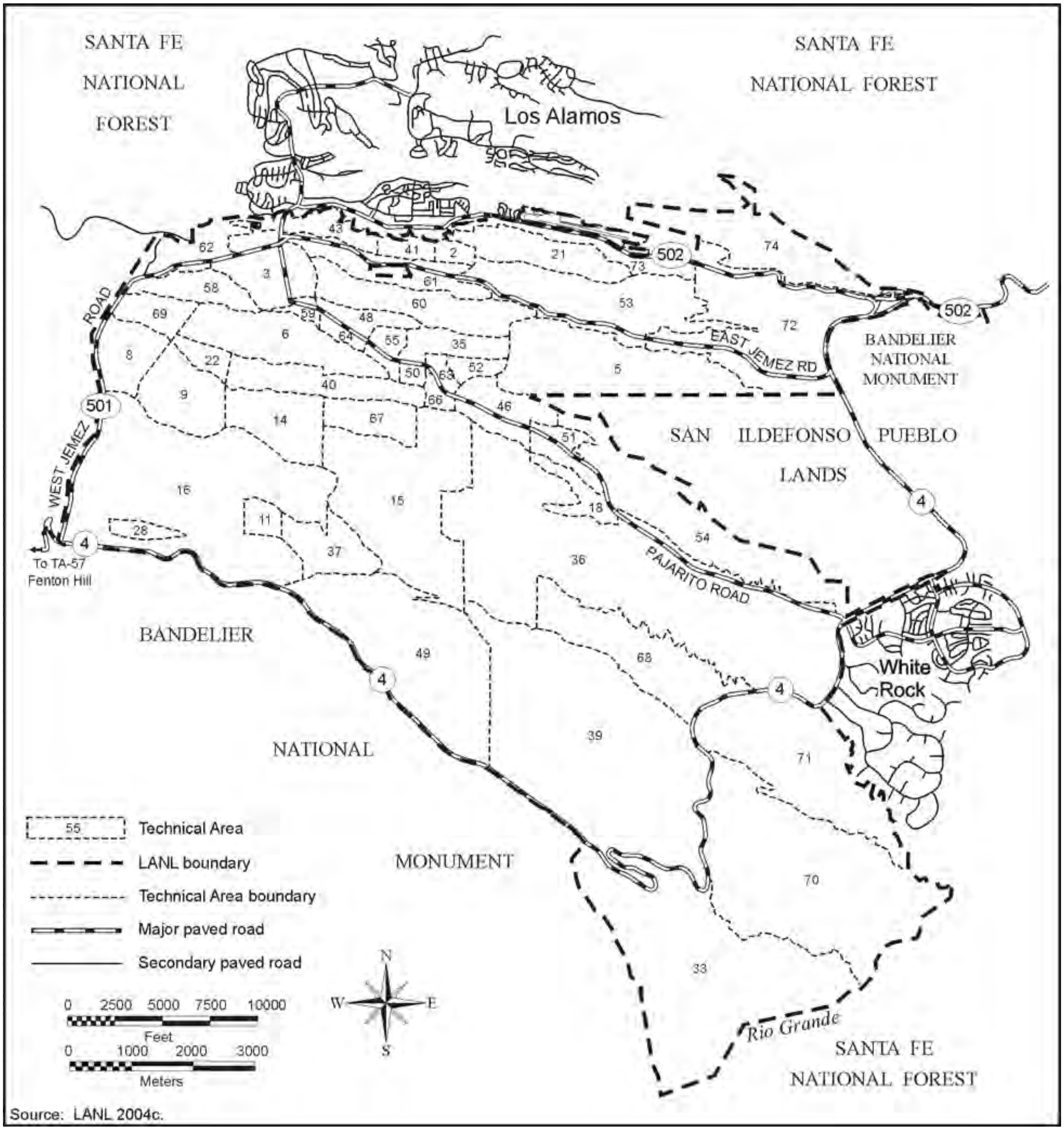


Figure 4–3 Technical Areas of Los Alamos National Laboratory

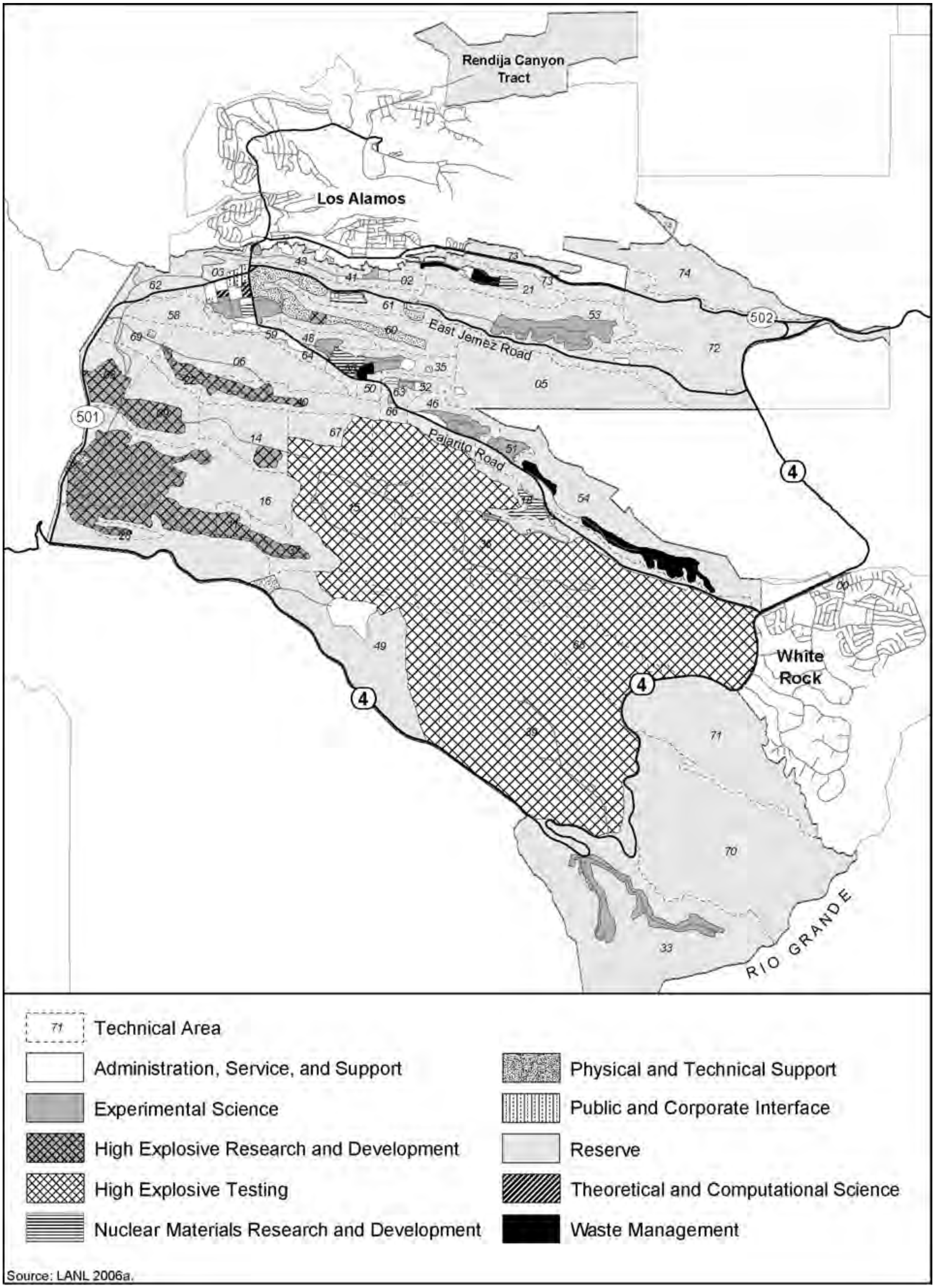


Figure 4–4 Los Alamos National Laboratory Site-Wide Land Use

The 10 land use categories noted above describe the activities at LANL and are defined below.

- *Administration, Service, and Support*—Administrative functions, nonprogrammatic technical expertise, support, and services for LANL management and employees.
- *Experimental Science*—Applied research and development activities tied to major programs.
- *High Explosives Research and Development*—Research and development of new explosive materials. This land is isolated for security and safety.
- *High Explosives Testing*—Large, isolated, exclusive-use areas required to maintain safety and environmental compliance during testing of newly developed explosive materials and new uses for existing materials. This land also includes exclusion and buffer areas.
- *Nuclear Materials Research and Development*—Isolated, secured areas for conducting research and development involving nuclear materials. This land use includes security and radiation hazard buffer zones. It does not include waste disposal sites.
- *Physical and Technical Support*—Includes roads, parking lots, and associated maintenance facilities; infrastructure such as communications and utilities; facility maintenance shops; and maintenance equipment storage. This land use generally is free from chemical, radiological, or explosives hazards.
- *Public and Corporate Interface*—Provides link with the general public and other outside entities conducting business at LANL, including technology transfer activities.
- *Reserve*—Areas that are not otherwise included in one of the previous categories. It may include environmental core and buffer areas, vacant land, and proposed land transfer areas.
- *Theoretical and Computational Science*—Interdisciplinary activities involving mathematical and computational research and related support activities.
- *Waste Management*—Provides for activities related to the handling, treatment, and disposal of all generated waste products, including solid, liquid, and hazardous materials (chemical, radiological, and explosive).

The U.S. Forest Service is responsible for the Santa Fe National Forest, which encompasses 1,567,181 acres (634,708 hectares) in the Sangre de Cristo Mountains to the east and Jemez Mountains to the west of LANL. The Santa Fe National Forest is managed for multiple-use activities such as logging, cattle grazing, hiking, fishing, hunting, camping, and skiing. The Dome Wilderness Area is located within the National Forest near Bandelier National Monument and provides habitat for a number of federally protected and state protected species (DOE 1999a).

The lands of the Pueblo of San Ildefonso are located immediately east of LANL (see Figure 4–2). Being neighbors of LANL, the Pueblo has a continuing interest in the site and its impact on Pueblo lands (see text box). The Pueblo owns or has use of 30,242 acres (12,239 hectares) of land, including approximately 2,106 acres (852 hectares) recently transferred from DOE (as described later in this subsection). Pueblo land use is a mixture of residential, gardening and farming, cattle grazing, hunting, fishing, food and medicinal plant gathering, and firewood production, along with general cultural and resource preservation. Most of the inhabitants of San Ildefonso live along New Mexico 30 (NM 30) in Santa Fe County, about 2.75 miles (4.43 kilometers) northeast of the LANL boundary. The Pueblo of San Ildefonso has not adopted a formal land use plan (DOE 1999a).

Pueblo of San Ildefonso Monitoring

The Pueblo of San Ildefonso, through various grants and in cooperation with DOE and the LANL operating contractor, conducts a program of environmental monitoring and assessment of associated risks. Under this program, the Pueblo environmental staff obtains environmental samples and monitors Pueblo of San Ildefonso lands. Environmental sampling and monitoring activities are conducted for air, water (both groundwater and surface water), sediment, biota, and radiation exposure. In addition, the Pueblo environmental staff tracks sampling sites on Pueblo of San Ildefonso lands that are used by Federal and state agencies, assists with maintaining these sites and collecting samples, and incorporates the sampling results from these external groups into their database. Monitoring activities are reported to DOE on a quarterly basis.

The National Park Service is responsible for Bandelier National Monument, which was established in 1916 and consists of two units: the Main Unit (32,937 acres [13,329 hectares]) located immediately south of LANL, and the Tsankawi Unit (790 acres [320 hectares]) located to the northeast of LANL. Only a small portion of the Main Unit has been developed for visitors; in fact, about 70 percent of this unit has been designated a Wilderness Area. The Tsankawi Unit is undeveloped. The number of visitors to the Monument peaked at 410,143 in 1997, but visitation declined to about 292,000 in 2002 (LANL 2006a).

Also located in the Los Alamos area is the Valles Caldera National Preserve, which was created in 2001 when the Federal Government purchased the 89,000-acre (36,017-hectare) Baca Ranch. It is located inside a volcanic caldera in the Jemez Mountain 20 miles (32.2 kilometers) west of Los Alamos. Studded with eruptive domes and featuring Redondo Peak (11,254 feet [3,430 meters]), this old ranch property is now being developed to explore a new way of managing public lands (Valles Caldera Trust 2005).

In 2004, Los Alamos County completed a preliminary draft of the *Los Alamos County Comprehensive Plan* (LAC 2004a). This action was part of the process to update its 1987 Plan (previously addressed in the *1999 SWEIS*). The county consists of approximately 69,860 acres (28,272 hectares), most of which is owned by the Federal Government. Only about 8,753 acres (3,542 hectares), including land that was conveyed from DOE (as described later in the subsection), are under county jurisdiction; much of this land is located within the Los Alamos townsite and White Rock. Among the nine land use types designated in the Plan, "Federal" applies to land owned by the Federal Government, primarily the U.S. Forest Service and DOE. Although the county government has no jurisdiction over these lands, it continues to seek the cooperation of each Federal entity to achieve the goals set forth in the *Los Alamos County Comprehensive Plan*. When Federal land changes ownership, the new owner is required to submit a proposed amendment to the general plan and an application for a zoning change before the land can be developed (LAC 2004a). In 1999, Los Alamos County leased 41.5 acres (16.8 hectares) of TA-3 from LANL for development of a research park; to date, about 5 acres (2 hectares) has been developed (LANL 2003h, 2006a).

On the evening of May 4, 2000, employees of the National Park Service ignited a prescribed burn in a forested area approximately 3.5 miles (2.2 kilometers) west of LANL. The area of the burn was within the boundaries of Bandelier National Monument along a mountain slope of the Cerro Grande (DOE 2000f). The next day, the fire was declared a wildfire. By the time it was fully contained on June 8, the fire had consumed approximately 43,000 acres (17,400 hectares), including about 7,700 acres (3,110 hectares) of LANL land (Balice, Bennett, and Wright 2004) (see **Figure 4–5**). Direct effects of the fire on LANL land use included impacts on numerous site structures. Of the 332 structures affected by the fire, 236 were impacted, 68 were damaged, and 28 were destroyed (ruined beyond economic repair). Fire mitigation work such as flood retention facilities affected about 50 acres (20.2 hectares) of undeveloped land (LANL 2003h). Following the fire, the Cerro Grande Rehabilitation Project was created to facilitate and implement post-fire remediation activities. A *Wildfire Hazard Reduction Project Plan* (LANL 2001b) was developed to identify and prioritize projects and to provide guidelines for project implementation. This Plan called for treatment, including thinning of existing stands, of up to 10,000 acres (4,047 hectares) to reduce wildfire hazard. Between 2001 and 2005, 9,150 acres (3,703 hectares) were treated. In addition, 800 acres (324 hectares) were thinned between 1997 and 1999 (LANL 2006g).

As a result of the passage of Public Law 105-119, Section 632, 10 tracts (consisting of a number of subtracts) comprising 4,078.4 acres (1,650.5 hectares) have been designated for conveyance from DOE to the Incorporated County of Los Alamos or the New Mexico Department of Transportation, as well as for transfer to the Department of the Interior to be held in trust for the Pueblo of San Ildefonso. The change in ownership was to be completed in 2007. However, as part of the fiscal year 2007 Defense Authorization Act, DOE has been given an additional 5 years to complete the conveyance and transfer process. To date, 2,258.87 acres (914.14 hectares) have been turned over, including all tracts to the Department of the Interior for the Pueblo of San Ildefonso (LANL 2006l, 2006a). This turnover reduced the size of LANL to about 25,600 acres (10,360 hectares).

Table 4–2 provides the acreage of each subtract, its status, and the designated recipient. **Figure 4–6** shows the location of the 10 tracts to be turned over. As noted above, under the draft *Los Alamos County Comprehensive Plan* (LAC 2004a), conveyed land falling under county jurisdiction would require a general plan amendment and zoning change before development would be permitted. Some of the lands proposed for transfer are in Santa Fe County and would require a similar planning process to establish land uses.

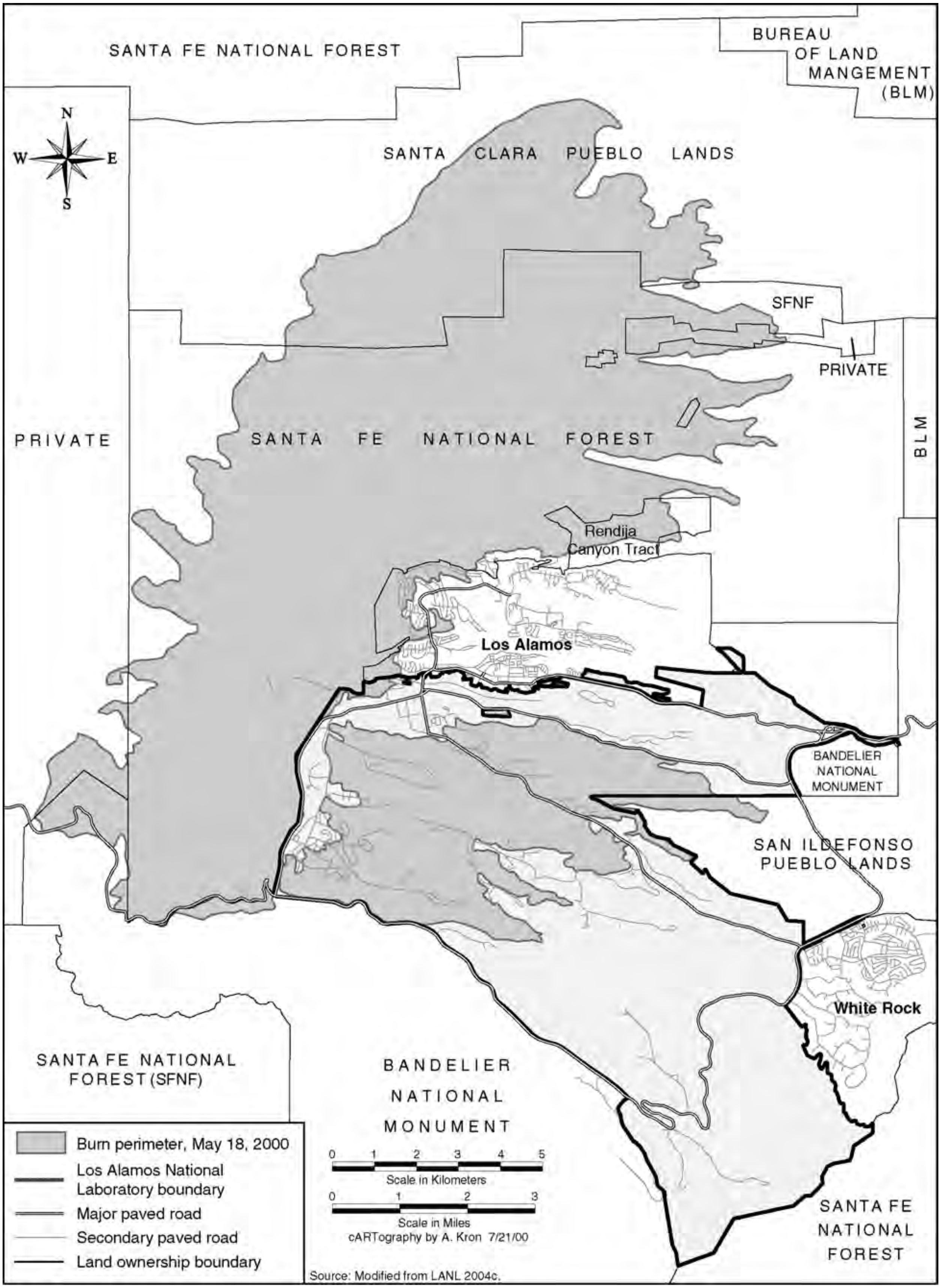


Figure 4–5 Cerro Grande Fire, Total Area Burned

Table 4–2 Lands Conveyed to Los Alamos County and Transferred to the Department of Interior to be Held in Trust for the Pueblo of San Ildefonso

Tract/Subtract				
Description	***Designator***	***Size (acres)***	***Status***	***Recipient***
Manhattan Monument	A-1	0.04	Conveyed	Los Alamos County
Site 22	A-2	0.17	Conveyed	Los Alamos County
Airport				
Airport-1 (East)	A-3	9.43	Conveyed	Los Alamos County
Airport-2 (North)	A-4	91.35	To be conveyed	Los Alamos County
Airport-3 (South)	A-5			
Unit 1	A-5-1	34.64	Conveyed	Los Alamos County
Unit 2	A-5-2	52.87	To be conveyed	Los Alamos County
Airport-4 (West)	A-6	4.18	Conveyed	Los Alamos County
Airport-5 (Central)	A-7	5.83	Conveyed	Los Alamos County
DP Road				
DP Road-1 (South)	A-8	25.01	To be conveyed	Los Alamos County
DP Road-2 (North)	A-9	4.25	Conveyed	Los Alamos County
DP Road-3 (East)	A-10	13.01	To be conveyed	Los Alamos County
DP Road-4 (West)	A-11	3.09	To be conveyed	Los Alamos County
Los Alamos Area Office				
Los Alamos Area Office-1 (East)	A-12	4.51	Conveyed	Los Alamos County
Los Alamos Area Office-2 (West)	A-13	8.81	To be conveyed	Los Alamos County
Rendija (A-14)	A-14	888.06	To be conveyed	Los Alamos County
Technical Area 21				
TA-21-1 (West)	A-15			
Unit 1	A-15-1	7.54	Conveyed	Los Alamos County
Unit 2	A-15-2	1.18	To be conveyed	Los Alamos County
Technical Area 74				
TA-74-1 (West)	A-17	5.52	Conveyed	Los Alamos County
TA-74-2 (South)	A-18	567.62	To be conveyed	Los Alamos County
TA-74-3 (North)	B-2	2,088.19	Transferred	Pueblo of San Ildefonso
TA-74-4 (Middle; Little Otowi)	B-3	3.36	Transferred	Pueblo of San Ildefonso
White Rock				
White Rock	C-1	15.39	To be conveyed	New Mexico Department of Transportation
White Rock-1	A-19	76.28	Conveyed	Los Alamos County
White Rock-2	B-1	14.93	Transferred	Pueblo of San Ildefonso
White Rock "Y"				
White Rock "Y"-1	C-2	104.0	To be conveyed	New Mexico Department of Transportation
White Rock "Y"-3	C-3	30.90	To be conveyed	New Mexico Department of Transportation
White Rock "Y"-4	C-4	18.24	To be conveyed	New Mexico Department of Transportation

Note: To convert acres to hectares, multiply by 0.40469.
Source: LANL 2006l.

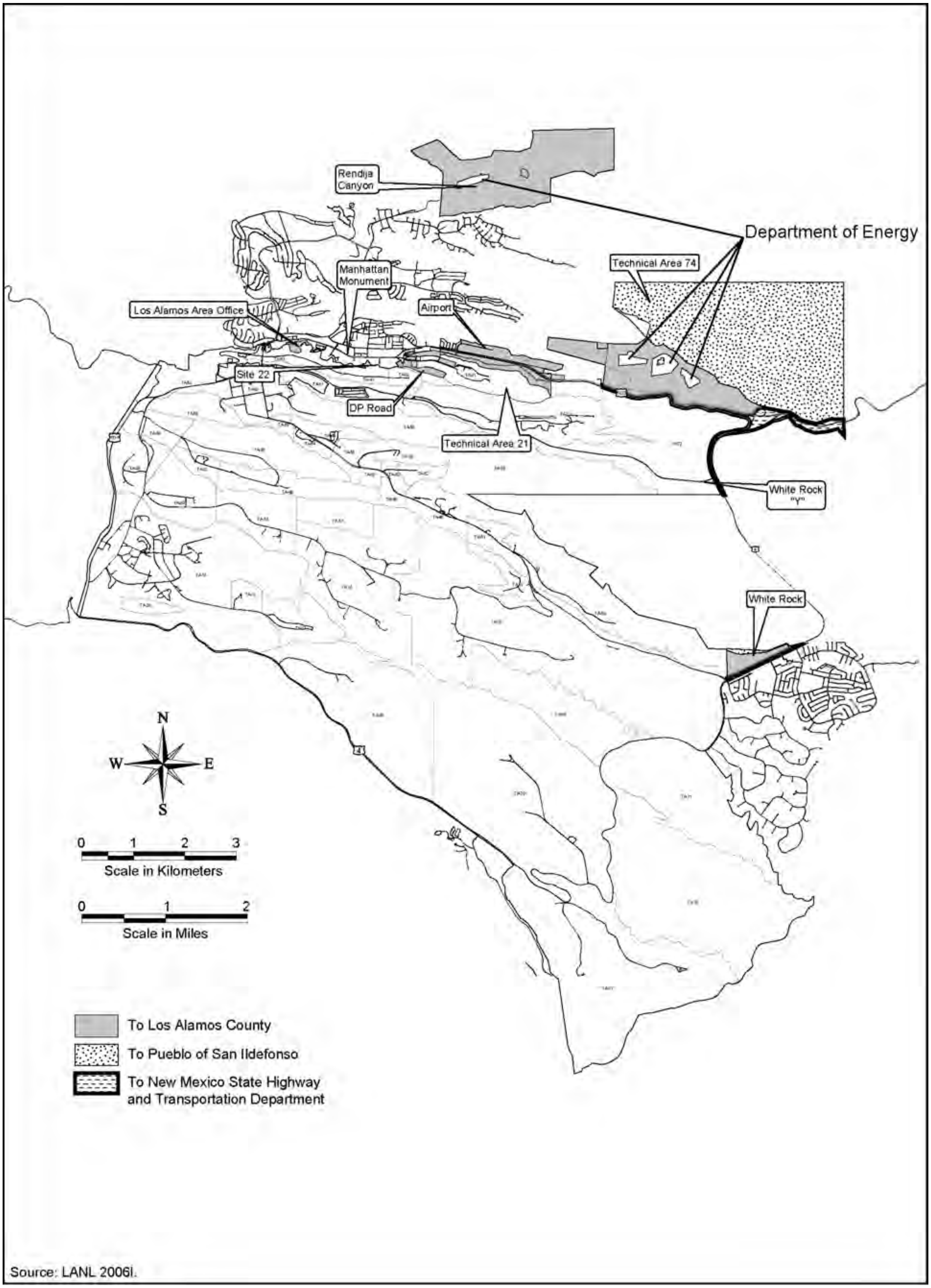


Figure 4–6 Overview of Land Conveyance and Transfer

4.1.2 Visual Environment

The natural setting of the Los Alamos area is panoramic and scenic. The mountain landscape, unusual geology, varied plant communities, burned over areas, and archaeological heritage of the area create a diverse visual environment. The topography of northern New Mexico is rugged, especially in the vicinity of LANL. Mesa tops are cut by deep canyons, creating sharp angles in the land form. In some cases, slopes are nearly vertical. Often, little vegetation grows on these steep slopes, exposing the geology, with contrasting horizontal strata varying from bright reddish orange to almost white in color.

A variety of vegetation occurs in the region, the density and height of which may change over time and can affect the visibility of an area within the LANL viewshed. Generally, portions of LANL located along mesa tops at lower elevations toward the eastern site boundary are covered with grasslands, mixed shrubs, or short trees, with sparsely distributed taller trees, allowing greater visibility from within the viewshed. In contrast, portions of LANL located at upper elevations toward the western boundary are more densely covered by tall mixed conifer forests that reduce the visibility of these areas (DOE 1999a).

The most obvious modern alteration of the natural landscape is development. Many buildings at LANL were built as temporary structures and present an austere, utilitarian appearance. Viewed from a distance at lower elevations, LANL is primarily distinguishable among the trees in the daytime by views of its water storage towers, emission stacks, the white-colored domes at TA-54, and occasional glimpses of older buildings. The new National Security Sciences Building is eight stories in height and is highly visible. The Los Alamos townsite appears mostly residential in character. The water storage towers are visible against the forested backdrop of the Jemez Mountains. At elevations above LANL, along the upper reaches of the Pajarito Plateau rim, the view of LANL is primarily of scattered buildings among heavily forested areas and the multi-storied buildings within TA-3. Similarly, the residential character of the Los Alamos townsite is predominately visible from higher elevation viewpoints (DOE 1999a, LANL 2004c).

At night, the lights of LANL, the Los Alamos townsite, and White Rock are directly visible from various locations across the viewshed as far away as the towns of Española and Santa Fe. Because there is little nighttime activity at LANL, there are relatively few security light sources compared to the nearby communities; thus, at a distance, the distinction between LANL and the two communities is lost to the casual observer (DOE 1999a).

To decrease the impact of development, new structures generally have been designed and built in a more unified and modern style. Further, recent construction has been sensitive to the effects of taller, more visible structures on the visual environment. For example, radio towers and the Emergency Operations Center water tower, have been painted to blend with the background (LANL 2003h, DOE 2001).

Bandelier National Monument is an important area from which LANL may be viewed. Separate units of the Monument border LANL to the south (Main Unit) and northeast (Tsankawi Unit) (see Figure 4–2). Views from the Main Unit along NM 4 are of a generally natural landscape, although there are instances where LANL structures are visible. These include miscellaneous buildings and infrastructure located in TA-33, several facilities and infrastructure associated with

TA-49, and TA-16 facilities located east of NM 501 near where it meets NM 4. Visible near Bandelier's main entrance are a water tower and a National Radioastronomy Observatory Very Long Range Array telescope, both located within TA-33. Panoramic views of LANL and the Los Alamos townsite are available from higher elevations of the western portion of the Main Unit. Views from the Tsankawi Unit include the temporary truck inspection station and some of the taller structures found within LANL and the Los Alamos townsite.

Views from various locations in Los Alamos County and its immediate surroundings were altered by the Cerro Grande Fire of 2000. Although the visual environment is still diverse, interesting, and panoramic, both summer and winter vistas were severely affected by the fire. For example, rocky outcrops forming the mountains are now more visible through the burned forest areas than in the past, and the eastern slopes of the Jemez Mountains present a mosaic of burned and unburned areas. While many LANL facilities generally are screened from view, some developed areas that were previously screened by vegetation are now more visible to passing traffic (DOE 2000f, LANL 2004c).

Since 1997, wildfire prevention activities, such as forest thinning, have been implemented on the LANL site on an accelerated schedule. Between 1997 and 2005, 9,950 acres (4,027 hectares) of forests and woodlands were thinned resulting in a more open, park-like forest. This has, in turn, increased the visibility of some facilities. Additionally, an outbreak of bark beetles beginning in 2001 killed thousands of trees, further opening the forest and making LANL facilities more visible (LANL 2004c, 2006a).

To date, 2,259 acres (914 hectares) of land have been turned over to Los Alamos County and the Department of the Interior to be held in trust for the Pueblo of San Ildefonso (LANL 2004c). This turnover, however, has not changed the visual setting of either the LANL site or the surrounding area because development has not yet occurred on any of this land.

Following the events of September 11, 2001, a number of changes were initiated that limited or redirected public access to facilities at LANL. This has resulted in fewer opportunities for the public to view LANL facilities (LANL 2004c).

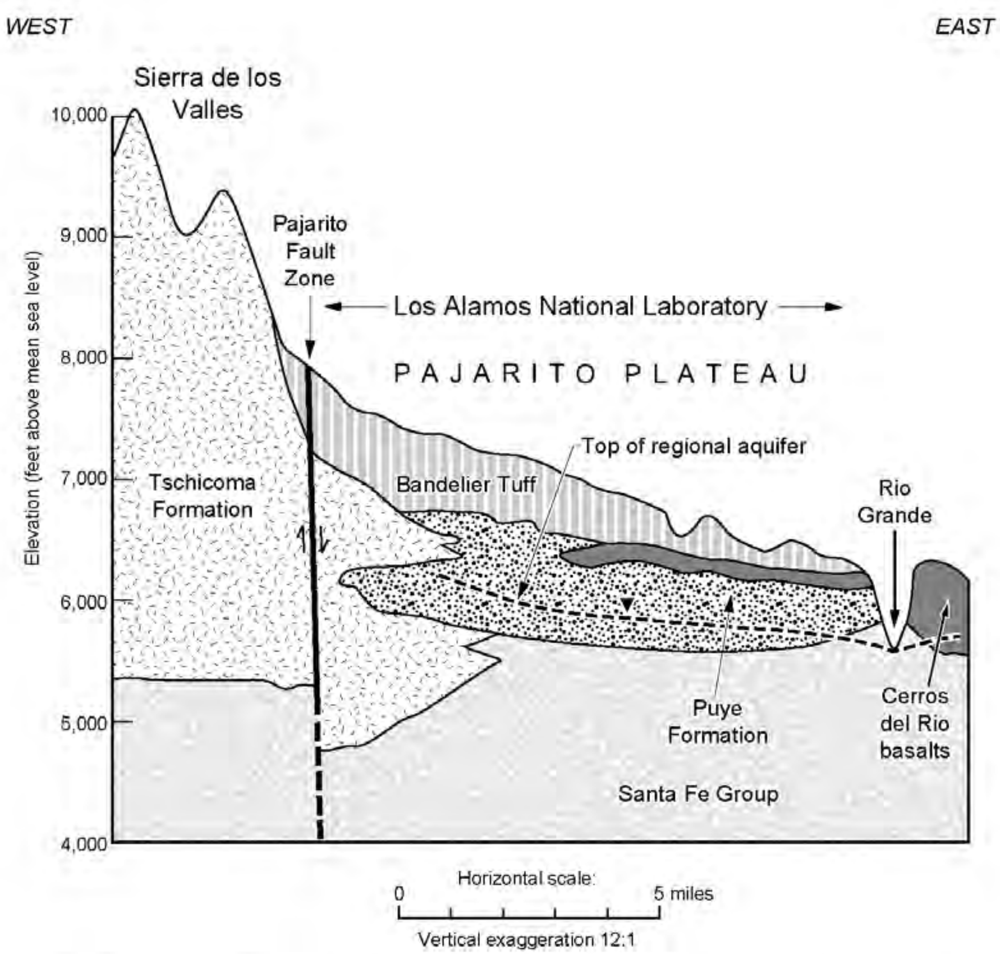
4.2 Geology and Soils

This section describes the geology, geologic conditions, soils, and mineral and geothermal resources present on the LANL site and in the surrounding area. In general, the information provided in Chapter 4, Section 4.2, of the *1999 SWEIS* is current; the most significant changes are updates to seismic conditions and the probabilistic seismic hazard analysis, as well as the effects of the 2000 Cerro Grande Fire on soil characteristics and erosion.

4.2.1 Geology

The geology of the LANL region is the result of complex faulting, sedimentation, volcanism, and erosion over the past 20 to 25 million years (DOE 1999a). LANL lies on the Pajarito Plateau, which is formed of volcanic tuffs (welded volcanic ash) deposited by past volcanic eruptions from the Jemez Mountains to the west (see **Figure 4–7**). The Jemez Mountains are a broad highland built up over the last 13 million years through volcanic activity. Late in the volcanic period, cataclysmic eruptions from calderas in the central part of the Jemez Mountains deposited the thick blankets of tuff that form the Pajarito Plateau (Broxton and Vaniman 2004). Volcanic activity culminated with the eruption of the rhyolitic Bandelier Tuff from 1.6 to 1.22 million years ago. During emplacement, intense heat and hot volcanic gases welded portions of these tuffs into the hard, resistant deposits that make up the upper surface of the plateau. Most of the bedrock on LANL property is composed of the salmon-colored Bandelier Tuff (DOE 1999a). The surface of the Pajarito Plateau is divided into numerous narrow, finger-like mesas separated by deep east-to-west-oriented canyons that drain to the Rio Grande. The canyons were formed by streams flowing eastward across the plateau from the Jemez Mountains to the Rio Grande.

Since the *1999 SWEIS* was issued, some specific geological information has been updated. The Cerro Toledo "Interval" of the Bandelier Tuff unit consists of volcaniclastic sediments and tephras reaching a thickness of 400 feet (122 meters) (LANL 2004c), an increase from the previously reported maximum thickness of 130 feet (40 meters) (DOE 1999a).



Notes:
1. The thickness of geologic units has been exaggerated on this figure to illustrate unit relationships and topography.
2. Offset of the Tschicoma formation on the Pajarito Fault zone is schematic due to the variation along the trace of the fault.
3. To convert feet to meters, multiply by 0.3048.

Source: LANL 2005h.

Figure 4–7 Generalized Cross-Section of the Los Alamos National Laboratory Area

4.2.2 Geologic Conditions

This subsection describes the geologic conditions that could affect the stability of buildings and infrastructure at LANL. It includes stratigraphy, volcanic activity, seismic activity (earthquakes), slope stability, surface subsidence, and soil liquefaction.

4.2.2.1 Stratigraphy

The upper sequence of rocks that underlie LANL are exposed in the 600- to 1,000-foot (183- to 305-meter)-deep, steep-sided canyons cut into the surface of the Pajarito Plateau. The exposed rocks range in age from middle Eocene sediments of the Santa Fe Group to Quaternary alluvium (LANL 1996a). The layers vary in hardness and resistance to erosion; the light-colored units tend to be softer and to form slopes on canyon walls, while darker-colored units tend to be harder and to form vertical cliffs. The following discussion briefly describes the geologic formations in relation to LANL.

The Santa Fe Group is the deepest sedimentary sequence beneath the site (see Figure 4–7). It was deposited in the Española basin, a Rio Grande rift basin that underlies the LANL area. The group ranges from early Eocene to late Pliocene in age; the uppermost sediments are late Miocene beneath the western and central Pajarito Plateau and grade upward into the late Pliocene to the east. The deposits consist of a series of light pink to buff-colored fluvial (stream deposited) siltstones and silty sandstones with a few lenses of conglomerate and clay. In some sections, the sediments are interbedded with basalt flows (NPS 2005a). To the east, these flows represent the Cerros del Rio Basalts (Broxton and Vaniman 2004).

The Puye Formation overlies the Santa Fe Group beneath the western and central Pajarito Plateau and thins beneath the eastern plateau (see Figure 4–7). It consists of coalescing alluvial fans that were shed eastward from the domes and flows of the Sierra de los Valles; as a result the formation overlaps and postdates the Tshicoma Formation. The sediments are late Miocene to late Pliocene in age and generally consist of interbedded gray-colored fluvial sandstones and gravels. The upper part of the Puye Formation is interlayered with lava flows. To the east, the flows represent the Cerros del Rio Basalts (see Figure 4–7), a series of basaltic and related lava flows separated by generally thin beds of sedimentary deposits of the Santa Fe Group and Puye Formation (Broxton and Vaniman 2004).

The Bandelier Tuff is the uppermost stratigraphic unit on the Pajarito Plateau. It forms the foundation for most LANL facilities as well as the canyon walls along LANL streams (LANL 1996a). The Bandelier is a late Pliocene to Quaternary volcanic deposit formed primarily by eruption of the Valles and Toledo calderas, which occurred 1.6 and 1.22 million years ago, respectively (DOE 1999a). These eruptions produced widespread, voluminous ash flow sheets composed of pumice, tuffs, and some interlayered sediments.

During and shortly after tuff deposition, extreme heat indurated (hardened by heating) some of the layers, forming welded tuff deposits. These welded tuffs and other volcanic deposits (including basalt flows) were fractured due to cooling and non-seismic processes. The size, extent, density, and orientation (vertical, horizontal, or inclined) of the fractures varies between successive layers and both vertically and laterally within individual layers. The induration and fracturing of the volcanic deposits on the LANL site are an important control on canyon wall formation, slope stability, subsurface fluid flow, seismic stability, and the engineering properties of the rocks.

The layers that form the Bandelier Tuff and the cliff-forming units are illustrated in **Figure 4–8**. Most LANL facility foundations are either on or within the Tshirege Member (upper member) of the Bandelier Tuff. The Tshirege Member consists of a series of generally thick, welded tuff sheets deposited by multiple volcanic flows. It contains several units, all of which are recognizable due to differences in physical and weathering properties. From the bottom to the top of the Member, the subunits are described as follows (LANL 1999a):

- The Tsankawi Pumice Bed is the basal pumice fallout deposit of the Member. This pumice bed is typically 20 to 30 inches (50 to 70 centimeters) thick on the LANL site. It is composed of angular to subangular volcanic rock particles up to 2.4 inches (6 centimeters) in diameter.

- Qbt 1g is the lowermost unit of the Member. It is a porous, nonwelded, poorly sorted, ash flow deposit. It is poorly indurated, but forms steep cliffs because a resistant bench near the top of the unit forms a protective cap over the softer underlying tuff. Qbt 1g underlies most of the mesas and is exposed in canyon walls on the Pajarito Plateau.

- Qbt 1v is a series of cliff- and slope-forming outcrops composed of porous, nonwelded, devitrified ash flow deposit. The base of the unit is a thin, horizontal zone of preferential weathering marking the abrupt transition from vitric tuffs below to devitrified tuffs above. The lower part of Qb1 1v is an orange-brown colored colonnade tuff (Qbt 1v-c) that forms a distinctive low cliff characterized by columnar jointing. The colonnade tuff is overlain by a white-colored band of slope-forming tuffs. Qbt 1v is exposed in canyon walls and is present beneath portions of canyon floors.

- Qbt 2 is a medium-brown, vertical cliff-forming ash flow deposit. It is devitrified, relatively highly welded, and forms the steep, narrow canyon walls in the central and eastern portions of the Pajarito Plateau. It underlies canyon flows in the central and western portions of the plateau. Qbt 2 forms a resistant caprock on mesa tops in the eastern portion of the Pajarito Plateau.

- Qbt 3 is a nonwelded to partly welded, devitrified ash flow deposit. The basal part of Qbt 3 is a soft, nonwelded tuff that forms a broad, gently sloping bench on top of Qbt 2 in canyon wall exposures and on the broad canyon floors in the central part of the Pajarito Plateau. The upper part of Qbt 3 is a partly welded tuff that forms the caprock of mesas in the central part of the Pajarito Plateau, such as at TA-50. This unit is more densely welded to the west and locally contains apparent horizontal bedding or fracturing.

- Qbt 4 is a partially to densely welded ash flow deposit characterized by small, sparse pumices and numerous intercalated surge deposits. The unit is exposed on mesa tops on the western part of the Pajarito Plateau such as at TA-3. Some of the most densely welded areas occur on the western margin of LANL.

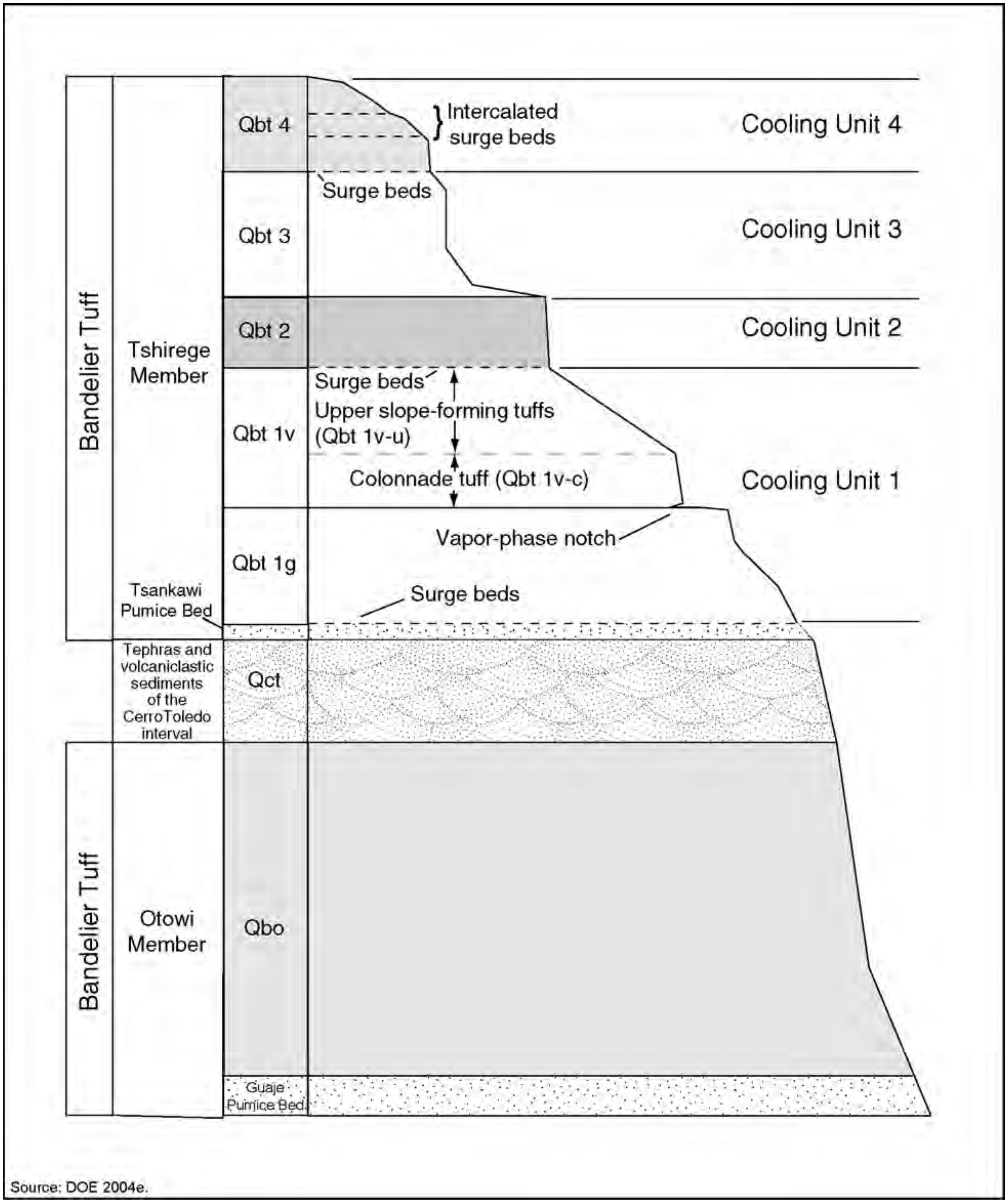


Figure 4–8 Stratigraphy of the Bandelier Tuff

In general, subunits of the Tshirege Member dip gently southeastward on the Pajarito Plateau. This dip is likely the primary initial dip, which mainly results from the burial of a southeast-dipping paleotopographic surface and thinning of units away from the volcanic source to the west.

Volcanic deposits postdating the eruption of the Bandelier Tuff are similar in character to the earlier unit. These deposits are intermittently present on the LANL site, with greater frequency of occurrence to the west.

Unconsolidated sediments form surficial, localized deposits across LANL. These deposits include colluvium and Quaternary alluvium. Colluvium, an accumulation of materials from rock falls and other gravity-driven processes, occurs at the base of slopes. Quaternary alluvium consists of recent stream deposits and occurs in and along LANL's canyons and watersheds as narrow bands of canyon-bottom sediments. Both materials consist of unconsolidated gravels, sands, and clays; however, colluvium is generally coarser-grained and less consolidated. Sediment is discussed in more detail in Section 4.3.1.5.

Overall, the complex interfingering and interlayering of strata beneath LANL results in variable properties that affect canyon wall formation, slope stability, subsurface fluid flow, seismic stability, and the engineering properties of the rocks. In general, poorly indurated and densely fractured layers tend to form canyon slopes that are susceptible to failure during erosion or seismic events and require remediation prior to installing engineered structures on the mesa surfaces, in the canyons, or crossing canyon walls. In such cases, the direction and density of the fractures is a critical engineering parameter. Beneath the Pajarito Plateau, the complex stratigraphy is reflected in the presence of perched groundwater zones. Perched groundwater occurs above welded tuffs in the Bandelier Tuff and other volcanic strata, above tuffs that have been altered to clays, above nonfractured basalt flows of the Cerro del Rio Basalts, and above fine-grained sedimentary deposits (such as lacustrine clays) in the Puye Formation (Robinson, Broxton, and Vaniman 2004). The upper surface of the regional aquifer (the water table) lies within the lower portion of the Puye Formation (see Figure 4–7). The aquifer includes the full thickness of the Santa Fe Group except along the Rio Grande, where the water table drops below the overlying Puye Formation. Interbedded basalt flows may account for localized confining conditions observed in the aquifer (NPS 2005a). The paleotopography and general dip to the southeast of the pre-Tshirege surface may strongly influence the direction of possible groundwater flow and contaminant migration in subsurface units. The paleotopography of the surface underlying the Bandelier Tuff may influence the flow direction of potential perched water zones (LANL 1999a).

In addition, the direction and rate of subsurface flow may be affected by the presence and orientation of fractures in some rock layers. As discussed above, these fractures may be related to cooling and formation of the individual strata. In some areas, faults related to seismic activity also may influence groundwater flow. The impact of geologic setting and geologic units on the hydrogeology beneath LANL is detailed in Appendix E.

4.2.2.2 Volcanism

There have been no significant changes to the information in this section from the *1999 SWEIS*; however, the unusually low amount of seismic activity in the Jemez Mountains has been reinterpreted to indicate that seismic signals of magma movement are partially absorbed deep in the subsurface due to elevated temperatures and high heat flow (LANL 2004c). The significance of this to LANL is that magma movement indicates that the Jemez Mountains continue to be a zone of potential volcanic activity, although at no greater probability than identified in the *1999 SWEIS*.

4.2.2.3 Seismic Activity

A comprehensive update to the LANL seismic hazards analysis was completed in June 2007 (LANL 2007a); the analysis presents estimated ground-shaking hazards and the ground motions that may result. The geological and geotechnical aspects of the study, along with a summary of the seismic setting, are incorporated in the following description. The relevance of the revised understanding of seismic hazards to LANL facilities is discussed in Chapter 5, Section 5.12, of this SWEIS.

The 2007 seismic hazard study updates the 1995 LANL study that was used for the *1999 SWEIS*. The studies consider all earthquake faults within 10 miles (16 kilometers) that meet the definition of the term "capable fault" as used by the U.S. Nuclear Regulatory Commission to assess the seismic safety of nuclear power reactors (Title 10 *Code of Federal Regulations* [CFR] Part 100, Appendix A).

The primary changes in the 2007 seismic update are the use of more recent field study data and the application of the most current seismic analysis methods (LANL 2007a). The only new characterization data regarding the dynamic properties of the subsurface beneath LANL are those from investigations performed at the Chemistry and Metallurgy Research Replacement Facility. Recent geological studies have refined the understanding of fault geometry, slip characteristics, and the relationship of the faults in the LANL area. The methods used in the updated 2007 analysis follow the Senior Seismic Hazard Advisory Committee's guidelines for a Level 2 analysis in *Recommendations for Probabilistic Seismic Hazard Analysis – Guidance on Uncertainty and Use of Experts* (NUREG/CR-6327, 1997). The study was designed and performed under the following DOE standards:

- DOE Standard 1020-2002, Natural Phenomena Hazards Design and Evaluation Criteria for DOE Facilities;
- DOE Standard 1022-94, Natural Phenomena Hazards Site Characterization Criteria; and
- DOE Standard 1023-95, Natural Phenomena Hazard Assessment Criteria.

The seismic hazards analysis report (LANL 2007a) includes details on refinement of the seismic source model, ground motion attenuation relationships, dynamic properties of the subsurface (particularly the Bandelier Tuff) beneath LANL, as well as the probabilistic seismic hazard, horizontal and vertical hazards, and design basis earthquake for LANL.

The dominant contributor to seismic risk at LANL is the Pajarito Fault System. The main element of the system is the Pajarito Fault. Secondary elements include the Santa Clara Canyon Fault, the Rendija Canyon Fault, the Guaje Mountain Faults, and the Sawyer Canyon Fault. The general fault geometry in the system is reflected in **Figure 4–9** (LANL 2004c).

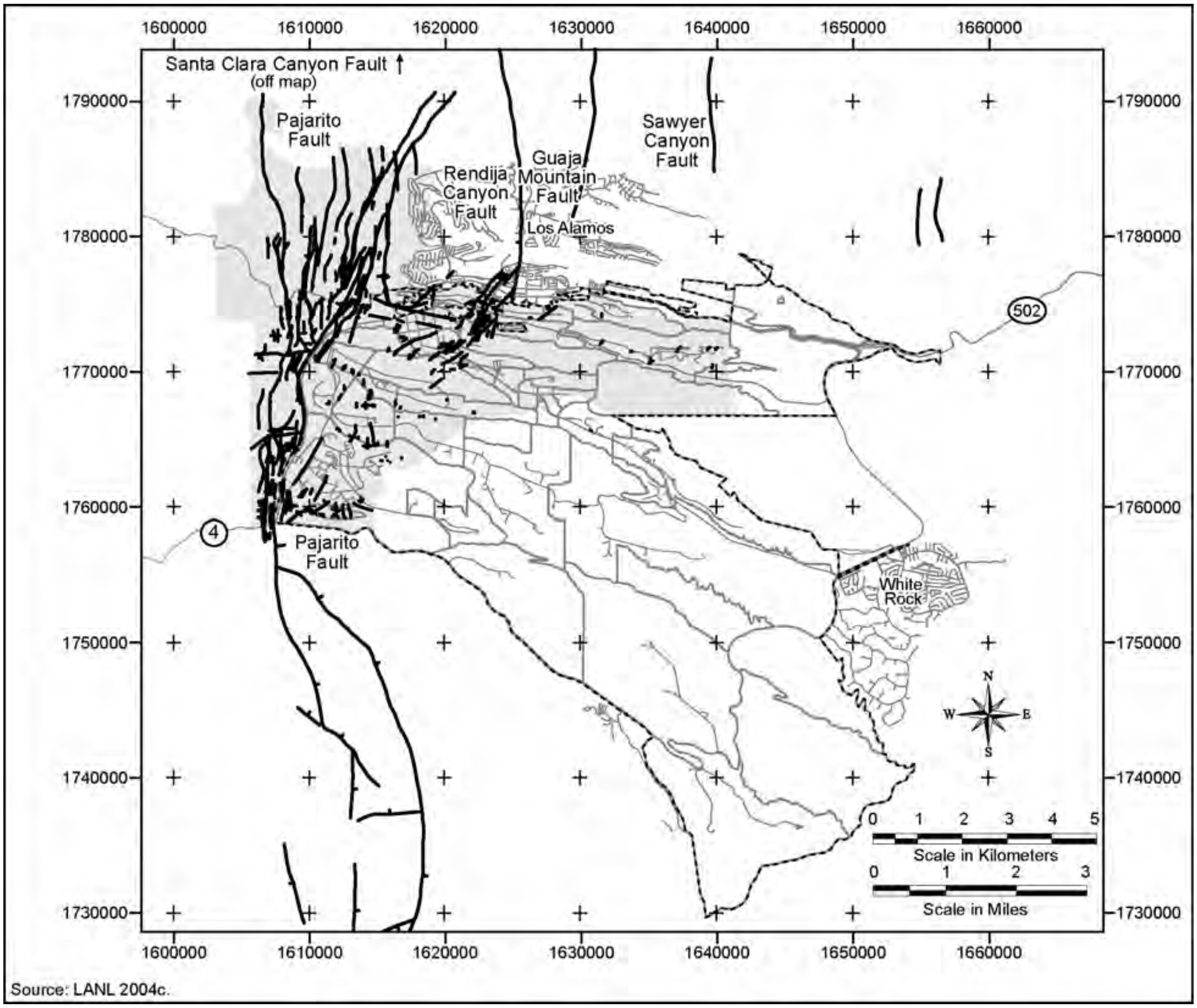


Figure 4–9 Mapped Faults in the Los Alamos National Laboratory Area

The descriptions of seismic settings and risk elements presented in the following sections are based on the 2007 seismic study (LANL 2007a) and data derived from trench and borehole studies, as well as other studies conducted on seismic hazards in the vicinity of LANL (LANL 2004c). These studies focused on the western third of LANL (the shaded area in Figure 4–9) because the principal faults, and thus the principal seismic risks at LANL, are located in that portion of the site.

Pajarito Fault

The Pajarito Fault is the main element of the Pajarito Fault System and contributes most of the seismic risk to LANL due to its proximity and level of seismic activity (LANL 2007a). It forms the main western margin of the Española Basin at LANL. The geometry of the Pajarito Fault varies appreciably along its north-south extent. Its shallow subsurface expression varies from a simple normal fault to broad zones of small faults to largely unfaulted monoclines. These features are all considered surface expressions of deep-seated normal faulting (LANL 2004c). Landslides along the main escarpment of the Pajarito Fault are cut by pronounced lineaments that are visible on aerial photographs and may express underlying faults, but this has not been confirmed.

The extent of movement along a fault may be approximated by the separation of stratigraphic layers on each side of the fault plane. Maximum stratigraphic separation on the Pajarito Fault occurs south-southwest of the LANL site, where down-to-the-east normal faulting shows up to 590 feet (180 meters) of stratigraphic separation on the Bandelier Tuff. Between Cañon de Valle and Pajarito Canyon, stratigraphic separation is approximately 475 feet (145 meters) on a series of faults over a lateral zone of about 3,300 feet (1,000 meters). In the vicinity of TA-16, deformation associated with the Pajarito Fault extends at least 5,000 feet (1,524 meters) to the east of the Pajarito Fault escarpment (LANL 2004c).

In the *1999 SWEIS*, the most recent faulting event along the Pajarito Fault was estimated to have occurred 45,000 years ago. More recent studies, including trench excavations and borehole stratigraphy and structure, indicated more recent movement (see **Table 4–3**) (LANL 2007a). Recent studies also indicated that movement on the Pajarito Fault may be linked to movement on the other fault segments in the Pajarito Fault System.

Table 4–3 Summary of Movement on Faults of the Pajarito Fault System

Name	***Approximate Length***	***Type***	***Most Recent Faulting Event***	***Maximum Earthquake Potential*** [a]
Pajarito	26 miles	Normal, down-to-the-east [b]	1,400 to 2,200 years ago	7
Rendija Canyon	8 miles	Normal, down-to-the-west	Less than 8,000 years ago	6.5
Guaje Mountain	8 miles	Normal, down-to-the-west	3,400 to 6,500 years ago	6.5

[a] Richter magnitude.
[b] The fault plane dips to the east and the crustal block on the east side of the fault slips downward to the east when fault movement occurs. Down-to-the-west reverses this fault plane angle and sense of movement.
Note: To convert miles to kilometers, multiply by 1.6093.
Sources: DOE 1999a, LANL 2004c, LANL 2007a.

Five small earthquakes (magnitudes of 2 or less on the Richter scale) have been recorded in the Pajarito Fault since 1991. These small events, which produced effects felt at the surface, are thought to be associated with ongoing tectonic activity within the Pajarito Fault zone (LANL 2004c).

The west-central area of LANL, generally between TA-3 and TA-16, lies within a part of the Pajarito Fault made up of subsidiary or distributed ruptures. Deformation extends at least 5,000 feet (1,500 meters) to the east of the Pajarito Fault Escarpment. The general north-south trend of the Pajarito Fault structure is disrupted in TA-62, TA-58, and TA-3 by some east-west trending faults. These faults may be related to the Pajarito Fault, the Rendija Canyon Fault (see below), or may be independent structures. These are areas of generally higher potential for seismic surface rupture, relative to locations farther removed from the Pajarito Fault zone.

Santa Clara Canyon Fault

The Santa Clara Canyon Fault is a secondary element of the Pajarito Fault System. It is located to the north of the Pajarito Fault (beyond the northern extent of Figure 4–9) and generally continues the northeastern trend of the Pajarito Fault as it extends north beyond LANL (LANL 2007a). It is another fault element that defines the western margin of the Española Basin, but it has less influence on seismicity at LANL due to its distance from the site. Although it continues the western Española Basin margin, there is a gap of approximately 3 miles (5 kilometers) between the mapped traces of the two faults. As discussed below, this gap may be accommodated by movement on the Rendija Canyon and Guaje Mountain faults.

Rendija Canyon Fault

Studies of the Rendija Canyon Fault (LANL 2007a) indicate that it is a dominantly down-to-the-west normal fault located approximately 2 miles (3 kilometers) east of the Pajarito Fault (see Figure 4–9 and Table 4–3). South of the Los Alamos townsite, the Rendija Canyon Fault turns southwest and splays into a zone of deformation about 1 mile (1.5 kilometers) wide. Displacement on the fault is up to 130 feet (40 meters), and the displacement gradually decreases to the south as the zone of deformation broadens (LANL 2004c). The fault probably ends just south of Twomile Canyon where displacement is about 30 feet (10 meters). At the southern end of the fault zone, east-west trending faults run between the Rendija Canyon and Pajarito Fault zones, generally within TA-63, TA-58, and TA-3 (see Figure 4–9). The east-west oriented faults may relate to the Pajarito and Rendija Canyon structures (in space or time or both) or they may record an independent history of brittle deformation. Additional study may determine the relationship between movement along the north-south and east-west fault zones at LANL. As mentioned above, these areas are associated with a higher potential for seismic surface rupture, however, previous analysis shows that the risk is not significant.

Trench exposures across the Rendija Canyon Fault at Guaje Pines cemetery indicate that the most recent surface rupture occurred about 8,600 to 23,000 years ago (LANL 2007a). Geologic mapping shows that there is no faulting in the near-surface directly beneath TA-55 (LANL 2004c). The closest fault is about 1,500 feet (460 meters) west of the TA-55 Plutonium Facility. The Rendija Canyon Fault, therefore, does not continue from the Los Alamos townsite directly south to TA-55.

Within TA-3, there is no evidence of faulting in a 1.2 million-year-old member of the Bandelier Tuff (Tshirege Member) beneath the site of the Metropolis Center for Modeling and Simulation and the Nonproliferation International Security Center. A study at the Chemistry and Metallurgy Building identified two small, closely spaced, parallel reverse faults with a combined vertical separation of 8 feet (2.4 meters). Drilling at the National Security Sciences Building identified a small normal fault with less than 3 feet (1 meter) of displacement. The Rendija Canyon Fault does not extend farther west than Pajarito Road, but its eastern extent has yet to be conclusively defined (LANL 2004c).

Guaje Mountain Fault

The Guaje Mountain Fault is subparallel to the Pajarito Fault and Rendija Canyon Fault and is located approximately 1.2 miles (2 kilometers) east of the Rendija Canyon Fault (see Figure 4–9) (LANL 2004c). It is somewhat shorter than the Rendija Canyon Fault and the southern extent is not well documented. The fault exhibits about 115 feet (35 meters) of down-to-the-west displacement on the south side of Guaje Mountain, between Rendija and Guaje Canyons (Carter and Winter 1995) (see Table 4–3). The fault continues to have topographic expression as far south as Bayo Canyon. However, the displacement along the length of the fault and the southern extent are generally not well defined.

Geologic surface mapping and trenching at Pajarito Mesa demonstrated the absence of faulting in that area for at least the last 50,000 to 60,000 years. Small displacement faults traverse the mesa, but no southward continuation of the Guaje Mountain Fault was identified (LANL 2004c).

Based on available data, a series of seismic events have been identified on the Guaje Mountain Fault. These range in age from 3,400 to 300,000 years ago and have up to approximately 7 feet (2 meters) of displacement (LANL 2004c, 2007a).

Sawyer Canyon Fault

The Sawyer Canyon Fault is a short, west-dipping fault that is subparallel to and located east of the Rendija Canyon and Guaje Mountain Faults. Its effect on seismicity at LANL is relatively small because the surface trace is located at a distance from the site and the structure migrates away from LANL at depth. This fault is included in the 2007 seismic update to simplify modeling (LANL 2007a).

Other Areas of LANL

Surveying of Bandelier Tuff contacts at Mesita del Buey (TA-54) revealed 37 faults with vertical displacements of 2 to 26 inches (5 to 65 centimeters). These small faults appear to be secondary effects associated with large earthquakes in the main Pajarito Fault zone, or perhaps earthquakes on other faults in the region (LANL 2004c).

Geologic mapping and related field and laboratory investigations in the north-central to northeastern portion of LANL (TAs 53, 5, 21, 72, and 73) revealed only small faults that have little potential for seismic surface rupture. The study identified six small-displacement (less than 5 feet [1.5 meters] vertical displacement) faults or fault zones. These faults are considered subsidiary to the principal faults of the Pajarito Fault system (that is, the Pajarito, Rendija Canyon, and Guaje Mountain Faults) and likely experienced small amounts of movement during earthquakes on the principal faults (LANL 2004c).

Pajarito Fault System Event Chronology and Probabilistic Seismic Hazard Analysis

Recent work has shown that the Pajarito Fault system is a broad zone of distributed deformation, and that the primary Pajarito Fault itself probably breaks the surface along only part of its length in the vicinity of LANL (LANL 2004c). Most of the geologic structures that have been the targets of seismic studies are, in fact, faults subsidiary to the primary and secondary segments of the Pajarito Fault System (LANL 2007a). Establishing the precise seismic relationship, timing of events, and probability of seismic activity on each segment is made more difficult because the individual faults do not provide a complete record of paleoseismic events for the entire system. Results from paleoseismic investigations indicate that there have been at least two and possibly three surface-rupturing events on the Pajarito Fault System since 11,000 years ago. Reaching back to the Late Quaternary (110,000 years ago), a total of five to nine events have been identified, suggesting a longer recurrence interval than in the more recent past. The apparent difference in recurrence interval may be due to the loss of event markers earlier in the geologic record.

The following discussion represents the 2007 update of the understanding of seismic hazards at LANL (LANL 2007a). Overall, the Pajarito Fault System acts as a broad zone of faults that form an articulated monoclinal flexure and consists of several distinct fault segments. These include the Pajarito Fault (the primary segment), Santa Clara Canyon Fault, Rendija Canyon Fault, Guaje Mountain Fault, and Sawyer Canyon Fault (secondary segments). These faults show evidence of progressive linkage in the recent past and exhibit complex rupture patterns, including the recent surface-rupturing pattern described above. As the primary fault segment in the Pajarito Fault System, the Pajarito Fault is the primary source of seismic risk at LANL. Movement on the primary fault may be temporally related to movement on the secondary faults.

A combination of empirical and site-specific attenuation relationships were used in the probabilistic seismic hazard analysis. As in the 1995 analysis, the lack of region-specific attenuation relationships was mitigated by use of a stochastic ground motion modeling approach. This approach was used for four target areas, including the Chemistry and Metallurgy Research Replacement Facility, TA-3, TA-16, and TA-55. The Chemistry and Metallurgy Research Replacement Facility and technical areas were selected for use in the calculations because they all contain LANL facilities of interest and field data were available to support the calculations. In addition, an attenuation relationship was developed for dacite at LANL. (Dacite is a type of igneous rock of volcanic origin.) In this application, it was used as a modeling analog for the Bandelier Tuff. By combining the depth to the top of dacite beneath an area and the dacite attenuation relationship, the probabilistic seismic hazard analysis can be applied beyond the four target areas to other areas of interest across LANL.

The probabilistic hazard for peak ground acceleration at all of the sites is dominated by the Pajarito Fault System for all return periods, and the Pajarito Fault System is in turn the primary contributor to seismic hazard at LANL. Peak ground acceleration for the Uniform Hazard Response Spectra is presented in **Table 4–4**; results are calculated for a range of recurrence intervals. Similarly, the peak ground acceleration calculated for Seismic Design Criteria for the target areas are presented in **Table 4–5**.

The estimated probabilistic hazard has increased significantly, up to 83 percent, compared to the 1995 probabilistic seismic hazard analysis (**Table 4–6**) (LANL 2007a), due in large part to recognition of increased seismic activity along the Pajarito Fault System. The 1995 probabilistic seismic hazard analysis was used to set the seismic hazard and design basis earthquake in the *1999 SWEIS* (DOE 1999a) and in this SWEIS, as well as to determine the design criteria for facilities at LANL. The 2007 probabilistic seismic hazard analysis updates these parameters and will require review and revision of the seismic hazard and the design basis earthquake for use in designing and establishing operating limits for LANL facilities. Earthquake hazard analyses for LANL facilities are discussed in Chapter 5, Section 5.12, of this SWEIS.

Table 4–4 Los Alamos National Laboratory Mean Peak Ground Acceleration Values (g) from the Uniform Hazard Response Spectra

Return Period (years)	*CMRR*		*TA-3*		*TA-16*		*TA-55*		*Site-Wide*		*Dacite*	
	Horiz.	*Vert.*	*Horiz.*	*Vert.*	*Horiz.*	*Vert.*	*Horiz.*	*Vert.*	*Horiz.*	*Vert.*	*Horiz.*	*Vert.*
1,000	0.27	0.32	0.27	0.32	0.25	0.31	0.27	0.32	0.27	0.32	0.13	0.12
2,500	0.52	0.60	0.52	0.59	0.47	0.57	0.52	0.60	0.52	0.60	0.27	0.27
10,000	1.03	1.21	1.03	1.10	0.93	1.05	1.03	1.21	1.03	1.21	0.65	0.65
25,000	1.47	1.79	1.45	1.57	1.33	1.50	1.47	1.79	1.47	1.79	1.01	0.97
100,000	2.30	3.01	2.29	2.79	2.11	2.57	2.30	3.01	2.30	3.01	1.69	1.65

g = acceleration equal to gravity, Horiz. = horizontal, Vert. = vertical.
Source: LANL 2007a.

Table 4–5 Los Alamos National Laboratory Peak Ground Acceleration Values (g) from the Design Response Spectra

SDC	*CMRR*		*TA-3*		*TA-16*		*TA-55*		*Site-Wide*		*Dacite*	
	Horiz.	*Vert.*	*Horiz.*	*Vert.*	*Horiz.*	*Vert.*	*Horiz.*	*Vert.*	*Horiz.*	*Vert.*	*Horiz.*	*Vert.*
3	0.47	0.56	0.47	0.53	0.43	0.50	0.47	0.60	0.47	0.56	0.28	0.27
4	0.72	0.87	0.71	0.78	0.65	0.74	0.72	0.86	0.72	0.86	0.47	0.45
5	1.17	1.50	1.17	1.39	1.07	1.29	1.17	1.50	1.17	1.50	0.84	0.82

g = acceleration equal to gravity, SDC = seismic design criteria, Horiz. = horizontal, Vert. = vertical.
Source: LANL 2007a.

Table 4–6 Comparison of Probabilistic Peak Horizontal Accelerations in g's from 1995 and 2007 Studies

Return Period	*1,000 Years*		*2,500 Years*		*10,000 Years*	
	1995	*2007*	*1995*	*2007*	*1995*	*2007*
CMRR	–	0.27	–	0.52	–	1.03
TA-3	0.21	0.27	0.33	0.52	0.56	1.03
TA-16	0.21	0.25	0.32	0.47	0.53	0.93
TA-55	0.22	0.27	0.33	0.52	0.56	1.03

g = acceleration equal to gravity, CMRR = Chemistry and Metallurgy Research Replacement Facility, TA = technical area.
Source: LANL 2007a.

4.2.2.4 Slope Stability, Subsidence, and Soil Liquefaction

There are two changes to the *1999 SWEIS* relative to slope stability, subsidence, and soil liquefaction. The Cerro Grande Fire increased soil erosion due to loss of vegetative cover and hydrophobic soil formation. This in turn decreased slope stability in some localized areas. This effect is dissipating as vegetation returns (Gallaher and Koch 2004). The discussion in the *1999 SWEIS* of slope stability at the Omega West Facility is no longer pertinent because that facility was completely demolished in 2003 (LANL 2004c).

4.2.3 Soils

Most of the LANL facilities are located on mesa tops, where the soils are generally well-drained and thin (0 to 40 inches [0 to 102 centimeters]). A general description of LANL soils was included in the *1999 SWEIS*.

In May 2000, the Cerro Grande Fire burned approximately 43,000 acres (17,400 hectares), including about 7,700 acres (3,110 hectares) on LANL (Balice, Bennett, and Wright 2004). The fire severely burned much of the mountainside that drains onto LANL (Gallaher and Koch 2004). The effects of the fire included increased soil erosion due to loss of vegetative cover, formation of hydrophobic soils, and soil disturbance during construction of fire breaks, access roads, and staging areas (DOE 2000f). The increased potential for flooding and erosion led to construction of mitigation structures to retain floodwaters and reinforce road crossings (DOE 2002j).

Hydrophobic soils are formed by high intensity fires when compounds from plant litter are volatilized by the heat of the fire, forced deeper into the soil, and precipitate out as a waxy-like substance on cooler soil particle surfaces (Gallaher and Koch 2004). This limits the paths available for water percolation through the soil. Combined with loss of vegetation, hydrophobic soil formation enhances the potential for increased runoff, soil erosion, downslope flooding, and degradation of water quality. Approximately 9,310 acres (3,768 hectares) of hydrophobic soils were formed in the Jemez Mountains from the Cerro Grande Fire (DOE 2000f).

Soil composition was also affected by the Cerro Grande Fire. The high temperatures associated with forest fires cause a reduction in the oxidation state of metal constituents and combustion of organic carbon in surface soil. A change in the oxidation state of a metal can significantly alter its solubility; this may contribute to the observed release of manganese from soils affected by forest fires (Gallaher and Koch 2004). Studies show that these changes are temporary, usually lasting less than 5 years (Gallaher and Koch 2004).

4.2.3.1 Soil Monitoring

As described in the *1999 SWEIS*, soils on and surrounding LANL are sampled annually as part of the Environmental Surveillance and Compliance Program to determine if they have been contaminated by LANL operations. The soil sampling and analysis program provides information on the inventory, concentration, distribution, and changes over time of radionuclides in soils near LANL. The program has provided annual updates (through the yearbooks) to the data reported in the *1999 SWEIS*. Sediments, which occur along most segments of LANL canyons as narrow bands of canyon-bottom deposits, are not part of the soil monitoring program and are discussed in Section 4.3.1.4.

The following summarizes the discussion provided in *Information Document in Support of the Five-Year Review and Supplement Analysis for the Los Alamos National Laboratory Site-Wide Environmental Impact Statement* (LANL 2004c), except where otherwise noted. The soil monitoring program at LANL comprises: (1) an institutional component that monitors soil contaminants within and around LANL, and (2) a facility component that monitors soil contaminants within and around the principal low-level waste disposal area at LANL (Area G), as well as the principal explosive test facility at the site (Dual Axis Radiographic Hydrodynamic Test [DARHT]).

As part of the institutional program, soil samples are collected from onsite, perimeter, and offsite (regional) locations (see **Figure 4–10** and **Figure 4–11**). Onsite areas sampled at LANL are not potential release sites or wastewater outfalls. Instead, the majority of onsite sampling stations are located close to and downwind from major facilities and operations at LANL in an effort to assess radionuclide, radioactivity, heavy metals, and organics in soils that may have been contaminated as a result of air stack emissions and fugitive dust (such as the resuspension of dust from potential release sites).

The soil radionuclide and radioactivity samples collected from 1974 through 2005 have been analyzed for tritium; cesium-137; plutonium-238, -239, and -240; americium-241; strontium-90; total uranium; gross alpha; gross beta; and gross gamma activities. As reported in LANL 2004c, sources of radionuclides in soil include natural minerals, atmospheric fallout, and planned or unplanned releases of radioactive gases, liquids, and solids from LANL operations. Naturally-occurring uranium is present in relatively high concentrations in soil and rocks due to the regional geologic setting. Plutonium sources at LANL include LANL operations and atmospheric fallout. Metals in soil may be naturally-occurring or may result from LANL releases (LANL 2004c).

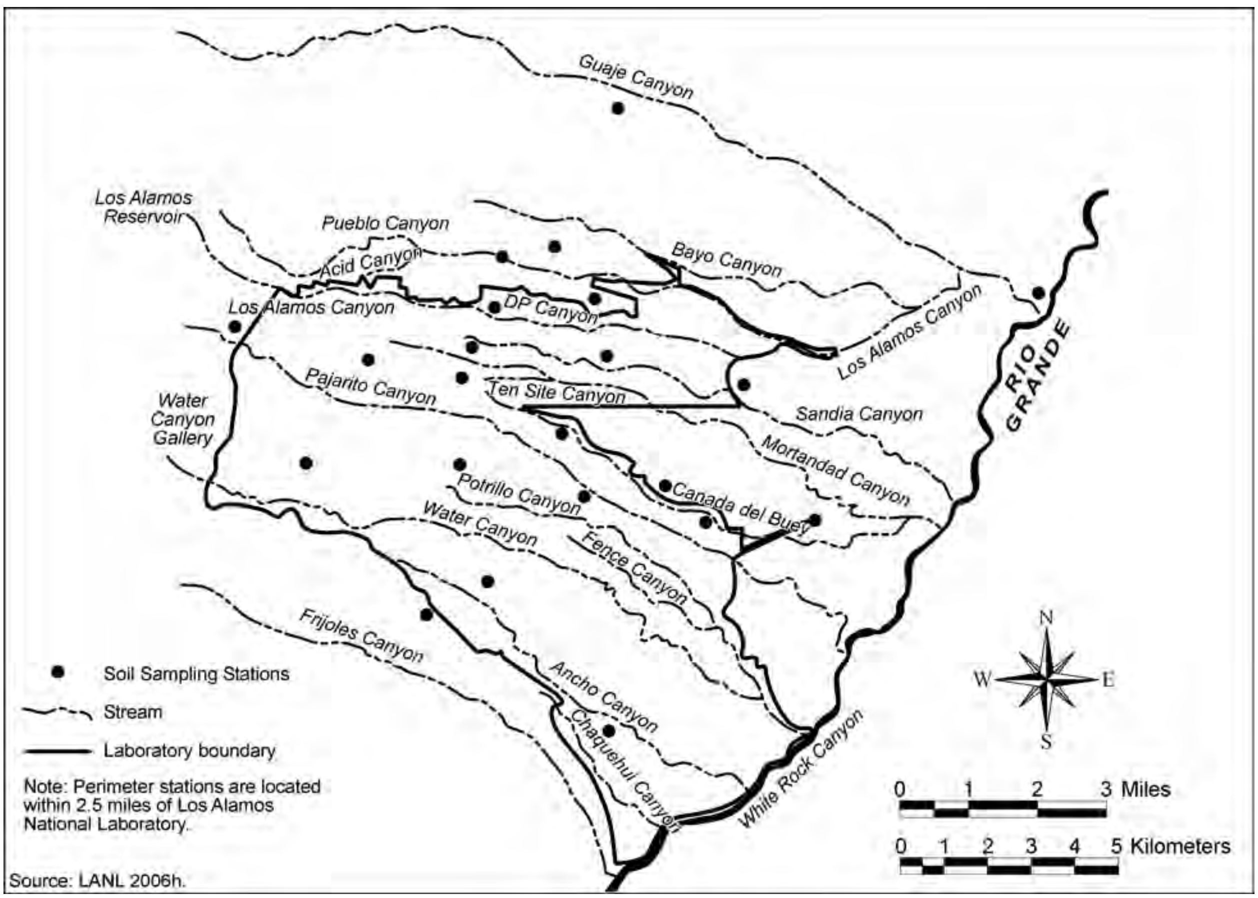


Figure 4–10 Onsite and Perimeter Soil Sampling Locations

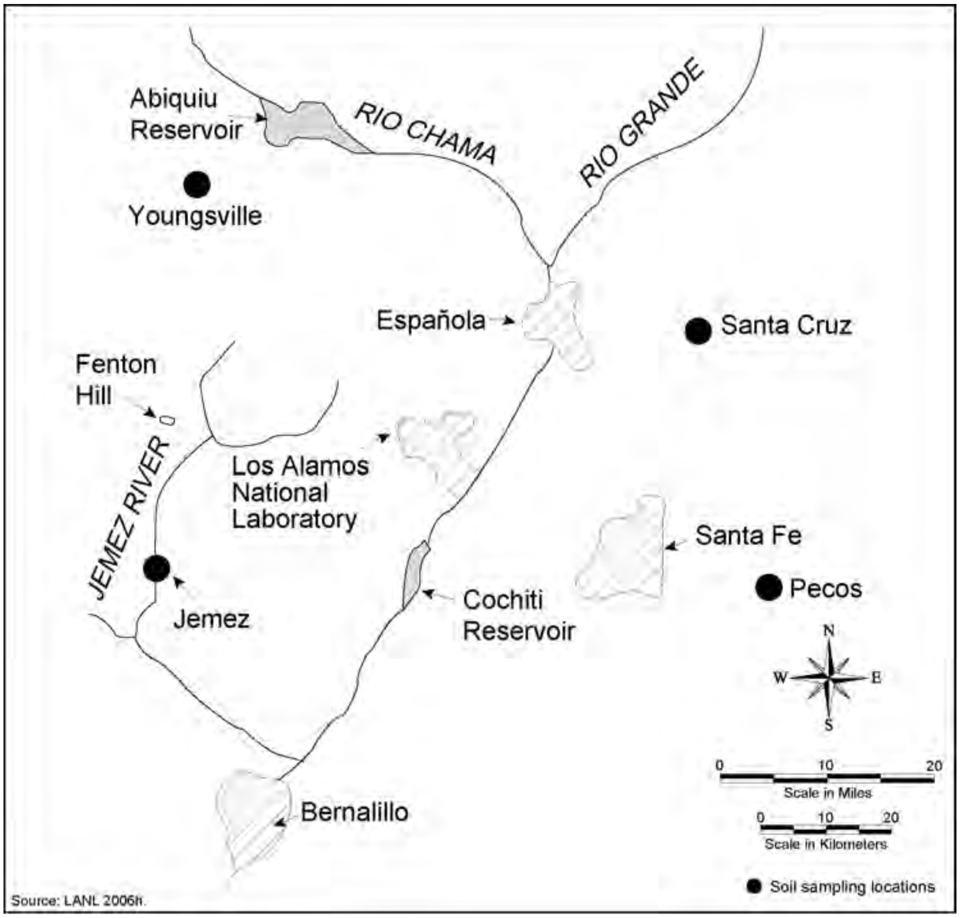


Figure 4–11 Offsite (Regional) Soil Sampling Locations – 2003

LANL onsite and perimeter soil samples are collected and analyzed for radiological and nonradiological constituents, and compared to the regional (background) locations. In general, based on the most recent data, most radionuclide concentrations (activity) in soils collected from individual perimeter and onsite stations were nondetectable (LANL 2004c). Of the radionuclides that were detected, most were still within regional statistical reference levels, indicating that they represent natural and fallout levels. This is consistent with the results presented in the *1999 SWEIS*.

Of the radionuclides detected in soils from perimeter and onsite stations that exceeded regional statistical reference levels, most were plutonium-239 and plutonium-240. Most of the detections were just above the regional statistical reference level, and were probably a result of fallout amplified by higher precipitation (rain) events. However, two soil samples, one onsite (at the DP Site in TA-21) and one at the site perimeter (at the west airport) contained concentrations above regional fallout levels. These levels were probably associated with activities at LANL. The west airport site is located just north and slightly downwind of the former Plutonium Processing Facility at TA-21; this is likely the source of the elevated plutonium result. The DP Site, a former plutonium processing facility that is currently undergoing decontamination and decommissioning, shows a great deal of variation in concentrations of plutonium-239 and plutonium-240 isotopes in soils over time. These variations are likely due to past facility operations or releases from potential release sites and not current operations (LANL 2004c).

Although soil samples at TA-21 (DP Site) contained plutonium-239 and plutonium-240 concentrations above regional statistical reference level, the values are still very low (picocuries range) and far below screening action levels. LANL screening action levels are used to identify the presence of contaminants of concern and are derived from a risk assessment pathway using a 15 millirem per year dose limit. The screening action levels in the *1999 SWEIS* were based on a 10 millirem per year dose limit. LANL also uses screening action levels to identify "hot spots" that require additional sampling and may require remediation. In every case, regional statistical reference levels are much lower than screening action levels.

Trend analyses show that most radionuclides and radioactivity in soils from onsite and perimeter areas at LANL have been decreasing over time. The exceptions are plutonium-238 and gross alpha concentrations not associated with specific radioisotopes. These observations continue the trends identified in the *1999 SWEIS*. The continuing decreases are likely due to: (1) the decrease in LANL operations and improvements in continuing facility operations, (2) the cessation of aboveground nuclear weapons testing in the early 1960s, (3) weathering (wind, water erosion, and leaching), and (4) radioactive decay (half-life). The persistence of plutonium-238 concentrations may be a result of low contaminant mobility, long half-life, and levels that approach background. The persistence of gross alpha levels may indicate that the observed levels approach background.

As part of the institutional program, soils were analyzed for trace and heavy metals. In general, few individual sites from either perimeter or onsite areas have metals concentrations above regional statistical reference levels. Metals that exceeded the regional statistical reference levels included barium, beryllium, mercury, and lead. Although above regional statistical reference levels, the detections were below U.S. Environmental Protection Agency (EPA) screening levels (LANL 2004c), indicating that they do not present a significant health concern. Trending analysis showed that the concentration of most metals does not appear to be rising over time; they appear to be remaining steady or decreasing. This was consistent with the trend reported in the *1999 SWEIS*, which suggested that facility operations are not a continuing source of metal contamination in site soils. However, mercury concentrations in all soils, including regional soils, appeared to be decreasing over time. This decrease was not entirely understood, but may be a reflection of better waste disposal methods and reduced air emissions from regional coal-fired manufacturing facilities (LANL 2006a).

Organic constituents were also studied within and around LANL, particularly after the 2000 Cerro Grande Fire. Volatile organic compounds, semivolatile organic compounds, organochlorine pesticides, polychlorinated biphenyls, high explosives, and dioxin and dioxin-like compounds were assessed in soils from LANL, perimeter, and background soil samples. Most organic compounds were not detected above reporting limits in any of the soils collected within or around LANL. However, two of the less toxic dioxin-like compounds (1,2,3,4,6,7,8,9-octachlorodibenzo-p-dioxin [OCDD] and 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin [HpCDD]) were detected above reporting limits in most of the soil samples analyzed. These compounds are the least toxic of the six dioxin-like compounds analyzed. They are known byproducts of burning in natural (forest fires) and human-made (residential wood burning and municipal and industrial waste incinerators) settings. The highest observed concentrations of organic contaminants (3.7 parts per trillion of HpCDD and 29.1 OCDD) were from samples collected near the Los Alamos airport (TA-72). The total of these maximum detections is equivalent to

0.029 parts per trillion toxicity equivalents, which is well below the Agency for Toxic Substances and Disease Registry (ATSDR) soil screening level of 50 parts per trillion toxicity equivalents (ATSDR 1997, LANL 2004c). In addition, OCDD was detected at similar concentrations both upwind and downwind of the Cerro Grande Fire area, so it was probably not related to the fire (LANL 2004c).

Under the facility monitoring program, soils are monitored for contaminants around the perimeter of Area G and DARHT. Area G covers approximately 63 acres (25 hectares) in TA-54 at the east end of LANL. The soils and sediment are monitored for tritium, strontium-90, americium-241, cesium-137, plutonium isotopes, and uranium isotopes. Both tritium and plutonium isotopes have been detected at concentrations significantly above regional statistical reference levels, and tritium in soils in some locations is increasing over time. However, a special monitoring study of tritium determined that tritium in vegetation decreases to regional statistical reference levels at a distance of approximately 295 feet (90 meters) from Area G (LANL 2004c).

DARHT covers approximately 20 acres (8 hectares) and is located at TA-15 at the southwest end of LANL. Soils and sediments are monitored for the same radionuclides as at Area G, plus a number of heavy metals. Results are compared with baseline statistical reference levels established over a 4-year-long preoperational period prior to DARHT operations. After 4 years of operation at DARHT, sample analysis results demonstrate that most radionuclides and trace elements in soil, sediment, and biota are within baseline statistical reference levels (LANL 2004c).

As described in *Effects of the Cerro Grande Fire (Smoke and Fallout Ash) on Soil Chemical Properties Within and Around Los Alamos National Laboratory* (LANL 2000d), surface soil samples from LANL were evaluated to determine what effects the wildfire had on soil composition. The analytes were the same radionuclides, metals, and organic compounds as used in the soil monitoring program. For this analysis, the post-fire samples were compared to those collected in 1999 from the same sites. In general, the post-fire results were statistically similar to those collected before the fire, indicating that the impacts to soil chemistry as a result of the fire were minimal.

4.2.3.2 Soil Erosion

A general description of soil erosion at LANL was included in the *1999 SWEIS*. The Cerro Grande Fire increased soil erosion due to loss of vegetative cover and hydrophobic soil formation. This, in turn, increased the frequency and severity of flooding (DOE 2000g); total runoff volume in 2000 increased 50 percent over prefire years (Gallaher and Koch 2004). The increased potential for flooding and erosion led to construction of mitigation structures to retain floodwaters and reinforce road crossings (DOE 2002j). Tree loss due to the bark beetle increased soil erosion by decreasing vegetative cover.

Increased erosion results in steeper canyon walls with greater potential for slope failure. It also produces greater releases of soil particles, with their bound and interstitial legacy contaminants, to LANL streams. The waste legacy constituents are characterized under the soil monitoring program described above. The levels and fate of constituents in stream sediments is described in

Section 4.3.1.5. Increased runoff from fire-impacted areas continued in 2001, 2002, and 2003, but is expected to decrease over time as revegetation occurs (Gallaher and Koch 2004).

4.2.4 Mineral Resources

Potential mineral resources at LANL consist of rock and soil for use as backfill or borrow material for construction of remedial structures such as waste unit caps. Suitable borrow materials in the LANL area include Santa Fe Group sedimentary deposits and Pliocene-age volcanic rocks, especially poorly- to moderately-welded Bandelier Tuff (Stephens and Associates 2005). Quaternary alluvium deposits along stream channels could also be a source of borrow material, but these are typically of limited volume. Similarly, sediment deposits that have formed at the flood control structures built to mitigate the effects of the Cerro Grande Fire could be a potential borrow source, but these too are generally of limited volume.

The only borrow pit presently established onsite at LANL is the East Jemez Road Borrow Pit in TA-61 (Stephens and Associates 2005), which is currently used for soil and rubble storage and retrieval. The pit is cut into the upper Bandelier Tuff, which represents good source material for certain construction purposes (LANL 2005b).

There are numerous commercial offsite borrow pits and quarries in the vicinity; eleven are within 30 miles (48 kilometers) of LANL (this distance is taken as the upper economically viable limit for hauling borrow material to a cover site) (Stephens and Associates 2005). In general, these produce sand and gravel.

4.2.5 Paleontological Resources

A single paleontological artifact has been reported at a site within LANL boundaries (DOE 2003d). The artifact is described as a post-Pliocene (less than 1.6 million year-old) bison bone. It was found in the White Rock-Y area (LANL 2002f). Paleontological artifacts are generally not expected at LANL because near-surface stratigraphy is not conducive to preserving plant and animal remains. The near-surface materials are volcanic ash and pumice that were extremely hot when deposited; most carbon-based materials (such as bones or plant remains) would likely have been vaporized or burned, if present.

4.3 Water Resources

This section addresses surface water, groundwater, sediments, and floodplains located onsite, on adjacent properties, and extending to northern New Mexico and southern Colorado. Wetlands are discussed in Section 4.5.2 because they provide important habitat for many of the animals found on LANL. Water resources in the LANL region are used for human consumption, traditional and ceremonial uses by American Indians, aquatic and wildlife habitat, domestic livestock watering, irrigation, industry, and commercial purposes. Water resources in proximity to LANL may be affected by water withdrawals, effluent discharges, waste disposal, spills and unplanned releases, soil erosion, or stormwater runoff from LANL operations. The LANL area includes 15 subwatersheds as shown in **Figure 4–12**, with 12 local watersheds crossing LANL boundaries. The local watersheds are named for the canyons that receive their runoff.

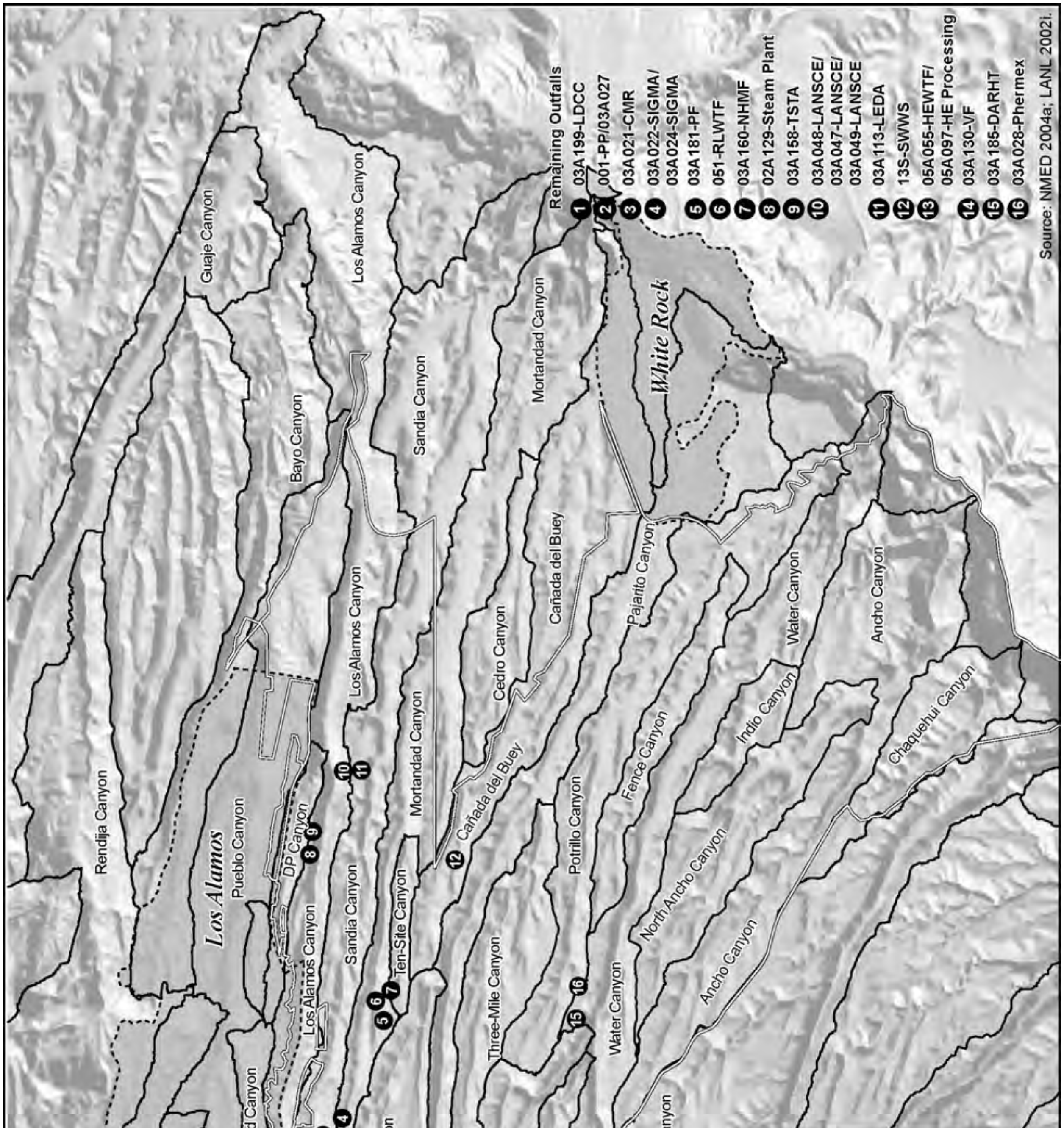


Figure 4–12 Watersheds in the Los Alamos National Laboratory Region

Detailed information on the geology, hydrology, and hydrogeology of the area was presented in Chapter 4, Sections 4.2 and 4.3, of the *1999 SWEIS*, with updated information provided annually in the *SWEIS Yearbooks* (LANL 2001e, 2002e, 2003h, 2004f, 2005f, 2006g, as well as Chapter 4, Section 4.2, and Appendix E of this SWEIS). Since the *1999 SWEIS* analysis, the Cerro Grande Fire changed the water resources environment by removing vegetation and surface organic layers, decreasing the ability of the soil to take in water. These changes caused increased surface water runoff and soil erosion to adversely affect local water resources by accelerating the movement of contaminants in sediments transported in stormwater downstream of LANL. An overview of the Cerro Grande Fire impacts on water resources is further discussed in Section 4.3.1.7.

Another change since the *1999 SWEIS* is related to the Fenton Hill site, a part of LANL located about 20 miles (32 kilometers) west of LANL. In 2003, DOE completed decommissioning the Fenton Hill Hot Dry Rock Geothermal Project by plugging and abandoning all remaining wells. In addition, most structures and equipment associated with the project were removed from the site. There are no environmental permits required for the operations remaining at the site, so Fenton Hill will not be discussed further in this section (LANL 2004c).

Water resources are regulated by a variety of standards, including the Clean Water Act, Safe Drinking Water Act, the New Mexico Water Quality Control Commission standards, and DOE Derived Concentration Guides. These standards and guides are discussed in Chapter 6 of this SWEIS.

Surface Water Terms

For the purposes of this SWEIS, the following terms apply to various forms of surface water.

- *Effluent* or *Discharge* applies only to industrial wastewater released to the environment through a National Pollutant Discharge Elimination System outfall.
- *Flow* applies to streams, springs, stormwater, or effluents, regardless of whether the water flows over an industrial site, a construction site, a natural landscape, or out of an outfall pipe.
- *Runoff* applies only to stormwater, because the precipitation runs off the surface, instead of infiltrating into the ground. Runoff is considered a "discharge" within the NPDES program, but that term will not be used for stormwater in this SWEIS for clarity.
- *Perennial* applies to streams that flow continuously due to natural springs or industrial effluents throughout the year in all years.
- *Ephemeral* applies to streams that flow only in response to local precipitation or snowmelt in the immediate area.
- *Intermittent* applies to streams that surface because the water table is higher than the streambed at certain times of the year.

4.3.1 Surface Water

Surface water may be affected by LANL operations when streams and springs receive industrial effluents discharged from LANL, stormwater flows over the site, and sediments are mobilized by stormwater runoff. At certain times of the year and under certain precipitation and flow conditions, surface water flowing through and from LANL can reach the Rio Grande.

Streams that drain the LANL area are dry for most of the year, and the area's surface water flows primarily in intermittent streams in response to local precipitation or snowmelt. Only about 2 miles (3.2 kilometers) of the over 85 miles (137 kilometers) of watercourses within LANL boundaries are naturally occurring perennial streams. Approximately 3 miles (4.8 kilometers) of watercourses are perennial waters created by supplemental flows from wastewater discharges.

Some of the surface water at LANL comes from shallow groundwater discharging as springs into canyons (LANL 2005h). Surface waters on- and offsite provide recharge to subsurface groundwater via infiltration to alluvial groundwater, intermediate perched groundwater, and the regional aquifer. Surface water is not a source of municipal, industrial, irrigation, or recreational water, though it is used by wildlife. While there is minimal direct use of the surface water within LANL, flows may extend beyond the site boundaries, where there is more potential for use of the water. Certain stream flows extend onto San Ildefonso Pueblo Tribal land and these may be used by Tribal members for traditional or ceremonial purposes, including ingestion or direct contact. Surface waters that flow off LANL property also may reach the Rio Grande, where contaminants could flow downstream.

4.3.1.1 Surface Water and Sediment Quality

Surface water quality is compared to many standards and reference guidelines established by Federal and state agencies. Drinking water standards are used for comparison, although surface water on the Pajarito Plateau is not used for this purpose. Sediments are also compared to several references and risk-based levels to determine if they could cause harm to human health or the environment. **Table 4–7** summarizes the standards and references used to evaluate surface water and sediment quality.

Table 4–8 summarizes the locations of LANL-impacted surface water and sediments. Surface water quality has been affected by LANL operations, with the greatest effects caused by past discharges into Acid, Pueblo, Los Alamos, and Mortandad Canyons.

After evaluating surface water quality data collected from streams within and downstream of LANL, the New Mexico Environment Department (NMED) identified several impaired stream reaches. These data were compared to the standards for the designated use of each stream, according to Section 303(d) of the Clean Water Act. Most surface water on the Pajarito Plateau is designated for use as wildlife habitat, livestock watering, and secondary contact. Some reaches have aquatic life designations. **Table 4–9** lists the impaired reaches within and downstream of LANL. These reaches are displayed in **Figure 4–13**.

Sources of Impacts to Surface Water Resources

LANL personnel recognize and manage the following sources that might impact local surface water resources:

- Industrial effluents discharged through National Pollutant Discharge Elimination System (NPDES) outfalls. This source is referred to as "NPDES-permitted outfalls" and includes point-source discharges from LANL wastewater treatment plants and cooling towers (see Section 4.3.1.2);
- Stormwater runoff, including stormwater runoff from certain industrial activities, construction activities, and solid waste management units (see Section 4.3.1.3);
- Dredge and fill activities or other work within perennial, intermittent, or ephemeral water courses (see Section 4.3.1.4); and
- Sediment transport (see Section 4.3.1.5).

Table 4–7 Standards and References Used for Evaluating Water Quality

Type	Source	Standard or Reference Value	Potentially Applicable To: Pajarito Plateau – Perennial Surface Water (spring supported, effluent supported)	Pajarito Plateau – Intermittent and Ephemeral Surface Waters	Pajarito Plateau – Sediments	Rio Grande – Surface Water	Rio Grande – Sediments
Standard	NMWQCC	Irrigation	NA	NA	NA	X	NA
Standard	NMWQCC	Livestock Watering	X	X	NA	X	NA
Standard	NMWQCC	Wildlife Habitat	X	X	NA	X	NA
Standard	NMWQCC	Secondary Contact	X	X	NA	X	NA
Standard	NMWQCC	Coldwater Aquatic Life	X	NA	NA	X	NA
Standard	NMWQCC	Aquatic Life-acute	X	X	NA	X	NA
Standard	NMWQCC	Aquatic Life-chronic	X	NA	NA	X	NA
Standard	NMWQCC	Human Health (persistent contaminants)	X	X	NA	X	NA
Standard	NMWQCC	Human Health (cancer causing, or toxic)	X	NA	NA	X	NA
Reference	NMWQCC	Groundwater for Human Health	X (filtered samples)	X (filtered)	NA	NA	NA
Reference	NMWQCC	Groundwater other Standards for Domestic Water	X (filtered)	X (filtered)	NA	NA	NA
Reference	EPA	Drinking Water Systems MCL (filtered)	NA	NA	NA	X	NA
Reference	EPA	Fish Consumption and Water	NA	NA	NA	X	NA
Reference	EPA	EPA Region 6 Tap Water Screening Level	X	X (filtered)	NA	NA	NA
Risk-plant and animal	DOE	DOE BCGs (1 rad per day for aquatic animals and plants; 0.1 rad per day for terrestrial animals)	X	X	NA	NA	NA
Risk-human	EPA	EPA Region 6 Residential and Industrial Outdoor Worker Soil Screening Levels (metals, organics, chemicals)	NA	NA	X	NA	X
Risk-human	LANL/USGS	Residential Soil Screening Action Levels (radionuclides)	NA	NA	X	NA	X
Reference	Environment Canada	Guideline for Protection of Aquatic Life	NA	NA	NA	NA	X
Reference	LANL	Background radionuclides and metals	NA	NA	X	NA	NA
Reference	LANL	Background radionuclides	NA	NA	NA	NA	X
Reference	USGS	Prefire metals and organic chemicals	NA	NA	NA	NA	X
Reference	LANL/NMED	Prefire metals and radionuclides	X	X	X	X	X

NMWQCC = New Mexico Water Quality Control Commission, NA = not applicable, EPA = U.S. Environmental Protection Agency, MCL = maximum contaminant level, BCG = Biota Concentration Guide, USGS = U.S. Geological Survey, NMED = New Mexico Environment Department.

Sources: DOE 1990, 2002g; Environment Canada 2002; EPA 2002, 2007a; Gilliom, Mueller, and Nowell 1997; LANL 2006g, 2006h; NMAC 20.6.2; NMAC 20.6.4.

Table 4–8 Surface Water and Sediment Contamination Affected by Los Alamos National Laboratory Operations

Contaminant	Onsite	Offsite	Significance	Trends
Radionuclides in Sediments	Higher than background in sediments because of LANL contributions in Pueblo, DP, Los Alamos, Pajarito, and Mortandad Canyons.	Yes, in Los Alamos, Acid, and Pueblo Canyons; and slightly elevated in the Rio Grande and Cochiti Reservoir.	Sediments below health concern, except onsite along a short distance of Mortandad Canyon; exposure potential is limited.	Plutonium-239 and -240 and cesium-137 concentrations temporarily increased after the Cerro Grande Fire, but fell back to pre-fire levels in Pueblo and Los Alamos Canyons
Radionuclides in Surface Water	Higher than background in runoff in Pueblo, DP, Los Alamos, and Mortandad Canyons.	Yes, in Los Alamos and Pueblo Canyons.	Minimal exposure potential because storm events are sporadic. Mortandad Canyon surface water is 7 percent of Biota Concentration Guide.	Flows in Pueblo Canyon occurring more often after the Cerro Grande Fire. Flows in other LANL canyons recovered to near pre-fire levels.
Polychlorinated Biphenyls in Sediments	Detected in sediment in nearly every canyon.	Yes, particularly in Los Alamos and Pueblo Canyons.	Wildlife exposure potential in Sandia Canyon. Elsewhere, findings include non-LANL and LANL sources.	None
Polychlorinated Biphenyls in Surface Water	Detected in Los Alamos and Sandia Canyon runoff and base flow above New Mexico Stream Standards.	No	Wildlife exposure potential in Sandia Canyon. Elsewhere, findings include non-LANL and LANL sources.	Polychlorinated biphenyls are found everywhere in the Rio Grande, both upstream and downstream of LANL
Dissolved Copper, Lead, and Zinc in Surface Water	Detected in many canyons above New Mexico acute aquatic life standards.	Yes, in Los Alamos Canyon	Origins uncertain; probably multiple sources.	None
High Explosive Residues and Barium in Surface Water	Detections near or above screening values in Cañon de Valle base flow and runoff.	No	Minimal potential for exposure.	None
Benzo(a)pyrene	Detections near or above industrial screening levels in Los Alamos Canyon.	Yes, in Los Alamos and Acid Canyons.	Origins uncertain; probably multiple sources.	None

Sources: LANL 2005h, 2006h.

Other possible sources of surface water impacts are isolated spills, former photographic processing facilities, highway runoff, and residual Cerro Grande Fire ash (LANL 2005h). While most of the major sources were discussed in the *1999 SWEIS*, that evaluation focused on the NPDES-permitted outfalls and sediment transport (DOE 1999a; LANL 2004c). Over the past few years, regulatory emphasis has shifted away from the NPDES-permitted outfalls towards managing stormwater runoff from operating facilities, construction sites, and solid waste management units. As New Mexico stream water quality standards are becoming more stringent, LANL programs are emphasizing improved management of its stormwater runoff (NNSA 2004c).

Table 4–9 New Mexico Environment Department List of Impaired Reaches

Impaired Reach	Unsupported Designated Uses	Probable Causes of Impairment	Probable Sources of Impairment
Upper Rio Grande Watershed			
Guaje Canyon (San Ildefonso Pueblo boundary to headwaters)	- Livestock Watering - Wildlife Habitat - Secondary Contact	- Gross Alpha - Selenium	- Inappropriate Legacy Waste Disposal - Natural Sources - Post-development Erosion and Sedimentation - Surface Mining - Watershed Runoff following Forest Fire
Rendija Canyon (Guaje Canyon to headwaters)	- Wildlife Habitat - Secondary Contact	- Selenium	- Natural Sources - Post-development Erosion and Sedimentation - Surface Mining - Watershed Runoff following Forest Fire
Los Alamos Reservoir	- Coldwater Aquatic Life - Livestock Watering - Wildlife Habitat - Irrigation - Primary Contact	- Other	- Watershed Runoff following Forest Fire
Los Alamos Canyon Ephemeral and Intermittent Segments (San Ildefonso Pueblo boundary to Los Alamos Reservoir)	- Livestock Watering - Wildlife Habitat - Limited Aquatic Life - Secondary Contact	- Gross Alpha - Selenium	- Inappropriate Legacy Waste Disposal - Industrial and Commercial Site Stormwater Discharge (Permitted) - Natural Sources - Post-development Erosion and Sedimentation - Watershed Runoff following Forest Fire
Pueblo Canyon (Los Alamos Canyon to headwaters)	- Livestock Watering - Wildlife Habitat - Secondary Contact	- Gross Alpha - Mercury - Selenium	- Contaminated Sediments - Impervious Surface and Parking Lot Runoff - Inappropriate Legacy Waste Disposal - Industrial and Commercial Site Stormwater Discharge (Permitted) - Municipal (Urbanized High Density Area) - Natural Sources - Post-development Erosion and Sedimentation - RCRA Hazardous Waste Sites - Watershed Runoff following Forest Fire
Rio Grande – Santa Fe Watershed			
Sandia Canyon Perennial Segment (Sigma Canyon upstream to LANL NPDES Outfall 001)	- Coldwater Aquatic Life - Livestock Watering - Wildlife Habitat - Secondary Contact	- Polychlorinated biphenyl-1254 - Polychlorinated biphenyl-1260	- Atmospheric Deposition of Toxics - Inappropriate Legacy Waste Disposal - Landfills - Post-development Erosion and Sedimentation
Sandia Canyon Ephemeral and Intermittent Segments (San Ildefonso Pueblo boundary to Sigma Canyon)	- Livestock Watering - Wildlife Habitat - Limited Aquatic Life - Secondary Contact	- Polychlorinated biphenyl-1254 - Polychlorinated biphenyl-1260	- Atmospheric Deposition of Toxics - Inappropriate Legacy Waste Disposal - Landfills - Post-development Erosion and Sedimentation

Impaired Reach	*Unsupported Designated Uses*	*Probable Causes of Impairment*	*Probable Sources of Impairment*
Mortandad Canyon (San Ildefonso Pueblo boundary to headwaters)	- Livestock Watering - Wildlife Habitat - Limited Aquatic Life - Secondary Contact	- Gross Alpha - Selenium	- Impervious Surface and Parking Lot Runoff - Inappropriate Legacy Waste Disposal - Industrial Point Source Discharge - Natural Sources - Post-development Erosion and Sedimentation - Watershed Runoff following Forest Fire
Pajarito Canyon Perennial Segment (Arroyo de la Delfe upstream into Starmers Gulch and Starmers Spring)	- Coldwater Aquatic Life - Livestock Watering - Wildlife Habitat - Secondary Contact	- Gross Alpha - Selenium	- Inappropriate Legacy Waste Disposal - Natural Sources - Post-development Erosion and Sedimentation - Watershed Runoff Following Forest Fire
Pajarito Canyon (Rio Grande to Arroyo de la Delfe and upstream from Starmers Spring)	- Livestock Watering - Wildlife Habitat - Limited Aquatic Life - Secondary Contact	- Gross Alpha - Selenium	- Inappropriate Legacy Waste Disposal - Natural Sources - Post-development Erosion and Sedimentation - Watershed Runoff following Forest Fire
Water Canyon Perennial Segments (Area A Canyon upstream to NM 501) and Cañon de Valle Perennial Segment (LANL stream gage E256 upstream to Burning Ground Spring)	- Coldwater Aquatic Life - Livestock Watering - Wildlife Habitat - Secondary Contact	- Gross Alpha - Selenium	- Inappropriate Legacy Waste Disposal - Industrial Point Source Discharge - Industrial and Commercial Site Stormwater Discharge (Permitted) - Natural Sources - Post-development Erosion and Sedimentation - Watershed Runoff Following Forest Fire
Water Canyon and Cañon de Valle Ephemeral and Intermittent Segments (portions within DOE lands)	- Limited Aquatic Life - Livestock Watering - Wildlife Habitat - Secondary Contact	- Gross Alpha - Selenium	- Inappropriate Legacy Waste Disposal - Industrial Point Source Discharge - Industrial and Commercial Site Stormwater Discharge (Permitted) - Natural Sources - Post-development Erosion and Sedimentation - Watershed Runoff following Forest Fire
Rito de los Frijoles (Rio Grande to headwaters)	- High Quality Coldwater Fishery - Primary Contact - Secondary Contact	- DDT - Fecal Coliform - Water Temperature - Turbidity	- Natural Sources - Other Recreational Pollution Sources - Other Spill Related Impacts - Source Unknown

RCRA = Resource Conservation and Recovery Act, DDT = dichlorodiphenyl-trichlorethane, NPDES = National Pollutant Discharge Elimination System.
Sources: NMED 2004a, NMWCC 2006.

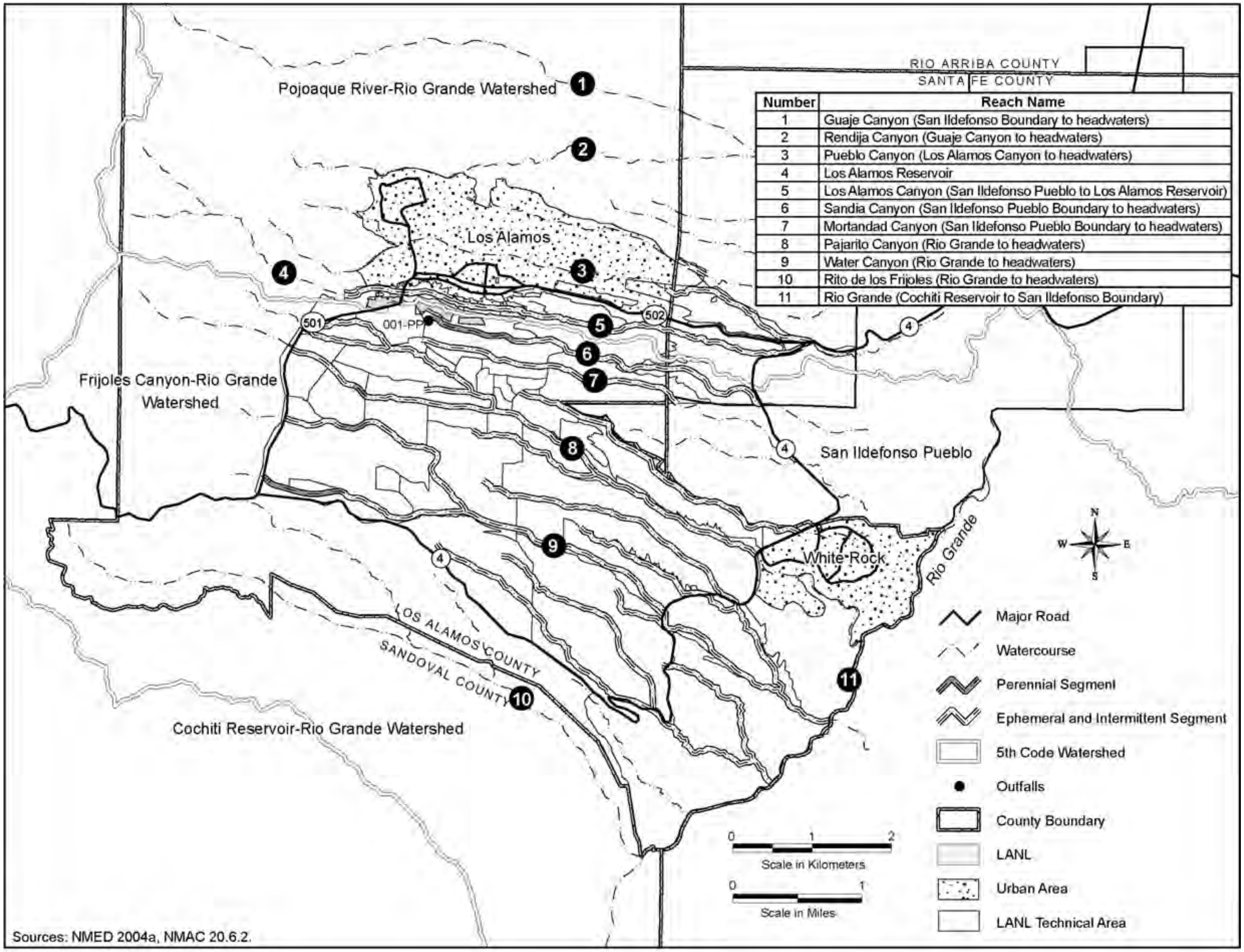


Figure 4–13 Impaired Reaches in the Vicinity of Los Alamos National Laboratory

In accordance with DOE Order 450.1, "Environmental Protection Program," and other statutory requirements, LANL personnel routinely monitor surface water, stormwater, and sediments as part of their ongoing environmental monitoring and surveillance program. The monitoring results are published annually in Environmental Surveillance Reports. One improvement since the *1999 SWEIS* is that LANL personnel expanded the focus to a site-wide monitoring program that integrates groundwater, surface water, stormwater, and sediment monitoring, on a watershed basis.

The *1999 SWEIS* presented surface water quality data from 1991 to 1996. Updated information was collected and presented yearly in the LANL Environmental Surveillance Reports, and current data are now available through 2005 (LANL 2005h). An overview of the 2005 data is presented below to provide an understanding of the current surface water quality conditions.

- While nearly every major watershed shows some level of impact from LANL operations, the overall quality of most surface water is described as good. Most samples of 200 possible contaminants have concentrations that are far below regulatory standards or risk-based advisory levels (LANL 2006h).

- Past discharges of radioactive liquid effluents into Pueblo (including its tributary Acid Canyon), DP, and Los Alamos Canyons and current releases from the Radioactive Liquid Waste Treatment Facility into Mortandad Canyon have introduced americium-241, cesium-137, plutonium-238, plutonium-239, plutonium-240, strontium-90, and tritium into both surface waters and canyon sediments (LANL 2005h). The sum of the ratios of all radionuclides to their Biota Concentration Guides is less than 11 percent in the major canyons (LANL 2006h).

- Radioactivity in lower Pueblo Canyon and Mortandad Canyon surface water at locations below the Radioactive Liquid Waste Treatment Facility outfall, as compared to the DOE Biota Concentration Guide, is shown in **Table 4–10**. This is similar to the conditions described in the *1999 SWEIS* (DOE 1999a; LANL 2004d, 2006h).

In addition to environmental monitoring, LANL personnel maintain other compliance programs. Liquid effluents from NPDES-permitted outfalls are required to meet limits established by the NPDES permit program (see Section 4.3.1.2) and the groundwater discharge permit program. Currently, LANL has one groundwater discharge permit for the TA-46 sanitary wastewater systems plant, the Metropolis Center, and the TA-3 power plant combined outfalls, and has submitted an application for another groundwater discharge permit for the TA-50 Radioactive Liquid Waste Treatment Facility outfall.

LANL activities that require excavation, filling, or other work within a watercourse are subject to Section 404 of the *Clean Water Act* and require dredge and fill permits issued by the U.S. Army Corps of Engineers and certification per Section 401, Water Quality Certification, by the NMED. These permits include operating conditions that must be observed to protect water quality and wildlife and ensure compliance with New Mexico stream standards (LANL 2006h). These activities are referred to as dredge and fill or Sections 404 and 401 activities and are discussed further in Section 4.3.1.4.

Table 4–10 Estimated Average Annual Concentrations of Radionuclides in Base Flows in Pueblo and Mortandad Canyons Compared with the Biota Concentration Guides

Radionuclide	BCGs (picocuries per liter)	*Lower Pueblo Canyon (at NM 502)* Estimated 2005 Time-Weighted Annual Average (picocuries per liter)	*Lower Pueblo Canyon (at NM 502)* Ratio to BCG	*Mortandad Canyon below TA-50 Radioactive Liquid Waste Treatment Facility Outfall* Estimated 2005 Time-Weighted Annual Average (picocuries per liter)	*Mortandad Canyon below TA-50 Radioactive Liquid Waste Treatment Facility Outfall* Ratio to BCG
Americium-241	400	0.4	0.001	5.1	0.013
Cesium-137	20,000	Not detected	0.0	20	0.001
Tritium	300,000,000	Not detected	0.0	237	0.0000008
Plutonium-238	200	Not detected	0.0	2.1	0.0105
Plutonium-239 and Plutonium-240	200	11	0.055	2.9	0.0145
Strontium-90	300	0.4	0.0013	3.4	0.0011
Uranium-234	200	1.7	0.0085	2.0	0.01
Uranium-235 and Uranium-236	200	0.1	0.0005	1.1	0.0055
Uranium-238	200	1.6	0.008	1.9	0.0095
Sum of Ratios			0.07	–	0.07

BCG = Biota Concentration Guide, TA = technical area.
Source: LANL 2006h.

4.3.1.2 Industrial Effluents

Liquid effluents from LANL's industrial and sanitary outfalls are permitted under the NPDES Industrial Point Source Outfall Program (called NPDES-permitted outfalls). The NPDES permit requires routine monitoring of discharges and reporting of sampling results. The permit specifies the parameters to be measured and the sampling frequency (EPA 2007b).

Notable changes since the *1999 SWEIS* include a reduction in the number of permitted outfalls and the total effluent flow from outfalls, changes to LANL treatment facilities at the Radioactive Liquid Waste Treatment Facility at TA-50 and the High-Explosives Wastewater Treatment Facility at TA-16, and water conservation projects that recycle treated effluent to cooling towers from the TA-46 Sanitary Wastewater Systems Plant (formerly known as the Sanitary Wastewater Systems Consolidation Plant).

LANL has 21 outfalls currently permitted under the industrial permit program. **Table 4–11** shows the number of outfalls and the type of effluent that is discharged through the outfalls.

The 21 NPDES-permitted outfalls at LANL discharge into five local canyons in the LANL region, with the amount of discharge varying from year to year. Figure 4–13 shows the location of the NPDES-permitted industrial outfalls. In 2005, approximately 198 million gallons (749 million liters) of effluent were discharged from all permitted outfalls. This represents a reduction in the number of outfalls, the number of watersheds receiving flow, and the total amount of effluent discharged since publication of the *1999 SWEIS*. Thirty-five outfalls were removed from service as a result of efforts to reroute and consolidate flows and eliminate outfalls; one outfall was reinstated to serve the Laboratory Data Communication Center (TA-3-1498) cooling towers (DOE 1999a, LANL 2005f). The annual flow from permitted outfalls and discharges by watershed is shown in **Table 4–12**.

Table 4–11 National Pollutant Discharge Elimination System Industrial Point Source Outfalls

Number of Outfalls	*Type of Discharge*
1	Power Plant Discharge
1	Boiler Blowdown Discharge
15	Treated Cooling Water Discharge
2	High Explosive Wastewater Treatment
1	Radioactive Liquid Waste Treatment
1	Sanitary Wastewater Treatment
Total 21	

Source: EPA 2007b.

Table 4–12 National Pollutant Discharge Elimination Systems Permitted Outfalls and Discharges by Watershed

Canyon	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
Cañada del Buey [a]							
Number of permitted outfalls	3	1	1	1	1	1	1
Discharge (million gallons per year)	2.6	0	0	0	0	0	0
Guaje [b]							
Number of permitted outfalls	6	0	0	0	0	0	0
Discharge (million gallons per year)	1.7	0	0	0	0	0	0
Los Alamos							
Number of permitted outfalls	7	5	5	5	5	5	5
Discharge (million gallons per year)	45.2	37.4	19.34	36.79	34.52	29.57	53.58
Mortandad							
Number of permitted outfalls	6	5	5	5	5	5	5
Discharge (million gallons per year)	39.3	31.6	4.21	31.4	33.12	15.9	16.84
Pajarito [c]							
Number of permitted outfalls	2	0	0	0	0	0	0
Discharge (million gallons per year)	0	0	0	0	0	0	0
Pueblo							
Number of permitted outfalls	1	0	0	0	0	0	0
Discharge (million gallons per year)	0.9	0	0	0	0	0	0
Sandia							
Number of permitted outfalls	6	4	4	5	5	5	5
Discharge (million gallons per year)	213.2	180.2	100.38	108.58	140.41	116.43	127.54
Water [d]							
Number of permitted outfalls	5	5	5	5	5	5	5
Discharge (million gallons per year) (Includes discharge to Cañon de Valle, a tributary)	14.3	16.2	0.102	1.41	1.77	0.62	0.50
Totals							
Number of permitted outfalls	36	20	20	21	21	21	21
Discharge (million gallons per year)	317.2	265.4	124.04	178.18	209.82	162.52	198.46

[a] Includes Outfall 13S from the Sanitary Wastewater Systems Plant, which is permitted to discharge to Cañada del Buey or Sandia Canyon. The discharge is currently piped to TA-3 and ultimately discharged to Sandia Canyon via Outfall 001.
[b] Includes 04A-176 discharge to Rendija Canyon, a tributary to Guaje Canyon.
[c] Includes 06A-106 discharge to Threemile Canyon, a tributary to Pajarito Canyon.
[d] Includes 05A-055 discharge to Cañon de Valle, a tributary to Water Canyon.
Note: To convert gallons to liters, multiply by 3.7853.
Sources: LANL 2003h, 2004f, 2005f, 2006g.

Five canyons (Pueblo, Cañada del Buey, Guaje, Chaquehui, and Ancho Canyons) that previously received LANL discharges are no longer receiving any industrial effluent. Pajarito Canyon has not received any effluent since 1998. Water Canyon and its tributary, Cañon de Valle, Sandia Canyon, Mortandad Canyon, and Los Alamos Canyon continue to receive LANL effluent discharges. Cañada del Buey is permitted to receive effluent from the TA-46 Sanitary Wastewater Systems Plant, but that effluent has been routed to Sandia Canyon since the plant opened (LANL 2005f). Total effluent discharges to the canyons from LANL decreased by about 37 percent over the past 6 years.

It should be noted that the method used to measure and report flow rates at NPDES-permitted outfalls has significantly changed since the *1999 SWEIS*. Historically, instantaneous flow was measured and extrapolated over a 24-hour day, 7-day week period. Flow meters, used since 2001 in many (but not all) outfalls and measuring stations, provide more accurate flow measurements. At those outfalls without meters, the flow is still calculated according to the previous method. Without comparable values, trend analysis of yearly flows is difficult.

The distribution of total industrial effluent contributed by the various facilities (Key and non-Key Facilities) has also changed since the *1999 SWEIS*. Annual effluents generated and discharged are listed by facility in **Table 4–13**. Total effluent discharges from all facilities in 2005 were 63 percent of the total discharges in 1999. In 2005, Key Facilities discharged about 63 million gallons (240 million liters) of effluent, representing 32 percent of the total annual flow; and non-Key Facilities discharged about 135 million gallons (511 million liters) of effluent, or 68 percent of the annual flow. Flows from Key and non-Key Facilities have fluctuated, but generally decreased since 1999. The apparent increase in effluent from the Tritium Facility is due to increased effluent discharges from the TA-21 Steam Plant (LANL 2006g).

Quality of Effluent from NPDES-Permitted Outfalls

LANL personnel collect weekly, monthly and quarterly samples to analyze effluents for compliance with NPDES permit levels. The *1999 SWEIS* reported that LANL had "chronic problems meeting NPDES industrial/sanitary permit conditions" (DOE 1999a). This condition has improved significantly. Since 2000, LANL has maintained an average compliance rate with permit conditions of 99.75 percent. The current compliance rate is summarized in **Table 4–14**. Permit exceedance trends are shown in **Figure 4–14**. The number of samples exceeding permit limits in Table 4–14 may differ from the number of exceedances shown in Figure 4–14 because one sample may exceed two limits. Each of these samples were counted as two exceedances until October 2004, when the method of reporting exceedances was changed so a single sample could only represent one exceedance of permit limits (LANL 2006a). In the event that a permit level is exceeded, DOE reports the condition to the EPA and takes corrective action to address the noncompliance. Details of all exceedance events are provided in the Environmental Surveillance Reports for the respective years (LANL 1999b, 2000e, 2001f, 2002d, 2004a, 2004d, 2005h, 2006h). Generally, exceedances of permit standards in the 5 years since 2000 were of excess total residual chlorine.

Table 4–13 National Pollutant Discharge Elimination Systems Permitted Outfalls and Discharges by Facility

Facility	1999	2000	2001	2002	2003	2004	2005
Plutonium Complex							
Number of permitted outfalls	1	1	1	1	1	1	1
Discharge (million gallons per year)	8.6	6.5	0.41	2.82	3.02	2.72	2.40
Tritium Facility [a]							
Number of permitted outfalls	2	2	2	2	2	2	2
Discharge (million gallons per year)	9.0	8.6	0.39	13.4	19.03	22.09	32.98
CMR Building							
Number of permitted outfalls	1	1	1	1	1	1	1
Discharge (million gallons per year)	4.5	2.3	0.02	0.76	2.16	1.19	0.92
Sigma Complex							
Number of permitted outfalls	2	2	2	2	2	2	2
Discharge (million gallons per year)	5.77	3.9	0.06	2.00	7.62	1.97	3.80
High Explosives Processing Facility							
Number of permitted outfalls	3	3	3	3	3	3	3
Discharge (million gallons per year)	0.2	0.1	0.04	0.03	0.02	0.037	0.029
High Explosives Testing Facility							
Number of permitted outfalls	3	2	2	2	2	2	2
Discharge (million gallons per year)	14.3	16.1	9.00 [b]	1.38	1.75	0.58	0.47
LANSCE							
Number of permitted outfalls	4	4	4	4	4	4	4
Discharge (million gallons per year)	37.2	30.5	20.45	24.04	16.46	8.12	21.00
Biosciences Facilities (previously called Health Research Laboratory)							
Number of permitted outfalls	1	0	0	0	0	0	0
Discharge (million gallons per year)	0	0	0	0	0	0	0
Radiochemistry Facility							
Number of permitted outfalls	1	0	0	0	0	0	0
Discharge (million gallons per year)	0	0	0	0	0	0	0
Radioactive Liquid Waste Treatment Facility	1	1	1	1	1	1	1
Number of permitted outfalls	5.3	4.9	3.6	2.92	2.97	2.14	1.83
Discharge (million gallons per year)							
Number of permitted outfalls	0	0	0	0	0	0	0
Discharge (million gallons per year)	0	0	0	0	0	0	0
Applies to each of the following facilities: - Pajarito Site - Machine Shops - MSL - Waste Management - TFF - Operations							
Sub-Total Key Facilities							
Number of permitted outfalls	19	16	16	16	16	16	16
Discharge (million gallons per year)	85.0	72.5	24.99	47.17	53.03	38.85	63.43
Non-Key Facilities							
Number of permitted outfalls	17	4	4	5	5	5	5
Discharge (million gallons per year)	232	192.5	99.01	130.83	156.79	123.67	135.03
Totals							
Number of permitted outfalls	36	20	20	21	21	21	21
Discharge (million gallons per year)	317	265	124	178	209.8	162.52	198.46

CMR = Chemistry and Metallurgy Research, LANSCE = Los Alamos Neutron Science Center, MSL = Materials Science Laboratory, TFF = Target Fabrication Facility.

[a] The TA-21 Steam Plant Outfall is included in the Tritium Facility outfall totals and is usually 90 percent or more of the total flow attributed to this Key Facility, although it serves other facilities within that technical area.

[b] Value was incorrectly reported in the LANL 2003h Table 3.2-4 as .006638. The correct value is 9.0, per LANL 2004c.

Note: To convert gallons to liters, multiply by 3.785.

Source: LANL 2003h, 2004c, 2004f, 2005f, 2006g.

Table 4–14 Effluent Quality Monitoring and Compliance with Permit Limits for National Pollutant Discharge Elimination Systems-Permitted Outfalls

	1999	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
Industrial Outfalls							
Number of permitted outfalls (as of end of calendar year)	19	20	20	20	20	21	21
Number of samples collected	1,248	1,121	1,085	1,084	958	1,283	949
Number of samples exceeding permit limits	14 [a]	0	4	2 [b]	3 [c]	1 [d]	1
Yearly compliance rate (percent)	98.88	100	99.63	99.82	99.69	99.92	99.89
Sanitary Outfalls							
Number of permitted outfalls (as of end of calendar year)	1	1	1	1	1	1	1
Number of samples collected	175	200	134	129	132	145	126
Number of samples exceeding permit limits	0	0	0	0	0	0	0
Compliance rate (percent)	100	100	100	100	100	100	100

[a] Number of samples differs from Environmental Surveillance Report for 1999 because two samples exceeding permit limits were taken from the Guaje Well, which had been transferred to Los Alamos County ownership in 1998 (LANL 2006a).
[b] One sample exceeded both monthly average and daily maximum permit limits, so it counted as two exceedances.
[c] Two samples exceeded both monthly average and daily maximum permit limits, so they each counted as two exceedances.
[d] One sample exceeded both monthly average and daily maximum permit limits, but is counted as one exceedance under the new reporting method.
Sources: LANL 1999b, 2000e, 2001f, 2002d, 2004a, 2004d, 2005h, 2006a, 2006h.

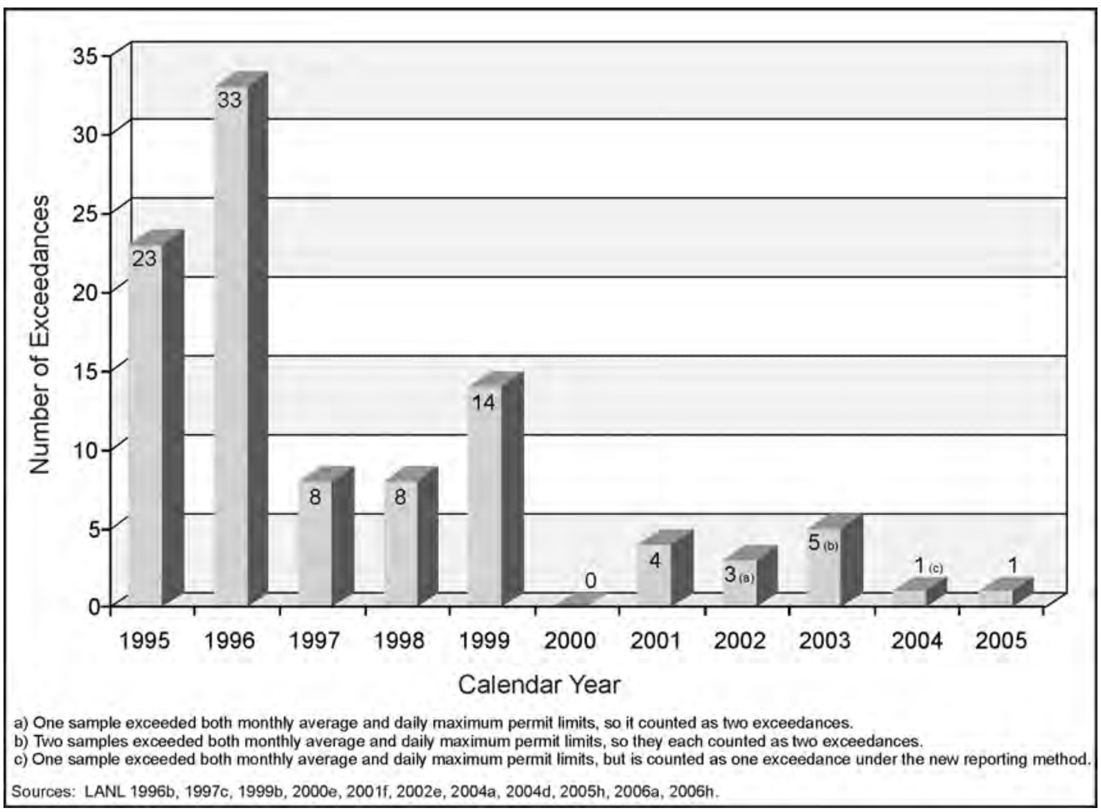


Figure 4–14 National Pollutant Discharge Elimination Systems Permit Exceedance Trend

Wastewater Treatment Facility Outfalls

LANL has three wastewater treatment facilities permitted to discharge treated effluent. The sanitary outfall shown in Table 4–14 refers to the TA-46 Sanitary Wastewater System Plant. The other two wastewater treatment facilities are the TA-50 Radioactive Liquid Waste Treatment Facility and the TA-16 High Explosives Wastewater Treatment Facility. Information on the operations of treatment facilities is presented in Section 4.9. Details on the improvements made to the treatment processes at the various wastewater treatment facilities may be found in the *SWEIS Yearbooks* (LANL 2002e, 2003h, 2004f, 2005f, 2006g).

The volume of treated effluent discharged from the TA-50 Radioactive Liquid Waste Treatment Facility has steadily decreased since the *1999 SWEIS*. In 2005, the Radioactive Liquid Waste Treatment Facility discharged 1.83 million gallons (6.9 million liters) compared to the 5.3 million gallons (20 million liters) discharged in 1999. Annual effluent discharges are shown in Table 4–13.

Effluent quality from the Radioactive Liquid Waste Treatment Facility has improved since the *1999 SWEIS.* At that time, the Radioactive Liquid Waste Treatment Facility effluent did not meet water quality discharge standards, resulting in a letter of noncompliance issued by NMED to LANL (LANL 2004c). New treatment processes have been installed since then to improve effluent quality. With these improvements, calendar year 2005 marked the sixth consecutive year that the Radioactive Liquid Waste Treatment Facility effluent had no violations of the NPDES permit limits or exceedances of the DOE Derived Concentration Guides for radioactive liquid wastes (Del Signore and Watkins 2005, LANL 2006a).

During this same 6-year period, the Radioactive Liquid Waste Treatment Facility has also met voluntary NMED groundwater standards for nitrates, fluoride, and total dissolved solids. Similarly, perchlorate concentrations in Radioactive Liquid Waste Treatment Facility effluent has been below the detection limit since March 2002, when perchlorate treatment equipment was installed. In addition, Radioactive Liquid Waste Treatment Facility tritium discharges have been less than one percent of the DOE Derived Concentration Guide since March 2001. Tritium-contaminated effluent that exceeds this voluntary standard of 20,000 picocuries per liter, which is the EPA drinking water standard, is now treated via evaporation at the TA-53 Radioactive Liquid Waste Treatment Plant (LANL 2004d). **Table 4–15** summarizes the water quality in the Radioactive Liquid Waste Treatment Facility effluent for 2005 for certain contaminants.

Since 1999, construction of TA-16 High Explosives Wastewater Treatment Facility has been completed and full operation has begun to comply with Federal Facility Compliance Act Agreement AO Docket No. VI-94-1210. With the operation of this new facility, 19 NPDES-permitted outfalls that previously received contamination from high explosives discharges have been eliminated. Three high explosives processing outfalls remain in use and the effluent discharged through these outfalls was reduced to 0.029 million gallons (0.11 million liters) per year in 2005. Yearly effluent discharged is shown in Table 4–13, High Explosives Processing Facility. The High Explosives Wastewater Treatment Facility is discussed further in Section 4.9 (LANL 2004d, 2005f, 2006g).

Table 4–15 Selected Water Quality Data for Radioactive Liquid Waste Treatment Facility Effluent in 2005

Contaminant	*Average Effluent Concentration in 2005*	*Standard Concentration Limit*	*Water Quality Standard*
Sum of 39 radionuclide ratios, including tritium	Less than 0.18	1.0 Sum of Ratios	DOE Derived Concentration Guideline
Nitrogen as nitrate	3.7 milligrams per liter	10 milligrams per liter	NMED Groundwater Standard for Human Health
Fluoride	0.24 milligrams per liter	1.6 milligrams per liter	NMED Groundwater Standard for Human Health
Total dissolved solids	182 milligrams per liter	1,000 milligrams per liter	NMED Groundwater Standard for Domestic Water Supply
Perchlorate	Not detected	(a)	No current standard
Tritium	3,200 picocuries per liter	2,000,000 picocuries per liter	DOE Derived Concentration Guideline
		20,000 picocuries per liter	EPA Primary Drinking Water Standard

NMED = New Mexico Environment Department, EPA = U.S. Environmental Protection Agency.
[a] The EPA has proposed a drinking water standard for perchlorate of 4 micrograms per liter, but it has not been issued yet.
Sources: LANL 2005h, 2006a, 2006h; Del Signore and Watkins 2005.

Treated liquid effluent from the TA-46 Sanitary Wastewater Systems Plant is currently pumped to storage tanks at TA-3 for reuse or is discharged to Sandia Canyon through an NPDES-permitted outfall.

The *1999 SWEIS* reported that the Los Alamos County Bayo Wastewater Treatment Facility discharges into Pueblo Canyon where that effluent could mobilize sediment contaminants from former LANL operations in Acid Canyon downstream. This facility is not owned or operated by LANL, but it may have an impact on contaminant transport in surface water and groundwater contamination (LANL 2005h).

4.3.1.3 Stormwater Runoff

During New Mexico's summer rainy season, there can be a large volume of stormwater runoff flowing over LANL facilities and construction sites picking up pollutants. The most common pollutants transported in stormwater flows are radionuclides, polychlorinated biphenyls, and metals (LANL 2005h). At the time of publication of the *1999 SWEIS*, conventional programs were in place at LANL to manage and control stormwater runoff from its industrial activities and construction projects. Since then, LANL has improved its monitoring of stormwater runoff. The program improvements are the result of changes in the EPA NPDES stormwater permitting program, increased regulatory attention on stormwater flows from solid waste management units, and ongoing programmatic changes that improve monitoring activities and implement best management practices for stormwater pollution prevention.

Stormwater runoff at LANL was managed under a Multi-Sector General Permit for industrial activities and a General Permit for construction projects in 1999. The Multi-Sector General Permit covered stormwater runoff from 25 onsite industrial activities, which included all solid waste management units as one of those industrial activities. Until March 2003, the Construction General Permit requirements addressed the management of stormwater runoff from various construction activities disturbing 5 or more acres (2 hectares) (64 *Federal Register* [FR] 68721). After March 2003, the threshold for obtaining a permit was lowered to 1 acre (0.4 hectare).

As conditions of these general permits, LANL developed and implemented Stormwater Pollution Prevention Plans at industrial and construction sites. Stormwater monitoring was conducted downstream of the waste management areas (TA-54, Areas G and J, and TA-50) and in 29 locations within eight watersheds (DOE 1999a). Several new gaging stations and automated samplers have been added since 2001. Samples are analyzed and results are published biannually in the discharge monitoring reports. In addition, changes in the stormwater management program, including the status of stormwater pollution prevention plans and stormwater monitoring activities, have been reported in the annual Environmental Surveillance Reports.

Currently, DOE's strategy for managing stormwater runoff includes the following programs:

- The *NPDES Industrial Stormwater Permit Program*, which regulates stormwater runoff from industrial activities under a Multi-Sector General Permit. Stormwater monitoring and erosion controls are required at these sites.

- An integrated *Stormwater Monitoring Program* that monitors stormwater runoff on a watershed basis and at individual solid waste management units. Erosion controls are required at sites where a water quality threshold has been exceeded. LANL recently began to implement these programs in response to the 2004 Federal Facility Compliance Agreement between the EPA and DOE.

- The *NPDES Construction Stormwater Program*, which regulates stormwater from construction activities disturbing 1 acre (0.4 hectare) or more, per the EPA Construction General Permit.

Table 4–16 shows a summary of the stormwater program activity between 1999 and 2004. The current status of the program is discussed in the following sections.

Table 4–16 Summary of Stormwater Program Activity

	1999	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
National Pollutant Discharge Elimination System Industrial Stormwater Program							
Number of industrial activities permitted for discharge of stormwater	22	19	20	18	17	15	15
National Pollutant Discharge Elimination System Stormwater Construction Program							
Number of construction projects permitted under General Permit for Stormwater Discharges from Construction Activities	6	8	10	13	21	34	37
Number of stormwater pollution prevention plans implemented at construction sites	Not applicable	Not applicable	23 [a]	44 [a]	51 [b]	67 [b]	64 [b]
Number of stormwater pollution prevention plan inspections conducted at construction sites	Not applicable	Not applicable	Not applicable	435	675	616	833

[a] Required for construction sites disturbing 5 acres or more.
[b] Required for construction sites disturbing 1 acre or more.
Sources: LANL 1999b, 2000e, 2001f, 2002d, 2004a, 2004d, 2005h, 2006a, 2006g.

Recent data from stormwater runoff monitoring detected some contaminants onsite and offsite, but the exposure potential for these contaminants is limited (see Table 4–8). Radionuclides have been detected in runoff at higher levels than the 15 picocuries per liter livestock watering criterion in Guaje, Pueblo, Los Alamos, Mortandad, Pajarito, and Water Canyons, with sporadic detections extending offsite in Pueblo and Los Alamos Canyons. As the areas burned in the Cerro Grande Fire recovered, total suspended solids that transport radionuclides decreased along with the radionuclide concentrations. Los Alamos Canyon and Sandia Canyon runoff and base flows contain polychlorinated biphenyls at levels above New Mexico human health stream standards (NMAC 20.6.4.900.B), but polychlorinated biphenyl levels are above background levels both upstream and downstream of LANL in the Rio Grande. Dissolved copper, lead and zinc have been detected in many canyons above the New Mexico acute aquatic life stream standards, and these metals were detected offsite in Los Alamos Canyon. Some of these polychlorinated biphenyl and metals' detections were upstream of LANL facilities, which indicates that non-LANL urban runoff was one source of the contamination. Mercury was detected slightly above wildlife habitat stream standards in Los Alamos and Sandia Canyons. The installation of erosion controls near the polychlorinated biphenyl and mercury sources to minimize further migration of these contaminants is an example of the watershed-based approach to surface water quality protection. Surface water in Cañon de Valle, a tributary of Water Canyon, occasionally has explosive residue levels greater than the 6.1 parts per billion EPA Tap Water Health Advisory level, but the barium levels have dropped below the New Mexico Groundwater Standard (LANL 2005h). Other organics detected in stormwater runoff above New Mexico Water Quality Standards include benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and chrysene. Inorganics detected in stormwater runoff include aluminum, silver, arsenic, cadmium, and selenium (LANL 2006h).

NPDES Industrial Stormwater Permit Program

The NPDES Industrial Stormwater Permit Program regulates stormwater flows from industrial activities at LANL (including solid waste management units). Historically, these flows were managed under the 1995 NPDES Multi-Sector General Permit. The current EPA Multi-Sector General Permit, effective since December 2000, regulates stormwater runoff from the following conventional industrial activities at LANL:

- Hazardous waste treatment, storage, and disposal facilities (including solid waste management units);
- Landfills and land application sites;
- Steam and electric power generating facilities;
- Asphalt batch plant operations;
- Metal fabrication activities;
- Primary metal activities; and
- Vehicle maintenance activities, and warehousing.

Under the Multi-Sector General Permit, DOE maintains and implements stormwater pollution prevention plans for industrial locations; maintains and samples monitoring stations for each industrial activity; and implements best management practices to control runoff and erosion from the industrial locations (NNSA 2004b). A *Storm Water/Surface Water Pollution Prevention Best Management Practices Guidance Document* has been developed by DOE to describe these practices (LANL 1998b). As of 2005, LANL protected 25 industrial activity locations with 15 stormwater pollution prevention plans, sampled stormwater flow at over 70 monitoring stations, inspected and maintained best management practices, and published and reported monitoring results to EPA and NMED in discharge monitoring reports (LANL 2006b).

NPDES Stormwater Construction Program

At the time of the *1999 SWEIS*, stormwater from construction projects was regulated under an NPDES General Permit. EPA changed the disturbed land threshold requiring a Construction General Permit from 5 to 1 acre (2 to 0.4 hectares) in 2003, when it updated the Stormwater Construction regulations. Under the current Construction General Permit Program, permits are required for all LANL construction activities or other projects that disturb 1 acre (0.4 hectare) or more. Conditions of the permit require the development and implementation of site-specific stormwater pollution prevention plans and the use of best management practices to reduce or eliminate the potential for offsite erosion and stormwater contamination. Construction projects with stormwater pollution prevention plans are inspected regularly to ensure compliance with the terms of the Construction General Permit (LANL 2004d).

In 2004, the LANL *Engineering Standards Manual* and the *LANL Master Construction Specifications* were updated to require that all land-disturbing projects, regardless of size, control the transport of sediment and other pollutants from disturbed areas. Meeting this requirement would maintain sediment yield and stormwater runoff rates within the watershed at values equal to or less than those experienced prior to any development, significantly minimizing post-development impacts on the surrounding area. This would be accomplished by stabilizing all disturbed areas through revegetation or placement of permanent structures or other equivalent measures (asphalt, concrete, gravel), as well as managing runoff from the impermeable surfaces through permanent controls such as detention ponds with controlled outlets. Best management practices would prohibit the flow of stormwater runoff across a designated environmental restoration site (such as a potential release site, solid waste management unit, or area of concern), minimizing the potential for the transport of legacy pollutants from these areas (LANL 2004b, 2004j, 2006e). The current program protects more construction sites from erosion and contaminant transport than were covered in 1999.

Another improvement began in 2003 with the use of a geographic information system-based tracking system to help manage Construction General Permit sites. The tracking system maintains records for each construction site, such as site coordinates, inspections, conditions of best management practices, Stormwater Pollution Prevention Plan deficiencies, and deficiency corrections. Construction General Permit information for LANL is accessible to the public through postings in the Los Alamos County Municipal Building (LANL 2004d).

Information in Table 4–16 shows the increase in Stormwater Construction Program activities since the *1999 SWEIS*, including the number of permits issued, Stormwater Pollution Prevention Plans implemented, and inspections conducted.

Stormwater Monitoring from Solid Waste Management Units

The management of stormwater runoff from solid waste management units has changed significantly since the *1999 SWEIS*. From 1992 through 2003, solid waste management units were considered an industrial activity and stormwater runoff was managed under the Multi-Sector General Permit Program. Since 2003, DOE has been transitioning towards managing stormwater runoff from the solid waste management units under an individual NPDES industrial activity permit. DOE began implementing an integrated stormwater monitoring program to meet the anticipated requirements of the Federal Facility Compliance Agreement in mid-2004 and submitted the first part of an individual permit application in late 2004. The Federal Facility Compliance Agreement is an interim step for managing runoff from solid waste management units until the individual permit is issued. The Agreement was issued in 2005 and is to remain in effect until the goals of the agreement are completed. More information on the Federal Facility Compliance Agreement is provided in Chapter 6 of this SWEIS (EPA 2005a; NNSA 2004b, 2004c).

DOE's integrated stormwater program under the Federal Facility Compliance Agreement includes the following two major elements.

- A watershed-based monitoring program. This includes approximately 60 automated monitoring and gaging stations located within nine LANL watersheds. Watershed monitoring is performed under a Stormwater Monitoring Plan, which was submitted to EPA and NMED in 2004 and will be updated annually (LANL 2005f, NNSA 2004b).

- Site-specific sampling at solid waste management units and areas of concern. This program requires stormwater sampling immediately downstream of approximately 300 designated sites on a rotating basis over a four-year schedule. The program will be performed under a unit-specific stormwater pollution prevention plan.

For the watershed program, gaging stations monitor flow rates. Stormwater samples are analyzed for radionuclides, metals, polychlorinated biphenyls, dioxin and furan, high explosives, perchlorate, cyanide, and suspended sediment concentrations (EPA 2005a, LANL 2006h). The sampling data are routinely published in monthly and annual reports submitted to EPA and NMED. Monitoring results are compared to stormwater-specific screening action levels and are the basis for corrective actions, the use of best management practices, and potential source removal. Erosion control measures installed to minimize sediment transport or pollutant migration are inspected after major storm events. The plans for each program (the Stormwater Monitoring Program and the unit-specific stormwater pollution prevention plans) are updated annually to include new information and requirements to ensure continuous improvement of the program. The stormwater program information has been integrated into the geographic information system-based tracking system to help manage the monitoring sites and maintain records, including stormwater pollution prevention plan inspections, the condition of best management practices, and the progress of corrective actions.

Fully implemented in 2005, the integrated stormwater monitoring program triggers actions that will minimize erosion and the transport of pollutants from solid waste management units, and provides information on a watershed scale to identify problems that could violate New Mexico surface water quality standards. With these changes, the adverse impacts to surface water from stormwater runoff are expected to be less in the future than the impacts identified in the *1999 SWEIS* (LANL 2006e, NNSA 2004c).

4.3.1.4 Watercourse Protection

DOE conducts a variety of activities that require excavation, filling, crossing, working in, or otherwise disturbing a watercourse or wetland. These activities may be subject to Sections 401 and 404 of the Clean Water Act, commonly called the *Dredge and Fill 404 and 401 Permit Program*. A 404 and 401 permit sets specific conditions for the use of best management practices to protect water quality and to ensure compliance with New Mexico surface water quality standards (DOE 1999a). Since the *1999 SWEIS,* DOE has continued to obtain permits and comply with Sections 404 and 401 permit conditions for construction activities conducted in watercourses.

Table 4–17 shows a summary of the Clean Water Act Sections 404 and 401 permit activities between 1999 and 2004. Permitted activities typically last for less than one year.

As a result of increased runoff after the Cerro Grande Fire, DOE conducted numerous dredge and fill activities to stabilize road crossings, clean roadside culverts, and armor utility lines crossing LANL canyons. Each project was required to obtain a 404 and a 401 permit, implement stormwater pollution prevention plans and best management practices, and meet permit conditions to protect surface waters. Most of these project activities have now been completed, but the stormwater pollution prevention plans will remain in place until the sites have been stabilized (LANL 2004c).

Table 4–17 Summary of Dredge and Fill Permits Issued Each Year

	1999	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
Dredge and Fill Permit (Section 404/401) Program							
Number of permits for dredge and fill activities in water courses	9	9	24	8	2	2	2

Sources: LANL 2006a, 2006h.

4.3.1.5 Watershed and Sediment Monitoring

DOE monitors watersheds and sediments onsite, offsite, and at regional locations. Several new onsite gaging stations and automated samplers have been added to the monitoring network since the Cerro Grande Fire. Flow records for LANL stream gages have been published annually since 1995. The most recent report is *Surface Water Data at Los Alamos National Laboratory, 2003 Water Year* (Schaull et al. 2004). Sediments are sampled from all major canyons that cross LANL (onsite and offsite), as well as from the Rio Grande and area reservoirs, along tributary canyons, in major canyons upstream and downstream of LANL, and at watercourse junctions with the Rio Grande. Detailed information about sampling activities and monitoring results are published annually in LANL Environmental Surveillance Reports.

Sediments deposited in and along canyons on the Pajarito Plateau occur as narrow bands that can be transported by surface water, effluent discharges, stormwater runoff, spills, or flooding within the canyons. Past LANL activities have resulted in contamination of sediments both onsite and downstream, primarily transported by effluent discharges from LANL outfalls and stormwater runoff (DOE 1999a). Polychlorinated biphenyls have been detected in sediments in all the major canyons that cross LANL property, with the exception of Ancho Canyon and Cañada del Buey. The highest concentrations of polychlorinated biphenyls were found in Sandia Canyon sediments below LANL's main TA. Polychlorinated biphenyls and benzo(a)pyrene were detected on a widespread basis in 2004 sediment samples. The *LANL 2004 Environmental Surveillance Report* presents maps showing the distribution and concentrations of these organic compounds. The highest concentrations of the benzo(a)pyrene were found in Los Alamos Canyon sediments near downtown Los Alamos. The highest concentrations were several times greater than EPA Region 6 screening levels for residential and industrial outdoor workers. Recent environmental restoration investigations concluded that the polycyclic aromatic hydrocarbons in this area were principally derived from urban sources, such as asphalt (LANL 2005h).

The condition of LANL stream flows and sediments has changed since 1999 as programs for monitoring sediments and watersheds have evolved and improved. Major program changes include the following:

- *Improved stormwater monitoring under the Federal Facilities Compliance Agreement*. As discussed in Section 4.3.1.3, DOE is implementing a site-wide Stormwater Monitoring Plan that prescribes an integrated, watershed-based approach for stormwater monitoring and includes controls to minimize erosion and sediment transport.

- *Redistribution of contaminated sediments following the Cerro Grande Fire*. Following the Cerro Grande Fire, contaminated sediments in canyons were transported and redistributed downstream by higher volumes of stormwater runoff from the affected areas (Ford-Schmid, Englert, and Bransford 2004). The post-fire changes to the canyons and sediments are discussed in Section 4.3.1.7.

- *Decreased discharge of effluent from LANL into canyons*. The number of outfalls discharging effluent to canyons has decreased from 36 in 1999 to 21 in 2004. Comparing 2005 operating data to 1999 data, discharges to Sandia Canyon decreased about 40 percent (85.7 million gallons [324 million liters] per year); Los Alamos Canyon discharges increased about 19 percent (about 8.4 million gallons [32 million liters] per year); discharges into Mortandad Canyon decreased about 57 percent (22.5 million gallons [85 million liters] per year); and discharges into Water Canyon decreased about 97 percent (about 13.8 million gallons [52.2 million liters] per year) (LANL 2006g).

- *Removal of contaminated sediments from Los Alamos Canyon.* In 2001, DOE removed contaminated sediment in Los Alamos Canyon, which was known to contain radionuclide contamination from LANL's past operations. Approximately 915 cubic yards (700 cubic meters) of soil and sediment were removed from a 2.5 acres (1 hectare) site, minimizing the potential for contaminant transport in the event of a flood.

Sediments in the LANL area contain naturally occurring minerals, metals, and radionuclides. Sediments also contain contaminants that are the result of historic LANL operations. The *1999 SWEIS* presented a general understanding of sediment quality with regard to the presence of radionuclides, metals, and organics, based on sampling results from 1994 through 1996. DOE continues to monitor for these constituents and has added polychlorinated biphenyls, high explosive residues, barium, and six radionuclides to the list of analyzed constituents (LANL 2005h, Gallaher and Koch 2004). Monitoring results are compared against a variety of reference standards, screening action levels, and background values as described in Table 4–7. With these improvements, DOE has a better understanding of sediment contamination in the area than in 1999.

During the 2005 monitoring season, most samples above background levels came from stormwater runoff (see the discussion of recent stormwater runoff data in Section 4.3.1.3). Sediments contaminated with radionuclides remained below residential screening action levels throughout the site, and temporary increases in plutonium-239, plutonium-240, and cesium-137 concentrations have decreased to near pre-Cerro Grande Fire levels.

4.3.1.6 Floodplains

Floodplains are areas adjacent to watercourses that can become inundated with surface waters during high flows from runoff due to precipitation or snowmelt. At LANL, the floodplains are generally located in the canyons that lie between the mesa fingers (DOE 2002d). DOE regulations [10 CFR 1022.4] consider the critical action floodplain to be those areas affected during a 500-year flood (has a 0.2 percent chance of occurrence in any given year). The base floodplain, which is the floodplain considered by DOE’s Resource Conservation and Recovery Act (RCRA) Permit, is the 100- year floodplain (has a 1.0 percent chance of occurrence in any given year) [40 CFR 270.14(b)(11)(iii)]. To meet the requirements of its RCRA permit, DOE delineated the 100-year floodplain boundaries within the facility in 1992 (McLin 1992). DOE considered the 100-year flood at LANL to be created by the 100-year, 6-hour storm (McLin, Van Eeckhout, and Earles 2001).

In May 2000, the Cerro Grande Fire changed the extent and elevation of the floodplains in the canyons that traverse LANL. The Cerro Grande Fire created hydrophobic soils and removed vegetation, so surface water runoff and soil erosion were greatly increased over pre-fire levels. Due to concerns about the increased potential for flooding of LANL facilities and homes down-canyon from the burned areas, several flood and sediment retention structures were constructed as part of the emergency response. These structures include:

- a flood retention structure in Pajarito Canyon to retain sediment and prevent flooding;
- a low-head weir and sediment detention basin in lower Los Alamos Canyon to retain and prevent sediments from moving offsite;
- reinforcements to the reservoir in upper Los Alamos Canyon to serve as a catchment basin for stormwater runoff and sediment.

- four road crossing reinforcements along Anchor Ranch Road in Twomile Canyon and along NM 501 at Twomile Canyon, Pajarito Canyon, and Water Canyon; and
- a steel diversion wall above TA-18 in Pajarito Canyon.

These structures will remain in place until vegetative growth returns the watershed to approximately pre-Cerro Grande Fire or at least stable conditions. When that occurs, all or part of the flood retention structure and the entire steel diversion wall above TA-18 will be removed (DOE 2002j). Due to the increased chance of flooding after the Cerro Grande Fire, the floodplain boundaries were remapped for all the major canyons within the LANL facility (see **Figure 4–15**) (McLin, Van Eeckhout, and Earles 2001).

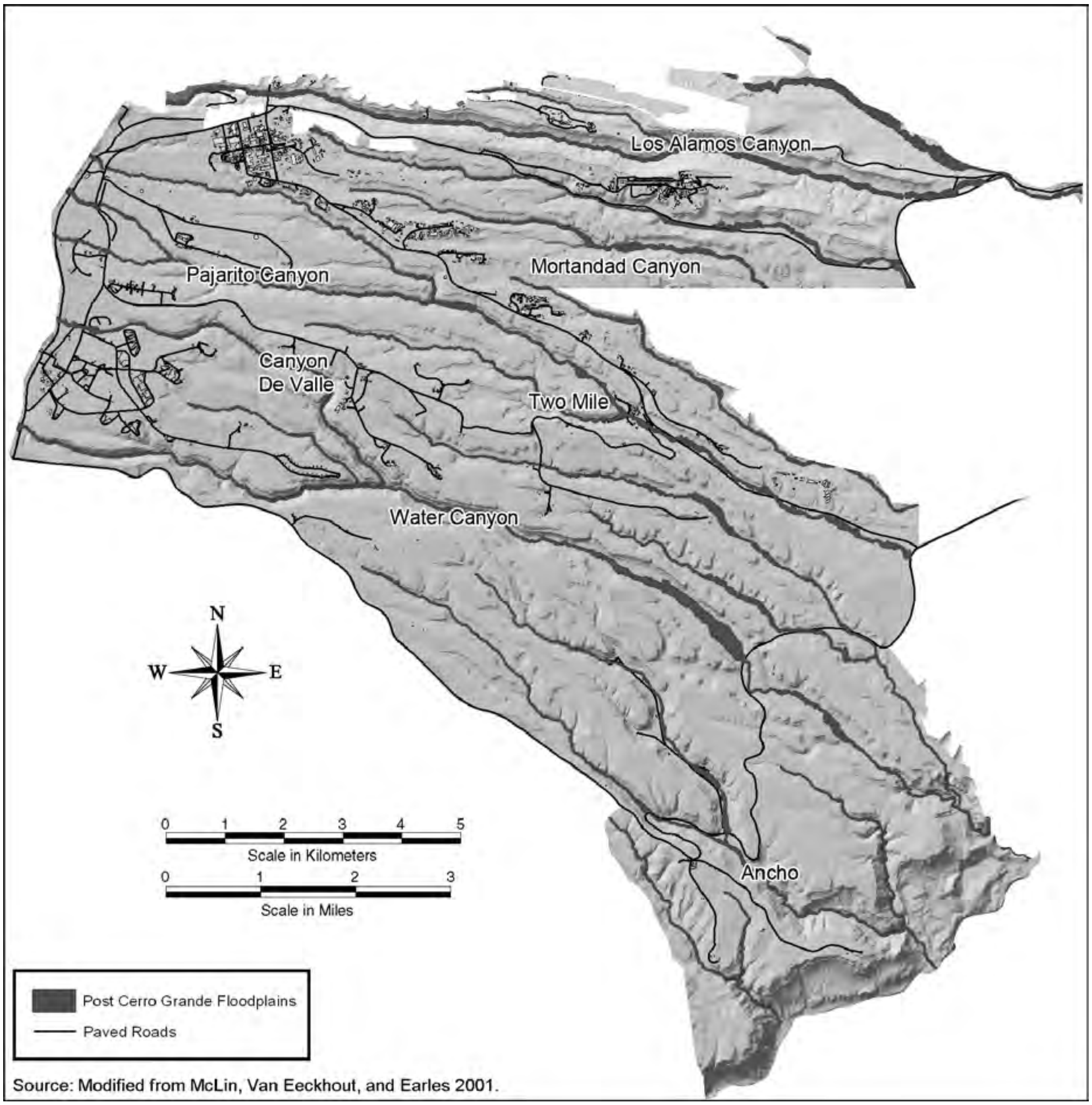


Figure 4–15 Post-Cerro Grande Fire Floodplains

Figure 4–15 represents a single point in time, as 4 years of vegetative growth in the burned forests west of LANL increased infiltration and reduced runoff volumes to the channels. The flood retention structures caused increased floodplain elevations upstream of the structures, and decreased flood elevations downstream. Sediment transport has altered the size and shape of the floodplains, so continued refinement of the post-fire floodplain maps is essential to determining an accurate picture of the LANL canyons (McLin, Van Eeckhout, and Earles 2001).

Using a geographic information system, LANL staff compared the post-Cerro Grande Fire floodplain files with the building location files. A list of buildings was generated including eight at TA-39 in Ancho Canyon, three at TA-41 in Los Alamos Canyon, and four at TA-72 in Los Alamos Canyon, that are completely within the post-Cerro Grande Fire 100-year floodplain boundaries. In addition, there were twelve buildings at TA-39, three buildings at TA-41, eight buildings at TA-72, one building at TA-18 in Pajarito Canyon, and one building at TA-36 in Potrillo Canyon that were partially within the post-Cerro Grande Fire 100-year floodplain boundaries. Most of these structures are small storage buildings, guard stations, well heads, water treatment stations, and some light laboratory buildings. Some facilities are characterized as moderate hazard due to the presence of sealed sources or x-ray equipment, but most have low hazard or no hazard designations. The Solution High-Energy Burst Assembly Building at TA-18 is within the 100-year floodplain, but the assembly is located there only during an experiment. The Omega West reactor is no longer located within the Los Alamos Canyon floodplain, as it was decommissioned and demolished in July 2003. There have never been waste management facilities in the 100-year floodplain (DOE 2002d; LANL 1998a, 2004c).

4.3.1.7 Overview of Cerro Grande Fire Impacts on Los Alamos Watersheds

The Cerro Grande Fire in May 2000 adversely affected the major canyons that cross LANL. The fire destroyed vegetation and changed the surface soils, causing increases in the amount of stormwater runoff entering the canyons. This increased stormwater runoff carried more soil, sediment, and ash from the entire affected watershed, including some areas at LANL that contain contaminants such as chemicals and radioactive materials (Ford-Schmid, Englert, and Bransford 2004). Sediment and ash from the burned areas of the Cerro Grande Fire have largely filled in the Los Alamos Reservoir. The reservoir now is periodically dredged to provide flood control, but it is no longer used for recreation, swimming, fishing, or irrigation (LANL 2004a). All of this raised concerns about adverse impacts to downstream water quality, as shown in Table 4–9, where selenium is listed as a probable cause of impairment due to mobilization from the Cerro Grande Fire.

Following the Cerro Grande Fire, the NMED contracted with Risk Assessment Corporation to perform a comprehensive, multi-media, analysis of risks to humans from exposure to LANL- and fire-associated contaminants (RAC 2002). One of the methods of contaminant transport analyzed was stormwater, which carried LANL- and fire-contaminated sediments and ash downstream of the LANL boundaries. After considering hypothetical exposures to radionuclides and chemicals through a variety of activities, such as farming, the report concluded that overall risks were within EPA acceptable ranges. Those findings were consistent with the conclusions of separate studies conducted by a multi-agency risk assessment team (IFRAT 2002) and by DOE (Kraig et. al. 2002).

After the Cerro Grande Fire, runoff events were monitored through the summer rainy seasons of 2000 through 2004. In 2005, DOE published two summary reports on the four years of post-fire monitoring and the resulting impacts to water quality and sediments (Gallaher and Koch 2004, LANL 2005j). The first report included results of sampling performed by DOE, as well as sampling performed by NMED and the U.S. Geological Survey. The second report is a summary of water quality and stream flow after the Cerro Grande Fire, that addresses issues raised by the after-effects of the fire (LANL 2005j). The NMED also published reports describing its findings of post-fire changes to stream flow and stormwater transport (Ford-Schmid and Englert 2004, Ford-Schmid, Englert, and Bransford 2004). A summary of the findings of these reports with regard to significant post-fire changes in runoff, sediment, and water quality is presented below.

In the first rainy season after the fire, water quality across the Los Alamos area was dominated by fire-created contaminants. By the end of the 2002 rainy season, most contaminant concentrations in surface water fell to near pre-fire levels (LANL 2004k). However, during 2003, the suspended sediment transport in downstream runoff continued to be elevated at about one order of magnitude higher than pre-fire conditions (Gallaher and Koch 2004).

Stormwater runoff increased significantly after the Cerro Grande Fire, due to the loss of vegetative cover. The first post-fire storms producing peak runoff flows in some drainages that were more than 1,000 times greater than pre-fire levels (LANL 2004a). Total runoff volumes for the year 2000 increased 50 percent over pre-fire years, and increased runoff continued in 2001, 2002, and 2003 at rates 2 to 4 times higher than pre-fire averages. In 2003, the total runoff from LANL was 2.7 times higher than pre-fire conditions, indicating that the effects from the fire are still present. Partial recovery of the area is indicated by the significantly lower peak flows and runoff yields from most drainages in 2002 and 2003. Unlike pre-fire years, most of the runoff in 2001 through 2003 was in Pueblo Canyon, where inventories of legacy contaminants are present in sediments. In 2002 and 2003, the runoff rates in areas south of Pueblo Canyon, which includes most of LANL, were similar to pre-fire conditions (Gallaher and Koch 2004). Significant urbanization of upper Pueblo Canyon may account for the continued high runoff volumes (LANL 2005j).

The most significant change after the Cerro Grande Fire was the increased concentration and transport of radionuclides, particularly plutonium-239 and plutonium-240, in stormwater runoff and sediments. This is due to higher stream flows that carry larger suspended sediment concentrations. Natural and LANL-derived radioactive particles are bound to these suspended sediments, so large floods in Pueblo Canyon, in particular, carried LANL-derived plutonium downstream. Median concentrations of total radionuclides in runoff increased 10 to 50 times from pre-fire levels, with most (95 percent or more) of the radionuclides bound to suspended sediments. LANL personnel estimate that the yearly movement of plutonium-239, and plutonium-240 beyond LANL boundaries during the 3 years after the fire increased by as much as 55 times over the previous 5-year average (LANL 2004k, 2005j; Gallaher and Koch 2004).

Plutonium has been transported beyond LANL boundaries in Pueblo Canyon, Los Alamos Canyon, and Acid Canyon. LANL-derived plutonium at levels near atmospheric fallout may have been transported 2 miles (3.2 kilometers) across the Pueblo of San Ildefonso boundary (LANL 2005h). Plutonium found in the Rio Grande riverbank and Cochiti Reservoir core sediments was analyzed using isotopic “fingerprinting” methods to determine its origin. This analysis found that about 60 percent of the Cochiti Reservoir sediment could be attributed to atmospheric fallout. The remaining 40 percent of the plutonium was primarily traceable to historic releases from the pre-1960s LANL operations in the Pueblo Canyon watershed (Gallaher and Efurd 2002).

Figures 4–16 and **4–17** show the changes in radionuclide concentrations in stormwater runoff and the increased transport of plutonium-239 and plutonium-240 in sediments compared to pre-fire levels. Concentrations of plutonium-238, plutonium-239, plutonium-240, and uranium in stormwater increased from pre-fire levels, with the most notable increase in plutonium-239, plutonium-240 concentrations from the pre-fire average of 2.3 picocuries per liter to a 2002 average of 105 picocuries per liter. The increases in plutonium-238, plutonium-239, plutonium-240, and americium-241 were attributed to contamination deposited during LANL historical operations, while cesium-137 and strontium-90 concentrations were attributed to fire-related effects and not LANL operations. By 2003, stormwater runoff from LANL contained significantly lower concentrations of radionuclides (except uranium), indicating improved conditions and reduced impacts from the Cerro Grande Fire. Uranium concentrations were attributed to runoff from LANL and from other sources (Gallaher and Koch 2004).

Downstream LANL Runoff, Pre-Cerro Grande Fire to 2003

Post-fire monitoring found that, by 2004, most flows had returned to normal conditions, so the pre- and post-fire monitoring data comparisons are limited to 2000 through 2003. Monitoring showed that storm events in 2001 through 2003 transported plutonium-contaminated sediments from Pueblo Canyon downstream into lower canyons at a level two orders of magnitude higher than pre-fire runoff (Gallaher and Koch 2004). NMED reported a similar rate of plutonium-239 and plutonium-240 transported in suspended sediments (Ford-Schmid, Englert, and Bransford 2004). From 2000 through 2003, DOE estimates that 64 millicuries of plutonium-239 and plutonium-240 were transported in suspended sediments in runoff downstream of Pueblo Canyon, representing about six percent of the inventory of plutonium in the canyon (Gallaher and Koch 2004). In comparison, NMED estimates 87 millicuries of plutonium-239 and plutonium-240 was transported between 2000 and 2002, representing about nine percent of the pre-fire plutonium inventory (Ford-Schmid, Englert, and Bransford 2004). A summary of estimated suspended transport of plutonium-239 and plutonium-240 by runoff before the Cerro Grande Fire and in the years 2000 through 2003 is presented in Figure 4–17. The total estimated plutonium-239 and plutonium-240 transported offsite in stormwater runoff was 5 microcuries in 2005 (LANL 2006h). Concentrations of americium and uranium in sediments also increased and are attributed to historic LANL activities (Gallaher and Koch 2004).

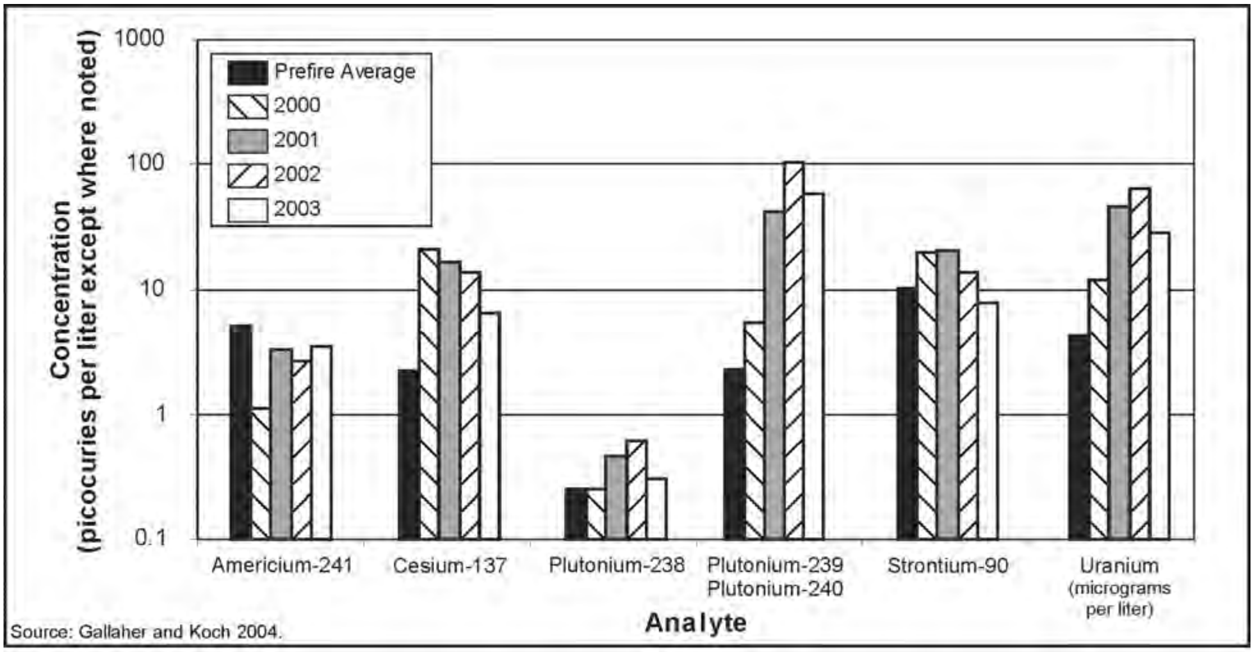


Figure 4–16 Flow-Weighted Average Concentrations of Radionuclides, Pre-Cerro Grande Fire to 2003

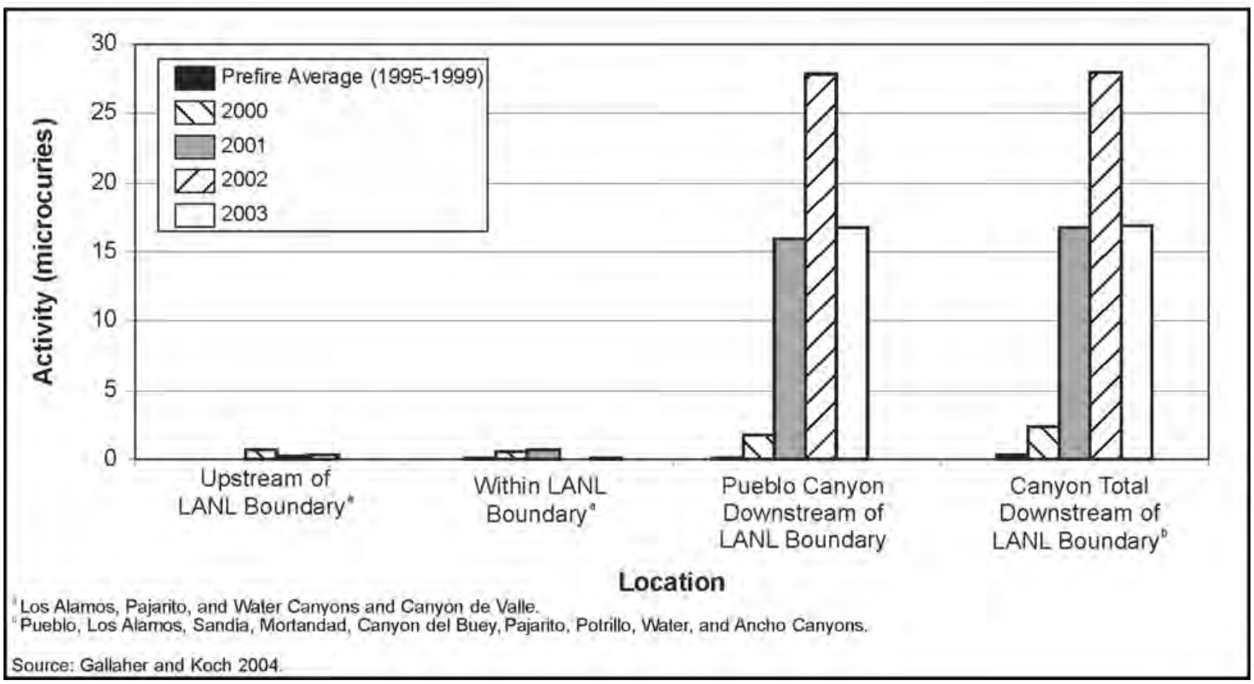


Figure 4–17 Estimated Plutonium-239 and Plutonium-240 Transported by Suspended Sediment in Runoff, Pre-Cerro Grande Fire to 2003

Post-fire stormwater runoff at LANL exceeded the applicable water standards for total gross alpha (New Mexico livestock watering standard) and the 100 millirem per year Derived Concentration Guide for plutonium-239 and plutonium-240. One runoff sample in 2000 contained plutonium-239 and plutonium-240, slightly higher than the EPA drinking water standard, so sediments were removed from the local area in 2001. A review of gross alpha results showed that concentrations at locations upstream of LANL were comparable to or higher than those within LANL. This indicates that other factors than LANL operations contributed to the high concentrations of gross alpha, which correlated with increased sediment concentrations in runoff after the fire. By 2003, the gross alpha activities in stormwater runoff were similar to those in pre-fire years. Concentrations of cesium-137, tritium, plutonium-238, strontium-90, and uranium in stormwater runoff between 2000 through 2003 remained within the applicable water quality standards. Amendable cyanide and total dissolved solids in runoff exceeded the New Mexico water quality standard in 2000 and 2001; however, amendable cyanide did not exceed standards during 2002 and 2003. Bicarbonate, calcium, cyanide, magnesium, nitrogen, phosphorous, potassium, barium, manganese, and strontium all showed elevated concentrations in post-fire runoff. The concentrations of these constituents declined progressively from 2000 through 2002 and were largely undetected in 2003 (Gallaher and Koch 2004).

Post-fire monitoring also detected metals in several locations. Total recoverable selenium was detected in many canyons at levels exceeding the New Mexico surface water stream standard for wildlife habitat of 5 micrograms per liter. Most of the selenium was probably due to non-LANL sources, because concentrations at locations upstream of LANL were comparable to or higher than those within LANL. In 2002, about 20 percent of storm runoff samples contained detectable concentrations of mercury, at levels below New Mexico short-term (acute) aquatic life standards. Spills of mercury have occurred at LANL in the past, but it remains uncertain if the mercury in the runoff is from LANL operations. Background levels of mercury in waters and sediments are appreciable. Mercury in runoff is a concern because it can enter the Rio Grande and accumulate in fish. Concentrations of mercury in Rio Grande sediments downstream of LANL were statistically similar to those measured upstream of the site. Dissolved metals concentrations in stormwater runoff were detected at concentrations greater than New Mexico groundwater standards for barium and chromium and New Mexico acute aquatic life surface water standards for copper and zinc. Because some of these higher concentrations were also found upstream or north of LANL, it is uncertain if they were due to site operations. Given the short duration of the stormwater runoff events, there is minimal opportunity for direct exposure to the water (LANL 2005h). The only metal consistently found at levels higher than New Mexico livestock watering and wildlife habitat stream standards was aluminum, which occurs naturally in soils (LANL 2005j).

With regard to changes in the Rio Grande and downstream reservoirs, LANL personnel concluded that post-fire runoff did not have an appreciable influence on flow rates or the water quality of the Rio Grande. Dissolved concentrations of radionuclides and metals in Rio Grande surface water were lower than EPA drinking water standards and comparable to pre-fire concentrations, indicating no lasting impacts to the river water from the fire. However, sediment samples collected from Cochiti Reservoir showed an increase in cesium-137, plutonium-238, and plutonium-239 concentrations from 3 to 6 times above pre-fire concentrations. These increases were attributed to the increased transport of LANL-impacted sediments from Pueblo Canyon.

Concentrations of cesium-137, plutonium-239, and plutonium-240 in the sediment were below risk-based screening levels (Gallaher and Koch 2004, LANL 2005j).

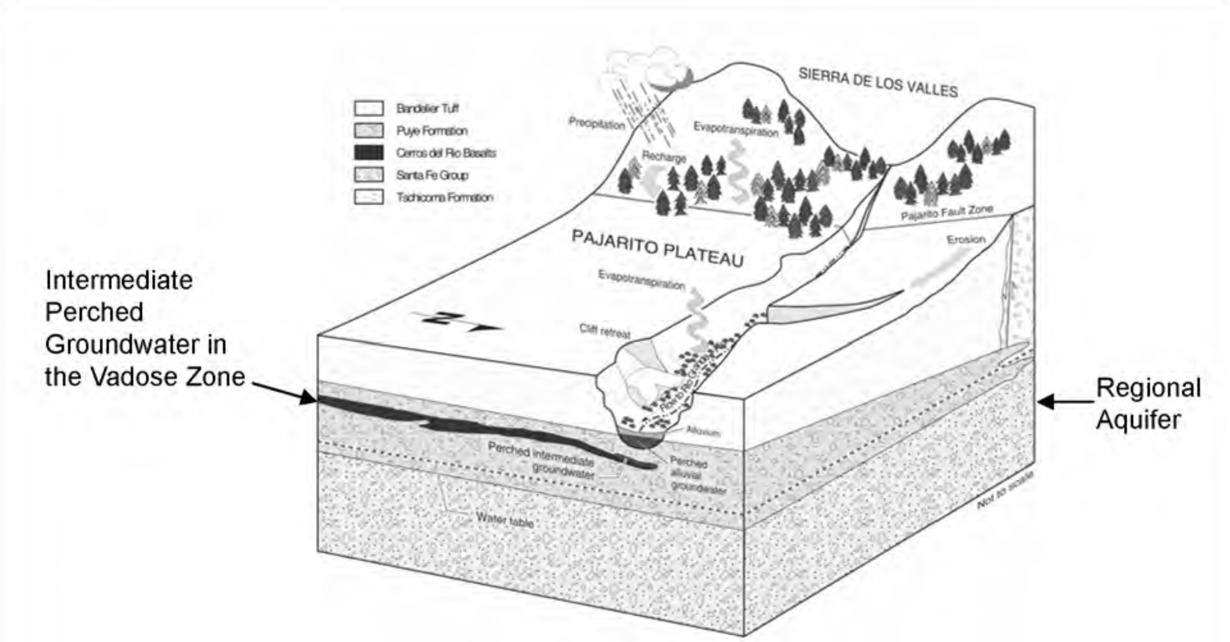
After the Cerro Grande Fire, NNSA constructed flood control structures at LANL and implemented a number of projects to control sediments and provide retention and deceleration of stormwater flows, as discussed in Section 4.3.1.6. The following projects continue to have beneficial impacts to the local canyons.

- Best management practices, including native vegetation planting and installation of jute matting, rock check dams, log silt barriers, and straw wattles, were implemented at 91 locations with possible contamination to control runoff and sediment transport.
- Contaminated sediment was removed from existing sediment traps in Mortandad Canyon, increasing the capacity of the existing traps and reducing further migration of the contamination.
- As discussed in Section 4.3.1.5, contaminated sediment was removed from areas in Los Alamos Canyon known to contain radionuclide contamination from LANL operations, minimizing the potential for contaminant transport in the event of a flood.
- The disposition of the flood control structures has not yet been determined. Options for complete or partial removal were evaluated in an Environmental Analysis document: *Proposed Future Disposition of Certain Cerro Grande Fire Flood and Sediment Retention Structures at LANL* (DOE 2002j). LANL personnel will continue monitoring and maintaining these structures until they are removed or until the affected watersheds are recovered or hydrologically stable (LANL 2004c).

Comparing post-fire and pre-fire conditions shows significant changes in the volume of stormwater runoff and sediment yield, which affects water quality. The increased stormwater flow and sediment transport is expected to diminish with time, as infiltration increases with the growth of new vegetation in the burned areas. Accelerated transport of legacy contaminants (radionuclides) occurred after the Cerro Grande Fire, with contaminated sediments moving from Pueblo Canyon into lower canyons. There are indications that stormwater runoff and sediment transport from most of the burned watersheds have improved and metal and radionuclide contaminant levels in stormwater runoff from the burned hillsides west of LANL have returned to near pre-fire levels. Sediment from these burned areas was deposited in the canyons, and erosion of this sediment continues, although the sediment load in stormwater runoff is decreasing. Watershed conditions are expected to return to pre-fire conditions by 2010 (DOE 2002j; LANL 2004d, 2005j).

4.3.2 Groundwater

Groundwater in the LANL area is located in several different places in the rocks underneath the site. **Figure 4–18** illustrates the hydrologic cycle on a typical watershed such as the Pajarito Plateau. Some precipitation runs off the ground surface into a local drainage (stormwater runoff); some soaks into the soil, where it is used by plants and released back into the atmosphere (evapotranspiration); and some infiltrates into the soil, passing through the plant root zone into the rocks, becoming part of the groundwater system (recharge).



Source: Modified from LANL 2005i.

Figure 4–18 Illustration of the Hydrologic Cycle at Los Alamos National Laboratory

The amount of rainfall in the LANL region is generally controlled by elevation. The Pajarito Plateau receives much less rainfall than the slopes of the Sierra de los Valles. Plants on the plateau use most of the water that enters the soil. Where the ground surface in the canyons is at or below the elevation of saturated layers of alluvium or rock, discharge of groundwater may occur as springs.

The three modes of groundwater occurrence are: 1) perched alluvial groundwater in canyon bottom sediments, 2) zones of intermediate-depth perched groundwater whose location is controlled by availability of recharge and by changes in rock permeability, and 3) the regional aquifer beneath the Pajarito Plateau. In wet canyons, stream runoff percolates through the alluvium until downward flow is impeded by less permeable layers of tuff, maintaining shallow bodies of perched groundwater within the alluvium. If not impeded by less permeable layers, surface water will eventually reach the regional aquifer.

Underneath portions of Pueblo, Los Alamos, Mortandad, and Sandia Canyons, intermediate perched groundwater occurs within the lower part of the Bandelier Tuff and within the underlying Puye Formation and Cerros del Rio Basalt. These intermediate-depth groundwater bodies are formed in part by recharge from the overlying perched alluvial groundwater. Intermediate groundwater occurrence is controlled by availability of recharge and variations in permeability of the rocks underlying the plateau. Depths of the intermediate perched groundwater vary. For example, intermediate perched groundwater has been found a shallow as 120 feet (37 meters) in Pueblo Canyon and as deep as 750 feet (230 meters) in Mortandad Canyon.

Some intermediate perched water occurs in volcanics on the flanks of the Sierra de los Valles to the west of LANL. This water discharges at several springs (Armstead and American) and yields a significant flow from a gallery in Water Canyon. Intermediate perched water also occurs within the LANL border just east of the Sierra de los Valles, in the Bandelier Tuff at a depth of approximately 700 feet (210 meters). The source of this perched water may be infiltration from streams that discharge from canyons along the mountain front and underflow of recharge from the Sierra de los Valles. Refer to Appendix E, Section E.6.2.2, for further discussion of the occurrence of perched water.

The regional aquifer of the Los Alamos area occurs at a depth of approximately 1,200 feet (370 meters) along the western edge of the plateau and about 600 feet (180 meters) along the eastern edge. The regional aquifer lies about 1,000 feet (300 meters) beneath the mesa tops in the central part of the plateau. Water in the aquifer flows generally east or southeast toward the Rio Grande, and groundwater model studies indicate that underflow of groundwater from the Sierra de los Valles in the Jemez Mountains is the main source of recharge for the regional aquifer (Nylander et al. 2003). Groundwater flow from the Sierra de los Valles to the Pajarito Plateau may be affected by the Pajarito Fault.

Figure 4–18 illustrates the relationships between perched water, the regional groundwater table, and the rocks beneath the surface in the LANL area. About 350 to 620 feet (110 to 190 meters) of unsaturated tuff, basalt, and low moisture content sediments separate the alluvial and perched groundwater zones and the regional aquifer (LANL 2005h).

Perched groundwater occurs in alluvium (sediment deposited by streams), found in the canyon bottoms, or at greater depths in the Bandelier Tuff or Puye Formation. The zones of perched water are typically not continuous, but are created where rock layers with low permeability impede downward water movement (LANL 2005i). These rock layers vary greatly in their ability to transmit water in saturated and unsaturated states. None of these perched water zones (shallow or intermediate) provide enough water to be a source for municipal drinking water.

Runoff or effluent discharges that does not infiltrate into the mesa tops flows down the canyons, and can enter the alluvium to form an unconfined groundwater body, particularly during spring snowmelt and mid- to late-summer thunderstorms. There are major LANL discharges into Sandia, Mortandad, and Los Alamos Canyons that help create alluvial groundwater bodies below those canyons.

Deep below the ground surface, there is an area of saturation that forms the regional groundwater aquifer. The regional aquifer is the only aquifer in the area capable of serving as a municipal water supply; the regional aquifer suppliers various customers including LANL, Los Alamos County, and others located in parts of Santa Fe and Rio Arriba Counties (LANL 2005h). A regional aquifer model was created for the *1999 SWEIS* to estimate the amount of groundwater stored beneath the Pajarito Plateau. More recently developed models have focused on the amount of drawdown in the aquifer and the effects of pumping near the water supply wells for Los Alamos County. The recent regional drought would only affect water levels through increased withdrawals for water supply use, because recharge from the surface occurs at a slow rate that changes only over a period of decades. The annual drop in the water table remains at 1 to 2 feet (0.3 to 0.6 meters) per year as projected in the *1999 SWEIS*.

4.3.2.1 Flow and Transport of Groundwater

Knowledge about the mechanisms of groundwater recharge and contaminant transport into the regional aquifer has increased since the *1999 SWEIS* was prepared. Additional characterization wells have been drilled at LANL, and groundwater hydrology has been modeled as part of the Hydrogeologic Work Plan, to further understand the hydrogeology and detect contamination in the regional aquifer (LANL 2003c). Additional information on geology and hydrology in the LANL vicinity is presented in Appendix E.

The Bandelier Tuff is an important rock formation due to its resistance to downward flow and its ability to capture and hold contaminations. The tuff is a complex of several volcanic ash and pumice falls that occurred at different periods during the history of the region. The porosity, permeability, and water content of the tuff are the principal physical characteristics that affect groundwater movement. Refer to Appendix E, Section E.6.3, for additional discussion of the hydrogeologic characteristics of the Bandelier Tuff.

The chemical interaction between tuff and water is also important. Volcanic glass in the tuff captures some contaminants by chemically attaching them to mineral surfaces (adsorbing) or by taking them into the structure of the minerals themselves (absorbing). As a result, large volumes of contaminants can be trapped, some permanently and some temporarily. The combination of these physical and chemical processes in the unsaturated tuff slows the movement of some contaminants toward the regional groundwater table.

Most of the alluvium in the canyon channels is composed of weathered tuff and pumice fragments that strongly hold some of the contaminants. Some of the contaminants introduced to the canyons by LANL outfalls are held in these perched water zones by adsorption to the sediments. Lateral movement of contaminants in the canyon channels and movement of contaminants downward into local perched water bodies underlying the canyon channels are being monitored (LANL 2005i).

4.3.2.2 Groundwater Quality in the Los Alamos National Laboratory Area

Groundwater chemistry varies with some general properties of the groundwater environment, such as the acidity of the water and the chemistry of local rock. Uranium, silicon, sodium, arsenic, and other chemical constituents that are common in the volcanic rocks of the LANL area appear as natural constituents in the groundwater of the Jemez Mountains region. Of interest for regional groundwater quality are levels of contaminants larger than those expected from naturally occurring groundwater constituents.

Since the 1940s, liquid effluent disposal by DOE has degraded water quality in the shallow perched groundwater that lies beneath the floor of several canyons. These water quality impacts extend, in a few cases, to perched groundwater at depths of a few hundred feet beneath these canyons. Recharge to the regional aquifer from the shallow contaminated perched groundwater bodies occurs slowly because the perched water is separated from the regional aquifer by hundreds of feet of unsaturated rock. As a result, little contamination reaches the regional aquifer from the shallow perched groundwater bodies, and water quality impacts on the regional aquifer, although present, are small.

Groundwater Quality Standards

LANL staff currently applies regulatory standards and risk levels to evaluation of groundwater samples. Standards and risk levels exist for both radioactive and nonradioactive contaminants.

For radioactive contaminants, LANL staff compares concentrations in samples from water supply wells that draw water from the regional aquifer to (1) EPA maximum contaminant levels for public drinking water systems and (2) the derived concentration guides for ingested water calculated from DOE's 4-millirem[1] per year drinking water dose limit (see below). For risk-based radioactivity screening, groundwater samples from sources other than water supply wells are compared to EPA maximum contaminant levels and to DOE's 4-millirem drinking water derived concentration guides.

EPA's maximum contaminant levels for public drinking water systems are contained in 40 CFR Part 141 and were derived for radionuclides and nonradionuclides in accordance with the provisions of the Safe Drinking Water Act. EPA maximum contaminant levels were established on the basis of limiting the risk from consuming contaminants in the water to very small levels and are often used as a standard or for comparison purposes for groundwater protection or remediation. For radionuclides, the EPA standard limits the radiation dose to a person drinking water from a public drinking water system to 4 millirem per year from manmade radionuclides emitting beta and photon radiation. EPA maximum contaminant levels for these radionuclides represent the concentration of each radionuclide in water that would result in an annual dose of 4 millirem, assuming consumption of 2 liters of water per day. EPA has also established maximum contaminant levels for other radionuclides or for groups of radionuclides (such as alpha-emitting radionuclides). For example, the EPA maximum contaminant level for tritium is 20,000 picocuries per liter of water, while the EPA maximum contaminant level for strontium-90 is 8 picocuries per liter.

In DOE Order 5400.5, "Radiation Protection of the Public and the Environment," DOE limits the radiation dose that may be received by members of the public from all routine DOE activities to 100 millirem in a year from all pathways. DOE also limits the radiation dose to persons drinking water from a DOE-supplied system to 4 millirem per year from water consumption alone.[2] To assist in compliance with these requirements, and for screening purposes, DOE has established derived concentration guides for exposure to individual radionuclides through air and water pathways. The derived concentration guides for ingested water in DOE Order 5400.5 correspond to the concentrations of individual radionuclides in water that, if ingested at a rate of 2 liters per day, would result in an annual dose of 100 millirem (100-millirem DOE derived concentration guide). A 4-millirem derived concentration guide for a radionuclide is derived by multiplying the 100-millirem derived concentration guide for that radionuclide by 0.04 (4-millirem DOE derived concentration guide).

---

[1] A millirem is a measure of the overall dose to an individual, whether from external radiation or contact with radioactive material. The dose is calculated by using radiation weighting factors and tissue weighting factors to adjust for the various types of radiation and the various tissues in the body receiving the radiation. Federal government standards limit the dose that the public may receive from operations at facilities such as LANL.

[2] DOE also requires operation of DOE facilities so that liquid effluents will not cause a private or public drinking water system downstream of the facility discharge to exceed the drinking water radiological limits in 40 CFR Part 141.

For nonradioactive contaminants, the New Mexico drinking water regulations and EPA maximum contaminant levels for nonradioactive constituents apply as regulatory standards in water supply samples and may be used as risk-based screening levels for other groundwater samples.

The New Mexico Water Quality Control Commission groundwater standards apply to concentrations of nonradioactive chemical quality parameters in all groundwater samples (NMAC 20.6.4). The toxic pollutants listed in the standards were screened at a risk level of 10^{-5} (1 chance in 100,000) for cancer-causing substances or a Hazard Index of one for non-cancer-causing substances. A Hazard Index of 1 or less indicates that no (noncancer) adverse human health effects are expected to occur. LANL staff uses the EPA Region 6 tap water screening levels to screen for New Mexico Water Quality Control Commission toxic pollutant compounds (EPA 2007a). For cancer-causing substances, because the Region 6 tap water screening levels are at a risk level of 10^{-6} (1 chance in a million), LANL staff uses 10 times these values to screen for a risk level of 10^{-5} (1 chance in 100,000). Because groundwater is a source of flow to springs and other surface waters that are used by neighboring Native American Tribes and wildlife, the standards for groundwater or the New Mexico Water Quality Control Commission surface water standards, including the wildlife habitat standards, apply to this water (LANL 2004d, NMAC 20.6.4). Examples of standards and screening levels used at LANL for nonradioactive contaminants include the 10-milligram-per-liter EPA drinking water maximum contaminant level for nitrate and the 1-milligram-per-liter New Mexico groundwater standard for molybdenum for irrigation use. The New Mexico groundwater standard for barium is 1 milligram per liter, while the EPA Region 6 tap water screening level for RDX (an explosive) is 6.1 parts per billion. For perchlorate, EPA established a drinking water equivalent level of 24.5 milligram per liter in 2006 (LANL 2006h).

Groundwater Monitoring Program

The March 1, 2005, Compliance Order on Consent (Consent Order) specifies the process for conducting groundwater monitoring at LANL and requires submittal of an Interim Facility Groundwater Monitoring Plan (Interim Plan) to NMED for approval. Prior to approval of this Interim Plan in June 2006, LANL staff expanded the number of groundwater locations monitored during 2005 to comply with the draft Consent Order. As the result of the Consent Order, DOE is changing the focus to watershed-specific investigations to find groundwater contamination and contaminant transport mechanisms.

From 1998 through 2004, 25 monitoring wells reaching to the regional aquifer were constructed. Additionally, six intermediate-depth wells were drilled (LANL 2005i).

By the end of 2005, 21 additional characterization wells were drilled using air rotary in the vadose zone and water, foam, mud, or EZ-MUD (a polymer) rotary in the saturated zone. Geologic cores were collected in the upper vadose zone in some of the wells. Geologic cuttings were collected at defined intervals during the drilling operations, and geophysical logging was conducted in each well to enhance understanding of the stratigraphy and rock characteristics (LANL 2006h).

Seven intermediate-depth wells were also installed on LANL property in and adjacent to Mortandad Canyon to improve the conceptual model of the geology, hydrogeology, and hydrochemistry of the area. The data collected from these intermediate wells will be used for numerical modeling studies addressing contaminant migration in the vadose (unsaturated) zone (LANL 2006h).

Sampling in 2006 indicated that chromium contamination is present in the regional aquifer in a limited area beneath Sandia and Mortandad Canyons and in perched groundwater beneath Mortandad Canyon. Chromium contamination was not detected in water-supply wells. In recognition of these results, the LANL contractor prepared an *Interim Measures Work Plan for Chromium Contamination in Groundwater* (LANL 2006d). The goals of the work plan are to:

- Determine the primary sources of chromium contamination and the nature of operations associated with the releases;
- Characterize the present-day spatial distribution of chromium and related constituents;
- Collect data to evaluate the geochemical and physical/hydrologic processes that govern chromium transport; and
- Collect and evaluate data to help guide subsequent investigations and remedy selection.

To accomplish these goals, work plan activities include:

- Conducting quarterly sampling of selected regional aquifer and intermediate groundwater wells;
- Investigating surface water and alluvial groundwater loss in Sandia Canyon;
- Installing six core holes in lower Sandia Canyon;
- Installing five alluvial wells in lower Sandia Canyon;
- Determining chromium distributions in the upper vadose zone from archival and new cores collected from Los Alamos, Sandia, and Mortandad Canyons;
- Rehabilitating well R-12 in lower Sandia Canyon;
- Refining the understanding of background concentrations and speciation of chromium in groundwater; and
- Collecting and synthesizing data and information to support conceptual model development and remedy selection.

Results of monitoring for contamination of environmental media around LANL are reported annually in LANL environmental surveillance reports. Contamination detected in monitoring samples reflects worldwide fallout of radioactive particles from nuclear weapons testing; nuclear accidents such as Chernobyl; releases from industrial, commercial, medical, and household uses of chemicals and radionuclides; and releases from decades of activities at LANL. Some contaminants are present onsite at levels above applicable standards and guidelines. Elevated levels are investigated to confirm the validity of the results, determine the source and extent of the contamination, and evaluate needed control and cleanup technologies.

Perched Alluvial and Intermediate-Depth Groundwater

Perched alluvial and intermediate-depth groundwaters are not used as drinking water supplies. The following review of sampling results is taken from the 2005 LANL environmental surveillance report (LANL 2006h).

The discharge of radioactive effluents has caused alluvial groundwater contamination in DP, Los Alamos, and Mortandad Canyons. Strontium-90 is consistently measured in these canyons at levels above its 8-picocuries-per-liter EPA drinking water maximum contaminant level. Mortandad Canyon also has a localized groundwater concentration of plutonium-238, plutonium-239, plutonium-240, and americium-241 above the 4-millirem DOE derived concentration guide for these radionuclides. Mortandad Canyon is the only location where in the mid 1990s, tritium was detected above the 20,000-picocuries per liter EPA drinking water maximum contaminant level; measured levels dropped below this standard in 2001, and have been dropping steadily since then. None of the radionuclide levels exceeded the 100-millirem-per-year DOE derived concentration guide for public dose from all pathways (LANL 2004d, 2005h).

In Pueblo Canyon, samples from one intermediate well contained 944 picocuries per liter of tritium. Tritium concentrations in other intermediate well samples ranged from nondetectable to 34 picocuries per liter. Samples from all four alluvial wells in Pueblo Canyon indicated strontium-90 in concentrations ranging from 6 percent to 14 percent of the 8 picocuries per liter EPA drinking water maximum contaminant level. Three wells had detectable levels of plutonium-239 and -240. In Los Alamos Canyon, samples from two intermediate wells that are downstream from a former radioactive liquid waste discharge into DP Canyon contained 4,300 and 890 picocuries per liter of tritium.

In DP and Los Alamos Canyons, alluvial groundwater samples showed strontium-90 in concentrations above the 8-picocuries per liter EPA drinking water maximum contaminant level, while in DP Spring, the strontium-90 concentrations were above the 4-millirem DOE derived concentration guide screening level. Other LANL-derived radionuclides were found in alluvial groundwater, but in concentrations well below the 4-millirem DOE derived concentration guide screening level. Since the cessation of discharges, tritium concentrations in alluvial groundwater samples from DP and Los Alamos Canyons have fallen to levels between 80 and 200 picocuries per liter. Plutonium-238 concentrations in samples from lower Los Alamos Canyon were just above the detection limit for this radionuclide.

Tritium was found in four wells in intermediate groundwater in Mortandad Canyon in concentrations ranging from 4,300 to 23,500 picocuries per liter. Upstream toward the effluent discharge location the tritium concentration was 136 picocuries per liter. Technetium-99 was detected in three wells in concentrations ranging from 2.6 to 7.9 picocuries per liter.

Radionuclide levels in Mortandad Canyon alluvial groundwater (which is not a source of drinking water) were, in general, highest in samples nearest to the TA-50 Radioactive Liquid Waste Treatment Facility outfall. In years prior to 2005, the concentrations of strontium-90, plutonium-238, plutonium-239 and -240, and americium-241 exceeded the 4-millirem DOE derived concentration guides for these radionuclides. In 2005, results for the following radionuclides were near or above their 4-millirem DOE derived concentration guide screening levels: strontium-90; total uranium (likely an outlier, it was not supported by a laboratory replicate); and unfiltered americium-241, plutonium-238, and plutonium-239 and -240. The strontium-90 levels were above the EPA drinking water maximum contaminant level by a factor of up to 5.4.

In Pajarito Canyon, tritium was found at a concentration of 60 picocuries per liter in an intermediate-depth borehole near the eastern LANL boundary. No LANL-derived radionuclides were found in samples from five intermediate springs in the canyon.

In the intermediate perched zone of the Water Canyon watershed, tritium was detected in three wells and in several springs. Concentrations ranged from 7 to 68 picocuries per liter for the wells and from 70 to 195 picocuries per liter for the springs. Plutonium-239 and -240 were found in concentrations just above the analytical method detection limit in one unfiltered sample from a well in an intermediate perched zone, but not in the filtered sample.

Until new treatment methods were installed in 1999 to remove nitrate and in 2002 to remove perchlorate, discharges from the Radioactive Liquid Waste Treatment Facility caused high levels of nitrate and perchlorate in both alluvial and intermediate perched groundwater in Mortandad Canyon. In 2003 and 2004, nitrate levels were below the 10-milligram-per-liter EPA maximum contaminant level in alluvial groundwater samples in Mortandad Canyon, after being close to or exceeding that level in previous years. Nitrate concentrations in Pueblo Canyon have been in the vicinity of the nitrate maximum contaminant level in recent years.

Perchlorate was detected in four Mortandad Canyon wells in concentrations ranging from 81 to 256 micrograms per liter. EPA has not established a drinking water standard for perchlorate, but in January 2006, established a Drinking Water Equivalent Value of 24.5 micrograms per liter. Perchlorate was detected in all groundwater zones in Mortandad Canyon in 2005 in Pueblo Canyon off the LANL site, and just above the perchlorate background level (0.08 micrograms per liter) in the alluvial groundwater in Cañon de Valle. Sample concentrations of perchlorate in Mortandad Canyon alluvial and intermediate groundwater exceeded the EPA Drinking Water Equivalent Value.

Perchlorate concentrations in alluvial wells in Pueblo Canyon ranged from nondetectable to 1.9 micrograms per liter. Perchlorate values from the intermediate zone were nondetectable or background, except for a sample result of 1.5 micrograms per liter from one well. In Los Alamos Canyon, samples from intermediate-depth wells contained 8.1 and 2.5 micrograms per liter of perchlorate. In Sandia Canyon, perchlorate was not detected in samples from the intermediate groundwater.

Except for Bulldog Spring, perchlorate was found at background levels in intermediate waters in Pajarito Canyon. The Bulldog Spring perchlorate concentration was 0.6 micrograms per liter. Sampling results for alluvial springs and wells showed that perchlorate was either not detected or within background ranges.

---

[3] *Several of the newer monitoring wells are equipped with ports so that groundwater can be monitored at different depths.*

Perchlorate in the Water Canyon watershed intermediate wells and springs in the intermediate perched zones ranged from not detected to below background (0.58 micrograms per liter) for the wells and slightly above background (0.74 micrograms per liter) for the springs.

The chemical 1,4-dioxane was detected in two wells sampled from the perched intermediate zone in Mortandad Canyon. Although there is no Federal or state standard for 1,4-dioxane, LANL and NMED are working to determine the extent and impact of this contaminant.

Recently sampled perched water from intermediate and regional aquifer wells within the Mortandad, Los Alamos, and Sandia watersheds showed increasing concentrations of total dissolved chromium.

In Water Canyon, chromium concentrations were high in unfiltered samples and nickel concentrations were high in filtered and unfiltered samples taken from intermediate depths. At a depth of 755 feet (230 meters) below ground surface, unfiltered chromium concentrations ranged from 17 to 45 micrograms per liter; except in 2005 when the measured concentration was 153 micrograms per liter. The filtered chromium concentration at the same well and depth ranged from 0.8 micrograms to 6.2 micrograms per liter. If the values for filtered and unfiltered chromium were similar, which was not the case, it would indicate the presence of hexavalent chromium. At a depth of 892 feet (272 meters) below ground surface, unfiltered concentrations of chromium ranged from 6.7 micrograms to 35 micrograms per liter, except in 2005, when the value was 70 micrograms per liter. At the same well and depth, filtered chromium concentrations ranged between 0.7 and 1.9 micrograms per liter. These concentrations are less than the New Mexico standard of 50 micrograms per liter for chromium in filtered samples. For nickel, recent (2005) filtered concentrations at depths of 758 and 892 feet (231 and 272 meters) below ground surface were 720 micrograms and 520 micrograms per liter, respectively. The EPA maximum contaminant level for nickel is 100 micrograms per liter.

Samples from Test Well 1A in Pueblo Canyon, an older intermediate well, showed high iron, manganese, lead, and zinc concentrations related to rust and flaking from aging well components. Molybdenum is found in Los Alamos Canyon alluvial groundwater resulting from treatment chemicals no longer used in TA-53 cooling towers. Levels of molybdenum in the alluvial groundwater have been quite variable in recent years, perhaps because of large variations in stream flow caused by drought conditions. Barium and RDX (an explosive) are present in alluvial groundwater of Cañon de Valle in concentrations exceeding the New Mexico groundwater standard of 1 milligram per liter and the EPA Region 6 screening level of 6.1 parts per billion, respectively (LANL 2004d).

Regional Groundwater Quality

Water produced by regional aquifer wells at LANL continues to meet Federal and state drinking water standards, but contaminants reaching the regional aquifer have been documented (LANL 2005i). Naturally occurring uranium is the primary radionuclide detected in the regional aquifer and has been found in concentrations near the EPA drinking water maximum contaminant level of 30 micrograms per liter. Tritium is present at trace levels beneath Pueblo, Los Alamos, and Sandia Canyons. Tritium concentrations in Pueblo Canyon regional aquifer monitoring wells increased downstream, from nondetection at Test Well 4 (above a former outfall of radioactive wastewater in Acid Canyon, a tributary to Pueblo Canyon) to 117 picocuries per liter at Test Well 1 (near Otowi-1). Tritium in the former supply well Otowi-1 was measured at a concentration of 33 picocuries per liter. In Los Alamos Canyon, sample results indicated tritium concentrations up to 14.9 picocuries per liter (LANL 2006h).

Beneath Mortandad Canyon, a sample result from a regional aquifer well showed a technetium-99 concentration of 5.24 picocuries per liter, which is smaller than the 4-millirem DOE derived concentration guide of 4,000 picocuries per liter. After reanalysis, technetium-99 was not detected in three other samples from this well. Samples from another well showed that tritium concentrations increased from 2 picocuries per liter in 2000 to 31 picocuries per liter in 2005. This was attributed to some contribution of recent recharge to the regional aquifer. Samples from another well indicated tritium in concentrations up to 181 picocuries per liter. No other regional aquifer well in Mortandad Canyon had repeatable low-detection limit detections of tritium (the method detection limit is about 1 picocurie per liter).

Water supply wells on the mesa top south of Cañada del Buey had one sampling event in 2005. Tritium was detected in one sample, but was not detected in a reanalysis.

In 2005, samples from supply well PM-2 in Pajarito Canyon did not contain tritium detectable by the low-detection-limit method. Two apparent detections of DOE-derived radionuclides (cobalt-60 and combined plutonium-239 and -240) were found in Pajarito Canyon regional aquifer well samples. The cobalt-60 results are inconsistent with other data from two sampling events in 2005. Plutonium-239 and -240 detected in a filtered sample was not detected in the corresponding unfiltered sample, or in two reanalyses of the filtered sample. Samples from the only regional well in Pajarito Canyon that indicated tritium (well R-22, east of the low-level radioactive waste management facility MDA G) showed results of 2 to 3 picocuries per liter from 5 upper well screens and 11 picocuries per liter at the deepest well screens.

No tritium was found in any regional aquifer samples within the Water Canyon watershed. In Ancho Canyon, strontium-90 was found at a concentration slightly above its detection limit in a field blank and in one sample from a depth of 670 feet (204 meters) below ground surface. Strontium-90 was not detected in a filtered sample.

Perchlorate has been detected in the regional aquifer beneath Pueblo and Mortandad Canyons, with a few sample concentrations reaching as high as 6 parts per billion, and is present in concentrations smaller than 1 part per billion in groundwater throughout northern New Mexico. Perchlorate was detected in the regional aquifer in supply well Otowi-1 in Pueblo Canyon. Supply well Otowi-1 was taken off line because sample results indicated concentrations of perchlorate that averaged one tenth of the EPA Drinking Water Equivalent Value (or about 2.45 micrograms per liter). Perchlorate in a Los Alamos Canyon sample was 0.98 micrograms per liter, while samples from other regional aquifer and supply wells in Los Alamos Canyon were at background levels (smaller than 0.6 micrograms per liter). The PCB compound Aroclor-1254 was found in one sample, but was not found in any of the four samples collected during the previous year and is most likely an analytical artifact (LANL 2006h).

Samples from Sandia Canyon regional wells showed perchlorate concentrations in the range of 0.77 and 0.62 micrograms per liter, or slightly above the background range. Samples from supply wells PM-1 and PM-3 showed concentrations of about 0.42 micrograms per liter, also within the background range. Perchlorate in the regional aquifer below Mortandad Canyon has increased from less than 5 to 7 micrograms per liter. This increase was attributed to the lingering effects of well installation caused by the addition of water during drilling or well development or some change of concentration within the surrounding groundwater during this time. In other regional aquifer wells in Mortandad Canyon, perchlorate sample results were smaller than 0.5 micrograms per liter. Sampling at water supply wells PM-4 and PM-5 indicated a perchlorate presence of 0.34 micrograms per liter. This result was unchanged from previous samples and was similar to samples from other water supply wells in northern New Mexico.

In 2005, samples from supply well PM-2 in Pajarito Canyon showed an average perchlorate concentration of 0.31 micrograms per liter for six perchlorate analyses. These results were similar to prior data. Perchlorate was within its background range in samples from a regional aquifer well in the same canyon. Perchlorate concentrations in Water Canyon watershed samples were either not detected or were smaller than 0.31 micrograms per liter (background). Perchlorate in samples from a regional well located in Ancho Canyon was either not detected or was within the background range.

Samples from Water Canyon have shown elevated levels of the explosives compounds RDX and trinitrotoluene (TNT), as well as the organic solvents perchloroethylene and trichloroethylene. These solvents were found at levels near EPA Region 6 tap water screening levels, but slightly below EPA maximum contaminant levels (LANL 2004c, 2006h).

Naturally-occurring arsenic is present in Guaje Canyon wells in concentrations smaller than the EPA maximum contaminant levels. Several of the newer regional aquifer wells had high levels of aluminum, iron, and manganese due to drilling fluid or turbidity effects in samples.

On December 23, 2005, DOE notified NMED that samples collected in May, September, and November of 2005 from the regional aquifer in Mortandad Canyon contained chromium concentrations between 375 and 404 parts per billion. This exceeds the New Mexico Water Quality Control Commission standard of 50 parts per billion and the EPA maximum contaminant level of 100 parts per billion (Bearzi 2005). NMED directed DOE to provide an Interim Measures Work Plan. The plan was to provide a detailed assessment of hydraulic properties of the regional aquifer from data obtained from wells in Mortandad and Sandia Canyons and from monitoring wells in Los Alamos and Pajarito Canyons. Also, NMED required assessments of historical pumping, groundwater gradients, and effluent discharges. DOE was required to report the results of geochemical and geophysical studies related to the investigations, investigate surface water and alluvial water loss to the subsurface, and provide groundwater sampling plans.

An interim measures investigation was conducted by LANL and reported in November 2006 in accordance with the Consent Order. The report describes work performed to address chromium contamination problems in the groundwater at LANL and to ensure the protection of drinking water while long-term measures are being evaluated and implemented. Results of the investigation indicate that, although the predominant zone of infiltration into the vadose zone occurs in the middle reaches of Sandia Canyon, water-balance calculations show that infiltration may occur further up the canyon than initially thought (LANL 2006k).

Regional groundwater sampling data from monitoring wells and production wells showed that wells R-11 and R-28 have the highest levels of hexavalent chromium contamination (derived from past laboratory activities, primarily effluent from cooling-water systems). The highest concentration of total dissolved chromium was sampled at regional aquifer monitoring well R-28 in Mortandad Canyon, where the concentration increased from 375 to 428 micrograms per liter in filtered samples collected in 2005 and 2006. The hexavalent chromium concentration ranged from 376 to 423 micrograms per liter. The concentration of total dissolved chromium measured in regional aquifer monitoring well R-11 in Sandia Canyon increased from 18.4 to 29.4 micrograms per liter in samples collected during 2005 and 2006. The increasing concentrations imply that these wells may be on the leading edge of a chromium plume (LANL 2006k). Other wells may have slightly elevated chromium levels, but further assessments are required. Two deep wells are planned and the need for deep drilling is to be assessed as part of the next phase of the work plan. The focus will be on the nature and extent of all contamination and will not be limited to chromium (LANL 2006k).

Filtered samples collected at well R-15 showed concentrations of total dissolved chromium ranging from 2.6 to 7.9 micrograms per liter. Concentrations of hexavalent chromium in samples collected on January 30, 2006, ranged from 7 (filtered) to 7.1 (unfiltered) micrograms per liter. These results were slightly elevated for total dissolved chromium and hexavalent chromium compared to background concentrations for the regional aquifer. Detectable concentrations of total dissolved chromium and hexavalent chromium in samples collected from other wells ranged from 2.73 to 12.3 micrograms per liter for unfiltered samples and from 0.93 to 8.2 micrograms per liter for filtered samples (LANL 2006k). Hexavalent chromium concentrations in samples from a regional aquifer well in Sandia Canyon averaged 20 micrograms per liter in both filtered and unfiltered samples.

Chromium was found at 31.4 micrograms per liter in an unfiltered sample obtained from a well in Pajarito Canyon, at a depth of 907 feet below ground surface, but was found at 1.8 micrograms per liter in the filtered sample. Because prior unfiltered samples ranged from nondetectable to 3.2 micrograms per liter, the 2005 LANL Environmental Surveillance Report states that, "this latest unfiltered chromium result does not yet lend itself to a pattern that can be evaluated," (LANL 2006h).

4.4 Air Quality and Noise

4.4.1 Climatology and Meteorology

The LANL area climate is described in the *1999 SWEIS*. Changes in the meteorological data collection system at LANL and the meteorological data summary are discussed in this section, based on information in the *Information Document In Support of the Five-Year Review and Supplement Analysis for the Los Alamos National Laboratory Site-Wide Environmental Impact Statement* (LANL 2004c).

Climatological averages for atmospheric variables such as temperature, pressure, winds, and precipitation presented in this subsection are based on observations made at the official LANL meteorological weather station from 1971 to 2000. The current official weather station, which has five sample heights (4, 37.5, 75, 150, and 300 feet [1.2, 11, 23, 46, and 92 meters]), is located at TA-6 (LANL 2004c). Five other meteorological towers are also used at LANL. The locations of all six meteorological towers are shown in **Figure 4–19**.

Normal (30-year mean) minimum and maximum temperatures for the communities of Los Alamos and White Rock and Los Alamos Townsite temperature extremes are reported in the *1999 SWEIS*. Average rainfall and snowfall extremes are also reported in the *1999 SWEIS*. Normal (30-year mean) precipitation for the communities of Los Alamos and White Rock (see **Figure 4–20**) and the extremes of precipitation are unchanged for the expanded period 1971 through 2000 (DOE 1999a, LANL 2004c).

Figure 4–19 Los Alamos National Laboratory Meteorological Network

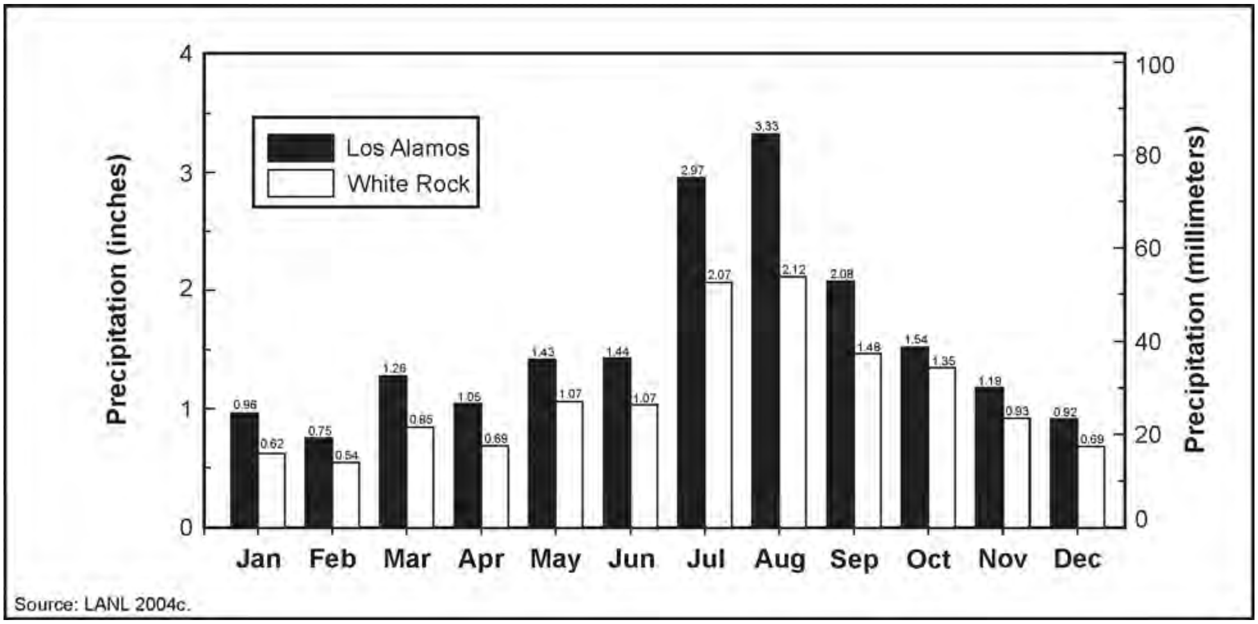


Figure 4–20 Los Alamos Area Mean Precipitation (1971 to 2000)

Since preparation of the *1999 SWEIS*, perhaps the most widespread and pervasive change in the region has been drought. LANL precipitation records show that between 1995 and 2004 there was only 1 year (1997) with above average precipitation. Precipitation patterns leading into the recent drought are strikingly similar, but of greater duration, to the period from 1953 to 1956, commonly referred to as the 1950s drought. The 1950s drought consisted of 4 years of progressively declining rainfall, with a sharp increase in precipitation in 1957 that ended the drought. The recent drought has been partially responsible for several disturbances that have greatly affected the regional environment. Dry weather facilitated the Cerro Grande Fire in May 2000, and set the stage for the bark beetle infestation that started around the summer of 2002 (LANL 2004c). Precipitation in 2004 was close to average, and in 2005 it was above average; however, there was a return to drought conditions toward the end of the year (LANL 2005h, 2006h).

4.4.1.1 Wind Conditions

Wind speed, direction, and turbulence are pertinent to air quality analysis. Los Alamos County winds average 7 miles per hour (3 meters per second). Wind speeds vary seasonally, with the lowest wind speeds occurring in December and January. The highest winds occur in the spring (March through June) due to intense storms and cold fronts. The highest recorded wind in Los Alamos County was 77 miles per hour (34 meters per second). Surface winds often vary dramatically with the time of day, location, and elevation, due to the region's complex terrain. Average wind direction and wind speed for the four primary measurement stations are plotted in wind roses and are presented in **Figures 4–21, 4–22**, and **4–23**. **Figure 4–24** presents the same wind information for the LANL measurement site on Pajarito Mountain and in Los Alamos Canyon at TA-41. For all stations except Pajarito Mountain, the data plotted are from 1996 through 2000. Pajarito Mountain's data spans 1998 through 2000. A wind rose is a vector representation of wind velocity and duration. It appears as a circle with lines extending from the center representing the direction from which the wind blows. The length of each spoke is proportional to the frequency at which the wind blows from the direction indicated. The frequency of calm winds (less than 1 mile per hour [0.5 meter per second]) is presented in the center of the wind rose (LANL 2004c).

In addition to seasonal changes in wind conditions, surface winds often vary with the time of day. An up-slope air flow can develop over the Pajarito Plateau in the morning hours. By noon, winds from the south usually prevail over the entire plateau. The prevalent nighttime flow ranges from the west-southwest to northwest over the western portion of the plateau. These nighttime winds result from cold air drainage off the Jemez Mountains and the Pajarito Plateau (LANL 2004c).

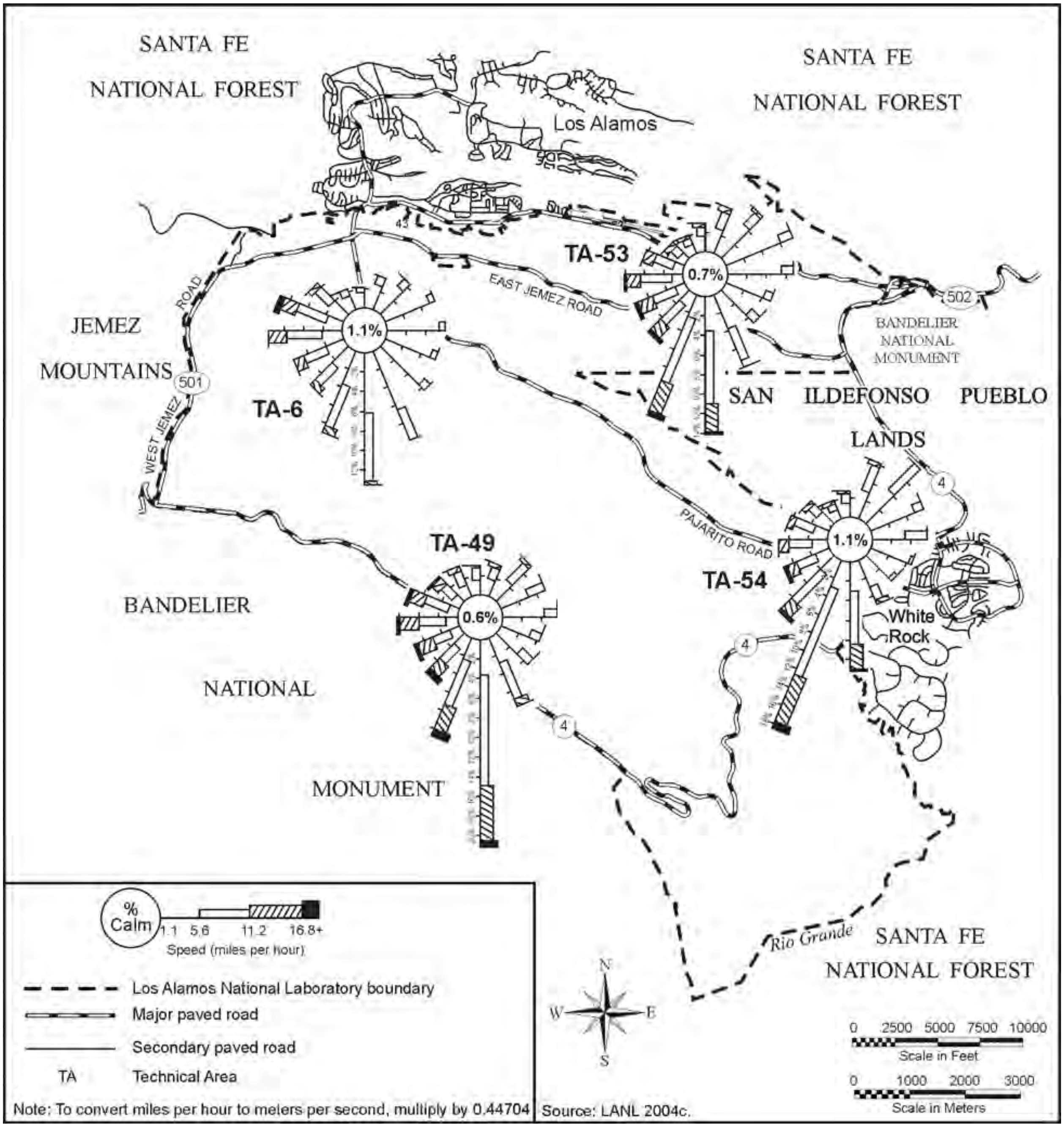


Figure 4–21 Los Alamos National Laboratory Meteorological Stations with Daytime Wind Rose Data

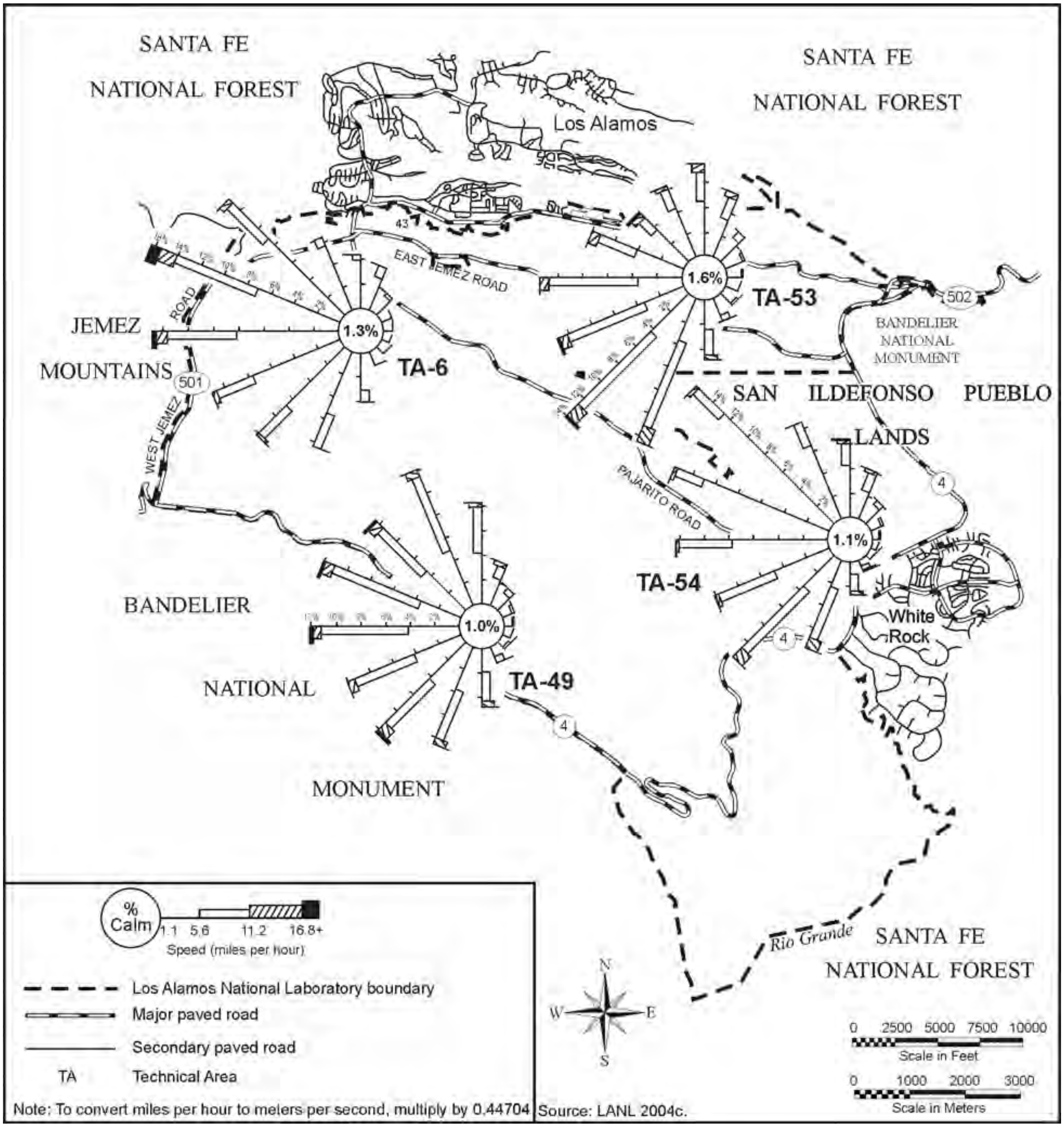


Figure 4–22 Los Alamos National Laboratory Meteorological Stations with Nighttime Wind Rose Data

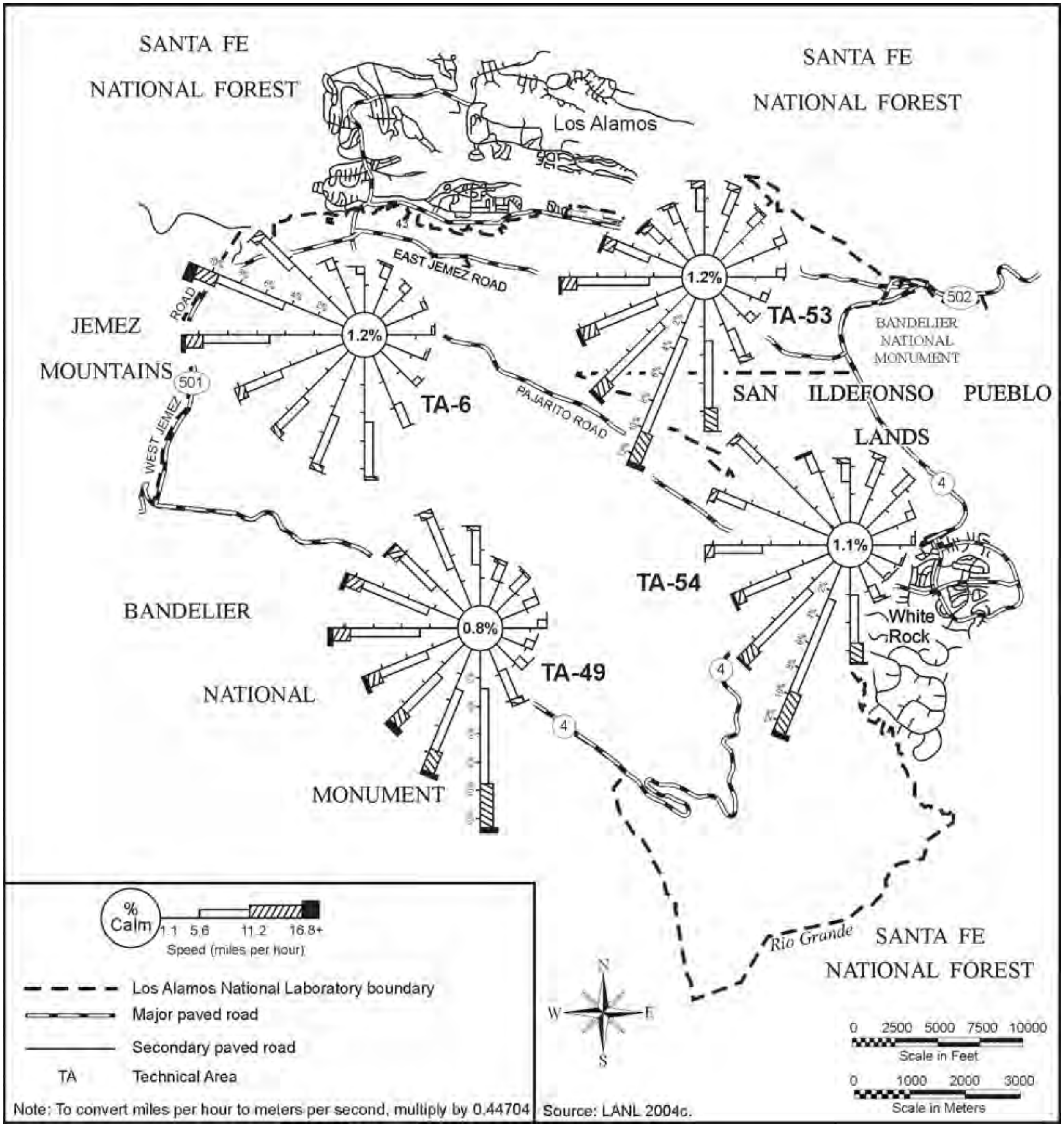


Figure 4–23 Los Alamos National Laboratory Meteorological Stations with Total Wind Rose Data

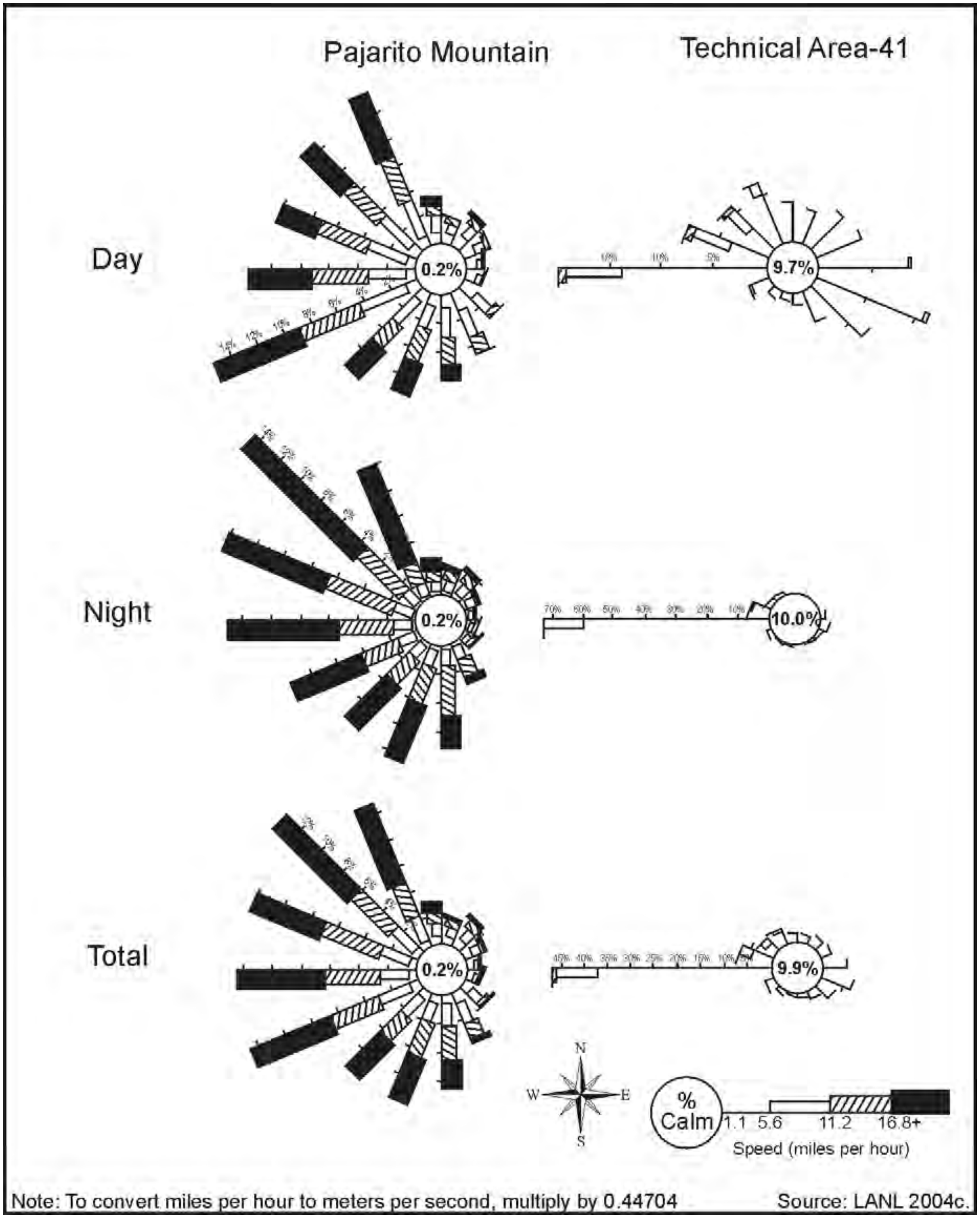


Figure 4–24 Pajarito Mountain and Technical Area 41 Associated Wind Rose Data

Analyses of Los Alamos Canyon wind data indicate a difference between the air flow in the canyon and the air flow over the Pajarito Plateau. Cold air drainage flow is observed about 75 percent of the time during the night and continues for an hour or two after sunrise until an up-canyon flow forms. Nighttime canyon flows are predominantly weak drainage winds from the west. Because of the stability of these nighttime canyon flows and the relatively weak mesa winds, the development of rotors at night in the canyon is rare. But, a turbulent longitudinal whirl or "rotor" that fills the canyon can develop when the wind over the Pajarito Plateau has a strong cross-canyon component (LANL 2004c).

The irregular and complex terrain and rough forest surfaces in the region also affect atmospheric dispersion. The terrain and forests increase horizontal and vertical turbulence and dispersion. The dispersion generally decreases at lower elevations where the terrain becomes smoother and less vegetated. The region's canyons channel the air flow which limits dispersion (LANL 2004c).

Light wind conditions under clear skies can create strong, shallow surface inversions that trap the air at lower elevations and severely restrict dispersion. These light wind conditions occur primarily during the autumn and winter months, with intense surface air inversions occasionally occurring. Inversions are most severe during the night and early morning. Overall dispersion is greater with strong winds in the spring. However, vertical dispersion is greatest during summer afternoons. Deep vertical mixing occurs in the summer afternoons, lowering concentrations near the surface (LANL 2004c).

4.4.1.2 Severe Weather

Thunderstorm and hailstorm frequency and occurrences of other severe weather events are discussed in the *1999 SWEIS*. An average of 60 thunderstorms occurs in Los Alamos County in a year. Hailstorms occur frequently with measurable accumulations.

4.4.2 Nonradiological Air Quality

LANL operations can result in the release of nonradiological air pollutants that can affect the air quality of the surrounding area. Information regarding the applicable air quality standards and guidelines and existing nonradiological air quality are presented in this section.

4.4.2.1 Applicable Requirements and Guidelines

The Clean Air Act mandates that EPA establish National Ambient Air Quality Standards (NAAQS) for pollutants of nationwide concern. These pollutants, known as criteria pollutants, are carbon monoxide, sulfur dioxide, nitrogen dioxide, ozone, lead, and particulate matter. As of July 18, 1997, in addition to the particulate matter equal to or less than 10 microns (10 micrometers) in aerodynamic diameter (PM_{10}), a new standard became effective for particulate matter equal to or less than 2.5 microns in aerodynamic diameter ($PM_{2.5}$). EPA designated New Mexico as attaining the $PM_{2.5}$ standards (40 CFR 81.332) (LANL 2004c).

In 1997, EPA revised the NAAQS for ground-level ozone, setting it at 0.08 parts per million averaged over an 8-hour timeframe. Litigation delayed implementation of this standard for several years. However, in March 2002, the District of Columbia Circuit Court rejected all remaining challenges to the 8-hour ozone standard and EPA began implementing the requirements. The entire State of New Mexico, including Los Alamos County, has been designated as in attainment with the 8-hour ozone standard (40 CFR 81.332) (LANL 2004c).

National primary air quality standards define levels of air quality judged necessary, with an adequate margin of safety, to protect public health. National secondary ambient air quality standards define levels of air quality judged necessary to protect public welfare from any known or anticipated adverse effects of a pollutant. A primary NAAQS has been established for carbon monoxide, and both primary and secondary standards have been established for the remaining criteria pollutants. The area encompassing LANL and Los Alamos County is classified as an attainment area for all six criteria pollutants (40 CFR 81.332) (LANL 2004c).

The State of New Mexico has also established ambient air quality standards for carbon monoxide, sulfur dioxide, nitrogen dioxide, total suspended particulates (which is not PM_{10}), hydrogen sulfide, and total reduced sulfur. Additionally, New Mexico established permit requirements for toxic air pollutants. Toxic air pollutants are chemicals that are generally found in trace amounts in the atmosphere, but that can result in chronic health effects or increase the risk of cancer when they are present in amounts that exceed established health-based limits. Because of the financial constraints and the unavailability of sufficient information on the effects of toxic air pollutants, New Mexico has not established ambient standards for toxic chemicals. To approach this issue, New Mexico has developed permit requirements that are used by the NMED for determining if a new or modified source emitting a toxic air pollutant would be issued a permit under Subpart IV 20.2.72 NMAC (New Mexico Administrative Code) (LANL 2004c). Although many operations at LANL were in existence before August 31, 1972, when NMED air permit regulations were first applicable, operations are now subject to a site-wide operating permit.

In accordance with Title V of the Clean Air Act, as amended, and 20.2.70 NMAC, the management and operating contractor and DOE submitted a Clean Air Act operating permit application to NMED in December 1995. In 2002, the management and operating contractor and DOE submitted a revised operating permit application as requested by NMED. NMED issued a Notice of Completeness for both applications and issued operating permit P100 in April 2004 (LANL 2004c, NMED 2004b), as well as a modified permit P100M1 in June 2006 (NMED 2006a). Air quality permits are discussed further in Chapter 6.

The primary purpose of the operating permit program is to identify all Federal and state air quality requirements applicable to LANL operations so that a single site-wide permit can be granted. Under this permit, the management and operating contractor at LANL tracks pollutant emissions by reporting semiannual emissions, based on chemical purchase data, material and fuel usage, knowledge of operations, and suitable emission factors (LANL 2004c). Appendix B, Table B–2, of the SWEIS lists chemicals used at LANL in 2004 (LANL 2005f).

Emissions of criteria and hazardous air pollutants from activities at LANL are subject to the limitations in the Title V operating permit. These limits are summarized in **Table 4–18**. In addition, there are limits on visible emissions. The permit also includes limitations derived from the New Source Performance Standard for Small Industrial-Commercial-Institutional Steam Generating Units (40 CFR Part 60 Subpart Dc), which is applicable to two TA-55 boilers;

Table 4–18 Operation Permit Emission Limits

Facility	*Emissions (tons per year unless stated)*					
	Nitrogen Oxides	*Carbon Monoxide*	*Volatile Organic Compounds*	*Sulfur Dioxide*	*Particulate Matter*	*Hazardous Air Pollutants*
LANL – Entire Facility	245	225	200	150	120	24 combined/ 8 individual
Asphalt Production (TA-60-BDM)	1.0	2.6	1.0	1.0	0.04 grams per dry standard cubic foot, 35.4 pounds per hour	NA
Beryllium Activities						
CMR Facility (TA-3-29)	NA	NA	NA	NA	Beryllium 10 grams per 24 hours	NA
Sigma Facility (TA-3-66)	NA	NA	NA	NA	Beryllium 10 grams per 24 hours	NA
Beryllium Test Facility (TA-3-141)	NA	NA	NA	NA	Beryllium 0.35 grams per 24 hours 3.5 grams per year	NA
TA-16-207	NA	NA	NA	NA	Beryllium 10 grams per 24 hours	NA
TA-35-87	NA	NA	NA	NA	Beryllium 10 grams per 24 hours	NA
Target Fabrication Facility (TA-35-213)	NA	NA	NA	NA	Beryllium 1.8×10^{-4} grams per hour, 0.36 grams per year	NA
Plutonium Facility (TA-55-PF4)						
Machining Operation	NA	NA	NA	NA	Beryllium - 0.12 grams per 24 hours, 2.99 grams per year Aluminum - 0.12 grams per 24 hours, 2.99 grams per year	NA
Foundry Operation	NA	NA	NA	NA	Beryllium - 3.49×10^{-5} grams per 24 hours, 8.73×10^{-4} grams per year Aluminum - 3.49×10^{-5} grams per 24 hours, 8.73×10^{-4} grams per year	NA
Boilers and Heaters [a]	80	80	50	50	50	NA
Carpenter Shops						
TA-15-563	NA	NA	NA	NA	2.81	NA
TA-3-38	NA	NA	NA	NA	3.07	NA
Chemical Usage (facility wide)	NA	NA	200	NA	NA	8 individual chemical 24 total
Degreasers – TA-55-DG-1, TA-55-DG-2, and TA-55-DG-3	NA	NA	200 facility wide	NA	NA	8 individual 24 total
Internal Combustion Sources						
TA-33-G-1 (diesel generator)	18.1 tons per year, 40.3 pounds per hour	15.2 tons per year, 33.7 pounds per hour	0.3 tons per year, 0.7 pounds per hour	2.5 tons per year, 5.5 pounds per hour	TSP 0.6 tons per year, 1.4 pounds per hour PM_{10} 0.6 tons per year, 1.4 pounds per hour	NA
Various Standby Generators [b]	NA	NA	NA	NA	NA	NA
Data Disintegrator/ Industrial Shredder	NA	NA	NA	NA	TSP 9.9 tons per year, 2.3 pounds per hour PM_{10} 9.9 tons per year, 2.3 pounds per hour	NA

Facility	Emissions (tons per year unless stated)					
	Nitrogen Oxides	*Carbon Monoxide*	*Volatile Organic Compounds*	*Sulfur Dioxide*	*Particulate Matter*	*Hazardous Air Pollutants*
Power Plant at TA-3-22						
TA-3-22-1	10.2 pounds per hour gas 11.3 pounds per hour oil	7.0 pounds per hour gas 6.5 pounds per hour oil	1.0 pounds per hour gas 0.3 pounds per hour oil	1.1 pounds per hour gas 9.6 pounds per hour oil	TSP 1.3 pounds per hour gas 4.3 pounds per hour oil PM_{10} 1.3 pounds per hour gas 3.0 pounds per hour oil	NA
TA-3-22-2	10.2 pounds per hour gas 11.3 pounds per hour oil	7.0 pounds per hour gas 6.5 pounds per hour oil	1.0 pounds per hour gas 0.3 pounds per hour oil	1.1 pounds per hour gas 9.6 pounds per hour oil	TSP 1.3 pounds per hour gas 4.3 pounds per hour oil PM_{10} 1.3 pounds per hour gas 3.0 pounds per hour oil	NA
TA-3-22-3	10.2 pounds per hour gas 11.3 pounds per hour oil	7.0 pounds per hour gas 6.5 pounds per hour oil	1.0 pounds per hour gas 0.3 pounds per hour oil	1.1 pounds per hour gas 9.6 pounds per hour oil	TSP 1.3 pounds per hour gas 4.3 pounds per hour oil PM_{10} 1.3 pounds per hour gas 3.0 pounds per hour oil	NA
Boilers Combined	60.2 tons per year	41.3 tons per year	5.6 tons per year	7.9 tons per year	TSP 8.4 tons per year PM_{10} 8.2 tons per year	NA
TA-3-22 CT-1	23.8 pounds per hour 33.2 tons per year	170.9 pounds per hour 19.8 tons per year	1.0 pounds per hour	1.4 pounds per hour 1.9 tons per year	TSP 1.6 pounds per hour 2.3 tons per year PM_{10} 1.6 pounds per hour 2.3 tons per year	NA

NA = not available, CMR = Chemistry and Metallurgy Research, TSP = total suspended particulate, PM^{10} = particulate matter less than 10 microns in aerodynamic diameter, TA = technical area.

[a] Including TA-16-1484-BS-1, TA-16-1484-BS-2, TA-21-357-1, TA-21-357-2, and TA-21-357-3, TA-48-1-BS-1, TA-48-1-BS-2, TA-48-1-BS-6, TA-50-2, TA-53-365-BHW-1, TA-53-365-BHW-2, TA-55-6-BHW-1, TA-55-6-BHW-2, TA-59-BHW-1, TA-59-BHW-2.

[b] Standby generators are limited to an average of 168 hours per year; tons per year to metric tons per year, multiply by 0.9072.

Note: To convert pounds per hour to kilograms per hour, multiply by 0.45359; tons per year to metric tons per year, multiply by 0.90718.

Source: NMED 2006a.

New Source Performance Standard for Hot Mix Asphalt Facilities (40 CFR Part 60 Subpart I); New Source Performance Standard for Stationary Gas Turbines (40 CFR Part 60 Subpart GG), which is applicable to the new gas turbine; National Emission Standards for Hazardous Air Pollutants for Beryllium (40 CFR Part 61 Subpart C) which is applicable to beryllium operations at TA-3, TA-16, TA-35, and TA-55; National Emission Standards for Hazardous Air Pollutants for Asbestos (40 CFR Part 61 Subpart M) which may be applicable to some demolition projects; National Emission Standards for Hazardous Air Pollutants for Radon Emissions from DOE Facilities (40 CFR Part 61 Subpart Q) applicable to operations at TA-55; and National Emission Standards for Hazardous Air Pollutants for Radionuclides other than Radon from DOE Facilities (40 CFR Part 61 Subpart H), which is discussed further in Chapter 4, Section 4.6.1.2 and in Appendix C, Section C.1.1.5. National Emissions Standards for Halogenated Solvent Cleaning (40 CFR Part 63 Subpart T) is applicable to certain activities at TA-55 and specifies applicable controls (NMED 2006a).

4.4.2.2 Sources of Nonradiological Emissions

Criteria pollutants released from LANL operations are emitted primarily from combustion sources such as boilers and emergency generators. Although motor vehicle emissions have an impact on local air quality, no quantitative analysis of vehicle emissions was performed as part of the *1999 SWEIS*. Instead, vehicle emissions were included in the assumed background concentrations for each of the criteria pollutants in the *LANL SWEIS* analysis (LANL 2004c).

Estimated emissions from operations at LANL for the years 1999 through 2004 are shown in **Table 4–19**. These data include emissions from the operation of facilities at LANL. Construction emissions from new facilities and facility upgrades during the period 1999 through 2004 resulted in temporary increases in LANL emissions. Construction emissions were not quantified in the *1999 SWEIS* or in the *SWEIS Yearbook 2005, Comparison of 2005 Data Projections of the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory (SWEIS Yearbook – 2005)* (LANL 2006g). Most of the National Environmental Policy Act (NEPA) documents for activities that were under construction during the period 1999 to 2004 determined that impacts from construction emissions would be small and of short duration and similar to other construction activities at LANL. The data presented for criteria pollutants in the *SWEIS Yearbook – 2005* are summarized as annual emissions for each pollutant. Appendix B, Attachment 1, of the *1999 SWEIS* presents criteria pollutant emissions for individual combustion sources.

Table 4–19 Emissions of Criteria Pollutants

Pollutant [a]	*Emissions (tons per year)*						
	1999	*2000*	*2001*	*2002*	*2003*	*2004* [b]	*2005* [b]
Carbon monoxide	32	26	29.08	28.1	31.9	35.4	35.1
Nitrogen oxides	88	80	93.8	64.7	49.6	50.5	50.5
Particulate matter	4.5	3.8	5.5	15.5 [c]	22.1 [c]	4.8	5.0
Sulfur oxides	0.55	4.0 [d]	0.82	1.3 [e]	1.6 [e]	1.5	1.9

[a] Tons per year.
[b] Values include emissions from small boilers and heaters and standby generators not included in previous years' emissions inventories, but included on LANL's Title V Operating Permit Emissions Report.
[c] Increased emissions of particulate matter were primarily due to operation of three air curtain destructors used to burn wood and slash from the fire mitigation activities.
[d] The higher emissions of sulfur oxides were due to the main steam plant burning fuel oil during the Cerro Grande Fire.
[e] The increased emissions of sulfur oxides were due to operation of the three air curtain destructors used to burn wood and slash from fire mitigation activities.
Note: To convert tons per year to metric tons per year, multiply by 0.9072.
Sources: LANL 2003h, 2006g.

Increased particulate matter emissions in 2002 and 2003 were attributable primarily to operation of three air curtain destructors that were used to burn wood and slash from the fire mitigation activities around LANL. Operation of the air curtain destructors emitted 12.2 tons (10 metric tons) of particulate matter and 1 ton (0.9 metric tons) of sulfur oxides in 2002. The air curtain destructors emitted a total of 19.1 tons (17.3 metric tons) of particulate matter and 1.3 tons (1.2 metric tons) of sulfur oxides during 2003. The air curtain destructors were shut down in September 2003 (LANL 2003h, 2004f).

Sulfur oxides emissions in 2000 increased as a result of burning fuel oil in the main steam plant during the Cerro Grande Fire. Use of alternate fuel is not typical of steam plant operations and was necessary due to natural gas supplies being cut off to the area during the fire (LANL 2003h).

Approximately two-thirds of the most significant criteria pollutant, nitrogen oxides, results from the TA-3 steam plant. In late 2000, DOE received a permit from NMED to install flue gas recirculation equipment on the steam plant boilers to reduce emissions of nitrogen oxide. This equipment became operational in 2002, and initial source tests indicated a reduction in emissions, of approximately 64 percent. The water pump, which was a large source of nitrogen oxide emissions, was transferred to Los Alamos County in November 2001 (LANL 2003h, 2004f).

The Clean Air Act, as amended, requires that Federal actions conform to the host State's "State Implementation Plan." A State Implementation Plan provides for the implementation, maintenance, and enforcement of the NAAQS for the six criteria pollutants, sulfur dioxide, particulate matter, carbon monoxide, ozone, nitrogen dioxide, and lead. Conformance with the State Implementation Plan is required to eliminate or reduce the severity and number of violations of NAAQS and to expedite the attainment of NAAQS. No Department, agency, or instrumentality of the Federal Government shall engage in or support in any way (i.e., provide financial assistance for, license or permit, or approve) any activity that does not conform to an applicable implementation plan. The final rule for *Determining Conformity of General Federal Actions to State or Federal Implementation Plans* (58 FR 63214) took effect on January 31, 1994. LANL is within an area that is currently designated as an attainment area for criteria air pollutants. Therefore, the actions considered in the *1999 SWEIS* and the other proposed projects considered in this *SWEIS* do not require a conformity determination.

Air pollutant emissions for Key Facilities at LANL are presented in Appendix A of the *SWEIS Yearbook – 2005* and are based on chemical usage in these areas (LANL 2006g). Total emissions of hazardous air pollutants and volatile organic compounds for 2000 through 2005 are presented in **Table 4–20**.

Table 4–20 Emissions of Hazardous Air Pollutants and Volatile Organic Compounds from Chemical Use

Pollutant	***Emissions (tons per year)***					
	2000	***2001***	***2002***	***2003***	***2004***	***2005***
Hazardous Air Pollutants	6.5	7.4	7.74	7.32	5.71	5.4
Volatile Organic Compounds	10.7	18.6	14.9	11.2	7.95	11.2

Note: To convert tons per year to metric tons per year, multiply by 0.9072.
Source: LANL 2006g.

The total emissions of hazardous air pollutants and volatile organic compounds showed considerable variation over the period 2000 through 2005. Operation of the air curtain destructors resulted in increases of hazardous air pollutants and volatile organic compounds during 2002 and 2003. The air curtain destructors accounted for 2.1 and 22.9 tons (1.9 and 20.8 metric tons) of hazardous air pollutants and volatile organic compound, respectively, in 2002. In 2003, they accounted for 3.3 and 36.0 tons (3.0 and 32.7 metric tons) of hazardous air pollutants and volatile organic compounds, respectively. As noted above, the air curtain destructors were shutdown in September 2003 (LANL 2004f). With the completion of Cerro Grande Rehabilitation Project tree thinning and removal, emissions of hazardous air pollutants and volatile organic compounds returned to lower levels more typical of pre-fire conditions. Emissions of volatile organic compounds were lower in 2004 due to the shutdown of activities in July 2004 (LANL 2006g).

Toxic and hazardous air pollutant emissions from LANL activities are released primarily from laboratory, maintenance, and waste management operations. Unlike a production facility with well-defined operational processes and schedules, LANL is a research and development facility with great fluctuations in both the types of chemicals emitted and their emission rates. DOE has a program to review new operations for their potential to emit toxic and hazardous air pollutants. Toxic air pollutant emissions from the use of chemicals are generally below the levels for which the State of New Mexico would require a permit for a new source under its permit regulations for toxic air pollutant emissions (NMAC 20.2.72.400 - 502). The Title V operating permit limits the emissions of hazardous air pollutants such that operations at LANL are below the major source threshold for hazardous air pollutants. Emissions of hazardous air pollutants are monitored and reported annually to NMED as required by the permit. Past actual emissions of hazardous air pollutants have been well below the threshold (LANL 2004c).

In the *1999 SWEIS*, a list of 382 chemicals of interest was selected for evaluation. A comparison of a calculated maximum emission rate derived from health-based standards to the potential emission rate from key LANL facilities was made. In this analysis, a screening level emission value was developed for each chemical and for each TA where that chemical was used. A screening level evaluation value is a theoretical maximum emission rate that, if emitted at that TA over a short-term (8-hour) or long-term (1-year) period, would not exceed a health-based guideline value. This value was compared to the emission rate that would result if all the chemicals purchased for use in the facilities at that TA over the course of 1 year were available to become airborne (LANL 2004c).

Estimates for selected toxic and hazardous air pollutant emissions from key LANL facilities were made in the *1999 SWEIS* based on chemical use at LANL and assumed stack and building parameters. Chemical purchasing records for these key facilities have been reviewed each year and estimated emissions reported in the annual Yearbooks (LANL 2003h, LANL 2004f, LANL 2006g). The amount of individual chemicals purchased varies from year to year. However, in some areas the total amounts of the chemicals of interest have stayed relatively constant from year to year. For example, at TA-3 during the period 1999 and 2002, the total chemical usage has varied by about plus or minus 25 percent. The variation in estimated chemical emissions would be expected to be similar (LANL 2004c). At other areas such as at the High-Explosives Processing areas, chemical emissions show greater variability from year to year. Evaluation of emissions of individual chemicals indicates that most chemicals would be emitted at levels below the screening levels identified in the *1999 SWEIS*.

DOE Order 450.1, "Environmental Protection Program," requires DOE facilities to incorporate an environmental management system approach into their Integrated Safety Management Systems. This includes the protection of resources from wildland and operational fires. Fires are conducted from time to time at LANL for the reduction of forest fuel to reduce the potential for wildland fires. These fires result in emissions of various chemical compounds such as fine particulate matter, nitrogen oxides, carbon monoxide, and organic compounds. Some impairment of visibility at Bandelier National Monument can result from these fires. Air quality impacts from prescribed fires are controlled through proper planning and the regulatory process (NMAC 20.2.60 and 20.2.65) (DOE 2004f).

4.4.2.3 Existing Ambient Air Conditions

Only a limited amount of ambient air monitoring has been performed for nonradiological air pollutants within the LANL region. NMED operated a DOE-owned ambient air quality monitoring station adjacent to Bandelier National Monument between 1990 and 1994 to record sulfur dioxide, nitrogen dioxide, ozone, and PM_{10} levels as discussed in the *1999 SWEIS*. DOE and NMED discontinued operation of this station in fiscal year 1995 because recorded values were well below applicable standards.

The State of New Mexico does not have an ambient air quality standard for beryllium. Beryllium concentrations are monitored at over 20 sites located near potential beryllium sources at LANL or in nearby communities. For comparison purposes, the results are compared to the ambient standard from the National Emission Standard for Hazardous Air Pollutants standard for beryllium of 10 nanograms per cubic meter (40 CFR Part 61 Subpart C). DOE is not required to monitor to this standard because all beryllium-permitted sources meet the emission standards, but it is used in this case for comparative purposes. All monitored beryllium values were 2 percent or less of the National Emission Standard for Hazardous Air Pollutants Standard (LANL 2006h).

After the Cerro Grande Fire in the spring of 2000, there was concern that an adequate baseline of nonradiological ambient air sampling was not in place at LANL. Therefore, in 2001, DOE designed and implemented a new air monitoring program, entitled NonRadNET, to provide nonradiological background ambient data under normal conditions. The NonRadNET program includes real-time ambient sampling for PM_{10} and $PM_{2.5}$. Additionally, air samples were collected in the first year of this program and analyzed for up to 20 inorganic elements and up to 160 volatile organic compounds. The results for PM_{10} and $PM_{2.5}$ are included for 2005 in **Table 4–21**. Results for the inorganic elements and the volatile organic compounds were all below any published ambient or occupational exposure limits. More information about this ambient monitoring program can be found in the report entitled *Nonradioactive Ambient Air Monitoring at Los Alamos National Laboratory 2001-2002* (LANL 2004e).

Table 4–21 2005 Ambient Air Monitoring for Particulate Matter

Station Location	*Constituent*	*Annual Mean Monitored Value (micrograms per cubic meter)*	*NAAQS Primary Annual Standard (micrograms per cubic meter)*	*Maximum 24-Hour Monitored Value (micrograms per cubic meter)*	*NAAQS 24-Hour Standard (micrograms per cubic meter)*
48th Street, Los Alamos	PM_{10}	12	50	34	150
	$PM_{2.5}$	7	15	20	65
Los Alamos Medical Center	PM_{10}	15	50	55	150
	$PM_{2.5}$	8	15	27	65
White Rock Fire Station	PM_{10}	13	50	34	150
	$PM_{2.5}$	7	15	20	65

NAAQS = National Ambient Air Quality Standards, PM_n = Particulate matter less than n microns in aerodynamic diameter.
Source: LANL 2006h.

As part of the Title V operating permit application, NMED requested that the management and operating contractor at LANL provide a facility-wide air quality impacts analysis. The purpose of the analysis was to ensure that the emission limits requested in the Title V permit application would not cause exceedances of any NAAQS or New Mexico Ambient Air Quality Standards. The analysis also demonstrated that simultaneous operation of all regulated air emission units described in the Title V permit application, being operated at their maximum requested permit limits, would not result in exceedances of any ambient air quality standards (Jacobson, Johnson, and Rishel 2003).

4.4.3 Radiological Air Quality

Individuals are continuously exposed to airborne radioactive materials. These materials come primarily from natural resources, such as the short-lived decay products of radon, found worldwide. However, airborne radioactive materials can also be emitted by manmade operations. Some LANL operations may result in the release of radioactive materials to the air from point sources such as stacks or vents or from nonpoint (area) sources such as the radioactive materials in contaminated soils. The concentrations of radionuclides in point-source releases are continuously sampled or estimated based on knowledge of the materials used and the activities performed. Nonpoint-source emissions are directly monitored or sampled or estimated from airborne concentrations outdoors. The radiological air quality at LANL described in the *1999 SWEIS* is based on data collected from 1991 through 1996. The sections below discuss radiological air quality on the basis of data collected between 1999 and 2005. Radiation doses from LANL airborne emissions and radiological emission standards are discussed in Section 4.6 of this *SWEIS*.

4.4.3.1 Radiological Monitoring

The LANL radiological air-sampling network, referred to as AIRNET, measures environmental levels of airborne radionuclides, such as plutonium, americium, uranium, tritium, and activation products that could be released from LANL operations. Most regional airborne radioactivity comes from the following sources: (1) natural radioactive constituents in particulate matter (such as uranium and thorium), (2) terrestrial radon diffusion out of the Earth and its subsequent decay products, (3) material formation from interaction with cosmic radiation, and (4) fallout from past atmospheric nuclear weapons tests conducted by several countries. **Table 4–22** summarizes regional levels of radioactivity in the atmosphere over the period 1999 to 2005.

In 2005, 28 stacks were continuously monitored for the emission of radioactive material to the ambient air. LANL staff categorizes these radioactive stack emissions into four types: (1) particulate matter, (2) vaporous activation products, (3) tritium, and (4) gaseous mixed activation products. Measurements of LANL stack emissions during 2005 totaled approximately 19,100 curies. Of this total, tritium emissions composed approximately 704 curies, and air activation products from Los Alamos Neutron Science Center (LANSCE) stacks contributed nearly 18,400 curies. Combined airborne materials such as plutonium, uranium, americium, and thorium were less than 0.00002 curies. Emissions of particulate/vapor activation products totaled less than 0.02 curies (LANL 2006h). **Table 4–23** provides further detailed emissions data for buildings with sampled stacks in the years 1999 through 2005. Overall, radiological air emissions at LANL tend to be dominated by emissions from LANSCE stacks and tritium.

Table 4–22 Annual Average Background Concentration of Radioactivity in the Regional Atmosphere

	Units [a]	***EPA Concentration Limit*** [b]	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***
Gross Alpha	fCi/m^3	NA	1	1	0.8	0.8	0.8	1.1	0.9
Gross Beta	fCi/m^3	NA	13.4	13	13.9	13.3	13.7	18.3	16.3
Tritium	pCi/m^3	1,500	0.5	0.8	NM	NM	NM	0.1	0.1
Strontium-90	aCi/m^3	19,000	NA	NA	NA	4	11	NA	NA
Plutonium-238	aCi/m^3	2,100	NM	0	0	0	NM	0.09	0
Plutonium-239 and Plutonium-240	aCi/m^3	2,000	0.1	0	0.1	0.3	NM	NM	0.1
Americium-241	aCi/m^3	1,900	NM	0.3	NM	0.3	NM	NM	0.1
Uranium-234	aCi/m^3	7,700	16.1	17.1	17.9	21.7	20.9	17.4	12.4
Uranium-235	aCi/m^3	7,100	1.2	0.9	1.3	2.4	1.8	1.17	1.2
Uranium-238	aCi/m^3	8,300	15.2	15.9	17.7	21.8	20.1	17.0	13.2

EPA = U.S. Environmental Protection Agency, NA = not available, NM = not measurable.
[a] m^3 = cubic meters, pCi = picocurie = 10^{-12} curie, fCi = femtocurie = 10^{-15} curie, aCi = attocurie = 10^{-18} curie.
[b] Each EPA limit corresponds to 10 millirem per year.
Source: LANL 2004d, 2005h, 2006h.

4.4.4 Visibility

In accordance with the Clean Air Act, as amended, and New Mexico regulations, the Bandelier National Monument and Wilderness Area have been designated as a Class I area (defined as wilderness areas that exceed 10,000 acres [4,047 hectares]) where visibility is considered to be an important value [40 CFR 81.421, NMAC 20.2.74] and requires protection). Visibility is measured according to a standard visual range, how far an image is transmitted through the atmosphere to an observer some distance away. Visibility has been officially monitored by the National Park Service at the Bandelier National Monument since 1988. **Table 4–24** reflects average visibility from 1993 through 2002 from approximately 79 to 113 miles (127 to 182 kilometers) (LANL 2004c). This would represent a reduction in the visual range of 2 to 31 percent compared to the estimated natural median visual range for the western states of 110 to 115 miles (177 to 186 kilometers) (Malm 1999).

4.4.5 Noise, Air Blasts, and Vibration Environment

Noise (considered to be unpleasant, loud, annoying or confusing sounds to humans), air blasts (also known as air pressure waves or over pressures), and ground vibrations are intermittent aspects of the LANL area environment. Although the receptor most often considered for these environmental conditions is human, sound and vibrations may also be perceived by animals in the LANL vicinity. Little is known about how different wildlife species may process these sensations, or how certain species may react to them. The vigor and well being of area wildlife and sensitive, federally protected bird populations suggests that these environmental conditions are present at levels within an acceptable tolerance range for most wildlife species and sensitive nesting birds found along the Pajarito Plateau (DOE 1999a). Ecological resources are discussed in more detail in Section 4.5.

Table 4–23 Range of Annual Airborne Radioactive Emissions from Los Alamos National Laboratory Buildings with Sampled Stacks from 1999 through 2005 (curies)

TA Building	*Tritium* [a]	*Americium-241*	*Plutonium* [b]	*Uranium* [c]	*Thorium* [d]	*P/VAP* [e]	*G-MAP* [f]	*Strontium-90*
TA-3-029	–	1.3×10^{-7} - 2.6×10^{-6}	2.1×10^{-6} - 2.1×10^{-5}	2.8×10^{-6} - 9.8×10^{-6}	1.3×10^{-7} - 1.3×10^{-6}	2.2×10^{-5} [g]	–	2.1×10^{-7} - 3.9×10^{-7}
TA-3-102	–	1.0×10^{-10} [h]	3.9×10^{-10} [i]	4.4×10^{-9} - 3.3×10^{-7}	8.0×10^{-10} - 7.2×10^{-9}	–	–	–
TA-16-205	140-7900 [j]	–	–	–	–	–	–	–
TA-21-155	66-520	–	–	–	–	–	–	–
TA-21-209	61-760	–	–	–	–	–	–	–
TA-48-001	–	–	1.7×10^{-9} [i]	6.1×10^{-10} - 6.5×10^{-9}	1.1×10^{-9} [h]	0.00023-0.017	–	–
TA-50-001	–	6.9×10^{-9} - 1.3×10^{-7}	7.4×10^{-9} - 5.1×10^{-8}	2.5×10^{-8} [i]	3.7×10^{-8} - 7.0×10^{-8}	–	–	–
TA-50-037	–	5.8×10^{-10} [i]	8.9×10^{-10} [i]	1.9×10^{-8} [k]	3.4×10^{-9} [h]	–	–	3.4×10^{-9} [h]
TA-50-069	–	5.8×10^{-11} - 7.6×10^{-10}	9.9×10^{-11} - 5.3×10^{-9}	–	1.2×10^{-10} - 1.2×10^{-9}	–	–	–
TA-53-003	0.57-1.8	–	–	–	–	3.5×10^{-10} [h]	1.7- 8.4	–
TA-53-007	0.45-7.2	–	–	–	–	0.016-60	300-18,400	–
TA-55-004	1.8-61	6.2×10^{-9} - 5.9×10^{-7}	4.3×10^{-8} - 2.5×10^{-6}	7.1×10^{-8} - 2.3×10^{-7}	3.4×10^{-8} - 1.5×10^{-7}	–	–	5.6×10^{-8} [h]

TA = technical area.
[a] Includes both gaseous and oxide forms of tritium.
[b] Includes plutonium-238, plutonium-239, and plutonium-240.
[c] Includes uranium-234, uranium-235, and uranium-238.
[d] Includes thorium-228, thorium-230, and thorium-232.
[e] P/VAP - Particulate and vapor activation products.
[f] G-MAP - Gaseous mixed activation products.
[g] Only emitted during 2005.
[h] Only emitted during 2003.
[i] Only emitted during 2002.
[j] The 7,900 curies were an unanticipated one-time release in 2001.
[k] Only emitted during 1999.
Sources: LANL 2004d, 2005h, 2006h.

Table 4–24 Average Visibility Measurements at Bandelier National Monument (1993 to 2002) [a]

Season	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*
Winter	94	99	104	113	108	102	106	113	105	111
Spring	96	95	110	84	100	91	96	82	102	91
Summer	87	87	86	92	84	79	93	86	100	88
Fall	93	103	101	106	105	87	91	104	104	104

[a] Distance in miles.
Note: To convert miles to kilometers, multiply by 1.6093.
Source: LANL 2004c.

"Public noise" is the noise present outside LANL site boundaries. It is from the combined effect of the existing LANL traffic and site activities and the noise generated by activities around the Los Alamos and White Rock communities. "Worker noise" is the noise generated by DOE activities within LANL boundaries. Air blasts consist of a higher frequency portion of air pressure waves that are audible and that accompany an explosives detonation. This noise can be heard by both workers and the area public. The lower frequency portion of air pressure waves is not audible, but may cause a secondary and audible noise within a testing structure that may be heard by workers. Air blasts and most ground vibrations generated at LANL result from testing activities involving aboveground explosives research (DOE 1999a).

The forested condition of much of LANL (especially where explosives testing areas are located), the prevailing area atmospheric conditions, and the regional topography that consists of widely varied elevations and rock formations all influence how noise and vibrations can be both attenuated (lessened) and channeled away from receptors. These regional features are jointly responsible for there being little environmental noise pollution or ground vibration concerns to the area resulting from DOE operations. Sudden loud "booming" noises associated with explosives testing are similar to the sound of thunder and may occasionally startle members of the public and LANL workers alike. The human startle response is usually related to the total amounts of explosives used in the test, the prevailing atmospheric conditions, and the receptor's relative location to the source location and to channeling valleys. Although these noises are sporadic or episodic in nature, they contribute to the perception of noise pollution in the area (DOE 1999a).

Loss of large forest areas from the Cerro Grande Fire in 2000 has had an adverse effect on the ability of the surrounding environment to absorb noise. However, types of noise and noise levels associated with LANL and from activities in surrounding communities have not changed significantly as a result of the fire (DOE 2000f).

Concerns for damage that may be caused by ground vibrations as a result of explosives testing are primarily related to sensitive architectural receptors, such as the many archeological sites and historic buildings near the LANL firing ranges. The low masonry adobe or rock walls at prehistoric sites, and the nonrobust walls of what were expected to be temporary or short-term use buildings when originally constructed, could be speculated to suffer from subtle structural deterioration (fatigue damage) over time. However, field observations of eight prehistoric archeological sites in the vicinity of the firing ranges determined that none of the sites exhibited deterioration other than natural weathering (DOE 1999a).

Limited data currently exist on the levels of routine background ambient noise levels, air blasts, or ground vibrations produced by LANL operations that include explosives detonations. The following discussions of noise level limitations are provided to identify applicable regulatory limits or administrative controls regarding LANL's noise, air blast, and vibration environment; there are no regulatory, worker health protective, or maximum permissible level limitations for air blasts or ground vibrations. Available LANL noise and vibration information from specific activities is also summarized and presented (DOE 1999a).

4.4.5.1 Noise Level Regulatory Limits and Los Alamos National Laboratory Administrative Requirements

Noise generated by operations at LANL, together with the audible portions of explosives air blasts, is regulated by county ordinance and worker protection standards. The standard unit used to report sound pressure levels is the decibel (dB); the A-weighted frequency scale (db[A] or dBA) is an expression of adjusted pressure levels by frequency that accounts for human perception of loudness. Los Alamos County has promulgated a local noise ordinance that establishes noise level limits for residential land uses. Noise levels that affect residential receptors are limited to a maximum of 65 dBA during daytime hours and 53 dBA during nighttime hours (that is 9 p.m. and 7 a.m.). Between 7 a.m. and 9 p.m. the permissible noise level can be increased to 75 dBA in residential areas, provided that noise is limited to 10 minutes in any one hour. Activities that do not meet the noise ordinance limits require a permit (LANL 2004c).

Noise standards related to protecting worker hearing at LANL includes an occupational exposure limit for steady-state noise, defined in terms of accumulated daily (8-hour) noise exposure that allows for both exposure level and duration of 85 dBA (LANL 2003g). When a worker is exposed for a shorter duration, the permitted noise level is increased. LANL Administrative Requirements also limit worker impulse impact noise exposures that consist of a sharp rise in sound pressure level (high peak) followed by a rapid decay less than 1 second in duration and greater than 1 second apart. No Exposure of an unprotected ear in excess of a C-weighted peak of 140 dB is permitted (LANL 2004c).

4.4.5.2 Existing Los Alamos National Laboratory Noise, Air Blast, and Vibration Environment

Existing LANL-related publicly detectable noise levels are generated by a variety of sources, including truck and automobile movements to and from site TAs, high explosives testing, and security guards' firearms practice activities. Noise levels within Los Alamos County unrelated to LANL are generated predominately by traffic movements and, to a much lesser degree, other residential-, commercial-, and industrial-related activities within the county's communities and surrounding areas. Noise and vibration sources at LANL and noise measurements are discussed in the *1999 SWEIS* (DOE 1999a).

Although the workforce has been above the Record of Decision (ROD) projections since 1997, reaching 13,504 at the end of 2005, or about 19 percent above the projected level (LANL 2006g), the resulting increase in traffic noise levels would be less than 1 dBA and would not be expected to result in increased annoyance to the public.

Construction is an ongoing activity at LANL and there have been temporary increases in construction traffic since 1999. These increases in noise levels from construction activity and traffic at LANL have not been reported to result in increased annoyance to the public. Operation of new and modified facilities has not been reported to result in increased annoyance to the public from offsite noise impacts.

In July 1999, with the appropriate DOE authorization, the DARHT Project Office initiated DARHT facility (a High Explosive Facility) operations on the DARHT first axis. In late fall of 2000, the first major hydrotest using the DARHT first axis was completed and testing has continued. As part of the DARHT Mitigation Action Plan, DOE has undertaken a long-term monitoring program at the ancestral pueblo of Nake'muu to assess the impact of these LANL mission activities on cultural resources. Nake'muu is the only pueblo at LANL that still contains its original standing walls. It dates circa A.D. 1200 to 1325 and contains 55 rooms, with walls standing up to 6 feet (1.8 meters) high. Over the six-year monitoring program, the site has witnessed a 0.6 percent displacement rate of chinking stones and 0.2 percent displacement of masonry blocks. The annual loss rate ranges from 0.5 to 2.0 percent for the chinking stones and 0.05 to 1.3 percent for the masonry blocks. Statistical analyses indicate that these displacement rates are significantly correlated with annual snowfall, but not with annual rainfall or shots from the DARHT Facility (LANL 2004c).

4.5 Ecological Resources

Ecological resources include terrestrial resources, wetlands, aquatic resources, and protected and sensitive species. Each of these areas, as well as biodiversity is addressed separately below. Field investigations are an important element in the evaluation of ecological conditions at LANL. Such studies, which are conducted by LANL staff and may involve handling animals in the field, help determine species present, seasonality, density, and overall health. Special ecological studies, such as the evaluation of site wetlands, may be undertaken by outside experts.

4.5.1 Terrestrial Ecology

LANL is located in a region of diverse landform, elevation, and climate. The combination of these features, including past and present human use, has given rise to correspondingly diverse, and often unique, biological communities and ecological relationships at LANL and the region as a whole (DOE 1999a, LANL 2004c).

Five vegetation zones have been identified within LANL (see **Figure 4–25**). In general these zones result from changes in elevation, temperature, and moisture along the approximately 12-mile (19-kilometer) wide, 5,000-foot (1,500-meter) elevational gradient from the Rio Grande to the western edge of the site. The five zones include: Juniper (*Juniperus monosperma* [Engelm.] Sarg.) Savannas; Pinyon (*Pinus edulis* Engelm.)-Juniper Woodlands; Grasslands; Ponderosa Pine (*Pinus ponderosa* P. & C. Lawson) Forests; and Mixed Conifer Forests (Douglas fir [*Pseudotsuga menziesii* (Mimel) Franco], ponderosa pine, and white fir [*Abies concolor* (Gord. & Glend.) Lindl. ex Hildebr.]). While Mixed Conifer Forests are prevalent at higher elevations to the west of LANL, within the site this vegetation zone is restricted to cooler north-facing canyons walls. This diversity in vegetative communities has resulted in the presence of over 900 species of vascular plants. There is a comparable diversity in regional wildlife with 57 species of mammals, 200 species of birds, 28 species of reptiles, 9 species of amphibians, and over 1,200 species of arthropods having been identified (DOE 1999a, LANL 2004c).

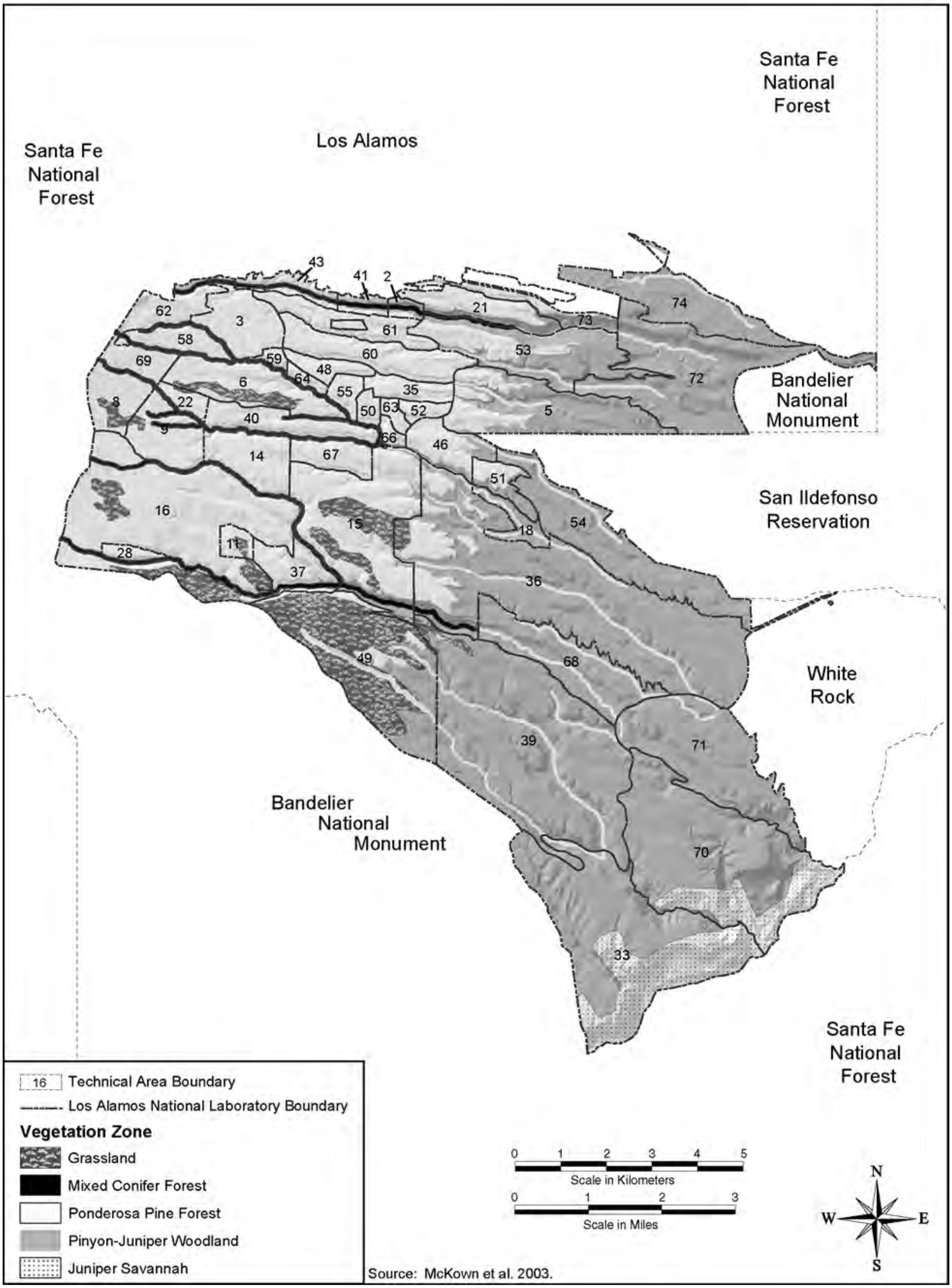


Figure 4–25 Los Alamos National Laboratory Vegetation Zones

Impacts to site terrestrial resources since publication of the *1999 SWEIS* have resulted from construction of new facilities, the Cerro Grande Fire, a bark beetle outbreak, and the conveyance and transfer of land. Major construction projects conducted between 1998 and 2003 have affected somewhat less than 100 acres (40 hectares) of previously undeveloped land. Impacts associated with this development include the loss of habitat and associated wildlife. In 2000, the Cerro Grande Fire burned 43,000 acres (17,400 hectares), including about 7,700 acres (3,110 hectares) on LANL (Balice, Bennett, and Wright 2004). Direct impacts on terrestrial resources included a reduction in habitat and the loss of wildlife (DOE 2000f). Fire mitigation work, such as flood retention facilities, affected about 50 acres (20 hectares) of undeveloped land (LANL 2005f). Additionally, about 9,950 acres (4,027 hectares) of forest have been thinned between 1997 and 2005 to reduce future wildfire potential (LANL 2006a). Thinning also creates a forest that appears more park-like with an increase in the diversity of shrubs, herbs, and grasses in the understory (Loftin 2001). An Interagency Wildfire Management Team, established in the late 1990s addresses continuing wildfire management and mitigation issues such as placement of fuel fire roads and breaks across the Pajarito Plateau (Webb and Carpenter 2001). There has been a decrease in elk (*Cervus elaphus*)-vehicle collisions since the fire. This is likely related to the amount of forage in burned areas west of LANL, as well as a lack of snowfall during the drought period. These factors have resulted in elk remaining at higher elevations away from major roadways (Sherwood, Biggs, and Hansen 2004).

Within two years of the Cerro Grande Fire a bark beetle outbreak occurred that resulted in 95 percent mortality of pinyon pine trees and 12 percent mortality of ponderosa pine trees across the Pajarito Plateau by the end of 2004. At lower elevations of the Mixed Conifer Forest Vegetation Zone on north-facing slopes of the canyons, up to 100 percent of the Douglas fir trees were also killed by the drought. The infestation could result in an increase in runoff, herbaceous growth, and the potential for wildfire. It would also be expected to impact wildlife populations. While at least partially the result of the fire, the bark beetle outbreak appears to be more a consequence of stress resulting from drought conditions and historical overstocking (LANL 2005f). Although precipitation was above average during much of 2005, there was a return to drought conditions toward the end of the year (LANL 2006h).

As noted in Section 4.1.1, approximately 2,259 acres (914 hectares) have been conveyed to Los Alamos County or transferred to the Department of the Interior to be held in trust for the Pueblo of San Ildefonso (LANL 2004c). This has reduced the size of LANL to about 25,600 acres (10,360 hectares). Much of the transferred land is in a natural state and falls within the Pinyon-Juniper Woodland and Ponderosa Pine Forest Vegetation Zones. To date, little of this land has been developed, although future development could result in both direct and indirect impacts to terrestrial habitats and species.

4.5.2 Wetlands

Wetlands are defined as, “Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.” Specific diagnostic criteria used by the U.S. Army Corps of Engineers to identify wetlands include vegetation, soil, and hydrology; these are spelled out in the *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987).

Approximately 34 acres (13.8 hectares) of wetlands have been identified within LANL boundaries during a survey in 2005 with 45 percent of these located in Pajarito Canyon. Dominant wetland plants found in site wetlands include reed canary grass (*Phalaris arundinacea* L.), narrow-leaf cattail (*Typha angustifolia* L.), coyote willow (*Salix exigua* Nutt.), Baltic rush (*Juncus balticus* Wildl.), wooly sedge (*Carex lanuginose* Michx.), American speedwell (*Veronica americana* Schwein. ex Benth.), common spike rush (*Eleocharis macrostachya* Britt.), and curly dock (*Rumex crispus* L.) (ACE 2005). Wetlands in the LANL region are primarily associated with canyon stream channels or are present on mesas, often in association with springs, seeps, or effluent outfalls. Cochiti Lake and the area near the LANL Fenton Hill site (TA-57) support lake-associated wetlands. There are also some springs within White Rock Canyon that support wetlands. Wetlands in the general LANL region provide habitat for reptiles, amphibians, and invertebrates, and potentially contribute to the overall habitat requirements of a number of species, including sensitive species (LANL 2004c, DOE 1999a).

The *1999 SWEIS* reported that there were 50 acres of wetlands on LANL. However, many of the outfalls with which these wetlands were associated have been closed or re-routed and the wetlands no longer exist. A further explanation for the difference in wetland acreage found in 1999 is that the methodology used in the past included as wetlands waters of the United States (ACE 2005). These channel areas were not delineated in the present survey as wetlands since they do not meet the criteria of the 1987 *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987).

During the Cerro Grande Fire, 16 acres (6.5 hectares) of the wetlands on LANL were burned at a low or moderate intensity. No wetlands within LANL were severely burned. Some riparian areas along the drainages also burned during the fire; however, these are not wetlands and are not included in the total acres of wetland. In addition to direct impacts from the fire, wetlands could receive increased sediment from stormwater runoff. While small amounts of sediment from the burned areas would enhance wetland growth, large amounts of deposited sediment could permanently alter the condition of existing wetlands and destroy them. The effects of the Cerro Grande Fire on LANL wetlands have yet to be fully assessed (DOE 2000f).

Fire suppression did not result in any direct impacts to wetlands since fire roads or breaks were not placed in wetlands. While construction of stormwater control projects following the fire resulted in minor impacts to wetlands (for example, culvert cleaning downstream from TA-18), these actions will protect downstream wetlands from erosion (DOE 2000f). Water retention structures built in drainages following the fire could develop wetland characteristics over time; however, with the ongoing drought, they have not yet been defined as wetlands (LANL 2006a).

To date, all or portions of 8 tracts have been conveyed or transferred to Los Alamos County and the Department of the Interior to be held in trust for the Pueblo of San Ildefonso (see Table 4–2). These tracts contain a total of about 9 acres (3.6 hectares) of wetlands, including stream channels. Although these wetlands are still protected by Federal and state regulations, they are no longer under the control of DOE. To date, there has been no change in the status of these wetlands because development has not taken place; however, future development could result in a direct loss of wetland structure and function and a potential increase in downstream and offsite sedimentation (DOE 1999d).

4.5.3 Aquatic Resources

The watersheds draining the Jemez Mountains and the Pajarito Plateau are tributary to the Rio Grande, the fifth largest watershed in North America. Approximately 11 miles (18 kilometers) of the eastern boundary of LANL border the rim of White Rock Canyon or descend to the Rio Grande. The riverine, lake, and canyon environment of the Rio Grande as it flows through White Rock Canyon makes a major contribution to the biological resources and significantly influences ecological processes of the LANL region. The construction of Cochiti Dam at the mouth of White Rock Canyon for flood and sediment control, recreation, and fish and wildlife purposes in the late 1960s, has significantly changed the features of White Rock Canyon and introduced new ecological components and processes. Twelve species of fish (found in the Rio Grande, Cochiti Lake, and the Rito de los Frijoles) have been identified in the LANL region (DOE 1999a, LANL 2004c).

While the Rio Grande and Rito de los Frijoles in Bandelier National Monument are the only truly perennial streams in the immediate vicinity, many canyon floors contain reaches of perennial surface water, such as the streams draining LANL property from lower Pajarito and Ancho Canyons to the Rio Grande. No fish species have been found within LANL boundaries (DOE 1999a, LANL 2004c). Actions taken since publication of the *1999 SWEIS* have not affected site aquatic resources.

4.5.4 Protected and Sensitive Species

The presence and use of LANL by protected and sensitive species is influenced not only by the actual presence and operation of the facility, but by management of contiguous lands and resources, and, importantly, by years of human use. A number of special status species have been documented on LANL or in the immediate vicinity (see **Table 4–25**). Federally listed wildlife includes 2 endangered species, 2 threatened species, 1 candidate, and 8 species of concern. New Mexico protected and sensitive plants and animals include 3 endangered species, 7 threatened species, 2 species of concern, and 14 sensitive species. Additionally, 18 species of birds are listed as birds of conservation concern. Information related to the occurrence of these species within the LANL region is included in the table. Changes that have occurred in the number of protected and sensitive species since publication of the *1999 SWEIS* have resulted from changes in the Federal and state lists and more complete data on species occurrence acquired by LANL biologists.

Table 4–25 Protected and Sensitive Species

Common Name	***Scientific Name***	***Status*** [a]		***Notes***
		Federal	***State***	
Plants				
Sapello Canyon larkspur	*Delphinium sapellonis* (Tidestrom)		Species of Concern	
Springer's blazing star	*Mentzelia springeri* (Standley) Tidestrom		Species of Concern	
Wood lily (Mountain lily)	*Lilium philadelphicum* L. var. *anadinum* (Nutt.) Ker		Endangered	Observed on Los Alamos County, Bandelier National Monument, and Santa Fe National Forest lands
Yellow lady's slipper orchid	*Cyprepedium calceolus* L. var. *pubescens* (Willd.) Correll		Endangered	Observed on Bandelier National Monument lands
Insects				
New Mexico silverspot butterfly	*Speyeria nokomis nitocris*	Species of Concern		
Fish				
Rio Grande chub	*Gila pandora*		Sensitive	
Amphibians				
Jemez Mountain salamander	*Plethodon neomexicanus*	Species of Concern	Threatened	Permanent resident, Los Alamos County, Bandelier National Monument, and Santa Fe National Forest lands
Birds				
American peregrine falcon	*Falco peregrinus anatum*	Species of Concern, Conservation Concern	Threatened	Forages on LANL, nests and forages on adjacent lands
Arctic peregrine falcon	*Falco peregrinus tundrius*	Species of Concern, Conservation Concern	Threatened	
Bald Eagle	*Haliaeetus leucocephalus*	Threatened	Threatened	Observed as a migratory and winter resident along Rio Grande and adjacent LANL lands
Bendire's thrasher	*Toxostoma bendirei*	Conservation Concern		
Black-throated gray warbler	*Dendroica nigrescens*	Conservation Concern		
Crissal thrasher	*Toxostoma crissale*	Conservation Concern		
Feruginous hawk	*Buteo regalis*	Conservation Concern		Considered accidental or transient on Bandelier National Monument
Flammulated owl	*Otus flammeolus*	Conservation Concern		Permanent resident on LANL
Graces's warbler	*Dendroica graciae*	Conservation Concern		

Common Name	Scientific Name	Status [a]		Notes
		Federal	State	
Golden eagle	*Aquila chrysaetos*	Conservation Concern		Has been known to nest in the Los Alamos area, but not found every year
Gray vireo	*Vireo vicinior*	Conservation Concern	Threatened	Considered accidental or transient on Bandelier National Monument
Lewis's woodpecker	*Melanerpes lewis*	Conservation Concern		Breeding resident on LANL
Loggerhead shrike	*Lanius ludovicianus*		Sensitive	Considered accidental or transient on Bandelier National Monument
Mexican spotted owl	*Strix occidentalis lucida*	Threatened	Sensitive	Breeding resident on LANL, Los Alamos County, Bandelier National Monument, and Santa Fe National Forest lands; critical habitat designated on Santa Fe National Forest lands
Northern goshawk	*Accipiter gentilis*	Species of Concern	Sensitive	Observed as a breeding resident on Los Alamos County, LANL, Bandelier National Monument, and Santa Fe National Forest lands
Northern harrier	*Circus cyaneus*	Conservation Concern		Considered rare or occasional on Bandelier National Monument
Pinyon jay	*Gymnorhinus cyanocephalus*	Conservation Concern		Breeding resident on LANL
Prairie falcon	*Falco mexicanus*	Conservation Concern		
Sage sparrow	*Amphispiza belli*	Conservation Concern		Breeding resident on LANL
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Endangered	Present on LANL and White Rock Canyon, Jemez Mountains, and near Española; potential nesting area on LANL
Virginia's warbler	*Vermivora virginiae*	Conservation Concern		Breeding resident on LANL
Williamson's sapsucker	*Sphyrapicus thyroideus*	Conservation Concern		Breeding resident on LANL
Yellow-billed cuckoo	*Coccyzus americanus*	Candidate, Conservation Concern	Sensitive	Has been recorded along Rio Grande, adjacent to LANL
Mammals				
Big free-tailed bat	*Nyctinomops macrotis*		Sensitive	Migratory visitor on Bandelier National Monument and Santa Fe National Forest lands; breeding resident on Los Alamos County
Black-footed ferret	*Mustella nigripes*	Endangered		
Fringed myotis	*Myotis thysanodes*		Sensitive	Breeding resident on LANL

Common Name	Scientific Name	Status [a]		Notes
		Federal	State	
Goat Peak pika	*Ochotona princeps nigrescens*	Species of Concern	Sensitive	Observed on Los Alamos County and Bandelier National Monument lands
Long-eared myotis	*Myotis evotis*		Sensitive	Breeding resident on LANL
Long-legged myotis	*Myotis volans*		Sensitive	Breeding resident on LANL
New Mexico meadow jumping mouse	*Zapus hudsonius luteus*	Species of Concern	Threatened	Permanent resident on Bandelier National Monument and Santa Fe National Forest lands; overwinters by hibernating
Ringtail	*Bassariscus astutus*		Sensitive	Observed in Los Alamos County
Spotted bat	*Euderma maculatum*		Threatened	Seasonal resident on LANL, Bandelier National Monument, and Santa Fe National Forest lands
Townsend's big-eared bat	*Plecotus townsendii*	Species of Concern	Sensitive	Seasonal resident on LANL
Western small-footed myotis	*Myotis ciliolabrum*		Sensitive	Seasonal resident on LANL
Yuma myotis	*Myotis yumanensis*		Sensitive	Summer resident on LANL, Los Alamos County, and Santa Fe National Forest lands

[a] Status:

Endangered:

Federal – in danger of extinction throughout all or a significant portion of its range.

State – Animal: any species or subspecies whose prospects of survival or recruitment in New Mexico are in jeopardy.

– Plant: a taxon listed as threatened or endangered under provision of the Federal Endangered Species Act, or is considered proposed under the tenets of the Act, or is a rare plant across its range within the State, and of such limited distribution and population size that unregulated taking could adversely impact it and jeopardize its survival in Mexico.

Threatened:

Federal – likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

State – Animal: any species or subspecies that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range in New Mexico.

– Plant: New Mexico does not list plants as threatened.

Candidate: Substantial information exists in U.S. Fish and Wildlife Service files on biological vulnerability to support proposals to list as endangered or threatened.

Conservation Concern: Migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act.

Sensitive: Those taxa that, in the opinion of a qualified New Mexico Department of Game and Fish biologist, deserve special consideration in management and planning, and are not listed as threatened or endangered by the State of New Mexico.

Species of Concern:

Federal – conservation standing is of concern, but status information is still needed; they do not receive recognition under the Endangered Species Act.

State – a New Mexico plant species, which should be protected from land use impacts when possible because it is a unique and limited component of the regional floral.

Sources: LANL 2004c, 2006a, NMAC 19.21.2, NMDGF 2004a, 2004b, NMNHP 2004, NMSF 2004, USFWS 2002, 2004a, 2004b.

A brief summary discussion of the Federal and state endangered and threatened species is provided below. The reader is referred to the *1999 SWEIS* for more detailed information on these and other species presented in Table 4–25. DOE coordinates with the New Mexico Department of Game and Fish and the U.S. Fish and Wildlife Service to locate and conserve protected and sensitive species.

LANL's Habitat Management Plan Summary

The LANL *Threatened and Endangered Species Habitat Management Plan* was developed to provide protection for threatened and endangered species that may reside on or use LANL property, as well as facilitating the implementation of DOE's mission at LANL. The three goals of the Plan are to: 1) develop a comprehensive management plan that protects undeveloped portions of LANL that are suitable or potentially suitable habitat for threatened and endangered species, while allowing current operations to continue and future development to occur with a minimum of project or operational delays or additional costs related to protecting species or their habitats; 2) facilitate DOE compliance with the Endangered Species Act and related Federal regulations by protecting and aiding in the recovery of threatened and endangered species; and 3) promote good environmental stewardship by monitoring and managing threatened and endangered species and their habitats using sound scientific principles. The Plan consists of Areas of Environmental Interest, Site Plans, and Monitoring Plans. Areas of Environmental Interest consist of a core area that contains important breeding or wintering habitat for a specific species and a buffer area around the core area. The Site Plans contain descriptions of individual species, the Area of Environmental Interest for that species, and current impacts in the Area Environmental Interest. Monitoring Plans describe the methodology used to determine if Federally listed species are present at LANL and may be designed to estimate reproduction, abundance, and distribution of the species at LANL.

The wood lily (*Lilium philadelphicum* L. var. *anadinum* (Nutt.) Ker) and yellow lady's slipper orchid (*Cyprepedium calceolus* L. var. *pubescens* (Willd.) Correll) are both listed as endangered in New Mexico. The wood lily grows in ponderosa pine, mixed-conifer, and spruce-fir forests and requires riparian areas. This plant has been observed on Los Alamos County, Bandelier National Monument, and Santa Fe National Forest lands. The yellow lady's slipper orchid, which grows in mixed-conifer forests, also requires riparian areas with moist soil conditions. It has been observed within the Bandelier National Monument (DOE 1999a).

The southwestern willow flycatcher (*Empidonax traillii extimus)* (federally and state-listed as endangered) occurs in riparian habitats along rivers, streams, or wetlands. Potential suitable nesting for this habitat species is present on LANL but is limited to a single canyon area. The southwestern willow flycatcher has been observed at higher elevations in the Jemez Mountains west of LANL and at lower elevations along the Rio Grande in the vicinity of Española. A migrant willow flycatcher was identified by song on LANL once during May 1997 and 2005. However, the willow flycatcher discovered on LANL cannot be confirmed to belong to the southwestern race (DOE 1999a, LANL 2006a).

The black-footed ferret (*Mustella nigripes*), which is listed as endangered by the U.S. Fish and Wildlife Service, was last reported in New Mexico in 1934. This species, which requires greater than 80 acres (32 hectares) of prairie dog towns (for its prey base), has a low potential of occurrence on LANL since no large prairie dog towns occur on the site (Keller and Koch 2001).

The Jemez Mountain salamander (*Plethodon neomexicanus*) is listed as threatened in New Mexico. It can be found in mixed-conifer forests and requires north-facing moist slopes. It is a permanent resident in Los Alamos County, Bandelier National Monument, and Santa Fe National Forest (DOE 1999a).

Two federally threatened birds, the bald eagle (*Haliaeetus leucocephalus*) and Mexican spotted owl (*Strix occidentalis lucida*), are found in the LANL region. State-listed threatened birds found in the area include the peregrine falcon (*Falco peregrinus*) (both subspecies), bald eagle, and gray vireo (*Vireo vicinior*). The bald eagle has been observed as a migratory and winter resident along the Rio Grande and on adjacent LANL lands. The Mexican spotted owl prefers tall, old-growth forest in canyons and moist areas for breeding. It is found in mixed conifer and ponderosa forests and is a breeding resident on LANL, Los Alamos County, Bandelier National Monument, and Santa Fe National Forest lands (DOE 1999a). Mexican spotted owls were recorded breeding on LANL from 1994 through 1999 and in 2005. Although adult birds were seen, there was no recorded breeding between 2000 and 2004 after the Cerro Grande fire. In 2004, a resident Mexican spotted owl was confirmed in the north-central part of LANL; however the nesting status of this bird was not determined. In 2005, a second occupied territory in the southwestern portion of LANL was confirmed to have a nesting pair and three young were fledged (LANL 2006a). The peregrine falcon, which requires cliffs for nesting, has been found within juniper savannah and pinyon-juniper, ponderosa pine, and mixed-conifer forests. It forages on LANL and nests and forages on adjacent lands. The gray vireo uses riparian areas in juniper savannah and pinyon-juniper forests. It has been observed on Bandelier National Monument.

Two state-threatened mammals have been found in the LANL area. These include the New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) and spotted bat (*Euderma maculatum*). The former is found in mixed-conifer and spruce-fir forests and requires riparian areas. It is a permanent resident on Los Alamos County and Santa Fe National Forest lands. The spotted bat is found in pinyon-juniper woodland, ponderosa pine forest, and spruce-fir forest. It roosts in cliffs near water. This species is a seasonal resident on Bandelier National Monument and Santa Fe National Forest; it is a seasonal resident on LANL (DOE 1999a).

Habitat that is either occupied by federally protected species or that is potentially suitable for use by these species in the future has been delineated within LANL; occupied habitat is protected as if it were critical habitat[4] for the species. The *Los Alamos Threatened and Endangered Species Habitat Management Plan*, implemented in 1999, identifies Areas of Environmental Interest for various federally listed threatened or endangered species. In general, an Area of Environmental Interest consists of a core area that contains important breeding or wintering habitat for a specific species and a buffer area around the core area. The buffer protects the core area from disturbances that would degrade its value. Areas of Environmental Interest have been established at LANL for the Mexican spotted owl, bald eagle, and southwestern willow flycatcher (LANL 1998c). Recently, changes in the boundaries for all Mexican Spotted Owl Area of Environmental Interest have been approved by the U.S. Fish and Wildlife Service. These changes, which were made in response to implementation of a new habitat model, resulted in the removal of some areas from the Areas of Environmental Interest and the addition of other areas.

[4] *Critical habitat = specific areas occupied by a species on which are found those physical and biological features essential to its conservation and which may require special management consideration or protection. These areas are designated by the U.S. Fish and Wildlife Service under the Endangered Species Act of 1973.*

Areas of Environmental Interest have not been established for the black-footed ferret, since suitable habitat for this species does not occur at LANL (DOE 2003d).

Although many of the Mexican spotted owl Areas of Environmental Interest received moderate- and low-severity burns, part of the Sandia-Mortandad Area of Environmental Interest was severely burned during the Cerro Grande Fire. Habitat within the southwestern willow flycatcher and bald eagle Area of Environmental Interest did not burn (DOE 2000f). There is no evidence that the fire caused a long-term change to the overall number of federally listed threatened or endangered species inhabiting the region. LANL's species of greatest concern, the Mexican spotted owl, was seen within weeks of the fire and in all subsequent breeding seasons; however, there was no recorded breeding between 2000 and 2004. It was not until 2005 that a nested pair was observed. Some State-listed species, including the Jemez Mountain salamander (*Plethodon neomexicanus*), have undoubtedly been less fortunate and recovery of the species to pre-fire levels may take a long time (LANL 2003h, 2006a).

As noted above (see Section 4.1.1), 2,259 acres (914 hectares) have been conveyed to Los Alamos County and transferred to the Department of the Interior to be held in trust for the Pueblo of San Ildefonso. Some of the areas that have been turned over to these two entities have Areas of Environmental Interest for the Mexican spotted owl. However, the *LANL Threatened and Endangered Species Habitat Management Plan* (LANL 1998c), under which the Areas of Environmental Interest are designated, is no longer in effect for conveyed or transferred land (DOE 1999d).

4.5.5 Biodiversity

Biodiversity refers to the variety and variability among living organisms and the ecological complexes in which they occur (EPA 2005c). The major human-caused disturbance factors, which are addressed in detail in the *1999 SWEIS* and identified by the Council on Environmental Quality as responsible for the decline in biodiversity at multiple scales, including global, regional, and site-specific scales, are the following:

- Physical alteration of the landscape,
- Over harvesting,
- Disruption of natural processes, such as flooding and fires,
- Introduction of nonnative (exotic) species,
- Pollution, and
- Global climate change (which is considered outside the scope of this analysis).

Since publication of the *1999 SWEIS*, development at LANL, the Cerro Grande Fire, the conveyance and transfer of land, the drought, and the bark beetle outbreak have all had (or have the potential to have) an effect on biodiversity. For example, development has reduced available habitat and fragmented the environment, thereby altering the composition of wildlife populations present on the site. Further, these factors may have broad scale detrimental impacts on soil erosion. The introduction of non-native plant species (also called exotic plants) can result from the elimination of native species through land disturbance. Presently there are 150 exotic plants growing at LANL. Certain actions initiated at LANL and at other land-management area across the Pajarito Plateau could act to positively affect the environment. For example, the thinning of forests will create a woodland environment closer to the one that existed prior to the advent of fire suppression activities in the 1890s, which may serve to attract a more diverse animal population back into the area.

Pollution impacts on ecosystems include direct lethal, sub-lethal, and reproductive effects (including those resulting from bioaccumulation) and degradation of habitat. Sub-lethal effects of environmental contamination may indirectly cause mortality at widely varying temporal scales and on widely varying levels of ecological organization. Possible mechanisms include immunological effects enhancing susceptibility to disease, alteration of nutrient cycles through effects on bioavailability or uptake mechanisms, metabolic effects, and behavior modification affecting ability to feed, hunt, avoid predation, or breed. The contribution of pollutants to environmental media by LANL operations is due primarily to past practices. Long-term monitoring of soils, sediment, water, and air, as well as biomonitoring, have not demonstrated levels of contaminants that would pose a health risk, nor have there been obvious toxic effects observed. There is no evidence of any contaminants originating at LANL that would pose a risk to recreational fishing in the Rio Grande and downstream of Cochiti Lake (LANL 2004c). Monitoring data for a variety of environmental media are published annually in the site Environmental Surveillance Reports (LANL 2002d, 2004a, 2004d, 2005h, 2006h).

4.6 Human Health

The following sections summarize current information on public and worker health in and around LANL. The methods that are in place to monitor and reduce the risks to the public and workers from all hazards are described in the *1999 SWEIS* (see Chapter 4, Sections 4.6.1 and 4.6.2).

4.6.1 Public Health in the Los Alamos National Laboratory Vicinity

4.6.1.1 Cancer Incidence and Mortality in the Los Alamos Region

The *1999 SWEIS* presented a detailed discussion of cancer incidence and mortality in the Los Alamos region, based on national and regional statistics through about 1995. The *1999 SWEIS* summarized National Cancer Institute data for the State of New Mexico and its counties, as well as the results of independent studies conducted to investigate reported increased incidence of specific cancers in Los Alamos County and the surrounding communities. This section presents a summary of cancer incidence and mortality figures for the Los Alamos region as derived from the most recent data made available by the National Cancer Institute (through 2003).

Table 4–26 presents a summary of total cancer mortality, incidence of all cancers, and incidence of selected cancer types for the State of New Mexico, as well as Los Alamos, Santa Fe, Sandoval, and Rio Arriba Counties, for the period 1999 through 2003. During that period, the overall cancer incidence (412.2) and death rates (171.1) for the State of New Mexico were somewhat below the national average (462.2 and 195.7, respectively). Total cancer incidence in Los Alamos County (434.9) and two of the three contiguous counties exceeded the State average, although the rates in all four counties were below the national averages. As reported in the 1993

Los Alamos Cancer Rate Study (Athas and Key 1993), the incidence rates of melanoma of the skin, prostate cancer, and female breast cancer remain elevated in Los Alamos County with respect to the State averages. The rate of thyroid cancer also exceeded the State average for the period. Cancers of the lung, colon, and rectum occurred at rates below the State averages. Due to the small number of reported cases and resulting statistical unreliability of the data, the rates of non-Hodgkin's lymphoma, ovarian cancer, brain cancer, leukemia, and stomach cancer in Los Alamos County were not reported by the National Cancer Institute (NCI 2006).

Table 4–26 Five-Year Profile of Cancer Mortality and Incidence in the United States, New Mexico, and Los Alamos Region, 1999 through 2003 [a]

Statistic	*United States* [b]	*New Mexico*	*Los Alamos County*	*Santa Fe County*	*Sandoval County*	*Rio Arriba County*
Average Deaths Per Year	554,165	2,966	25	178	140	60
Annual Death Rate (per 100,000)	195.7 (195.5, 196.0)	171.1 (168.4, 173.9)	132.3 (109.5, 160.1)	147.7 (138.0, 158.0)	169.2 (156.9, 182.3)	163.4 (145.3, 183.3)
Annual Incidence Rate (per 100,000)						
All sites [c]	462.2 (461.4, 463.0)	412.2 (408.0, 416.5)	434.9 (394.0, 480.4)	478.1 (461.1, 495.5)	444.8 (424.9, 465.4)	337.0 (311.4, 364.3)
Brain and Other Nervous System	6.5 (6.4, 6.6)	5.6 (5.1, 6.1)	NA [d]	6.0 (4.3, 8.3)	4.7 (2.9, 7.3)	NA [d]
Breast (female)	124.9 (124.4, 125.5)	115.0 (112.0, 118.1)	127.2 (98.7, 165.7)	155.4 (142.9, 168.8)	123.6 (109.8, 138.7)	89.0 (72.0, 109.0)
Colon and Rectum	52.0 (51.7, 52.3)	42.9 (41.5, 44.3)	39.8 (28.0, 56.8)	44.2 (39.0, 49.8)	50.8 (44.2, 58.1)	40.6 (32.0, 50.9)
Leukemia	11.3 (11.2, 11.4)	12.5 (11.7, 13.2)	NA [d]	19.7 (16.3, 23.5)	13.3 (10.0, 17.3)	7.8 (4.4, 12.9)
Lung and Bronchus	67.5 (67.2, 67.8)	46.9 (45.5, 48.4)	28.5 (18.8, 43.7)	42.0 (36.9, 47.6)	48.1 (41.7, 55.4)	32.4 (24.6, 42.0)
Melanoma of Skin	16.6 (16.4, 16.7)	17.3 (16.4, 18.2)	29.6 (20.0, 44.4)	23.6 (20.0, 27.7)	19.1 (15.2, 23.6)	NA [d]
Non-Hodgkin's Lymphoma	18.4 (18.2, 18.5)	15.6 (14.7, 16.4)	NA [d]	19.8 (16.4, 23.7)	17.9 (14.0, 22.5)	12.6 (8.0, 19.1)
Ovary	13.1 (12.9, 13.2)	13.0 (12.0, 14.1)	NA [d]	15.3 (11.5, 20.1)	12.1 (8.1, 17.5)	NA [d]
Prostate	161.2 (160.4, 161.9)	152.2 (148.3, 156.1)	244.7 (202.4, 296.6)	198.3 (182.0, 216.1)	158.0 (140.3, 177.7)	151.4 (126.6, 180.2)
Stomach	7.1 (7.0, 7.2)	7.1 (6.5, 7.7)	NA [d]	7.1 (5.1, 9.7)	7.3 (5.0, 10.4)	12.1 (7.6, 18.6)
Thyroid	8.2 (8.1, 8.3)	10.2 (9.5, 10.9)	19.5 (11.3, 33.5)	10.8 (8.4, 13.6)	13.7 (10.5, 17.6)	12.6 (8.1, 18.9)

NA = not available.
[a] Age-adjusted incidence rates. 95 percent confidence interval in parentheses.
[b] The U.S. average number of deaths and annual death rate reported by the National Cancer Institute are for the entire 1999 through 2003 rate period. The U.S. annual incidence rates reported by the National Cancer Institute are for the year 2002.
[c] All cancers, all races, both sexes.
[d] Data not available. When the number of reported cases is small, some data are suppressed in National Cancer Institute reports to ensure confidentiality and stability of rate estimates.
Source: NCI 2006.

In a study entitled *Public Health Assessment, Final, Los Alamos National Laboratory*, the ATSDR of the U.S. Department of Health and Human Services Public Health Service reported on its review of possible public exposures to radioactive materials and other toxic substances in the environment near LANL (ATSDR 2006). The study also examined the results of the *Los Alamos Cancer Rate Study* (Athas and Key 1993), and a related work entitled *Investigation of Excess Thyroid Cancer Incidence in Los Alamos County* (Athas 1996), and determined that there were no data to link environmental factors, other than naturally occurring ultraviolet light from the sun, with the observed incidence of any cancer in Los Alamos County. The ATSDR report concluded that, "Overall, cancer rates in the Los Alamos area are similar to cancer rates found in other communities. In some time periods, some cancers will occur more frequently and others less frequently than seen in reference populations. Often, the elevated rates are not statistically significant."

4.6.1.2 Radiation in the Environment around Los Alamos National Laboratory

Radiation in the environment around LANL is attributed to external, naturally-occurring radiation and from past and present operations at LANL. External radiation comes from two sources that are approximately equal: cosmic radiation from space and terrestrial gamma radiation from radionuclides naturally in the environment. Doses from cosmic radiation range from 50 millirem per year at lower elevations near the Rio Grande to about 90 millirem per year in the mountains. Doses from terrestrial radiation range from 50 to 150 millirem per year depending on the amounts of natural uranium, thorium, and potassium in the soil.

The largest dose from radioactive material is from the inhalation of naturally occurring radon and its decay products, which contribute about 200 millirem per year. An additional 40 millirem per year results from naturally-occurring radioactive materials in the body, primarily potassium-40, which is present in all food and in all living cells.

In addition, members of the U.S. population receive an average dose of 50 millirem per year from medical and dental uses of radiation, 10 millirem per year from manmade products such as stone and adobe walls, and less than 1 millirem per year from global fallout from nuclear weapons tests. Because of the above factors, published estimates of the background doses received by people in the area around LANL generally give a range of rounded values, from a low of about 300 to a high of about 500 millirem per year (LANL 2006h). For this reason, the background dose varies and, for the purpose of this SWEIS, the typical LANL area resident is assumed to receive a dose near the middle of this range (approximately 400 millirem per year) from background sources.

Radiological Emissions Standards

Federal Government standards limit the dose that the public may receive from LANL operations. The DOE public dose limit to any individual from LANL operations is 100 millirem per year received from all pathways (that is, all ways in which people can be exposed to radiation, such as inhalation, ingestion, and direct radiation). The dose received from airborne emissions of radionuclides is further restricted by the EPA dose standard of 10 millirem per year (40 CFR Part 61). These doses are in addition to exposures from natural background, consumer products, and medical and dental radiation.

Radiological Dose Assessment

The LANL Environmental Surveillance and Compliance Program oversees the monitoring of the site and surrounding region foodstuffs, air, water, and soil for radiation, radioactive materials, and hazardous chemicals. The information is used for continually determining time trends and to assess potential risks to human health and the environment. The information is published annually in the LANL environmental surveillance report.

The *1999 SWEIS* provided a dose assessment as reported in the LANL *Environmental Surveillance and Compliance at Los Alamos During 1996* (LANL 1997c). The dose assessment provided below was reported in *Environmental Surveillance at Los Alamos During 2005* (LANL 2006h).

Doses, calculated and reported in the LANL Environmental Surveillance and Compliance Reports are incremental (above background) doses caused by operations at LANL. Annual radiation doses to the public are evaluated for three principal exposure pathways: inhalation, ingestion, and direct (external) radiation. Doses for the following cases are calculated:

- The entire population within 50 miles (80 kilometers) of the site,
- The maximally exposed individual (MEI) who is not on LANL or DOE property (referred to as the offsite MEI),
- Residents in the Los Alamos Townsite and White Rock.

The doses from the first two cases above, for the past 13 years, are shown in **Figures 4–26** and **4–27**. The two graphs are similar because LANSCE is the major contributor to both. Generally, the year-to-year fluctuations are the result of variations in the number of hours that LANSCE operates, whereas the downward trend is the result of efforts to reduce LANSCE emissions by installing delay lines and fixing small leaks. The increase in 2005 occurred because LANSCE operational time was over twice the 2004 level and a valve in the LANSCE emissions control system was defective.

In addition, offsite doses to individuals from water ingestion, food ingestion, and direct exposure from soil contamination are calculated based on measurements of radionuclide concentrations in groundwater, surface water, sediments, surface soil, and radioactive content of foods.

Population within 50 Miles (80 kilometers)

The distribution of population has changed since the *1999 SWEIS*. Details are shown in **Table 4–27**. There is an increase in the total population within a 50-mile (80-kilometer) radius of LANSCE (TA-53). The effects on the population dose and accident analyses of the shift in population will vary based on the meteorology of the area and which radionuclides are dominating the assessment.

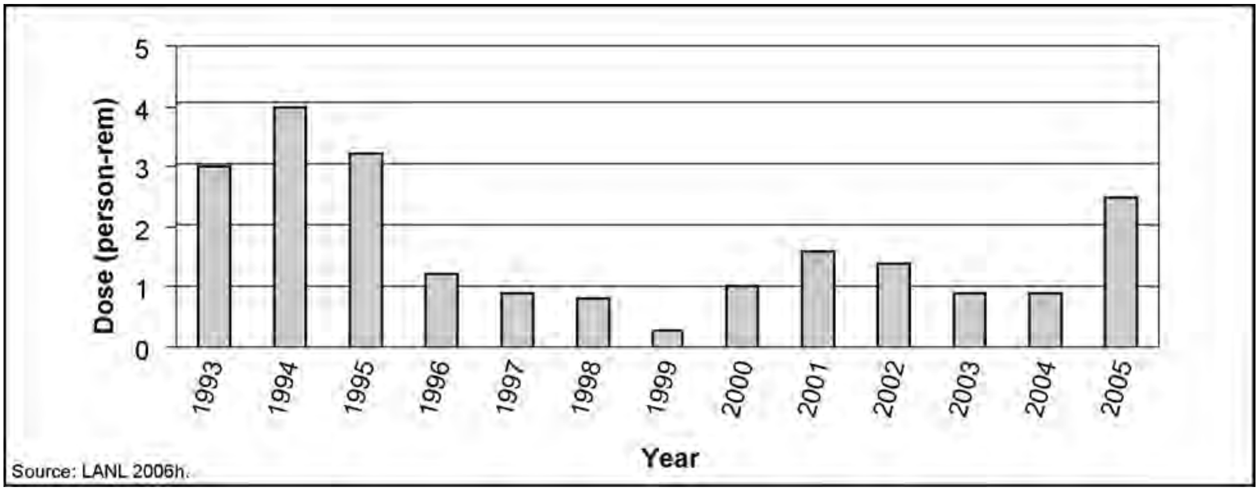


Figure 4–26 Annual Collective Dose (person-rem) to the Population within 50 Miles (80 kilometers) of Los Alamos National Laboratory

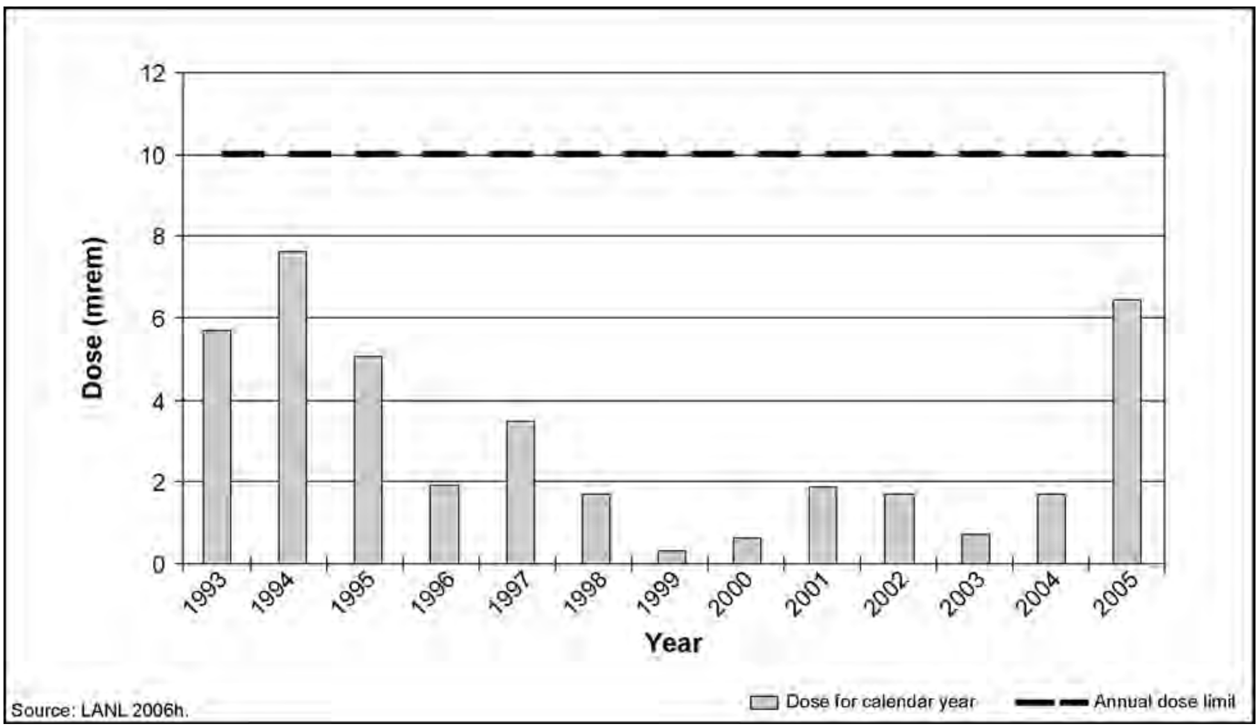


Figure 4–27 Annual Dose (millirem) to the Maximally Exposed Individual Offsite

Table 4–27 Changes in Population Distribution Since the *1999 SWEIS*

Miles from LANL [a]	*0 to 10*	*10 to 20*	*20 to 30*	*30 to 40*	*40 to 50*	*Total*	*Percent Increase*
1999 SWEIS	19,919	50,046	85,602	30,563	56,175	242,305	–
Current SWEIS	19,646	48,081	101,113	26,481	80,192	275,513	14 (33,208)

[a] Centered at the Los Alamos Neutron Science Center (TA-53).
Note: To convert miles to kilometers, multiply by 1.6093.
See Appendix C for further details.

The 2005 collective population dose attributable to LANL operations to persons living within 50 miles (80 kilometers) of the site was 2.46 person-rem. Tritium contributed about 17 percent of the dose, and short-lived air activation products such as carbon-11, nitrogen-13, and oxygen-15 from LANSCE contributed about 83 percent. This increase in the 2005 collective population dose was due to a longer beam time (over twice that of 2004) at LANSCE and a malfunction in the air emissions control system that was later fixed. Until 2005, population doses had declined from a high of about 4 person-rem in 1994 to less than 1 person-rem in 2004. As of November 2006, the collective population dose was expected to decrease in 2006 to the 2004 level.

Offsite Maximally Exposed Individual

The offsite MEI is a hypothetical member of the public who, while not on LANL property, would receive the largest dose from LANL operations. During 2005, two potential MEI locations were analyzed. One was at East Gate along NM 502, at the east side of Los Alamos County. East Gate is normally the location of greatest exposure because of its proximity to LANSCE. The total dose to the MEI at the East Gate in 2005 was estimated at 6.46 millirem, of which approximately 6.31 millirem would come from LANSCE. Emissions from LANSCE stacks were greatly elevated during 2005 due to longer beam operating time (almost 10 months in 2005 versus 4 months in 2004) and a malfunction in the air emissions control system. As of November 2006, the emissions were expected to return to the 2004 rates as a result of the system's repair and additional controls implemented in 2005.

The second location evaluated as a potential MEI in 2005 was the boundary of the Pueblo de San Ildefonso Sacred Area north of Area G. The dose at this location was calculated to be approximately 0.9 millirem per year, less than the MEI dose at the East Gate. The MEI dose of 6.46 millirem is below the 10 millirem per year airborne emissions dose limit for the public (40 CFR Part 61). The year-to-year fluctuations in the emission rate from LANSCE are the result of variations in the number of hours that LANSCE runs. The downward trend indicated in recent years resulted from installing delay lines and fixing small leaks.

Onsite Maximally Exposed Individual

The onsite MEI is a member of the public who would receive a radiological dose from LANL operations while onsite. This MEI had been evaluated in previous years, but because of increased security restrictions, members of the public are prevented from accessing many of the technical areas. This change, combined with the relocation of significant radiation sources, makes an onsite MEI no longer applicable.

Doses in Los Alamos Townsite and White Rock

Los Alamos Townsite. During 2005, the measurable contributions to the dose at an average Los Alamos residence were as follows: 0.08 millirem from radionuclides produced at LANSCE and 0.01 millirem from tritium. Other nuclides contribute less than 0.02 millirem. These doses add up to 0.11 millirem.

White Rock. During 2005, the measurable contributions to the dose at an average White Rock residence were as follows: 0.04 millirem from emissions at LANSCE and 0.01 millirem from tritium. Other nuclides each contribute less than 0.01 millirem. These add up to 0.06 millirem.

Water (Ingestion Pathway)

The majority of radionuclides detected in groundwater samples collected during 2005 resulted from the presence of natural radioactivity in these sources. Tritium was the only radionuclide detected in these groundwater samples that could possibly be attributed to LANL operations. The highest concentration of tritium from a known or potential drinking water source (349 picocuries per liter) was measured in a sample from an alluvial spring in Upper Los Alamos Canyon, which is not a recognized drinking water supply. This concentration was far below the EPA maximum contaminant level of 20,000 picocuries per liter and results in a dose less than 0.1 millirem per year (LANL 2006h).

Soil (Direct Exposure Pathway)

Soil samples were collected on the perimeter of San Ildefonso Pueblo land within Mortandad Canyon, downwind of Area G. No samples had radionuclide concentrations above the Regional Statistical Reference Levels. As the strontium-90 and cesium-137 soil concentrations at the sample location were less than the Regional Statistical Reference Levels for both radionuclides, the doses from cesium-137 and strontium-90 concentrations in soil are most likely from global fallout, not LANL. The tritium could mainly come from three sources: cosmic rays, nuclear weapons testing, and LANL; however, the total dose from tritium in soil was virtually nonexistent. Similarly, transuranics (such as plutonium) may include a small contribution from LANL, but the dose would be less than 0.1 millirem per year. Finally, the isotopic mixture of uranium was consistent with natural uranium. Therefore, the LANL contribution to dose from soil is less than 0.1 millirem per year, and the majority of the radionuclides detected are primarily due to fallout (LANL 2006h).

Food (Ingestion Pathway)

Over the years, LANL staff has collected a variety of foodstuff samples (fruits, vegetables, grains, fish, milk, eggs, honey, herbal teas, mushrooms, pinyon nuts, domestic animals, and large and small game animals) from the surrounding area and communities to determine the impacts of LANL operations on human health via the human food chain. During 2005, predator and bottom-feeding fish were caught at Abiquiu and Cochiti Reservoirs and purslane (*Portulaca* species), a wild edible plant, was collected on the perimeter of San Ildefonso Pueblo within Mortandad Canyon, downwind of Area G. Fish caught at Abiquiu Reservoir serve as a background population that is essentially removed from the influence of LANL because the reservoir is upstream of the site. Cochiti Reservoir is downstream of LANL and fish caught there are potentially impacted by LANL operations. A review of the radionuclide concentrations indicated that the dose received from consuming predator and bottom-feeding fish caught at Cochiti Reservoir would be much less than 0.1 millirem per year.

Purslane was again chosen for analysis in 2005 to better define the reasons for slightly higher levels of some radionuclides in wild edible plants in 2004. The analyses of the nine radionuclides in purslane plants collected from Mortandad Canyon on San Ildefonso Pueblo lands showed that strontium-90 was the only radionuclide detected in concentrations above the Regional Statistical Reference Level. The highest level of strontium-90 in purslane plants from Mortandad Canyon was below the screening level of 1 picocurie per gram. Assuming consumption of approximately 30 pounds of purslane per year, a total dose of approximately 0.1 millirem would be received from the consumption of wild purslane. The LANL contribution to the dose from consuming foodstuffs would be on the order of 0.1 millirem per year if wild foodstuffs were collected and consumed. In summary, the total annual dose to an average resident from ingestion of fish and wild purslane was approximately 0.1 millirem.

4.6.1.3 Radionuclides and Chemicals in the Environment Around Los Alamos National Laboratory

The risk to the public health from ingestion of water, foodstuffs, and from incidental ingestion of soils and sediments was estimated in the *1999 SWEIS* from environmental surveillance data within and surrounding LANL. As indicated in the *1999 SWEIS*, the risk of toxicity and carcinogenicity continues to be dominated by existing concentrations of radionuclides and chemicals in environmental media due to naturally occurring materials, global fallout, and other anthropogenic sources affecting the region, and historical operations (including emissions and effluents, and accidental spills and releases).

Estimates of dose and risk from radioactive and nonradioactive contaminants potentially ingested by residents, recreational users of LANL lands, and via special pathways are evaluated in Appendix D of the *1999 SWEIS* based on contaminant data published in *Environmental Surveillance Reports* for the period between 1991 and 1997. According to the *1999 SWEIS*, the total worst-case ingestion doses for the offsite resident of Los Alamos County and Non-Los Alamos County resident would be 11 and 17 millirem per year, respectively. If this person is also a recreational user of the Los Alamos canyons, drinking canyon water and ingesting canyon sediments, the worst-case additional dose would range up to 1 millirem per year. If the individual has traditional American Indian or Hispanic lifestyles, the worst-case additional dose would be 3 millirem per year (DOE 1999a). Thus the worst-case individual could receive 15 and 21 millirem per year. The associated excess latent cancer fatality risk for the offsite resident would be in the range of 9 to 13 in one million (using a conversion risk factor of 0.0006 excess latent cancer fatalities per rem).

Estimates were also made in the *1999 SWEIS* of the potential health risk from nonradioactive contaminants in groundwater, surface water, soils, and sediments, vegetables, fruit, and fish. According to the *1999 SWEIS*, the hazard indices for all detectable metals were generally less than 1 (a Hazard Index of 1 or greater than 1 is considered indicative of a potential health hazard to the exposed individual) and the latent cancer fatality risk less than one in one million per year.

Appendix C, of this *SWEIS*, re-examines the potential health risk to specific receptors from contaminants in the environment around LANL. Dose and risk were estimated using environmental surveillance data reported over several years. The reported concentrations were averaged and a 95 percent upper confidence level (95 percent upper confidence limit) concentration was determined for each contaminant in each of several foodstuffs and environmental media. Using published guidelines, consumption rates for specific foodstuffs and environmental media were selected to depict the exposure of residents to environmental contaminants. Exposures were calculated for typical (average) and high levels of consumption. As represented by the Appendix C calculations, the ”Offsite Resident” is a person who depends heavily on locally acquired foodstuffs (including some fish, game, and other wild foods) and whose living habits and diet result in higher-than-average exposure to radionuclides and chemicals in the environment. Additional pathway components were analyzed to account for exposures to an avid recreational user of wildlands at LANL (the “Recreational User”). Finally, several additional diet items (“Special Pathways”) were analyzed to assess the potential added impacts to Native American, Hispanic, and other residents with traditional living habits and diets. Where appropriate, updated exposure pathway parameters and risk factors were used to estimate the dose and risk from radioactive and nonradioactive contaminants in the environment.

The results of these analyses are not much different from those presented in the *1999 SWEIS*. As represented by the sum of all the analyzed pathway components, the worst-case individual (an “Offsite Resident” who is also a “Recreational User” and consumes the “Special Pathways” diet items) would receive a radiation dose of 11 millirem per year and the associated excess latent cancer fatality risk would be 6.6 in one million. With the exception of several naturally-occurring metals, the hazard indices for all nonradioactive contaminants are again found to be generally less than 1 and the latent cancer fatality risk less than 1 in one million per year. The findings of the *1999 SWEIS* regarding exposure of Los Alamos County residents to naturally-occurring arsenic and beryllium are confirmed in Appendix C.

Arsenic and vanadium were identified as having a Hazard Index above 1 in groundwater that supplies Los Alamos County and San Ildefonso Pueblo. Excess latent cancer fatality risk from arsenic greater than 1 in one million per year was also estimated for consumption of soils, sediments, and surface water, by some residents and recreational users of LANL. While the risk associated with arsenic ingestion was greater than 1 in one million per year, the arsenic was not associated with discharges at LANL. Arsenic and vanadium are endemically present in the rocks, soils, groundwater, and surface waters in the region in which New Mexico is located (DOE 1999a).

Beryllium has no Hazard Index for ingestion exceeding 1. However, excess latent cancer fatality rates greater than 1 in one million are estimated in several pathways. Beryllium concentrations in waters, soils, and sediments are typical of those in background readings in the northern New Mexico region. Based on the environmental surveillance data from LANL, the portion of beryllium associated with LANL operations is not a significant contributor to beryllium concentrations in the immediate area of LANL (DOE 1999a).

Radionuclide and chemical concentrations in the environment around LANL are not expected to change significantly over time. If anything, they are expected to diminish with the radioactive decay of the radionuclide constituents. An event, however, with a potential for redistribution of radionuclide and chemical constituents in the vicinity of LANL was the Cerro Grande fire that occurred in May 2000. The Cerro Grande Fire burned areas that were known or suspected to be contaminated with radionuclides and chemicals, which raised concerns about health effects to the public offsite. Studies were conducted to determine radiological and nonradiological effects in the vicinity of LANL after the fire (RAC 2002, LANL 2002g).

The LANL study considered the possibility that the fire enhanced flooding in watersheds that have residual contamination from early LANL operations (LANL 2002g). The objective was to estimate potential radiological and nonradiological effects from the fire that might have been experienced by receptors most affected during calendar year 2000. Observations and sampling showed that the aftereffects of the Cerro Grande Fire resulted in increased concentrations of radioactive and chemical contaminants in runoff and in sediments deposited during 2000. The predominance of these effects was caused by the increased mobilization of locally deposited worldwide fallout or of naturally-occurring substances that were concentrated by the fire. The study concluded that none of the receptors most affected (residents of Totavi or direct and indirect users of Rio Grande water) was likely to have experienced health effects as a result of exposures to radioactive and nonradioactive contaminants during calendar year 2000.

The study performed by the Risk Assessment Corporation (RAC 2002), was performed at the request of the NMED and was funded by DOE. It was an independent assessment of public health risks from radionuclides and chemicals associated with LANL releases as a result of the fire. The assessment covered releases to the air and to surface waters.

With regard to air releases, the Risk Assessment Corporation assessment indicated that "exposure to LANL-derived chemicals and radionuclides released to the air during the Cerro Grande Fire did not result in a significant increase in health risk over the risk from the fire itself" (RAC 2002). The risk of cancer from exposure to radionuclides and carcinogenic metals released from vegetation that burned was greater than that from radionuclides and chemicals released from contaminated sites at LANL. All cancer risks were below the EPA established range acceptable risks of 1 in one million to 1 in 10,000. "Potential intakes of noncarcinogenic LANL-derived chemicals exceeded acceptable intakes established by EPA at some locations on LANL property" (RAC 2002). However, the estimated intakes were conservative, and the actual risks were likely overestimated.

Cancer risks from exposure to LANL-derived radionuclides and carcinogenic chemicals released to the surface water as a result of the Cerro Grande Fire were within acceptable limits established by the EPA. Estimated intakes of noncarcinogenic LANL-derived chemicals were also less than acceptable limits established by EPA. Of the exposure scenarios considered, the estimated health risks were highest for the hypothetical resident living year round on the bank of the Rio Grande near the confluence of Water Canyon. The most important type of exposure in terms of risk was eating fish. The potential annual cancer risk for that individual was calculated to be less than 3 in one million. For comparison, this *SWEIS* (Appendix C) estimates a worst case ingestion pathway dose of 0.0011 rem, which corresponds (using the current risk conversion factor of 0.0006 excess latent cancer fatalities per rem) to an excess latent cancer fatality risk of 6.6 in one million.

In the *Public Health Assessment* (ATSDR 2006), ATSDR reviewed environmental monitoring data from 1980 to 2001 and assessed past, current, and potential future human exposure situations. Based on the observed levels of various contaminants in the environment and the potential exposure pathways, the ATSDR concluded that no harmful exposures due to chemical or radioactive contamination detected in groundwater, surface soil, surface water and sediment, air or biota are occurring or expected to occur in the future. The data considered in the ATSDR assessment included at least one full year of environmental monitoring results from the period following the Cerro Grande fire. Retrieval of documents and data from the pre-1980 period is continuing. Based on the results of that retrieval effort, the ATSDR will determine if additional actions need to be taken to evaluate pre-1980 potential exposures.

In 1999, the Centers for Disease Control and Prevention began the Los Alamos Historical Document Retrieval and Assessment Project to systematically identify the information available concerning past releases of chemicals and radionuclides from the site between 1943 and the present. In January 2006, the project team issued an interim report summarizing historical operations at Los Alamos, materials that were used, materials that were likely released offsite, development of residential areas around Los Alamos, and the relative importance of identified releases in terms of potential health risks. The results of efforts to use plutonium measurements in soil around LANL to gain information about the potential magnitude of historical plutonium releases were also presented. The project is ongoing and the Centers for Disease Control and Prevention has expressed its intent to work with stakeholders to evaluate whether historical releases of radionuclides or other toxic materials from Los Alamos operations warrant more detailed evaluation (CDC 2006).

4.6.2 Los Alamos National Laboratory Worker Health

This section summarizes operational health risk experience at LANL, including exposure of workers to radioactive materials and hazardous materials resulting in intakes and recordable incidents due to exposure or physical injuries from workplace hazards. The *1999 SWEIS* contained a summary of radiological and chemical exposure and physical hazard incidents affecting worker health at LANL during the 1990s. It also included a summary of worker health-related studies at LANL as well as a description of all LANL worker health programs. This section provides information concerning worker safety, updated for the years 1999 to 2004.

Worker conditions at LANL have remained essentially the same as those identified in the *1999 SWEIS*. More than half the workforce remains routinely engaged in activities that are typical of office and computing industries. Much of the remainder of the workforce is engaged in light industrial and bench-scale research activities. Approximately one-tenth of the general workforce at LANL continues to be engaged in production, services, maintenance, and research and development within nuclear and moderate hazard facilities (LANL 2003h).

4.6.2.1 Worker Exposures to Ionizing Radiation

Occupational radiation exposures for workers at LANL from 1999 to 2005 are summarized in **Table 4–28**. The collective total effective dose equivalent (TEDE) for the LANL workforce during 2005 was 156 person-rem, considerably lower than the workforce dose of 704 person-rem projected in the *1999 SWEIS* ROD (LANL 2006h).

Table 4–29 summarizes the highest individual dose data for 1999 through 2005. The highest individual doses in 2005 were 2.051, 1.603, 1.398, 1.285, and 1.146 rem. There were no doses that exceeded DOE’s 5 rem per year Radiation Protection Standard. With one exception, all worker doses were below the 2 rem per year performance goal set by the as low as reasonably achievable Steering Committee in accordance with LANL procedures (LANL 2006g).

Table 4–28 Radiological Exposures of Los Alamos National Laboratory Workers

Parameter	Units	1999	2000	2001	2002	2003	2004	2005
Collective TEDE (external plus internal)	person-rem	131	196	113	164	241	125	156
Number of workers with measurable dose	Number	1,427	1,316	1,332	1,696	1,989	1,710	2,169
Average measurable dose (external plus internal)	Millirem	92	149	85	96	121	73	72
Average measurable dose (external only)	Millirem	90	65	83	95	111	68	69

TEDE = total effective dose equivalent.
Source: LANL 2006g.

Table 4–29 Highest Individual Doses to Los Alamos National Laboratory Workers [a]

1999	2000	2001	2002	2003	2004	2005
1.910	1.048	1.284	2.214	3.0 [b]	1.539	2.051
1.866	1.013	1.225	1.897	1.8 [b]	1.510	1.603
1.783	0.905	1.123	1.813	1.710	1.500	1.398
1.755	0.828	1.002	1.644	1.569	1.148	1.285
1.749	0.815	0.934	1.619	1.214	1.061	1.146

[a] Units = rem.
[b] Two workers were exposed to plutonium-238 while performing pre-inventory checks at TA-55. These radiation doses are revised down from what was originally reported.
Sources: LANL 2006g.

The collective TEDE for 2005 is 75 percent of the 208 person-rem for 1993 through 1995 used as a baseline in the *1999 SWEIS* and significantly less than the 704 person-rem collective TEDE projected in the *1999 SWEIS*. Several offsetting factors can be responsible for helping keep the dose below the *1999 SWEIS* baseline. The primary factor is that pit manufacturing has not become fully operational while other factors include: (1) changes in work load and types of work, and (2) improvements in the as low as reasonably achievable program (LANL 2006g).

4.6.2.2 Non-ionizing Radiation, Chemical and Biological Exposures

Non-ionizing radiation refers to any type of electromagnetic radiation that does not carry enough energy to ionize living material, that is, to completely remove an electron from an atom. Because non-ionizing radiation has lower energy than ionizing radiation, it has fewer health risks than ionizing radiation. Technologies used at LANL that generate non-ionizing radiation include lasers, microwave-generating and radiofrequency devices, technologies that generate ultraviolet radiation, video displays and instrumentation, welding, and security-related devices. Devices that generate nonionizing radiation are regulated by the U.S. Food and Drug Administration, while worker exposures are regulated by the Occupational Safety and Health Administration. Public exposures are not expected as any non-ionizing radiation generated by site operations are localized in nature. Devices that can generate larger amounts of non-ionizing radiation, such as some lasers, can cause eye injury to anyone who looks directly into the beam or its mirror reflection, or skin burns. Worker exposures could occur because of equipment failure, improper use of equipment, or non-adherence to procedures. Mitigation measures include regular equipment maintenance and inspections, use of design measures such as interlocks that prevent laser operation unless the enclosure is secured, and administrative controls and training. Workers who operate more powerful lasers are required to have an eye examination, complete a laser safety training course, and understand and follow applicable procedures.

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, soil through direct contact or ingestion). Section 4.4.2 of this chapter presents the atmospheric concentrations of the more prevalent chemicals. The presence of chemicals in surface and groundwater at LANL is presented in Section 4.3.1.3 and Section 4.3.2. Soil conditions are presented in Section 4.2.3.1 while chemical wastes generated by site operations are presented in Section 4.9.3.

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at LANL via inhalation of air containing hazardous chemicals released to the atmosphere by LANL operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

Chemical exposure pathways to LANL workers during normal operations may include inhaling the workplace atmosphere, drinking LANL potable water, and possible other contact (that would lead to absorption through the skin) with hazardous materials associated with work assignments. Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. LANL workers are also protected by adherence to the Occupational Safety and Health Administration and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals used in the operation processes, ensures that these standards are met. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at LANL are substantially better than required by standards.

LANL staff currently work with biological organisms as part of the national science and security missions of the site. Microorganisms are found naturally in the environment, yet only a very small percentage of these can cause infection and mild to severe disease in humans. Potential worker exposures to microorganisms could occur through inhalation, ingestion, or cutaneous contact with biological material generated from normal laboratory activity. In addition, other biohazardous materials with which workers may come in contact include animals and animal carcasses through wildlife management programs, and sanitary waste at the Sanitary Wastewater System, but these are considered minor sources of biological exposure as compared to the microbiological materials used in projects related to the national security missions. Work conducted in the LANL biosciences laboratories are governed by safety and security requirements for biohazardous materials as outlined in the document entitled "Biosafety in Microbiological and Biomedical Laboratories" by the Centers for Disease Control and

Prevention (see Appendix C). Worker exposure to biohazardous material is primarily regulated through the Occupational Safety and Health Administration. Laboratory safety and security measures are used to reduce or eliminate laboratory staff and the general public from potential exposures to microorganisms being researched at LANL. These mitigation measures include safety equipment, laboratory design, administrative controls, training, and containment measures for appropriate biohazardous material (see Appendix C). There have been no public health hazards attributed to LANL operations due to the use of these safety control measures for biological laboratories.

4.6.2.3 Occupational Injuries and Illness

Table 4–30 summarizes occupational injury and illness rates at LANL from 1999 through 2005. Occupational injury and illness rates for workers in 2005, although higher than some previous years, continue to be small as shown in the table. These rates correlate to reportable injuries and illnesses during the year for 200,000 hours worked or roughly 100 workers (LANL 2006g).

Table 4–30 Occupational Injury and Illness Rates at Los Alamos National Laboratory [a]

Calendar Year	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
TRC [b]	2.52	1.97	1.96	2.39	2.30	2.86	2.80
DART [c]	1.37	0.94	0.91	1.46	1.26	1.35	0.99

[a] All workers, including University of California workers.
[b] Total Recordable Cases, number per 200,000 hours worked.
[c] Days away, restricted, or transferred, number of cases per 200,000 hours worked.
Source: LANL 2006g.

4.6.3 Accident History

Accidents were discussed in the *1999 SWEIS*. Since 1999, accidents at LANL have included the following. On August 5, 2003, in a storage room in TA-55 a package containing residues from plutonium-238 operations breached while being handled by two workers performing a pre-inventory check. The breach was caused by degradation of the container. The pressurized release of materials from the package resulted in confirmed intakes of plutonium by both workers. The internal doses to the workers were initially estimated to be in excess of 10 rem committed effective dose equivalent. However, based on follow-up bioassay results, the assigned doses were later revised downward to about 1.8 and 3 rem (NNSA 2003). Cleanup of the storage room, including repackaging of the nuclear materials, is ongoing with containers at risk having been removed, or repackaged or temporarily mitigated prior to final repackaging. Decontamination of the room will be completed upon completion of repackaging or removal of the nuclear materials (LANL 2006a).

On February 15, 2001, plutonium-238 was released into the air from a glovebox when the hot nuclear material caused a crack in a technician's uninsulated glove. The accident was partially a result of the failure to follow procedures for safely handling plutonium-238. DOE investigated allegations concerning this incident, along with radiological incident reports from 1999 and 2000 at TA-55. As a result, recommendations were made, accepted by DOE, and instituted in corrective actions at TA-55 (DOE 2003f).

In March 2000, a radiological release of plutonium-238 occurred near a glovebox in the Plutonium Facility at TA-55. Seven workers had confirmed intakes of plutonium-238. The source of the release was a compression fitting in a contaminated vacuum line serving the glovebox. After an investigation was completed, lessons learned from this incident were documented by DOE. As a result, DOE performed a check of over 50,000 mechanical fittings at TA-55 and corrected leak problems (DOE 2000c).

Since 1945, there have been 13 criticality accidents at LANL (LANL 2000c). The accidents occurred during processing, critical experiment setups, and operations. These accidents resulted in various levels of radiation exposure to involved workers and in no or little damage to the equipment. The early criticality accidents (prior to 1946) resulted in worker fatalities. After 1947, remote criticality experiment facilities were constructed, leading to minimum doses to workers from criticality accidents. None of the accidents resulted in any significant exposure to members of the public. Although a number of criticality accidents were experienced at LANL in the period from 1945 to the early 1980s, a review of more recent LANL annual environmental and accident reports indicates that there have been no accidents since that time that have resulted in significant adverse impacts to workers, the public, or the environment. During the review period, from 1986 to 1990, site operations were much greater than in previous years and higher than anticipated for the future (DOE 2000c).

Beginning May 4, 2000, the Cerro Grande Fire damaged or destroyed 112 structures at LANL and about 230 residential structures in the Los Alamos Townsite. By the time it was contained (16 days later), it had burned about 7,700 acres (3,110 hectares) within the boundaries of LANL. DOE is conducting an extensive environmental monitoring and sampling program to evaluate the effects of that fire at LANL. The program will identify changes from pre-fire baseline conditions that will aid in evaluating potential future impacts, especially those from any contaminants that may have been transported offsite (LANL 2000c). Effects from the fire on different environmental resources are described in the applicable sections of this chapter.

In addition to the aforementioned radiological and wildfire accidents, a number of non-radiological accidents have occurred at LANL from 2000 to 2005. On July 14, 2004, an undergraduate student working with a LANL scientist using two lasers in an experiment suffered a retinal traumatic hole in one eye caused by pulsed laser light. This accident occurred because neither experiment participant was wearing the required laser eye protection and they looked directly down the laser beam path. The employees involved further exacerbated this accident by not reporting the incident immediately and securing the scene. After this accident the LANL director temporarily suspended all operations and ordered a complete safety review of the lab (LANL 2004h, 2004i).

On May 27, 2005, a chemical accident occurred in TA-9 Building 21 resulting in injury to two involved workers. The workers were weighing a normally inert chemical material when it experienced a chemical reaction that caused the release of energy. Both employees suffered a range of wounds, none of which were fatal and were treated at the Los Alamos Medical Center. One employee was released from the center on the same day as the accident. The event was localized to the area immediately surrounding the location of the chemical handling (Delucas 2005).

In June 2005, two LANL workers were mixing hydrochloric and nitric acid to form a corrosive liquid called aqua regia. They both inhaled vapors that evolved during the mixing operation. One employee had a temporary shortness of breath while the other suffered longer-term respiratory symptoms, which eventually caused him to be hospitalized for six days. Neither employee suffered permanent injuries. LANL management was not informed of this event until after the hospitalized employee returned to work (Lenderman 2005). During the last several years, a number of incidents have occurred at TA-55 PF-4, which resulted in worker contamination and doses due to plutonium-238 uptakes. DOE investigated each incident, analyzed it for root causes, and developed a set of recommendations. The DOE Lessons Learned Database was also updated with information from these incidents. In each case, LANL staff performed specific actions in the areas of procedures, training, inspection, and component upgrading and replacement in order to address the root causes and preclude reoccurrence of the event (DOE 2000b, 2003f, 2004b, 2004d).

4.6.4 Los Alamos National Laboratory Emergency Management and Response Program

Emergency response facilities and equipment, trained staff, and effective interface and integration with offsite emergency response authorities and organizations support LANL's emergency management system. LANL personnel maintain the necessary apparatus, equipment, and Emergency Operations Center to respond effectively to virtually any type of emergency, not only on the LANL site, but throughout the local community as well.

The Emergency Response and Management Program is operated out of a new two-story, 38,000-square foot (3,530-square-meter) Emergency Operations Center. Construction of the facility began in January 2002, and it became operational in December 2003. The building serves as the command center for responding agencies in an emergency and has space and resources to house up to 120 personnel, including representatives from neighboring Pueblos, the Federal Bureau of Investigation, the Federal Emergency Management Agency, DOE, U.S. Forest Service, National Park Service, National Guard, New Mexico State Police, Los Alamos County Police, Firefighters, Emergency Managers, the Red Cross, and others.

The Center's multi-faceted communications includes a multi-band radio system; a media interface and emergency broadcast system; a mobile communications van and mobile command center, to which essential functions can be transferred immediately in an emergency; fixed wing and helicopter surveillance; and emergency communications of all kinds. More than 600 telephone and high-speed data lines serve the Emergency Operations Center.. The Emergency Operations Center can receive video from fixed cameras monitoring traffic at key points throughout Los Alamos County and LANL, and can control programmable signs that advise motorists of emergency or traffic conditions on the main roads. The Emergency Operations Center information network includes a data mirror with the latest information on facility conditions, hazardous material inventories, and other updates that would aid first responders.

LANL's Emergency Response and Management Program effectively combines Federal and local emergency response capabilities. A coordinated effort to share emergency information with Los Alamos County is a cornerstone of the Emergency Management Program. LANL emergency management staff and Los Alamos County police, fire, emergency medical, and 911 dispatch personnel operate out of the LANL Emergency Operations Center. It is the United States' first Emergency Operating Center that combines Federal and local operations. A computer-aided dispatch system provides a centralized dispatch capability for the Los Alamos Police and Fire Departments. First responders from different agencies share real-time information from the same Emergency Operations Center, resulting in a more coordinated emergency response.

The construction of the new Emergency Operations Center was initiated in response to the destructive wildfires in northern New Mexico in the summer of 2000. It replaces a cramped, outdated facility that was located in TA-59, could accommodate only 16 people, and had limited communications capabilities. DOE, with assistance from the LANL Emergency Response and Management staff, is responsible for initiating, coordinating, and reviewing all written emergency response agreements. The agreements serve as the basis for communicating roles and responsibilities, dispatching mutual aid, carrying out emergency operations, and providing for treatment and care of patients during an emergency event at LANL. These agreements and memoranda of understanding are established with county and state agencies, local fire and law enforcement entities, and local emergency medical centers. Key organizations and agencies having mutual aid agreements with DOE and LANL are Los Alamos County Mutual Aid, Los Alamos Medical Center, St. Vincent Hospital Mutual Assistance, Española Hospital, and University of New Mexico Hospital. DOE subcontracts with Los Alamos County for fire department services.

There are several mechanisms to coordinate site emergency response plans and training opportunities with local offsite response agencies. Routine coordination between LANL staff and offsite agencies is primarily handled through the Los Alamos County Local Emergency Planning Committee, which meets monthly and is headed by the Los Alamos County Emergency Manager. The Planning Committee includes representatives from the Emergency Response and Management Program, various Los Alamos County and nearby county emergency response agencies, the National Forest Service, the National Park Service, and other interested parties. County personnel are heavily involved in planning efforts for most LANL exercises, including discussions on scenario selection. Conversely, if a LANL training and exercise scenario does not meet the county's needs, the county runs its own scenario with LANL staff participating as a response organization. Furthermore, LANL personnel provide training at no cost to a variety of county-associated response entities, including members of the bomb disposal and crisis negotiation teams.

Operating under the oversight of the NNSA Los Alamos Site Office, LANL's emergency management and response system is a mature program with an acceptable level of readiness. The program operates in accordance with applicable Federal requirements, including DOE Order 151.1C *Comprehensive Emergency Management System*, and encompasses five main areas:

- Emergency planning activities, including the identification of hazards and threats, hazard mitigation, development and preparation of emergency plans and procedures, and identification of personnel and resources needed for an effective response;
- Emergency preparedness activities, including the acquisition and maintenance of resources and the implementation of a training, drill, and exercise program;
- Emergency response activities, including the application of available resources to mitigate the consequences of an emergency to workers, the public, the environment, national security, and the initiation of recovery planning. Trained LANL personnel, including specialized teams such as the HazMat, Crisis Negotiation, and Hazardous Devices teams are available to respond on a 24-hour basis;
- Emergency recovery activities, including planning and actions to return site or facility operations to a normal state following termination of the emergency; and
- Emergency readiness assurance activities, including assessments, documentation, and program management plans to ensure emergency capabilities are adequate.

LANL personnel are responsible for the development of the *Wildland Fire Management Plan*. It will be integrated into the existing Fire Protection Program and implemented and administered by the Emergency Response and Management Program.

4.6.5 Los Alamos National Laboratory Security Program

LANL maintains special nuclear material inventories, classified matter, and facilities that are essential to nuclear weapons production. These security interests are protected against a range of threats that include adversarial groups, theft or diversion of special nuclear material, sabotage, espionage, and loss or theft of classified matter or government property.

LANL's physical security protection strategy is based on a graded and layered approach supported by an armed guard force trained to detect, deter, and neutralize adversary activities and backed up by local, state, and Federal law enforcement agencies. This strategy employs the concept of defensible concentric layers where each layer provides addition controls and protections.

The defense-in-depth approach begins in the airspace above LANL, which is restricted to approximately 5,000 feet (1,500 meters) above the ground surface. On the ground protection begins at the site perimeter and hardened access control points and builds inwardly to facility exteriors and designated interior zones and control points.

Both staffed and automated access control systems limit entry into areas and facilities to authorized individuals. Additional security measures include random stops and inspections of cars. Automated access control systems use booths, turnstiles, doors, and gates controlled by magnetic-stripe badge readers and hand-geometry personal identifiers. Escorting requirements provide access controls for visitors entering security areas. Access control is also provided through control of the selection, use issuance, and safeguarding of keys and cores for locks.

Entrance and exit inspections and portal systems with metal detectors, nuclear material monitors, explosives detectors, and X-ray machines are used to prevent unauthorized introduction or removal of prohibited items and security interests. The guard force also performs random roving inspections throughout the site. Additionally, handlers use highly trained explosives detection and drug detection dogs to conduct random and systematic inspections. The LANL contractor uses truck and package inspection facilities with detection equipment and canine support to segregate, inspect, and stage materials prior to delivery.

Physical security protection also includes barriers, electronic surveillance systems, and intrusion detection systems that form a comprehensive site-wide network of monitored alarms. Various types of barriers are used to delay or channel personnel, or to deny access to classified matter, special nuclear material, and vital areas. Barriers are used to direct the flow of vehicles through designated entry control portals and to deter and prevent penetration by motorized vehicles where vehicular access could significantly enhance the likelihood of a successful malevolent act. Barriers may be passive and designed to require the use of special tools and high explosives to penetrate them. Barriers may also have an active component designed to dispense an obscuration agent, viscous barrier, or sensory irritant.

Tamper-protected surveillance, intrusion detection, and alarm systems designed to detect an adversary action or anomalous behavior inside and outside LANL facilities are paired with assessment systems to evaluate the nature of the adversary action. Random patrols and visual observation are also used to deter and detect intrusions. Penetration-resistant alarmed vaults and vault-type rooms are used to protect classified materials.

Guards are stationed in mobile and fixed posts around LANL 24 hours a day, 365 days a year. They are trained and equipped to respond to alarms and adversary action in accordance with well-designed and thoroughly tested plans using specialized equipment and weapons.

4.7 Cultural Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulations, and guidelines. To fully meet the requirements of these laws, regulations, and guidelines, DOE is implementing *A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico* (LANL 2006f). Implementation of this plan, which has undergone public review, involves a Programmatic Agreement between DOE, the Advisory Council on Historic Preservation, and the New Mexico State Historic Preservation Office (DOE 2006b). By carrying out the terms of the agreement, DOE will fulfill its responsibilities under Section 106 of the National Historic Preservation Act.

The three general categories of cultural resources addressed in this section are archaeological resources, historic buildings and structures, and traditional cultural properties. Archaeological resources include any material remains of past human life or activities which are of archaeological interest, including items such as pottery, basketry, bottles, weapons, rock art and carvings, graves, and human skeletal materials. The term also applies to sites that can provide information about past human lifeways. Historic buildings include buildings or other structures constructed after 1942 and LANL-era buildings that have been evaluated for eligibility to the National Register of Historic Places (NRHP). Traditional cultural properties are defined as a place of special heritage value to contemporary communities (often, but not necessarily, American Indian groups) because of their association with the cultural practices or beliefs that are rooted in the histories of those communities and are important in maintaining the cultural identity of the communities (LANL 2006f).

LANL's Cultural Resources Management Plan

A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico (Cultural Resources Management Plan) defines the responsibilities, requirements, and methods for managing cultural resources at LANL. It provides a series of steps and procedures for complying with Federal historic preservation laws and regulations, such as the National Historic Preservation Act and the Native American Graves Protection and Repatriation Act, as well as DOE policies and directives related to cultural resources protection.

Critical to success of the Cultural Resources Management Plan are strategies that effectively administer those cultural resources warranting long-term protection while at the same time facilitating land-use flexibility in support of the DOE mission at LANL. The Plan supports this by specifying steps for the timely integration of cultural resource concerns and reviews into program and project planning.

The initial step is notification about a proposed project by the responsible organization at LANL. Cultural resources in an area of potential effects are next identified by reviewing background information and conducting additional studies, as necessary. Approximately 800 to 1000 cultural resource reviews of projects are performed at LANL each year.

Cultural resources are then assessed to determine if adverse effects could occur and to identify ways to avoid, minimize, or resolve any anticipated consequences. Project reviews and evaluations might also involve field checks by qualified cultural resource managers. Additionally, DOE consults with State or Tribal Historic Preservation Officers, as well as other knowledgeable parties, as appropriate.

Finally, a plan is formulated to resolve any anticipated adverse effects. Actions that might be undertaken could include avoiding the cultural resource, modifying the undertaking to minimize adverse effects, completely documenting the property, and wholly or partially excavating the site. As necessary, the boundaries of a cultural resource are clearly marked prior to initiating physical work on a project to assist in avoiding any adverse effects.

Occupation and use of the Pajarito Plateau began as early as 10,000 BC as foraging groups used the area for gathering and hunting large game animals. Since that time a succession of peoples have populated the area as reflected in the rich archaeological resources and historic buildings and structures that are present. The chronological sequence associated with the cultural history for the northern Rio Grande is presented in **Table 4–31**. A detailed description of each period is provided in *A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico* (LANL 2006f).

Table 4–31 Culture History Chronology for Northern Rio Grande Specific to Los Alamos National Laboratory and the Pajarito Plateau

Culture Period Dates	*Culture Period Dates*	*Culture Period Dates*
Paleoindian	Clovis	9500 to 8000 BC
	Folsom	9000 to 8000 BC
	Late Paleoindian	8000 to 5500 BC
Archaic	Jay	5500 to 4800 BC
	Bajada	4800 to 3200 BC
	San Jose	3200 to 1800 BC
	Armijo	1800 to 800 BC
	En Medio	800 BC to AD 400
	Trujillo	AD 400 to 600
Ancestral Pueblo	Early Developmental	AD 600 to 900
	Late Developmental	AD 900 to 1150
	Coalition	AD 1150 to 1325
	Classic	AD 1325 to 1600
American Indian, Hispanic, and Euro-American	Early Historic Pajarito Plateau	AD 1600 to 1890
	Homestead	AD 1890 to 1943
Federal Scientific Laboratory	Manhattan Project	AD 1942 to 1946
	Cold War (Early Cold War)	AD 1956 to 1990 (AD 1946 to 1956)

Source: LANL 2006f.

Two potential National Historic Landmarks and one potential National Register Historic District have been proposed at LANL. The former includes the "Project Y" Manhattan Project and Los Alamos National Laboratory Ancestral Pueblo National Historic Landmarks. "Project Y" of the Manhattan Project lasted only four years (1942 through 1946), but represented one of the defining moments of recent world history. The main goal of "Project Y" was the immediate development and possible deployment of the world's first atomic weapon. The potential Los Alamos National Laboratory Ancestral Pueblo National Historic Landmark would consist of four discrete units totaling 132 acres (53.4 hectares) and would recognize a number of the Ancestral Pueblo archaeological sites that are especially important due to integrity of location and the nature of the resource (LANL 2006f).

The potential Los Alamos Archaeology National Register Historic District would consist of a number of sites and clusters of sites that, while not deemed of sufficient significance to be considered for inclusion in the two potential National Historic Landmarks, nevertheless are important to the State of New Mexico and to the Nation. The proposed National Register Historic District would contain a total of 10 discrete components with a combined size of 1,496 acres (605.4 hectares). Included are six complexes rich in resources dating from the Archaic Period through the Ancestral Pueblo Classic Period and four components relating to the Homestead Period (LANL 2006f).

4.7.1 Archaeological Resources

As of 2005, archaeological surveys have been conducted on approximately 90 percent of the land within LANL boundaries with 86 percent having been intensively surveyed. This represents an increase of 15 percent in the total area surveyed since publication of the *1999 SWEIS*. The majority of these surveys emphasized American Indian cultural resources. Information on these resources was obtained from the LANL cultural resources database, which is organized primarily by site type. A total of 1,915 archaeological resource sites have been identified at LANL. Of these, 1,776 are prehistoric sites related to the Paleoindian, Archaic, and Ancestral Pueblo Cultures and 139 are related to the early American Indian, Hispanic, and Euro-American Cultures. Although about 400 archaeological resource sites have been determined to be NRHP-eligible, most of the remaining sites have yet to be formally assessed and are therefore assumed to be eligible until assessed (LANL 2006f).

Following the Cerro Grande Fire, surveys identified 333 archaeological resource sites that were impacted. Of these sites, 269 were damaged by the fire, 35 by suppression activities, and 29 by rehabilitation activities. Damage included direct loss, soot staining, spalling, and cracking of stone masonry walls of Ancestral Pueblo field houses and room blocks, and exposure of artifacts from erosion. The fire offered the opportunity for rehabilitation of selected Ancestral Pueblo archaeological sites and such work, including erosion control, placing protective fences, and tree thinning (to protect sites from future fires), was conducted at 107 sites (LANL 2004c). The Cerro Grande Fire also affected a number of homestead era sites with many wooden structures being burned. The Grant and Gomez homesteads located in Water Canyon and north of Pajarito Canyon, respectively, are two examples where the fire and subsequent rehabilitation measures damaged or destroyed Homestead Period resources (LANL 2006f). Additionally, the fire, as well as the tree thinning measures taken to reduce wildfire hazard, resulted in the discovery of 447 new archaeological sites (LANL 2006a).

The conveyance and transfer of land has resulted in archaeological sites being removed from DOE protection (LANL 2002b). Archaeological protection easements are a means by which these resources may be protected. Such easements have been established on 79.5 acres (32 hectares) of TA-74, which has largely been conveyed to Los Alamos County in order to protect 31 archaeological sites. Protective easements will also be established in Rendija Canyon to protect traditional cultural properties and allow access to these properties by San Ildefonso and Santa Clara Pueblos. These easements are being set up with a private conservation trust to provide protection in perpetuity (LANL 2004c, 2004f).

Since publication of the *1999 SWEIS*, a number of actions have occurred that have affected archaeological resources at LANL. Vandalism to two sites within the Rendija Canyon Tract was caused when vehicles drove through the sites during a holiday weekend. This tract is to be conveyed to Los Alamos County. Additionally, a contractor associated with the West Jemez Road Upgrade Project drove through an archaeological site. In both cases, corrective actions were taken to prevent any recurrence (LANL 2006a).

4.7.2 Historic Buildings and Structures

In terms of the historic built environment, there are a total of 510 buildings and structures that date to the Manhattan Project and early Cold War. Of these, 31 date to the Manhattan Project. A total of 179 of these 510 buildings and structures have been evaluated for eligibility for inclusion in the NRHP, of which 98 have been determined eligible and 81 not eligible. These figures include a small number of structures younger than 50 years in age that are likely to be deemed of exceptional national significance and are thus eligible for inclusion in the NRHP despite not yet having achieved the 50-year-old age limit normally required for inclusion. These potentially exceptional structures are those identified as the 15 "SWEIS Key Facilities" in the *1999 SWEIS* (LANL 2006f).

A number of factors have served to greatly reduce the number of Manhattan Project buildings still extant as of October 2004. These include (1) the expedient initial construction of the original buildings and structures; (2) post-Manhattan Project infrastructure development particularly during the late 1950s and early 1960s, and again beginning in the late 1990s through the first decade of the 21st century; (3) the development of the Los Alamos townsite during the 1950s and 1960s; (4) the Cerro Grande Fire; and (5) contamination of some buildings by asbestos and radioactive isotopes. As of 2003, only 28 Manhattan Project buildings retained sufficient historical and physical integrity for listing on the NRHP, and only a handful are deemed suitable for long-term preservation and interpretation (LANL 2006f). Additionally, the decrease in the number of historic buildings reported in the *1999 SWEIS* is due to no longer counting temporary and modular properties, shed, and utility features associated with the Manhattan Project and Cold War Periods. These properties were removed from the count because they are exempt from review under terms of the Programmatic Agreement between DOE, the New Mexico State Historic Preservation Office, and the Advisory Council on Historic Preservation (DOE 2006b).

As a result of the conveyance and transfer of 2,259 acres (914 hectares) of land to Los Alamos County and the Pueblo of San Ildefonso, two historic buildings have been removed from DOE protection. Archaeological protection easements established within TA-74 (see Section 4.7.1) will protect one of these resources (LANL 2006a).

Since publication of the *1999 SWEIS*, two historic sites associated with the Manhattan Project have been affected by the TA-33 Remodeling Project and road construction at the TA-8 Gun Site. In the case of the TA-33 Remodeling Project, a rollup door on a Manhattan Project building was removed before consultation and documentation was carried out. Corrective action included photographic documentation of the building after the door was removed, along with the creation of archival quality negatives from digital photographs taken prior to the door removal. The Manhattan Project complex at the TA-8 Gun Site was disturbed by road construction; however, corrective actions, including restoring the parking lot area, establishing a new access road, constructing a retaining wall, and reseeding disturbed areas, have been completed (LANL 2006a). An additional Manhattan Project site, the V-site, was affected by the Cerro Grande Fire. The remaining standing building at the site is currently being stabilized as part of the "Save America Treasures" program (LANL 2006f).

4.7.3 Traditional Cultural Properties

Within LANL's boundaries there are ancestral villages, shrines, petroglyphs (carvings or line drawings on rocks), sacred springs, trails, and traditional use areas that could be identified by Pueblo and Hispanic communities as traditional cultural properties. According to the DOE compliance procedure, American Indian Tribes may request permission for visits to sacred sites within LANL boundaries for ceremonies (DOE 1999a).

When a project is proposed, LANL arranges site visits with Tribal representatives from the San Ildefonso, Santa Clara, Jemez, and Cochiti Pueblos as appropriate to solicit their concerns and to comply with applicable requirements and agreements. Provisions for coordination among these four Pueblos and DOE are contained in Accords that were entered into in 1992 for the purpose of improving communication and cooperation among Federal and Tribal Governments (DOE 1999a).

During preparation of the *1999 SWEIS*, consultations were conducted with 19 American Indian Tribes and two Hispanic communities to identify cultural properties important to them in the LANL region. All of the consulting groups stated that they had at least some traditional cultural properties present on or near LANL. Categories and numbers of traditional cultural properties identified included 15 ceremonial and archaeological sites, 14 natural features, 10 ethonobotanical sites, 7 artisan material sites, and 8 subsistence features. Although these resources were stated as being present throughout LANL and adjacent lands; no specific features or locations were identified that would permit formal evaluation and recognition as traditional cultural properties. In addition to physical cultural entities, concern has been expressed that "spiritual," "unseen," "undocumentable," or "beingness" aspects can be present at LANL that are an important part of American Indian culture (DOE 1999a).

A "Comprehensive Plan for the Consideration of Traditional Cultural Properties and Sacred Sites at Los Alamos National Laboratory, New Mexico" was sent by DOE to 26 different Tribes to help complete the traditional cultural properties identification and evaluation process begun in the *1999 SWEIS*. As of September 30, 2005, this process had narrowed the number of Tribes with active traditional cultural properties concerns on LANL to the Pueblo of San Ildefonso, the Pueblo of Santa Clara (Rendija Canyon), and possibly the Pueblo of Cochiti. DOE maintains ongoing discussions with these pueblos. Such discussions with the Pueblo of San Ildefonso have identified one traditional cultural property, which is in the process being forwarded to the New Mexico State Historic Preservation Office for review and concurrence. In addition, several other locations have been identified by the Pueblo of San Ildefonso for consideration as traditional cultural properties. None of these are locations that would have a significant impact on current mission activities at LANL.

The Cerro Grande Fire did not damage any known traditional cultural properties with the exception of light damage to one site in Rendija Canyon. Subsequent rehabilitation and fire prevention was carried out at all traditional cultural properties within the Rendija Canyon. The conveyance of the Rendija Tract to Los Alamos County would affect a number of traditional cultural properties (LANL 2002b).

A number of traditional cultural properties were identified in the Rendija Canyon Tract in 1993 in response to the then proposed Bason Land Exchange (LANL 2002b); another traditional cultural property was identified during the Land Conveyance and Transfer Project. Although not directly disturbed, seven traditional cultural properties within the tract were threatened by persons driving through a traditional cultural properties-dense area and by disturbance through the removal of stones to use in the apparent burial of a pet. Corrective actions have been taken in order to prevent further damage to these sites including placing fencing around all traditional cultural properties in the Rendija Canyon Tract, posting areas as environmentally sensitive, documenting damage, strengthening gates, and installing surveillance cameras. Additionally, discussion have been held with Santa Fe National Forest archaeologists and recreation specialists to formulate a shared strategy for helping to prevent or limit future vandalism in Rendija Canyon (LANL 2006a).

4.8 Socioeconomics and Infrastructure

This section describes changes that have occurred in the LANL socioeconomic region of influence and LANL site infrastructure since the publication of the *1999 SWEIS*. These changes have been compared to impact projections made in the *1999 SWEIS* for the Expanded Operations Alternative at LANL. This comparison provides an appraisal of whether those projected impacts continue to fall within the operating envelope established by the *1999 SWEIS* with regard to impacts on socioeconomic conditions in the region of influence and demands and usage of LANL site infrastructure.

4.8.1 Socioeconomics

Socioeconomic impacts are defined in terms of changes to the demographic and economic characteristics of a region. The number of jobs created by the Proposed Action could affect regional employment, income, and expenditures. Job creation is characterized by two types: (1) construction-related jobs, which are transient in nature and short in duration, and thus less likely to impact public services; and (2) operations-related jobs, which would last longer, and thus could create additional public service requirements in the region of influence.

In order to determine whether socioeconomic impacts in the region of influence since publication of the *1999 SWEIS* are below, at, or above levels predicted for the Expanded Operations Alternative, comparisons were made between site employment projections predicted in the *1999 SWEIS* and those reported in the *SWEIS Yearbook* – 2005 (LANL 2006g) and other site documents.

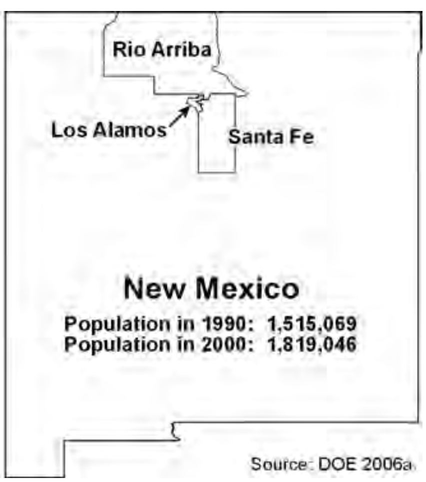


Figure 4–28 Counties in the Los Alamos National Laboratory Region of Influence

4.8.1.1 Regional Economic Characteristics

Socioeconomic impacts were analyzed in the *1999 SWEIS* for a region of influence that included the "Tri-County" region consisting of Los Alamos, Rio Arriba, and Santa Fe Counties in New Mexico (see **Figure 4–28**). Over 85 percent of LANL site employees and their families reside in these counties (see **Table 4–32**). Thus, the socioeconomic conditions of these counties have the most potential to be directly or indirectly affected by changes in operations at LANL. In 2005, a total of 13,504 persons were employed by LANL contractors, of which approximately 12,650 resided in New Mexico.

Table 4–32 Distribution of Los Alamos National Laboratory Affiliated Work Force by Place of Residence in the Region of Influence

Year	*Total LANL Employees*	*LANL Employees that Reside in the ROI*	*Percent of LANL Employees that Reside in the ROI*	*ROI Employed*	*LANL as a Percent of ROI Employed*
1996	11,155	9,913	88.9	86,038	11.5
1997	11,496	10,259	89.2	87,819	11.7
1998	12,008	10,703	89.1	90,046	11.9
1999	12,412	11,028	88.9	92,246	12.0
2000	12,015	10,780	89.7	96,258	11.2
2001	12,380	10,941	88.4	98,121	11.2
2002	13,524	11,867	87.7	99,960	11.9
2003	13,616	12,031	88.4	102,945	11.7
2004	13,261	11,727	88.4	104,185	11.3
2005	13,504	11,564	85.6	107,090	10.8
Average 1996 to 2005	12,537	11,081	88.4	96,471	11.5

ROI = Region of Influence.
Sources: NMDOL 2005, 2006a; LANL 2003h, 2004f, 2005f, 2006g.

Between 2000 and 2005, the civilian labor force in the Tri-County area increased 11.6 percent to the 2005 level of 112,003. In 2005, the annual unemployment average in the region of influence was 4.4 percent, which was smaller than the annual unemployment average of 5.3 percent for New Mexico (NMDOL 2006a).

In 2005, direct government employment represented the largest sector of employment in the Tri-County area (29.9 percent), followed by retail and wholesale trade (14.1 percent), leisure and hospitality (12.8 percent), and healthcare and social assistance (11.4 percent). The totals for these employment categories in New Mexico were 23.2 percent, 15.0 percent, 10.8 percent, and 11.1 percent, respectively (NMDOL 2006b).

4.8.1.2 Demographic Characteristics

The 2000 demographic profile of the region of influence population and income information is included in **Table 4–33**. Persons self-designated as minority individuals in the Tri-County region comprise 57.9 percent of the total population. This minority population is composed largely of Hispanic or Latino and American Indian residents. The Pueblos of San Ildefonso, Santa Clara, San Juan, Nambe, Pojoaque, Tesuque, and part of the Jicarilla Apache Indian Reservation are included in the region of influence.

The *1999 SWEIS* projected that within the first year of expanded operations, the total population in the Tri-County region would grow by 2.5 percent. In the 10 years between the 1990 census and the 2000 census, the population in this area grew 24.7 percent, or approximately 2.3 percent a year (DOC 2006a, 2006b). In July 2005, the total population in the Tri-County region was estimated to be 200,292 (DOC 2007).

Table 4–33 Demographic Profile of the County Population in the Los Alamos National Laboratory Region of Influence

Population Group	*Los Alamos County – Population (percent)*	*Rio Arriba County – Population (percent)*	*Santa Fe County – Population (percent)*	*Region of Influence – Population (percent)*
Minority				
Hispanic alone	1,505 (8.2)	17,701 (43.0)	36,263 (28.0)	55,469 (29.4)
Black or African American	67 (0.4)	143 (0.3)	826 (0.6)	1,036 (0.5)
American Indian or Alaska Native	107 (0.6)	5,717 (13.9)	3,982 (3.1)	9,806 (5.2)
Asian	694 (3.8)	56 (0.1)	1,133 (0.9)	1,883 (1.0)
Native Hawaiian or Pacific Islander	6 (0.0)	47 (0.1)	94 (0.1)	147 (0.1)
Some other race	495 (2.7)	10,554 (25.6)	22,936 (17.7)	33,985 (18.0)
Two or more races	418 (2.3)	1,353 (3.3)	5,268 (4.1)	7,039 (3.7)
Total Minority	3,292 (17.9)	35,571 (86.4)	70,502 (54.5)	109,365 (57.9)
White alone	15,051 (82.1)	5,619 (13.6)	58,790 (45.5)	79,460 (42.1)
Total	18,343 (100.0)	41,190 (100.0)	129,292 (100.0)	188,825 (100.0)

Source: DOC 2006b.

4.8.1.3 Regional Income

Income information for the LANL region of influence is included in **Table 4–34**. There are major differences in the income levels among the three counties, especially between Rio Arriba County at the low end with a median household income in 2004 of $32,935 and a per capita income of $22,194 and Los Alamos County at the upper end with a median household income of $94,640 and a per capita income of $52,524. The median household income in Los Alamos County is over twice that of the New Mexico State average and is the highest for any county in the Nation (DOC 2006c). In 2004, only 3.2 percent of the population in Los Alamos County was below the official poverty level compared with 18.1 percent of the population of Rio Arriba County.

Table 4–34 Income Information for the Los Alamos National Laboratory Region of Influence

	Los Alamos County	*Rio Arriba County*	*Santa Fe County*	*New Mexico*
Median household income 2004 (dollars)	94,640	32,935	43,727	37,838
Per capita income 2004 (dollars)	52,524	22,194	36,095	26,679
Percent of persons below poverty line (2004)	3.2	18.1	12.0	16.7

Sources: BEA 2007, DOC 2006c.

The Pueblo of San Ildefonso is a minority-dominated community near LANL (see Figure 4–1) and had, in the year-2000 census, a median household income of $30,457. About 12.4 percent of the families lived below the poverty level. The median household incomes of four additional nearby pueblos were as follows (DOE 2004e):

- Santa Clara: $30,946 (16.4 percent of families below poverty level);
- Cochiti: $35,500 (13.2 percent of families below poverty level);

- Jemez: $28,889 (27.2 percent of families below poverty level); and
- Pojoaque: $34,256 (11.3 percent of families below poverty level).

4.8.1.4 Los Alamos National Laboratory-Affiliated Work Force

The LANL-affiliated workforce includes both management and operating contractor employees and subcontractors (see **Table 4–35**). From 1999 through 2005, the number of employees exceeded *1999 SWEIS* ROD projections. The 13,504 employees at the end of 2005 were 2,153 more employees than *1999 SWEIS* ROD projections of 11,351. The 1999 projections were based on 10,593 employees identified for the index year (employment as of March 1996) (LANL 2003h).

Table 4–35 Los Alamos National Laboratory-Affiliated Work Force

SWEIS ROD [a]	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
11,351	12,412	12,015	12,380	13,524	13,616	13,261	13,504

[a] The total number of employees was presented in the *1999 SWEIS;* the breakdown had to be calculated based on the percentage distribution shown in that document for the base year.

Sources: LANL 2003h, 2004f, 2005f, 2006g.

These employees have had a positive economic impact on northern New Mexico. Through 1998, DOE published a report each fiscal year regarding the economic impact of LANL on north-central New Mexico, as well as the State of New Mexico. The findings of these reports indicate that LANL's activities resulted in a total increase in economic activity in New Mexico of about $3.2 billion in 1996, $3.9 billion in 1997, and $3.8 billion in 1998. The publication of this report was discontinued after 1998 due to funding deficiencies. However, based on the increases in number of employees and payroll, it is assumed that LANL's yearly economic contribution has continued to increase (LANL 2004f).

4.8.1.5 Housing

Table 4–36 lists the total number of occupied housing units and vacancy rates in the region of influence. In 2000, there were a total of 83,654 housing units in the Tri-County area, with 89.7 percent occupied and 10.3 percent vacant. The median value of owner-occupied homes in Los Alamos County ($228,300) was the greatest of the three counties, and over twice the median value of owner-occupied homes in Rio Arriba County ($107,500). The vacancy rate was the smallest in Los Alamos County (5.5 percent) and highest in Rio Arriba County (16.5 percent). During the Cerro Grande Fire, approximately 230 housing units were destroyed or damaged in the northern portions of Los Alamos County (DOE 2000f) and as a result, vacancy rates likely decreased. Although available housing can change year to year, in 2005 there was generally a housing shortage in Los Alamos County.

The residential distribution of management and operating contractor employees reflects the overall housing market dynamics of the three counties. In 2005, approximately 86 percent of management and operating contractor employees continued to reside in the Tri-County area as shown in **Table 4–37**.

Table 4–36 Housing in the Los Alamos National Laboratory Region of Influence

	Los Alamos County	*Rio Arriba County*	*Santa Fe County*	*Region of Influence*
Housing (2000)				
Total units	7,937	18,016	57,701	83,654
Occupied housing units	7,497	15,044	52,482	75,023
Vacant units	440	2,972	5,219	8,631
Vacancy Rate (percent)	5.5	16.5	9.0	10.3
Median value (dollars)	228,300	107,500	189,400	175,067

Source: DOC 2006b.

Table 4–37 Percentage of Los Alamos National Laboratory Employees Residing in the Region of Influence

Year	*Los Alamos County*	*Rio Arriba County*	*Santa Fe County*	*Total*
1999	52.6	16.6	19.7	88.9
2000	52.6	17.0	20.1	89.7
2001	50.9	17.6	19.9	88.4
2002	49.5	17.5	20.8	87.7
2003	49.2	17.6	21.5	88.4
2004	48.3	18.5	21.6	88.4
2005	47.3	15.9	22.4	85.6

Sources: LANL 2003h, 2004f, 2005f, 2006g.

4.8.1.6 Local Government Finances

Local DOE activities directly and indirectly account for more than a third of employment, wage and salary income, and business activity in the Tri-County region. If there is a change in employment, employee incomes, or procurement at LANL, these changes would be expected to have an immediate and direct effect on city and county revenues, such as the gross receipts tax, in the Tri-County region (Lansford et al. 1996).

Table 4–38 shows the general funds revenues for the Tri-County region. Los Alamos County generates the highest revenues, more than double those of Santa Fe County and nearly 7 times those of Rio Arriba County. The general funds of these communities support the ongoing operations of their governments as well as community services such as police protection and parks and recreation. In Los Alamos County, the fire department serving LANL and the community is funded through a separate fund derived from DOE contract payments. In addition to the general fund, most governments have separate enterprise funds for utilities and capital improvements.

Table 4–38 General Funds Revenues in the Tri-County Region (Fiscal Year 2003)

Source	*Los Alamos County*	*Rio Arriba County* [a]	*Santa Fe County* [b]
Property Taxes	4,298,335	4,178,176	26,782,625
Gross Receipt Taxes	16,541,971	9,309,389	66,982,214
Oil, Gas and Mineral Taxes	Not available	7,256,598	0
Other Taxes, Penalties and Interest	428,236	721,654	9,426,917
Licenses, Permits, Fees and Service Charges	64,203,173	5,566,310	65,304,807
Misc. Income	Not available	3,536,397	16,905,470
Restricted Funds	Not available	5,146,384	16,928,997
Other	55,760,870	6,943,392	47,645,434
Total Receipts	141,232,585	42,658,300	249,976,464

[a] Includes revenues for Española.
[b] Includes revenues for the city of Santa Fe.
Source: LANL 2004c.

4.8.1.7 Services

New Mexico is divided into 89 school districts, 4 of which are predominantly within the Tri-County area. Total public school enrollment in these districts is 24,061 students for the 2005 to 2006 school year. In the Los Alamos School District, enrollment of 3,628 in 2005 to 2006 is essentially the same as it was 5 years earlier. Enrollment at the Española Public School District decreased by approximately 5 percent from 2000 to 2001 school year to the 2005 to 2006 school year; current enrollment is 4,702 students. At the Pojoaque Public School District, enrollment remained relatively stable over the same time frame with current enrollment at 1,991 students. Enrollment in the Santa Fe Public School District grew by 2.7 percent over that time frame to the current enrollment of 13,740 students (NMDOE 2002, NMPED 2006).

The Los Alamos County Fire Department provides fire suppression, medical, rescue, wildland fire suppression and fire prevention services to both LANL and the Los Alamos County community. There are six manned fire stations with 141 budgeted positions including 123 uniformed personnel (LAC 2006a).

The Los Alamos County Police Department has 31 officers and 10 detention staff. The ratio of commissioned police officers in Los Alamos County was 1.58 officers per 1,000 of population in 2000 compared to Albuquerque (2.02) or Santa Fe (2.14) (DOJ 2004).

Four hospitals serve the Tri-County region: Los Alamos Medical Center, Española Hospital, and St. Vincent Regional Medical Center and the Public Health Service Santa Fe Indian Hospital in Santa Fe. These hospitals have a bed capacity of 47, 80, 268, and 39, respectively (LAMC 2006, Presbyterian 2006, St. Vincent 2006, AHA 2007).

4.8.2 Infrastructure

Site infrastructure includes the physical resources required to support the construction and operation of LANL facilities. Utility infrastructure at LANL encompasses the electrical power, natural gas, steam, and water supply systems. Sanitary wastewater treatment and solid waste management are addressed in Sections 4.3 and 4.9, respectively. Transportation infrastructure is addressed in Section 4.10. There have been a number of developments at LANL regarding utility infrastructure since the *1999 SWEIS* was issued, both in terms of the trend in resource usage and infrastructure capacity availability as well as with regard to the purveyor of some utility services.

4.8.2.1 Electricity

Electrical service to LANL is supplied through a cooperative arrangement with Los Alamos County, known as the Los Alamos power pool, which was established in 1985. Electric power is supplied to the pool through two existing regional 115-kilovolt electric power lines. The first line (the Norton-Los Alamos line) is administered by DOE and originates from the Norton Substation east of White Rock, and the second line (the Reeves Line) is owned by the Public Service Company of New Mexico and originates from the Bernalillo-Algodones Substation south of LANL. Both substations are owned by the Public Service Company of New Mexico (DOE 2003d, LANL 2006g). These facilities are shown in **Figure 4–29**.

Import capacity is now limited only by the physical capability (thermal rating) of the transmission lines based on recent changes (as of August 1, 2002) in transmission agreements with the Public Service Company of New Mexico. The import capacity is approximately 110 to 120 megawatts from a number of hydroelectric, coal, and natural gas-powered generators throughout the western United States (LANL 2004c, 2006g). Previously, the pool's import capacity was contractually limited to 72 megawatts during the winter months and 94 megawatts during the spring and early summer months (DOE 1999a). In addition, renewable energy sources such as wind farms and solar plantations are providing a small (about 5 percent) but growing percentage of Public Service Company of New Mexico's total power portfolio (PNM Resources 2006, PSCNM 2006).

Within LANL, DOE also operates a natural gas-fired steam and electrical power generating plant at TA-3 (TA-3 Co-Generation Complex or Power Plant), which is currently capable of producing up to 20 megawatts of electric power that is shared by the power pool under contractual arrangement. Generally, onsite electricity production is used to fill the difference between peak loads and the electric power import capability. The DOE-maintained electric distribution system at LANL consists of various low-voltage transformers at LANL facilities and approximately 34 miles (55 kilometers) of 13.8-kilovolt distribution lines. It also consists of two older power distribution substations: the Eastern TA Substation and the TA-3 Substation (LANL 2004c; LANL 2006g). In 2002, DOE completed construction of the new Western TA Substation (see Figure 4–29). This 115-kilovolt (13.8-kilovolt distribution) substation has a main transformer rated at 56-megavolt-amperes or about 45 megawatts. The substation will provide redundant capacity for LANL and the Los Alamos Townsite in the event of an outage at either of LANL's two existing substations (LANL 2004c, 2006g).

The trends in peak electric load demand and total electrical energy consumption within the Los Alamos power pool are provided in **Table 4–39** and **Table 4–40**, respectively. Annual (fiscal year) observed peak load and total energy requirements for the period 1999 through 2005 are compared to projections made in the *1999 SWEIS* for the Expanded Operations Alternative. These data provide the basis for the projections made in Chapter 5 of this SWEIS.

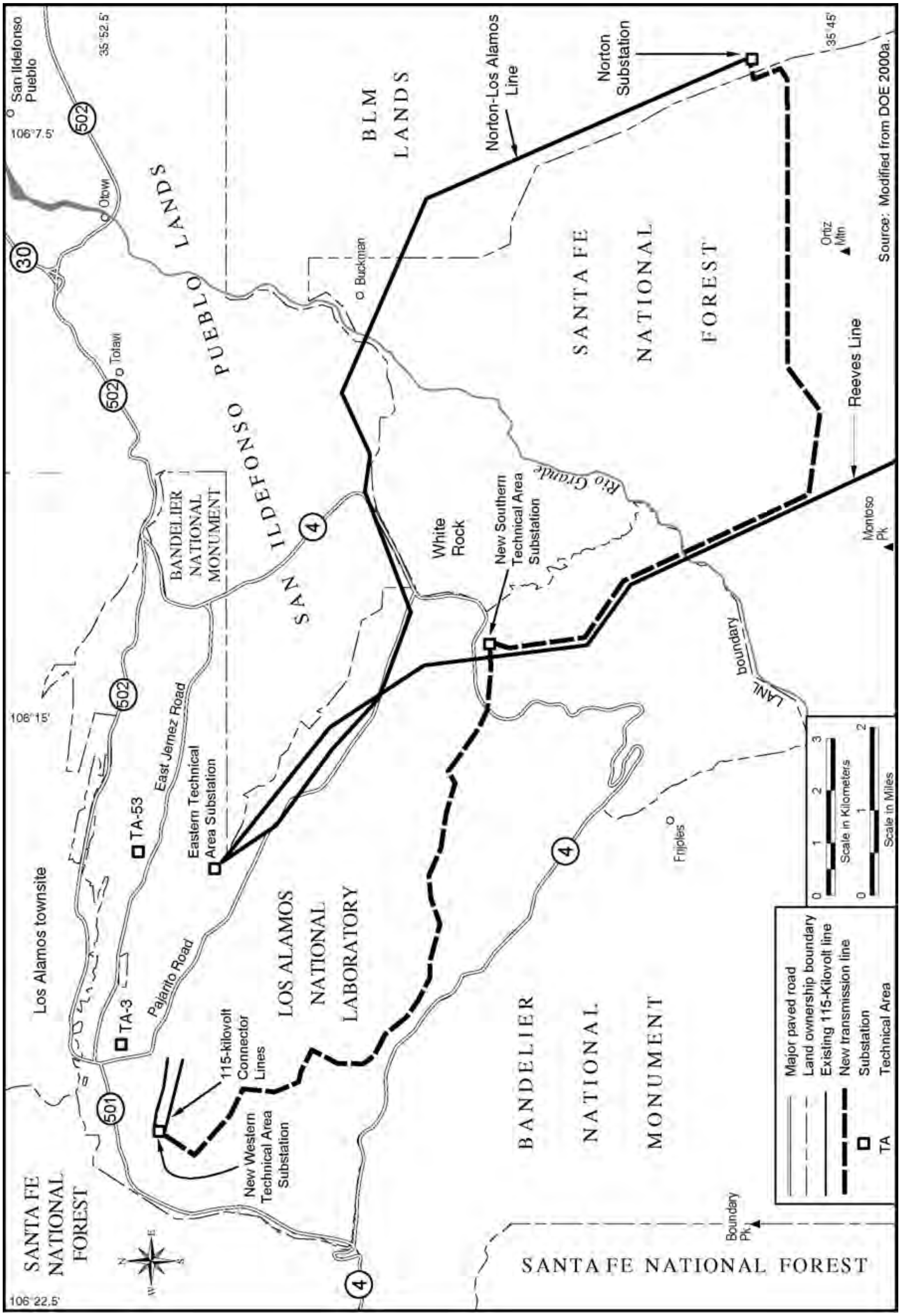


Figure 4–29 Los Alamos Area Electric Power Distribution System

Table 4–39 Trend in Peak Electric Load Demand for the Los Alamos Power Pool

Fiscal Year	*LANL Base*	*LANSCE*	*LANL Total*	*County Total*	*Pool Total*
1999 SWEIS [a]	50,000	63,000	113,000	Not projected	Not projected
1999	43,976	24,510	68,486	14,399	82,885
2000	45,104	20,343	65,447	15,176	80,623
2001	50,146	20,732	70,878	14,583	85,461
2002	45,809	20,938	66,747	16,653	83,400
2003	50,008	20,859	70,867	16,910	87,777
2004	47,608	21,811	69,419	16,231	85,650
2005	47,586	21,874	69,460	18,319	87,779

LANSCE = Los Alamos Neutron Science Center.
[a] Projections from the *1999 SWEIS* for the Expanded Operations Alternative.
Note: All values are in kilowatts consistent with the reporting convention used in the *LANL SWEIS Yearbooks*. To convert kilowatts to megawatts, divide by 1,000.
Sources: DOE 1999a; LANL 2000f, 2001e, 2002e, 2003h, 2004c, 2004f, 2006g.

Table 4–40 Trend in Total Electrical Energy Consumption for the Los Alamos Power Pool

Fiscal Year	*LANL Base*	*LANSCE*	*LANL Total*	*County Total*	*Pool Total*
1999 SWEIS [a]	345,000	437,000	782,000	Not projected	Not projected
1999	255,562	113,759	369,321	106,547	475,868
2000	263,970	117,183	381,153	112,216	493,369
2001	294,169	80,974	375,143	116,043	491,186
2002	299,422	94,966	394,398	121,013	515,401
2003	294,993	87,856	382,849	109,822	492,671
2004	327,117	86,275	413,392	127,429	540,821
2005	328,371	93,042	421,413	129,457	550,870

LANSCE = Los Alamos Neutron Science Center.
[a] Projections from the *1999 SWEIS* for the Expanded Operations Alternative (DOE 1999a).
Note: All values are in megawatt-hours. To convert megawatt-hours to kilowatt-hours, multiply by 1,000.
Sources: DOE 1999a; LANL 2004c, 2006g.

Electrical energy use at LANL remains below projections in the *1999 SWEIS*. Peak demand was projected to be 113 megawatts with 63 megawatts being used by LANSCE and about 50 megawatts being used by the rest of LANL. Annual electrical energy consumption was projected to be 782,000 megawatt-hours with 437,000 megawatt-hours being used by LANSCE and about 345,000 megawatt-hours being used by the rest of LANL. Actual use has fallen below these values to date, and the projected periods of brownouts have not occurred. On a regional basis, failures in the Public Service Company of New Mexico system have caused blackouts in northern New Mexico and elsewhere (LANL 2006g).

Historically, year-to-year fluctuations in LANL's total electrical energy use have largely been attributable to LANSCE operations. In recent years, an increase in LANL base peak load demand and particularly in base electrical energy use, independent of LANSCE operations, is evident. This is punctuated by the observed spike both in LANL base electrical energy use and in use by other Los Alamos County consumers since 2003 within the generally upward trend in total electricity demand (see Table 4–40).

Nevertheless, operations at several of the large LANL load centers have changed since 1999 including at LANSCE, which complicates attempts to forecast future electricity demands. For the past several years, LANSCE's electric load demand peaked with the rest of LANL, usually in July or August, but the peak load has now shifted to the winter (around January). This will change the overall electric demand for LANL, since LANSCE's peak load demand is such a large portion of the site's total peak load. Otherwise, LANSCE operations continued at reduced levels due to budgetary constraints that continued through fiscal year 2005. Also at TA-53, the Low-Energy Demonstration Accelerator which had not operated since fiscal year 2000 due to funding constraints was decommissioned in fiscal year 2003. This has reduced load demands by 2 to 4 megawatts (LANL 2006g). Regular, full-power operations of the Low-Energy Demonstration Accelerator as originally proposed would have tripled electric peak load demand to more than 60 megawatts, consistent with the projection from the *1999 SWEIS* (LANL 2006a). Further, while the National High Magnetic Field Laboratory in TA-35 has not operated since fiscal year 2000, the 60-Tesla superconducting magnet that failed in 2000 has been redesigned and reconstructed and has been operational since 2004 at about 2 megawatts of load. The DARHT facility began commissioning operations of its first axis in fiscal year 2001. The load level is about 1 megawatt for the first axis (LANL 2006g). LANL received authorization to begin full power operations of the second axis in January 2008.

Overall, in 2005 the total peak load was about 69.5 megawatts for LANL and about 18.3 megawatts for the rest of the power pool users (see Table 4–39). A total of 421,413 megawatt-hours of electricity were used at LANL in 2005. Other Los Alamos County users consumed an additional 129,457 megawatt-hours for a power pool total electric energy consumption of 550,870 megawatt-hours (see Table 4–40). Over the period 1999 to 2005, total maximum peak load demand has fluctuated, but has shown an upward trend, peaking again in 2005 when LANL and other Los Alamos County users required 59 percent of the capacity of the power pool. In a similar fashion, total maximum electric energy demand occurred in 2005 when 42 percent of the power pool system capacity was required. Electric power availability from the existing transmission system of the power pool is conservatively estimated at 963,600 megawatt-hours (reflecting the lower thermal rating of 110 megawatts for 8,760 hours per year available for import). An additional 20 megawatts (175,200 megawatt-hours per year) is currently available via the upgraded TA-3 Co-Generation Complex for a power pool total electric energy availability of 1,138,800 megawatt-hours.

The *1999 SWEIS* documented the limitations of the electric transmission lines that deliver electric power to the Los Alamos power pool, as well as the need to upgrade the aging TA-3 Co-Generation Complex and onsite electrical distribution system (DOE 1999a). Specifically, projects to improve the reliability of electric power transmission to the power pool include construction of a third transmission line and associated substation and uncrossing the two existing transmission lines (the Norton and Reeves Lines) where they cross on LANL (see Figure 4–29). The reliability of these lines in serving the power pool is compromised because they do not provide physically separate avenues for the delivery of power from independent power supply sources. The crossing of power lines results in a situation where a single outage event, such as a conductor or structural failure, could potentially cause a major power loss to the power pool. Loss of power from the regional electric system results in system isolation where the TA-3 Co-Generation Complex is the only source of sufficient capacity to prevent a total blackout. If such an event occurred when the TA-3 Co-Generation Complex was not operating or was being serviced or repaired, there would be no power available to the power pool. A single outage event could have serious and disruptive consequences to LANL and to the citizens of Los Alamos County. This vulnerability was noted by the Defense Nuclear Facilities Safety Board (LANL 2006g). For example, fire damage to transmission systems from the Cerro Grande Fire in 2000 resulted in the shutdown of both 115-kilovolt transmission lines. The steam turbines at the TA-3 Co-Generation Complex were operated and the critical electric power requirement of approximately 15 megawatts was maintained until the transmission lines could be repaired and power delivery through them resumed (LANL 2004c).

To address such situations, a new transmission line was proposed that would be constructed in two segments: (1) from the Norton Substation to a new substation (Southern TA) that is being constructed near White Rock, and (2) from the new Southern TA Substation to the Western TA Substation (see Figure 4–29). The first segment will be constructed at 345 kilovolts but operated in the short term at 115 kilovolts, as large pulse power loads at LANL will need the higher voltage in the future. The second segment will be constructed and operated at 115 kilovolts (LANL 2006g). Construction of the portion of the new transmission line from the Southern TA Substation to the Western TA Substation was completed in February 2006, and construction of the new Southern TA switchyard was finished in March 2006. Refurbishment of the existing Eastern TA Substation was completed in 2007. The project to uncross the two existing transmission lines is scheduled to be complete by 2010. The construction of the portion of the line from the Norton Substation to the Southern TA Substation is in the design phase (LANL 2006a).

In late 2005, project planning was initiated for a new TA-50 Substation on the existing LANL 115-kilovolt power distribution loop. The substation would be constructed with an installed transformer capacity of 50 megavolt-amperes (about 40 megawatts) and is intended to provide independent power feed to the existing TA-55 Plutonium Complex and new Chemistry and Metallurgy Research Replacement Building (LANL 2006a).

As previously described, onsite electrical generating capability for the power pool is limited by the existing TA-3 Co-Generation Complex, which is capable of producing up to 20 megawatts of electric power. Refurbishment of this facility began in 2003, and includes upgrades to the Number 3 steam turbine and to the steam path. The Number 3 steam turbine is currently a 10-megawatt unit, and rewinding of this unit is expected to increase its output to about 17 megawatts (LANL 2006g). However, due to limitations in auxiliary systems, including cooling water, the total net capacity of the TA-3 power plant will not increase. Refurbishment activities were completed in 2007 (LANL 2006a, 2006g). In addition, construction was completed on a new gas-fired combustion turbine generator at the TA-3 Co-Generation Complex. This new 20-megawatt unit also became operational in September 2007. A second generator may be constructed at a later date. At present, DOE has no timetable for installing the second new unit, which was proposed for reliability purposes only (LANL 2006a).

Also, as part of ongoing electric reliability upgrades at LANL, a conceptual design report for the Electrical Infrastructure and Safety Upgrades Project was completed in 1998. This project seeks to upgrade the electrical infrastructure in buildings throughout LANL to improve electrical safety. Thirty-one buildings were identified for upgrades and were prioritized based on the safety hazard they presented. Since then, the project has been coordinated with annual site planning activities, and subprojects have been removed from the list as the buildings have been identified for decommissioning and demolition. To date, five subprojects have been removed from the list, for a new total of 26 General Plant Projects. An evaluation of the LANL electrical safety maintenance backlog could increase the number of subprojects under the Electrical Infrastructure and Safety Upgrades Project. As of November 2006, five upgrade projects had been completed (TA-3-40-S&W, TA-3-40-N&E, TA-3-43, TA-16-200, TA-40-1), four projects were in construction (TA-3-261, TA-43-1, TA-46-31, TA-8-21), two projects were through design (TA-46-1, TA-53-2), and two projects were still undergoing final design (TA-48-1, TA-35-2) (LANL 2006a, 2006g).

4.8.2.2 Fuel

Natural gas is the primary heating fuel used at LANL and in Los Alamos County. The natural gas system includes a high-pressure main and distribution system to Los Alamos County and pressure-reducing stations at LANL buildings. LANL and the County both have delivery points where gas is monitored and measured (DOE 2003d). In August 1999, DOE sold the 130-mile-long (209-kilometer-long) main gas supply line and associated metering stations to the Public Service Company of New Mexico. This gas pipeline traverses the area from Kutz Canyon Processing Plant south of Bloomfield, New Mexico, to Los Alamos. Approximately 4 miles (6.4 kilometers) of the gas pipeline are within LANL boundaries (LANL 2006g). Natural gas is distributed to the point of use via some 62 miles (100 kilometers) of distribution piping (LANL 2000a).

Approximately 98 percent of the gas used by LANL is currently used for heating (both steam and hot air) with the TA-3 Co-Generation Complex being the principal user of natural gas at LANL. The remainder is used for steam-generated electrical power production at the TA-3 Co-Generation Complex (see Section 4.8.2.1) (LANL 2006g). The TA-3 Co-Generation Complex currently has three dual fuel boilers with associated steam turbine-generator sets, with natural gas being the primary fuel and No. 2 fuel oil available for use as a standby fuel (LANL 2003f). The low-pressure steam is supplied to the TA-3 district heating system and some process needs and the electricity is routed into the power grid. The TA-3 steam distribution system has about 5.3 miles (8.5 kilometers) of steam supply and condensate return lines (DOE 1999a). Steam for facility heating is also currently generated at the TA-21 steam plant. This facility has three relatively small boilers, each with only about 5 percent of the capacity of the units at the TA-3 Co-Generation Complex. They are primarily natural gas-fired but can also burn No. 2 fuel oil. Steam produced in the TA-21 steam plant is used to provide space heating for the buildings in TA-21. LANL also maintains about 200 other smaller boilers, which are primarily natural gas fired (LANL 2003f). As mentioned above, relatively small quantities of fuel oil are also stored at LANL as a backup fuel source for emergency generators.

The trends in natural gas consumption for the Los Alamos service area and associated steam production at LANL are provided in **Table 4–41** and **Table 4–42**, respectively. Annual (fiscal year) recorded natural gas consumption for the period 1999 through 2005 is compared to projections made in the *1999 SWEIS* for the Expanded Operations Alternative. Total LANL natural gas consumption remains below projections in the *1999 SWEIS*. Steam production was not projected in the *1999 SWEIS* but has been tracked at LANL as a secondary measure of energy consumption for facility heating and onsite electricity generation. Total LANL natural gas consumption was projected to be 1,840,000 decatherms annually (equivalent to approximately 1.84 billion cubic feet [52.1 million cubic meters]). As shown in Tables 4–41 and 4–42, total natural gas consumption and associated steam production has trended downward at LANL since 1999 in concert with a general decline in heating demand, while consumption for electricity production has fluctuated, sometimes dramatically, from year to year. The decline in heating demand in recent years is mainly attributable to warmer winters and secondarily due to replacement of older buildings and associated workforce consolidation into more energy-efficient structures. During fiscal year 2005, total LANL natural gas consumption was 1,187,855 decatherms (equivalent to about 1.19 billion cubic feet [33.7 million cubic meters]) and total steam production was 357,341 thousand pounds. For fiscal year 2005, natural gas consumption for electricity generation was again the lowest since issuance of the *1999 SWEIS*.

Table 4–41 Trend in Natural Gas Consumption for Los Alamos National Laboratory and Los Alamos County

Fiscal Year	*Natural Gas*			*Los Alamos County Consumption* [a]	*Total Los Alamos Area Consumption*
	Total LANL Consumption	*Total Used for Electric Production*	*Total Used for Heat Production*		
1999 SWEIS [b]	1,840,000	Not projected	Not projected	Not projected	Not projected
1999	1,428,568	241,490	1,187,078	No comparable data	No comparable data
2000	1,427,914	352,126	1,075,788	870,402	2,298,316
2001	1,492,635	273,312	1,219,323	928,329	2,420,964
2002	1,325,639	212,976	1,112,663	871,566	2,197,205
2003	1,220,137	41,632	1,178,505	933,439	2,153,576
2004	1,149,936	25,680	1,124,256	931,940	2,081,876
2005	1,187,855	20,086	1,167,768	943,559	2,111,327

[a] Los Alamos County's natural gas consumption data are based on its fiscal year, which runs from July to June, as opposed to the Federal fiscal year used by LANL, which runs from October to September.
[b] Projections from the *1999 SWEIS* for the Expanded Operations Alternative (DOE 1999a).
Note: All values are in decatherms. To convert decatherms to cubic feet, multiply by 1,000; cubic feet to cubic meters, multiply by 0.028317.
Sources: Arrowsmith 2005, 2006; DOE 1999a; LANL 2004c, 2006g.

Table 4–42 Trend in Steam Production for Los Alamos National Laboratory

Fiscal Year	*TA-3 Steam Production*	*TA-21 Steam Production*	*Total Steam Production*
1999	576,548	29,468	606,016
2000	634,758	27,840	662,598
2001	531,763	29,195	560,958
2002	478,007	26,206	504,213
2003	351,905	26,147	378,052
2004	347,110	23,910	371,020
2005	333,042	24,299	357,341

TA = technical area.
Note: All values are in thousands (1,000) of pounds which is the unit of measurement at LANL. To convert pounds to kilograms, multiply by 0.45359.
Sources: LANL 2004c, 2006g.

The observed downward trend in natural gas consumption at LANL is contrasted by the generally upward trend among other Los Alamos County users, which can be attributed to development and population growth within the region (see Table 4–41). In 2005, other Los Alamos County users consumed 943,559 decatherms (equivalent to about 944 million cubic feet [26.7 million cubic meters]) as compared to 870,402 decatherms (870 million cubic feet [24.6 million cubic meters]) in 2000. For 2005, total natural gas usage for the Los Alamos service area was 2,111,327 decatherms (equivalent to about 2.11 billion cubic feet [59.7 million cubic meters]). For the period, total maximum natural gas demand occurred in 2001 when LANL and other Los Alamos County users required 30 percent of the system supply capacity. However, natural gas is abundant in New Mexico, and the region has a high import capacity. The natural gas delivery system servicing the Los Alamos area has a contractually-limited capacity of about 8.07 billion cubic feet (229 million cubic meters) per year (DOE 2003d).

It was noted in the *1999 SWEIS* that the age of the natural gas transmission and distribution system serving LANL facilities and Los Alamos County dictated modification and upgrade. This need was stressed particularly should the TA-3 Co-Generation Plant be required to burn more natural gas to meet future electricity demands. Several segments of natural gas transmission and delivery pipeline have been upgraded, and redundant loops of pipeline have been installed across LANL and across New Mexico in general over the past two decades. The most recent major upgrades to the natural gas transmission line to LANL and Los Alamos County, which included the installation of relocated segments of redundant loops, occurred in the early to mid-1990s. Within that time frame, several additional segments of the aged supply pipeline, without redundant portions, were identified across northern New Mexico. Plans to provide redundant service supply were undertaken by Public Service Company of New Mexico to correct this supply system deficiency. A critical segment of 8.1-inch (20-centimeter) pipeline in Los Alamos County and within LANL's boundaries was identified as of being of non-standard size and construction making its replacement necessary.

DOE has issued an easement to the Public Service Commission of New Mexico to allow construction, operation, and maintenance of approximately 15,000 feet (4,500 meters) of 12-inch (30-centimeter) coated steel natural gas pipeline within LANL boundaries in Los Alamos Canyon. The new segment would replace the existing 8.1-inch (20-centimeter) segment, and would cross east across the site down Los Alamos Canyon from TA-21 to connect to the existing 12-inch (30-centimeter) coated steel gas transmission mainline located within the right-of-way of New Mexico 502 in TA-72 (DOE 2002h, NNSA 2005b). Construction of the pipeline was completed in late 2005, with tie-in to the existing transmission system that was completed at the end of 2006 (LANL 2006a).

4.8.2.3 Water

The Los Alamos County water production system consists of 14 deep wells, 153 miles (246 kilometers) of main distribution lines, pump stations, and storage tanks. The system supplies potable water to all of the County, LANL, and Bandelier National Monument. Specifically, the deep wells are located in three well fields (Guaje, Otowi, and Pajarito). Water is pumped into production lines, and booster pump stations lift this water to reservoir tanks for distribution. Prior to distribution, the entire water supply is disinfected with a process that replaces the formerly used chlorine disinfectant process (LANL 2004c, DOE 2003d).

On September 8, 1998, DOE transferred operation of the system from DOE to Los Alamos County under a lease agreement. Under the transfer agreement, DOE retained responsibility for operating the distribution system within LANL boundaries, whereas the county assumed full responsibility for ensuring compliance with Federal and state drinking water regulations. DOE's right to withdraw an equivalent of about 5,541 acre-feet or 1,806 million gallons (6,830 million liters) of water per year from the main aquifer and its right to purchase a water allocation of some 1,200 acre-feet or 391 million gallons (1,500 million liters) per year from the San Juan-Chama Transmountain Diversion Project were included in the transfer (DOE 2003d, LANL 2006g).

On September 5, 2001, DOE completed the transfer of ownership of the water production system to Los Alamos County, along with 70 percent (3,879 acre-feet or 1,264 million gallons [4,785 million liters] annually) of the DOE water rights. The remaining 30 percent (1,662 acre-feet or 542 million gallons [2,050 million liters] annually) of the water rights are leased by DOE to the County for 10 years, with the option to renew the lease for four additional 10-year terms. LANL is now considered a Los Alamos County water customer, and DOE is billed and pays for the water LANL uses. The current 10-year agreement (water service contract) with Los Alamos County, started in 1998, includes an escalating projection of future LANL water consumption (LANL 2006g). While the contract does not specify a supply limit to LANL, the water right owned by DOE and leased to the county (that is 1,662 acre-feet or 542 million gallons [2,050 million liters] per year) is a good target ceiling quantity under which LANL should remain (LANL 2001a). The distribution system serving LANL facilities now consists of a series of reservoir storage tanks, pipelines, and fire pumps. The LANL distribution system is gravity fed with pumps for high-demand fire situations at limited locations (LANL 2006g).

Los Alamos County continues to pursue the use of San Juan-Chama water as a means of preserving those water rights (DOE 2003d, LANL 2006g). Studies conducted in 2002 and 2003 determined the feasibility of accessing the San Juan-Chama water allocation by lifting it from the Rio Grande up onto the mesa that overlooks White Rock Canyon. Two options were evaluated for construction of a collector system that would allow the diversion of water from the layer of gravel beneath the Rio Grande. These include (1) pumping and piping the water from the Rio Grande up the side of White Rock Canyon and (2) boring a tunnel under the mesa and drilling a collector well on top to intercept the water flowing in the tunnel, which is environmentally preferable (LAC 2004b, Glasco 2005). Since completion of Los Alamos County's San Juan-Chama project water utilization study in 2004, other options under consideration by the county include direct delivery of project water to LANL in lieu of groundwater. This would facilitate a reduction in overall LANL water demand because of the large percentage of water used for cooling purposes at LANL. As a result, the use of the low-silica San Juan-Chama project water would allow LANL's cooling towers to be operated at higher (recirculation) cycles before the water must be discharged, resulting in lower total water use (Stephens 2006).

On September 19, 2006, New Mexico Governor Richardson signed new repayment contracts on behalf of five towns and cities and two counties, including Los Alamos County, that formally secured water rights with the Bureau of Reclamation for San Juan-Chama project water. Unlike the previous purchase form contracts, the repayment contract has no termination date, giving Los Alamos County and other municipalities perpetual rights and thus negating the need to renegotiate and renew contracts in the future. Los Alamos County will have permanent use of the water as long as it meets the terms of the contract (LAC 2006b, Newman 2006). Completion of this process was necessary before the County could move forward with additional investment in the project (Glasco 2005, LAC 2006b). Use of the San Juan-Chama project along with conservation are integral to the County's Long-Range Water Supply Plan, which was commissioned to provide a sustainable water supply for the next 40 years and was completed in August 2006 (Stephens 2006).

The trend in water use for LANL and other Los Alamos County users is shown in **Table 4–43**. Annual (fiscal year) observed water demands for the period 1999 through 2005 are compared to projections made in the *1999 SWEIS* for the Expanded Operations Alternative. Water use at LANL remains below projections made in the *1999 SWEIS*. In 2005, approximately 359.3 million gallons (1,360 million liters) of water were used at LANL. This was about 400 million gallons (1.51 billion liters) less than the *1999 SWEIS* projected consumption of 759 million gallons (2.87 billion liters) per year. Approximately 60 percent of LANL's water use has historically been used for cooling tower operation, resulting in evaporative losses (LANL 2001a). The three cooling towers at LANSCE historically required about 77 million gallons (291 million liters) of water annually, or about 15 percent of the water use for all of LANL (LANL 2006a). Construction of a new cooling tower (structures 53-963 and 53-952) was completed in 2000. These new units replaced cooling towers 53-60, 53-62, and 53-64, which have been taken off line (LANL 2006g).

Table 4–43 Trend in Water Use for Los Alamos National Laboratory and Los Alamos County

Calendar Year [a]	*LANL*	*Los Alamos County*	*Total*
1999 SWEIS [b]	759,000	Not projected	Not applicable
1999	453,094	880,282	1,333,376
2000	441,000	1,133,277	1,574,277
2001	393,123	1,033,764	1,426,887
2002	324,514	1,230,826	1,555,340
2003	377,768	1,179,799	1,557,567
2004	346,624	1,035,461	1,382,085
2005	359,252	1,033,923	1,393,175

[a] Water data are routinely collected and summarized by calendar year, rather than by fiscal year as is done for electricity and natural gas.
[b] Projection from the *1999 SWEIS* for the Expanded Operations Alternative.
Note: All values are in thousands (1,000) of gallons which is the unit of measurement at LANL. To convert thousands of gallons to millions of gallons, divide by 1,000; thousands of gallons to thousands of liters, multiply by 3.7854.
Sources: Arrowsmith 2006; DOE 1999a; Glasco 2005; LANL 2004c, 2006g.

Regular, full-power operation of the Low-Energy Demonstration Accelerator at LANSCE, now decommissioned as noted in Section 4.8.2.1, was originally forecast to more than double LANSCE's total water use after 2000, which was reflected in the *1999 SWEIS* projections for LANL site-wide water use (LANL 2006a). Current water use at LANL compared to the calculated NPDES-regulated industrial effluent discharge of 198.5 million gallons (751 million liters) in 2005 indicates that the site's consumptive water use (reflecting the volume evaporated or otherwise lost and not returned as effluent) is about 55 percent (LANL 2006g). Further, water demand at the site continues to be well below the 30 percent (1,662 acre-feet or 542 million gallons [2,050 million liters] per year) of DOE's water rights that are leased by DOE to the county. The firm rated capacity of the Los Alamos County water production system is 7,797 gallons per minute (29,500 liters per minute) or approximately 4.1 billion gallons (15.5 billion liters) annually. The firm rated capacity is the maximum amount of water that can be pumped immediately to meet peak demand (LANL 2001a).

While LANL total and consumptive water use has generally decreased from 1999 to 2005, water usage by other Los Alamos County users has exhibited a generally upward trend over the period. Water use by LANL and by other Los Alamos County users declined noticeably from 2003 to 2004, as 2003 was a very dry year in the Los Alamos area compared to 2004, which illustrates the close relationship between climate and water use in the arid Southwest. Water use for 2005 is very comparable to 2004. For the period, total maximum water demand occurred in 2000 (the year of the Cerro Grande wildfire) when LANL and other Los Alamos County users required 87 percent of the available water rights from the regional aquifer.

DOE continues to maintain the onsite distribution system by replacing portions of the greater than 50-year old system as problems arise. The condition of the water distribution system was identified as a concern in the *1999 SWEIS*. DOE is also in the process of installing additional water meters and a Supervisory Control and Data Acquisition and Equipment Surveillance System on the water distribution system to keep track of water usage and to determine the specific water use for various applications. Data are being accumulated to establish a baseline for conserving water. In remote areas, DOE is trying to automate monitoring of the system to be more responsive during emergencies such as the Cerro Grande Fire. DOE has instituted a number of conservation and gray-water[5]-reuse projects, including a cooling tower conservation project to reduce water usage further and ensure that future LANL initiatives are not limited by water availability. For example, treated wastewater from the Sanitary Wastewater System Plant at TA-46 is conveyed to the TA-3 Co-Generation Complex for reuse as cooling tower makeup water (LANL 2006g).

4.9 Waste Management and Pollution Prevention

A wide range of waste types are generated through activities at LANL related to research, production, maintenance, construction, decontamination, decommissioning, demolition and environmental restoration. These waste types include: wastewaters (sanitary liquid waste, high-explosive-contaminated liquid waste, and industrial effluent); solid (sanitary) waste, including routine household-type waste and construction and demolition debris; and radioactive and chemical wastes. These wastes, discussed in more detail in Section 4.9.1 through 4.9.3 below, are regulated by Federal and state regulations, applicable to specific waste classifications. Institutional requirements for waste management activities are determined and documented by the Laboratory Implementation Requirements Program. This program provides details on proper management of all process wastes and contaminated environmental media. The waste management operation tracks waste generating process; quantity; chemical and physical

[5] *Generally treated or untreated water that is not suitable for drinking but can be used for secondary purposes such as industrial cooling.*

characteristics; regulatory status; applicable treatment and disposal standards; and final disposition of the waste (LANL 2004f).

A significant portion of waste management operations take place in facilities designed for and dedicated to waste management. Liquid wastes are treated in the Sanitary Wastewater Systems Plant, the High Explosives Wastewater Treatment Facility, and the Radioactive Liquid Waste Treatment Facility. Specialized facilities in TA-50 and TA-54 house a variety of chemical and radioactive waste management operations, including size reduction, compaction, assaying, and storage. Many hazardous wastes are now accumulated for up to 90 days at consolidated storage facilities and are then shipped directly offsite. Four of these consolidated storage facilities exist at LANL and two more are planned (LANL 2003e)

Waste minimization and pollution prevention efforts at LANL are coordinated by the Pollution Prevention Program. Source reduction, including materials substitution and process improvements, is the preferred method of reducing waste. Recycling and reuse practices are also considered for wastes, together with volume reduction and treatment options. Progress in pollution prevention initiatives at LANL in measured annually against metrics approved by the DOE (LANL 2004l). In 1999, the DOE established the 2005 Pollution Prevention goals. These goals required that DOE meet the following waste reductions for routine waste, based on the 1993 baseline:

- greater than 80 percent reduction in low-level radioactive waste
- greater than 80 percent reduction in mixed low-level radioactive waste
- greater than 50 percent reduction in transuranic waste
- greater than 90 percent reduction in hazardous waste (includes New Mexico Special waste and Toxic Substances Control Act waste)
- greater than 10 percent reduction in clean up and stabilization waste
- greater than 55 percent reduction in per capita generation of solid sanitary waste
- greater than 50 percent recycle rate
- greater than 90 percent reduction in toxic release inventory chemical usage
- 100 percent replacement of specific ozone-depleting chillers
- 100 percent affirmative procurement purchases of EPA-designated recycled content items

DOE achieved an overall rating of 97 percent towards the DOE 2005 Pollution Prevention goals for fiscal year 2005. In 2004, DOE established a prevention-based Environmental Management System at LANL based on the International Standards Organization 14001 standard to meet DOE Order 450.1. The Environmental Management System is a systematic method for assessing mission activities, determining environmental impacts of those activities, prioritizing improvements, and measuring results (LANL 2004l). Environmental Management System action plans have been developed to address environmental issues, including objectives for pollution prevention, compliance and continual improvement.

4.9.1 Wastewater Treatment and Effluent Reduction

LANL has three primary sources of wastewater: sanitary liquid wastes, high explosives-contaminated liquid wastes, and industrial effluent. Radioactive liquid waste is addressed in Section 4.9.3.

4.9.1.1 Sanitary Liquid Waste

DOE continues to operate the TA-46 Sanitary Wastewater System Plant to treat liquid sanitary wastes, as described in the *1999 SWEIS*. Treated liquid effluent from the Sanitary Wastewater System Plant is pumped to storage tanks near the TA-3 Power Plant before being discharged to Sandia Canyon through NPDES-permitted outfall. The Sanitary Effluent Reclamation Facility treats some liquid effluent for reuse in the cooling towers at the Metropolis Center for Modeling and Simulation.

4.9.1.2 Sanitary Sludge

Sanitary sludge from the Sanitary Wastewater System Plant is dried for a minimum of 90 days to reduce pathogens and then disposed of as New Mexico Special Waste at an authorized, permitted landfill. The volume of sanitary sludge generated and disposed of by DOE is reported annually in the site environmental surveillance reports (for example, LANL 2005h).

Between 1997 and September 2000, sludge generated from the Sanitary Wastewater System Plant was managed as polychlorinated biphenyl-contaminated (50 to 499 parts per million) waste in accordance with the Toxic Substances Control Act and disposed of at a Toxic Substances Control Act-permitted landfill. This management practice was necessary because low-levels of polychlorinated biphenyls (less than 5 parts per million) had been repeatedly detected in the sludge. During this time, DOE completed an investigation that identified the source of the polychlorinated biphenyls and subsequently completed a cleanup of contaminated sewer lines. After cleanup was completed and verified by sampling, DOE notified EPA and began managing Sanitary Wastewater System sludge as New Mexico Special Waste (LANL 2001f, 2002d, 2004a, 2004d). Additional information may be found in the site annual environmental surveillance reports.

4.9.1.3 High Explosives-Contaminated Liquid Wastes

The High Explosives Wastewater Treatment Facility, located in TA-16, became fully operational in 1997. The High Explosives Wastewater Treatment Facility treats process waters containing high-explosive compounds, using three treatment technologies. Sand filtration is used to remove particulate high explosives; activated carbon is used to remove organic compounds and dissolved high explosives; and ion exchange units are used to remove perchlorate and barium. The High Explosives Wastewater Treatment Facility receives some wastewaters by truck from processing facilities located outside TA-16 (DOE 1999a, LANL 1999b).

Equipment upgrades were performed to replace water-sealed vacuum pumps and wet high explosives collection systems with systems that do not use water. In addition, sources of non-high explosives industrial wastewater have been eliminated from the high explosives processing areas (DOE 1999a). These upgrades have resulted in a significant reduction in quantities of high explosives wastewater treated and effluent discharged to NPDES-permitted outfalls. In 2005, the High Explosives Wastewater Treatment Facility discharged about 30,000 gallons (114,000 liters) to an outfall, compared to the *1999 SWEIS* projection of 170,000 gallons (644,000 liters) (LANL 2006g).

4.9.1.4 Industrial Effluent

Industrial effluent is discharged to a number of NPDES-permitted outfalls across LANL. Currently, LANL discharges wastewater to a total of 21 outfalls, down from the 55 outfalls identified in the *1999 SWEIS*. An effort to reduce the number of outfalls was initiated in 1997, with significant reductions realized in 1997 and 1998. Most of these reductions resulted from changes at the High-Explosives Processing Key Facility and High Explosives Testing Key Facility, with the redirection of some flows to the sewage plant at TA-46, and the routing of high explosives-contaminated flows through the High Explosives Wastewater Treatment Facility (LANL 2003h).

Discharges to outfalls are regulated under an NPDES permit, effective February 1, 2001. At most outfalls, actual flows are recorded by flow meters; at the remaining outfalls, flow is estimated based on instantaneous flows measured during field visits. With the exception of discharges during 1999, total discharges for the period of 1998 through 2005 from LANL outfalls have fallen within *1999 SWEIS* projections (LANL 2003h, 2004f, 2005f, 2006g).

4.9.2 Solid Waste

Sanitary solid waste is excess material that is not radioactive or hazardous and can be disposed of in a solid waste landfill. Solid waste generated at LANL is disposed of at the Los Alamos County Landfill, located within LANL boundaries, but operated by Los Alamos County. Solid waste includes paper, cardboard, plastic, glass, office supplies and furniture, food waste, brush, and construction and demolition debris. Through an aggressive waste minimization and recycling program, the amount of solid waste at LANL requiring disposal has been greatly reduced. In 2004, 6,380 tons (5,789 metric tons) of solid waste were generated at LANL, of which 4,240 tons (3,847 metric tons) was recycled (LANL 2004l). The per capita generation of routine solid waste (food, paper, plastic) at LANL has decreased by about 58 percent over the 10-year period from 1993 through 2003 (LANL 2004f). Nonroutine solid waste is generated by construction and demolition projects, and also includes waste generated by Cerro Grande Rehabilitation Project cleanup activities. Recycling of sanitary waste currently stands at 60 percent compared to 1993, when LANL recycled only about 10 percent of the sanitary waste. In 2005, the total amount of recycled sanitary waste reached 4,417 tons (4,007 metric tons), an increase from 2004 (LANL 2006g).

The *1999 SWEIS* projected that the Los Alamos County Landfill would not reach capacity until 2014, however, in accordance with direction from NMED, the County plans on closing the landfill (LAC 2006c). The landfill is expected to operate until fall 2008, when a new transfer station, operated by the County, will be used to sort and ship LANL sanitary wastes to a solid waste landfill outside the county (DOE 2005a).

Construction and Demolition Debris—Construction and demolition debris is regulated as a separate category of solid waste under the New Mexico Solid Waste Regulations. Construction and demolition debris is not hazardous and may be disposed of in a municipal landfill or a construction and demolition debris landfill (NMAC 20.9.1). This category of waste was included in the chemical waste projections in the *1999 SWEIS* and continues to be tracked as chemical waste in the *SWEIS Yearbooks*. Although construction and demolition debris continue to be included in the chemical waste category, recent LANL tracking and projection efforts also have created a subcategory for construction and demolition debris. In 2005, approximately 78 percent of the uncontaminated construction and demolition waste was recycled. The total amount of construction waste generated in 2005 increased by 10 percent from 2004 (LANL 2006g).

4.9.3 Radioactive and Chemical Waste

Radioactive and chemical wastes are generated by research, production, maintenance, construction and environmental cleanup activities. Radioactive wastes are divided into the following categories: low-level; mixed low-level; transuranic; and mixed transuranic. Chemical wastes are a broad category including hazardous waste (designated under the RCRA regulations), toxic waste, construction and demolition debris, and special waste. Waste quantities vary with level and type of operation, construction activities, and implementation of waste minimization activities. Waste minimization efforts have resulted in overall waste reduction across most categories, due to process improvements and substitutions of nonhazardous chemicals for commonly used hazardous chemicals (LANL 2004f).

Most wastes generated are subsequently managed through the LANL waste treatment, storage, and disposal infrastructure. This section evaluates waste generation rates and the capabilities of that infrastructure. An increasing amount of waste, including wastes generated through environmental restoration activities, are shipped directly from the point of generation to offsite facilities; these wastes have little impact on the LANL waste management infrastructure (LANL 2004g).

Table 4–44 summarizes the radioactive and chemical waste quantities generated from 1999 through 2004 by waste type. The quantities include contributions across LANL, including Key Facilities, non-Key Facilities and the LANL environmental restoration activities. Projections from the ROD for the *1999 SWEIS* are included for comparison.

Site-wide waste quantities for the 7-year period from 1999 through 2005 generally were below projections presented in the *1999 SWEIS* for all waste types, with a few exceptions discussed below. For each waste type, significant variances from the *1999 SWEIS* ROD projections are noted in footnotes to the waste generation tables that follow. Most variances are due to one-time events, such as maintenance, construction, or remediation activities, rather than higher quantities of operations waste. For most waste types, the quantities produced across LANL facilities did not approach the levels projected in the *1999 SWEIS*. Waste minimization efforts have reduced waste generation rates for specific waste types as facility processes were improved and nonhazardous product substitutions were implemented. In some cases, facility workloads were less than expected, resulting in less waste generated. Additional comparisons to *1999 SWEIS* projections are presented in the waste-specific sections that follow.

Table 4–44 Los Alamos National Laboratory Waste Types and Generation

Waste Type	*Units*	*1999 SWEIS ROD Projection*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
Low-Level Radioactive Waste	cubic yards per year	16,000 [a]	2,190	5,530	3,400	9,560	7,640	19,400	7,080
Mixed Low-Level Radioactive Waste	cubic yards per year	830	30	780	80	30	50	50	90
Transuranic Waste	cubic yards per year	440	190	160	150	160	530	50	100
Mixed Transuranic Waste	cubic yards per year	150	110	120	60	110	210	30	130
Chemical Waste	10^3 pounds per year	7,160	34,000	61,000	60,800	3,820	1,520	2,460	4,340

ROD = Record of Decision.
[a] Values are rounded.
Note: To convert cubic yards to cubic meters, multiply by 0.76456; pounds to kilograms, multiply by 0.4536.
Sources: LANL 2003h, 2004f, 2005f, 2006g.

Low-Level Radioactive Wastes—Low-level radioactive waste is defined as waste that is radioactive and does not fall within any of the following classifications: high-level radioactive waste, transuranic waste, spent nuclear fuel, or by-product materials (uranium and thorium mill tailings). These wastes are generated at LANL when materials, equipment, and water are used in radiological control areas as part of the work activities; when these contaminated items are no longer useable, they are removed from the area as low-level radioactive waste. Typical waste streams include: laboratory equipment, service and utility equipment, plastic bottles, disposable wipes, plastic sheeting and bags, paper, and electronic equipment (LANL 2004l). Environmental restoration and decontamination, decommissioning, and demolition (DD&D) activities also generate low-level radioactive waste, primarily in the form of contaminated soils and debris.

Most low-level radioactive waste generated at LANL is disposed of onsite at TA-54, Area G. Disposal operations expanded into Zone 4, providing sufficient capacity for operational wastes for the long term. The facility-specific low-level radioactive waste generation rates for the 7-year period are shown in **Table 4–45**. Contributions from non-Key Facilities exceeded *1999 SWEIS* projections for several years, primarily due to heightened operational activities and new construction (LANL 2004f, 2005f, 2006g). Although there were several instances of individual facilities exceeding *1999 SWEIS* projections, overall LANL low-level radioactive waste generation was well below those levels predicted in the *1999 SWEIS* for 6 years of the 7-year period. In 2004, the *1999 SWEIS* projection was exceeded due to heightened activities and new construction at non-Key Facilities (LANL 2005f).

Table 4–45 Low-Level Radioactive Waste Generation at Los Alamos National Laboratory by Facility (cubic yards per year)

Facility	*SWEIS ROD*	*1999* [a]	*2000* [a]	*2001* [a]	*2002* [a]	*2003* [b]	*2004* [c]	*2005* [d]
Chemistry and Metallurgy Research Building	2,380	240	345	586	509	553	175	237
Sigma Complex	1,256	80	68	< 1	264	162	< 1	83
Machine Shops	793	53	535	29	58	20	20	175
Materials Science Laboratory	0	0	0	0	0	0	0	0
High-Explosives Processing	21	11	4	1	11	37	0	5
High-Explosives Testing	1,229	< 1	< 1	0	0	0	114	< 1
Tritium Facilities	628	62	64	0	118	143	33	65
Pajarito Site	190	41	18	17	0	13	0	0
Target Fabrication Facility	13	0	0	< 1	< 1	0	0	0
Biological Sciences	45	18	0	0	0	0	4	8
Radiochemistry Laboratory	353	52	75	72	45	102	23	38
Radioactive Liquid Waste Treatment Facility	209	229	173	676 [e]	252	510 [f]	464 [g]	339 [h]
Los Alamos Neutron Science Center	1,419	92	37	< 1	0	92	3	67
Solid Radioactive and Chemical Waste Facilities	228	28	17	18	46	267	54	368 [i]
Plutonium Facilities	986 [j]	451	260	392	388	513	247	380
Total low-level radioactive waste for Key Facilities	9,750	1,358	1,597	1,794	1,692	2,412	1,138	1,766
Non-Key Facilities	680	458	3,637 [k]	744	698	4,948 [l]	18,262 [m]	1,368 [n]
Total low-level radioactive waste for Key and non-Key Facilities	10,430	1,816	5,234	2,538	2,390	7,366	19,400	3,134
Percentage of Total from Key Facilities	**94**	**75**	**44**	**71**	**71**	**33**	**6**	**56**
Environmental Restoration	5,572	374	296	812	7,173	283	1	3,945
Total low-level radioactive waste for non-Key Facilities and Environmental Restoration	6,252	832	3,933	1,556	7,871	5,231	18,263	5,313
Total low-level radioactive waste = Key + non-Key Facilities and Environmental Restoration	16,002	2,190	5,530	3,350	9,563	7,643	19,401	7,079
Percentage of Total from Key Facilities	**61**	**62**	**29**	**54**	**18**	**32**	**6**	**25**

ROD = Record of Decision.
[a] LANL 2003h.
[b] LANL 2004f.
[c] LANL 2005f.
[d] LANL 2006g.
[e] Amount includes approximately 497 cubic yards of water transferred to TA-53, due to high tritium content (LANL 2003h).
[f] *1999 SWEIS* ROD projection exceeded due in part to the removal of sludge from the concrete storage tank in WM-2 (LANL 2004f).
[g] *1999 SWEIS* ROD projection exceeded due to the generation of 46 cubic yards of water pumped from manholes, 194 cubic yards of aqueous evaporator bottoms, and 136 cubic yards of soil associated with construction of new influent tanks (LANL 2005f).
[h] *1999 SWEIS* ROD projection exceeded due to soil and debris generated during tank installation and the generation of aqueous evaporator bottoms (LANL 2006g).
[i] *1999 SWEIS* ROD projection exceeded due to empty drums resulting from repackaging of transuranic waste (LANL 2006g).
[j] Includes estimates of waste generated from the facility upgrades associated with pit fabrication (LANL 2003h).
[k] Amount includes waste generated from decontamination and demolition activities and from soil and sediment removal in Mortandad and Los Alamos Canyons (LANL 2003h).
[l] *1999 SWEIS* ROD projection exceeded due to heightened activities and new construction (LANL 2004f).
[m] *1999 SWEIS* ROD projection exceeded due to heightened activities and new construction (LANL 2005f).
[n] *1999 SWEIS* ROD projection exceeded due to heightened activities and new construction (LANL 2006g).
Note: To convert cubic yards to cubic meters, multiply by 0.76456.

Mixed Low-Level Radioactive Wastes—Mixed low-level radioactive waste is waste that contains both low-level radioactive waste and hazardous waste as defined by the RCRA. Most of the operational mixed low-level radioactive waste is generated by the stockpile stewardship and research and development programs. Typical waste streams include: contaminated lead shielding bricks and debris, spent chemical solutions, fluorescent light bulbs, copper solder joints, and used oil. Environmental restoration and DD&D activities also produce some mixed low-level radioactive waste (LANL 2004l).

The facility-specific mixed low-level radioactive waste generation rates for the 7-year period are shown in **Table 4–46**. Although there were some facility-specific variances with *1999 SWEIS* projections of mixed low-level radioactive waste, LANL-wide quantities were relatively low. The largest single contributor to mixed low-level radioactive waste generation was the remediation of material disposal area (MDA) P (LANL 2004f). Overall LANL mixed low-level radioactive waste generation was below the *1999 SWEIS* projections for each year of the 7-year period.

Transuranic Wastes—Transuranic waste is waste containing greater than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years. This type of waste contains radioactive isotopes such as plutonium, neptunium, americium and curium. Specific categories are excluded from the definition of transuranic waste: 1) high-level waste; 2) waste that DOE has determined, and EPA has concurred, does not need the same degree of isolation as most transuranic waste; and 3) waste that the Nuclear Regulatory Commission has approved, on a case-by-case basis, for disposal at a low-level radioactive waste facility (LANL 2004l).

Transuranic waste is generated during research, development, and stockpile manufacturing and management activities. The waste forms include contaminated scrap and residues, plastics, lead gloves, glass, and personnel protective equipment. Transuranic waste may also be generated through environmental restoration, legacy waste retrieval, offsite source recovery, and DD&D activities. Transuranic waste is characterized and certified prior to shipment to the Waste Isolation Pilot Plant (WIPP) (LANL 2004l).

The facility-specific transuranic waste generation rates for the 7-year period are shown in **Table 4–47**. Non-Key Facilities exceeded *1999 SWEIS* projections for the years 2000 through 2005; these exceedances are all attributable to the Off-Site Source Recovery Project (LANL 2003h, LANL 2004f, LANL 2006g). Overall transuranic waste generation at LANL was well below the *1999 SWEIS* projections for 6 years of the 7-year period. In 2003, transuranic waste quantities exceeded the LANL-wide *1999 SWEIS* projection due to: (1) repackaging of legacy waste for shipment to WIPP, and (2) receipt and storage of waste by the Off-Site Source Recovery Project (LANL 2004f).

Table 4–46 Mixed Low-Level Radioactive Waste Generation at Los Alamos National Laboratory by Facility (cubic yards per year)

Facility	*SWEIS ROD*	*1999* [a]	*2000* [a]	*2001* [a]	*2002* [a]	*2003* [b]	*2004* [c]	*2005* [d]
Chemistry and Metallurgy Research Building	25	< 1	< 1	< 1	1	6	< 1	6
Sigma Complex	5	< 1	0	2	0	0	7	0
Machine Shops	0	0	< 1	< 1	0	0	0	0
Materials Science Laboratory	0	< 1	0	0	0	0	0	0
High-Explosives Processing	0.3	0	0	0	0	0	0	0
High-Explosives Testing	1	0	0	0	0	0	25 [e]	0
Tritium Facilities	4	0	0	< 1	1	2	< 1	< 1
Pajarito Site	2	10 [f]	0	0	0	0	0	0
Target Fabrication Facility	0.5	0	0	0	0	0	< 1	0
Biological Sciences	4	< 1	0	0	0	0	0	0
Radiochemistry Laboratory	5	< 1	2	4	3	8	2	< 1
Radioactive Liquid Waste Treatment Facility	0	4 [g]	3 [g]	3 [g]	5 [g]	0	< 1	0
Los Alamos Neutron Science Center	1	< 1	6	< 1	1	< 1	0	< 1
Solid Radioactive and Chemical Waste Facilities	5	0	0	0	0	0	0	0
Plutonium Facilities	17 [h]	5	2	17	4	5	2	17
Total mixed low-level radioactive waste for Key Facilities	70	25	15	30	15	22	40	26
Non-Key Facilities	39	3	13	12	11	26	13	3
Total mixed low-level radioactive waste for Key and non-Key Facilities	109	28	28	42	26	48	53	29
Percentage of Total from Key Facilities	**65**	**89**	**52**	**71**	**58**	**45**	**75**	**90**
Environmental Restoration	717	2	755 [i]	38	0	0	0	66
Total mixed low-level radioactive waste for non-Key Facilities and Environmental Restoration	756	5	768	50	11	26	13	69
Total mixed low-level radioactive waste = Key + non-Key Facilities and Environmental Restoration	826	30	783	80	26	48	53	95
Percentage of Total from Key Facilities	**9**	**83**	**2**	**38**	**58**	**45**	**75**	**27**

ROD = Record of Decision.
[a] LANL 2003h.
[b] LANL 2004f.
[c] LANL 2005f.
[d] LANL 2006g.
[e] Amount consisted mostly of lead bricks and shielding, contaminated with beryllium and depleted uranium (LANL 2005f).
[f] *1999 SWEIS* ROD projection exceeded due to maintenance activities (LANL 2003h).
[g] *1999 SWEIS* ROD projections did not envision use of Resource Conservation and Recovery Act listed hazardous chemicals in the facility or the resulting mixed waste (LANL 2003h).
[h] Includes estimates of waste generated from the facility upgrades associated with pit fabrication (LANL 2003h).
[i] Amount includes 751 cubic yards of waste generated as the result of emergency cleanups following the Cerro Grande Fire (LANL 2003h).
Note: To convert cubic yards to cubic meters, multiply by 0.76456.

Table 4–47 Transuranic Waste Generation at Los Alamos National Laboratory by Facility (cubic yards per year)

Facility	*SWEIS ROD*	*1999* [a]	*2000* [a]	*2001* [a]	*2002* [a]	*2003* [b]	*2004* [c]	*2005* [d]
Chemistry and Metallurgy Research Building	37 [e]	12	32	61 [f]	13	10	6	12
Sigma Complex	0	0	0	0	0	0	0	0
Machine Shops	0	0	0	0	0	0	0	0
Materials Science Laboratory	0	0	0	0	0	0	0	0
High-Explosives Processing	0	0	0	0	0	0	0	0
High-Explosives Testing (listed as transuranic/mixed transuranic)	0.3	0	0	0	0	0	0	0
Tritium Facilities	0	0	0	0	0	0	0	0
Pajarito Site	0	0	0	0	0	0	0	0
Target Fabrication Facility	0	0	0	0	0	0	0	0
Biological Sciences	0	0	0	0	0	0	0	0
Radiochemistry Laboratory	0	0	0	0	0	2	< 1	0
Radioactive Liquid Waste Treatment Facility	39	0	21	< 1	3	0	0	0
Los Alamos Neutron Science Center	0	0	0	0	0	0	0	0
Solid Radioactive and Chemical Waste Facilities	35	52	35	13	39	115 [g]	0	< 1
Plutonium Facilities	310 [e]	123	71	47	53	283	18	62
Total transuranic Waste for Key Facilities	421	187	159	122	108	410	25	75
Non-Key Facilities [h]	0	0	4	32	48	118	28	23
Total transuranic Waste for Key and non-Key Facilities	421	187	163	154	156	528	53	98
Percentage of Total from Key Facilities	**100**	**100**	**98**	**79**	**69**	**78**	**47**	**76**
Environmental Restoration	14	0	0	0	0	0	0	0
Total transuranic Waste for non-Key Facilities and Environmental Restoration	14	0	4	32	48	118	28	23
Total transuranic = Key + non-Key Facilities and Environmental Restoration	436	187	163	154	156	528	53	98
Percentage of Total from Key Facilities	**97**	**100**	**98**	**79**	**69**	**78**	**47**	**76**

ROD = Record of Decision.
[a] LANL 2003h.
[b] LANL 2004f.
[c] LANL 2005f.
[d] LANL 2006g.
[e] *1999 SWEIS* projections modified to reflect the ROD determination to produce nominally 20 pits per year (LANL 2003h).
[f] *1999 SWEIS* ROD projection exceeded due to remodeling activities (LANL 2003h).
[g] *1999 SWEIS* ROD projection exceeded due to Decontamination and Volume Reduction System repackaging of legacy transuranic waste (LANL 2004f).
[h] *1999 SWEIS* ROD projections exceeded due to wastes received by the Off-Site Source Recovery Project. Because this waste comes from shipping and receiving, it is attributed to non-Key Facilities (LANL 2003h, 2004f, 2005f, 2006g).
Note: To convert cubic yards to cubic meters, multiply by 0.76456.

Mixed Transuranic Wastes—Mixed transuranic waste is waste that contains both transuranic waste and hazardous waste as defined by RCRA. Mixed transuranic waste is generated through research, development, and stockpile manufacturing and management activities. The waste forms include contaminated scrap and residues, plastics, lead gloves, glass, and personnel protective equipment. Mixed transuranic waste may also be generated through environmental restoration, legacy waste retrieval, and DD&D activities. Mixed transuranic waste is characterized and certified prior to shipment to the WIPP (LANL 2004l).

The facility-specific mixed transuranic waste generation rates for the 7-year period are shown in **Table 4–48**. Generally, facility-specific generation rates are within the *1999 SWEIS* projections, with only a limited number of facilities producing mixed transuranic wastes. In the year 2000, Non-Key Facilities generated 82 cubic yards (63 cubic meters) of mixed transuranic waste compared to a *1999 SWEIS* projection of zero; the mixed transuranic waste generation for this category is solely attributable to the Transuranic Waste Inspection and Storage Project drum retrieval project (LANL 2001e). The Solid Radioactive and Chemical Waste Facilities generated mixed transuranic waste beyond that projected for the years 2000 through 2004, most notably in 2003 due to increased rates of transuranic waste repackaging for shipment to WIPP (LANL 2003h, LANL 2004f, LANL 2005f). The increasing trend, through 2003, in mixed transuranic waste generation for the Plutonium Complex and the Chemistry and Metallurgy Research Building reflect operations scaling toward full-scale production of war reserve pits (LANL 2004f). In 2004, mixed transuranic waste generation rates at the Plutonium Complex and Chemistry and Metallurgy Research Building were lower due to the 2004 work suspension and less than full-scale production (LANL 2005f). Overall mixed transuranic waste generation at LANL was below the *1999 SWEIS* projections for 6 years of the 7-year period. In 2003, mixed transuranic waste quantities exceeded the *1999 SWEIS* projection due to repackaging of legacy waste for shipment to WIPP (LANL 2004f).

Chemical Wastes—At LANL, chemical wastes are defined as a broad category including: hazardous waste (designated under RCRA regulations); toxic waste (asbestos and polychlorinated biphenyls, designated under the Toxic Substances Control Act); and special waste (designated under the New Mexico Solid Waste Regulations and including industrial waste, infectious waste, and petroleum contaminated soils). Construction and demolition debris was also included in the chemical waste category in the *1999 SWEIS* and continues to be tracked as chemical waste in the *SWEIS Yearbooks*, although this debris is disposed of as solid waste. The chemical waste category also includes all other nonradioactive waste that is managed through the Solid Chemical and Radioactive Waste Facilities, generally because the waste type is not accepted by solid waste disposal facilities (LANL 2005f). Typical hazardous waste streams include solvents, unused chemicals, acids and bases, solids such as barium-containing explosive materials, laboratory trash, and cleanup materials such as rags. Chemical waste is generated by many routine operations throughout LANL and also by environmental restoration and DD&D activities (LANL 2004l).

Table 4–48 Mixed Transuranic Waste Generation at Los Alamos National Laboratory by Facility (cubic yards per year)

Facility	*SWEIS ROD*	*1999* [a]	*2000* [a]	*2001* [a]	*2002* [a]	*2003* [b]	*2004* [c]	*2005* [d]
Chemistry and Metallurgy Research Building	17 [e]	3	1	1	22 [f]	15	< 1	4
Sigma Complex	0	0	0	0	0	0	0	0
Machine Shops	0	0	0	0	0	0	0	0
Materials Science Laboratory	0	0	0	0	0	0	0	0
High-Explosives Processing	0	0	0	0	0	0	0	0
High-Explosives Testing (Listed as transuranic/Mixed transuranic)	0.3	0	0	0	0	0	0	0
Tritium Facilities	0	0	0	0	0	0	0	0
Pajarito Site	0	0	0	0	0	0	0	0
Target Fabrication Facility	0	0	0	0	0	0	0	0
Biological Sciences	0	0	0	0	0	0	0	0
Radiochemistry Laboratory	0	0	0	0	0	0	0	0
Radioactive Liquid Waste Treatment Facility	0	6	0	6	< 1	4	0	0
Los Alamos Neutron Science Center	0	0	0	0	0	0	0	0
Solid Radioactive and Chemical Waste Facilities	0	0	10	17	20	77 [g]	< 1	3
Plutonium Facilities	133 [e]	86	22	39	72	102	31	125
Total of Mixed transuranic for Key Facilities	150	95	33	63	115	198	33	132
Non-Key Facilities	0	20	82	0	< 1	8 [h]	0	< 1
Total Mixed transuranic Waste for Key and non-Key Facilities	150	114	116	63	114	206	31	133
Percentage Total from Key Facilities	**100**	**83**	**29**	**100**	**99**	**96**	**100**	**99**
Environmental Restoration	0	0	0	< 1	0	0	0	0
Total of Mixed transuranic Waste for non-Key Facilities and Environmental Restoration	0	20	82	< 1	< 1	8	0	< 1
Total Mixed transuranic = Key + non-Key Facilities and Environmental Restoration	150	115	115	63	116	206	33	133
Percentage of Total from Key Facilities	**100**	**83**	**29**	**99**	**99**	**96**	**100**	**99**

ROD = Record of Decision.
[a] LANL 2003h.
[b] LANL 2004f.
[c] LANL 2005f.
[d] LANL 2006g.
[e] *1999 SWEIS* projections modified to reflect the ROD determination to produce nominally 20 pits per year (LANL 2003h).
[f] *1999 SWEIS* ROD projection exceeded due to remodeling activities (LANL 2003h).
[g] *1999 SWEIS* ROD projection exceeded due to Decontamination and Volume Reduction System repackaging of legacy transuranic waste (LANL 2004f).
[h] Waste generated by recovery operations at Area G involving new compactible fiberglass-reinforced crates. Because this waste was generated at a building not identified as part of the Solid Radioactive and Chemical Waste Key Facility, it is attributed to non-Key Facilities (LANL 2006g).
Note: To convert cubic yards to cubic meters, multiply by 0.76456.

The facility-specific chemical waste generation rates for the 7-year period are shown in **Table 4–49**. From 1999 through 2001, large quantities of chemical wastes were generated by environmental restoration activities through cleanups in TA-16, including MDA P, PRS 3-056(c) in TA-3, and MDA R (LANL 2003h). Wastes generated by environmental restoration activities generally are shipped offsite for treatment and disposal and do not directly impact LANL waste management resources. Numerous facility-specific variances to the *1999 SWEIS* ROD projections occurred, mostly due to one-time events as documented in Table 4–49.

Table 4–49 Chemical Waste Generated at Los Alamos National Laboratory by Facility (pounds per year)

Facility	*SWEIS ROD*	*1999* [a]	*2000* [a]	*2001* [a]	*2002* [a]	*2003* [b]	*2004* [c]	*2005* [d]
CMR Building	23,800	10,640	4,050	1,490	1,560	3,640	3,890	370
Sigma Complex	22,050	7,070	8,100	2,790	71,420 [e]	1,940	86,620 [f]	4,890
Machine Shops	1,045,000	8,720	1,960	58,370	4,460	340	910	850
MSL	1,320	340	1,940 [g]	560	330	430	450	390
High-Explosives Processing	28,700	29,400	2,277,300 [h]	827,300 [i]	33,300 [j]	53,400 [k]	16,100	9,100
High-Explosives Testing	77,800	2,240	133,240 [l]	2,950	2,830	2,330	30	2,700
Tritium Facilities	3,750	70	20	5,770 [m]	11,390 [n]	90	20	20
Pajarito Site	8,820	3,760	280	200	180	60	60	10
Target Fabrication Facility	8,380	1,310	2,340	1,470	1,990	2,890	1,840	17,030 [o]
Biological Sciences	28,660	3,730	5,230	3,000	9,930	6,330	1,540	3,380
Radiochemistry Laboratory	7,280	3,340	27,470 [p]	39,080 [q]	410,350 [r]	10,710 [s]	68,100 [t]	1,060
Radioactive Liquid Waste Treatment Facility	4,850	440	850	151,700 [u]	2,520	150	210	20
Los Alamos Neutron Science Center	36,600	24,400	2,660	8,940	4,410	15,240	214,520 [v]	1,980
Solid Radioactive and Chemical Waste Facilities	2,030	70	1,780	990	1,900	1,800	2,640 [w]	6,240 [x]
Plutonium Facilities	18,500	5,600	3,450	25,800 [y]	31,400 [z]	42,670 [aa]	17,200	2,840
Total Chemical Waste for Key Facilities	1,317,540	101,130	2,470,670	1,130,410	587,970	142,020	414,130	50,880
Non-Key Facilities	1,435,000	1,687,400 [bb]	810,800	2,766,100 [cc]	737,100	1,377,500	2,047,100 [dd]	1,374,190
Total Chemical Waste for Key and non-Key Facilities	2,752,540	1,788,530	3,281,470	3,896,510	1,325,070	1,519,520	2,461,230	1,425,070
Percentage of Total from Key Facilities	**48**	**6**	**75**	**29**	**44**	**9**	**17**	**4**
Environmental Restoration	4,409,200	32,252,800 [ee]	57,728,200 [ff]	63,526,800 [ff]	2,497,300	68,300	207,200	2,914,400
Total Chemical Waste for non-Key Facilities and Environmental Restoration	5,844,200	33,940,200	58,539,000	66,292,900	3,234,400	1,445,800	2,254,300	4,288,590
Total Waste = Key + non-Key Facilities and Environmental Restoration	7,161,740	34,041,330	61,009,670	67,423,310	3,822,370	1,587,820	2,668,430	4,339,470

Facility	SWEIS ROD	1999 [a]	2000 [a]	2001 [a]	2002 [a]	2003 [b]	2004 [c]	2005 [d]
Percentage of Total from Key Facilities	**18**	**< 1**	**4**	**2**	**15**	**9**	**16**	**1**

CMR = Chemistry and Metallurgy Research, MSL = Materials Science Laboratory, ROD = Record of Decision.

[a] LANL 2003h.

[b] LANL 2004f.

[c] LANL 2005f.

[d] LANL 2006g.

[e] Amount includes a significant quantity of waste generated by structure rehabilitation and equipment disposal associated with bringing the Press Building back on-line (LANL 2003h).

[f] *1999 SWEIS* ROD projection exceeded due to disposal of four years accumulation of graphite waste (nonhazardous but not accepted at solid waste or recycling facilities) and beryllium waste from the Beryllium Technology Facility (LANL 2005f).

[g] *1999 SWEIS* ROD projection exceeded due to remodeling of a C-Wing laboratory (LANL 2003h).

[h] Cleanup of MDA R generated 2,225,932 pounds of waste (LANL 2003h).

[i] Cleanup of MDA R generated 815,975 pounds of waste (LANL 2003h).

[j] *1999 SWEIS* ROD projection exceeded due to wastes disposed of through chemical cleanout initiative (LANL 2003h).

[k] *1999 SWEIS* ROD projection exceeded due to the demolition of Buildings TA-16-220, -222, -223, -224, -225, and -226 (LANL 2003h).

[l] *1999 SWEIS* ROD projection exceeded due to cleanup following the Cerro Grande Fire (LANL 2003h).

[m] Amount includes 5,181 pounds generated by refrigerant replacement at TA-16-450 (LANL 2003h).

[n] Amount includes 8,818 pounds generated by refrigerant replacement at TA-16-450 (LANL 2003h).

[o] *1999 SWEIS* ROD projection exceeded due to disposal of beryllium contaminated waste, including wastes from cleanout of a beryllium operations room and disposal of excess equipment originally from Rocky Flats (LANL 2006g).

[p] Amount includes 24,160 pounds of construction and demolition debris generated during cleanup following the Cerro Grande Fire (LANL 2003h).

[q] Amount includes 19,535 pounds of waste generated through chemical cleanout initiative (LANL 2003h).

[r] Amount includes 403,204 pounds of contaminated soil excavated during a construction project outside TA-48-1 (LANL 2003h).

[s] Amount includes waste generated through chemical cleanout initiative and the recycling of two mercury-containing shields weighing a total of 8,000 pounds (LANL 2004f).

[t] Amount includes waste generated through chemical cleanout initiative and disposal of mercury shielding as part of the facility radiological status downgrade effort (LANL 2005f).

[u] Amount includes 151,200 pounds of waste (soil and asphalt) generated as a result of replacement of storage tanks and plumbing (LANL 2003h).

[v] Amount includes four year accumulation of metals which could not be recycled due to the DOE moratorium on commercial recycling of metals from radiological areas. The moratorium metal was shipped to Oak Ridge for evaluation and disposition.

[w] *1999 SWEIS* ROD projection exceeded due to the Decontamination and Volume Reduction System repackaging of legacy transuranic waste (LANL 2005f).

[x] *1999 SWEIS* ROD projection exceeded due to generation of cutting fluids (nonhazardous mineral oil and water) during repacking of transuranic waste (LANL 2006g).

[y] Amount includes 23,001 pounds of contaminated soil and debris from the replacement of hydraulic cylinders at the front gate (LANL 2003h).

[z] Amount includes oil-contaminated soil generated when a transformer was dropped during relocation (LANL 2003h).

[aa] Amount includes 22,000 pounds of soil contaminated with diesel fuel, 1,887 pounds of waste solutions from experiments, and an additional 818 pounds of soil contaminated with diesel fuel (LANL 2004f).

[bb] *1999 SWEIS* ROD projection exceeded due to environmental restoration cleanups (LANL 2000f).

[cc] Amount includes 161,926 pounds of construction and demolition debris resulting from cleanup following the Cerro Grande Fire (LANL 2003h).

[dd] *1999 SWEIS* ROD projection exceeded due to heightened activities and new construction (LANL 2005f).

[ee] *1999 SWEIS* ROD projection exceeded due to soils excavated during remediation of MDA P (LANL 2003h).

[ff] Amount includes industrial and other chemical waste resulting from the cleanup following the Cerro Grande Fire (LANL 2003h).

Note: To convert pounds to kilograms, multiply by 0.45359.

Radioactive Liquid Waste Treated at LANL—Radioactive liquid waste treatment takes place at three facilities located at TA-21, TA-53, and TA-50. Treatment facilities are connected to source facilities by 22,000 feet (6,706 meters) of piping. The treatment facility at TA-50 handles the vast majority of radioactive liquid waste, receiving liquid waste from about 1,800 points across LANL. The Radioactive Liquid Waste Treatment Facility at TA-50 is over 40 years old, and many systems are at the end of their design life.

Radioactive liquid waste treatment rates and waste quantities for the 7-year period are shown in **Table 4–50**. The *1999 SWEIS* contained projections of volumes treated and resulting effluents and waste quantities, including the following categories: pretreatment liquids, effluent discharges, and low-level waste sludges. Of these categories, the most significant parameter is annual effluent discharge from the Radioactive Liquid Waste Treatment Facility. For the 7-year period of 1999 through 2005, all annual effluent quantities from the Radioactive Liquid Waste Treatment Facility were well within the *1999 SWEIS* projection. Source reduction efforts and process improvements were the two factors that contributed to reduced waste volumes (LANL 2005f, 2006g).

Projections made within the *1999 SWEIS* were exceeded for individual treatment activities in several instances, all related to quantities of sludge to be dewatered or solidified; the liquid waste treatment increases due to these activities are small compared to radioactive liquid treatment capacity. The overall radioactive liquid waste treatment rates at LANL were consistent with the *1999 SWEIS* projections for each year of the 7-year period.

4.9.4 Offsite Shipments of Radioactive and Chemical Wastes

Most of the radioactive and chemical wastes generated at LANL are shipped offsite for treatment and disposal. The quantities of wastes shipped offsite during 2002 through 2005 are presented in **Table 4–51**. Although low-level radioactive waste may be disposed of onsite at LANL, some is transported offsite for disposal. All mixed low-level radioactive waste is transported offsite for treatment and disposal. Transuranic and mixed transuranic wastes are characterized, certified, and placed in drums or other containers, which are then loaded into shipment containers for transport to the WIPP. Although there have been delays in meeting the planned schedule for transuranic waste shipments, process improvements have been made and recent gains in shipment numbers have been realized. In October 2006, the one-hundredth shipment of transuranic waste for the year was shipped, exceeding the number of annual shipments for any previous year (LANL 2006g). Additionally, the volume of waste shipped in 2006 (684 cubic yards [523 cubic meters]) was more than three times that of 2005 (LANL 2006a). In 2007, 823 cubic yards (629 cubic meters) of transuranic waste was sent to WIPP in 121 shipments. All chemical wastes are shipped offsite for treatment and disposal. For the subset of chemical wastes that are regulated under RCRA, onsite storage is limited to 1 year. The environment impacts associated with shipments of radioactive and chemical wastes are described in Section 4.10.

Table 4–50 Radioactive Liquid Waste Treated at Los Alamos National Laboratory

Facility	SWEIS ROD	1999 [a]	2000 [a]	2001 [a]	2002 [a]	2003 [b]	2004	2005 [c]
Pretreatment of radioactive liquid waste at TA-21	237,800 gallons per year	11,900 gallons	11,900 gallons	120,700 gallons	8,000 gallons	6,510 gallons	0	0
Percentage of SWEIS projection of pretreatment at TA-21	–	5	5	51	3	3	0	0
Pretreatment of radioactive liquid waste from TA-55	21,100 gallons per year	Less than 21,100 gallons	2,380 gallons	5,810 gallons	9,350 gallons	13,700 gallons	13,700 gallons	0
Percentage of SWEIS projection of pretreatment from TA-55	–	Less than 100	10	30	40	70	70	0
Solidification of transuranic (transuranic) sludge at TA-50	4 cubic yards per year	7 cubic yards	7 cubic yards	None	None	4 cubic yards	0	0
Percentage of SWEIS projection of solidification of transuranic sludge	–	170	170	0	0	100	0	0
Radioactive liquid waste treated at TA-50	9,246,000 gallons per year	5,283,400 gallons	5,019,300 gallons	3,698,400 gallons	3,038,000 gallons	3,566,300 gallons	2,166,200 gallons	1,796,400 gallons
Percentage of SWEIS projection of radioactive liquid waste treated at TA-50	–	57	54	40	33	39	23	19
De-water low-level radioactive waste sludge at TA-50	13 cubic yards per year	48 cubic yards	63 cubic yards	79 cubic yards	13 cubic yards	38 cubic yards	18 cubic yards	0
Percentage of SWEIS projection of low-level radioactive waste sludge de-watered at TA-50	–	370	480	600	100	290	137	0
Radioactive liquid waste treated at TA-53	Not projected	(d)	(d)	(d)	64,200 gallons	103,900 [e] gallons	88,800 [f] gallons	93,800 [f] gallons
Percentage of SWEIS projection of radioactive liquid waste treated at TA-53	NA	NA	NA	NA	NA	NA	NA	NA

ROD = Record of Decision, TA = technical area, NA = not available.
[a] LANL 2003h.
[b] LANL 2004f.
[c] LANL 2006g.
[d] Flows into the TA-53 surface impoundments started in 2000, but were first reported in the *2002 Yearbook* (LANL 2003h).
[e] LANL 2004c.
[f] LANL 2006a.
Note: To convert gallons to liters, multiply by 3.7853; cubic yards to cubic meters, multiply by 0.76456.

Table 4–51 Amount of Radioactive and Chemical Wastes Shipped Offsite

Type of Waste	Year			
	2002	2003	2004	2005
Low-Level Radioactive (cubic yards)	5	2,070	390	1,510
Mixed Low-Level Radioactive (cubic yards)	50	90	90	20
Transuranic (including mixed transuranic) (cubic yards) [a]	1	370	0	216
Chemical (pounds)	1,690,700	1,805,200	2,517,800	1,645,100

[a] Data is for fiscal year.
Note: To convert cubic yards to cubic meters, multiply by 0.76456; pounds to kilograms, multiply by 0.45359.
Sources: LANL 2006a, 2006j.

4.10 Transportation

The primary methods and routes used to transport LANL-affiliated employees, commercial shipments, hazardous and radioactive material shipments, transportation packaging, transportation accidents, and onsite and offsite traffic volumes are presented in this subsection.

4.10.1 Regional and Site Transportation Routes

Motor vehicles are the primary means of transportation to LANL. The nearest commercial bus terminal is in Santa Fe. The nearest commercial rail connection is at Lamy, New Mexico, 52 miles (83 kilometers) southeast of LANL. There is a spur into central Santa Fe used by the Santa Fe Southern Railway. However, LANL does not currently use rail for commercial shipments.

Park-and-ride services are provided by a commercial corporation, in conjunction with the New Mexico Department of Transportation. Over 80 daily departures between Santa Fe and Española, Santa Fe and Los Alamos, Española and Los Alamos, and Albuquerque and Santa Fe and Los Alamos are provided for commuters. Monthly passes are available for unlimited use of most park-and-ride services. **Table 4–52** shows the pick-up and drop-off locations that are included among those currently serviced by this public transportation service. Typical weekday riderships for the two park-and-ride routes serving Los Alamos are shown in **Table 4–53**.

The primary commercial international airport in New Mexico is located in Albuquerque. The small Los Alamos County Airport is owned by the Federal Government, and the operations and maintenance are performed by the County of Los Alamos. The airport is located parallel to East Road at the southern edge of the Los Alamos community. The airport has one runway running east-west at an elevation of 7,150 feet (2,180 meters). Takeoffs are predominantly from west to east, and all landings are from east to west. The airport is categorized as a private use facility; however, U.S. Federal Aviation Administration-licensed pilots and pilots of transient aircraft may be issued permits to use the airport facilities.

Table 4–52 Park and Ride Pickup and Drop-Off Locations

Santa Fe
CORDOVA/CERRILLOS – This is located on the Southeast corner of Cerrillos and Cordova in the State Highway Department General Office parking lot. The bus pulls up on the Northwest corner of the parking area in front of the building.
ALTA VISTA – This is located on Alta Vista, just east of Cerrillos on the north side. The parking area is marked with signs and is just west of the Railroad crossing on Alta Vista.
SHERIDAN/PALACE – This pick up and drop off point only (no vehicle parking) is on Sheridan, just south of Marcy. It is also the north transfer point for Santa Fe Trails.
PERA – PERA Building is on the Northeast corner of Paseo de Peralta and the Old Santa Fe Trail. The boarding area is near the middle of the parking lot on the West side of the building.
DISTRICT 5 – This parking lot is located on Jaguar Street, west of Cerrillos on the south side. It is a fenced lot on the New Mexico Department of Transportation property.
Española
ESPAÑOLA – This parking lot is located on Onate, about 0.25 miles west of Riverside (US84/285) on the south side.
Los Alamos
TA-3 – This parking area and shuttle pick up area for LANL is located just east of Diamond Drive on Jemez Road on the south side.
CENTRAL/20th – This parking and drop off area is in front of the Los Alamos Library, just west of 20th Street.

Note: To convert miles to kilometers, multiply by 1.6093.
Source: All Aboard America 2005.

Table 4–53 Park and Ride Use

Route	*Dates*	*Average Number of Riders - Daily*	*Percent of Capacity*
Blue Route: Santa Fe/Los Alamos	October 24-28, 2005	369	71
Green Route: Española/Los Alamos	October 24-28, 2005	165	66

Source: NMDOT 2005b.

Northern New Mexico is bisected by I–25 in a generally northeast-southwest direction. This interstate highway connects Santa Fe with Albuquerque. The regional highway system and major roads in the LANL vicinity are illustrated in **Figure 4–30**. Regional transportation routes connecting LANL with Albuquerque and Santa Fe are I–25 to US 84/285 to NM 502, with Española is NM 30 to NM 502, and with Jemez Springs and western communities is NM 4. Hazardous and radioactive material shipments leave or enter LANL from East Jemez Road to NM 4 to NM 502. East Jemez Road, as designated by the State of New Mexico and governed by 49 CFR 177.825, is the primary route for the transportation of hazardous and radioactive materials. The average daily traffic flow at LANL's main access points are presented in **Table 4–54**.

Table 4–54 Los Alamos National Laboratory Main Access Points

Location	*Average Daily Vehicle Trips*
Diamond Drive across the Los Alamos Canyon Bridge	24,545
Pajarito Road at NM 4	4,984
East Jemez Road at NM 4	9,502
West Jemez Road at NM 4	2,010
DP Road at Trinity Drive	1,255
Total	42,296

Source: KSL 2004, LAC 2005.

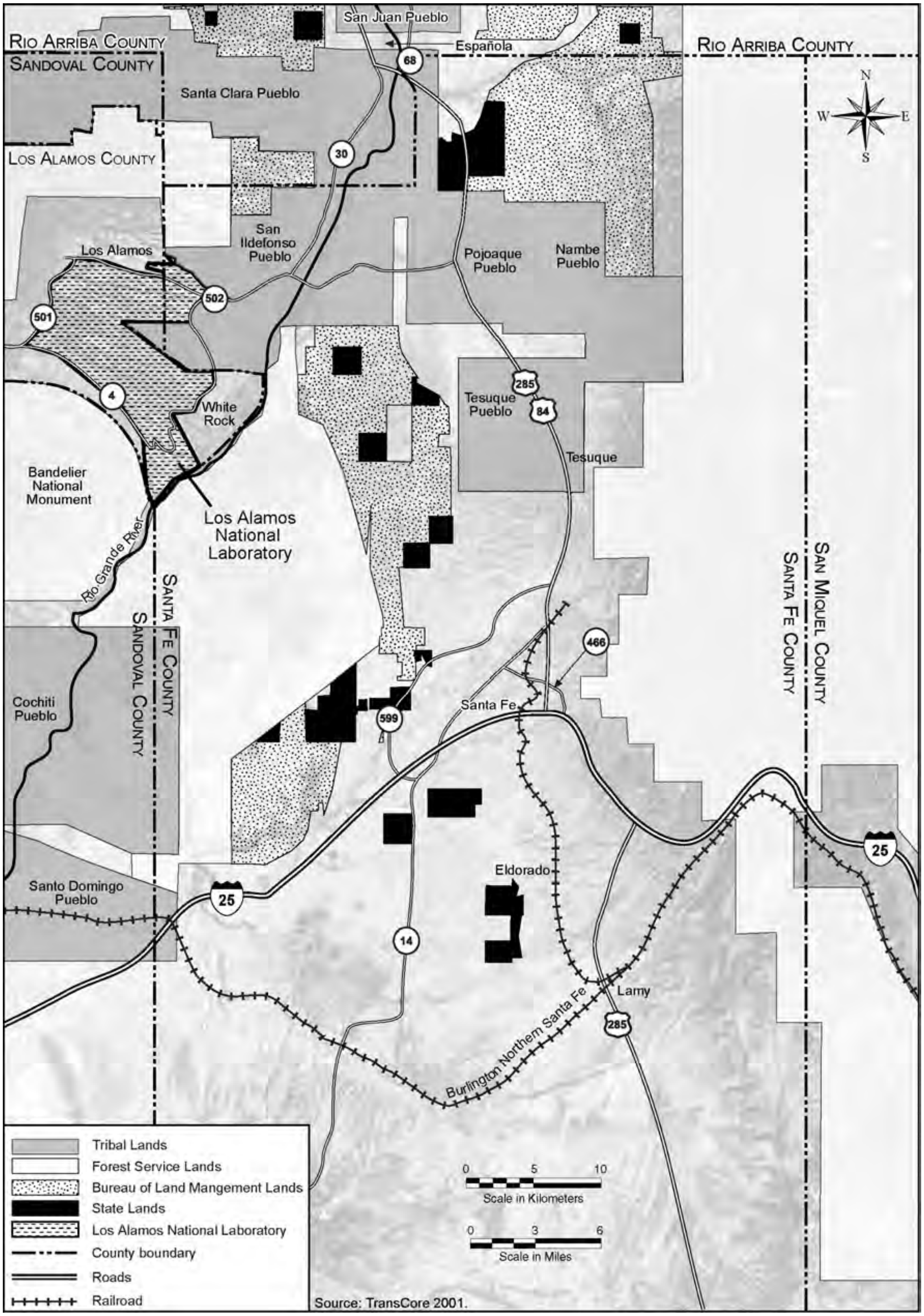


Figure 4–30 Los Alamos National Laboratory Vicinity Regional Highway System and Major Roads

Only two major roads, NM 502 and NM 4, access Los Alamos County. Los Alamos County traffic volume on these two segments of highway is primarily associated with LANL activities. Most commuter traffic originates from Los Alamos County or east of Los Alamos County (Rio Grande Valley and Santa Fe) as a result of the large number of LANL employees that live in these areas (see Section 4.8.1). A small number of LANL employees commute to LANL from the west along NM 4. The average weekday traffic volume at various points in the vicinity of NM 502 and NM 4 measured in September 2004 are presented in **Table 4–55**.

Table 4–55 Average Weekday Traffic Volume in the Vicinity of NM 502 and NM 4

Location	*Average Daily Vehicle Trips*
Eastbound on NM 502 east of the intersection with NM 4	10,100
Westbound on NM 502 east of the intersection with NM 4	7,765
Eastbound on NM 502 west of the intersection of NM 502 and NM 4	6,540
Westbound on NM 502 west of the intersection of NM 502 and NM 4	4,045
Westbound on NM 4 between East Jemez Road and the NM 502/4 intersection	6,505
Eastbound on NM 4 between East Jemez Road and the NM 502/4 intersection	6,665
Transition road from northbound NM 4 to eastbound NM 502	5,170
Transition road from eastbound NM 502 to southbound NM 4	1,610

Source: LSC 2004.

The primary route designated by the State of New Mexico to be used for radioactive and other hazardous material shipments to and from LANL is the approximately 40-mile (64-kilometer) corridor between LANL and Interstate–25 at Santa Fe. This route passes through the Pueblos of San Ildefonso, Pojoaque, Nambe, and Tesuque and is adjacent to the northern segment of Bandelier National Monument. This primary transportation route bypasses the city of Santa Fe on NM 599 to Interstate–25.

4.10.2 Transportation Accidents

Motor vehicle accidents in Los Alamos County and nearby counties are reported in **Table 4–56**. In 2004, there were over 5,700 motor vehicle accidents in Los Alamos, Rio Arriba, and Santa Fe Counties resulting in 58 fatalities. When accidents are considered per 100 million vehicle miles traveled, travel in Santa Fe County was the most dangerous in the region of influence during 2004, although Rio Arriba County had the highest fatality rate. Since the *1999 SWEIS* was issued, there have been two fatal traffic accidents on the site. On November 1, 1999, there was one fatality as a result of two private vehicles colliding at the intersection of Eniwetok Drive and Diamond Drive, and on October 2, 2001, a motorcyclist was killed after colliding with a private vehicle at the intersection of Sigma Road and Diamond Drive (LANL 2006a).

Table 4–56 New Mexico Traffic Accidents in Los Alamos and Nearby Counties, 2004

County	Total Accidents	Crash Rate [a]	Fatalities	Death Rate [b]
Los Alamos	274	246	0	0
Rio Arriba	698	144	32	6.61
Santa Fe	4,744	267	26	1.46
New Mexico	52,288	223	522	2.23

[a] Crash rate measures crashes per 100 million vehicle miles traveled.
[b] Death rate measures deaths per 100 million vehicle miles traveled.
Source: NMDOT 2006.

Table 4–57 shows the accident history for Los Alamos County from 1999 through 2004. As shown in the table, the county's crash rate and death rate were lower than the state average during this period.

Table 4–57 Los Alamos County Traffic Accidents, 1999 - 2004

Year	Total Accidents	Crash Rate [a]	Fatalities	Death Rate [b]
1999	252	119	1	0.47
2000	252	123	0	0
2001	270	132	3	1.46
2002	307	310	0	0
2003	259	221	1	0.85
2004	274	246	0	0
County Average 99-04	269	192	0.8	0.46
State Average 99-04	48,359	210	462	2.0

[a] Crash rate measures crashes per 100 million vehicle miles traveled.
[b] Death rate measures deaths per 100 million vehicle miles traveled.
Sources: NMDOT 2001, 2002, 2003, 2004, 2005a, 2006.

4.10.3 Los Alamos National Laboratory Shipments

Hazardous, radioactive, industrial, commercial, and recyclable materials, including wastes, are transported to, from, and on the LANL site during routine operations. Hazardous materials include commercial chemical products that are nonradioactive and are regulated and controlled based on whether they are listed materials, or if they exhibit the hazardous characteristics of ignitability, toxicity, corrosivity, or reactivity. Radioactive materials include special nuclear material (plutonium, enriched uranium), medical radioisotopes, and other miscellaneous radioactive materials. Offsite shipments, both to and from LANL, are carried by commercial carriers (including truck, air-freight, and government trucks), and by DOE safe secure transport trailers. Numerous regulations and requirements govern the transportation of hazardous and radioactive materials, including those of the U.S. Department of Transportation, U.S. Nuclear Regulatory Commission, DOE, U.S. Federal Aviation Administration, International Air Traffic Association, and LANL.

4.10.3.1 Onsite Shipments

Onsite hazardous and radioactive material shipments are transported in conformance with U.S. Department of Transportation regulations. A shipment is considered an onsite shipment if both the origin and destination are at LANL. These shipments are transported in LANL-operated vehicles. These vehicles vary depending on the quantity and radioactivity of the material shipped, from LANL-owned pick-up trucks to DOE-owned safe secure trailers. Maintenance of these vehicles is closely monitored for physical performance as well as security.

Hazardous material shipments vary from bulk gases and liquids to small quantities of laboratory chemicals. Hazardous waste shipments are made to the hazardous waste storage facility at TA-50 and radioactive and hazardous waste shipments are made to the waste management area at TA-54.

Onsite radioactive material shipments are transported in conformance with U.S. Nuclear Regulatory Commission regulations or DOE requirements. A primary feature of these regulations is stringent packaging requirements governing shipments on public roads. In a few cases, it is not cost effective for DOE to meet these stringent packaging requirements. In such cases, roads are temporarily closed during the shipments; DOE safety requirements still apply in these cases.

Onsite transport constitutes the majority of activities that are part of routine operations in support of various programs. The radioactive materials transported onsite between TAs are mainly of limited quantities, short travel distances, and mostly on closed roads. The impacts of these activities are part of the normal operations at these areas. For example, worker dose from handling and transporting the radioactive materials are included as part of operational activities. Specific analyses performed in the *1999 SWEIS* indicated that the projected collective radiation dose for LANL drivers from a projected 10,750 onsite shipments to be 10.3 person-rem per year, or on average, less than 1 millirem per transport. Review of recent onsite radioactive materials transportation indicates a much smaller number of shipments than those projected in the *1999 SWEIS*.

4.10.3.2 Offsite Shipments

Offsite transports of radioactive materials would occur using both trucks and airfreight. The radioactive materials transported would include tritium, plutonium, uranium (both depleted and enriched), offsite source recovery, medical isotopes, small quantities of activation products, low-level radioactive waste, and transuranic waste. At LANL, DOE transports and receives radioactive and other hazardous materials and waste shipments to and from other DOE facilities and commercial facilities nationwide. As discussed above, shipments meet applicable U.S. Department of Transportation, U.S. Nuclear Regulatory Commission, U.S. Federal Aviation Administration, regulations or DOE requirements. Most unclassified shipments are transported via commercial carriers.

From 2002 through 2005, there was an average of 273 offsite waste shipments per year. These consisted, on average, of 199 shipments of hazardous materials and 74 shipments of radioactive materials as shown in **Table 4–58**. Significant year-to-year changes in the volume of waste generated are discussed in Section 4.9.2 and provide the basis for the fluctuations shown in Table 4–58.

Table 4–58 Offsite Waste Shipments 2002 - 2005

Waste Type	*2002*	*2003*	*2004*	*2005*	*Total*
Hazardous	154	157	262	225	798
Low-Level Radioactive	3	68	12	50	133
Mixed Low-Level Radioactive	17	19	19	16	71
Transuranic	1	46	0	44	91
Total	175	290	293	335	1,093

Source: LANL 2006a.

DOE regulations require that safe secure trailers be used for offsite shipments of special nuclear material, weapons components, and explosive-like assemblies in DOE custody. Safe secure trailers are similar in appearance to commercial tractor-trailers but are equipped with unique security and safeguard features that prevent unauthorized cargo removal and minimize the likelihood of an accidental radioactive materials release as a result of a vehicle accident. Classified shipments are made in safe secure trailers.

The primary regulatory approach to promote safety from radiological exposure is the specification of standards for the packaging of radioactive materials. Packaging represents the primary barrier between the radioactive material being transported and radiation exposure to the public, workers, and the environment. Transportation packaging for radioactive materials must be designed, constructed, and maintained to contain and shield its contents during normal transport conditions. For highly radioactive material such as high-level radioactive waste or spent nuclear fuel, packagings must contain and shield its contents in the event of severe accident conditions. The type of packaging used is determined by the total radioactive hazard presented by the material within the packaging. Four basic types of packaging are used: Excepted, Industrial, Type A, and Type B. See Appendix K for additional information on the shipment of radioactive materials to and from LANL.

4.11 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing potential disproportionately high and adverse human health and environmental impacts on minority or low-income populations. Minority persons are those who identify themselves as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or multi-racial (with at least one race designated as a minority race under Council on Environmental Quality Guidelines [CEQ 1997]). Persons whose income is below the Federal poverty threshold are designated as low income.

Disproportionately High and Adverse Human Health Effects

Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal adverse impacts on human health. Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as defined by NEPA) and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group (CEQ 1997).

Disproportionately High and Adverse Environmental Effects

A disproportionately high environmental impact that is significant (as defined by NEPA) refers to an impact or risk of an impact on the natural or physical environment in a low-income or minority community that appreciably exceeds the environmental impact on the larger community. Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as defined by NEPA). In assessing cultural and aesthetic environmental impacts, impacts that uniquely affect geographically dislocated or dispersed minority or low-income populations or American Indian Tribes are considered (CEQ 1997).

4.11.1 Region of Analysis

The region of analysis for environmental justice corresponds to the region of analysis for the resource area being considered. The source of offsite impacts addressed in the SWEIS is radiological air emissions. The study area considered in the *1999 SWEIS* environmental justice analysis was the area within a 50-mile (80-kilometer) radius of LANL. **Figure 4–31** shows areas potentially at radiological risk from the current missions performed at LANL. These areas include the city of Santa Fe and Indian Reservations in North Central New Mexico. Eight counties are included or partially included in the potentially affected area (see **Figure 4–32**): Bernalillo, Los Alamos, Mora, Rio Arriba, Sandoval, San Miguel, Santa Fe, and Taos.

The center of the area was the emissions stack at LANSCE in TA-53. The LANSCE stack was chosen because it was the primary source of LANL airborne radionuclide emissions and therefore has the greatest potential for affecting offsite populations. Today, LANSCE is still the largest contributor to radioactive air emissions (LANL 2005h). Sampling data collected from vegetation, animals, fish, water and soils onsite or near LANL were used to estimate doses from ingestion by individuals existing on a subsistence diet. On this basis, the same study area is used for this environmental justice analysis of human health impacts. The use of a 50-mile (80-kilometer) radius is patterned after the methodology used by the U.S. Nuclear Regulatory Commission for assessing potential risks to populations from nuclear power plants and is intended to encompass the potential impacts from LANL operations (DOE 1999a). The location of minority and low-income populations within the 50-mile (80-kilometer) radius circle remained unchanged since the publication of the *1999 SWEIS*. However, the number of persons in these communities rose slightly over the past 5 years.

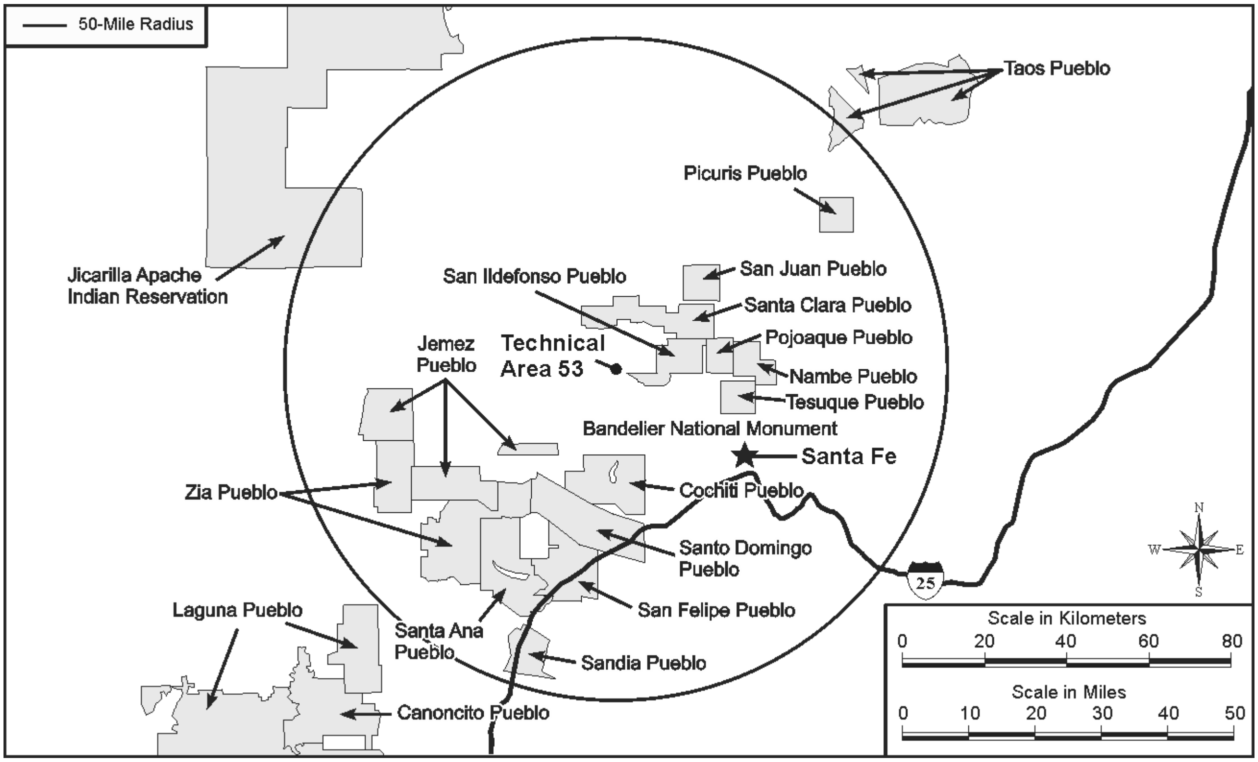


Figure 4–31 Location of Technical Area 53 and Indian Reservations Surrounding Los Alamos National Laboratory

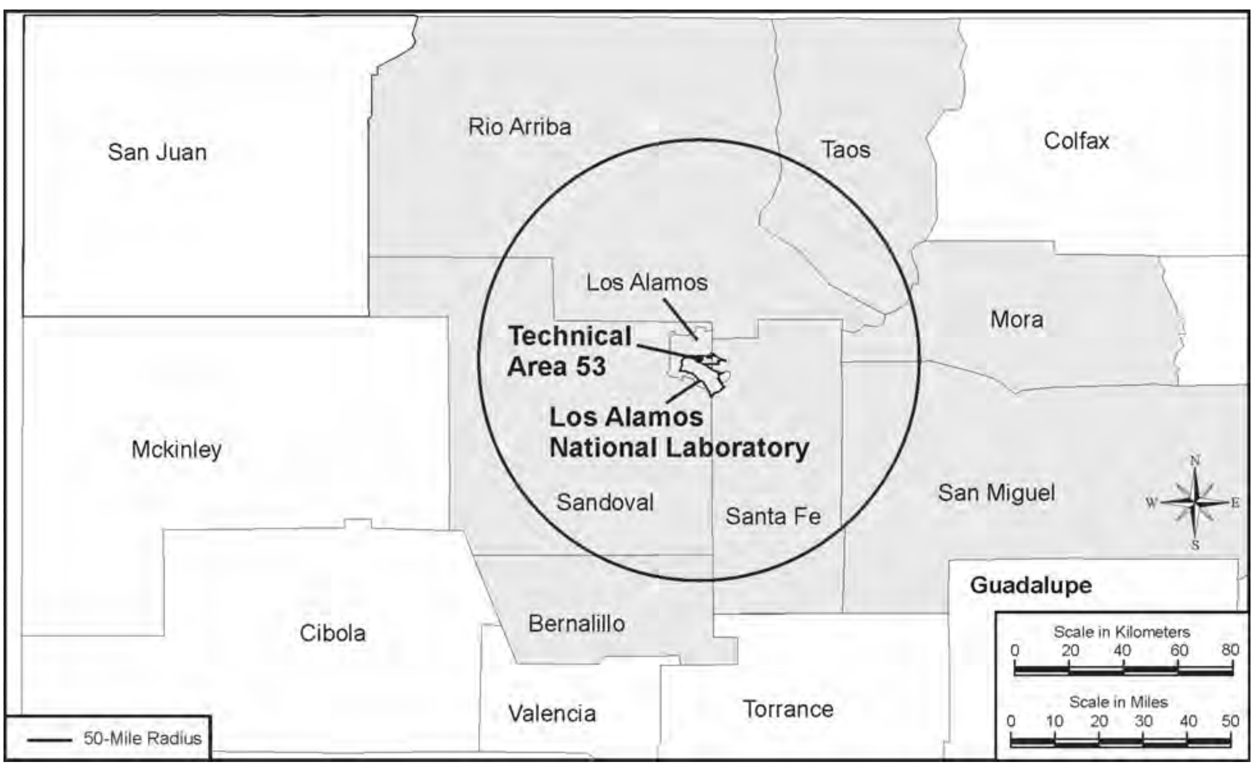


Figure 4–32 Potentially Affected Counties Surrounding Los Alamos National Laboratory

4.11.2 Changes Since the *1999 SWEIS*

To determine the extent of changes in minority and low-income populations in potentially affected counties surrounding LANL since the publication of the *1999 SWEIS*, comparisons were made between population estimates based on 1990 and 2000 census data. However, caution must be used when interpreting these changes, because of changes in the definitions of race and ethnicity used in the 2000 census. As a result, 2000 census data on race are not directly comparable with data from the 1990 or earlier censuses. Nevertheless, census data demonstrate that the minority population in these potentially affected counties grew by 33 percent between 1990 and 2000.

Table 4–59 provides the racial and Hispanic composition for these counties using data obtained from the census conducted in 2000. In the year 2000, a majority (54 percent) of these county residents designated themselves as members of a minority population. Hispanics and American Indians or Alaska Natives comprised approximately 91 percent of the minority population. As a percentage of the total resident population in 2000, New Mexico had the largest percentage minority population (55 percent) among the contiguous states and the second largest percentage minority population among all states (only Hawaii had a larger percentage minority population [77 percent]).

Table 4–59 Populations in Potentially Affected Counties Surrounding Los Alamos National Laboratory in 2000

Population Group	*Population*	*Percentage of Total*
Minority	490,172	54.4
Hispanic	400,725	44.5
Black or African American	15,945	1.8
American Indian or Alaska Native	44,468	4.9
Asian	12,188	1.4
Native Hawaiian or Pacific Islander	527	0.1
Two or more races	14,859	1.6
Some other race	1,460	0.2
White	410,524	45.6
Total	900,696	100.0

Source: DOC 2006b.

The percentage of low-income population for whom poverty status was determined was approximately 13 percent of those residing in potentially affected counties in 2000. In 2000, nearly 18 percent of the total population of New Mexico reported incomes less than the poverty threshold.

In terms of percentages, minority populations and low-income resident populations in potentially impacted counties were lower than the State percentage in 2000. Despite slight increases in the percentage of minority and low-income populations in the potentially affected counties, impacts to these populations over the past 5 years have not been disproportionately high or adverse, due to the overall low level of potential impacts. The effects of new construction projects since the publication of the *1999 SWEIS* were either minor, confined to the site, or within the historical operational effects of LANL.

Since 1990, the minority population in potentially affected counties surrounding LANL grew by about 33 percent (from 49.3 percent in 1990 to 54.4 percent in 2000) of the total population in the potentially affected counties (see **Table 4–60**). The area's largest minority group, the Hispanic population, grew by 30 percent, followed by American Indians (26 percent) and Asians (52 percent). The African-American population remained relatively unchanged.

Table 4–60 Populations in Potentially Affected Counties Surrounding Los Alamos National Laboratory in 1990

Population Group	*Population*	*Percentage of Total*
Minority	368,785	49.3
Hispanic	309,520	41.4
Black	15,595	1.8
American Indian, Eskimo, or Aleut	35,319	4.7
Asian or Pacific Islander	8,038	1.1
Some other race	2,313	0.3
White	379,644	50.7
Total	748,429	100.0

Source: DOC 2007.

In 1989, 21 percent of the population of New Mexico lived below the poverty threshold (DOE 1999a). In 1999, 18 percent of the population of New Mexico lived below the poverty threshold (see Section 4.11.4).

4.11.3 Minority Population in 2000

According to 2000 census data, approximately 153,518 minority individuals resided within the 50-mile (80-kilometer) radius of LANL. This represented 55 percent of the total population within the 50-mile (80-kilometer) radius. The largest minority group in the study area was the Hispanic population (127,671 or about 46 percent), followed by American Indians (17,371 or about 6 percent). Minorities are about 18 percent of Los Alamos County's population, with Hispanics being the largest minority group (12 percent). Hispanics reside throughout the 50-mile (80-kilometer) radius area, but most are located in the Española Valley and in the Santa Fe metropolitan area.

Census block groups with minority populations exceeding 50 percent were considered minority block groups. Based on 2000 census data, **Figure 4–33** shows minority block groups within the study area where more than 50 percent of the block group population is minority.

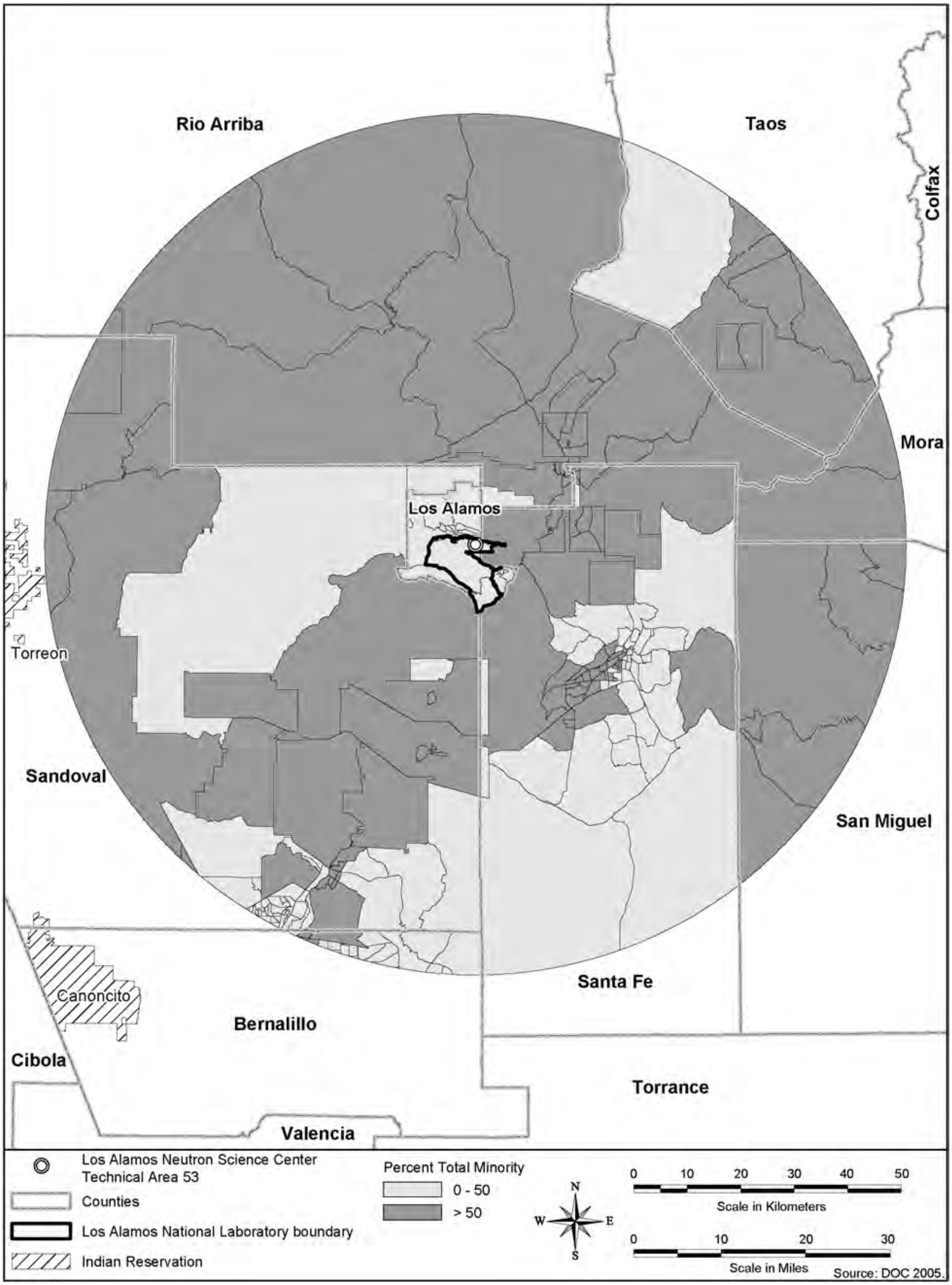


Figure 4–33 Minority Population – Block Groups with More Than 50 Percent Minority Population within a 50-Mile (80-kilometer) Radius of Los Alamos National Laboratory

4.11.4 Low-Income Population in 2000

According to 2000 census data, approximately 44,278 individuals residing within the 50-mile (80-kilometer) radius of LANL were identified as living below the Federal poverty threshold, which represent approximately 16 percent of the study area population. The median household income for New Mexico in 1999 was $34,133, while 18 percent of the population was determined to be living below the Federal poverty threshold ($17,029 for a family of four).

Los Alamos County had the highest median income ($78,993) within the State, and the lowest percentage (2.9 percent) of individuals living below the poverty level when compared to other counties in the area.

Census block groups were considered low-income block groups if the percentage of the populations living below the Federal poverty threshold exceeded 18 percent. Based on 2000 Census data, **Figure 4–34** shows low-income block groups within the study area where more than 18 percent of the block group population is living below the Federal poverty threshold.

4.12 Environmental Restoration

Environmental restoration activities are designed to reduce the risks associated with the legacy of past operations that resulted in releases of contaminants. As the LANL environmental restoration effort completes site investigations and cleanups, this progress translates to a reduction in the risk posed by past releases, and, in some cases, provides additional land use options in and around LANL. The *1999 SWEIS* evaluated environmental restoration impacts in the ecological and human health risk assessments and in analyses related to the transport, treatment, storage, and disposal of waste.

The LANL environmental restoration staff originally identified over 2,100 potential release sites, at and around LANL, including 1,099 regulated by the NMED under RCRA and 1,025 regulated by DOE. However, as a result of investigations, remediations, no further action determinations, and consolidation of geographically proximate sites, a total of 829 potential release sites remained within the environmental restoration program at the end of 2005 (LANL 2006g).

Each site remediation reduces potential impacts to ecological and human health. The environmental restoration project has made significant progress in the last 6 years. A multi-year cleanup at MDA P was completed in 2002, resulting in the excavation of more the 52,500 cubic yards (40,100 cubic meters) of soil and debris. Over this same timeframe, three wastewater surface impoundments at TA-53 were remediated (LANL 2003h). The project has also completed a number of source removals through voluntary corrective actions and has continued site investigations (LANL 2003h, 2004f). In 2005, the LANL environmental restoration staff completed nine characterization and remediation reports, performed soil and sediment sampling at a number of locations, and planned and performed accelerated remediation work in support of infrastructure improvements (LANL 2006g). In 2005, numerous characterization and remediation plans and reports were submitted to NMED in accordance with the Consent Order. In addition, accelerated remediation activities were implemented at sites that potentially could be affected by upcoming infrastructure and construction projects. NMED issued certificates of completion (replacing former no further action determinations) for eight sites (LANL 2006g).

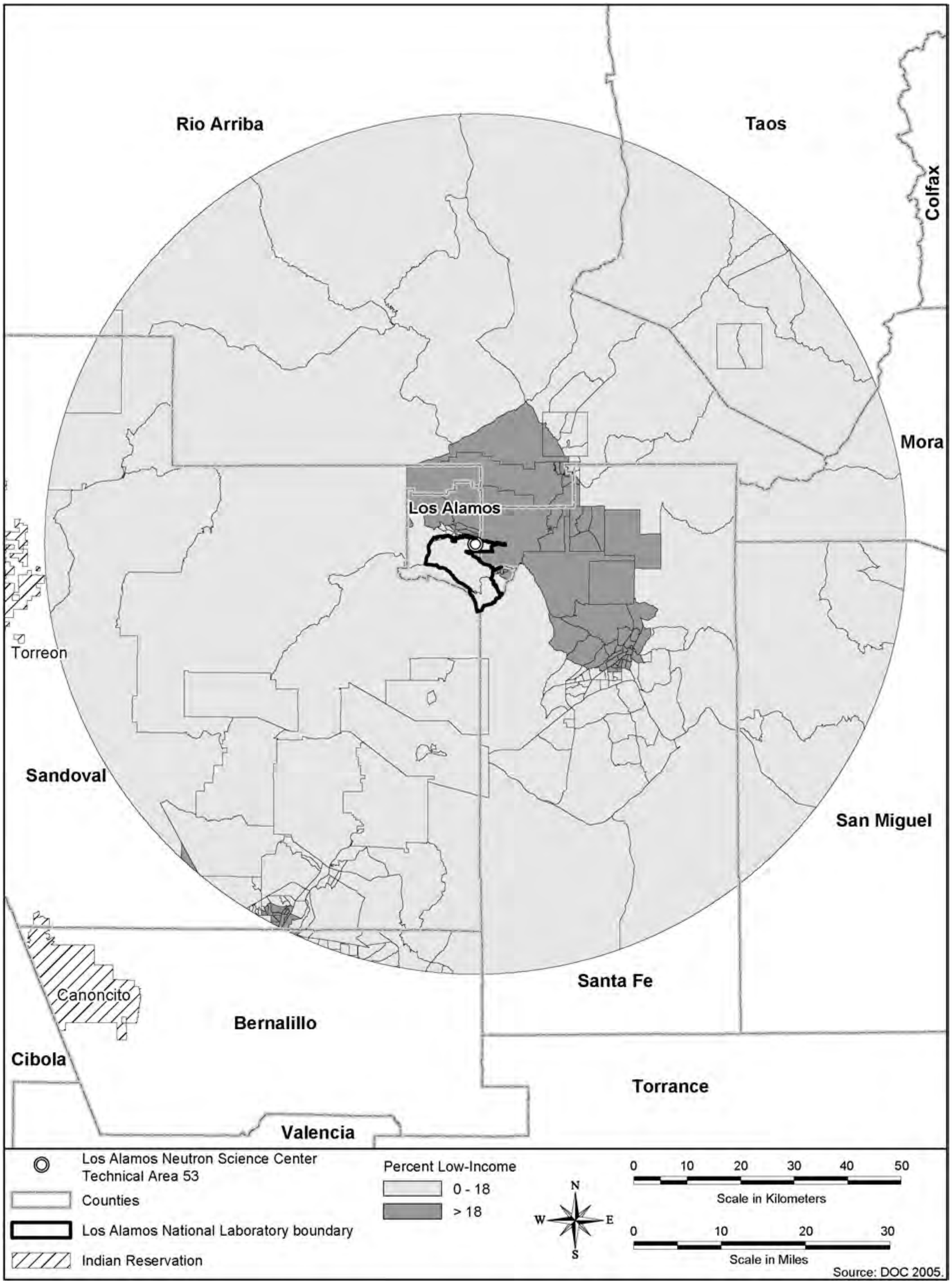


Figure 4–34 Low-Income Population – Block Groups with More Than 18 Percent of the Population Living Below the Federal Poverty Threshold within a 50-mile (80-kilometer) Radius of Los Alamos National Laboratory

Major unplanned environmental restoration activities were undertaken by LANL in response to the Cerro Grande Fire. Due to the threat of erosion and enhanced contaminant transport, the following activities were performed: evaluation and stabilization of sites touched by the fire; baseline sampling to characterize conditions in fire-impacted watersheds; and evaluation, stabilization or removal of sites subject to flooding. Accelerated cleanups in response to the fire were conducted at MDA R and in Los Alamos Canyon (LANL 2003h)

The large-scale cleanups have generated significant quantities of mostly chemical wastes, as discussed in Section 4.9. Because waste types and quantities at environmental restoration sites are difficult to estimate in advance, the generation of chemical waste exceeded *1999 SWEIS* ROD projections for several years out of the previous six. For many site cleanups, wastes are transported directly offsite from the point of generation, minimizing impacts on LANL waste management infrastructure.

Other environmental restoration-related impacts addressed qualitatively in the *1999 SWEIS* include fugitive dust, surface runoff, soil and sediment erosion, and worker health and safety risks (DOE 1999a). The controls presented in the *1999 SWEIS* to mitigate these impacts continue to be implemented, and in many cases, have been enhanced in response to the Cerro Grande Fire.

The successful site cleanups have produced beneficial environmental impacts, including risk reductions and land transfers. Actions taken in response to the Cerro Grande Fire prevented additional impacts that could have resulted from increased erosion and enhanced mobility of contaminants. With the exception of the chemical waste generation rates discussed in Section 4.9, environmental restoration activities have operated within the envelope evaluated in the *1999 SWEIS*.

Requirement for correction actions performed at LANL in accordance with RCRA and its Hazardous and Solid Waste Amendments (HSWA) has been transferred from the LANL's RCRA Permit to a Compliance Order on Consent (Consent Order), signed on March 1, 2005 (NMED 2005). The Consent Order is a comprehensive agreement that documents the investigation and remediation steps necessary to complete RCRA- and HSWA-driven environmental restoration activities at LANL by the year 2015. However, the Consent Order does not cover more than 500 sites that received no further action decisions from the EPA when it had primary authority, preventing duplication of completed work. The Consent Order also does not address releases of radionuclides, which are under the regulatory authority of DOE. Nonetheless, 125 non-HSWA module sites previously approved by DOE for no further action will be re-evaluated by NMED under the terms of the Consent Order. Notwithstanding the Order, LANL's environmental restoration activities and associated impacts have remained within the scope of the *1999 SWEIS* and the ROD projections.

CHAPTER 5
ENVIRONMENTAL CONSEQUENCES

5.0 ENVIRONMENTAL CONSEQUENCES

The following sections evaluate the environmental consequences of proposed Los Alamos National Laboratory (LANL) construction and operations on the surrounding region. The impact on each resource area is evaluated for the three proposed alternatives: the No Action Alternative, Reduced Operations Alternative, and Expanded Operations Alternative. In addition, the analysis looks at the cumulative impacts of these alternatives when combined with other past, present, and future actions that could affect the region. As applicable, possible mitigation measures are discussed with regard to implementing one of the proposed alternatives.

As described in earlier chapters, changes have occurred or are expected to take place at LANL that were not anticipated at the time the 1999 *Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (*1999 SWEIS)* was issued together with the Record of Decision (ROD). Such changes include alteration of the physical environment, as well as changes to LANL's operations and capabilities. The Cerro Grande Fire of 2000 resulted in changes to the physical environment in the form of burned habitat, damaged or destroyed structures, and potential for significant runoff and erosion. Another change to the physical environment is the past and planned conveyance of certain lands to Los Alamos County and the transfer of land to the U.S. Department of the Interior (to be held in trust for the San Ildefonso Pueblo) that, in effect, alters the site boundaries and removes from National Nuclear Security Administration (NNSA) stewardship the ecological and cultural resources included in those lands.

Included in the analysis supporting this new Site-Wide Environmental Impact Statement (SWEIS) are the impacts associated with manufacturing plutonium pits at LANL. Under the No Action and Reduced Operations Alternatives, the analysis includes the impacts associated with manufacturing up to 20 pits per year in existing facilities in the Plutonium Facility Complex (Technical Area [TA-] 55). The Expanded Operations Alternative includes the impacts associated with manufacturing up to 80 pits per year in TA-55. Manufacturing pits in TA-55 at any of the levels discussed above is not expected to have a distinguishable effect on a number of resource areas evaluated in this SWEIS. The different levels of pit manufacturing activities in TA-55 would likely cause only minor differences in impacts on land use, visual resources, water resources, geology and soils, air quality, noise, ecological resources, public health, cultural resources, and infrastructure. Depending on the alternative chosen, larger impacts to worker health, socioeconomics, waste management, and transportation would be expected.

The analysis also includes the impacts associated with the remediation of material disposal areas (MDAs) and other potential release sites (PRSs). For several years, the LANL management and operating contractor has conducted an environmental restoration program to identify locations where hazardous constituents may have been released into the environment and to carry out corrective measures in compliance with the Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act (RCRA). Since 1990, investigations and corrective actions have been carried out in accordance with the LANL Hazardous Waste Facility permit. The Compliance Order on Consent (Consent Order) entered into by the U.S. Department of

Energy (DOE), the University of California as the management and operating contractor, and the State of New Mexico requires a more specific program of studies and corrective measures and that cleanup be completed by 2015. The impacts of implementing the investigations and remediations under the Consent Order are presented as part of the Expanded Operations Alternative. Two scenarios for environmental restoration have been evaluated to bound the range of possible consequences of implementing corrective measures required by the Consent Order. A Capping Option, a Removal Option, and a No Action Option are assumed and evaluated in Appendix I of this SWEIS. The No Action Option is the base case in which remedial investigations and activities would continue at a level comparable to that of recent years, and this option is part of the No Action and Reduced Operations Alternatives[1]. The Capping Option reflects the assumption that the waste and contamination within the MDAs would be left in place and stabilized by installation of evapotranspiration caps as a mitigation measure. The Removal Option reflects the assumption that the waste and contamination within the MDAs would be removed. For both the Capping and Removal Options, several additional PRSs would be remediated annually. These options are intended to bound the range of possible corrective measures and are included in the Expanded Operations Alternative.

As changes in the operations and capabilities active at LANL could change the releases to the environment and the impacts of potential accidents, they are factored into the analyses presented below. In addition to changes in LANL operations and the environment, new projects or ongoing projects to maintain existing LANL capabilities are also evaluated for environmental impacts. The impacts of these individual projects are detailed in Appendices G through J and are discussed in this chapter as appropriate. These projects are generally included as part of the Expanded Operations Alternative.

5.1 Land Resources Impacts

This section addresses the impacts of the No Action, Reduced Operations, and Expanded Operations Alternatives on Land Use and Visual Resources. **Table 5–1** summarizes the expected land use impacts for each of the three alternatives.

5.1.1 Land Use

Land use is defined as, "The way land is developed and used in terms of the kinds of anthropogenic activities that occur (for example, agriculture, residential areas, industrial areas)" (EPA 2003). A comparative methodology was used to determine impacts to land use at LANL. Construction, building modification, operations, and demolition activities associated with each alternative were examined, as appropriate, and compared to existing land use conditions and future land use projections. Impacts were identified as they relate to changes in land use categories, ownership, and alternative or conflicting uses.

---

[1] NNSA intends to implement actions necessary to comply with the Consent Order regardless of decisions it makes on other actions analyzed in this SWEIS.

Table 5–1 Summary of Environmental Consequences of Land Use Changes

	No Action Alternative	***Reduced Operations Alternative***	***Expanded Operations Alternative***
LANL Site			
	Land Conveyance and Transfer – 1,820 acres (737 hectares) remain to be conveyed or transferred. – Development could occur on up to 826 acres (334 hectares). – Potential introduction of incompatible land uses. – Loss of recreational opportunities. *Electrical Power System Upgrades* – 473 acres (191 hectares) affected by upgrades. – Project generally compatible with existing land use, but some constraint on high explosives testing and future experimental use within part of LANL. *Wildfire Hazard Reduction Program* – No impact *Disposition of Flood Retention Structures* – No impact	Same as No Action Alternative	Same as No Action Alternative plus: *MDA Remediation Project* – Fewer restrictions on land use for the Removal Option than for the Capping Option. – No major changes in land use designations in most cases because surrounding land uses would remain in their current classification; however, some land use changes possible. *Security-Driven Transportation Modifications Project* – Most development would not conflict with current land use designations. – Auxiliary Action A – Within scope of current land use plans. – Auxiliary Action B – Partially within scope of current land use plans; however, plans have no provision for a bridge over Sandia Canyon.
Affected Technical Areas			
TA-3	No change in land use	Same as No Action Alternative	*Replacement Office Buildings Project* – 13 acres (5.3 hectares) of undisturbed land would be developed. – Development would be consistent with a change in future land use from Reserve to Physical/Technical Support.
TA-21	No change in land use	Same as No Action Alternative	*TA-21 Structure DD&D Project* – Future LANL development could negate the proposed change in land use from the current designation to Reserve.
TA-72	No change in land use	Same as No Action Alternative	*Remote Warehouse and Truck Inspection Station* – Construction would affect 4 acres (1.6 hectares) of undisturbed land. – Land use designation would change from Reserve to Physical/Technical Support.

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
Key Facilities			
Pajarito Site (TA-18)	No change in land use	Same as No Action Alternative	*TA-18 DD&D* Land use could change from Nuclear Material Research and Development to Reserve.
Radiochemistry Facility (TA-48)	No change in land use	Same as No Action Alternative	*Radiological Sciences Institute* – 12.6 acres (5.1 hectares) of undeveloped land to be developed. – Land use change is consistent with future land use designations.
Radioactive Liquid Waste Treatment Facility (TA-50)	No change in land use	Same as No Action Alternative	*Radioactive Liquid Waste Treatment Facility Upgrade* – Construction of new liquid waste management buildings would not result in a change in land use. – New evaporation tanks, if built, would likely result in a change in land use designation from Reserve to Waste Management. – Construction would affect up to 5.4 acres (2.2 hectares) of undeveloped land.
Solid Radioactive and Chemical Waste Facilities (TA-54 and Generic Site)	No change in land use	Same as No Action Alternative	*Waste Management Facilities Transition* – No change in land use within TA-54 – Construction of the TRU (Transuranic) Waste Facility could affect up to 7 acres (2.8 hectares) of undeveloped land and could result in a change in land use designation.
Bioscience Facilities	No change in land use	Same as No Action Alternative	*Science Complex* – Construction would affect 5 acres (2 hectares) of undeveloped land. – For Options 1 and 2, development would be consistent with a change in future land use from Reserve to Experimental Science. – For Option 3 there would be no change in land use designation.

MDA = material disposal area; TA = technical area; DD&D = decontamination, decommissioning, and demolition.

5.1.1.1 No Action Alternative

The No Action Alternative is discussed in terms of the existing environment as it relates to land use; actions that DOE has decided upon, but has not fully implemented; and the results of National Environmental Policy Act (NEPA) compliance reviews issued since the *1999 SWEIS*. Impacts on land use are described in terms of projects that affect the site as a whole and those that affect only specific TAs. Key Facilities are addressed separately. Only those projects that have been evaluated via their respective environmental analyses to have an impact on land use are addressed below.

Los Alamos National Laboratory Site-Wide Impacts

Since issuance of the *1999 SWEIS* ROD, NEPA documentation has been prepared for two projects that are being implemented and have potential impacts on land use across a number of TAs: (1) conveyance and transfer of land under Public Law 105-119, and (2) proposed electrical power system upgrades (DOE 1999a, 1999d, 2000a).

Conveyance and transfer of land from DOE to Los Alamos County and the U.S. Department of the Interior to be held in trust for the Pueblo of San Ildefonso began in 2002. At the end of 2006, 2,259 acres (914 hectares) had been turned over (see Chapter 4, Section 4.1.1). To meet the requirements of Public Law 105-119, Section 632 and the extension mandated in the Defense Authorization Act, the remaining acreage (1,820 acres [737 hectares]) may be turned over by 2012. The direct impact of the conveyance and transfer process on land use is a reduction in the land area of LANL to its present size of about 25,600 acres (10,360 hectares). Indirect impacts (impacts resulting from actions undertaken by the recipients after conveyance and transfer of the tracts) include possible development or redevelopment of up to 826 acres (334 hectares), potential introduction of land uses that would be incompatible with adjacent land owners' resource protection efforts, and loss of recreational opportunities on some tracts (DOE 1999d).

Although the electrical power system upgrades are not expected to have a major effect on existing land uses, they would affect up to 473 acres (191 hectares) and be 19.5 miles (31 kilometers) in length. In general, project-related activities would traverse the southwestern portion of LANL, entering the site from the east at TA-70 and proceeding northwest through portions of White Rock, Water and Pajarito Canyons, and terminating at TA-69. Construction and operations activities have been determined to be consistent and compatible with all existing land uses along the project's route, and these land uses would likely continue. Several minor impacts are possible, however, including short-term impacts on cattle grazing and recreational use during construction on one segment that is outside of LANL and potentially adverse effects on existing or future high explosives testing within LANL. Additionally, the project could provide a minimal constraint of activities within the Dynamic Testing Area and Twomile Mesa South in areas designated for future experimental use, because development could not occur within the power line right-of-way (DOE 2000a).

Management of construction fill, another activity affecting multiple TAs, would not be expected to have an effect on existing land uses. Construction fill would be stored in existing borrow areas at TA-16 or TA-61.

5.1.1.2 Reduced Operations Alternative

Los Alamos National Laboratory Site-Wide and Technical Area Impacts

Under the Reduced Operations Alternative, the same impacts on land use resulting from actions addressed under the No Action Alternative (see Section 5.1.1.1) would occur. None of the actions proposed under the Reduced Operations Alternative that differ from those proposed under the No Action Alternative would impact land use.

5.1.1.3 Expanded Operations Alternative

The Expanded Operations Alternative reflects proposals that would expand the overall operations levels at LANL beyond those established for the No Action Alternative (which also would take place). As such, the Expanded Operations Alternative includes a number of new projects that potentially could impact land use at LANL. Not all new projects would affect land use; many would involve actions within or modifications to existing structures or construction of new facilities within previously developed areas of LANL. Only those proposed projects that would impact land use are addressed below.

Los Alamos National Laboratory Site-Wide Impacts

Under this alternative, two proposed projects could impact land use across a number of TAs at LANL: (1) MDA Remediation and (2) the Security-Driven Transportation Modifications Project. A detailed analysis of each of these two actions is presented in Appendices I and J, respectively.

Action options for remediation of MDAs include capping or removal. Remedies for MDAs subject to the March 2005 Consent Order would be recommended by LANL, but decisions would be made by the New Mexico Environment Department. Decisions on actions would be implemented on an MDA-by-MDA basis and could involve a combination of partial removal and capping (a hybrid action for the purposes of this analysis). Because the Capping Option would stabilize rather than remove existing contaminants, future use of MDAs would remain restricted. At present, most MDAs are open areas that are fenced and excluded from any use other than safely maintaining inventories of waste. In the future, MDAs would have to be surveyed and maintained to protect public health and safety and the environment. Under the Removal Option, there would be fewer restrictions on land use than under the Capping Option. Complete removal of waste and contamination from MDAs could free up to roughly 110 acres (45 hectares) for purposes other than use as an exclusion area for storing radioactive waste. This would not mean, however, that major changes would occur in the designated land use of the TAs containing the MDAs. The extent of removal would depend on information obtained from the program and on regulatory decisions.

The investigation and remediation program for MDA B would remove waste and contamination. Alternative uses of this portion of TA-21 may be possible. Opportunities for different uses of some lands may arise following PRS remediation. This would depend on the corrective measure required by the New Mexico Environment Department and implemented by the LANL management and operating contractor, as well as the overall mission of the TA containing the PRS. Under a hybrid action, land use generally would be similar to that for the Capping Option.

Security-driven transportation modifications in the Pajarito Corridor West would require construction of two parking lots or structures (in TA-48 and TA-63), a new two-lane road along the east edge of TA-63, new auto and pedestrian crossings connecting TA-63 and TA-35, and a road through the northern edge of TA-35. While this alternative would affect future land use by developing currently undeveloped portions of the Pajarito Corridor West, all construction, except the pedestrian walkway, would take place within areas designated either for Development or for Infill. Thus, this alternative generally would be compatible with the land use plans for the Pajarito Corridor West outlined in the *Comprehensive Site Plan 2001* (LANL 2001c).

Auxiliary Action A for the Security-Driven Transportation Modifications Project involves construction of a two-lane bridge within a 1,000-foot (300-meter)-wide corridor across Mortandad Canyon and a new two-lane road from the north end of the new bridge westward through TA-60 to connect TA-35 with TA-3. These actions are within the scope of the land use plans described in the *Comprehensive Site Plan 2001*. Auxiliary Action B involves construction of a second new two-lane bridge within a 1,000-foot (300-meter)-wide corridor across Sandia Canyon, as well as a new two-lane road from the new bridge to connect with East Jemez Road. Although the terminus of the bridge and the new road to East Jemez Road would be within an area designated as Primary Development in the *Comprehensive Site Plan 2001*, there is no provision in the plan for a bridge corridor over Sandia Canyon, as there is for the bridge over Mortandad Canyon. Thus, construction of a bridge corridor over Sandia Canyon would represent a departure from the current site development plan; however, the *2000 Comprehensive Site Plan* did address the concept of a future road over the canyon (LANL 2000a, 2001c).

Technical Area Impacts

Three projects are proposed that could impact land use within TA-3, TA-21, and TA-72. The impacts described below are from project-specific analyses in Appendices G and H.

Technical Area 3

Construction of the Replacement Office Buildings at TA-3 would require 13 acres (5.3 hectares) of undeveloped land that is presently designated as Reserve. Additional acreage would be required within recently disturbed portions of the TA that are classified as Physical/Technical Support. The future land use proposal calls for the Reserve area to be redesignated as Physical/Technical Support.

Technical Area 21

Following decontamination and demolition of its buildings and structures, a 7.6-acre (3.0-hectare) parcel in the western portion of TA-21 was conveyed to Los Alamos County. In the future, it is likely that this area could be used for commercial or industrial purposes. The eastern portion of TA-21 would remain a part of LANL for the foreseeable future. Portions of the eastern parcel, however, are being considered as brownfield sites for potential reuse. Future land use proposals call for this area to be redesignated from Waste Management, Service/Support, and

Nuclear Materials Research and Development to Reserve; however, redevelopment could negate this change in designation (see Appendix H).

Technical Area 72

Construction of the Remote Warehouse and Truck Inspection Station along the south side of East Jemez Road would require clearing about 4 acres (1.6 hectares) of land. As current and future land use within the site area is designated as Reserve, development of the site would change the land use designation from Reserve to Physical/Technical Support.

Key Facilities Impacts

Five projects that could impact land use at LANL Key Facilities are proposed as part of the Expanded Operations Alternative. The impacts described below are from project-specific analyses in Appendices G and H.

Pajarito Site

Decontamination, decommissioning, and demolition (DD&D) of TA-18 buildings and structures would change the overall land use designation of the TA because the site would not be used for other LANL development purposes. The land use designation of the site would change from Nuclear Material Research and Development to Reserve.

Radiochemistry Facility

Construction of the Radiological Sciences Institute would require about 33.6 acres (13.6 hectares) of land, mainly within TA-48, as well as a small part of TA-55, of which about 12.6 acres (5.1 hectares) are currently undeveloped. Development would require some areas that are currently designated Reserve and Experimental Science to be redesignated as Nuclear Materials Research and Development; however, this is consistent with future land use concepts because TA-48 is within the Pajarito Corridor West Development Area. Construction of the Radiological Sciences Institute would take place in areas designated as Primary Development, Proposed Parking, and Potential Infill.

Radioactive Liquid Waste Treatment Facility

Construction of the new liquid waste management buildings would occur in a developed area of TA-50 and would not change the TA's current or future land use designation as Waste Management. If the evaporation tanks, which could occupy up to 4 acres (1.6 hectares) of land, were constructed near the border of TA-52 and TA-5, the land use designation for the tank areas and a portion of the pipeline route (1.4 acres [0.6 hectares]) would likely change from Reserve to Waste Management.

Solid Radioactive and Chemical Waste Facilities

While activities taking place within TA-54, including some new construction and removal of the domes, would not change the existing land use designation within the TA, construction of the TRU Waste Facility (previously called the Transuranic Waste Consolidation Facility) in an as-yet identified location in the Pajarito Road corridor could impact land use. The greatest potential impact to land use would occur at a generic site that is presently not developed. With the exception of TA-54 West, all generic sites are undeveloped; thus, up to 7 acres (2.8 hectares) of land would be disturbed. Construction of the TRU Waste Facility would change the present land use category to Waste Management at all generic sites except at TA-63. However, all generic sites have been determined to be suitable for future development because they have been designated in the *Comprehensive Site Plan 2001* (LANL 2001c) as Primary Development, Secondary Development, or Potential Infill.

Biosciences Facilities

Under Option 1, the Northwest TA-62 Site Option, a site located to the west of TA-3 would be used for construction of the Science Complex. Land use within this site area is currently designated as Reserve, and this is not predicted to change in the future (LANL 2003h). Construction of the Science Complex, however, would disturb 5 acres (2 hectares) of undeveloped land and would change the site area's future land use designation from Reserve to Experimental Science. Option 2, the Research Park Option, would also change the site area's future land use designation from Reserve to Experimental Science. Option 3, the South TA-3 Site Option, would locate the facility in an area presently occupied by a parking lot and would result in no change to its land use designation.

5.1.2 Visual Environment Impacts

Visual resources are natural and manmade features that give a particular landscape its character and aesthetic quality. A comparative analysis of the impacts to visual resources was performed, consisting of a qualitative examination of potential changes in the visual environment. Aspects of visual modification examined included site development, building modification, and demolition, as appropriate. Each of these activities could alter the appearance of LANL structures or obscure views of the surrounding landscape, result in changes in surrounding land cover that could make structures more or less visible, and cause light pollution that would alter the night sky. **Table 5–2** summarizes the expected impact on visual resources at LANL.

5.1.2.1 No Action Alternative

The visual environmental impacts of the No Action Alternative are related to the existing visual environment at LANL, including actions that DOE or NNSA has decided upon, but has not fully implemented, as well as the impacts identified by other NEPA compliance reviews issued since the *1999 SWEIS* ROD. Impacts to the visual environment are described in terms of those projects that affect the site as a whole and those that affect specific TAs. Key Facilities are addressed separately. Only those projects that have been evaluated in their respective environmental analyses to have an impact on the visual environment at LANL are addressed below.

Table 5–2 Summary of Environmental Consequences on the Visual Environment

Location	***No Action Alternative***	***Reduced Operations Alternative***	***Expanded Operations Alternative***
LANL Site			
Site-Wide	*Land Conveyance and Transfer* – Development could degrade views of presently undeveloped tracts. *Electrical Power System Upgrades* – Short-term visual impacts during construction. – Adverse visual impact in undisturbed areas. – No overall change in view from Bandelier National Monument. *Wildfire Hazard Reduction Program* – Forest would appear more park-like. – Some LANL facilities would be more visible. *Disposition of Flood Retention Structures* – Temporary impacts if staging areas are located near Pajarito Road. – Overall, little impact because most disposition projects are not visible to the public.	Same as No Action Alternative	Same as No Action Alternative plus: *MDA Remediation Project* – Short-term visual impacts during MDA capping or removal and during remediation of other PRSs. – Temporary containment domes used under the MDA Removal Option. – Minor changes in distant views if MDAs are capped; would be maintained as open grassy areas. – Borrow pit in TA-61 would become more visible due to the large quantities of material needed. *Security-Driven Transportation Modifications Project* – Short-term impacts during construction. – Pronounced impacts due to roads, bridges, and parking lots, as well as vehicle and pedestrian bridges under auxiliary actions.
Affected Technical Areas			
TA-3	No change in impacts to visual resources	Same as No Action Alternative	*Physical Science Research Complex* – Short-term impacts during construction. – New structures would be of a unified design. – Demolition of vacated structures would improve the overall appearance of TA-3, TA-35, and TA-53. *Replacement Office Buildings Project* – Short-term impacts during construction. – New buildings and parking lot would be readily visible from West Jemez Road and Pajarito Road. – Impact of the project on distant views would be minimal.
TA-21	No change in impacts to visual resources	Same as No Action Alternative	*TA-21 Structure DD&D* – Enhancement of visual environment from removal of old structures. – Both conveyed and non-conveyed parcels could undergo development, which could change the visible environment.

Location	*No Action Alternative*	*Reduced Operations Alternative*	*Expanded Operations Alternative*
TA-72	No change in impacts to visual resources	Same as No Action Alternative	*Remote Warehouse and Truck Inspection Station* – Short-term impacts during construction. – 4 acres (1.6 hectares) would be cleared making the site readily visible from East Jemez Road. Lighting could be visible from the Tsankawi Unit of Bandelier National Monument.
Key Facilities			
Chemistry and Metallurgy Research Building (TA-3, TA-48, and TA-55)	– Temporary impacts during construction of replacement building. – Minimal visual impact to public from Pajarito Plateau rim and employees from Pajarito Road.	Same as No Action Alternative	Same as No Action Alternative
High Explosives Processing Facilities (TA-16)	– Temporary impacts during construction of replacement or new buildings. – New structures of unified design. – Removal of old buildings would enhance visual environment.	Same as No Action Alternative	Same as No Action Alternative
High Explosives Testing Facilities (TA-6, TA-22, and TA-40)	– Temporary impacts during construction of new buildings. – Minimal long-term impacts. – Removal of old buildings would enhance visual environment.	Same as No Action Alternative	Same as No Action Alternative
Pajarito Site DD&D (TA-18)	No change in impacts to visual resources	Same as No Action Alternative	*TA-18 DD&D* – Short-term impact from demolition. – Long-term positive impact as area is restored to more natural appearance.
Radiochemistry Facility (TA-48)	No change in impacts to visual resources	Same as No Action Alternative	*Radiological Sciences Institute* – Short-term impacts during demolition and construction. – Minimal visual impact to public from Pajarito Plateau rim and employees from Pajarito Road from new construction west of current buildings.
Radioactive Liquid Waste Treatment Facility (TA-50)	No change in impacts to visual resources	Same as No Action Alternative	*Radioactive Liquid Waste Treatment Facility Upgrade* – Short-term impact from construction of new treatment building in TA-50. – Permanent change to the visual environment if evaporation tanks are built near the border of TA-52 and TA-5.

Location	***No Action Alternative***	***Reduced Operations Alternative***	***Expanded Operations Alternative***
Solid Radioactive and Chemical Waste Facilities (TA-50 and TA-54)	No change in impacts to visual resources	Same as No Action Alternative	*Waste Management Facilities Transition* – Short-term impacts during construction. – Beneficial impact on near and distant views from removal of domes in TA-54. – Minimal visual impact of new TRU Waste Facility to public from Pajarito Plateau rim and employees from Pajarito Road. – Construction at generic sites within TA-51, TA-52, and TA-54 West would be visible from lands of the Pueblo of San Ildefonso.
Bioscience Facilities	No change in impacts to visual resources	Same as No Action Alternative	*Science Complex Project* – Short-term impacts during construction. – Under Options 1 and 2, the new facility would be readily visible from West Jemez Road and forested buffer between LANL and Los Alamos Canyon would be lost. – Potential impacts to Los Alamos Canyon from night lighting under Options 1 and 2. – Minimal impact under Option 3 because the new facility would be generally located within a developed part of TA-3.

MDA = material disposal area; PRS = potential release site; TA = technical area; DD&D = decontamination, decommissioning, and demolition.

Los Alamos National Laboratory Site-Wide Impacts

Conveyance of land to Los Alamos County, the New Mexico Department of Transportation, and transfer of land to the U.S. Department of the Interior (to be held in trust for the Pueblo of San Ildefonso) have been evaluated with respect to impacts on the visual environment. Most tracts would maintain their current level of visual aesthetic value after conveyance and transfer and any subsequent development, and the visual resources of some tracts could be improved by the removal and replacement of industrial buildings. The evaluation also determined, however, that commercial and residential development of currently undeveloped areas, such as the Rendija Canyon and White Rock Tracts, could degrade the local visual landscape. Overall, the reduction in visual quality was not found to be substantial on a regional scale (DOE 1999d).

The electrical power system upgrades were determined to affect the visual environment near the power line right-of-way both during and after construction. During construction, staging areas and equipment would cause short-term visual effects that would be out of character with the surrounding environment. Revegetation after construction, however, would return disturbed areas to a more natural condition. Analysis determined that, after construction, the power line would have two principal visual effects – selectively cleared corridors in wooded areas and visible pole structures and lines that would contrast with natural landforms. Because the corridors would be cleared selectively, no major swathes of devegetated areas would be visible. The finished power line would be most disruptive in areas where the surrounding land is undeveloped or where the contrast with the natural landscape is marked. The evaluation determined that electrical power system upgrades would not dramatically change the overall character of the view from the Bandelier National Monument Wilderness Area (DOE 2000a).

The Wildfire Hazard Reduction Program was found to have minimal effect on visual resources at LANL and in the surrounding area, given the degraded panoramas of the Pajarito Plateau and Jemez Mountains resulting from the Cerro Grande Fire. The primary aspect of the program that would affect visual resources is vegetation removal, which would occur as a result of selective thinning activities. The forest at LANL would become more natural as the diversity of shrubs, herbs, and grasses in the understory increased. Some facilities currently screened from casual view could become visible to viewers at various vantage points. The overall effect of the Wildfire Hazard Reduction Program would be to enhance the contrast between the background setting and LANL's industrial character (DOE 2000e).

Disposition of flood and sediment retention structures was determined to affect visual resources temporarily if the staging areas for the concrete removal were located near Pajarito Road. Actual demolition of the flood retention structure in Pajarito Canyon and the steel diversion wall upstream from TA-18 would occur in restricted areas that are not visible to the public. The low-head weir, located in Los Alamos Canyon, and the road reinforcements in Twomile Canyon, Pajarito Canyon, and Water Canyon would remain in place, with no change to visual resources (DOE 2002j).

Management of construction fill would not be expected to affect visual resources. Construction fill would be stored in existing borrow areas at TA-16 and TA-61.

Technical Area Impacts

No actions are contemplated under the No Action Alternative that would impact visual resources in terms of the TAs beyond the impacts related to Key Facilities, as discussed below.

Key Facilities Impacts

Since publication of the *1999 SWEIS*, NEPA compliance has been achieved for three currently active projects related to Key Facilities: construction of the Chemistry and Metallurgy Research Replacement Facility at TA-55, consolidation and refurbishment of the Weapons Manufacturing Support Facility at TA-16, and construction at the Dynamic Experimentation Complex at TA-6, TA-22, and TA-40. The impacts of these projects to visual resources are discussed below.

Chemistry and Metallurgy Research Replacement Building

Impacts to visual resources resulting from construction of the Chemistry and Metallurgy Research Replacement Facility at TA-55 were determined to be temporary in nature and include increased levels of dust and human activity. When complete, the general appearance of the new facility, which would include two buildings, would be consistent with other buildings located within TA-55. The Chemistry and Metallurgy Research Replacement Facility would be readily visible to LANL employees from Pajarito Road, and would be visible to the public from the upper reaches of the Pajarito Plateau rim (DOE 2003d). Future DD&D of the Chemistry and Metallurgy Research Building would likely result in a temporary park-like area once the site was revegetated. As infill building probably would occur later, no long-term visual change is likely because new construction would blend in with modern construction.

High Explosives Processing Facilities

Construction and demolition activities at the Weapons Manufacturing Support Facility at TA-16 would have some local short-term adverse effects and long-term beneficial effects on the viewscape. Short-term adverse visual effects would occur during the construction period. As the existing engineering complex is highly industrial in appearance, these effects would be minor. In the long term, the area would experience a beneficial effect because temporary buildings would be removed and newly built structures would be of a similar style. The visual effects of the new facilities would be confined to the immediate area of the current complex because the area generally is not visible from public roads. Demolition activities generally would result in the same local short-term adverse effects identified for the construction phase. Overall, the removal of buildings would enhance the visual characteristics of TA-3, TA-8, and TA-16 (DOE 2002l).

High Explosives Testing Facilities

Dynamic Experimentation Complex construction activities at TA-6, TA-22, and TA-40 would have some local short-term adverse effects on visual resources; long-term effects from construction and demolition are expected to be minimal. The project, which would involve constructing 15 to 25 new one- to two-story buildings, as well as new roads and parking lots, generally is not visible from public roads, and new buildings would be similar in height to existing structures. The visual effects of construction would be confined to the immediate area. In the long term, the area would experience minimal effects because its industrial park appearance would continue, but on an expanded scale with similar architecture. Demolition activities generally would result in the same local short-term adverse effects identified for the construction phase. Overall, the removal of buildings would enhance visual characteristics as some areas return to more natural conditions (DOE 2003e).

5.1.2.2 Reduced Operations Alternative

Under the Reduced Operations Alternative, the same impacts on the visual environment as those addressed under the No Action Alternative (see Section 5.1.2.1) would occur.

5.1.2.3 Expanded Operations Alternative

The Expanded Operations Alternative reflects proposals that would expand the overall operations levels at LANL beyond those established for the No Action Alternative. Additionally, the Expanded Operations Alternative includes a number of new projects that could impact the visual environment at LANL. Not all new projects would affect the visual environment because many would involve actions within or modifications to existing structures. Only those projects that impact the visual environment are addressed below.

Los Alamos National Laboratory Site-Wide Impacts

Two proposed projects could impact visual resources across a number of TAs at LANL: the MDA Remediation Project and the Security-Driven Transportation Modifications Project. A detailed analysis of each is presented in Appendices I and J, respectively.

Action options for remediation of MDAs include capping, removal, or a combination of both. Remedies for MDAs subject to the Consent Order would be recommended by the LANL management and operating contractor on an MDA-by-MDA basis, and the decision would be made by the New Mexico Environment Department. Each option would have some temporary short-term visual impacts resulting from activities such as stripping or disrupting the existing vegetative cover over the MDAs, removing waste, placing cover materials in compacted lifts, and providing revegetation. Not all land would be affected at the same time. Many of the affected sites would not be in areas that are routinely visible to the public; however, a number of MDAs are located on DP Mesa in TA-21 and are visible from the Los Alamos townsite. Remediating the MDAs would have a relatively minor impact on visual resources from higher elevations to the west and, in a few cases, from the townsite. Once capped, the views generally would be similar to those in existence prior to implementation of corrective measures. One difference between the Capping and Removal options is that, under the Removal Option, MDAs would be covered by enclosures as needed while waste is being removed. (The investigation and remediation program at MDA B also would be conducted under enclosures.) These domed structures would be visible from greater distances than the MDAs themselves under the Removal Option; however, their presence would be temporary. After waste removal was completed, the enclosures would be removed and the site would be revegetated. Under both the Capping and Removal Options, the need to obtain fill may require removal of a small hill that currently screens the TA-61 borrow pit from observation from East Jemez Road. Thus, the borrow pit, which is a cleared area several acres in size, might become visible from East Jemez Road and would remain visible until the area ultimately is reclaimed and revegetated. Remediating PRSs other than MDAs would result in few additional long-term visual impacts.

The Security-Driven Transportation Modifications Project would take place within Pajarito Corridor West, which is a highly developed area that is readily visible from both nearby and higher elevations to the west. While many actions associated with implementing the Security-Driven Transportation Modifications Project would have few or no visual impacts, construction of the two parking lots, new roads across TA-63 and TA-35, and highway and pedestrian bridges over Ten Site Canyon would noticeably add to the built-up appearance of the area. Visual impacts of constructing the parking lots and the highway and pedestrian bridges would be especially pronounced because they would involve removal of existing forest and span a forested canyon that has an otherwise natural appearance. The bridges would be readily visible from the canyon where little development is presently apparent; they would also be visible from more distant areas.

Auxiliary Action A for the Security-Driven Transportation Modifications Project involves construction of a two-lane bridge within a 1,000-foot (300-meter)-wide corridor across Mortandad Canyon and a new two-lane road from the north end of the new bridge westward through TA-60 to connect TA-35 with TA-3. Although the roadway would have minimal impact on visual resources because it would follow an existing unpaved road, the proposed bridge would represent a highly visible change in the appearance of the local environment and would stand out in contrast to the forested setting of the canyon, altering its natural appearance when viewed from both nearby locations and higher elevations to the west.

Auxiliary Action B involves construction of a second, new two-lane bridge within a 1,000-foot (300-meter)-wide corridor across Sandia Canyon and a new two-lane road from the new bridge to connect with East Jemez Road. Because Auxiliary Action B would not proceed independently of Auxiliary Action A, the impacts on visual resources would be similar to those addressed for Auxiliary Action A, but would involve bridges across two canyons.

Technical Area Impacts

Three projects are planned that could impact visual resources at TA-3 and TA-21. These projects are addressed below.

Technical Area 3

Construction of the Physical Science Research Complex (formerly the Center for Weapons Physics Research) would result in short-term impacts to the visual environment, including construction activities and increased dust generation. Once complete, the facility would be visually compatible with nearby office and computing structures and would enhance the overall architectural character of the Core Development Area. Distant views of TA-3 would not change appreciably due to the highly developed nature of the area. DD&D of buildings vacated as a result of the project would cause temporary construction-related impacts, but in the long term would improve the general appearance of TA-35 and TA-53.

Construction of the Replacement Office Buildings would require clearing and grading of 13 acres (5.3 hectares), which would result in short-term impacts to the visual environment such as construction activities and increased dust generation. The forested area along West Jemez Road would be replaced with buildings and a parking lot that would be readily visible from West Jemez Road, Pajarito Road, and nearby areas. Views from Pajarito Road, however, only would be apparent to employees because the road is closed to the public (see Appendix G). Due to the highly developed nature of TA-3, distant views would not change appreciably.

Technical Area 21

DD&D activities at TA-21 would have short-term adverse impacts on visual resources due to the presence of heavy equipment and an increase in dust. Following removal of buildings and structures, the area would be contoured and revegetated, as appropriate. These efforts, however, would be aimed primarily at soil stabilization, not recreating a more natural environment, because both the western part of the site, which has been transferred to Los Alamos County, and the eastern section could be developed in the future. With redevelopment likely, future views of the TA from NM 502 and from higher elevations to the west would remain commercial or industrial in nature. Nevertheless, with proper planning, the view would be of modern architecturally compatible buildings rather than the current mix of 50-year-old structures (see Appendix H).

Key Facilities

Five projects related to Key Facilities at LANL are proposed under the Expanded Operations Alternative. The impacts described below are from project-specific analyses in Appendices G and H.

Pajarito Site

The use of heavy equipment for DD&D of buildings at TA-18 and the resultant increase in dust would have short-term impacts on visual resources; however, long-term impacts would be positive. Once the buildings and structures were removed and the site restored, including grading and planting of native species, the canyon bottom would present a natural appearance and, given time, would blend with previously undisturbed portions of the TA (see Appendix H).

Radiochemistry Facility

Construction of the Radiological Sciences Institute would result in changes in both near and distant views of TA-48. Short-term impacts would include the construction activity itself, as well as increased dust generation. Upon completion, the new buildings and parking lots would be more visible from the road than current facilities due to their increased number and size. Most of the changes to area views would be visible only to LANL workers. Construction of the Radiological Sciences Institute also would change distant views of TA-48 because the size of the developed area would increase along with the numbers of buildings and parking lots. The overall broad viewshed effect would be minimal due to the extensive nature of existing development on the mesa.

Demolition of buildings and structures at TA-48 prior to constructing the Radiological Sciences Institute would have short-term and long-term impacts on visual resources. In the short term, dust and demolition activity would adversely affect these resources; however, in the long term, the new facility would be more aesthetically pleasing in terms of architectural style than the mix of existing structures. These changes would be observed primarily by LANL employees. Distant views from higher elevations to the west would not change appreciably (see Appendix G).

Radioactive Liquid Waste Treatment Facility

One or more treatment buildings and a separate utilities structure would be constructed, or the existing building could be renovated. Regardless of the construction option, visual impacts would be temporary and localized. Any new buildings would be no more than two stories high with established color schemes for the building exteriors. If evaporation tanks were constructed, it would permanently change the visual environment because the area near TA-52 and TA-5 where the tanks would be constructed currently is undeveloped and wooded. Views of this natural setting from higher areas to the west of LANL would be disrupted by a noticeable break in the forest cover.

Solid Radioactive and Chemical Waste Facilities

Waste Management Facilities Transition activities primarily would involve work within TA-54 and a generic site. Actions taking place within TA-54, including some new construction and removal of the domes and other facilities, would occur within previously disturbed areas. While most activities taking place within TA-54 would have minimal impacts on visual resources due to the developed nature of the area, removal of the domes at MDA G would have a beneficial impact on both near and distant views because these structures can be seen many miles away from areas in the Nambe and Española area and in western and southern Santa Fe. The domes also are visible from the lands of the Pueblo of San Ildefonso. Generic sites for the TRU Waste Facility, with the exception of TA-54 West, are located within undeveloped areas. Thus, while construction of the new facility would have minimal visual impact within TA-54 West, it would create a change in the visual environment of the other generic sites. However, construction would generally not be visible to the public since Pajarito Road is open only to LANL personnel. Construction at generic locations within TA-51, TA-52, and TA-54 West would be visible from lands of the Pueblo of San Ildefonso. Regardless of where the TRU Waste Facility would be built, when viewed from higher elevations to the west it would add somewhat to the developed nature of LANL along Pajarito Road.

A second option related to the Waste Management Facilities Transition would require additional storage space for remote-handled and contact-handled transuranic waste that could be collocated with the TRU Waste Facility or be separated from it. This option also involves upgrading satellite storage areas around LANL for mixed low-level radioactive waste and hazardous or chemical waste. While impacts on visual resources from construction of the TRU Waste Facility would be similar to those described above, construction of new transuranic waste storage buildings would increase the visual impact under this option. DOE would mitigate these impacts by following the design principles provided in the LANL architectural guide (LANL 2002a).

Biosciences Facilities

The Science Complex would consist of two four-story buildings and a six-story parking structure, as well as related supporting structures and utilities. Construction of the complex would result in temporary visual impacts related to the presence of heavy equipment and dust.

Once complete, the addition of the Science Complex at the Northwest TA-62 Site or Research Park Site would impact visual resources in this area because views from TA-3 or from West Jemez Road to the west, north, and east would be obstructed. In addition, after construction of the Science Complex on the north side of the road, the natural forested buffer area between LANL and Los Alamos Canyon would be lost. These options would add somewhat to the overall "built-up" appearance of LANL when viewed from higher elevations to the west. Under the South TA-3 Site option, there would be little overall impact to visual resources because the Science Complex would be located within a highly developed part of LANL.

Under the Northwest TA-62 Site or Research Park Site options, it is possible that the security lighting associated with the Science Complex may illuminate some portion of the south and north walls of Los Alamos Canyon; however, the project would conform to the New Mexico Night Sky Protection Act per architectural and design guidelines and LANL engineering standards. Impacts from night lighting under the South TA-3 option would not be expected.

Remote Warehouse and Truck Inspection Station

Construction of the Warehouse and Truck Inspection Station would result in temporary visual impacts related to clearing activities, the presence of heavy equipment, and dust. Once complete the facility would be readily visible from East Jemez Road. Nighttime lighting would be required in a location that previously was unlighted. Although the Remote Warehouse and Truck Inspection Station would not be visible from the trails or parking lot at the Tsankawi Unit of Bandelier National Monument, the nighttime sky glow from lighting at the facility could be visible from Tsankawi under normal conditions. The trails at Tsankawi, however, are closed to the public after dusk. The lighting that would be installed would comply with the New Mexico Night Sky Protection Act to the extent it does not compromise security.

5.2 Geology and Soils

This section discusses the projected impact on LANL geology and soils under the three alternatives evaluated in this SWEIS. In general, present LANL operations have limited impact on geology and soils, except in specific circumstances. This is because most of LANL is not industrialized, so the majority of the soil column is not disturbed, and few LANL processes involve subsurface work, so there is limited interaction with geological materials. Although LANL activities do not impact geology and soils, there is a geological impact that applies to LANL facilities. An updated seismic hazard analysis completed in 2007 (LANL 2007a) presents an increased estimated probabilistic seismic hazard for LANL. As a result, the hazard assessments for existing and planned facilities will be evaluated and updated as necessary to meet DOE facility design criteria. This may impact LANL facilities under all of the three alternatives (see Section 5.12).

The information for the geology and soils sections feeds into several other sections within this new SWEIS, including human health, accidents, and ecological risk. The following section addresses each of the subject areas previously described in Chapter 4, Affected Environment.

Table 5–3 summarizes the impacts of each of the proposed alternatives on geology and soils.

Table 5–3 Summary of Environmental Consequences for Geology and Soils

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
		LANL Site	
	Volcanism & Seismic Activity – No activities that could increase the probability of seismic events. *Slope Stability, Subsidence, & Soil Liquefaction* – No impact. *Soil Monitoring* – No increase in the level of legacy contaminants. – Overall decrease in soil contamination occurring over time. *Soil Erosion* – No impact. *Mineral Resources* – No impact.	Same as No Action Alternative, except: *Soil Monitoring* – Potential for soil contamination would decrease due to the 20 percent reduction in high explosives testing activities.	Same as No Action Alternative, except: *Soil Monitoring* – Facility DD&D and MDA and PRS remediation would have a positive impact by removing or containing legacy contamination. *Soil Erosion* – Combined activities could impact up to 3.2 million cubic yards (2.5 million cubic meters) of soil and rock. – Standard best management practices would serve to minimize soil erosion and loss. *Mineral Resources* – MDA remediation would have a significant impact on geological resources -- up to 2.5 million cubic yards (1.9 million cubic meters) of crushed tuff and other materials would be required under the Capping Option. – Up to 2.2 million cubic yards (1.7 million cubic meters) of crushed tuff and other materials would be required under the Removal Option. – Materials would be available at LANL or from nearby offsite sources. – TA-61 borrow pit would be expanded. *Security-Driven Transportation Modifications Project* – Would disturb up to 240,000 cubic yards (183,000 cubic meters) of soil and rock for construction. – Construction of bridges as part of the auxiliary actions could disturb up to 28,000 cubic yards (21,000 cubic meters) of soil and rock. – Excavated materials would be managed to minimize erosion and losses.
		Affected Technical Areas	
TA-3	No impacts to geology and soils.	Same as No Action Alternative	Same as No Action Alternative except: – Construction of Replacement Office Buildings and Physical Science Research Complex would impact approximately 868,000 cubic yards (664,000 cubic meters) of soil and rock for building excavation. – Excavated materials would be managed to minimize erosion and losses; backfill for DD&D buildings would be obtained at LANL or from nearby offsite sources. – Legacy contamination would be reduced due to removal of contaminated soils during DD&D.

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
TA-21	No impacts to geology and soils	Same as No Action Alternative	Same as No Action Alternative except: – No impact to native soils because all areas were disturbed previously by site activities. – Positive impact due to removal or improved containment of contaminated soils as a result of MDA remediation and DD&D of existing structures.
TA-61	No impacts to geology and soils	Same as No Action Alternative	Same as No Action Alternative, except: – If all MDA Capping Option tuff requirements came from TA-61, 25 acres (10 hectares) would have to be excavated an average of 50 feet (15 meters). – If all MDA Removal Option tuff requirements came from TA-61, up to 24 acres (9.7 hectares) would have to be excavated an average of 50 feet (15 meters).
TA-72	No impacts to geology and soils	Same as No Action Alternative	Same as No Action Alternative, except: – Construction of Remote Warehouse and Truck Inspection Station would impact about 90,000 cubic yards (69,000 cubic meters) of soil and rock for building excavation. – Excavated materials would be managed to minimize erosion and losses; backfill for DD&D buildings would be obtained at LANL or from nearby offsite sources. – Negative impact in the areas where construction would occur in areas with previously undisturbed soils.
Key Facilities			
Pajarito Site DD&D (TA-18)	No impacts to geology and soils	Same as No Action Alternative	Same as No Action Alternative, except: – No impact to native soils because all areas were disturbed previously. – Positive impact due to removal of contaminated soils and reduction of legacy soil contamination at LANL.
Radiochemistry Facility (TA-48)	No impacts to geology and soils	Same as No Action Alternative	Same as No Action Alternative, except: – DD&D of existing facilities would reduce legacy contamination and potential soil erosion. – Construction of Radiological Sciences Institute would impact approximately 802,000 cubic yards (613,000 cubic meters) of soil and rock for building excavation, some up to 45 feet (14 meters) below grade. – Excavated materials would be managed to minimize erosion and losses; backfill for DD&D buildings would be obtained at LANL or from nearby offsite sources. – Negative impact in the areas where construction would occur in areas with previously undisturbed soils.
Radioactive Liquid Waste Treatment Facility (TA-50 and TA-54)	No impacts to geology and soils	Same as No Action Alternative	Same as No Action Alternative, except: – Construction would impact up to 95,000 cubic yards (73,000 cubic meters) of soil and rock for building excavation. – Construction of evaporation tanks and pipeline would impact approximately 69,000 cubic yards (53,000 cubic meters) of soil and rock. – Excavated materials would be managed to minimize erosion and losses; backfill for DD&D buildings would be obtained at LANL or from nearby offsite sources. – DD&D of North or South Annexes would reduce legacy contamination and potential soil erosion.

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
			– Negative impact in the areas where construction would occur in areas with previously undisturbed soils.
Bioscience Facilities	No impacts to geology and soils	Same as No Action Alternative	Same as No Action Alternative, except: – Construction of Science Complex would impact about 840,000 cubic yards (640,000 cubic meters) of soil and rock for building excavation. – Excavated materials would be managed to minimize erosion and losses; backfill for DD&D buildings would be obtained at LANL or from nearby offsite sources. – Negative impact in the areas where construction would occur in areas with previously undisturbed soils.
Solid Radioactive and Chemical Waste Facilities (TA-50 and TA-54)	No impacts to geology and soils	Same as No Action Alternative	Same as No Action Alternative, except: – Waste Management Facilities transition would impact up to 169,000 cubic yards (129,000 cubic meters) of soil and rock for building excavation and construction. Option 1 (Accelerated Actions) would impact approximately 80,000 cubic yards (61,000 cubic meters) and Option 2 (Interim Actions) would impact up to 89,000 cubic yards (68,000 cubic meters), depending on whether Option 2a, 2b, or 2c were selected. – No impact to native soils because all areas were disturbed previously. – Positive impact due to removal of wastes, contaminated soils and reduction of legacy soil contamination at LANL. – Excavated materials would be managed to minimize erosion and losses; backfill would be obtained at LANL or from nearby offsite sources.
Radiography Facility (TA-55)	No impacts to geology and soils	Same as No Action Alternative	Same as No Action Alternative, except: – Construction of the New Radiography Building would impact up to 8,000 cubic yards (6,100 cubic meters) of soil and rock for building excavation. – No impact to native soils because all areas were disturbed previously. – Positive impact due to removal of contaminated soils and reduction of legacy soil contamination at LANL. – Excavated materials would be managed to minimize erosion and losses; backfill would be obtained at LANL or from nearby offsite sources.

DD&D = decontamination, decommissioning, and demolition; MDA = material disposal area; PRS = potential release site; TA = technical area.

5.2.1 No Action Alternative

Los Alamos National Laboratory Site-Wide Impacts

Volcanism and Seismic Activity

LANL operations under the No Action Alternative do not include activities that could modify the movement of magma, trigger volcanic activity, or increase the probability of seismic events (such as underground nuclear tests or operation of injection wells). This is unchanged from the *1999 SWEIS* impact analysis (DOE 1999a). The estimated potential for seismic impact to LANL facilities was updated in 2007 (LANL 2007a). The result is an increase in the probabilistic hazard that will require a review and update to the existing seismic hazard assessment for existing facilities.

Slope Stability, Subsidence, and Soil Liquefaction

The No Action Alternative does not include any new activities that would result in additional slope stability impacts. This is unchanged from the *1999 SWEIS* impact analysis (DOE 1999a). The potential for slope failure under this alternative is related primarily to increased stream downcutting, which may result from greater streamflow. The No Action Alternative does not include activities that would significantly increase streamflow, such as startup of new facilities or use of new industrial processes that discharge large volumes of water. Similarly, this alternative does not include any activities that would increase surface subsidence or the potential for soil liquefaction.

Soil Monitoring

The No Action Alternative does not include any activities that would appreciably increase the level of legacy contaminants (both chemical and radiological) in soils at the site. As discussed in Chapter 4, Section 4.2.3.1, the levels of legacy contaminants generally are decreasing over time as a result of contaminant decay, soil losses, improvements in LANL work practices, and environmental remediation.

Soil Erosion

The No Action Alternative does not include any activities that would significantly impact the potential for soil erosion. Construction activities yet to be undertaken under the No Action Alternative would continue using standard mitigation measures to minimize the effect of surface runoff and erosion.

Mineral Resources

The No Action Alternative would not affect the mineral resources in use at LANL. As discussed in Chapter 4, Section 4.2.4, the potential mineral resources at LANL are sand, gravel, tuff, and pumice deposits. These materials can be used for backfill or construction of evapotranspiration covers for environmental remediation projects. Under the No Action Alternative, the areas for proposed new construction activities are relatively small and would not impede the availability of borrow material. The only area being used for mineral resources, the East Jemez Road Borrow

Pit in TA-61 (Stephens and Associates 2005) would continue to be available under the No Action Alternative. At present, however, the pit is used to stockpile and manage materials from other areas; no quarrying is being conducted.

Technical Area Impacts

No activities planned under the No Action Alternative are expected to contribute additional impacts on geology and soils at any of the TAs.

Key Facilities

No activities planned under the No Action Alternative and related to construction or operations at any of the site's Key Facilities are expected to additionally impact geology and soils.

5.2.2 Reduced Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Geology and soils impacts under the Reduced Operations Alternative would be similar to those under the No Action Alternative.

Technical Area Impacts

Geology and soils impacts under the Reduced Operations Alternative with respect to the TAs would be similar to those under the No Action Alternative.

Key Facilities

High Explosives Testing Facilities

Compared to the No Action Alternative, the potential impact of LANL operations on soil contamination could decrease under the Reduced Operations Alternative due to a 20 percent reduction in activities at the High Explosives Testing Facilities.

5.2.3 Expanded Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Similar to the impacts expected under the No Action Alternative, LANL operations under the Expanded Operations Alternative would not be expected to impact the site with respect to volcanism, seismic activity, slope stability, subsidence, or soil liquefaction. Proposed activities (including facility construction and DD&D) would not significantly alter overall LANL subsurface conditions.

Volcanism and Seismic Activity

All proposed new facilities would be designed, constructed, and operated in compliance with the applicable DOE Orders, requirements, and governing standards established to protect public and worker health and the environment. DOE Order 420.1B (DOE 2005f) requires that nuclear or nonnuclear facilities be designed, constructed, and operated so that the public, the workers, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes. The Order stipulates the natural phenomena hazards mitigation requirements for DOE facilities and specifically provides for re-evaluation and upgrade of existing DOE facilities when there is a significant degradation in the safety basis for the facility. DOE Standard 1020-2002 (DOE 2002a) implements DOE Order 420.1B and provides criteria for the design of new structures, systems, and components, as well as for evaluation, modification, or upgrade of existing structures, systems, and components, to ensure that DOE facilities can safely withstand the effects of natural phenomena hazards such as earthquakes. The criteria specifically reflect adoption of the seismic design and construction provisions of the International Building Code for DOE Performance Category 1 and 2 facilities. The updated seismic hazard analysis completed in 2007 (LANL 2007a) presents increased estimated probabilistic seismic hazard for LANL. As a result, the hazard assessment for existing and planned facilities will be reviewed and updated so that these data can be used in facility design to meet DOE Orders, requirements, and governing standards.

Slope Stability, Subsidence, and Soil Liquefaction

Similar to the No Action Alternative, the Expanded Operations Alternative does not include any new activities that would result in additional slope stability impacts. This alternative also does not include activities that would significantly increase streamflow, such as startup of new facilities or use of new industrial processes that discharge large volumes of water. Similarly, this alternative does not include any activities that would increase surface subsidence or the potential for soil liquefaction. All new facilities built under this alternative would be located a sufficient distance away from steep slopes (such as canyon walls) and would use standard construction practices, as detailed in a text box in Appendix G, “Construction Work Elements,” to minimize the potential for slope failure.

Soil Monitoring

This alternative would decrease the level of legacy contamination at facility construction, DD&D, and MDA and PRS remediation sites, where excavated soil and rock would be monitored for contamination. Any contaminated materials would be managed according to the LANL environmental restoration and waste management programs. The overall effect would be to remove contaminated soil from LANL, thereby reducing the levels of legacy contamination onsite. The impact of removal would be much greater under the Expanded Operations Alternative than the No Action or Reduced Operations Alternatives due to the greater volume of soil to be excavated, monitored, and potentially removed as contaminated media.

At sites involving excavation or other soil disturbances, potential impacts on PRSs and PRS-affected areas could result. Prior to commencing any ground disturbance, potentially affected contaminated areas would be surveyed to determine the extent and nature of any contamination and required remediation in accordance with procedures established under the LANL Risk Reduction and Environmental Stewardship Remediation Program.

Soil Erosion

Under the Expanded Operations Alternative, facility construction and DD&D would impact geological materials. A total of approximately 3.2 million cubic yards (2.5 million cubic meters) of soil and rock would be impacted; however, over 90 percent of the material would be from areas already disturbed by present or past activities. This would minimize the impact to native soils (soils formed by natural processes and that are not impacted by construction or other anthropogenic activities). The impacts would include both facility footprints and support areas such as soil staging areas and construction equipment laydown yards.

Surface soils and unconsolidated sediments exposed in excavations would be subject to wind and water erosion if left exposed over time. In all instances, adherence to standard best management practices for soil erosion and sediment control, including watering during construction, would minimize soil erosion and loss. See Appendix G text box "Construction Work Elements" for description of additional examples. After construction, disturbed areas that have not been paved would be stabilized and/or revegetated and would not be subject to long-term soil erosion.

Mineral Resources

Projects and activities proposed under the Expanded Operations Alternative would significantly impact mineral resources at LANL due to the proposed closures of MDAs under the Consent Order[2] (NMED 2005) through either waste containment (via construction of evapotranspiration covers) or waste removal (via excavation and offsite disposal). If final covers were constructed at the MDAs and contaminated areas in TA-49 under the Capping Option, 750,000 to 2,000,000 cubic yards (570,000 to 1,500,000 cubic meters) of crushed tuff would be needed through 2016 depending on the required thickness of the covers. Up to 460,000 cubic yards (350,000 cubic meters) of additional rock, gravel, topsoil, and other bulk materials would be required for the final surface and erosion control. The total amount of geologic materials needed would be up to 2.5 million cubic yards (1.9 million cubic meters). Total impacts to soil and rock from possible construction of vertical and subsurface horizontal containment walls would be minor.

If the waste were removed under the Removal Option, approximately 1,300,000 cubic yards (1,000,000 cubic meters) of backfill would be needed to replace the excavated waste and contamination, as well as 61,000 cubic yards (47,000 cubic meters) of rock, gravel, topsoil, and other bulk materials used for erosion control and site restoration. An additional 220,000 to 600,000 cubic yards (170,000 to 460,000 cubic meters) of crushed tuff could be needed to cap remaining disposal units in Area G and contaminated areas in TA-49, as well as about 160,000 cubic yards (120,000 cubic meters) of additional bulk materials. The total amount of geologic materials needed would be up to 2.2 million cubic yards (1.7 million cubic meters). Total impacts to soil and rock from possible construction of vertical and subsurface containment walls would be minor.

---

[2] *NNSA is including impacts associated with Consent Order implementation in the SWEIS in order to more fully analyze the impacts resulting from Consent Order compliance. NNSA intends to implement actions necessary to comply with the Consent Order regardless of decisions it makes on other actions analyzed in the SWEIS.*

For economic and feasibility reasons, these materials would need to be produced from borrow pits and quarries in the LANL area (Stephens and Associates 2005). The only borrow pit now in use at LANL is the East Jemez Road Borrow Pit in TA-61. There would be sufficient tuff available for quarrying at the pit to provide the needed volumes of crushed tuff. Other sources available in the area would be required to provide other materials (such as soil and coarse material for erosion control) needed to complete MDA remediation. Borrow materials also could be collected from areas of opportunity on the site, such as facility construction or DD&D areas where excess uncontaminated excavated soils may meet backfill or capping criteria. The use of excavated soils as fill or cap material would minimize the need for additional borrow pits and the impacts to LANL soils and surface water, as well as the potential impact to groundwater from enhanced infiltration.

Security-Driven Transportation Modifications

The proposed Security-Driven Transportation Modifications Project would disturb up to 240,000 cubic yards (183,000 cubic meters) of soil and rock during construction. In addition, construction of both optional bridges under this proposal could disturb up to 28,000 cubic yards (21,000 cubic meters) of soil and rock.

Technical Area Impacts

Technical Area 3

Construction of the Replacement Office Buildings and the Physical Science Research Complex would impact about 868,000 cubic yards (664,000 cubic meters) of soil and rock due to building excavation. DD&D of existing facilities would reduce legacy contamination and potential soil erosion. Excavated materials would be managed to minimize erosion and losses, and backfill for DD&D buildings would be obtained at LANL or from nearby offsite sources. There would be negative impacts on areas where construction would affect undisturbed native soils.

Technical Area 21

Remediation of the MDAs in TA-21, as well as DD&D of structures, would occur in areas that are already disturbed by site activities so there would be no impacts on native soils. Additional fill materials would be obtained onsite or from nearby offsite sources. Completion of DD&D and MDA remediation would have a positive impact due to the removal of contaminated soils from the site and a reduction of legacy soil contamination at LANL.

Technical Area 61

As discussed above, the only borrow pit now in use at LANL is the East Jemez Road Borrow Pit in TA-61. The site containing the borrow pit currently covers approximately 43 acres (17 hectares). If all of the tuff materials required to support the MDA Capping Option at maximum thickness were taken from this borrow pit, 25 acres (10 hectares) of the pit would have to be excavated an average of 50 feet (15 meters). Under the MDA Removal Option, there would be a comparable maximum tuff requirement. The TA-61 borrow pit would need to be excavated an average of 50 feet (15 meters) over 24 acres (9.7 hectares).

Technical Area 72

Construction of the Remote Warehouse and Truck Inspection Station would require excavation of approximately 90,000 cubic yards (69,000 cubic meters) of soil and some of the underlying rock. The facility would be constructed in previously undisturbed areas, resulting in a negative impact due to the loss of native LANL soils. During construction, the excavated soil and rock would be managed to minimize erosion and losses. If necessary, backfill material would be obtained from LANL sources.

Key Facilities

Pajarito Site

DD&D and shutdown activities would have no impact to native soils because all areas were previously disturbed. After DD&D and shutdown were complete, there would be a positive impact due to the removal of contaminated soils from the site and a reduction of legacy soil contamination at LANL.

Bioscience Facilities

Construction of the Science Complex would impact about 840,000 cubic yards (640,000 cubic meters) of soil and rock due to building excavation. Although a similar volume of earthwork would be required under each of the three options for building this facility, the impact to native (undisturbed) LANL soils would depend on the option selected. Option 1 (Northwest TA-62 Site) and Option 2 (Research Park Site) would have the greater impact on LANL soils because the complex would be built in a relatively undeveloped area, resulting in excavation and disruption of the native soil material. Option 3 (South TA-3 Site) would have less impact on native LANL soils because the facility would be placed on an area presently occupied by a parking lot and on fill material previously placed at the site. There would be some impact to native LANL soils along the margins of facility construction under Option 3.

Materials excavated for facility construction would be managed to minimize erosion and losses. Backfill for facility construction would be obtained from LANL sources.

Radiochemistry Facility

Construction of the Radiological Sciences Institute would impact about 802,000 cubic yards (613,000 cubic meters) of soil and rock for building excavation. DD&D of existing facilities would reduce legacy contamination and potential soil erosion. Excavated materials would be managed to minimize erosion and losses and backfill for DD&D buildings would be obtained at LANL or from nearby offsite sources. There would be a negative impact on areas where construction would affect undisturbed native soils.

Radioactive Liquid Waste Treatment Facility

Construction of a Radioactive Liquid Waste Treatment Facility would impact up to 95,000 cubic yards (73,000 cubic meters) of soil and rock for building excavation. Another 69,000 cubic yards (53,000 cubic meters) of soil and rock would be impacted by construction of evaporation tanks and a pipeline. DD&D of the North or South Annexes would reduce legacy contamination and potential soil erosion. Excavated materials would be managed to minimize erosion and losses, and any additional backfill required would be obtained at LANL or from nearby offsite sources. There would be a negative impact on areas where construction would affect undisturbed native soils.

Solid Radioactive and Chemical Waste Facilities

Waste Management Facilities Transition activities primarily would involve work within TA-54, TA-50, and TA-63. Earthmoving operations would impact 80,000 to 169,000 cubic yards (61,000 to 129,000 cubic meters) of soil and rock; the total volume impacted would depend on the combination of Option 1 and Option 2a, 2b, or 2c. Option 1 (accelerated removal and disposition of wastes with supporting removal, relocation, and replacement of applicable facilities) would impact approximately 80,000 cubic yards (61,000 cubic meters) of rock and soil. The impacts of Option 2 (interim actions necessary for meeting Consent Order and other options) impacts would be additional to those under Option 1. Option 2a would impact approximately 89,000 cubic yards (68,000 cubic meters) of additional soil and rock for facility construction. Option 2b would impact approximately 82,000 cubic yards (63,000 cubic meters), and Option 2c would have a negligible impact on soil and rock because an additional facility would not be constructed.

There would be minimal loss of native LANL soils because the activities would occur in areas previously disturbed by LANL activities. During construction, excavated soil and rock would be managed to minimize erosion and losses. If necessary, backfill material would be obtained from LANL sources. The necessary backfill volume would not significantly deplete geological resources at LANL. There also would be a positive impact from the removal of wastes and contaminated soil from LANL, as well as a reduction in legacy soil contamination.

TA-55 Radiography Facility

Relocation of high-energy x-ray radiography into a TA-55 Radiography Facility would impact up to 8,000 cubic yards (6,100 cubic meters) of soil and rock. The construction would be at the site of the former Building TA-55-41, so there would be no impact to native LANL soils. During construction, best management practices would be implemented to prevent erosion and migration of disturbed materials from the site caused by stormwater, other water discharges, or wind. Uncontaminated backfill would be stockpiled at an approved material management area at LANL for future use.

5.3 Water Resources

Water resource impacts considered in this section include changes in surface water quality and quantity, sediments, floodplains, and groundwater quality and quantity.

5.3.1 Surface Water

Surface water quality is measured using sampling data from National Pollutant Discharge Elimination System (NPDES) outfalls, stormwater flows, and watershed monitoring stations. As it is difficult to predict future sampling results, a qualitative analysis of actions that could affect those results was performed based on patterns observed from previous actions. For example, one of the effects expected from installing a new treatment system at the Radioactive Liquid Waste Treatment Facility would be a reduction in the number of downstream surface water samples containing detectable levels of the treated constituents. The effect may not be immediate if effluents are diluted by perennial or stormwater flows, but the long-term effect would be improved surface water quality in that canyon, a significant beneficial impact.

A potential source of surface water contamination is the sediment located in certain canyon bottoms. Sampling results following the Cerro Grande Fire showed that unusually large volumes of stormwater could mobilize contaminants in sediment and transport them for long distances downstream. Actions that could increase surface water volumes would likely mobilize contaminated sediment, which would have potentially adverse effects on surface water quality.

Surface disturbance from construction activities could remove protective vegetative or other earth cover, loosen soil particles, and generate accelerated erosion that could result in sediment entering the waterways. For this analysis, it was assumed that accelerated erosion from surface disturbance during construction would be minimized by installation and maintenance of erosion and sediment controls specified in Stormwater Pollution Prevention Plans, in compliance with state and Federal regulations under the Clean Water Act, including the NPDES Construction General Permit and Section 404 and Section 401 permits.

Stormwater volumes could be directly affected by LANL construction due to changes in the size of impervious areas that affect runoff flow rates and volumes. Changes in LANL effluent discharges from the NPDES outfalls can affect the quantity of flow in sections of the canyons. The surface water flows in various canyons could be affected if some of the flood structures from the Cerro Grande Fire were removed.

To calculate the changes in runoff volume under each alternative, it is first necessary to estimate the acreage of the impervious area in each watershed located near the LANL facilities to be constructed; however, the proposed facility designs are not developed to the point where the footprint sizes of the facilities are usable for that purpose. Stormwater management controls, including mitigation measures for increased stormwater flows and sediment loads, are required as part of LANL's construction specifications (LANL 2004b). For this analysis, it was assumed that new construction would include installing construction site stormwater controls, so there would be only minor increases in sediment-laden runoff reaching the canyons.

The environmental consequences of LANL actions under the different alternatives could impact surface water quality, surface water quantity, floodplains and wetlands, and sediments. Impacts on wetlands are discussed in Section 5.5 because wetlands are an important habitat for diverse flora and fauna. **Table 5–4** summarizes the expected surface water impacts for each of the three alternatives.

Table 5–4 Summary of Environmental Consequences on Surface Water

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
		LANL Site	
	Land Transfer − Negligible impact on surface water quality and floodplains (White Rock Y and Rendija Canyon).	Same as No Action Alternative	Same as No Action Alternative
	Wildfire Hazard Reduction Program − Minor impact on surface water quality, quantity, and floodplains. Beneficial long-term effects due to wildfire risk reduction.		Same as No Action Alternative
	Flood Structures Removal − Minor beneficial impact on surface water quality and quantity. − Temporary adverse impact on Pajarito floodplains due to removal of structures that retained flow and sediment. Restoration of normal flow would cause sediments to alter channel and readjust floodplains.		Same as No Action Alternative
	Security Perimeter Project − Minor impact on surface water quality if soil contaminants mobilized.		Same as No Action Alternative
	MDA Remediation LANL's environmental restoration program continues, but no significant remediation of MDAs occurs.		Actions taken in compliance with the Consent Order with respect to MDA remediation would ensure water quality is protected (long-term) by removal or stabilization of potential contamination sources.
		TAs	
TA-21	No impact on surface water quality.	Same as No Action Alternative	DD&D of the Steam Plant and the Tritium Science and Fabrication Facility would result in removal of two NPDES-permitted outfalls. Minor impact on surface water quantity in Los Alamos Canyon, but little to no impact on surface water quality.
TA-46	Significant beneficial impact on surface water quality and quantity in Sandia Canyon from recycling Sanitary Wastewater Systems Plant outfall volume for use in cooling towers.	Same as No Action Alternative	Same as No Action Alternative

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
Key Facilities			
High Explosives Testing Facilities – Dynamic Operations Complex	Minor beneficial impact on surface water quality due to shot containment.	Minor impact on surface water quantity in Water Canyon due to reduction of operations. Minor beneficial impact on surface water quality by discharge reduction.	Same as No Action Alternative.
Radioactive Liquid Waste Treatment Facility (TA-50)	No impact on surface water quality.	Same as No Action Alternative	Although increased pit production would increase the Radioactive Liquid Waste Treatment Facility outfall volumes by 25 percent, this would have a negligible effect on surface water volumes in Mortandad Canyon because other facilities contribute 90 percent of the outfall flow in that canyon. Implementing the zero discharge option at the Radioactive Liquid Waste Treatment Facility would have a minor effect on surface water volume, but would improve surface water quality by reducing the movement of historical contaminants in the sediments downstream of that outfall.
LANSCE (TA-53)	No impact on surface water quality.	Effects may be temporary or permanent, if shut down. Significant beneficial impacts in Los Alamos Canyon due to shutdown of operations and removal of two NPDES – permitted outfalls.	Same as No Action Alternative.
Pajarito Site (TA-18)	No impact on surface water quality.	Same as No Action Alternative.	DD&D would have minor beneficial impact on surface water quality by removing potential contaminant sources. Minor impact to Pajarito Canyon floodplains by removing TA-18-184 building obstruction.

MDA = material disposal area; TA = technical area; DD&D = decontamination, decommissioning, and demolition; NPDES = National Pollutant Discharge Elimination System; LANSCE = Los Alamos Neutron Science Center.

LANL NPDES outfall volumes affect surface water quantities and could be altered by the proposed LANL activities. Although direct impacts from changes to effluent discharges are usually localized to a short section within a canyon, such changes could affect the entire downstream drainage system. Changes to effluent discharges under each alternative were compared to the baseline for NPDES outfall volumes in each canyon, as calculated from the totalized or estimated average flows from 2002 through 2005. **Table 5–5** summarizes the estimated outfall volumes for the three alternatives evaluated. The assumptions used to calculate the projected changes in outfall volumes for each alternative are listed at the end of Table 5–5.

Changes in outfall volume within a canyon of less than 5 percent of current flows are considered negligible, and changes of greater than 40 percent are considered significant. The greater-than-40-percent threshold for significance was selected specifically for this SWEIS to provide a measure of change that was based on past changes that made a difference to water quality and quantity. In those canyons where flows are typically relatively low, outfall changes are predicted to affect both water quality and quantity downstream.

5.3.1.1 No Action Alternative

Los Alamos National Laboratory Site-Wide Impacts

To reduce the potential impacts of LANL activities on water resources, LANL has several programs that monitor and protect surface water quality and quantity. Under the No Action Alternative, the NPDES industrial permit was modified (EPA 2007b) to reduce the total number of outfalls from 21 to 17. The four outfalls that were removed from the permit (03A024, 05A097, 03A047, and 03A049) have not discharged effluent in recent years, so no direct impacts to water quality or flow volumes in the canyons would result.

When NNSA determines that site conditions have returned to pre-Cerro Grande Fire conditions, the aboveground portion of the flood retention structure and the entire steel diversion wall upgradient of TA-18 would be removed via the Flood Structures Removal Project (DOE 2002j). Best management practices would be implemented during the controlled demolition and removal of the flood control structures to control disturbed sediment that might enter the watercourse during construction. No excavation or demolition debris would be placed in or near drainages or in the Pajarito Canyon floodplain, so the potential for surface water contamination after construction would be minimal (DOE 2002j). After removal of the flood control structures in Pajarito Canyon is completed, the potential for sediment transport would increase in the short term as the channel adjusts to the change (LANL 2002c).

Continued maintenance of the low-head weir and detention basin in Los Alamos Canyon and the road reinforcements above Pajarito, Twomile, Los Alamos, and Water Canyons would minimize adverse impacts to surface water quality and the floodplains in those canyons even if the Flood Structures Removal Project were implemented. Long-term stabilization at the sites of the removed structures using recontouring and reseeding would protect surface water quality in Pajarito Canyon. Sediment and water sampling in the canyons would monitor potential contamination and trigger remedial actions, if needed (DOE 2002j).

Table 5–5 Estimated National Pollutant Discharge Elimination System Permitted Discharges by Facility and Canyon (million gallons per year)

Facility	*No Action Alternative*	*Reduced Operations Alternative*	*Expanded Operations Alternative*
Los Alamos Canyon			
Tritium Facilities – 2 outfalls	17.4	17.4	0.0 [a]
LANSCE – 3 outfalls	28.2	0.0 [b]	28.2
Canyon Total	45.6	17.4	28.2
Sandia Canyon			
Sigma Complex – 1 outfall	0.0 [c]	0.0 [c]	0.0 [c]
LANSCE – 1 outfall	1.3	0.0 [b]	1.3
Nicholas C. Metropolis Center for Modeling and Simulation (Metropolis Center) – 1 outfall	13.6	13.6	17.7 [d]
Non-Key Facilities – 3 outfalls	172.4	172.4	172.4
Canyon Total	187.3	186.0	191.4
Mortandad Canyon			
Chemistry and Metallurgy Research Building –1 outfall	1.9	1.9	1.9
Sigma Complex – 1 outfall	5.8	5.8	5.8
Plutonium Complex– 1 outfall	4.1	4.1	4.1
Radioactive Liquid Waste Treatment Facility– 1 outfall	4.0	4.0	5.0 [e]
Non-Key Facilities – 1 outfall	28.5	28.5	28.5
Canyon Total	44.3	44.3	45.3
Water Canyon (including Cañon de Valle)			
High Explosives Processing – 3 outfalls	0.06	0.05 [f]	0.06
High Explosives Testing – 2 outfalls	2.2	1.8 [g]	2.2
Canyon Total	2.26	1.81	2.26
Subtotal Key Facilities (including the Metropolis Center)	78.6	48.6	66.2
Non-Key Facilities	200.9	200.9	200.9
Totals	279.5	249.5	267.1

LANSCE = Los Alamos Neutron Science Center.
Assumptions used to predict outfall volumes:
[a] Zero discharge based upon removal of TA-21 buildings including the Steam Plant Outfall and the Tritium Science and Fabrication Facility Outfall.
[b] Zero discharge based upon safe shutdown of LANSCE.
[c] This outfall has not discharged any effluents in recent years and has been proposed for removal from the National Pollutant Discharge Elimination System permit.
[d] 30 percent increase in cooling water based upon operation of a third cooling tower.
[e] 25 percent increase based upon increased activity of facilities that generate radioactive liquid waste.
[f] 20 percent decrease based upon 20 percent reduction in high explosives processing.
[g] 20 percent decrease based upon 20 percent reduction in high explosives testing.
Note: To convert gallons to liters, multiply by 3.78533. Totals may not add due to rounding.
Sources: EPA 2007b, LANL 2006a, 2006h.

The removal of fuels through the Wildfire Hazard Reduction Program would improve forest health, stabilize the watersheds, and reduce the long-term potential for wildfires. This would beneficially impact surface water quality because wildfires destroy the vegetation that stabilizes the soil and promotes stormwater infiltration. Fewer wildfires would reduce the potential for stormwater runoff eroding soil and mobilizing contaminants (DOE 2000e), and thus the potential for surface water contamination from high sediment loads in stormwater. Reducing the potential for wildfire also would limit other adverse impacts to surface water quality such as scoured stream channels that alter the extent of floodplains. Potentially adverse impacts resulting from tree cutting, chipping, and slash pile burning in the floodplains (performed as part of the Wildfire Hazard Reduction Program) would be mitigated through required environmental protection measures (DOE 2000e).

Construction activities associated with the Security Perimeter Project (DOE 2003a; NNSA 2004a, 2005a) could require compliance with Section 404 and Section 401 permits, thereby requiring provisions to protect the watercourse from potential increased runoff and sediments during bridge construction (although previously analyzed, a bridge is not included in current plans). Adverse impacts on surface water quality due to construction on the canyon walls, as well as access control and traffic improvements near the watercourse, would be minimized through implementation of a Stormwater Pollution Prevention Plan to control soil erosion in accordance with the NPDES Construction General Permit. Such best management practices could include the use of silt fences, straw bales, and check dams.

The Security Perimeter Project would have a minor beneficial effect on surface water quality if the PRSs at solid waste management units located in the proposed bypass road corridors were remediated, which would include removing contaminants found in the drainage pathway from a chemical (polychlorinated biphenyls) storage area. There would be a negligible adverse effect from increased stormwater runoff over the new impervious road surfaces that would allow additional flows containing potential contaminants.

Continuing the LANL environmental restoration program in existence before the 2005 Consent Order would cause the removal of contaminated soil and sediment, and thus have a positive impact on surface water quality.

Management of construction fill would have no effect on surface water quality. Construction fill would be stored at existing borrow areas at TA-16 and TA-61. Best management practices would be employed to protect surface waters.

Technical Area Impacts

NPDES-permitted outfalls would be maintained at four non-Key Facilities: the TA-3 Power Plant (001); the TA-3 Laboratory Data Computing Center cooling tower outfall (03A199); the Sanitary Wastewater Systems Plant at TA-46 (13S), which routes its effluent through storage tanks at TA-3 for recycling or discharge; and a cooling tower outfall at TA-35 (03A160). Total effluent discharges from these outfalls would continue to be lower than the 1999 actual volumes, although individual facilities could have higher volumes. If the Sanitary Effluent Recycling Facility for supplying water to cooling towers at the Metropolis Center becomes effective, reduced NPDES-outfall volumes and associated contaminants from the TA-46 Sanitary Wastewater System Plant would have a significant beneficial impact on surface water quality and quantity in Sandia Canyon (LANL 2006a).

Key Facilities Impacts

Sigma Complex

At the Sigma Complex, one cooling tower NPDES outfall (03A024) has been removed. There has been no flow from this outfall in recent years, so flow volumes in Mortandad Canyon, where this effluent discharged, would not be affected. The Sigma Complex would retain a separate cooling water outfall into Sandia Canyon (03A022) (LANL 2006a).

High Explosives Processing Facilities

At the High Explosives Processing Facilities, one NPDES outfall (05A097) has been removed. There has been no flow from this outfall in recent years, so flow volumes in Water Canyon, where this effluent discharged in the past, would not be affected. The high explosives outfall from the High Explosives Wastewater Treatment Facilities (05A055) at TA-16 and the cooling water outfall (03A130) at TA-11 would continue discharging treated effluent into Water Canyon (LANL 2006a).

High Explosives Testing Facilities

At the High Explosives Testing Facilities, use of foam at the Dual Axis Radiographic Hydrodynamic Test site has reduced impacts to surface water quality from depleted uranium contamination by containing 75 percent of experimental material from shots (LANL 2001d). Enhanced containment of shot debris and augmented cleanup of debris from uncontained shots would have a minor long-term beneficial effect on water quality because it would reduce the potential contaminants that could be mobilized by stormwater.

Los Alamos Neutron Science Center

At the Los Alamos Neutron Science Center (LANSCE), a project to upgrade the cooling towers would reduce the number of cooling tower outfalls at the facility from four to two. Outfalls 03A047 and 03A049 have been removed from the NPDES permit. There has been no flow from the older cooling towers in recent years, so flow volumes in Los Alamos Canyon would not be affected.

5.3.1.2 Reduced Operations Alternative

Most of the same impacts on surface water quality and quantity resulting from actions discussed under the No Action Alternative also would occur under the Reduced Operations Alternative, except those explicitly associated with the reduced ordnance operations.

Key Facility Impacts

Under the Reduced Operations Alternative, impacts to surface water quality would be the same as those described under the No Action Alternative, with the exception of the impacts described below. There would be little or no effect on floodplains from changes to Key Facilities.

High Explosives Processing Facilities

Reduced operations at the High Explosives Processing Facility would have little or no effect on surface water quality or quantity. Effluent volumes from the High Explosives Wastewater Treatment Facility (05A055) and the cooling water (03A130) NPDES outfalls would be reduced by about 20 percent, but their expected flows (less than 0.05 million gallons per year [0.2 million liters] or less than 3 percent of the total effluent discharged in Water Canyon) are not large enough to produce significant beneficial impacts to surface water.

High Explosives Testing Facilities

Reduced operations at the High Explosives Testing Facilities would result in minor beneficial effects on local surface water quality and quantity. Expected effluent flows from the cooling water NPDES outfalls (03A028 and 03A185) into Water Canyon would be reduced about 20 percent from 2.2 million gallons (8.3 million liters) per year to about 1.8 million gallons (6.7 million liters) per year. The percentage change in flow volumes from these reduced operations would not exceed the significance threshold for surface water quantity in Water Canyon.

Los Alamos Neutron Science Center

Surface water impacts from shutting down operations at LANSCE may be short-term or permanent. Shutdown of LANSCE would significantly reduce the surface water quantity in Los Alamos Canyon compared to the No Action Alternative. Cooling water NPDES outfalls from LANSCE contribute about 60 percent of the effluent flowing into Los Alamos Canyon. Shutdown of LANSCE would have a negligible effect on Sandia Canyon, resulting in approximately 1 percent less effluent flow than under the No Action Alternative. This would beneficially impact surface water quantity in both canyons because reduced flows could mobilize fewer contaminated sediments.

5.3.1.3 Expanded Operations Alternative

The same surface water quality and quantity impacts resulting from actions discussed under the No Action Alternative also would occur under the Expanded Operations Alternative.

Los Alamos National Laboratory Site-Wide Impacts

Beneficial impacts to surface water quality would follow remediation of MDAs and other PRSs. Construction of MDA final covers under the Capping Option or removal operations under the Removal Option would disturb soils and remove stabilizing vegetation temporarily. In compliance with the terms of the NPDES Construction General Permit, installation of erosion control measures described in Stormwater Pollution Prevention Plans would minimize erosion and offsite sedimentation during construction.

Following closure of the MDAs, surface water quality would gradually improve as corrective measures remove or stabilize potential sources of contamination from release sites (see Appendix I). The Capping Option and the Removal Option would decrease the risk of surface water contamination more than the No Action Alternative because additional potential contamination sources at MDAs and PRSs would be avoided or eliminated.

Technical Area Impacts

DD&D of buildings at TA-21 would eliminate both the Tritium Science and Fabrication Facility and the Steam Plant, which both discharge industrial effluent into Los Alamos Canyon. As these are the only TA-21 outfalls, discharges from this TA would be eliminated in the Expanded Operations Alternative. The impact on surface water quantity in Los Alamos Canyon would be minor, as these effluents are less than 40 percent of the discharges into that canyon. Removal of these sources would have little to no impact on surface water quality, because the majority of the effluent comes from boiler blowdown and cooling water, which does not contain many contaminants.

Key Facilities Impacts

Under the Expanded Operations Alternative, impacts to surface water quality would be the same as described under the No Action Alternative, except as described below. Construction of a new Radioactive Liquid Waste Treatment Facility, two bridges, other building construction, and demolition of the existing annexes would have little or no adverse impact on surface water quality due to installation of stormwater management and erosion and sediment controls based on compliance with site-specific Stormwater Pollution Prevention Plans and LANL's construction specifications.

Radioactive Liquid Waste Treatment Facility

Proposed increased discharges from the Radioactive Liquid Waste Treatment Facility outfall resulting from increased activity at facilities that generate radioactive liquid waste (see Table 5–5) would result in about a 25 percent higher effluent discharge rate into Mortandad Canyon from that facility, compared to the No Action Alternative. This increase would have a negligible effect on Mortandad Canyon, as the Radioactive Liquid Waste Treatment Facility effluent currently accounts for about 9 percent of LANL's discharges into that canyon. This percentage of overall flow contribution would only increase to 11 percent at the higher discharge rate. Contaminant transport through sediment mobilization could be enhanced due to the increased outfall discharge rate. Cooling water discharges are the only other LANL effluents introduced into Mortandad Canyon.

Operation of a new Radioactive Liquid Waste Treatment Facility would have a beneficial impact on surface water quality because the improved low-level radioactive waste and transuranic waste processes would reduce the contaminant concentrations in the effluent discharged into Mortandad Canyon to levels that could meet potentially more stringent future water quality standards. An auxiliary action, which could be applied to any of the options for the new Radioactive Liquid Waste Treatment Facility, is to construct evaporation tanks and eliminate discharges into Mortandad Canyon. If the facility thus becomes a zero discharge facility, surface water quality would be positively affected. Elimination of effluent flows into the canyon at the Radioactive Liquid Waste Treatment Facility outfall would minimize the potential for contaminated sediments to become mobilized in streams, resulting in a beneficial impact to downstream surface water quality. There would be a minor reduction in surface water quantity in Mortandad Canyon if the Radioactive Liquid Waste Treatment Facility outfall were eliminated. Floodplain size would not be affected by this project.

Pajarito Site

Under the Expanded Operations Alternative, unneeded structures at TA-18 would be removed, thereby removing potential contamination sources from an area where they could be flooded. Parts of TA-18 lie within the 100-year floodplain for Pajarito Canyon. For example, the building that houses the Solution High-Energy Burst Assembly (SHEBA) is partially within the floodplain boundary. Although the possibility of floodwater mobilizing contaminants from the buildings is remote, complete removal of potential contaminant sources would protect surface water quality.

5.3.2 Groundwater Resources

Alternatives evaluated in the SWEIS have the potential to impact the quality of groundwater and the quantity of water available in aquifers. Groundwater quality can be affected by radionuclides and chemicals in liquid and solid waste that infiltrate into the ground. The quantity of groundwater available can be affected by changes in recharge rates and water supply well withdrawal rates. This section addresses potential impacts to groundwater from liquid effluent releases to the canyons and from solid radioactive waste disposal on the mesa tops. In addition, the effects of changes in recharge rates and water supply well withdrawal rates on water levels in the aquifer are discussed.

Impacts to the regional aquifer in the LANL area are generally measured over many years, primarily due to the long time necessary for contaminants to flow through the rock into the regional groundwater and the relatively small volume of water transported through the vadose zone in this arid climate. For the *1999 SWEIS*, significant adverse impacts to the regional aquifer were defined as changes to groundwater that alter the contaminant levels in concentrations above the drinking water standards in a way that can affect human health and safety. This could occur if any of the activities under consideration in the three SWEIS alternatives increase the flow rate of contaminants entering the deep groundwater.

Impacts to the alluvial groundwater are likely to occur more rapidly and could be affected either beneficially or adversely by changes to outfall flows from LANL. Some of the surface water carrying contaminants enters the alluvial groundwater system through canyon bottoms. Although surface-to-subsurface infiltration is fairly rapid in the canyons, any contaminants carried by the surface water are diluted by the large volume of water already stored in the ground; conversely, uncontaminated surface water infiltrating into already contaminated groundwater would cause its dilution over time.

Impacts to the alluvial aquifer may be considered significant if the concentrations of contaminants are altered in relation to the New Mexico and U.S. Environmental Protection Agency (EPA) groundwater standards for irrigation and other non-drinking-water uses. An adverse impact to the alluvial aquifer would be significant if, as a result of any of the activities proposed in the alternatives, contaminant levels increase so that the perched groundwater no longer meets state and Federal standards. A significant beneficial impact could occur if contaminant levels were reduced below these standards.

There are still uncertainties about how waterborne contaminants interact with and move through rock fractures and the rock matrix into the regional aquifer below LANL. There also are uncertainties about the chemistry, volumes, and infiltration rates of liquid wastes from past releases into the canyon bottoms and onto disturbed ground at the MDAs. LANL will be conducting future data collection activities, along with further analysis of existing data, to better define the interaction between groundwater and the rock matrix. It is expected that the new data, coupled with improvements in numerical flow and transport models and calculation techniques, will enable better prediction of flow and transport of groundwater in the LANL region and more accurate definition of the ultimate impacts on the regional groundwater resources below LANL. This new information is being used to update the performance assessment and composite analysis for the Area G low-level radioactive waste disposal facility. Flow and transport of contaminants to the regional aquifer are discussed in more detail in the surface water and groundwater sections in Chapter 4 and in the hydrogeologic and numerical modeling sections in Appendix E. **Table 5–6** summarizes the expected groundwater impacts for each of the three alternatives.

Table 5–6 Summary of Environmental Consequences on Groundwater

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
LANL Site			
	Construction and DD&D activities are unlikely to affect groundwater resources due to their short duration and the small quantity of contaminants that could be released and ultimately infiltrate to groundwater. Operations-related activities, including the planned reduction of LANL outfalls, would slightly reduce the transport of contaminants into the groundwater. No significant impacts to groundwater are expected to result in the short term. Long-term impacts to groundwater are not likely to be significant.	Similar to the No Action Alternative in terms of construction and DD&D activities. The long-term impacts of operations might be reduced by eliminating additional outfalls in the canyons.	Similar to the No Action Alternative plus: *MDA Remediation* – The effects of capping or removal of waste from MDAs would not appreciably change the rate of transport of contaminants presently in the vadose zone in the short term, but would likely reduce long-term contaminant migration and impacts on the environment.

DD&D = decontamination, decommissioning, and demolition; MDA = material disposal area.

5.3.2.1 No Action Alternative

Los Alamos National Laboratory Site-Wide Impacts

The No Action Alternative would continue current operations. Therefore, there would be little change in the flow of contaminants to the alluvial or regional groundwater as a result of the No Action Alternative. Proposed construction and demolition activities are unlikely to affect the groundwater resource due to their short duration and the small quantity of contaminants that could be released and ultimately infiltrate to underground water resources. As described in Section 5.8.2.1, under the No Action Alternative, 388 million gallons (1,469 million liters) per year of groundwater would be used, which is within the range of LANL's water use over the last 7 years (see Section 4.8.2.3), and within the LANL annual water use ceiling quantity of

542 million gallons (2,050 million liters). Therefore, additional impacts to water levels in the regional aquifer are not expected.

Groundwater is unlikely to be adversely affected in the short term by the No Action Alternative because discharges of liquid effluent have been curtailed substantially compared to past operations, and solid radioactive waste disposal on the mesa tops takes many years to affect the regional aquifer. As discussed in Section 5.3.1, discharges resulting from LANL operations are monitored to ensure that effluents to surface waters are kept below regulatory limits. In addition, as discussed in Section 4.3.2, groundwater is monitored to ensure that instances of contamination are investigated, understood, and mitigated, and that existing contamination does not impact drinking water sources.

Long-term impacts to groundwater are complex and require modeling to predict potential contaminant migration thousands of years in the future. At the waste disposal locations on the mesa tops, dry conditions coupled with porous flow and transport result in slow, unsaturated flow and contaminant transport. Annual net natural infiltration rates for dry mesas are estimated to be less than 0.4 inches per year (10 millimeters per year), and more often are estimated to be closer to 0.04 inches per year (1 millimeter per year) or less. Under these conditions, travel times for contaminants percolating downward beneath the plateau to the regional aquifer are expected to be several hundred to thousands of years. Site disturbance, however, can alter the speed of water moving through the vadose zone (Birdsell et al. 2005).

Although a sitewide groundwater model is still under development, groundwater modeling was performed for a performance assessment and composite analysis prepared for radioactive waste disposal at Area G (LANL 1997a). The impacts analysis assumed the continued existence of the interim covers currently covering the waste disposal units. The groundwater protection analysis analyzed performance over a period of 10,000 years to provide reasonable assurance that the groundwater protection performance objective could be met. The model predicted that there would be no offsite doses from the groundwater pathway during the institutional control period because no radionuclides were transported beyond the current LANL boundary within 100 years. Groundwater ingestion doses projected in the performance assessment were small, with only three contributing radionuclides (carbon-14, technetium-99, and iodine-129). The peak annual dose at 330 feet (100 meters) downgradient from Area G was 1.4×10^{-5} millirem at 4,000 years. The peak annual dose at the Pajarito Canyon location was 4.5×10^{-5} millirem at 700 years. These peak annual doses are well below the 4 millirem per year standard for groundwater protection (LANL 1997a).

Under the No Action Alternative, MDA H would be closed. The DOE-preferred closure option was to close MDA H in place and cover it with an engineered evapotranspiration cover that would be designed, constructed, and maintained to limit infiltration and slow contaminant migration from the MDA. The environmental assessment (EA) for the proposed corrective measures at MDA H concluded that neither surface nor groundwater quality would be adversely affected over the next 1,000 years (DOE 2004e). In its selection of a corrective remedy, the New Mexico Environment Department acknowledged that an evapotranspiration cover would be effective in reducing or limiting the amount of water that would percolate into the shafts under design conditions, but had concerns about the potential for intrusion into the waste by deep-rooted plants and burrowing animals, and for groundwater contamination from volatile organic compounds and tritium in soil pore gas. The selected remedy therefore requires complete encapsulation of the disposal shafts, installation of an engineered evapotranspiration cover, and installation of a soil vapor extraction system (NMED 2007b).

5.3.2.2 Reduced Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Most impacts to groundwater resources occurring under the No Action Alternative would also occur under the Reduced Operations Alternative. Impacts might be reduced by elimination of some outfalls to the canyons and reduction of water supply well withdrawals, but no quantitative estimate of the impact of these reductions can be made.

5.3.2.3 Expanded Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Impacts to groundwater resources occurring under the No Action Alternative would be similar to those under the Expanded Operations Alternative. Direct and indirect impacts to groundwater resulting from the proposed construction and operations under the Expanded Operations Alternative also would be similar, but greater than those described for the No Action Alternative. As described in Section 5.8.2.3, under the Expanded Operations Alternative 522 million gallons (1,980 million liters) per year of groundwater would be used, which would be greater than the range of LANL's water use over the last 7 years (Section 4.8.2.3), but within the range of LANL's water use over the last 14 years (LANL 2003h). Water use under the Expanded Operations Alternative would be within the LANL annual water use ceiling quantity of 542 million gallons (2,050 million liters). Therefore, impacts to water levels in the regional aquifer would be within historical levels.

Increased pit production under the Expanded Operations Alternative would have little to no impact on groundwater resources. Although increased pit production would generate larger volumes of waste liquids than those projected for the No Action Alternative, for either alternative the waste liquids would be processed at the Liquid Radioactive Waste Treatment Facility in TA-50. Treated liquid effluent from the Liquid Radioactive Waste Treatment Facility would be discharged from an NPDES-permitted outfall. Alternatively, under a proposed auxiliary action, discharge of liquid effluents from the Radioactive Liquid Waste Treatment Facility would be eliminated by the construction and use of evaporation tanks (see Appendix G, Section G.4).

Possible impacts to groundwater resources will be addressed as part of any required corrective measure evaluation performed for MDAs and other PRSs in accordance with the Consent Order. A corrective measure evaluation for an MDA would consider both capping and removal, two bounding options for MDA remediation that were considered in Appendix I. LANL management would recommend remedies for each MDA (or other PRSs subject to the Consent Order), and the New Mexico Environment Department would determine the remedy to be applied. A corrective measure evaluation performed for MDA G in TA-54 would be coordinated with an update to the performance assessment and composite analysis that is currently being prepared. In addition to providing more recent information about the site and the contents of the disposal units, this update would consider the application of a final cover over the disposal units. Once the new performance assessment and composite analysis becomes available, the results will be reviewed in accordance with the NEPA process, and the SWEIS impact analyses will be reviewed and supplemented as necessary.

The effects of either the Capping or the Removal Option would not appreciably affect the rate of transport of contaminants presently in the vadose zone in the near term, but would likely reduce long-term migration of contaminants and corresponding impacts on the environment from wastes present in the MDAs. Under the MDA Capping Option, where engineered barriers are used to cap MDAs, the covers would be designed, constructed, and maintained to limit infiltration. Over the long term, the covers, by limiting infiltration, would slow contaminant migration from the MDAs. Under the MDA Removal Option, excavation and removal of the waste and contaminated soil and rock would eliminate nearly all of the source term. The filled, compacted excavation, however, may still experience larger infiltration rates than undisturbed areas, which might further drive migration of deeper contaminants that are beyond the reach of conventional excavation. Under either MDA remediation option, impacts to the regional aquifer would likely be small, as described under the No Action Alternative.

5.4 Air Quality and Noise

5.4.1 Nonradiological Impacts

Air pollution refers to the direct or indirect introduction of any substance into the air that could:

- endanger human health,
- harm living resources and ecosystems,
- damage material property, or
- impair or interfere with the comfortable enjoyment of life and other legitimate uses of the environment.

For the purpose of this SWEIS, only outdoor air pollutants were addressed. These may be in the form of solid particles, liquid droplets, gases, or a combination of forms. Generally, they can be categorized as primary pollutants (those emitted directly from identifiable sources) and secondary pollutants (those produced in the air by interaction between two or more primary pollutants or by reaction with normal atmospheric constituents that may be influenced by sunlight). Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Thus, air quality is affected by air pollutant emission characteristics, meteorology, and topography.

Ambient air quality in a given location can be described by comparing the concentrations of various pollutants in the atmosphere with the appropriate standards. Ambient air quality standards have been established by Federal and state agencies to ensure an adequate margin of safety for the protection of public health and welfare from the adverse effects of pollutants in the ambient air. Pollutant concentrations higher than the corresponding standards are considered unhealthy; those below such standards are generally considered acceptable.

The pollutants of concern are primarily those for which Federal and state ambient air quality standards have been established, including criteria air pollutants, hazardous air pollutants, and other toxic air pollutants. Criteria air pollutants are those listed in National Primary and Secondary Ambient Air Quality Standards (40 *Code of Federal Regulations* [CFR] Part 50). Hazardous air pollutants are those listed in Title I of the Clean Air Act, as amended (Title 40 of the *United States Code*, Section 7401 *et seq.* [40 U.S.C. 7401 *et seq*.]) and those regulated by the National Emissions Standards for Hazardous Air Pollutants (40 CFR Part 61). Toxic air pollutants are considered to be those that have been proposed or adopted for regulation by the applicable state or are listed in state guidelines or permit regulations for toxic air pollutants. States may set ambient standards that are more stringent than the National Ambient Air Quality Standards. The more stringent of the state or Federal standards are shown in this document.

Potential air quality impacts of criteria pollutant emissions from construction, normal operations, and DD&D activities were evaluated for each alternative. This assessment included a comparison of pollutant concentrations under each alternative with applicable Federal and state ambient air quality standards. Operational air pollutant impacts were evaluated for combustion sources using the facility-wide analysis prepared for the LANL operating permit, as described in Appendix B. The analysis is based on the potential emissions from each source, and the results bound the potential impacts associated with the alternatives addressed in this SWEIS. Potential differences among these results are discussed for each alternative. The analysis included the following emission sources: air curtain destructors; TA-60 asphalt plant; four TA-16 boilers; three TA-48 boilers; two TA-53 boilers; two TA-55 boilers; two TA-59 boilers; TA-50 boiler; carpenter shops at TA-15 and TA-3; TA-33 generator; TA-52 paper shredder; TA-3 power plant; rock crusher; TA-21 steam plant; TA-9 boiler; and TA-35 boiler. The analysis was based on allowable facility-wide emission limits proposed in the permit application. Emissions were presented in the application for individual sources or for source groups. The emissions used in the analysis are conservative. For example, for the TA-3 boilers, the fuel with the highest emissions was assumed and all three boilers were assumed to operate simultaneously; normally only two boilers are operated at the same time (Jacobson, Johnson, and Rishel 2003). Also, air curtain destructors have been removed from operation at LANL. The impacts of criteria pollutant emissions from construction activities for various projects were evaluated using engineering estimates of emissions from site preparation and building erection activities and modeled using the Industrial Source Complex Short Term (ISCST3) dispersion model, as discussed in Appendix B.

The approach used to evaluate chemical air pollutants in the *1999 SWEIS* is based on the use of screening level emission values to identify chemicals that would be evaluated in more detail. Screening level emission values are conservatively estimated hypothetical emission rates for each of the toxic air pollutants that could be emitted from each of LANL’s TAs and would not result in air quality levels that are harmful to human health under current or future conditions. These screening level emission values were compared with conservatively estimated pollutant emission rates on a TA-by-TA basis to determine the potential air quality impacts of toxic air pollutants from LANL operations. Any pollutant that could contravene a guideline value was subject to evaluation in the health and ecological risk assessment process. This approach is described in more detail in Appendix B. **Table 5–7** summarizes the expected nonradiological air quality impacts for each of the three alternatives.

Table 5–7 Summary of Environmental Consequences on Nonradiological Air Quality

	No Action Alternative	***Reduced Operations Alternative***	***Expanded Operations Alternative***
LANL Site			
	General – Minor impacts from construction-type activities would occur primarily in the form of fugitive dust. *Land Conveyance and Transfer* – Very minor increases in air pollutant emissions could result from increases in commute distances. *Electrical Power System Upgrades and Security Perimeter Project* – Minor air quality impacts would result from construction. *Wildfire Hazard Reduction Program* – Minor emissions would result from activities. *Disposition of Flood and Sediment Retention Structures* – Minor emission would result from activities. *Trails Management Program* – Minor air quality impacts.	Same as No Action Alternative	Same as No Action Alternative, plus: – Minor air quality impacts would result from road, bridge, and walkway construction under the Security-Driven Transportation Modifications Project. – Minor increases in vehicle emissions could result from use of the new roads and would occur in new locations. – Minor to moderate air quality impacts would result from remediating MDAs and other PRSs. – Minor increase in air pollutant emissions from increased commuter vehicles and waste and materials shipments.
Affected Technical Areas			
TA-3	– Minor change in air quality impacts from operation of new turbine generators. – Minor air quality impacts from constructing three new office buildings. – Minor operation air quality impacts from new office buildings.	Same as No Action Alternative	Same as No Action Alternative, plus: – Minor construction air quality impacts from constructing additional office buildings and the Physical Science Research Complex.
TA-21	No change in air quality impacts.	Same as No Action Alternative	Minor construction-type air quality impacts from DD&D of structures.
TA-54	Minor air quality impacts would result from MDA closure activities. Some reductions in emissions could result from closure.	Same as No Action Alternative	Minor construction-type air quality impacts from construction of new buildings and DD&D of old structures.
TA-72	No change in air quality impacts.	Same as No Action Alternative	– Minor construction-type air quality impacts from constructing the Remote Warehouse and Truck Inspection Station. – Potential decrease in emissions from reduced delivery trips.

	No Action Alternative	***Reduced Operations Alternative***	***Expanded Operations Alternative***
		Key Facilities	
Chemistry and Metallurgy Research Building (TA-3, TA-48, and TA-55)	Minor air quality impacts from construction of new facility at TA-55.	Smaller air quality impacts from reduced construction scope.	Same as No Action Alternative
High Explosives Processing Facilities	Minor construction-type impacts from TA-16 Engineering Complex and demolition of structures. No change in operations air quality impacts.	Same as No Action Alternative for construction. Minor reduction in operations air quality impacts from 20 percent reduction in activities.	Same as No Action Alternative for construction. Minor increase in operations air quality impacts may be indicated by increased mock explosives use.
High Explosives Testing Facilities	No change in operation air quality impacts. Minor construction impacts from construction of 15 to 25 new structures (new offices, laboratories, and shops) within the TA-22 to replace about 59 structures currently used for dynamic experimentation operations and removal or demolition of vacated structures.	Reduction in operation air quality impacts from 20 percent reduction in activities. Same as No Action Alternative for construction.	Same as No Action Alternative
Tritium Facilities (TA-21)	No change in air quality impacts.	Same as No Action Alternative	– Minor construction-type air quality impacts from DD&D of all TA-21 tritium buildings as part of the project to decommission all of TA-21. – Minor reduction in operational emissions from shutdown of boilers under the complete DD&D option.
Pajarito Site (TA-18)	No change in air quality impacts.	Minor reduction in operation air quality impacts from shutdown of activities.	– Minor reduction in operation air quality impacts from shutdown of activities. – Minor construction-type air quality impacts from DD&D of TA-18 buildings.
Bioscience Facilities	No change in air quality impacts.	Same as No Action Alternative	– Minor change in operation impacts with transfer of the Bioscience Facilities operations to the new Science Complex location. – Minor construction air quality impacts from construction of the new Science Complex and associated DD&D actions.

	No Action Alternative	***Reduced Operations Alternative***	***Expanded Operations Alternative***
Radiochemistry Facility (TA-48)	No change in air quality impacts.	Same as No Action Alternative	Same as No Action Alternative for operation. – Minor construction air quality impacts from construction of the new Radiological Sciences Institute with construction of the Institute for Nuclear Nonproliferation Science and Technology (see Appendix G) and associated DD&D actions.
Radioactive Liquid Waste Treatment Facility (TA-50)	No change in air quality impacts.	Same as No Action Alternative	Same as No Action Alternative for operation. – Minor construction air quality impacts from construction of a replacement for the existing Radioactive Liquid Waste Treatment Facility at TA-50 (see Appendix G) and DD&D of the existing Radioactive Liquid Waste Treatment Facility.
LANSCE (TA-53)	No change in air quality impacts.	Reduction in air quality impacts from shutdown of LANSCE operations.	Negligible to minor air quality impacts from refurbishment.
Solid Radioactive and Chemical Waste Facilities (TA-50 and TA-54)	No change in air quality impacts.	Same as No Action Alternative	Minor air quality impacts from retrieving transuranic waste from below ground storage. – Minor air quality impacts from construction of a new TRU Waste Facility and new access control station, low-level radioactive waste compactor building, low-level radioactive waste certification building, and associated DD&D actions.
Plutonium Facility Complex (TA-55)	No change in air quality impacts.	Same as No Action Alternative	Same as No Action Alternative for operation. – Minor air quality impact from facility modifications in support of increased pit production rate and the Plutonium Facility Complex Refurbishment Project, and constructing radiography capabilities (see Appendix G). – Positive air quality impact from chiller replacement and steam system subproject; improved regulatory compliance with stack replacement.

MDA = material disposal area; PRS = potential release site; TA = technical area; DD&D = decontamination, decommissioning, and demolition; LANSCE = Los Alamos Neutron Science Center.

The National Emission Standard for Hazardous Air Pollutants for Asbestos, 40 CFR Part 61, Subpart M, requires that LANL provide advance notice to the New Mexico Environment Department for large renovation jobs that involve asbestos and for all demolition projects. The asbestos National Emission Standard for Hazardous Air Pollutants further requires that all activities involving asbestos be conducted in a manner that mitigates visible airborne emissions and that all asbestos-containing wastes be packaged and disposed of properly. LANL would be required to meet these requirements for all demolition and renovation projects as applicable to minimize the risk of asbestos exposure to the public and employees. For example, the contractor performing the demolition or renovation would employ techniques such as wetting of asbestos or the use of plastic tents to contain and capture asbestos and other airborne particulates during removal.

5.4.1.1 No Action Alternative

This section describes the estimated nonradiological air quality impacts from LANL operations under the No Action Alternative. Radiological air emissions and their impacts on human health are discussed in Sections 5.4.2 and 5.6.1, respectively.

Los Alamos National Laboratory Site-Wide Impacts

Minor impacts on nonradiological air quality would occur from construction-type activities related to previously approved projects, including construction of the electrical power system upgrades, Wildfire Hazard Reduction Program activities, disposition of flood and sediment retention structures, activities related to the Trails Management Program, mechanical and manual Wildfire Hazard Reduction Program activities, and construction related to the Security Perimeter Project. These projects would result in temporarily elevated concentrations of criteria air pollutants, especially fugitive dust from heavy equipment activity.

Analysis of criteria pollutant emissions from facilities at LANL was performed to obtain the LANL Title V operating permit. The results of this analysis were used to bound the potential impacts associated with the alternatives addressed in this SWEIS. The modeling results demonstrate that the simultaneous operation of LANL’s air emission sources at maximum capacity, as described in the Title V permit application, would not exceed any state or Federal ambient air quality standards (Jacobson, Johnson, and Rishel 2003). These results are presented in **Table 5–8**. All of the equipment at the TA-3 Co-Generation Complex (TA-3 Power Plant), including the three existing boilers, the new combustion turbine generator, and an additional combustion turbine generator that would be constructed in the 2007 to 2013 timeframe, would operate within the nitrogen oxides and carbon monoxide emissions analyzed (Jacobsen, Johnson, and Rishel 2003; DOE 2002l). The air quality permit limits co-generation complex emissions to (93.4 tons [84.7 metric tons] per year for nitrogen oxides and 61.1 tons [55.4 metric tons] per year for carbon monoxide (NMED 2006a).

For criteria pollutants, the concentrations from No Action Alternative operations would be smaller than those shown in the operating permit and well below the ambient standards established to protect human health with an adequate margin of safety. Criteria pollutant emissions under the No Action Alternative are expected to continue to have minor impacts on human health.

Table 5–8 Facility-Wide Criteria Pollutant Impacts

Pollutant	*Time Period*	*Maximum Estimated Concentrations (micrograms per cubic meter)*	*New Mexico Controlling Ambient Air Quality Standards [a] (micrograms per cubic meter)*
Carbon monoxide	8 hours 1 hour	192.4 1,071	7,900 11,900
Nitrogen dioxide	Annual 24 hours	7.0 40.2	75 150
Sulfur dioxide	Annual 24-hours 3-hours	10.2 83.5 397.3	42 209 1,050
Total suspended particulates	Annual 24-hours	5.7 135.0	60 150
PM_{10}	Annual 24-hours	5.24 101.6	50 150

PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 microns.
[a] New Mexico Ambient Air Quality standards for pollutants other than particulate matter are stated in parts per million. These values were converted to micrograms per cubic meter, with appropriate corrections for temperature and pressure (elevation) following New Mexico Dispersion Modeling Guidelines (NMAQB 2003). PM_{10} standards are the National Ambient Air Quality Standards (40 CFR Part 50). The annual PM_{10} standard has recently been revoked (71 *Federal Register* [FR] 61143).
Source: Jacobson, Johnson, and Rishel 2003.

Similarly, for toxic and hazardous air pollutants, the bounding analyses (based on the emission rates evaluated in the *1999 SWEIS*) indicate that the pollutant emissions that could exceed the guideline values used in the analysis to screen emission rates were:

- Emissions from High Explosives Firing Site operations at TA-14, TA-15, TA-36, TA-39, and TA-40 (DOE 1999a). The estimated concentration of a pollutant would be greater than its guideline value for the following releases:
  - Depleted uranium, beryllium, lead, aluminum, copper, tantalum, tungsten, and iron from TA-15;
  - Depleted uranium, beryllium, lead, copper, and iron from TA-36;
  - Beryllium, lead, aluminum, and copper from TA-39;
  - Depleted uranium and lead from TA-14; and
  - Copper from TA-40.
- Additive emissions from all of the pollutants from all TAs on receptor sites located near the Los Alamos Medical Center (DOE 1999a).

In the *1999 SWEIS*, emissions from High Explosives Testing Facilities operations under the No Action Alternative were projected to be the same as the emissions projected under the Expanded Operations Alternative; this projection is similar to anticipated emissions from High Explosives Testing Facilities operations under the No Action Alternative in this SWEIS. Emissions from High Explosives Testing Facilities operations are shown in **Table 5–9**.

Table 5–9 Estimated Emission Rates of the Pollutants that Could Be Released from High Explosives Testing Facilities

TAs with High Explosives Testing Operations [a]	*Pollutants that Could Be Released During Testing Operations*	*Estimated Maximum Amount of Material that Would Be Used During Testing Operations* [b]	*Estimated Respirable Fraction Release Rate*		
			Annual Rate [b]	*8-Hour Respirable Release Rate* [c]	
		(kilograms per year)	*(kilograms per year)*	*(kilograms)*	*(grams)* [d]
TA-14	Depleted Uranium	31.4	3.1	0.267	267
	Lead	31.4	3.1	0.267	267
TA-15	Depleted Uranium	2,700	270.0	23.0	23,000
	Beryllium	30	3.0	0.256	256
	Lead	150	15.0	1.28	1,280
	Aluminum	450	45.0	3.83	3,830
	Copper	300	30.0	2.56	2,560
	Tantalum	300	30.0	2.56	2,560
	Tungsten	300	30.0	2.56	2,560
	Iron	150	15.0	1.28	1,280
TA-36	Depleted Uranium	1,200	120.0	10.2	10,200
	Beryllium	30	3.0	0.256	256
	Lead	30	3.0	0.256	256
	Aluminum	30	3.0	0.256	256
	Copper	30	3.0	0.256	256
	Tantalum	30	3.0	0.256	256
	Tungsten	30	3.0	0.256	256
	Iron	150	15.0	1.28	1,280
TA-39	Beryllium	30	3.0	0.256	256
	Lead	30	3.0	0.256	256
	Aluminum [e]	45,000	4,500.0	383	383,000
	Copper [e]	45,000	4,500.0	383	383,000
	Tantalum	30	3.0	0.256	256
	Tungsten	30	3.0	0.256	256
	Iron [e]	30,000	3,000.0	256	256,000

TAs with High Explosives Testing Operations [a]	Pollutants that Could Be Released During Testing Operations	Estimated Maximum Amount of Material that Would Be Used During Testing Operations [b]	Estimated Respirable Fraction Release Rate		
			Annual Rate [b]	8-Hour Respirable Release Rate [c]	
		(kilograms per year)	(kilograms per year)	(kilograms)	(grams) [d]
TA-40	Aluminum	240	24.0	2.04	2,040
	Copper	300	30.0	2.56	2,560
	Tantalum	90	9.0	0.767	767
	Tungsten	30	3.0	0.256	256
	Iron	60	6.0	0.511	511

TA = technical area.

[a] High explosives testing operations involve detonations of explosives at TA-14, TA-15, TA-36, TA-39, and TA-40. Particulate emissions released into the atmosphere due to detonation of high explosives contain bonded metal emissions in respirable form.

[b] Respirable release rates were estimated based on the assumption that this fraction is 10 percent of the amount of material exploded.

[c] The total 8-hour respirable release rates (in kilograms), as a result of these operations, were estimated using the scale factor of 0.085.

[d] The total amount of material released, in grams, was used in dispersion analysis to estimate 1-hour average concentrations at specified receptor locations.

[e] These quantities are dominated by the support structures constructed for tests. These structures in actuality are not expended in explosive tests and do not contribute to test air emissions.

Note: To convert kilograms to pounds, multiply by 2.2046; grams to ounces, multiply by 0.035274.

Source: DOE 1999a.

These emissions were estimated to result in air pollutant concentrations that are larger than guidance values, indicating that a human health analysis should be performed. The human health analysis (Section 5.6.2) showed that the nonradiological pollutants released from LANL High Explosives Testing Facilities operations under the No Action Alternative are not expected to cause air quality impacts that would affect human health. Although not considered in the analysis, recent use of foam to suppress emissions from high explosives tests involving beryllium has reduced emissions from these shots by 50 to 95 percent. This reduction meets the requirements of Phase I of the Phased Containment Option outlined in the *Dual Axis Radiographic Hydrodynamic Test Facility Final Environmental Impact Statement* (DOE 1995a). Increased use of foam and vessels for explosives testing is expected to reduce these emissions further (LANL 2006a).

A minor increase in vehicle emissions could result from development that occurs as a result of conveyance and transfer of land. This increase is not expected to produce concentrations of pollutants that would threaten human health.

An increase in truck traffic from management of construction fill could increase vehicle emissions. This increase is not expected to produce concentrations of pollutants that would affect human health.

Emissions from beryllium sources at TA-3 and TA-55 are controlled by high-efficiency particulate air (HEPA) filtration with a removal efficiency of 99.95 percent. These emissions were analyzed in the *1999 SWEIS* using the annual emission rates shown in **Table 5–10**, which were estimated based on the existing permit applications. The results of the analysis with regard to public health are discussed in Section 5.6.2.

Table 5–10 Beryllium Annual Emission Rates Associated with Technical Area 3 and Technical Area 55 Facilities

Emission Source	*Annual Permitted Emission Rate*	
	Pounds per Year	*Grams per Second*
TA-3 Building 141 (Beryllium Technology Facility)	0.11	1.58×10^{-6}
TA-55 FE-15	0.003	4.32×10^{-8}
TA-55 FE-16	0.0042	6.05×10^{-8}

TA = technical area.
Source: DOE 1999a.

Technical Area Impacts

Minor construction-related nonradiological air quality impacts would occur from construction of new office buildings at TA-3 and MDA H closure activities at TA-54. The new turbine generator at TA-3 would operate within the emission combustion limits specified in the air quality permit for the TA-3 Co-Generation Complex (DOE 2002l) and analyzed in the facility-wide air quality impact analysis; minor operations-related air quality impacts would be expected.

Key Facilities Impacts

Minor nonradiological air quality impacts would occur from construction of the Chemistry and Metallurgy Research Replacement Facility at TA-55, completion of the TA-16 Engineering Complex, demolition of structures at TA-16, construction of new buildings at the consolidated Twomile Mesa Complex within TA-22, and demolition of unneeded structures nearby, as described below.

Operation of new buildings including the Chemistry and Metallurgy Research Replacement Facility, TA-16 Engineering Complex, various new structures for dynamic experiment operations, and a new dynamic experimentation structure at TA-15 would not be expected to increase emissions of criteria pollutants because a comparable amount of space would be removed through DD&D, resulting in a comparable reduction in emissions. Emissions related to these facilities primarily are associated with heating facilities and providing electric power.

Chemistry and Metallurgy Research Building

Operation of the Chemistry and Metallurgy Research Replacement Facility at TA-55 would result in additional periodic testing of emergency generators at that location instead of at TA-3. This change in operations would likely result in minor impacts on air pollutant concentrations at the site boundary. Criteria pollutant concentrations at the site boundary estimated for generator testing are shown in **Table 5–11**.

Table 5–11 Air Quality Concentrations from Chemistry and Metallurgy Research Replacement Facility Generator Testing at Technical Area 55 [a]

Pollutant	*Averaging Period*	*Maximum Incremental Concentration (micrograms per cubic meter)*
Carbon monoxide	8 hours 1 hour	53.2 239
Nitrogen dioxide	Annual 24 hours	0.0182 45.1
Sulfur dioxide	Annual 24 hours 3 hours	0.0113 28.1 207
Total suspended particulates	Annual 24 hours	0.001 2.43
PM_{10}	Annual 24 hours	0.001 1.39

PM_{10} = particulate matter less than or equal to 10 microns in diameter.
[a] The annual concentrations were analyzed at locations to which the public has access – the site boundary and nearby sensitive areas. Short-term (24 hours or less) concentrations were analyzed at the site boundary and at the fence line of the technical area where the public has temporary access. As access to the TA-55 fenceline has been restricted since the EIS for this facility was prepared, the short-term concentrations in public areas would be less.
Source: DOE 2003d.

Plutonium Facility Complex

Operations at TA-55 to produce 20 pits per year would represent about 25 percent of the 80-pits-per-year production rate analyzed in the *1999 SWEIS* for the Expanded Operations Alternative. Emission estimates for the Plutonium Facility Complex for 2005 included about 0.12 tons

(0.11 metric tons) per year of air pollutants from chemical use, about 1 percent of the 14.6 tons (13.2 metric tons) per year evaluated in the *1999 SWEIS* (DOE 1999a, LANL 2006g). Most of the estimated emissions are hydrochloric and nitric acids from plutonium recovery operations for the complex and are not directly associated with the level of pit production; the impacts of chemical air pollutant emissions under the No Action Alternative would be less than analyzed.

5.4.1.2 Reduced Operations Alternative

The same nonradiological air quality impacts anticipated to result from activities associated with the No Action Alternative also would occur under the Reduced Operations Alternative, except for those actions specific to the Reduced Operations Alternative.

Los Alamos National Laboratory Site-Wide Impacts

Minor impacts on air quality would occur from construction-related activities on previously approved projects, as discussed for the No Action Alternative. No new construction impacts on air quality would result from implementing the Reduced Operations Alternative.

For criteria pollutants, overall emission rates for the Reduced Operations Alternative would likely be lower than those for the No Action Alternative due to cessation of operations at TA-18 and shutdown of LANSCE. The boilers at TA-53 represent emissions of less than 1 percent of the emissions from facilities at LANL. Although it is unlikely that these boilers would be completely shut down if LANSCE were shut down, use of these boilers would be reduced and would result in a small reduction in pollutant emissions. Criteria pollutant emissions under the Reduced Operations Alternative are expected to result in concentrations below the ambient standards and to have minor impacts on human health.

There would be fewer high explosives experiments each year under the Reduced Operations Alternative than under the No Action Alternative, which would reduce overall emissions. As discussed in the No Action Alternative (Sections 5.4.1.1 and 5.6.2.1), reducing emissions from these activities would result in toxic air pollutant concentrations that would not be expected to cause air quality impacts that would affect human health.

Under the Reduced Operations Alternative, chloroform use would be similar to the usage level projected under the No Action Alternative. As discussed for the No Action Alternative, this usage level would result in emissions of chloroform that would not be expected to cause air quality impacts that would affect human health.

Based on the information discussed above, release of air pollutants as projected under the Reduced Operations Alternative would not be expected to cause air quality impacts that would affect human health and the environment.

Technical Area Impacts

Construction- and operations-related air quality impacts from the TAs under the Reduced Operations Alternative would be the same as those under the No Action Alternative, except as described below in relation to Key Facilities.

Key Facilities Impacts

Under the Reduced Operations Alternative, construction-related nonradiological air quality impacts from Key Facilities generally would be the same as those under the No Action Alternative; however, there would be slightly reduced construction-related nonradiological air quality impacts because of the reduced scope of construction for the Chemistry and Metallurgy Research Replacement Facility.

Chemistry and Metallurgy Research Building

Emissions of criteria and toxic air pollutants would continue at TA-3 from operation of boilers, emergency diesel generators, and other activities at TA-3, including operation of the Chemistry and Metallurgy Research Building for a period of time. Emissions would be smaller than those estimated for the Expanded Operations Alternative in the *1999 LANL SWEIS*, which were projected to remain within Federal and State standards for ambient air concentrations.

High Explosives Processing and High Explosives Testing Facilities

A minor decrease in operational impacts would be expected from reducing high explosives testing and processing activities by 20 percent. This could result in a reduction of about 0.01 tons (0.015 metric tons) per year of air pollutant emissions from high explosives testing and 0.05 tons (0.05 metric tons) per year from high explosives processing.

Los Alamos Neutron Science Center

Implementing the Reduced Operations Alternative for LANSCE at TA-53 would shut down that facility, reducing emissions from the TA-53 boilers.

Pajarito Site

Shutdown of operations at the Pajarito Site (TA-18) also would reduce emissions, which would have a minor positive affect on overall air quality.

5.4.1.3 Expanded Operations Alternative

The same nonradiological air quality impacts that would result from activities associated with the No Action Alternative also would occur under the Expanded Operations Alternative.

Los Alamos National Laboratory Site-Wide Impacts

Under the Expanded Operations Alternative, there would be emissions of criteria, toxic, and hazardous air pollutants, including fugitive dust, from construction activities at LANL. These emissions would be short-term for any particular project, but could be ongoing for a longer term as various facilities are constructed, demolished, and closed. In addition to emissions resulting from the construction activities described for the No Action Alternative, there would be temporary increases in air pollutant concentrations at the site boundary and along roads to which the public has access due to construction of new buildings in various TAs; DD&D of buildings; road, bridge, and walkway construction under the Security-Driven Transportation Modifications Project; and MDA remediation (as described in Appendix I). These impacts, apart from

MDA activities, would be similar to the impacts of other recent construction-related activities at LANL. Emissions of fugitive dust from these activities would be controlled with water sprays, application of soil stabilizers, and other controls as appropriate. The maximum ground-level concentrations offsite and along roads to which the public has regular access would be below the ambient air quality standards, except for possible short-term concentrations of nitrogen oxides and carbon monoxide for certain projects that could occur near the site boundary. Appropriate management controls and scheduling would be used to minimize impacts on the public and to meet regulatory requirements. The impact on the public would likely be minor.

The MDA Capping and Removal Options would require the use of heavy equipment that would result in additional air pollutant emissions, including criteria and hazardous pollutants. At some locations, these activities would be of longer duration than typical construction activities at LANL and would involve extensive movement of materials. Estimated emissions from these activities are presented in Appendix I. Particulate matter would be dispersed into the air from grading, earthmoving, and compaction at the MDA sites and at the borrow pit from which capping material or fill is excavated. These emissions have been estimated to be considerable and could result in minor to moderate increases in short-term concentrations of criteria pollutants near the MDA activities. In some cases, these estimated concentrations would occur near the site boundary and nearby residences and businesses. For example, based on the schedule and remediation methods assumed in Appendix I for the Removal Option at TA-21 (MDAs A, B, T, and U), estimated concentrations at the site boundary near the Los Alamos townsite would be above the 1-hour ambient standard for carbon monoxide and the 24-hour standard for nitrogen dioxide. In addition, for the Removal Option at TA-54 (MDA G), the estimated concentrations at the site boundary near White Rock would be above the 1-hour and 8-hour ambient standards for carbon monoxide and the 24-hour and annual standards for nitrogen dioxide. The contribution to concentrations of particulate matter less than or equal to 10 microns in diameter (PM_{10}) from the Removal Option at MDA G could result in concentrations greater than 80 percent of the ambient standard. Concentrations under the Capping Option at MDA G would be about 8 percent of those under the Removal Option. Overall emissions from heavy equipment for the Removal Option were estimated to be more than 10 times those for the Capping Option. The Removal Option would greatly reduce or eliminate long-term release of volatile organic compounds from the MDAs. Particulate emissions would be controlled using standard dust control measures such as water sprays or through use of an enclosure. Other emissions would be reduced by management controls and scheduling to minimize impacts on the public and to meet regulatory requirements.

Changes in LANL operations proposed under the Expanded Operations Alternative, including relocation of existing operations, reinvestment in and refurbishment of existing facilities, and new operations or levels of operations, would not result in emissions beyond the level evaluated for the facility-wide air quality impact analysis (see Section 5.4.1.1). The results of the analysis bound the impacts of the Expanded Operations Alternative, and the highest estimated concentration of each pollutant would be below the ambient air quality standards and would likely have minor impacts on human health.

The impacts of toxic and hazardous air pollutants were assessed for this SWEIS based on analysis of the *1999 SWEIS* Expanded Operation Alternative. In all but two cases, the estimated pollutant concentrations would be below the corresponding guideline values established for the analysis in the *1999 SWEIS*. Guideline values are the levels established to identify chemicals for further analysis. The two cases where estimated emission rates would be above guideline values (which were referred to the human health and ecological risk assessment processes for further analysis) were High Explosive Testing Facilities operations and additive emissions from all pollutants from all TAs on receptor sites located at or near the Los Alamos Medical Center.

Operational nonradioactive air pollutants released under the Expanded Operations Alternative in this SWEIS would not be expected to cause air quality impacts that would affect human health and the environment (see Sections 5.4.1.1 and 5.6.2). In addition, if activities from the Bioscience Facilities were moved to the new Science Complex, the impacts resulting from LANL operations on receptor sites located near the Los Alamos Medical Center would likely be reduced.

Minor changes in vehicle emissions could result from activities under the Security-Driven Transportation Modifications Project. A small increase from shuttle bus emissions could be partially offset by a decrease from less use of personally owned vehicles.

Increased employment under the Expanded Operations Alternative of 2.2 percent per year could result in similar increases in LANL commuter vehicle emissions from additional employee vehicles commuting from Santa Fe and Rio Arriba County and other locations. The increase in employee vehicles and the increase in other vehicles resulting from the population increase that the state projects will occur would result in increases in vehicle emissions along the routes used to access the site. Along NM 30 the estimated increase in traffic levels during the 2007 through 2011 time period from increased operation and construction employee traffic would be about five percent over current traffic levels. Along NM 502 the estimated increase in traffic levels during the 2007 through 2011 time period from increased operation and construction employee traffic and shipments would be about six percent over current traffic levels. Similar increases in air pollutants emissions from traffic along these routes would be expected. The primary pollutants from commuter vehicles are hydrocarbons, carbon monoxide and nitrogen oxides. Elevated levels of carbon monoxide inhibit the blood's capacity to carry oxygen. Nitrogen oxides and hydrocarbons are contributors to the formation of ozone. Ozone damages lung tissue, aggravates respiratory disease, and makes people more susceptible to respiratory infections. As discussed in Section 4.4.2.1 the area around Los Alamos and most of New Mexico is designated as attaining for the National Ambient Air Quality Standards for carbon monoxide, nitrogen oxides, ozone, and the other criteria pollutants (40 CFR 81.332). Even with the continuing growth in population there has been a decreasing or steady trend in concentrations in the region of carbon monoxide, nitrogen oxides, and ozone. Carbon monoxide and nitrogen oxides concentrations are well below the ambient standards (EPA 2006a). The ambient standards are set to protect the public health and welfare.

Technical Area Impacts

Construction-related nonradiological air quality impacts would be the same as those for the No Action Alternative for specific TAs (TA-3, TA-21, and TA-54), except for additional temporary construction impacts from new office buildings and the Physical Science Research Complex at TA-3, minor construction impacts from DD&D of TA-18 buildings, and temporary construction-related impacts at the Science Complex and the Remote Warehouse and Truck

Inspection Station. Construction-related impacts would occur during daytime hours from construction equipment operations and fugitive dust generation.

Operational nonradiological air quality impacts from specific TAs (TA-3, TA-21, and TA-54) would be similar to those under the No Action Alternative. There would be potential decreases in emissions from reduced intrafacility vehicle trips related to the Science Complex and from reduced delivery trips resulting from construction of the new Remote Warehouse and Truck Inspection Station.

Key Facilities Impacts

Construction-related nonradiological air quality impacts from Key Facilities would be similar to those of the No Action Alternative. Minor temporary construction impacts would occur from DD&D of TA-21 buildings, DD&D of TA-18 buildings, construction of the new Science Complex, construction of the new Radiological Sciences Institute and the Institute for Nuclear Nonproliferation Science and Technology, construction of a replacement for the Radioactive Liquid Waste Treatment Facility at TA-50, DD&D of the existing Radioactive Liquid Waste Treatment Facility, retrieval of transuranic waste from belowground storage at the Solid Radioactive and Chemical Waste Facilities, construction of a new TRU Waste Facility and other buildings, and minor facility modifications and construction at TA-55.

Operation of new buildings, including those discussed under the No Action Alternative, the new Science Complex, the Radiological Sciences Institute, the Institute for Nuclear Nonproliferation Science and Technology, the replacement Radioactive Liquid Waste Treatment Facility, the new TRU Waste Facility, new office buildings at TA-3, and a new radiography facility at TA-55, would not be expected to increase emissions of criteria pollutants because a comparable amount of space would be removed through DD&D of the old buildings. These emissions primarily would be associated with heating of facilities and providing electric power. Plutonium Facility Complex Refurbishment activities such as stack upgrades, steam system upgrades, and chiller replacement would have positive impacts on air quality and regulatory compliance. Operational nonradiological air quality impacts from other Key Facilities would be the same under the Expanded Operations Alternative as those under the No Action Alternative.

High Explosives Processing Facilities

There could be a minor increase in operational impacts corresponding to the 2.5 percent increase in High Explosives Processing Facilities activity indicated by the increased use of mock explosives. This could result in an increase of about 0.03 tons (0.027 metric tons) per year of hazardous air pollutant emissions from increased safety and mechanical testing. These chemicals could include various chemicals listed under the New Mexico permit regulations on toxic air pollutants and emission (NMAC 20.2.72.502) such as dicyclopentadienyl iron, ethyl ether, iodine, isopropyl alcohol, nitric acid, dimethyl acetamide, potassium hydroxide, sulfuric acid, and VM&P Naphtha. Hazardous air pollutant emissions such as chloroform, hydrazine, and nitrobenzene are subject to the limits on hazardous air pollutant emissions in the LANL Title V permit.

Tritium Facilities

Operations-related emissions from three boilers at TA-21 would be eliminated, which would reduce Tritium Facilities emissions by as much as 1.6 tons (1.5 metric tons) per year of nitrogen oxides (about 3.1 percent of nitrogen oxides emissions at LANL); 0.12 tons (0.11 metric tons) of particulates, (about 2.4 percent of the LANL total); and 1.3 tons (1.2 metric tons) of carbon monoxide (about 3.8 percent of carbon monoxide emissions at LANL).

5.4.2 Radiological Air Quality Impacts

Impacts of the emission of radioactive constituents to the air from continued operations at LANL were evaluated in terms of the increased dose (above the dose from background radiation) and corresponding risk of a latent cancer fatality (LCF) to the population in the vicinity of LANL and to a nearby maximally exposed individual (MEI). This impacts assessment is presented in Section 5.6. The following assessment of radiological air quality impacts represents an intermediate step in developing the dose estimates. The impacts are presented here as the projected quantities of radionuclides emitted under each alternative.

Radioactive air emissions from LANL come from point sources, such as stacks and vents, as well as diffuse or nonpoint (area) sources. Although there are other minor contributors of radioactive emissions, the Key Facilities represent essentially all of the site emissions that are relevant to the calculation of doses to the population and an MEI. Specifically, a few Key Facilities and certain radionuclides dominate the human health effects. Therefore, this analysis focuses on radioactive air emissions from those facilities, including gaseous mixed activation products associated with LANSCE operations and tritium, plutonium, americium, and uranium emissions associated with other Key Facilities.

Table 5–12 summarizes the expected radiological air emissions for each of the three alternatives. Air emissions are summarized as total emissions for the site. A detailed presentation of the radionuclides emitted from each of the Key Facilities is included in Appendix C.

5.4.2.1 No Action Alternative

Key Facility Impacts

Under the No Action Alternative, radioactive air quality impacts at the LANL site-wide and TA levels are not discussed separately because they are accounted for in the following discussion of emissions from the Key Facilities. Radiological air emissions for the No Action Alternative generally are projected to remain at levels similar to those projected in the *1999 SWEIS* Expanded Operations Alternative.

Chemistry and Metallurgy Research Building

The Chemistry and Metallurgy Research Replacement Facility at TA-55 would be completed and become operational. With the exception of the Wing 9 hot cell, activities in the current Chemistry and Metallurgy Research Building in TA-3 would be moved into the new facility. As a result of a decision not to move certain capabilities to the Chemistry and Metallurgy Research Replacement Building, tritium is no longer projected to be a significant emission from this building.

Table 5–12 Summary of Annual Projected Radiological Air Emissions (curies per year)

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
LANL Site [a]			
Tritium [b]	2,400	2,400	2,400 [c]
Americium-241	4.2×10^{-6}	4.2×10^{-6}	4.2×10^{-6} [d]
Plutonium [e]	0.00082	0.000092	0.00084 [d]
Uranium [f]	0.15	0.12	0.15
Particulate and Vapor Activation Products	30	0.014	30
Gaseous Mixed Activation Products	30,600	100 [g]	30,600 [g]
Mixed Fission Products [h]	1,650	1,650	1,650
Affected Technical Areas			
TA-21, TA-49, TA-50, TA-54 for major MDAs	Not applicable	Not applicable	Variable [i]

TA = technical area; MDA = material disposal area.

[a] These LANL site data include emissions from all Key Facilities. Radiological air emission data by Key Facility are presented in Appendix C.

[b] Includes both gaseous and oxide forms of tritium.

[c] Tritium emissions include 550 curies of tritium for TA-21 stacks. Emissions from TA-21 stacks were stopped in September 2006 as part of TA-21 shutdown activities. Decontamination, decommissioning, and demolition of TA-21 under the Expanded Operations Alternative would permanently eliminate this potential source of tritium release.

[d] Americium-241 emissions could increase to 1.1×10^{-5} curies per year and plutonium emissions to 0.00089 curies per year if the Decontamination and Volume Reduction System, the new TRU (Transuranic) Waste Facility (formerly the Transuranic Waste Consolidation Facility), and remote-handled transuranic waste retrieval and processing activities operated simultaneously (estimated to occur from 2012 through 2015).

[e] Includes plutonium-238, plutonium-239, and plutonium-240.

[f] Includes uranium-234, uranium-235, and uranium-238.

[g] Gaseous mixed activation product emissions would decrease by 100 curies per year after about 2009 due to the shutdown of TA-18 thereafter, resulting in zero emissions of gaseous mixed activation product for the Reduced Operations Alternative and 30,500 curies per year in the Expanded Operations Alternative.

[h] Mixed fission products include krypton-85, xenon-131m, xenon-133, and strontium-90.

[i] There would be additional emissions from the remediation of the larger MDAs. These emissions would depend on radionuclides present, whether an MDA is being capped or removed, the number of MDAs being remediated at one time, and whether exhumation occurs under an enclosure (see Appendix I).

Radiochemistry Facility

Based on actual emissions from 1999 to 2005, the projected level of emissions from the Radiochemistry Facility has been increased by 10 percent.

Los Alamos Neutron Science Center

Projected emissions from LANSCE are determined by multiplying the microamp-hours of LANSCE operations by an emissions factor derived from stack monitoring results. Based on LANSCE emissions over recent years, the emissions factor used to estimate releases of gaseous mixed activation products has increased by a factor of about 7 from about 0.003 to 0.02 curies per microamp-hour. Therefore, the projected emissions from LANSCE are higher than previously estimated.

5.4.2.2 Reduced Operations Alternative

Key Facility Impacts

Under the Reduced Operations Alternative, radioactive air quality impacts at the LANL site-wide and TA level are not discussed separately because they are accounted for in the following discussion of Key Facility emissions. Activities at selected Key Facilities would be reduced or eliminated from those identified in the No Action Alternative, resulting in lower emissions of radiological constituents. The lower radiological emissions would result in lower radiological doses and risks under the Reduced Operations Alternative compared to the No Action Alternative (see Section 5.6).

Chemistry and Metallurgy Research Building

Based on information in the *CMRR EIS* (DOE 2003d), continued operation of the Chemistry and Metallurgy Research Building in TA-3 is projected to result in reduced airborne emissions of actinides compared to the assumed operation of the Chemistry and Metallurgy Research Replacement Building in TA-55 for the No Action Alternative; that is, from 0.00076 to 0.00003 plutonium curies per year.

High Explosives Processing and High Explosives Testing Facilities

A lower level of operations at both the High Explosives Processing and High Explosives Testing Facilities would result in a 20 percent reduction in their emissions. This reduction is shown in Table 5–12 as a reduction in emissions of uranium isotopes from 0.15 to 0.12 curies per year.

Los Alamos Neutron Science Center

The largest impacts on emissions would be due to cessation of LANSCE operations. Emissions of particulate and vapor activation products would be reduced by about 30 curies per year; the remaining 0.014 curies per year shown in Table 5–12 would be from the Radiochemistry Facility. Shutdown of LANSCE would also eliminate emissions of about 30,500 curies per year of gaseous mixed activation products.

Pajarito Site

Cessation of operations at TA-18, particularly shutdown of SHEBA, would reduce the remaining gaseous mixed activation product emissions by 100 curies per year. Complete cessation of TA-18 operations is assumed to occur in about 2009.

5.4.2.3 Expanded Operations Alternative

Implementation of the Expanded Operations Alternative would decrease some emissions of radiological constituents due to closure and DD&D of certain facilities; however, there would be both long-term and short-term increases in other emissions. The long-term increases would be associated with higher levels of operational activities at certain facilities. The short-term increases could occur during construction or DD&D activities, as well as from actions related to the implementation of the Consent Order.

Los Alamos National Laboratory Site-Wide Impacts

Major MDA remediation, canyon cleanups, and other Consent Order actions could result in temporary increases of radiological air emissions. The highest level of emissions would be from remediation of the large MDAs, which is the focus of the analysis in Appendix I. Remediation of other PRSs is expected to produce lower emissions. Emissions of radiological contaminants from remediation activities would depend on a number of factors. (Emissions from each MDA would be greatly affected by the remediation option selected; removal would result in larger emissions than capping.) Under the Removal Option, various radiological air emissions would be expected depending on the inventory of the MDA being remediated and whether or not exhumation would occur inside an enclosure equipped with a filtered exhaust system. Under the Capping Option, improving the covers on the MDAs would reduce the potential for radiological air emissions. Remediation of an MDA would occur over a few months to several years depending on the size of the MDA and the remediation option implemented. All of these factors would affect the quantity and timing of releases of radiological constituents, resulting in variable releases over time. Although the amount of these releases would vary over time and depend on the remediation option selected, Section 5.6 presents an estimated dose based on the assumptions that the Removal Option would be selected for all of the MDAs and that some of the removal actions would occur within an enclosure with a filtered exhaust.

Technical Area Impacts

A number of the projects analyzed in Appendices G, H, and J involve construction activities related to either excavation or DD&D of buildings, or both. These activities could cause minor short-term increases in emissions of radiological contaminants. The potential for these emissions would be minimized by conducting radiation surveys before the activities begin, as well as the use of a range of contamination control techniques such as decontamination, application of dust suppressants, and use of enclosures. Consequently, these activities generally would not be expected to increase emissions appreciably. Effects on radiological emissions associated with the TA-21 Structure DD&D are discussed as part of the Tritium Facilities section under the Key Facilities Impacts.

Key Facility Impacts

The Expanded Operations Alternative would result in both increases and decreases in projected emissions from Key Facilities. In addition, the location of some emission sources would change. As discussed above under Technical Area Impacts above, construction and DD&D activities may result in minor, short-term increases in radioactive emissions. Similar minor short-term increases in emissions also may occur in connection with projects at Key Facilities.

Chemistry and Metallurgy Research Building

The Chemistry and Metallurgy Research Replacement Facility at TA-55 would be completed and become operational. With the exception of the Wing 9 hot cell, activities in the current Chemistry and Metallurgy Research Building in TA-3 would be moved into the new facility. As discussed in Appendix G, the Wing 9 hot cell capabilities would be moved to the Radiological Sciences Institute when it is available. Therefore, although the emissions location would change, there would be no net change in the projected level of radioactive emissions from Chemistry and Metallurgy Research activities.

Pajarito Site

Closure of the TA-18 Pajarito Site would eliminate SHEBA, the primary source of emissions from that site. Therefore, after permanent shutdown of SHEBA in about 2009, site-wide emissions would be reduced by 100 curies per year (of argon-41), resulting in total site-wide emissions of 30,500 curies per year of gaseous mixed activation products.

Tritium Facilities

TA-21 Structure DD&D would include buildings that are part of the Tritium Facilities. DD&D of structures at TA-21 would permanently eliminate these buildings as emissions sources, which would reduce projected tritium emissions by 550 curies per year to 1,850 curies per year after about 2009.

Los Alamos Neutron Science Center

Under the Expanded Operations Alternative, LANSCE emissions would remain the same as for the No Action Alternative. If the LANSCE Refurbishment Project were implemented, the facility and its operating systems and equipment would be refurbished, allowing for its continued use. This restoration of the facility could result in more operational time and therefore increase the emissions from normal operations. As described in the human health impacts of the No Action Alternative (see Section 5.6.1.1), the dose to the MEI from emissions at LANSCE would be limited by operational controls to 7.5 millirem per year.

Plutonium Facility Complex

Addition of capabilities and increased levels of operations under the Expanded Operations Alternative would not appreciably affect emissions from most Key Facilities. Increases in the level of activities at the Plutonium Facility Complex, however, including production of up to 80 pits per year, would cause a small increase in plutonium emissions. The higher level of activity would result in the annual emission of an additional 0.000019 curies per year of plutonium from the Plutonium Facility Complex, as shown in Appendix C, Table C–14.

Solid Radioactive and Chemical Waste Facilities

Implementing the Waste Management Facilities Transition Project (see Appendix H) could increase emissions temporarily. Implementation of the project may result in the simultaneous operation of the temporary remote-handled transuranic waste retrieval facility, the new TRU Waste Facility, and the existing Decontamination and Volume Reduction System Facility. If all three facilities operated at the same time, americium-241 emissions would increase to 1.1×10^{-5} curies per year and plutonium emissions would increase to 0.00089 curies per year. This increase could occur in the 2012 through 2015 timeframe until remote-handled transuranic waste retrieval is completed and the Decontamination and Volume Reduction System Facility is shut down in support of remediation of MDA G.

5.4.3 Noise Impacts

Noise (sound) results from the compression and expansion of air or some other medium when an impulse is transmitted through it. Sound requires a source of energy and a medium for transmitting the sound wave. Propagation of sound is affected by various factors, including meteorology, topography, and barriers. Noise is undesirable sound that interferes or interacts negatively with the human or natural environment. Noise can disrupt normal activities (for example, concentration or sleep), damage hearing, or diminish the quality of the environment.

Noise-level measurements used to evaluate the effects of nonimpulsive sound on humans are compensated by an A-weighting scale that accounts for the hearing response characteristics (frequency) of the human ear. Noise levels are expressed in decibels (dB); or in the case of A-weighted measurements, decibels A-weighted (dBA). The C-weighted scale is used in describing large amplitude impulsive sounds of short duration, and is expressed in decibels C-weighted (dBC). EPA has developed noise-level guidelines for different land use classifications (EPA 1974). The EPA guidelines identify a 24-hour exposure level of 70 dB as the level of environmental noise that will prevent any measurable hearing loss over a lifetime. Likewise, levels of 55 dB outdoors and 45 dB indoors are identified as the levels that prevent activity interference and annoyance.

Los Alamos County has promulgated a local noise ordinance that establishes noise level limits for residential land uses. Noise levels that affect residential receptors are limited to a maximum of 65 dBA during daytime hours and 53 dBA during nighttime hours between 9 p.m. and 7 a.m. Between 7 a.m. and 9 p.m., the permissible noise level can be increased to 75 dBA in residential areas, provided the noise is limited to 10 minutes in any 1 hour. Activities that do not meet the noise ordinance limits require a permit (LANL 2004c).

Noise standards related to protecting worker hearing are contained in LANL's *Noise and Temperature Stresses – Laboratory Implementation Requirements* (LANL 2003g). The occupational exposure limit for steady-state noise, defined in terms of accumulated daily (8-hour) noise exposure that allows for both exposure level and duration, is 85 dBA (LANL 2003g). When a worker is exposed for a shorter duration, the permitted noise level is increased. LANL administrative requirements also limit worker impulse/impact noise exposures that consist of a sharp rise in sound pressure level (high peak) followed by a rapid decay of less than 1 second in duration and greater than 1 second apart. No exposure of an unprotected ear in excess of a peak of 140 dBC is permitted (LANL 2004c).

Noise from facility construction or operations and associated traffic could affect human and animal populations. The region of influence for each facility includes the site and surrounding areas, as well as transportation corridors, where proposed activities might increase noise levels. Transportation corridors most likely to experience increased noise levels are those roads within a few miles of the site boundary that are expected to carry most of the site's employee and shipping traffic.

Noise impacts associated with the alternatives could result from construction and operations activities, including increased traffic. The impacts of proposed activities under each alternative were assessed according to the types of noise sources and the location of the facility site locations relative to the site boundary and noise-sensitive receptors. Assessments of potential traffic-related noise impacts were based on the likely increase in traffic volume. Evaluations of the possible impacts on wildlife were based on the possibility of sudden loud noises occurring during site activities under each alternative.

Table 5–13 summarizes the expected noise impacts for each of the three alternatives.

5.4.3.1 No Action Alternative

Common to all three alternatives is LANL's continued contribution to background noise generation within the Los Alamos County area. The background noise levels are expected to remain at or near current levels for most of the foreseeable future regardless of the alternative implemented. There is no single representative measurement of ambient noise available for the LANL site. For a description of existing noise levels, see Chapter 4, Section 4.4.5.

Background noise levels associated with LANL activities under any of the three alternatives would be unlikely to approach the upper limit for sound levels in the community based on the site operation activities associated with each alternative relative to the existing environment.

Los Alamos National Laboratory Site-Wide Impacts

The levels of noise and short-range ground vibrations generated by environmental restoration activities are consistent with those produced by most construction activities. Heavy equipment use (bulldozers, loaders, backhoes, and portable generators) typically produces noise with mean levels ranging from 81 to 85 dBA at 50 feet (15 meters). In comparison with these noise levels, normal conversation is usually conducted at a sound level of about 60 dBA (FICN 1992). If heavy machinery were operated over an 8-hour period, producing noise at levels above 85 dBA constantly, it would be considered unsafe for workers; however, such noise generally is produced for short or sporadic periods. While occasional short spurts of site activities could result in noise levels in excess of 85 dBA, these are expected to be well within the levels of noise considered safe for likely exposure time durations of less than 1 hour. Hearing protection is provided and worn by workers, as appropriate, according to their standard operating procedures. Additionally, some minor interior and outdoor construction activities are common across all alternatives. Noise produced by these activities would be noticed most by LANL workers at the site where these activities are being performed, and these workers would be provided with hearing protection as part of their standard operating procedures.

Table 5–13 Summary of Environmental Consequences for Noise at LANL

	No Action Alternative	***Reduced Operations Alternative***	***Expanded Operations Alternative***
		LANL Site	
	Normal Operations – Noise levels from operations would continue to have little impact on the public, with the exception of sporadic noise from explosives detonation and traffic noise. *Construction* – Noise impacts from construction-type activities would occur from construction, demolition, and remediation activities, and would likely have little impact on the public, except for traffic noise impacts. *Land Conveyance and Transfer* – Minor increases in traffic noise could result from development. – Minor noise impacts could result from development. *Electrical Power System Upgrades* – Minor noise impacts would result from construction. *Wildfire Hazard Reduction Program* – Minor noise impacts would result from activities and disposition of flood and sediment retention structures. – Minor noise impacts would result from the Trails Management Project and the Security Perimeter Project.	Same as No Action Alternative.	Same as No Action Alternative, plus: *Security-Driven Transportation Modifications Project* – Minor noise impacts would result from road, bridge, and walkway construction. – Minor increases in traffic noise could result from use of the new roads, especially at the Royal Crest Mobile Home Park under one of the auxiliary actions. *MDA Remediation* – Minor noise impacts from remediation activities near the LANL boundary could cause some public annoyance. – Minor to moderate increase in truck and personnel vehicle traffic noise could result along East Jemez Road and at White Rock under the various remediation options.
		Affected Technical Areas	
TA-3	– Minor changes in noise impacts would result from operation of new turbine generator. – Minor construction noise impacts would result from construction of three new office buildings. – Negligible operation noise impacts are expected from new office buildings.	Same as No Action Alternative.	Same as No Action Alternative, plus: – Minor construction equipment and traffic noise impacts would result from construction of the Physical Science Research Complex and the Replacement Office Buildings. – Negligible operational noise impacts would result from use of equipment at the Physical Science Research Complex and the Replacement Office Buildings.
TA-21	No change in noise impacts.	Same as No Action Alternative.	Minor construction equipment noise impacts would result from DD&D of structures. Some increase in traffic noise would result from waste shipments.
TA-54	Minor noise impacts would result from MDA H closure activities.	Same as No Action Alternative.	Same as No Action Alternative.

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
TA-61	No change in noise impacts.	Same as No Action Alternative.	*Borrow Pit* – Noise impacts from operation of construction-type equipment to withdraw crushed tuff for MDA remediation and from increased truck traffic.
TA-72	No change in noise impacts.	Same as No Action Alternative.	– Minor construction equipment and traffic noise would result from construction of the Remote Warehouse and Truck Inspection Station. – Noise could be noticeable to the public along East Jemez Road from operation of the Remote Warehouse and Truck Inspection Station.
		Key Facilities	
Chemistry and Metallurgy Research Building (TA-3, TA-48, and TA-55)	– Little or no change in impacts would result from operation of the CMRR Facility and relocation of CMR activities to TA-55. – Minor construction equipment and traffic noise impacts would result from DD&D of the old facility at TA-3 and construction of the new facility at TA-55.	Minor reduction in noise impacts if the nuclear facility portion of the CMRR Facility is not constructed.	Same as No Action Alternative.
High Explosives Processing Facilities	– No change in operation noise impacts. – Minor construction equipment and traffic noise impacts would result from construction of the TA-16 Engineering Complex and demolition of structures.	Same as No Action Alternative.	Same as No Action Alternative.
High Explosives Testing Facilities	– No change in operation noise impacts. – Minor construction equipment and traffic noise impacts would result from construction of 15 to 25 new structures (new offices, laboratories, and shops) to replace about 59 structures currently used for dynamic experimentation operations and removal or demolition of vacated structures.	Minor reduction in operation noise impacts would result from 20 percent reduction in activities. Same as No Action Alternative for construction.	Same as No Action Alternative.
Tritium Facilities (TA-21)	No change in noise impacts.	Same as No Action Alternative.	– Minor construction equipment and traffic noise impacts would result from DD&D of all TA-21 tritium buildings as part of the project to decommission all of TA-21.
Pajarito Site (TA-18)	No change in noise impacts.	Minor reduction in operation noise impacts would result from shutdown of activities.	– Minor reduction in operation noise impacts would result from shutdown of activities. – Minor construction equipment and traffic noise impacts would result from DD&D of TA-18 buildings.

	No Action Alternative	***Reduced Operations Alternative***	***Expanded Operations Alternative***
Target Fabrication Facility	No change in noise impacts.	Same as No Action Alternative.	Same as No Action Alternative.
Bioscience Facilities	No change in noise impacts.	Same as No Action Alternative.	– Negligible change in operation impacts would result from transfer of Bioscience Facilities operations to the new Science Complex. – Minor construction noise impacts from construction of the new Science Complex.
Radiochemistry Facility (TA-48)	No change in noise impacts.	Same as No Action Alternative.	– Minor construction equipment and traffic noise impacts from construction of the new Radiological Sciences Institute.
Radioactive Liquid Waste Treatment Facility (TA-50)	No change in noise impacts.	Same as No Action Alternative.	– Minor construction equipment and traffic noise impacts from construction of a replacement for the existing Radioactive Liquid Waste Treatment Facility at TA-50 and DD&D of the existing Radioactive Liquid Waste Treatment Facility.
LANSCE (TA-53)	No change in noise impacts.	Minor reduction in noise impacts from shutdown.	Negligible to minor noise impacts from refurbishment.
Solid Radioactive and Chemical Waste Facilities (TA-50 and TA-54)	No change in noise impacts.	Same as No Action Alternative.	– Minor noise impacts from retrieving transuranic waste from below ground storage. – Minor construction and traffic noise impacts from construction of a new TRU Waste Facility and new access control station, low-level radioactive waste compactor building, and low-level radioactive waste certification building.
Plutonium Facility Complex (TA-55)	No change in noise impacts.	Minor reduction in noise impacts if the nuclear facility portion of the CMRR Facility is not constructed.	– Minor construction equipment and traffic noise impact from minor facility modifications in support of increased pit production and the Plutonium Complex Refurbishment Project, as well as construction of radiography capabilities.

MDA = material disposal area; TA = technical area; DD&D = decontamination, decommissioning, and demolition; LANSCE = Los Alamos Neutron Science Center; CMRR = Chemistry and Metallurgy Research Replacement; CMR = Chemistry and Metallurgy Research Building.

Noise from LANL construction activities may be somewhat noticeable to nearby members of the public. Environmental restoration activities that occur near the Los Alamos townsite may be noticeable to the public but would be limited in duration. Because these activities are conducted during the daytime hours for short continuous durations, the noise levels and ground vibrations produced are unlikely to adversely impact the public or sensitive wildlife receptors and their habitats. If certain sensitive wildlife species are found to occupy habitat areas near locations where these types of activities need to occur, or if the occupancy status of these habitat areas is unknown, either these activities would need to be scheduled outside of the species' breeding season or other special protective measures would need to be planned and implemented (such as hand digging).

Specifically for the No Action Alternative, minor noise impacts would occur from construction activities, including construction related to previously approved projects such as the Electric Power System Upgrades, Wildfire Hazard Reduction Program, disposition of flood and sediment retention structures, Trails Management Program, and Security Perimeter Project. Management of construction fill would increase truck traffic. All of these construction projects would produce temporary increases in equipment and traffic noise.

Similarly, workers, the public, and sensitive wildlife receptors are unlikely to be adversely impacted by explosives testing, which is common to some degree among all of the three alternatives. Workers are allowed to experience impulsive/impact noise events up to a maximum of 140 dBC and are kept away from harmful noise levels and air blasts by gated exclusion zones that control their entry into explosives firing site detonation points. The public is not allowed within the fenced TAs that have firing sites, and noise levels produced by explosives tests are sufficiently reduced at locations where the public would be present to preclude hearing damage. Such tests would not be expected to adversely affect offsite sensitive receptors (such as those at Bandelier National Monument or at White Rock). Noises heard at that distance would be similar to thunder in their intensity, and air blast and ground vibrations are not expected to be present outside LANL at intensities great enough to adversely affect real properties. Sensitive wildlife species are unlikely to be adversely affected by "thunder-like" explosives testing events, given their continued presence in areas of the country that are known to be within higher-than-average lightning event areas and their continued presence on the LANL site over the past 10 years. In fact, the continued thriving of resident and long-term migratory populations of these sensitive species on the LANL site indicates that the level of noise generated by explosives testing under the No Action Alternative is at least tolerable to these particular species.

Implementing the No Action Alternative would likely result in the previously discussed operations-related effects that are common to all alternatives. Specifically for the No Action Alternative, a minor increase in vehicle noise could result from development that occurs under conveyance and transfer of land.

Technical Area Impacts

Minor and temporary construction-related noise impacts would occur from construction of three new office buildings at TA-3 and MDA H closure activities at TA-54. Workers in the vicinity of MDA H waste encapsulation equipment may require hearing protection. Minor operations-related noise impacts would result from operation of new office buildings at TA-3 and operation of the new turbine generator at TA-3.

Key Facilities Impacts

Minor construction-related noise impacts would occur from construction of the Chemistry and Metallurgy Research Replacement Facility at TA-55, demolition of facilities at TA-3, completion of the TA-16 Engineering Complex, demolition of structures at TA-16, construction of buildings at the new Twomile Mesa Complex site, and demolition of unneeded structures.

Minor operations-related noise impacts would occur from moving Chemistry and Metallurgy Research operations from TA-3 to TA-55 due to operation of heating, ventilation, and cooling systems and other equipment at new facilities, including new structures for dynamic explosion operations. Minor operations-related noise impacts also would occur from operation of a new dynamic explosion structure at TA-15 for high explosives testing.

5.4.3.2 Reduced Operations Alternative

Noise impacts resulting from activities associated with the No Action Alternative would still occur, except for those associated with reductions to operations considered part of the Reduced Operations Alternative.

Los Alamos National Laboratory Site-Wide Impacts

Construction-related noise impacts under the Reduced Operations Alternative would be similar to those under the No Action Alternative. Construction projects would result in temporary increases in noise from equipment and traffic.

The operations-related noise impacts of the Reduced Operations Alternative would be similar to those of the No Action Alternative. The primary noise, air blast waves, and ground vibration impacts from implementation of this alternative would be generated by the high explosives tests. There would be fewer of these explosions under the Reduced Operations Alternative, and the resulting noise would still result from occasional (rather than continuous) events. Noises associated with LANSCE and TA-18 operations would be eliminated by the shutdown of those facilities.

Technical Area Impacts

Construction- and operations-related noise impacts would be the same as those under the No Action Alternative.

Key Facilities Impacts

Noise impacts from construction equipment and traffic from Key Facilities would be the same as those under the No Action Alternative except in TA-55, where the nuclear facility portion of the Chemistry and Metallurgy Research Replacement Facility would not be constructed, and in TA-3 where the Chemistry and Metallurgy Research Building DD&D would be postponed. A minor reduction in operational noise impacts would occur from the reduction in high explosives testing and the shutdown of activities at TA-18 (Pajarito Site) and LANSCE at TA-53.

5.4.3.3 Expanded Operations Alternative

The same noise impacts associated with activities considered under the No Action Alternative would occur under the Expanded Operations Alternative.

Los Alamos National Laboratory Site-Wide Impacts

Under the Expanded Operations Alternative, interior and outdoor construction activities at LANL would increase. Individual activities would remain within the level of effects described for the No Action Alternative, but could be ongoing for a longer period. In addition to the construction activities discussed for the No Action Alternative, activities such as construction of new buildings in various TAs; DD&D of buildings; road, bridge, and walkway construction as part of the Security-Driven Transportation Modifications Project; and MDA remediation (described and discussed in Appendix I) would likely result in levels of noise and short-range ground vibrations similar to those associated with current construction and demolition activities. Workers would be primarily affected by these noises, although motorists could occasionally hear low levels of equipment noises along Pajarito Road under certain climatic conditions. The roadway, walkway, and bridge construction under the Security-Driven Transportation Modifications Project (Appendix J) would be short-term and similar to other roadway construction at LANL. Noise from increased activities at MDAs close to the site boundary, such as at TA-21, could increase public annoyance at nearby residences or businesses.

There would be no change in noise impacts to the public outside of LANL as a result of construction activities, except for a small increase in traffic noise levels from construction employees' vehicles, materials shipments, and a minor-to-moderate increase in truck traffic noise from MDA remediation, especially along East Jemez Road near the Royal Crest Mobile Home Park. Other proposed construction activities under this alternative include small-scale outdoor activities, interior work on existing buildings, construction of an addition to an existing building, construction of a new building in close proximity to others, and construction at specific TAs and Key Facilities, as described below. The effects of these construction activities would be primarily limited to involved workers and would not likely result in any adverse effects on sensitive wildlife species or their habitats.

The largest increases in traffic noise from construction activities would be associated with remediation of the MDAs. Estimated increases in traffic along Pajarito Road could be substantial during the years when remediation of MDA G occurs. A similar increase in traffic along NM 4 at White Rock could be expected. The associated increase in traffic noise may be noticeable to some residents at White Rock due to the increase in truck trips. As most of the truck trips are expected to occur during non-peak-traffic daytime hours, the truck noise levels would be higher during these hours. As most of the increase in traffic would be from personnel vehicles, much of the increased traffic and associated traffic noise would occur during peak traffic hours. Increases in traffic along East Jemez Road near the Royal Crest Mobile Home Park also could be substantial during the years when remediation of MDA G (under either the Capping or the Removal Option) occurs. The associated increased traffic noise due to the higher volume of truck and personnel vehicle trips may be noticeable to residents at the Royal Crest Mobile Home Park.

As discussed for the No Action Alternative, the primary noise from implementation of these alternatives would be generated by air blast waves and ground vibration impacts associated with high explosives tests, although these explosions and the resulting noise would be occasional (rather than continuous) events. The noise would be sporadic and would be mitigated by the distance of the tests to the nearest public receptors. The effects of these operational activities would be primarily limited to involved workers. They would not likely result in any adverse effect on sensitive wildlife species or their habitats, and would be similar to the effects discussed under the No Action Alternative.

A minor increase in vehicle noise could result from use of the new roads constructed under the Security-Driven Transportation Modifications Project, especially at the Royal Crest Mobile Home Park under one of the auxiliary actions being considered that would include a bridge across Sandia Canyon.

Technical Area Impacts

There would be no change in noise impacts to the public outside of LANL as a result of construction activities at specific TAs (TA-3, TA-18, TA-21, and TA-54), except for minor increases in traffic noise levels from construction employees' vehicles and materials shipments and in noise levels at nearby businesses from DD&D at TA-21. Construction noise impacts would result from the same activities as those under the No Action Alternative, plus construction of additional office buildings and the Physical Science Research Complex at TA-3, DD&D of TA-18 buildings, DD&D at TA-21, construction of the Science Complex, and construction of the Remote Warehouse and Truck Inspection Station. The effects of these construction activities would be primarily limited to involved workers and would not likely result in any adverse effects on sensitive wildlife species or their habitats.

Operational noise impacts would result from the same type of activities as those under the No Action Alternative, with minor changes to impacts from relocated and consolidated activities across the various TAs. Noise potentially noticeable to the public along East Jemez Road could occur from operations of the Remote Warehouse and Truck Inspection Station.

Key Facilities Impacts

There would be no changes in noise impacts to the public outside of LANL as a result of construction-type activities at Key Facilities, except for a small increase in traffic noise levels from construction employees' vehicles and materials shipments. Construction noise impacts from Key Facilities would be the same as those under the No Action Alternative, with minor impacts resulting from DD&D of TA-21 and TA-18 buildings; construction of the new Science Complex, new Radiological Sciences Institute, and Institute for Nuclear Nonproliferation Science and Technology; replacement of portions of the Radioactive Liquid Waste Treatment Facility at TA-50; DD&D of the existing Radioactive Liquid Waste Treatment Facility; refurbishment at LANSCE; retrieval of transuranic waste from below ground storage at the Solid Radioactive and Chemical Waste Facilities; construction of a new TRU Waste Facility and associated buildings; and construction of a radiography facility and minor facility modifications at TA-55. The effects of these activities would be primarily limited to involved workers and would not likely result in any adverse effect on the public or on sensitive wildlife species or their habitats. Some of these activities such as the Radiological Sciences Institute construction could include blasting noise. Traffic noise would increase in the area around LANL from increased numbers of employee vehicles and shipments of materials and wastes, as discussed in the site-wide section above.

Operational noise impacts for Key Facilities would result from the same activities as those under the No Action Alternative, except for a minor reduction in operational impacts from the removal of activities from TA-18 and minor changes in impacts due to the transfer of the Bioscience Facilities operations to the new Science Complex and changes related to the operations of the Radiological Sciences Institute, the replacement Radioactive Liquid Waste Treatment Facility, the new TRU Waste Facility, and new radiography facility at TA-55. Noise impacts from Key Facilities operations associated with the Expanded Operations Alternative, therefore, would likely be about the same as those under the No Action Alternative.

5.5 Ecological Resources

Ecological resources include terrestrial resources, wetlands, aquatic resources, and protected and sensitive species. Biological data from the *1999 SWEIS* and other environmental documents, wetlands surveys, and plant and animal inventories of LANL were reviewed to identify the locations of plant and animal species and wetlands. Lists of protected and sensitive species potentially present on LANL were developed from sources at the Federal, state, and site levels.

Impacts to ecological resources could result from land disturbance, water use and discharge, human activity, and noise associated with project implementation. Each of these factors was considered when evaluating the potential impacts of proposed projects and activities. For those alternatives involving construction of new facilities, direct impacts to ecological resources were based on the acreage of land disturbed by construction. Indirect impacts from factors such as human disturbance and noise were evaluated qualitatively. Indirect impacts to ecological resources from erosion due to construction were evaluated qualitatively, recognizing that standard erosion and sediment control practices would be followed.

In evaluating the potential impacts on protected and sensitive species, it is important to consider both direct effects and effects that a proposed project could have on the species' habitat. Accordingly, LANL has established Areas of Environmental Interest for three species: Mexican spotted owl (*Strix occidentalis lucida*) (federally listed as threatened and state-listed as sensitive), bald eagle (*Haliaeetus leucocephalus*) (federally and state-listed as threatened), and the southwestern willow flycatcher (E*mpidonax traillii extimus*) (federally and state-listed as endangered) (LANL 2000b). Areas of Environmental Interest for these species include both core and buffer zones, each of which has certain restrictions aimed at protecting the species and their habitats. DOE has prepared a biological assessment for the continued operation of LANL (LANL 2006b) that evaluates potential impacts to the Mexican spotted owl, bald eagle, and southwestern willow flycatcher in terms of potential effects to the species and their designated Areas of Environmental Interest.[3] The results of the biological assessment, as well as the

[3] *The biological assessment uses the phrases "reasonable and prudent measures" and "reasonable and prudent alternatives." In this SWEIS, the term reasonable and prudent measures includes both phrases used in the biological assessment.*

U.S. Fish and Wildlife Service (USFWS) responses to the assessment (see Chapter 6), have been incorporated into this Final LANL SWEIS.

This section addresses the impacts of the No Action, Reduced Operations, and Expanded Operations Alternatives on Ecological Resources. A summary of these impacts is presented in **Table 5–14**.

5.5.1 No Action Alternative

The No Action Alternative was analyzed in terms of its impacts on the existing environment and on ecological resources (see Sections 4.4.5 [for effects of explosives-related noise on wildlife] and 4.5), including the actions that will be implemented, based on other NEPA compliance reviews issued since the *1999 SWEIS*. The impacts to ecological resources are described in terms of those projects that would impact the site as a whole and those that would affect specific TAs. Key Facilities are addressed separately. Only those projects that were determined to impact ecological resources are addressed below. Continuing the LANL environmental restoration program is not expected to adversely affect ecological resources.

Los Alamos National Laboratory Site-Wide Impacts

Five projects that have been approved, and for which NEPA documentation has been prepared since publication of the *1999 SWEIS*, have potential impacts across a number of TAs. These projects are addressed separately below.

Conveyance and transfer of land from DOE began in 2002; by the end of 2005, 2,259 acres (914 hectares) had been conveyed or transferred (see Chapter 4, Section 4.1.1). Additional acreage may be turned over by 2012. The land that has been or is to be conveyed or transferred falls within the pinyon-juniper woodland and ponderosa pine forest zones. One of the direct impacts of the conveyance and transfer is a change in responsibility for resource protection. An indirect impact, as determined by the analysis, is potential future development within the conveyed and transferred parcels. Approximately 770 acres (312 hectares) of relatively undisturbed habitat within the ponderosa pine forest and pinyon-juniper woodland zones could be developed, which could affect potential habitats for several federally listed threatened and endangered species, including the Mexican spotted owl. In some tracts, wetlands could be reduced or possibly lost, potentially increasing downstream and offsite sedimentation. Another indirect impact of the land conveyance and transfer could be a much less rigorous environmental review and protection process for future activities because neither the County of Los Alamos nor the Pueblo of San Ildefonso have regulations matching the Federal review and protection process. Cumulatively, development could impact biodiversity due to fragmentation of habitat and disruption of wildlife migration corridors (DOE 1999d).

Table 5–14 Summary of Environmental Consequences of Ecological Resource Changes at Los Alamos National Laboratory

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
LANL Site			
	Land Conveyance and Transfer – 2,259 acres (914 hectares) of land within the pinyon-juniper woodland and ponderosa pine forest zones have been conveyed or transferred. – 770 acres (312 hectares) of habitat could be developed. – Transfer of resource protection responsibility could result in a less rigorous environmental and protection review process. *Electrical Power System Upgrades* – Minimal effects on vegetation. – Temporary impacts such as disturbance from construction activities, on wildlife. – Potentially positive impact from providing perching sites for larger birds. *Wildfire Hazard Reduction Program* – Short-term disturbance of wildlife due to forest thinning activities. – Recreate more natural historic forest conditions. – Increased forest health could benefit the Mexican spotted owl and other species. *Disposition of Flood Retention Structures* – Short-term disturbance of wildlife due to construction activities. – Potentially minor impacts on downstream wetlands. *Trails Management Program* – Short-term disturbance of wildlife due to implementation activities. – Where trails are closed, some increase in diversity of wildlife.	Same as No Action Alternative	Same as No Action Alternative, plus: *MDA Remediation Project* – Minimal temporary impact on wildlife during capping or waste removal. – Capping would reduce biointrusion and complete removal would eliminate it. – Capping would limit revegetation efforts, while there would be no restrictions under the Removal Option. – Possible loss of habitat at borrow pit in TA-61, including undeveloped buffer and core habitat for the Mexican spotted owl. Extension of the borrow pit would require consultation with the USFWS. – In a few cases remediation activities may affect, but are not likely to adversely affect, the Mexican spotted owl, bald eagle, and southwestern willow flycatcher. *Security-Driven Transportation Modifications Project* – Parking lot construction and placement of pedestrian and vehicle bridges would remove about 30 acres (12 hectares) of natural vegetation. – Auxiliary Action A would disturb up to 25.4 acres (10.6 hectares) of undeveloped core and buffer Mexican spotted owl habitat. – Auxiliary Action B would disturb up to 65.8 acres (26.6 hectares) of undeveloped core and buffer; a new section of road would remove 1.3 acres (0.6 hectares) of additional natural habitat. – Construction may affect, but is not likely to adversely affect, the bald eagle. – Bridges and traffic over the core zone of the Sandia-Mortandad Canyon Mexican spotted owl Areas of Environmental Interest could cause long-term impacts. Section 7 consultation with the USFWS would be needed.

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
Affected Technical Areas			
TA-3	No change in impacts to ecological resources.	Same as No Action Alternative.	*Replacement Office Buildings* – Clear 13 acres (5.3 hectares) of mixed conifer forest. – Short-term construction impacts on wildlife. – Construction may affect, but is not likely to adversely affect, the Mexican spotted owl and bald eagle.
TA-21	No change in impacts to ecological resources.	Same as No Action Alternative.	*TA-21 Structure DD&D* – Short-term construction impacts on wildlife in adjacent areas. – DD&D activities may affect, but is not likely to adversely affect, the Mexican spotted owl.
TA-61	No change in impacts to ecological resources.	Same as No Action Alternative.	*Borrow Pit* – Loss of wildlife habitat from expanding operations to process tuff for MDA remediation. Consultation with the USFWS would be required.
Remote Warehouse and Truck Inspection Station (TA-72)	No change in impacts to ecological resources.	Same as No Action Alternative.	*Remote Warehouse and Truck Inspection Station Project* − 4 acres (1.6 hectares) of ponderosa pine forest and pinyon-juniper woodland would be cleared. − Short-term construction impacts on wildlife. − Construction may affect, but is not likely to adversely affect, the bald eagle.
Key Facilities			
Chemistry and Metallurgy Research Building (TA-3, TA-48, and TA-55)	Limited acreage of ponderosa pine forest cleared with loss and displacement of wildlife.	Same as No Action Alternative.	Same as No Action Alternative.
High Explosives Testing Facilities (TA-6, TA-22, and TA-40)	Short-term impacts on wildlife from construction of new facilities and demolition of old structures.	Same as No Action Alternative, plus: – Reduction in the number of times animals would be subjected to stress resulting from explosives testing.	Same as No Action Alternative.
Pajarito Site (TA-18)	No change in impacts to ecological resources.	Same as No Action Alternative	– Minor impact to wildlife during demolition. – DD&D activities may affect, but are not likely to adversely affect, the Mexican spotted owl and southwestern willow flycatcher. – Restoration of site could create a more natural habitat and benefit wildlife, potentially including the Mexican spotted owl.

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
Radiochemistry Facility (TA-48)	No change in impacts to ecological resources.	Same as No Action Alternative.	*Radiological Sciences Institute* – Minor impact to wildlife during construction and demolition. – 12.6 acres (5 hectares) of ponderosa pine forest cleared. – Construction may affect, but is not likely to adversely affect, the Mexican spotted owl and bald eagle. – DD&D activities may affect, but are not likely to adversely affect, the Mexican spotted owl.
Radioactive Liquid Waste Treatment Facility (TA-50)	No change in impacts to ecological resources.	Same as No Action Alternative.	– Construction may affect, but is not likely to adversely affect, the Mexican spotted owl and bald eagle. – Implementation of the evaporation tank option would reduce wetlands and riparian habitat in Mortandad Canyon and the abundance and diversity of Mexican spotted owl prey species, requiring Section 7 consultation with the USFWS.
Solid Radioactive and Chemical Waste Facilities (TA-50 and TA-54)	No change in impacts to ecological resources.	Same as No Action Alternative.	*Waste Management Facilities Transition Project* − Short-term impacts on wildlife from new construction and demolition in TA-54 under both options. − Construction at TA-54 may affect, but is not likely to adversely affect, the southwestern willow flycatcher. − Construction of a TRU Waste Facility at a generic site could impact portions of Mexican spotted owl Areas of Environmental Interest and would require Section 7 consultation with the USFWS. − TRU Waste Facility construction could result in the loss of 2.5 to 7 acres (1.0 to 2.8 hectares) of ponderosa pine forest or open field.
LANSCE (TA-53)	No change in impacts to ecological resources.	Wetland reduction possible due to shut down.	Same as No Action Alternative.
Bioscience Facilities	No change in impacts to ecological resources.	Same as No Action Alternative.	*Science Complex Project* − Options 1 and 2 would remove 5 acres (2 hectares) of ponderosa pine forest. − Under Option 3 less than 5 acres (2 hectares) of grassland and forest would be cleared. − Short-term construction impacts on wildlife. − Construction may affect, but is not likely to adversely affect, the Mexican spotted owl and bald eagle.

MDA = material disposal area; TA = technical area; DD&D = decontamination, decommissioning, and demolition; LANSCE = Los Alamos Neutron Science Center; USFWS = U.S. Fish and Wildlife Service.

Electric power line upgrades were determined to have minimal effects on vegetation along the power line right-of-way. Construction-related impacts on wildlife would include displacement due to increased noise and human activity; however, some species would likely return to the new habitat within the proposed corridor, including deer and elk. Further, the power line may provide additional perching sites for larger birds that occupy or use the area through which it passes. Adverse effects on habitats for bald eagles, southwestern willow flycatchers, and Mexican spotted owls due to the proposed placement of structures, roads, and laydown areas in existing roadways or disturbed areas would not be expected. Timing of construction and maintenance actions to avoid adverse effects on sensitive species or their habitats would ensure that these species were not impacted (DOE 2000a).

In the long term, the Wildfire Hazard Reduction Program would create conditions at LANL that are consistent with a more natural historic ecological process accompanied by improved health and vigor and increased biological diversity for wildlife. In the short term, treatment measures would temporarily displace local wildlife such as deer, elk, birds, and small mammals; however, wildlife would return to treated forests and their numbers would likely increase over the long term. Sensitive species also would be expected to benefit from a general improvement in forest health. For example, reducing the risk of severe, high-intensity wildfires supports the recovery goals for the Mexican spotted owl (DOE 2000e).

The future disposition of certain flood and sediment retention structures built after the Cerro Grande Fire could have minor short-term effects on ecological resources. The demolition of the flood retention structure in Pajarito Canyon would disturb vegetation and could result in sedimentation of downstream wetlands. In addition, noise and other effects of demolition activities could temporarily disperse animals that use the area. Revegetation and implementation of best management practices would minimize impacts to terrestrial resources and wetlands. Constraints on the timing of activities and noise levels may be required if Mexican spotted owls were found in the area. Removal of the steel diversion wall upstream of TA-18 could cause short-term effects on plants and animals. Noise and activity constraints during the breeding season of the Mexican spotted owl would prevent adverse effects on the nearby Area of Environmental Interest if the area were to become occupied by that species. Activities taking place at the low-head weir, located in Los Alamos Canyon, as well as the road reinforcements in Twomile Canyon, Pajarito Canyon, and Water Canyon were not found to affect ecological resources (DOE 2002j).

No long-term or permanent changes to ecological resources would be expected from implementing the LANL Trails Management Program. Short-term effects on animals that live along trail reaches, however, could result from trail construction, maintenance, or closure activities. In areas where trails would be closed, some increase in animal diversity might occur. Sensitive species, including the Mexican spotted owl, and their critical habitats are unlikely to be adversely affected by activities associated with the Trails Management Program (DOE 2003b).

Management of construction fill would not be expected to affect ecological resources. Construction fill would be stored in previously existing borrow areas in TA-16 and TA-61.

Technical Area Impacts

TA impacts on ecological resources would be essentially unchanged from current conditions under the No Action Alternative.

Key Facilities Impacts

Since publication of the *1999 SWEIS*, NEPA compliance has been completed for two currently active projects related to Key Facilities that could affect ecological resources: the Chemistry and Metallurgy Research Replacement Facility construction at TA-55 and the Twomile Mesa Complex Consolidation at TA-22.

Chemistry and Metallurgy Research Building

The Chemistry and Metallurgy Research Replacement Facility would be built within TA-55 on both previously disturbed land and within a small area of ponderosa pine forest. A total of about 28 acres (11 hectares) of natural vegetation would be removed, some from previously disturbed land. Where construction would occur on previously disturbed land, there would be little or no impact to terrestrial resources. Construction also would remove some previously undisturbed ponderosa pine forest, causing the loss of less mobile wildlife such as reptiles and small mammals and temporarily displacing more mobile species such as birds and large mammals. Indirect impacts from construction, such as noise or human disturbance, could also affect wildlife living adjacent to the construction zone. The project would have no impact on wetlands or aquatic resources at LANL. Although TA-55 includes a portion of the buffer zone of the Pajarito Canyon Mexican spotted owl Area of Environmental Interest, construction of the Chemistry and Metallurgy Research Replacement Facility would not be expected to adversely affect it. Operational impacts were determined to be minimal (DOE 2003d). DD&D of the existing Chemistry and Metallurgy Research Building would allow revegetation of that site; however, as the site is within TA-3, infill building at a later date would likely occur.

High Explosives Testing Facilities

Construction of new facilities associated with the consolidation of activities at the Two-Mile Mesa Complex within TA-22 and the associated demolition of numerous structures within a number of TAs across LANL were determined to impact ecological resources only minimally. Small mammals and birds would be temporarily displaced by construction activities, but they would likely return to the area after construction was completed. Movement of large mammals is not likely to be altered. There would be no impacts to wetlands or sensitive species (DOE 2003e).

5.5.2 Reduced Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Under the Reduced Operations Alternative, impacts on ecological resources would be the same as those for the No Action Alternative (see Section 5.5.1).

Key Facilities Impacts

Activity levels at certain Key Facilities would change. High explosives processing and testing would be reduced by 20 percent. LANSCE would cease operation and be placed into a safe shutdown mode. Operations would cease at the Pajarito Site (TA-18), and that facility would be shut down. As there would be no change in impacts on ecological resources associated with the closure of LANSCE or TA-18 facilities, this action is not addressed further.

High Explosives Testing Facilities

Under the Reduced Operations Alternative, high explosives testing at LANL would be reduced by 20 percent. Although animals may adjust to constant noise levels, they do not readily adjust to intermittently high noise levels. Startle or fright is the immediate behavioral reaction to transient, unexpected, or unpleasant noise such as explosives testing (EPA 1980). Thus, although testing would be reduced, animals residing near test sites would still experience stress with the occurrence of each test. The overall number of times per year that this stress would be experienced, however, would be lessened.

5.5.3 Expanded Operations Alternative

The Expanded Operations Alternative reflects proposals that would expand the overall operations level at LANL above those established for the No Action Alternative. Thus, this alternative includes the ecological resource impacts for those actions addressed under that alternative (see Section 5.5.1), as well as the potential impacts of a number of new projects. Not all new projects or activities would affect these resources because many would involve actions within or modifications to existing structures, or the construction of new facilities within previously developed areas of LANL. For example, an increase in pit production would not require new construction and hence would not affect ecological resources. Only those projects that would likely impact ecological resources are addressed below.

Los Alamos National Laboratory Site-Wide Impacts

There are two options (capping and removal) related to remediation of MDAs at LANL. Under the Capping Option, terrestrial resources would be disrupted as the MDAs are cleared of existing vegetation and then capped. Provision of material for the caps could result in the loss of some habitat adjacent to the active portion of the borrow pit in TA-61 due to the need to enlarge the existing borrow area. At most sites, however, capping would have minimal biota impact because the MDAs are grassy areas enclosed within a fence that excludes most wildlife species except birds and very small animals. Noise and human presence during remediation could disturb wildlife in adjacent areas, but proper equipment maintenance and restrictions preventing workers from entering adjacent undisturbed areas would lessen these impacts. The caps would be designed to prevent or reduce biointrusion, which would reduce the ecological risks associated with reintroduction of contaminants into the environment. Once capped and revegetated, the MDAs would provide habitat similar to that existing prior to remediation. This option would not directly impact any wetlands or aquatic resources at LANL.

Impacts of MDA and PRS remediation activities to the Mexican spotted owl, bald eagle, and southwestern willow flycatcher were evaluated in a biological assessment prepared by DOE. This assessment determined that, provided reasonable and prudent measures are implemented, remediation activities may affect, but are not likely to adversely affect, the Mexican spotted owl (within MDAs N, Z, A, and AB), bald eagle (within MDA D), and southwestern willow flycatcher (within MDAs G and L). Activities at other MDAs and PRSs at LANL should not impact these species (LANL 2006b). The USFWS has concurred with the findings of the biological assessment (see Chapter 6, Section 6.5.2). Since expansion of the borrow pit could result in the removal of undeveloped buffer and core habitat for the Mexican spotted owl, consultation with the USFWS would be required prior to this activity.

Impacts to ecological resources under the MDA Removal Option would be similar to those described for the Capping Option. While remedial actions would create a disruptive environment for local wildlife in the short term, long-term impacts would likely be beneficial in terms of ecological risk because wastes would be removed. In addition, there would be no restrictions on the types of plants that could be introduced, which would permit reestablishment of more natural conditions that would, in turn, provide habitat for area wildlife (see Appendix I).

Most actions associated with implementing the Security-Driven Transportation Modifications Project would have little or no impact on ecological resources; however, the construction of the two parking lots, a portion of the new road across TA-63, and the highway and pedestrian bridges over the Ten Site branch of Mortandad Canyon would affect undeveloped ponderosa pine forest, open land, and wildlife. Other project elements would largely take place in currently developed areas. As no wetlands exist within Pajarito Corridor West and aquatic resources are not present on the mesa, impacts to these resources would not occur.

The parking lot in TA-63, the road across the eastern edge of TA-63, and the pedestrian and highway bridges fall within buffer habitat of the Mexican spotted owl Areas of Environmental Interest; a portion of the parking lot is within core habitat. A biological assessment performed by DOE determined that up to 18.8 acres (7.6 hectares) of buffer and 1 acre (0.4 hectares) of core Mexican spotted owl habitat could be lost and that the project would generate excess noise or light. The biological assessment concluded that even if reasonable and prudent measures are implemented to mitigate impacts, project activities may affect, and are likely to adversely affect, the Mexican spotted owl (LANL 2006b). However, following review of the biological assessment, the USFWS concluded that impacts to the spotted owl from construction activities associated with the Security-Driven Transportation Modifications Project would be insignificant and discountable, and would not result in adverse effects (see Chapter 6, Section 6.5.2). Additional USFWS consultation would be needed, however, if a land bridge, rather than a span bridge, were constructed.

Land disturbed by the Security-Driven Transportation Modifications Project does not fall within Areas of Environmental Interest for either the bald eagle or southwestern willow flycatcher. However, because the bald eagle forages over all of LANL and some habitat degradation is associated with the project, the biological assessment concluded that provided appropriate reasonable and prudent measures are implemented, the project may affect, but is not likely to adversely affect, the bald eagle. Because the southwestern willow flycatcher Area of Environmental Interest is more than 2 miles (3.3 kilometers) from the project site, the biological assessment concluded that the proposed project would have no effect on this species

(LANL 2006b). The USFWS has concurred with the biological assessment as it relates to the bald eagle and southeastern willow flycatcher (see Chapter 6, Section 6.5.2).

Auxiliary Action A for the Security-Driven Transportation Modifications Project involves construction of a two-lane bridge within a 1,000-foot (300-meter)-wide corridor across Mortandad Canyon and a new two-lane road from the north end of the new bridge westward through TA-60 to connect TA-35 with TA-3. Auxiliary Action B involves construction of a new two-lane bridge that would be constructed within a 1,000-foot (300-meter)-wide corridor across Sandia Canyon and a new two-lane road from the new bridge to connect with East Jemez Road. Construction of the roadways would have minimal impacts on habitat because they generally would follow the existing rights-of-way that have already been disturbed. The road that would be constructed under the second action, however, would require clearing and grading approximately 1.3 acres (0.5 hectares) of ponderosa pine forest. No wetlands or aquatic resources would be directly affected by roadway construction.

Under both auxiliary actions, road and bridge construction would take place within the buffer zone of the Sandia-Mortandad Canyon and Los Alamos Canyon Mexican spotted owl Area of Environmental Interest. Additionally, they would pass through the core zone of the Sandia-Mortandad Canyon Mexican spotted owl Area of Environmental Interest. The biological assessment prepared by DOE determined that Auxiliary Action A would disturb up to 25.3 acres (10.2 hectares) of undeveloped core habitat and 0.1 acres (0.4 hectares) of undeveloped buffer habitat. Under Auxiliary Action B, construction would directly impact up to 37.1 acres (15 hectares) of undeveloped core habitat and 28.7 acres (11.6 hectares) of undeveloped buffer habitat. Further, under both actions construction would cause temporary increases in light and noise which would be permanent once the bridge was operational. The biological assessment concluded that even if reasonable and prudent measures are implemented to mitigate impacts, project activities may affect, and are likely to adversely affect, the Mexican spotted owl (LANL 2006b). Upon review of the biological assessment, the USFWS determined that it could not adequately analyze the affects of the proposed actions since the exact location and design of the bridges have not been determined. Instead the agency requested that DOE submit a request for consultation when plans are finalized (see Chapter 6, Section 6.5.2).

The biological assessment determined that with reasonable and prudent measures, the project may affect, but is not likely to adversely affect, the bald eagle. This determination was made based on the fact that some foraging habitat degradation would be associated with construction. Since the closest southwestern willow flycatcher Area of Environmental Interest is more than 2.3 miles (3.7 hectares) from the nearest construction area, the biological assessment determined that there would be no effect to this species (LANL 2006b). The USFWS has concurred with the biological assessment as it relates to bald eagle and southeastern willow flycatcher (see Chapter 6, Section 6.5.2).

Technical Area Impacts

Two projects are planned that could impact ecological resources within TA-3 and TA-21. These are addressed below.

Technical Area 3

Construction related to the Replacement Office Building Project would involve clearing and grading 13 acres (5.3 hectares) of mixed conifer forest within TA-3, resulting in loss of less mobile wildlife such as reptiles and small mammals and displacing more mobile species such as birds or large mammals. Construction of the new buildings and parking lot would not impact wetlands because none are located in or near the construction zone. Potential impacts to the Mexican spotted owl were evaluated in a biological assessment prepared by DOE. This assessment noted that although 11.2 acres (4.5 hectares) of buffer habitat would be disturbed, if all reasonable and prudent measures are taken, actions associated with the construction may affect, but are not likely to adversely affect, the Mexican spotted owl. The Area of Environmental Interest for the bald eagle does not include any part of TA-3. However, since some bald eagle foraging habitat degradation could be associated with the project, the biological assessment concluded that provided reasonable and prudent measures are implemented, the project may affect, but is not likely to adversely affect, the bald eagle. The nearest southwestern willow flycatcher Area of Environmental Interest is more than 4.6 miles (7.4 kilometers) from the project site. Thus, the biological assessment concluded that the proposed project would have no effect on this species (LANL 2006b). The USFWS has concurred with the biological assessment as it relates to these three species (see Chapter 6, Section 6.5.2).

Operation of the Replacement Office Building complex would likely have minimal impact on terrestrial resources within or adjacent to TA-3 (see Appendix G.2).

Technical Area 21

DD&D of structures at TA-21 would occur within the highly disturbed industrial portion of the TA, which contains little wildlife habitat. Demolition-related disturbances to wildlife would likely be intermittent and localized. After DD&D of the buildings and structures, the site would be contoured and revegetated. Revegetation would have only relatively short-term benefits to wildlife, however, because both the parcel conveyed to Los Alamos County and the parcel retained by DOE could be developed in the future. Elimination of two NPDES-permitted outfalls associated with TA-21 operations would reduce the quantity of surface water discharged to the adjacent canyons.

TA-21 falls within the Los Alamos Canyon Mexican spotted owl Area of Environmental Interest. Because TA-21 is highly disturbed, no suitable foraging or nesting habitat would be lost as a result of DD&D activities. Because noise levels would increase as a result of demolition activities the biological assessment prepared by DOE concluded that provided reasonable and prudent measures are implemented, DD&D activities may affect, but are not likely to adversely affect, the Mexican spotted owl. Since no bald eagle nesting or foraging habitat would be lost as a result of DD&D activities and the southwestern willow flycatcher Area of Environmental Interest is more than 2.6 miles (4.2 kilometers) from TA-21, the biological assessment determined that the proposed project would have no effect on either species (LANL 2006b). The USFWS has concurred with the biological assessment as it relates to these three species (see Chapter 6, Section 6.5.2).

Key Facilities Impacts

Four projects related to Key Facilities at LANL are planned that could affect ecological resources.

Radiochemistry Facility

Although construction of some of the new facilities associated with the Radiological Sciences Institute would take place on previously disturbed land, it would be necessary to clear about 12.6 acres (5.1 hectares) of ponderosa pine forest at TA-48, which would directly and indirectly impact area wildlife. Construction of the Radiological Sciences Institute would not directly impact wetlands located in Mortandad Canyon or the small wetland situated between TA-48 and TA-55, and best management practices would reduce the potential for indirect impacts. There would be no impact to aquatic resources from construction and operation of the Radiological Sciences Institute.

Portions of TA-48 are located within core and buffer zones of the Sandia-Mortandad Canyon and Pajarito Canyon Mexican spotted owl Areas of Environmental Interest. However, only a small portion of the Radiological Sciences Institute may be built within buffer habitat. Thus, the biological assessment prepared by DOE concluded that with the application of reasonable and prudent measures, the project may affect, but is not likely to adversely affect, the Mexican spotted owl. Areas of Environmental Interest for the bald eagle do not include any part of TA-48 or TA-55. Since some bald eagle foraging habitat degradation is possible with construction of the Radiological Sciences Institute, the biological assessment concluded that with reasonable and prudent measures the project may affect, but is not likely to adversely affect, the bald eagle. The nearest southwestern willow flycatcher Area of Environmental Interest is over 3 miles (4.8 kilometers) from the project site. Thus, it was determined that there would be no effect on this species (LANL 2006b). The USFWS has concurred with the biological assessment as it relates to these three species (see Chapter 6, Section 6.5.2).

Removal of existing buildings and structures at TA-48, as well as those to be replaced by the Radiological Sciences Institute, would generate increased noise and levels of human disturbance. These impacts would be temporary, however, and would likely have minimal effect on wildlife because these structures exist within previously disturbed areas and wildlife in adjacent areas is accustomed to human activity. As wetlands do not exist in the immediate area of any of the buildings to be replaced by the new Radiological Sciences Institute, there would be no direct impacts on this resource. Of the buildings to be demolished in connection with the Radiological Sciences Institute project, only those located in TA-35 are located in developed core habitat for the Mexican spotted owl. The removal of these buildings could produce increased noise levels in undeveloped core habitat. However, the biological assessment concluded that demolition may affect, but is not likely to adversely affect, the Mexican spotted owl, provided that reasonable and prudent measures are followed. DD&D activities would have no effect on the bald eagle and southwestern willow flycatcher (LANL 2006b). The USFWS has concurred with the biological assessment as it relates impacts to these three species (see Chapter 6, Section 6.5.2).

Radioactive Liquid Waste Treatment Facility

No impacts to terrestrial resources or wetlands would be expected from implementing any of the alternatives for the Radioactive Liquid Waste Treatment Facility upgrade because it is located within a highly developed industrial area of TA-50. However, the evaporation tanks and pipeline that are proposed as an auxiliary action to this project would be located in undeveloped core and buffer habitat of the Sandia-Mortandad Canyon Mexican spotted owl Area of Environmental Interest. The biological assessment prepared by DOE determined that the tanks and pipeline would remove 3.1 acres (1.3 hectares) of undeveloped buffer habitat and 2.3 acres (0.9 hectares) of undeveloped core habitat. It was also determined that construction of the Radioactive Liquid Waste Treatment Facility would likely raise noise levels in the core zone. The biological assessment concluded that with the application of reasonable and prudent measures the project may affect, but is not likely to adversely affect, the Mexican spotted owl. The bald eagle Area of Environmental Interest is not located near the proposed project site; however, because the entire LANL site is considered potential bald eagle foraging habitat there may be some habitat degradation associated with the project. Provided reasonable and prudent measures are implemented, the biological assessment concluded that construction may affect, but is not likely to adversely affect, the bald eagle. The proposed project is not within or upstream of the southwestern willow flycatcher Area of Environmental Interest; thus, the project would not effect this species (LANL 2006b). The USFWS has concurred with the DOE biological assessment as it relates to these three species (see Chapter 6, Section 6.5.2). Implementation of the evaporation tank option would likely reduce the extent of perennial and intermittent stream reaches, associated wetlands, and riparian habitat, which would reduce the abundance and diversity of prey species for the Mexican spotted owl. Significant adverse impacts to the Mexican spotted owl, however, are not expected.

Solid Radioactive and Chemical Waste Facilities

Under both the options proposed as part of Waste Management Facilities Transition activities within TA-54, including new construction and removal of the white-colored domes, all activities would occur within developed areas. Thus, there would be little to no impact on ecological resources. Although TA-54 includes a portion of the southwestern willow flycatcher Area of Environmental Interest, the area within which project related activities would take place is located about 450 feet (137 meters) from the core habitat. Provided reasonable and prudent measures are implemented, the biological assessment prepared by DOE concluded that the project may affect, but is not likely to adversely affect, the southwestern willow flycatcher. With respect to the bald eagle and Mexican spotted owl, the biological assessment determined that there would be no effect on either species as a result of implementing the proposed project. This is the case since the site does not include any portion of Areas of Environmental Interest for these species, foraging habitat would not be disturbed, and noise levels would be low (LANL 2006b). The USFWS has concurred with this assessment as it relates to these three species (see Chapter 6, Section 6.5.2).

The proposed TRU Waste Facility could be located within a generic area in the Pajarito Road corridor selected from among a number of TAs, and would disturb about 2.5 to 7 acres (1 to 2.8 hectares) of land. In most cases this would involve the removal of ponderosa pine forest or open field habitat; however, the generic site within TA-54 West is developed. Impacts to wetlands and aquatic resources from this project would not be expected.

At least some portion of either the core or buffer zone of Mexican spotted owl Areas of Environmental Interest would be affected by construction of the new facility within all generic sites except in TA-48, TA-51, and TA-54 West. For those generic sites where the new facility has the potential to affect the spotted owl, either directly or indirectly (for example, by excess noise or light), it would be necessary to conduct a biological assessment and initiate formal consultation with the USFWS. None of the generic sites are within Areas of Environmental Interest for the bald eagle or southwestern willow flycatcher.

Pajarito Site

DD&D of facilities at TA-18 would have little impact on wildlife habitat because the facilities are located within areas that are developed and fenced. Animals could be intermittently disturbed by activity and noise during the demolition period. Implementation of best management practices during demolition would prevent potentially sediment-laden runoff from reaching the wetland located at the eastern end of TA-18. Ultimately, previously disturbed areas would be restored using native species, which would benefit area wildlife.

DD&D of buildings and structures at TA-18 would not directly impact the Mexican spotted owl because all activities would take place within developed areas. However, the biological assessment performed by DOE noted that noise levels in the core zone would be elevated above background levels. The biological assessment concluded that with the implementation of reasonable and prudent measures, DD&D activities may affect, but are not likely to adversely affect, the Mexican spotted owl. With respect to the bald eagle, DD&D of TA-18 facilities would have no effect since the project would not remove any bald eagle foraging habitat. While the project would take place upstream from the southwestern willow flycatcher Area of Environmental Interest, it was determined that with the application of reasonable and prudent measures, the project may affect, but is not likely to adversely affect, the southwestern willow flycatcher (LANL 2006b). The USFWS has concurred with the biological assessment as it relates to these three species (see Chapter 6, Section 6.5.2).

Biosciences Facilities

Construction of the Science Complex would involve clearing and grading approximately 5 acres (2 hectares) of ponderosa pine forest under the Northwest TA-62 and Research Park Site options, which would result in loss and displacement of wildlife. Indirect impacts from construction, such as noise or human disturbance, could also impact wildlife. Construction of the new buildings and parking structure would not impact wetlands because none are located in or near the construction zone under either option. Operation of the Science Complex would minimally impact terrestrial resources because wildlife residing in the area has already adapted to levels of noise and human activity associated with development in the general area. Impacts to ecological resources would be minimal under the South TA-3 option because the area is already partially developed and is within the more developed part of TA-3.

Under the Northwest TA-62 Option a portion of the project area falls within the core and buffer zone of the Los Alamos Canyon Area of Environmental Interest for the Mexican spotted owl. The biological assessment prepared by DOE determined that construction would remove some undeveloped core habitat and buffer habitat. Further, the project would potentially increase noise levels in the core zone. The biological assessment noted that provided all reasonable and prudent measures are implemented, the project may affect, but is not likely to adversely affect, the Mexican spotted owl. Areas of Environmental Interest for the bald eagle and southwestern willow flycatcher are not located near the proposed Northwest TA-62 Science Complex location. However, because the bald eagle forages over all of LANL and some habitat degradation associated with construction could occur, the biological assessment concluded that with reasonable and prudent measures, the project may affect, but is not likely to adversely affect, the bald eagle. The nearest southwestern willow flycatcher Area of Environmental Interest is not within or downstream of the project site; thus, there would be no effect on this species (LANL 2006b). The USFWS has concurred with the biological assessment as it relates to these three species (see Chapter 6, Section 6.5.2). Although the Research Park Site Option was not addressed in the biological assessment, the site is not within an Area of Environmental Interest for the Mexican spotted owl, bald eagle, or willow flycatcher. Thus, impacts to these species under this option would not be expected.

Warehouse and Truck Inspection Station

The proposed project would include clearing and grading approximately 4 acres (1.6 hectares) of ponderosa pine forest and pinyon-juniper woodland, which would result in loss and displacement of wildlife. Indirect impacts from construction, such as noise or human disturbance, could also impact wildlife. Operation of the proposed Remote Warehouse and Truck Inspection Station would not likely pose significant adverse effects to area wildlife. The new facility would not be located within Areas of Environmental Interest for the Mexican spotted owl, bald eagle, or southwestern willow flycatcher. However, because the bald eagle forages over all of LANL and some habitat degradation associated with construction could occur, the biological assessment prepared by DOE concluded that with appropriate reasonable and prudent measures, the project may affect, but is not likely to adversely affect, the bald eagle. The biological assessment further concluded that there would be no effect on the Mexican spotted owl or southwestern willow flycatcher (LANL 2006b). The USFWS has concurred with this assessment (see Chapter 6, Section 6.5.2).

5.6 Human Health

5.6.1 Radiological Impacts on the Public

People can be exposed to radiation through a variety of ways. Airborne radioactive particles can be inhaled. Radioactive particles can be ingested if they are on the surface of food or if the food was produced in areas that are contaminated with radioactive material that can be taken up by plants and animals. The body can be directly exposed to radiation from radionuclides in air emissions or from proximity to radioactive materials that have been deposited on the ground. Radiation also can enter the body through skin breaks. Estimates were made of the amount of radioactive materials to which the public could be exposed due to LANL radioactive air emissions (see Section 5.4.2). Using these estimates, radiation doses from LANL operations to the public and at certain receptor locations were calculated (details can be found in Appendix C).

The total annual radiation dose received by an individual is a combination of the potential dose received from LANL operations and the doses received from other radiation sources such as naturally occurring background radiation, medical radiation, and radiation from other nuclear activities. A challenge in measuring dose is that no person has the same actual exposure rate as any other. Because of this, health impacts analyses often evaluate the upper bound for individual exposure, which is expressed as the potential dose to the hypothetical MEI. For this analysis, the MEI is a hypothetical person who is assumed to remain in place outdoors without shelter and without taking any protective action for the entire period of exposure. In reality, no one would receive a dose approaching that of an MEI, but the concept is useful as an expression of the upper bound of any possible dose to an individual.

Historical data and capabilities were reviewed for the *1999 SWEIS* to determine which LANL facilities would be analyzed as Key Facilities. For this new SWEIS, changes to those capabilities and past emissions determined which facilities would remain designated as Key Facilities. **Table 5–15** lists those Key Facilities used in the human health analyses of this SWEIS.

Table 5–15 List of Facilities Modeled for Radionuclide Air Emissions from Los Alamos National Laboratory

Key Facility Name	*Technical Area/Building*
Chemistry and Metallurgy Research Building	TA-3-29
Sigma Complex	TA-3-66
Machine Shops	TA-3-102
High Explosives Processing Facilities	TA-11
High Explosives Testing Facilities	TA-15/36
Tritium Facilities [a]	TA-16
Pajarito Site	TA-18
Radiochemistry Facility	TA-48
LANSCE	TA-53
Solid Radioactive and Chemical Waste Facilities [b]	TA-54
Plutonium Facility Complex	TA-55
Non-Key Facilities	TA-21

TA = technical area, LANSCE = Los Alamos Neutron Science Center.

[a] This facility includes the Weapons Engineering Tritium Facility (TA-16). The Tritium Science Fabrication Facility and Tritium System Test Assembly at TA-21 continue to have emissions while awaiting DD&D, and are included under the non-Key Facilities.

[b] Includes MDA G and the Decontamination and Volume Reduction System.

Some facilities that have historically low emission rates are unmonitored. These unmonitored point sources receive periodic confirmatory measurements by LANL personnel to verify that emissions remain low. The *1999 SWEIS* analyzed air emissions data from TA-50-1 (Radioactive Liquid Waste Treatment Facility) and confirmed that air emissions were “insignificant relative to other sources at LANL” (LANL 1997b), so the public dose from those emissions was not analyzed. For this new SWEIS, air emissions data from the Radioactive Liquid Waste Treatment Facility were again reviewed for the period from 1999 to 2004. This review of actual radiological air emissions showed a decreasing trend since 1992, with a low of 7.9×10^{-8} curies per year recorded in 2004. The six-year average for TA-50 emissions during that period

(1.1×10^{-7} curies) is far less than emissions from LANSCE (2,700 curies), the major contributor to the public dose. It is anticipated that air emissions data would remain the same for the purposes of analyses presented in this new SWEIS, and therefore would result in insignificant health-related impacts to the public compared to other sources.

To calculate these doses for this new SWEIS, the Clean Air Act Assessment Package – 1988 (CAP-88) software was used. CAP-88 is an EPA-approved computer model for calculating the effective dose equivalent to members of the public, as required by emission monitoring and compliance procedures for DOE facilities [40 CFR 61.93 (a)]. CAP-88 uses modified Gaussian plume equations to estimate the average dispersion of radionuclides released to the air from up to six emitting sources. The program computes radionuclide concentrations in air, rates of deposition on ground surfaces, concentrations in food, and intake rates to people from ingestion of food produced in the assessment area.

For this SWEIS, an estimated dose to the facility-specific MEI was calculated for each modeled facility. The location of each facility-specific MEI is where the dose from that facility's emissions to a member of the public would be largest, and is based on wind direction and meteorological data for that facility. **Table 5–16** shows the distance and direction from each facility to its facility-specific MEI. Doses from all modeled facilities were calculated at the facility-specific MEI location; thus, the dose to the facility-specific MEI represents the estimated dose to an individual from the specific facility and all other modeled facilities. The LANL site-wide MEI is the single highest facility-specific MEI; therefore, any other facility-specific MEI doses would be less than the LANL site-wide MEI for the alternative under analysis.

Table 5–16 Distance and Direction from Key Facilities to the Facility-Specific Maximally Exposed Individual

Key Facility	*MEI Distance Feet (meters)*	*MEI Direction*
Chemistry and Metallurgy Research Building (TA-3–29)	3,575 (1,090)	N
Sigma Complex (TA-3–66)	3,560 (1,085)	N
Machine Shops (TA-3–102)	3,380 (1,030)	N
High Explosives Processing Facilities (TA-11)	4,300 (1,311)	S
High Explosives Testing Facilities (TA-15/36)	7,415 (2,260)	NE
Tritium Facilities (TA-16)	2,885 (879)	SSE
Pajarito Site (TA-18)	2,820 (860)	NE
Radiochemistry Facility (TA-48)	2,920 (890)	NNE
LANSCE (TA-53)	2,625 (800)	NNE
Solid Radioactive and Chemical Waste Facilities (TA-54)	1,195 (364)	NE
Plutonium Facility Complex (TA-55)	3,690 (1,125)	N
Non-Key Facilities (TA-21)	1,050 (320)	N

MEI = maximally exposed individual, TA = technical area, LANSCE = Los Alamos Neutron Science Center.

Population dose estimates were made for the entire population within a 50-mile (80-kilometer) radius of LANL by summing the estimated doses to all people within that radius. The population dose from each facility was modeled independently for each alternative. The total dose from all facilities for one alternative represents the projected population dose from implementing that alternative.

In addition to dose, estimates of risk to the public and the MEI were calculated. Scientists and decisionmakers quantify relationships among risks by using mathematical probabilities. In this SWEIS, risks are defined in terms of the number of additional latent cancer fatalities (excess LCFs due to the estimated dose) from LANL operations. The number of additional LCFs is calculated as the product of the dose in units of person-rem and the risk factor (0.0006 LCF per person-rem). These estimates are intended to be conservative measures of the potential public health impacts of the three alternatives for use in the decisionmaking process; they do not necessarily accurately represent actual anticipated fatalities.

Tables 5–17 and **5–18** summarize the projected public doses resulting from normal operations under each alternative for both an MEI near LANL property and the general population within 50 miles (80 kilometers) of LANL. The potential impact from shutdown of LANSCE operations under the Reduced Operations Alternative would substantially decrease the dose to the general public and to the MEI. Under all of the alternatives, the MEI would receive a smaller dose than the exposure limits set by DOE and EPA.

Table 5–17 Summary of Projected Doses to the Maximally Exposed Individual from Normal Operations at Los Alamos National Laboratory (millirem per year)

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
LANL Site-Wide			
Dose from MDA remediation only to LANL Site-Wide MEI	Not applicable	Not applicable	less than 0.42 [b]
Key Facilities [a], includes contributions from:			
CMR Building	0.011	0.0034	0.011
Sigma Complex	0.0041	0.0060	0.0041
Machine Shops	0.00032	0.00045	0.00032
High Explosives Processing Facilities	1.3×10^{-6}	1.8×10^{-6}	1.3×10^{-6}
High Explosives Testing Facilities	0.25	0.72	0.25
Tritium Facilities	0.0036	0.0045	0.0036
Pajarito Site	0.0070	0.0080 [c]	0.0070 [c]
Radiochemistry Facility	0.00029	0.00050	0.00029
LANSCE [d]	7.5	0	7.5
Solid Radioactive and Chemical Waste Facilities	0.0012	0.0012	0.0012 [e]
Plutonium Facility Complex	0.012	0.024	0.012
Non-Key Facility (TA-21)	0.012	0.0071	0.012 [f]
Total LANL Site-Wide MEI Dose	7.8	0.78	Less than 8.2 [b]

MDA = material disposal area, MEI = maximally exposed individual, CMR = Chemistry and Metallurgy Research, LANSCE = Los Alamos Neutron Science Center, TA = technical area.

[a] Under the No Action and the Expanded Operations Alternatives, the LANL site-wide MEI would be located near LANSCE. Under the Reduced Operations Alternative, the LANL site-wide MEI would be located near the High Explosives Testing (Firing Sites) at TA-36.

[b] This dose could be smaller depending on which MDA is being remediated, whether the MDA is being capped or removed, the number of MDAs being remediated at one time, and whether exhumation occurs under an enclosure (see Appendix I).

[c] Dose would be zero following shutdown of Pajarito Site (TA-18) after about 2009.

[d] The maximum dose to the MEI as a result of emissions from LANSCE would be limited to 7.5 millirem per year using administrative controls.

[e] This dose could increase to 0.0018 millirem per year if the Decontamination and Volume Reduction System, the new TRU Waste Facility, and remote-handled transuranic waste retrieval and processing activities operated simultaneously (estimated to occur from 2012 through 2015).

[f] Dose would be zero following decontamination, decommissioning, and demolition of TA-21 after about 2009.

Table 5–18 Summary of Projected Doses to the General Public Within 50 Miles (80 kilometers) of Los Alamos National Laboratory from Normal Operations (person-rem per year)

	No Action Alternative	***Reduced Operations Alternative***	***Expanded Operations Alternative***
LANL Site-Wide			
Dose from MDA remediation	Not applicable	Not applicable	Less than 6.2 [a]
Key Facilities, includes contributions from:			
CMR Building	0.43	0.11	0.43
Sigma Complex	0.16	0.16	0.16
Machine Shops	0.01	0.01	0.01
High Explosives Processing Facilities	0.00005	0.00004	0.00005
High Explosives Testing Facilities	6.4	5.2	6.4
Tritium Facilities	0.09	0.09	0.09
Pajarito Site	0.23	0.23 [b]	0.23 [b]
Radiochemistry Facility	0.01	0.01	0.01
LANSCE	22	0	22
Solid Radioactive and Chemical Waste Facilities	0.04	0.04	0.04 [c]
Plutonium Facility Complex	0.19	0.19	0.20
Non-Key Facility (TA-21)	0.09	0.09	0.09 [d]
Total Dose to General Population	**30**	**6.1**	**Less than 36.2 [a]**

MDA = material disposal area, CMR = Chemistry and Metallurgy Research, LANSCE = Los Alamos Neutron Science Center, TA = technical area.

[a] This dose could be smaller depending on which MDAs are being remediated, whether the MDA are being capped or removed, the number of MDAs being remediated at one time, and whether exhumation occurs under an enclosure (see Appendix I).

[b] Dose would be zero following shutdown of Pajarito Site (TA-18) after about 2009.

[c] This dose could increase to 0.06 person-rem per year if the Decontamination and Volume Reduction System, the new TRU Waste Facility, and remote-handled transuranic waste retrieval and processing activities operated simultaneously (estimated to occur from 2012 through 2015).

[d] Dose would be zero following decontamination, decommissioning, and demolition of TA-21 after about 2009.

5.6.1.1 No Action Alternative

Annual doses to the general public and the MEI under the No Action Alternative are generally projected to remain at levels similar to those projected in the *1999 SWEIS* Expanded Operations Alternative. The projected doses for the MEI and population are dominated by estimated emissions from operations at LANSCE. The projected doses also reflect the expected relocation of certain tritium capabilities from the Chemistry and Metallurgy Research Building to the Plutonium Facility Complex as well as the change in operating levels as the Tritium Facilities (TA-21) begin DD&D.

Los Alamos National Laboratory Site-Wide Impacts

The projected annual collective dose to the population living within a 50-mile (80-kilometer) radius of LANL could be as high as 30 person-rem for the No Action Alternative. Nearly all of this dose (greater than 99 percent) would result from Key Facilities operations; the remaining contribution would come from non-Key Facility operations. Overall, the projected dose of 30 person-rem would result in no additional fatalities in the affected population (0.018 LCFs). The doses to the general public and an MEI under the No Action Alternative are presented in

Table 5–19. To put the doses into perspective, comparisons with natural background radiation levels are included in the table.

Table 5–19 Annual Radiological Impacts on the Public from Los Alamos National Laboratory Operations under the No Action Alternative

	Population within 50 Miles (80 kilometers) [a]	***Maximally Exposed Individual***
Dose	30 person-rem	7.8 millirem (LANSCE MEI) [b]
Latent cancer fatality risk [c]	0.018	4.7×10^{-6}
Regulatory dose limit [d]	Not applicable	10 millirem
Dose as a percent of regulatory limit	Not applicable	78
Dose from background radiation [e]	135,000 person-rem	400 millirem
Dose as a percent of background dose	0.02	2

LANSCE = Los Alamos Neutron Science Center, MEI = maximally exposed individual.
[a] The population estimated to be living within 50 miles (80 kilometers) of each Key Facility is unique for each facility. The year 2000 estimates range from 271,568 to 404,913, depending on the facility used.
[b] As a mitigating measure, operational controls at LANSCE would limit the MEI dose to 7.5 millirem per year.
[c] Based on a risk estimate of 0.0006 LCF per person-rem.
[d] 40 CFR Part 61 establishes an annual limit of 10 millirem via the air pathway to any member of the public from DOE operations. There is no standard for a population dose.
[e] The annual individual dose from natural background radiation at LANL ranges from a low of about 300 to a high of about 500 millirem (see Appendix C).

Under this alternative, the LANL site-wide MEI would be located approximately 2,625 feet (800 meters) north-northeast of LANSCE. This is the location where the dose resulting from emissions from all Key Facilities would be the highest. The annual dose to the MEI under this alternative could be up to 7.8 millirem. This projected dose corresponds to an increased risk of the MEI developing a fatal cancer due to LANL operations under the No Action Alternative of about 1 in 213,000 (4.7×10^{-6}) per year.

Specific Receptors

In addition to potential impacts to the public from the air exposure pathway, the risk to individuals from ingestion of water, foodstuffs, and soils is analyzed in Appendix C. These three individual scenarios, collectively referred to as "specific receptors," include a Los Alamos County resident whose entire diet consists of locally produced foodstuffs, a user of outdoor recreational resources, and a special pathways receptor who relies heavily on fish and wildlife for subsistence. Using the average consumption rates, **Table 5–20** presents the projected doses to these individuals and the associated risks of developing a fatal cancer. Doses from a high consumption rate were also analyzed and detailed in their respective tables in Appendix C. The total doses to each receptor as a result of the potential consumption at these higher rates would be increased by a factor of less than three.

Table 5–20 Annual Ingestion Pathway Dose for Average Consumption Rates by Specific Receptors

	Dose (millirem)	***Cancer Fatality Risk*** [a]
Offsite county resident	2.7	1.6×10^{-6}
Recreational resources user	4.0	2.4×10^{-6}
Special pathways receptor	4.5	2.7×10^{-6}

[a] Based on a risk estimate of 0.0006 LCF per person-rem.

The associated LCF risks resulting from the doses shown in Table 5–20 would be about 1 in 230,000 for the offsite county resident, 1 in 180,000 for the recreational resources user, and 1 in 156,000 for the special pathways receptor per year. These doses from ingestion would be almost entirely due to naturally occurring radioactivity in the environment and contamination in water and soils from worldwide fallout and past LANL operations. The contribution to ingestion pathway doses from current and projected future LANL operations tends to be extremely small by comparison, largely due to the more stringent effluent control and waste management practices now in use. Accordingly, these ingestion pathway dose and risk values are expected to remain essentially unchanged for some time and would apply to all three alternatives.

Technical Area Impacts

No measurable doses to the population or the site-wide MEI are expected to result from TA impacts under the No Action Alternative outside those associated with Key Facilities operations (as discussed below).

Key Facility Impacts

Los Alamos Neutron Science Center

Nearly all of the calculated MEI dose (96 percent) under the No Action Alternative would be attributable to gaseous mixed activation products from operations at LANSCE. Because of the close proximity of the LANSCE facility to the LANL site boundary, gaseous mixed activation product emissions remain the largest source of offsite dose from the airborne pathway. As a mitigating measure, administrative controls have been established at LANSCE that regulate beam operations as emissions levels increase. These controls require operational changes to prevent the generation of excessive radioactive air emissions so that the maximum dose to the LANL site-wide MEI from air emissions at LANSCE is 7.5 millirem per year, or less. The remainder of the dose to the LANL site-wide MEI as a result of LANL operations at all other Key Facilities (0.3 millirem per year) is small compared to that from operations at LANSCE.

5.6.1.2 Reduced Operations Alternative

Under the Reduced Operations Alternative, a major decrease in doses to the public compared to those under the No Action Alternative would result from lack of radiological air emissions from LANSCE after potential shutdown. Doses lower than those under the No Action Alternative also would be expected from reductions in high explosives processing and testing operations, and from reduced emissions from the Chemistry and Metallurgy Research Building. In 2009, shutdown of Pajarito Site (TA-18) operations would further reduce doses to the public.

Los Alamos National Laboratory Site-Wide Impacts

The projected annual collective dose to the population living within a 50-mile (80-kilometer) radius of LANL, as shown in **Table 5–21,** could be as high as 6.1 person-rem under the Reduced Operations Alternative. Nearly all of this dose (greater than 98 percent) would come from Key Facilities operations, and the remaining contribution would come from non-Key Facility operations. Overall, the projected annual collective dose of 6.1 person-rem would produce no additional fatalities in the affected population (0.0038 LCFs).

Table 5–21 Annual Radiological Impacts on the Public from Los Alamos National Laboratory Operations under the Reduced Operations Alternative

	Population within 50 Miles (80 kilometers) [a]	*Maximally Exposed Individual*
Dose [b]	6.1 person-rem	0.78 millirem (TA-36 MEI)
Latent cancer fatality risk [c]	0.0037	4.7×10^{-7}
Regulatory dose limit [d]	Not applicable	10 millirem
Dose as a percent of regulatory limit	Not applicable	7.8
Dose from background radiation [e]	135,000 person-rem	400 millirem
Dose as a percent of background dose	0.005	0.2

TA = technical area, MEI = maximally exposed individual, MDA = material disposal area.

[a] The population estimated to be living within 50 miles (80 kilometers) of each Key Facility is unique for each facility. The year 2000 estimates range from 271,568 to 404,913, depending on the facility used.

[b] Shutdown of TA-18 in about 2009 would result in a decrease in the population dose of 0.23 person-rem and a negligible decrease in the MEI dose.

[c] Based on a risk estimate of 0.0006 LCF per person-rem.

[d] 40 CFR Part 61 establishes an annual limit of 10 millirem via the air pathway to any member of the public from DOE operations. There is no standard for a population dose.

[e] The annual individual dose from natural background radiation at LANL ranges from a low of about 300 to a high of about 500 millirem (see Appendix C).

The LANL site-wide MEI under this alternative would be located 7,415 feet (2,260 meters) northeast of the High Explosives Testing Facilities at TA-36. This is the location where the dose resulting from emissions from all Key Facilities would be the highest. The estimated dose to this MEI would be 0.78 millirem per year for the foreseeable future. This projected dose corresponds to an increased risk of the MEI developing a latent fatal cancer as a result of LANL operations under the Reduced Operations Alternative of about 1 in 2.1 million (4.7×10^{-7}) per year.

Specific Receptors

The risk to the public specific receptors from ingestion of foodstuffs and water under the Reduced Operations Alternative does not differ from that described under the No Action Alternative, as most of the risk is attributable to existing levels of contamination, not future operations at LANL.

Technical Area Impacts

No measurable doses to the population or the site-wide MEI are expected to result from TA impacts under the Reduced Operations Alternative other than those associated with Key Facilities operations (discussed below).

Key Facility Impacts

Los Alamos Neutron Science Center

Under this alternative, operations at LANSCE would not be active and high explosives processing and testing would be reduced by 20 percent, resulting in a 79 percent reduction in the total projected dose to the population compared to the dose for the No Action Alternative.

High Explosives Testing Facilities

Long-lived uranium isotope emissions from the reduced level of activities at the High Explosives Testing Facilities at TA-15 and TA-36 would produce the majority of the population dose (80 percent). Because the location of the LANL site-wide MEI under the Reduced Operations Alternative would change from the location of the MEI associated with the No Action Alternative, the dose contributions from each Key Facility to the new MEI location would be different. For instance, although there is a 20 percent reduction in high explosives testing under the Reduced Operations Alternative, the dose to the LANL site-wide MEI from operations at the High Explosives Testing Facilities under this alternative is projected to be 0.72 millirem per year, compared to a dose of 0.25 millirem from high explosives testing under the No Action Alternative. In fact, more than 90 percent of the dose to the MEI under the Reduced Operations Alternative would come from emissions of uranium isotopes produced at the High Explosives Testing Facilities.

Pajarito Site

After about 2009, a decrease in the population dose of 0.23 person-rem per year would result from permanent shutdown of operations at the Pajarito Site (TA-18). The population dose from the Reduced Operations Alternative would therefore decline by approximately 4 percent.

Chemistry and Metallurgy Research Building

Limited operation of the Chemistry and Metallurgy Research Building under this alternative would decrease the dose to the population surrounding LANL population by 0.32 person-rem, which is reflected in the estimated population dose of 6.1 person-rem per year.

5.6.1.3 Expanded Operations Alternative

Under the Expanded Operations Alternative, there would be increased levels of activities at certain facilities in addition to construction projects, as well as some reduced activities. Operations resulting from LANSCE's refurbishment could increase air emissions, including radiological emissions (and consequential dose), due to enhanced operational availability of the accelerator facilities. There also would be an increase in pit production within the Plutonium Facility Complex (TA-55), up to 80 pits per year, which would produce additional radiological air emissions. Under this alternative, there could be an additional temporary or one-time dose to the public from removal of waste from the MDAs, which would last until MDA exhumations are completed. Actions proposed under this alternative that would result in smaller doses include completion of DD&D of buildings at TA-21 and shutdown of SHEBA operations at TA-18.

Los Alamos National Laboratory Site-Wide Impacts

The projected annual collective dose to the population living within a 50-mile (80-kilometer) radius of LANL, as shown in **Table 5–22,** could be as high as 36 person-rem for the Expanded Operations Alternative; 30 person-rem of that total dose would come from operations at the Key Facilities and the remaining 6 person-rem from removal activities at the various MDAs. Overall, the projected dose of 36 person-rem would result in no additional fatalities in the affected population (0.022 LCFs).

Table 5–22 Annual Radiological Impacts on the Public from Los Alamos National Laboratory Operations under the Expanded Operations Alternative

	Population within 50 Miles (80 kilometers) [a]	***MEI***
Dose [b]	36 person-rem	8.2 millirem (LANSCE MEI) [c]
Latent cancer fatality risk [d]	0.022	4.9×10^{-6}
Regulatory dose limit [e]	Not applicable	10 millirem
Dose as a percent of regulatory limit	Not applicable	82
Dose from background radiation [f]	135,000 person-rem	400 millirem
Dose as a percent of background dose	0.027	2.1

LANSCE = Los Alamos Neutron Science Center, MEI = maximally exposed individual, MDA = material disposal area.

[a] The population estimated to be living within 50 miles (80 kilometers) of each Key Facility is unique for each facility. The year 2000 estimates range from 271,568 to 404,913, depending on the facility used.

[b] These reflect the additional doses to the public from remediation of the larger MDAs and the simultaneous operation of the Decontamination and Volume Reduction System, the new TRU Waste Facility, and remote-handled transuranic waste retrieval and processing activities. The shutdown of TA-18 and TA-21 in about 2009 would result in a decrease in population dose of 0.32 person-rem and a negligible decrease in MEI dose.

[c] As a mitigating measure, operational controls at LANSCE would limit the MEI dose to 7.5 millirem per year. Population and MEI doses are projected at 6.2 person-rem and 0.42 millirem respectively, and are attributable to MDA remediation.

[d] Based on a risk estimate of 0.0006 LCF per person-rem.

[e] 40 CFR Part 61 establishes an annual limit of 10 millirem via the air pathway to any member of the public from DOE operations. There is no standard for a population dose.

[f] The annual individual dose from natural background radiation at LANL ranges from a low of about 300 to a high of about 500 millirem.

Under this alternative, the LANL site-wide MEI would be located 2,625 feet (800 meters) north-northeast of LANSCE. This is the location where the dose resulting from emissions from all Key Facilities would be the highest. Including the additional dose from remediation activities at the MDAs under this Alternative could bring the MEI dose to about 8.2 millirem. This projected dose corresponds to an increased risk of developing a latent fatal cancer for the MEI from LANL operations under the Expanded Operations Alternative of about 1 in 203,000 (4.9×10^{-6}) per year.

The various effects of radiological air emissions from the major MDA remediation activities, canyon cleanups, and other Consent Order actions could range from small long-term to temporary short-term doses to the public under the Expanded Operations Alternative. Under the MDA Capping Option, although the waste would remain in place, the long-term doses to the public would be reduced. The potential for radionuclides to be dispersed into the air would be reduced by the improved covers, which also would reduce doses. The MDA Removal Option would result in lower long-term risks to the public because the bulk of the contamination would be removed from the site. In the short term, however, the release of radionuclides into the air during removal could result in higher radiological doses to the public. If that removal took place under an enclosure, radiological air emissions would be filtered before exiting the structure, resulting in lower short-term doses to the public.

Under the MDA Removal Option, various radiological air emissions could be released depending on the inventory of radionuclides at the MDA being remediated and whether the removal was performed under an enclosure. These removal activities would be completed within a finite time of a few months to several years, depending on the MDA. For that specified amount of time, there would be an additional dose to the public resulting from emissions released during the removal of the MDA. There are several large MDAs to be remediated. The total estimated dose to the public (6.2 person-rem per year) within 50 miles (80 kilometers) of operations at LANL under this alternative is based on a conservative assumption that all MDAs would be exhumed at the same time.

The same factors—the inventory of radionuclides present in a given MDA and whether or not an enclosure is used—would affect the dose to the MEI. In addition, the location of the MDA being remediated could affect the dose an MEI would receive. The impacts of remediating the MDAs on the LANL site-wide MEI were analyzed in Appendix I. Removal activities at each MDA could contribute to the dose received by the LANL site-wide MEI under the Expanded Operations Alternative, who is assumed to be located northeast of LANSCE near the East Gate. Assuming *all* the large MDAs were remediated at the same time, the portion of the estimated dose to the LANL site-wide MEI contributed by MDA removal activities would be no more than 0.42 millirem in any given year.

Specific Receptors

The risk to the public specific receptors from ingestion of foodstuffs and water under the Expanded Operations Alternative would not differ from that described under the No Action Alternative, as most of the risk is attributable to the existing levels of contamination, not future operations at LANL.

Technical Area Impacts

No measurable doses to the population or the site-wide MEI are expected to result from TA impacts under the Expanded Operations Alternative apart from those associated with Key Facilities operations (discussed below) or MDA remediation activities (discussed above).

Key Facility Impacts

Under the Expanded Operations Alternative, impacts to the public from activities at the Key Facilities, including both increases in some activities and decreases in others, would be similar to those under the No Action Alternative. The change in the location of emissions from the Chemistry and Metallurgy Research Building in TA-3 to the Chemistry and Metallurgy Research Replacement Facility in TA-55 would have little effect on doses to the public compared to impacts from operations at LANSCE. Increased pit production at the Plutonium Facility Complex in TA-55 would cause a small increase in emissions, but the resulting doses to the public would be relatively small compared to the contribution from activities at LANSCE. Similarly, if the evaporation tank auxiliary action were implemented under the Radioactive Liquid Waste Treatment Facility Upgrade, the doses that would result from the tank air emissions (primarily tritium) would be small and bounded by the impacts from other key facilities.

Los Alamos Neutron Science Center

Over 60 percent of the projected population dose (22.3 person-rem per year) would result from radiological air emissions from LANSCE (TA-53). Similar to the No Action Alternative, the majority of the dose to the LANL site-wide MEI under the Expanded Operations Alternative would result from emissions of gaseous mixed activation products from operations at LANSCE.

Because of the close proximity of LANSCE to the LANL site boundary, gaseous mixed activation product emissions remain the greatest source of offsite dose via the airborne pathway. If the LANSCE Refurbishment Project were implemented, the dose from air emissions at LANSCE to the LANL site-wide MEI could potentially increase. As described in the No Action Alternative (see Section 5.6.1.1), however, the dose to the LANL site-wide MEI from air emissions at LANSCE would be limited by operational controls to 7.5 millirem per year.

High Explosives Testing Facilities

An additional 18 percent of the dose (6.4 person-rem per year) to the public would come from operations at the High Explosives Testing Facilities (TA-15 and TA-36).

Solid Radioactive and Chemical Waste Facilities

Implementation of the Waste Management Facilities Transition Project would result in relatively small additional impacts to the population near LANL. From 2012 through 2015, there would be a potential for simultaneous operation of the Decontamination and Volume Reduction System, the new TRU Waste Facility, and remote-handled transuranic waste retrieval and processing activities. Resulting impacts to the population from operations of these systems during this time would be negligible (an additional 0.02 person-rem per year) and are included in Table 5–22. Long-term impacts to the public would include a reduction in dose due to eventual removal of stored wastes in Area G.

Plutonium Facility Complex

The higher level of activity at the Plutonium Facility Complex associated with increased pit production also would result in a small increase in the dose to the public to 0.20 person-rem per year. The higher level of activity at the Plutonium Facility Complex associated with increased pit production would cause a negligible increase in the dose to the LANL site-wide MEI (less than 0.001 millirem).

Pajarito Site and Tritium Facilities

The estimated population dose would decrease slightly (by 0.32 person-rem per year) due to the permanent elimination of emissions from activities at the Pajarito Site at TA-18 and the Tritium Facility at TA-21 which is expected to occur in about 2009. The lack of activity at the Pajarito Site (TA-18) and the Tritium Facility (TA-21) would have a small effect (a decrease of 0.02 millirem per year) on the dose to the MEI compared to the dose from operations at LANSCE (7.5 millirem per year).

5.6.2 Chemical Impacts on the Public

5.6.2.1 No Action Alternative

Key Facilities

The combined cancer risk due to all carcinogenic pollutants from all TAs, as analyzed in the *1999 SWEIS*, was dominated by chloroform emissions expected from the Bioscience Facilities (formerly the Health Research Laboratory) (see **Tables 5–23** and **5–24**). Assuming that 100 percent of the chloroform used was emitted (and assuming no change in other carcinogenic pollutant emissions compared to those evaluated), the estimated combined incremental cancer risk at the Los Alamos Medical Center would be slightly above the guideline value of 1 in a million (1.0×10^{-6}). In other words, one person in a population of a million would develop cancer if this population were exposed to this concentration over a lifetime, a level of concern established in the Clean Air Act. It is known, however, that less than 100 percent of the chloroform used is emitted as a toxic air pollutant (as much as 25 pounds per year [8 liters per year] were disposed of as liquid chemical waste); thus, the incremental cancer risk under the No Action Alternative would be less than the guideline value. In addition, recent use of chloroform has been about 30 percent of the use projected for the Expanded Operations Alternative described in the *1999 SWEIS*. Based on the information discussed above, toxic air pollutants released under this new SWEIS No Action Alternative are not expected to cause air quality impacts that would affect human health and the environment.

Table 5–23 Estimated Annual Emission Rates of Carcinogenic Pollutants that Could Be Released from the Health Research Laboratory of the Technical Area 43 Facilities

Pollutants	*Stack ID*	*Annual Average Emission Rates*	
		Pounds per Year	*Grams per Second*
Acrylamide	Building 247	0.00586	8.44×10^{-8}
	Building 124/126	0.00586	8.44×10^{-8}
	N. Side FH	0.00586	8.44×10^{-8}
	S. Side FH	0.00586	8.44×10^{-8}
Chloroform	Building 247	2.2	0.0000317
	Building 124/126	21.3	0.000307
	N. Side FH	21.3	0.000307
	S. Side FH	21.3	0.000307
Formaldehyde	Building 247	0.173	0.0000025
	Building 124/126	1.68	0.0000241
	N. Side FH	1.68	0.0000241
	S. Side FH	1.68	0.0000241
Methylene Chloride	N. Side FH	0.946	0.0000136
	S. Side FH	0.946	0.0000136
Trichloroethylene	N. Side FH	10.2	0.000147

Source: DOE 1999a.

Table 5–24 Results of the Dispersion Modeling Analysis of Carcinogenic Pollutants from the Health Research Laboratory at Technical Area 43

Carcinogenic Pollutants	*Estimated Annual Concentration (micrograms per cubic meter)*
Acrylamide	0.0000115
Chloroform	0.0304
Formaldehyde	0.0024
Methylene Chloride	0.00078
Trichloroethylene	0.00334

Source: DOE 1999a.

Public health consequences from emissions of beryllium, lead, and depleted uranium from the High Explosives Testing Facilities (see Table 5−9) were analyzed by calculating hazard indices for lead and depleted uranium and calculating the excess LCFs from beryllium. A hazard index equal to or above 1 is considered consequential from a human toxicity standpoint. Beryllium has no established EPA reference dose from which to calculate the hazard index. The worst-case hazard indices for lead and depleted uranium were less than 0.000015 and 0.000065, respectively. The excess LCFs from beryllium were estimated to be 1 in 2,780,000 (3.6×10^{-7}) (DOE 1999a). Use of foam to control emissions from the High Explosives Testing Facilities would further reduce these emissions and health effects by about 50 to 95 percent (LANL 2006a).

Emissions from beryllium sources currently at the Beryllium Technology Facility in the Sigma Complex (TA-3) and Plutonium Facility Complex (TA-55) (see Table 5–10) are controlled by HEPA filtration with a removal efficiency of 99.95 percent. The maximum cancer risk of beryllium releases from TA-3 using its unit risk factor is approximately 1 in 415 million (2.41×10^{-9}), which is below the guideline value of 1 in a million (1.0×10^{-6}). In other words, one person in a population of a million would develop cancer if this population were exposed to this concentration over a lifetime, a level of concern established in the Clean Air Act. The maximum combined cancer risk of beryllium releases from TA-55 using its unit risk factor is approximately 1 in 4.3 billion (2.35×10^{-10}), which is also below the guideline value of 1 in a million (1.0×10^{-6}) (DOE 1999a).

5.6.2.2 Reduced Operations Alternative

Key Facilities

Public risk resulting from chemical releases under the Reduced Operations Alternative would be approximately the same as those associated with the No Action Alternative. There would be a reduction in risks associated with high explosives processing and testing activities because these activities would be reduced by 20 percent under this alternative. There also would be minor reductions in risk to the public as a result of shutting down operations at LANSCE and the Pajarito Site (TA-18) under this alternative.

5.6.2.3 Expanded Operations Alternative

Key Facilities

Public risk resulting from chemical releases under the Expanded Operations Alternative would be approximately the same as those associated with the No Action Alternative, except for a small increase (2.5 percent) in risk due to high explosives processing activities.

5.6.3 Worker Health

Worker risks associated with continued operations at LANL include radiological (ionizing and non-ionizing) risks, chemical exposure risks, and risk of injury during normal operations. The consequences to worker health from implementing the No Action, Reduced Operations, and Expanded Operations Alternatives are discussed below.

DOE has developed new regulations to require non-nuclear DOE contractors to comply with relevant Occupational Safety and Health Administration safety and health standards. Noncompliance could result in monetary fines. This is the first DOE regulation to provide for the protection of non-nuclear contractor workers. This new rule, 10 CFR Part 851, goes into effect on February 7, 2007, to allow 1 year for contractor and site management compliance training (DOE 2006a).

5.6.3.1 No Action Alternative

Ionizing Radiation Consequences

Table 5–25 presents the projected worker exposure from normal operations under the No Action Alternative. This projection is larger than the average annual worker dose shown in Chapter 4, Section 4.6.2.1, because it includes the dose associated with achieving a production level of 20 pits per year at TA-55, as well as the dose from increased levels of activity associated with additional personnel working in the new Chemistry and Metallurgy Research Replacement Facility. This projected collective worker dose represents the dose to the LANL workforce for the foreseeable future under the No Action Alternative.

Table 5–25 Projected Worker Radiation Exposure under the No Action Alternative

Collective worker dose (person-rem per year)	280
Number of workers with measurable dose	2,018
Excess LCF risk per year among worker population	0.17 [a]
Average individual worker measurable dose (millirem)	139
Excess LCF risk per year for average individual worker	0.000083 [a]
DOE limit on annual worker radiation exposure (millirem)	5,000
LANL average individual worker dose as a percentage of DOE limit (percent)	2.8

LCF = latent cancer fatality.
[a] Based on a risk estimate of 0.0006 LCF per person-rem (see Appendix C).

Worker exposures to radiation and radioactive materials in radiological control areas would be controlled using established procedures that require doses to be kept as low as reasonably achievable (ALARA). Potential hazards would be evaluated as part of the radiation worker and occupational safety programs at LANL. Nonroutine construction activities may require special work permits and worker protection measures for specific locations and activities.

DOE limits set the standard for worker exposure at 5,000 millirem per year whole body dose equivalent. In 10 CFR Part 835, DOE requires the ALARA process to be applied to reduce worker exposure to ionizing radiation. DOE has set an administrative control level of 2,000 millirem per year for an individual worker exposure (DOE 1999e). This level can be intentionally exceeded only with higher-level management approvals.

Under the No Action Alternative, the average individual worker dose of 139 millirem per year represents an increased risk of developing a latent fatal cancer of approximately 1 in 12,000 (8.3×10^{-5}) per year of operations. In addition to the 2,018 workers expected to receive a measurable dose, under the No Action Alternative, over 11,000 LANL workers or approximately

85 percent of the workforce would not likely receive any measurable dose during a year of normal operations.

Non-ionizing Radiation Consequences

Under the No Action Alternative, negligible effects on LANL worker health from normal operations of non-ionizing radiation sources, infrared radiation from instrumentation and welding, lasers, magnetic and electromagnetic fields, and microwaves would likely continue.

Biohazardous Material Exposure Consequences

Under the No Action Alternative, there would be negligible effects on LANL worker health from normal operations of the existing Biosafety Level 1 and 2 facilities. As explained in Appendix C, workers are protected by a combination of microbiological safety practices, safety equipment acting as primary barriers, and facilities that provide secondary barriers to preclude contamination or infection by biohazardous material.

Chemical Exposure Consequences

Occasional reportable, but minor, chemical exposures could occur at the rate of one to three incidents annually due to worker exposure to airborne asbestos, lead paint particles, crystalline silica, fuming perchloric acid, hydrofluoric acid, or acids or alkalis (via skin contact).

Operation of the Beryllium Technology Facility in the Sigma Complex presents a potential risk of worker exposure to beryllium. Other uses of beryllium at LANL include metals applications, which present little risk. The annual worker risk associated with high-explosives-testing-related applications of beryllium (evaluated as a carcinogen in the *1999 SWEIS*) at LANL was estimated to be less than 1 in 2.7 million (3.6×10^{-7}). This estimate is still valid under the No Action Alternative of this SWEIS.

Occupational Injuries and Illness

Occupational injury and illness rates under the No Action Alternative are projected to follow the patterns observed from 1999 through 2005, as reported in Chapter 4, Section 4.6.2.1. Using LANL's average rates during this period, there would be 2.40 recordable cases and 1.18 cases when workers missed days or their activities were restricted or transferred due to an occupational injury or illness for every 200,000 hours worked. These rates are well below industry averages, which in 2004 were 4.8 recordable cases and 2.5 cases where days were missed as a result of an occupational injury or illness (BLS 2005). Assuming that LANL's employment levels remain at current levels as expected (see Section 5.8.1.1), there would be approximately 311 recordable cases of occupational injury and illness and approximately 153 cases that resulted in days away or restricted or transferred duties per year. No fatalities would be expected under this alternative.

5.6.3.2 Reduced Operations Alternative

Ionizing Radiation Consequences

As shown in **Table 5–26**, under the Reduced Operations Alternative, involved workers would be exposed to lower cumulative doses of ionizing radiation from normal operations at LANL than under the No Action Alternative due to the potential shutdown of LANSCE and TA-18 operations.

Table 5–26 Projected Worker Exposure to Radiation under the Reduced Operations Alternative

Collective worker dose (person-rem per year)	257
Number of workers with measurable dose	1,659
Excess LCF risk per year among worker population	0.15 [a]
Average individual worker measurable dose (millirem per year)	155
Excess LCF risk per year for average individual worker	0.000093 [a]
DOE limit on annual worker radiation exposure (millirem per year)	5,000
LANL average individual worker dose as a percentage of DOE limit (percent)	3.1

LCF = latent cancer fatality.
[a] Based on a risk estimate of 0.0006 LCFs per person-rem (see Appendix C).

The average dose received by workers is projected to increase slightly from 139 millirem per year to 155 millirem per year under the Reduced Operations Alternative compared to the No Action Alternative. This is due to a decrease in the number of workers who would receive less than the average dose under this alternative. The average individual worker dose of 155 millirem per year represents an increased risk of developing a latent fatal cancer of approximately 1 in 10,750 (9.3×10^{-5}) per year of operation. Similar to the No Action Alternative, 1,659 workers would be expected to receive a measurable dose, but over 11,000 LANL workers or over 87 percent of the workforce would not be expected to receive any measurable dose during a year of normal operations under the Reduced Operations Alternative.

Non-ionizing Radiation Consequences

Under the Reduced Operations Alternative, negligible effects on LANL worker health from non-ionizing radiation sources, infrared radiation from instrumentation and welding, lasers, magnetic and electromagnetic fields, and microwaves would likely continue.

Biohazardous Material Exposure Consequences

Under the Reduced Operations Alternative, effects on LANL worker health from normal operations would not be substantially different from those under the No Action Alternative.

Chemical Exposure Consequences

Under the Reduced Operations Alternative, chemical exposure consequences to workers would likely be small and not substantially different than those under the No Action Alternative.

Occupational Injuries and Illness

Under the Reduced Operations Alternative, the number of occupational injuries and illnesses would likely be smaller than those observed under the No Action Alternative due to a smaller projected workforce, as discussed in Section 5.8.1.2. Using LANL's average rates, there would be approximately 300 recordable cases of occupational injury and illness and approximately 147 cases that result in days away or restricted or transferred duties per year, compared to 311 and 153, respectively, under the No Action Alternative. No fatalities would be expected under this alternative.

5.6.3.3 Expanded Operations Alternative

Ionizing Radiation Consequences

As shown in **Table 5–27**, the expansion of certain radiologically intensive operations at LANL would increase cumulative worker dose and annual average worker exposure under the Expanded Operations Alternative. Operations expected to expand under this alternative include pit production, remediation of a number of large MDAs, and DD&D of a number of TAs. In the long run, DD&D of the TAs and closure of many facilities such as those associated with the MDAs at LANL and older waste management facilities in TA-54, Area G, should reduce workers' annual radiation exposures.

Table 5–27 Projected Worker Exposure to Radiation under the Expanded Operations Alternative

	With MDA Removal Option	*With MDA Capping Option*
Collective worker dose (person-rem per year)	543	407
Number of workers with measurable dose	3,849	2,344
Excess LCF risk per year among worker population	0.33 [a]	0.24 [a]
Average individual worker measurable dose (millirem per year)	141	174
Excess LCF risk per year for average individual worker	8.5×10^{-5} [a]	0.00010 [a]
DOE limit on annual worker radiation exposure (millirem per year)	5,000	5,000
LANL average individual worker dose as a percentage of DOE limit (percent)	2.8	3.5

MDA = material disposal area, LCF = latent cancer fatality.
[a] Based on a risk estimate of 0.0006 LCFs per person-rem (see Appendix C).

The largest factors affecting worker dose under this alternative are increased pit production at TA-55 from 20 plutonium pits per year to up to 80 pits per year and remediation of the MDAs. The contribution to the collective worker dose from production of 20 pits per year is 90 person-rem per year under the No Action Alternative compared to 220 person-rem from production of up to 80 pits per year under the Expanded Operations Alternative. Remediation of the MDAs under this alternative also is expected to add to the site-wide collective worker dose. If the MDA

Removal Option were pursued, it would add an average of 137 person-rem per year to the site-wide collective worker dose. If the MDA Capping Option were pursued, it would add an average of just over 1 person-rem per year to the site-wide collective worker dose. DD&D activities across the site would add another 6 person-rem per year to the site-wide collective worker dose. Conversely, cessation of SHEBA operations at TA-18 would reduce LANL's site-wide collective worker dose under the Expanded Operations Alternative by 10 person-rem per year.

Under the Expanded Operations Alternative – MDA Removal Option, the average individual worker dose of 141 millirem per year represents an increased risk of developing a latent fatal cancer of approximately 1 in 11,800 (8.5×10^{-5}) per year of operations. Under the Expanded Operations Alternative – MDA Capping Option, the average individual worker dose of 174 millirem per year represents an increased risk of developing a latent fatal cancer of approximately 1 in 10,000 (1.0×10^{-4}) per year of operations.

Waste management workers, who currently receive an average dose of approximately 163 millirem annually, would receive a lower annual dose under the Expanded Operations Alternative after 2015. By the end of 2015, all legacy transuranic waste would be removed from the site and shipped to the Waste Isolation Pilot Plant (WIPP). Direct penetrating radiation levels in Area G, which currently measure above background levels in certain areas, would decrease to within background levels by this time. Waste management workers would still process newly generated transuranic waste at the proposed new TRU Waste Facility (to be built in either TA-50 or TA-63), but their exposures would be smaller than those currently observed because management of the newly generated waste would not be as time-intensive as currently required. Workers associated with retrieval of remote-handled transuranic waste from below-ground storage between 2011 and 2015 could see increases in radiation exposure, but their exposures would be monitored and engineering and administrative controls would be used to ensure their exposures are ALARA and within administrative control levels.

Non-ionizing Radiation Consequences

Under the Expanded Operations Alternative, negligible effects on LANL worker health from non-ionizing radiation sources, infrared radiation from instrumentation and welding, lasers, magnetic and electromagnetic fields, and microwaves would likely continue.

Biohazardous Material Exposure Consequences

Under the Expanded Operations Alternative, effects on LANL worker health from normal operations would not be substantially different from those under the No Action Alternative.

Chemical Exposure Consequences

Under the Expanded Operations Alternative, chemical exposure consequences to workers would likely be small and not substantially different from those under the No Action Alternative.

Occupational Injuries and Illness

As shown in **Table 5–28**, the projected number of annual occupational injuries and illnesses would be higher under the Expanded Operations Alternative compared to the No Action Alternative. This is due to two main factors. First, the size of the workforce is expected to continue to grow under this alternative, as discussed in Section 5.8.1.3. Second, more construction, DD&D, and remediation work is expected under the Expanded Operations Alternative, and these activities have higher incidence rates of occupational injuries and illnesses than the other types of work being performed at LANL.

While both total recordable cases and cases resulting in days away or restricted or transferred duties would be 12 to 13 percent higher under the Expanded Alternative compared to the No Action Alternative, no fatalities are expected under this alternative.

Table 5–28 Annual Projected Occupational Injuries and Illnesses Under the Expanded Operations Alternative

	Total Recordable Cases	*Cases Resulting in Days Away, Restricted, or Transferred*
General Laboratory Operations [a]	291.4	143.2
Construction	21.3	10.4
Remediation (MDA Removal Option)	35.1	17.1
Decontamination, decommissioning, and demolition	2.4	1.2
Total	350.2	171.9

MDA = material disposal area.
[a] Based on LANL averages of 2.40 total recordable cases and 1.18 cases resulting in days away, restricted, or transferred per 200,000 hours worked.

5.7 Cultural Resources

Potential impacts to cultural resources were assessed under the No Action, Reduced Operations, and Expanded Operations Alternatives. Cultural resources include archaeological resources, historic buildings and structures, and traditional cultural properties. Information used for impact assessment was derived from the results of systematic cultural resource inventories on LANL.

The analysis of impacts to cultural resources addressed potential direct and indirect impacts at each site from construction and operation. Direct impacts included those resulting from groundbreaking activities associated with new construction, building modifications, and demolition, as appropriate. Indirect impacts included those associated with reduced access to resource sites, as well as with increased stormwater runoff, traffic, and visitation to sensitive areas. The locations of known cultural resources were compared to the areas of potential effect from LANL activities. The potential for these activities to impact cultural resources was then assessed.

A summary of impacts is presented in **Table 5–29**.

Table 5–29 Summary of Environmental Consequences on Cultural Resources

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
LANL Site			
	Land Conveyance and Transfer – Conveyance or transfer of known cultural resources out of the responsibility and protection of DOE. – Potential damage to cultural resources on conveyed or transferred parcels due to future development. – Potential impacts on protection and accessibility to American Indian sacred sites. *Trails Management Program* – Enhanced protection of cultural resources	Same as No Action Alternative	Same as No Action Alternative plus: *MDA Remediation Project* – No direct impacts expected for either Capping or Removal Options. – Potential indirect adverse effects on resources located in vicinity of some MDAs and PRSs. *Security-Driven Transportation Modifications Project* – No direct impacts. – Potential indirect adverse effects on historic site located in vicinity of TA-63 and the proposed bridge over Mortandad Canyon. – Pedestrian and vehicle bridges under all options could impact canyon views from traditional cultural properties.
Affected Technical Areas			
TA-3	No change in impacts to cultural resources.	Same as No Action Alternative	*Physical Science Research Complex* – Two historic buildings, one eligible for the National Register of Historic Places and one that will be assessed for eligibility, would be removed. *Replacement Office Buildings* – Potentially adverse effects on nearby historic trail.
TA-21	No change in impacts to cultural resources.	Same as No Action Alternative	*TA-21 Structure DD&D* – Adverse effects on National Register of Historic Place-eligible historic buildings and structures.
Key Facilities			
Chemistry and Metallurgy Research Building (TA-3, TA-48, and TA-55)	Resulted in excavation of an archaeological site in TA-50.	Same as No Action Alternative	Same as No Action Alternative
High Explosives Processing Facilities (TA-16)	Adverse effect from demolition and remodeling of historic buildings.	Same as No Action Alternative	Same as No Action Alternative
High Explosives Testing Facilities (TA-6, TA-22, and TA-40)	Adverse effects from demolition and remodeling of historic buildings.	Same as No Action Alternative	Same as No Action Alternative

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
Pajarito Site (TA-18)	No change in impacts to cultural resources.	Same as No Action Alternative	Potentially adverse effect from demolition of historic buildings.
Radiochemistry Facility (TA-48)	No change in impacts to cultural resources.	Same as No Action Alternative	*Radiological Sciences Institute Project* – Potentially adverse effects on two archeological sites located near Radiochemistry Building. – Potentially adverse effect from demolition of Radiochemistry Building and other potentially historic buildings.
Radioactive Liquid Waste Treatment Facility (TA-50)	No change in impacts to cultural resources.	Same as No Action Alternative	– Changes to the existing Radioactive Liquid Waste Treatment Facility could alter its original appearance. – Minimal impact on historic buildings possibly requiring documentation to resolve adverse effects.
Solid Radioactive and Chemical Waste Facilities (TA-50 and TA-54)	No change in impacts to cultural resources.	Same as No Action Alternative	– Potential indirect effects on cultural resources located in vicinity of project associated activities in TA-54. – Removal of domes would positively impact views from traditional cultural properties located on adjacent lands of the Pueblo of San Ildefonso. – Potential impact to cultural resources from construction of TRU Waste Facility. – TRU Waste Facility could be visible from lands of the Pueblo of San Ildefonso.
LANSCE (TA-53)	No change in impacts to cultural resources.	Same as No Action Alternative	– Potentially adverse effect to LANSCE or other historic buildings experiencing internal modifications.
Radiography Facility (TA-55)	No change in impacts to cultural resources.	Same as No Action Alternative	– Same as No Action Alternative.
Bioscience Facilities	No change in impacts to cultural resources.	Same as No Action Alternative	*Science Complex Project* – Under all options, an eligibility assessment of the buildings to be replaced by the new Science Complex would be required. – Potentially adverse effects on three prehistoric archeological sites under Option 1. – No adverse effects to cultural resource sites under Options 2 and 3.
Remote Warehouse and Truck Inspection Station (TA-72)	No change in impacts to cultural resources.	Same as No Action Alternative	– Potentially adverse effects on three archeological sites.

MDA = material disposal area; PRS = potential release site; TA = technical area; DD&D = decontamination, decommissioning, and demolition; LANSCE = Los Alamos Neutron Science Center.

5.7.1 No Action Alternative

The No Action Alternative was analyzed in terms of the existing environment as it relates to cultural resources (see Chapter 4, Section 4.7), as well as several actions that are planned, but have may not been fully implemented. These actions were analyzed in the *1999 SWEIS* or in other NEPA compliance reviews issued since the *1999 SWEIS*. Impacts to cultural resources are described in terms of those projects that impact the site as a whole and those that affect specific TAs. Key Facilities are addressed separately.

Los Alamos National Laboratory Site-Wide Impacts

Two projects have been approved since publication of the *1999 SWEIS* that could impact cultural resources across a number of TAs. These projects involve the conveyance and transfer of certain parcels of land and the management of the trails system at LANL. Site-wide projects that have been determined to have no impact on cultural resources include electrical power system upgrades, the Wildfire Hazard Reduction Program, disposition of Cerro Grande Fire structures, and the Security Perimeter Project (DOE 1999d, 2000a, 2000e, 2002j, 2003a, 2003b; NNSA 2004a, 2005a). Continuing the LANL environmental restoration program that existed before the 2005 Consent Order is expected to have little or no impact on cultural resources. Management of construction fill would not be expected to have an impact on cultural resources because the fill would be stored in existing borrow areas at TA-16 or TA-61.

The conveyance and transfer of 10 tracts of land would have both direct and indirect impacts on cultural resources. To date, eight parcels have been entirely or partly conveyed or transferred (see Chapter 4, Table 4–2). Direct impacts have included the transfer of known cultural resources and historic properties out of the responsibility and protection of DOE, including resources eligible for the National Register of Historic Places. It should be noted that a data recovery plan was implemented to resolve the adverse effects of conveying three tracts to the County of Los Alamos for future development that include 49 archaeological sites that are eligible for the National Register of Historic Places. In addition, 34 archaeological sites are included within three protective easements at a single tract to be conveyed to the county for recreational purposes (LANL 2002b). The disposition of each of these tracts affects their protection and accessibility as Native American sacred sites that are needed for the practice of traditional religion. In addition, the disposition of the tracts would potentially affect the treatment and disposition of any human remains, funerary objects, sacred objects, and objects of cultural patrimony that may be discovered on the tracts. Indirect impacts of the conveyance and transfer of land include potential future development of 826 acres (334 hectares) and use of the tracts for recreational purposes. This action could result in the physical destruction, damage, or alteration of cultural resources located on the tracts and in adjacent areas, as well as disturbance of traditional religious practices (DOE 1999d).

The Trails Management Program would enhance protection of cultural resources at LANL. Management activities would be coordinated with LANL archaeologists in consultation with appropriate Native American Tribes to minimize damages to any cultural resources present along the trail reaches. Where activities associated with trail maintenance or use would adversely affect a trail, that trail could be closed to all or certain users until the involved segment of trail could be rerouted around the cultural resources. Alternatively, certain trail segments could be closed periodically for Native American use. If work necessary to close a trail to all user groups would adversely affect a cultural resource, a data recovery plan would be prepared and the State Historic Preservation Officer and appropriate Native American Tribes would be consulted before such work commenced. New trails would not be constructed in locations where the activities of trail users or maintenance workers would adversely affect cultural resources (DOE 2003b).

Technical Area Impacts

Technical Area 3

One project within TA-3, the installation of combustion turbine generators, underwent a NEPA compliance review since issuance of the *1999 SWEIS* and was not fully implemented. The analysis presented in the project-specific EA determined that there would be no impact on cultural resources from implementation of this project (DOE 2002l).

Technical Area 54

Within TA-54, the proposed implementation of corrective measures at MDA H underwent a NEPA compliance review since issuance of the *1999 SWEIS*. The analysis presented in the EA for MDA H remediation supported NNSA's determination that implementation of corrective measures would not significantly impact cultural resources (DOE 2004e).

Key Facilities Impacts

Since issuance of the *1999 SWEIS*, NEPA compliance documentation was prepared for three currently active projects related to Key Facilities: Chemistry and Metallurgy Research Replacement Facility construction at TA-55, Weapons Manufacturing Support Facility consolidation and refurbishment at TA-16, and Two-Mile Mesa Complex consolidation at TA-22. Each of these projects was determined to have some potential impacts on cultural resources.

Chemistry and Metallurgy Research Building

A NEPA compliance review determined that construction of the new Chemistry and Metallurgy Research Replacement Facility at TA-55 would have no adverse impacts on cultural resources (DOE 2003d). A parking lot associated with the complex to be located in TA-50 will impact an archaeological site, the "Romero Cabin Site," which was originally excavated in the 1980s. Implementation of a data recovery plan to resolve the adverse effects of construction of the parking lot at the cabin site was completed in 2005.

High Explosives Processing Facilities

The planned consolidation and refurbishment of the TA-16 Weapons Manufacturing Support Facility will not affect the one prehistoric archaeological site that is located in the area. Demolition and remodeling of various buildings, however, which is a part of the project, will adversely affect historic structures, many of which were constructed in the 1950s, that are eligible for the National Register of Historic Places. A Memorandum of Agreement between NNSA and the State Historic Preservation Officer to resolve these adverse effects will be prepared following the State Historic Preservation Officer's concurrence with the National Register of Historic Places eligibility assessment of these structures. The Advisory Council on Historic Preservation will be notified of the Memorandum of Agreement and will have an opportunity to comment (DOE 2002l).

The planned consolidation and construction that is part of the Two-Mile Mesa Complex Project at TA-22 will not impact any recorded prehistoric or historic sites. Demolition of various historic buildings as a part of that action, however, will adversely affect historic structures that are potentially eligible for the National Register of Historic Places. As noted above for the TA-16 Weapons Manufacturing Support Facility, a Memorandum of Agreement between NNSA and the State Historic Preservation Officer to resolve these adverse effects will be prepared following the State Historic Preservation Officer's concurrence with the National Register of Historic Places eligibility assessment. The Advisory Council on Historic Preservation will be notified of the Memorandum of Agreement and will have an opportunity to comment (DOE 2003e).

5.7.2 Reduced Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Under the Reduced Operations Alternative, the same impacts to cultural resources as those discussed under the No Action Alternative (see Section 5.7.1) would occur.

Key Facilities Impacts

Activity levels at certain Key Facilities would change. High explosives processing and testing would be reduced by 20 percent. LANSCE would cease operation and be placed into a safe shutdown mode, and buildings at the Pajarito Site (TA-18) would undergo safe shutdown as well. As a result, the Pajarito Site would be dropped from the list of Key Facilities. As there would be no change in cultural resources associated with the reduction in high explosives processing and testing or the closure of LANSCE and TA-18, these actions are not addressed further.

5.7.3 Expanded Operations Alternative

The Expanded Operations Alternative includes proposals that would expand overall operations levels at LANL above those established for the No Action Alternative. Thus, under the Expanded Operations Alternative, the same impacts to cultural resources as those discussed under the No Action Alternative (see Section 5.7.1) would occur. Additionally, some of the new projects proposed under the Expanded Operations Alternative would potentially impact cultural resources. Not all new projects or activities would affect these resources, however, because many would involve actions within or modifications to existing structures, or the construction of new facilities within previously developed areas of LANL. For example, an increase in pit production would not require new construction and hence would not affect cultural resources. Only those projects that could impact cultural resources are addressed below.

Los Alamos National Laboratory Site-Wide Impacts

There are two options (Capping and Removal) for remediation of MDAs at LANL. The cultural resources impacts for both options would be generally similar. The surfaces of the MDAs would be disturbed whether they are capped or contamination is removed. Because no archaeological resources are located within any of the MDAs, neither option would directly impact such sites. Risk of impacts to cultural resources during remediation of any of the hundreds of other PRSs at LANL would depend on the situation and the corrective measure implemented, if any. Unlike the MDAs, many of the PRSs (such as firing sites) contain only surface or near-surface contamination that could be recovered relatively easily.

Indirect impacts to cultural resources from remedial actions are possible due to increased erosion resulting from clearing, capping, removal, or contamination recovery operations; from locating temporary remediation support facilities near the remediation sites; and from workers or equipment in the work area. In those cases where archaeological resource sites and historic buildings and structures are located near work areas, site boundaries would be marked and the site would be fenced, as appropriate. As one example, a building eligible for the National Register of Historic Places is located within the solid waste management units comprising Firing Site R-44 in TA-15. If remediation of R-44 were required by the New Mexico Environment Department, however, it would take place in a manner that protects the building.

Most actions associated with implementing the Security-Driven Transportation Modifications Project would have little or no impacts on cultural resources because no known cultural sites are located within any of the areas to be disturbed. A historic site is situated near an area to be disturbed within TA-63; however, direct impacts would be unlikely. Prior to any disturbance, site boundaries would be marked and the site would be fenced, as appropriate. If previously unknown resources were identified during ground-disturbing activities, the procedures in *A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico* (*Cultural Heritage Management Plan*) would be followed (LANL 2006f). The proposed vehicle and pedestrian bridges over Ten Site Canyon would be highly visible from both nearby and distant locations. Thus, they may degrade views of the canyon from sites identified by Native American and Hispanic communities as traditional cultural properties.

Under Auxiliary Actions A and B of the Security-Driven Transportation Modifications Project, bridges would be built over Mortandad Canyon and Sandia Canyon, respectively. As the corridors where the bridges would be constructed do not contain any known cultural resource sites, it is unlikely that construction of the bridges (or associated roadways) would directly impact such resources. There are a number of prehistoric sites and one historic site located to the east and west of the proposed Mortandad Canyon bridge corridor. Due to the relative proximity of these resources to the bridge corridor, it may be necessary to mark and fence sites, as appropriate. No cultural resource sites are located near the Sandia Canyon bridge corridor. In the event that a previously unknown resource is identified during ground-disturbing activities associated with the proposed options, the procedures in LANL's *Cultural Heritage Management Plan* (LANL 2006f) would be followed. As noted above for the road and pedestrian bridges over Ten Site Canyon, construction of the bridges could degrade views of the canyon from sites identified by Native American and Hispanic communities as traditional cultural properties (see Appendix J).

Technical Area Impacts

Three projects are being proposed that would potentially impact cultural resources within TA-3 and TA-21. These projects are related to the Physical Science Research Complex and the Replacement Office Buildings in TA-3 and TA-21 Structure DD&D.

Technical Area 3

The proposed site of the Physical Science Research Complex is in an already-developed area of TA-3. Building TA-3-0028, a potentially significant historic building, would be removed. Prior to its demolition, it would be assessed for inclusion in the National Register of Historic Places. The current Administration Building (TA-3-0043) has been formally declared as eligible for the National Register of Historic Places and a Memorandum of Agreement has been signed regarding required documentation prior to its removal.

Although no cultural resource sites that are eligible for the National Register of Historic Places are located in TA-3 in the vicinity of the Replacement Office Buildings, a historic trail located to the south of the parking lot must be managed until formally determined otherwise. Due to its proximity to the proposed project, there could be potentially adverse effects to the trail from construction. Appropriate measures, such as fencing, would be implemented to resolve any potentially adverse effects.

Technical Area 21

Decontamination and demolition of buildings and structures at TA-21 would directly affect those associated with the Manhattan Project and Cold War years that are eligible for the National Register of Historic Places. In total, there are 15 historic buildings and structures in TA-21; however, a number of these are located within the parcel that was conveyed to Los Alamos County. Regarding those historic buildings and structures that would be affected, NNSA, in conjunction with the State Historic Preservation Officer, has developed documentation measures to resolve adverse effects to eligible properties. Prior to demolition, these measures would be incorporated into a formal Memorandum of Agreement between NNSA and the New Mexico Historic Preservation Division. The Advisory Council on Historic Preservation would be notified of the Memorandum of Agreement and would have an opportunity to comment.

Key Facilities Impacts

Four projects are proposed that are related to Key Facilities at LANL under the Expanded Operations Alternative.

Pajarito Site

Prehistoric resources (specifically, 40 cavates and a rock shelter) and historic resources (specifically the Ashley Pond Cabin) are located on the Pajarito Site (TA-18). These resources would continue to be protected during DD&D activities. Three LANL-associated buildings located within TA-18 have been identified as eligible for the National Register of Historic Places, including the Slotin Building (18-1) and two other buildings (18-2 and 18-5). However, there are additional buildings within the TA that have yet to be assessed for eligibility to the National

Register of Historic Places. Prior to any DD&D activities, these buildings would have to be evaluated. Those that are candidates for long-term retention would be protected during DD&D activities, whereas others would be documented to resolve the adverse effects. As noted previously, NNSA, in conjunction with the State Historic Preservation Officer, has developed documentation measures to resolve adverse effects on eligible properties at LANL. Appropriate measures would be defined in a Memorandum of Agreement between NNSA and the New Mexico Historic Preservation Division prior to any DD&D activities. The Advisory Council on Historic Preservation would be notified of the Memorandum of Agreement and would have an opportunity to comment.

Radiochemistry Building

Construction of the Radiological Sciences Institute would not directly impact prehistoric cultural resources because none are located within areas to be disturbed by construction. One prehistoric site, however, is located across the access road from the existing Radiochemistry Building, which is itself is considered a historic structure. New construction in the area of the prehistoric site would require the site boundaries to be marked and the site to be fenced.

Before demolition could begin on parts of the Radiochemistry Building or other structures to be replaced by the Radiological Sciences Institute, NNSA, in conjunction with the State Historic Preservation Officer, would implement documentation measures to resolve any adverse effects to eligible properties. These measures would be incorporated into a formal Memorandum of Agreement between NNSA and the New Mexico Historic Preservation Division. The Advisory Council on Historic Preservation would be notified of the Memorandum of Agreement and would have an opportunity to comment. Impacts from construction and operation of the Radiological Sciences Institute on traditional cultural properties are unlikely because most development would take place within previously disturbed portions of TA-48. Potential views of TA-48 from any traditional cultural properties located in the vicinity would remain largely unchanged (see Appendix G, Section G.3.3.2).

Radioactive Liquid Waste Treatment Facility

Under the construction options for upgrades to the Radioactive Liquid Waste Treatment Facility, one or more treatment buildings would be constructed near the existing facility and the East and North Annexes would be demolished. Effects to cultural resources would be minimal. Under one of the auxiliary actions, which could be applied to any of the options, evaporation tanks and pipelines would be constructed. Impacts to cultural resources in the vicinity of the pipeline and evaporation tanks would be avoided during the siting process. If the pipeline alignment were to encroach on archaeological sites near the evaporation tanks, however, the archaeological sites would require testing or excavation. These options would have minimal effects on historic buildings because removal of later annexes to Radioactive Liquid Waste Treatment Facility would not likely affect the original historic fabric of the building. Changes to the process area of Radioactive Liquid Waste Treatment Facility, however, would require historic documentation before any equipment is removed from the building. The environmental consequences to cultural resources would be the same if the upgraded treatment capabilities were housed in one or multiple structures.

The New Construction and Renovation Option for the Radioactive Liquid Waste Treatment Facility involves renovation of the existing facility in addition to construction of one or more treatment buildings. This option also would result in minimal adverse effects on cultural resources. If the auxiliary action of construction of evaporation tanks and pipeline were implemented, the impacts to cultural resources would be the same as described above. However, changes to the structure of the existing Radioactive Liquid Waste Treatment Facility would alter the original historic appearance of the building. Removal of equipment, modification of the building, and demolition of the annexes would require documentation and consultation with the New Mexico Historic Preservation Office. For all options, mitigation plans would have to be implemented before or during implementation of the project.

Solid Radioactive and Chemical Waste Facilities

Impacts to cultural resources from Waste Management Facilities Transition activities would be similar under both options: Option 1, Accelerated Actions for Meeting the Consent Order or Option 2, Interim Actions Necessary for Meeting the Consent Order. All activities taking place in TA-54, including new construction and removal of the domes, would occur within developed areas. Thus, there would be no direct impacts on cultural resources. But because a number of cultural resource sites are located nearby, a potential exists for indirect impacts to these resources. To ensure these resources would not be affected under either alternative, cultural resource site boundaries would be marked and fenced, as appropriate. Although archaeological resources are located in the generic area considered for the TRU Waste Facility, only those in TA-50, TA-54-West, and TA-66 have the potential to be directly affected by construction of the TRU Waste Facility. Direct and indirect impacts to archaeological resources would require notifying appropriate LANL personnel and implementing the requirements of the LANL Cultural Resources Management Plan (LANL 2006f). Mitigation measures, including avoidance, would be taken to ensure that construction activity, traffic and ground disturbances would not result in damage to the resources. These measures would be incorporated into a formal Memorandum of Agreement between DOE and the New Mexico Historic Preservation Division to resolve adverse effects. The Advisory Council on Historic Preservation would have an opportunity to comment on the Memorandum of Agreement. Construction of the TRU Waste Facility would not impact any National Register of Historic Places-eligible buildings or structures. However, if the TRU Waste Facility were built within generic sites in TA-51, TA-52, or TA-54-West, it would be visible from San Ildefonso Pueblo lands. Thus, impacts to traditional cultural properties are possible if the new facility were built within these TAs. Impact potential is reduced within TA-54-West because construction would take place within a developed area. Removal of the white-colored domes at TA-54 would positively impact views from Pueblo of San Ildefonso lands, which border the TA to the north.

Los Alamos Neutron Science Center

The LANSCE accelerator building has been determined to be eligible for the National Register of Historic Places. Although project-related modifications would not affect the external appearance of the structure, it would be necessary to determine the potentially adverse effects and document existing conditions, as appropriate. Additionally, any other significant historic buildings at TA-53 that could experience internal modifications would have to be evaluated for National Register of Historic Places eligibility status; these buildings must be considered potentially eligible until formally assessed.

Science Complex

Three archaeological sites are situated near the proposed Northwest TA-62 location, and each has been determined to be eligible for the National Register of Historic Places. These three sites are at risk of indirect adverse effects from construction of the Science Complex. Mitigation measures would be taken as appropriate to resolve any adverse effects in conjunction with the State Historic Preservation Office and Advisory Council on Historic Preservation. There would be no adverse effects on cultural resources from construction of the Science Complex under the Research Park Site or South TA-3 Site options. Under all options, the buildings to be replaced by the Science Complex would have to be evaluated for their historic importance prior to being demolished.

Remote Warehouse and Truck Inspection Station

The Remote Warehouse and Truck Inspection Station could impact the three recorded prehistoric archaeological sites at the proposed location. Mitigation measures would be taken in conjunction with the State Historic Preservation Office and Advisory Council on Historic Preservation, as appropriate, to ensure that construction activity, traffic, and ground disturbances do not damage the sites. The Mortandad Trail located east of the proposed project site leads to the Mortandad Cave Kiva National Historic Landmark and is closed to public access except for organized tours. Although the proposed project would not affect normal access to the trail, it would incorporate fencing around the perimeter of the Warehouse and Truck Inspection Station to protect sensitive areas, including the Mortandad Cave Kiva National Historic Landmark, from unauthorized increased visitation.

5.8 Socioeconomics and Infrastructure

This section discusses the environmental effects of LANL operations on the socioeconomic region of influence and LANL site infrastructure. The effects are described for each of the alternatives.

5.8.1 Socioeconomics

The primary (direct) and secondary (indirect) impacts of LANL activities on employment, salaries, and procurement are analyzed in this SWEIS. The primary impacts were determined by analyzing projected changes in employment (in terms of full-time equivalents at LANL). Changes in employment were projected based on information regarding changes in activities at the Key Facilities. Employment for the rest of LANL was assumed to remain the same.

Projected changes in employment were distributed among the tri-county area (the three counties closest to LANL: Los Alamos County, Rio Arriba County, and Santa Fe County). Employment changes would likely result in additional, secondary changes in employment, salaries, and expenditures in the area, as well as changes in demands for social services. These secondary impacts would occur within a regional economy because jobs added in a primary industry such as LANL would create local opportunities for new employment in supporting industries. Analysis of these secondary economic and social impacts of LANL activities across the alternatives was conducted using the multipliers developed by the U.S. Department of Commerce, Bureau of

Economic Analysis's Regional Input-Output Modeling System (RIMS II) for the tri-county area to predict total LANL socioeconomic impacts in the area (DOC 2006d)[4]. For example, if LANL were to expand employment by 100 full-time workers who resided in the tri-county area, the secondary effect would be the addition of approximately 106 new secondary jobs in the tri-county labor market. On the other hand, if LANL were to reduce employment by 100 full-time workers, the reverberating effect across the tri-county economy would be the loss of 106 other jobs.

The projected changes in employment were used to determine whether there would be significant impacts in the tri-county area on the need for housing units, construction requirements at LANL, changes in local government finances, and the need for public services.

Table 5–30 summarizes the expected socioeconomic changes for each of the proposed alternatives.

5.8.1.1 No Action Alternative

Los Alamos National Laboratory Site-Wide Impacts

LANL Employment

LANL continues to be a major economic force within the region of influence consisting of Santa Fe, Los Alamos, and Rio Arriba Counties (the tri-county area). Chapter 4, Table 4–28, shows the percentage of LANL employees residing in the region of influence. As shown in this table, approximately 11.5 percent of the total number of persons employed in the region of influence are affiliated with LANL, and this level has remained relatively steady over a number of years.

At the end of 2005, LANL employed 13,504 individuals, nearly 19 percent more than the employment projection of 11,351 presented in the *1999 SWEIS*. From 1996 through 2005, employment at LANL increased by approximately 2.2 percent per year. During the same period, employment in the region of influence increased by an average of 2.5 percent annually. Under the No Action Alternative, it is assumed that LANL employment levels would no longer increase but would remain steady at the 2005 level.

Assuming LANL continues to directly employ 13,504 employees, it is estimated that approximately 11,560 of these employees would live within the region of influence based on existing residence rates (LANL 2006g). The existence of these direct jobs would be expected to result in the creation of another 12,240 indirect jobs for a total number of jobs related to LANL operations in the region of influence of approximately 23,800 jobs; about 21 percent of the total number of people expected to be employed in the region of influence in 2007.

---

[4] The LANL site specific multiplier was developed using a weighted average of RIMS II detailed industry multipliers for the tri-county area made up of the following industries: scientific research and development, environmental and other technical consulting services, construction, and investigative and security services.

Table 5–30 Summary of Socioeconomic Consequences

No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
LANL Site		
LANL Employment		
2005 levels of employment assumed to remain steady at 13,504 employees, 11,560 of whom would be expected to reside in the region of influence creating another 12,240 indirect jobs in the region of influence.	A decrease of 500 employees from 2005 levels would be expected to result in the loss of about 530 indirect jobs in the region. Loss of 1,030 jobs in the region would be less than 1 percent of total civilian workforce.	An employment increase of 2.2 percent per year from 2007 to 2011 would result in an additional 600 to 1,890 employees working at LANL and creation of another 640 to 2,000 indirect jobs. This growth rate is consistent with the projected regional growth rate.
Housing		
No new housing units would be needed specific to changes in LANL's employment level.	Additional housing units could become available in the tri-county area as a result of the projected decrease in LANL's employment level. These would likely offset the need for additional housing units in the region because the population would still be expected to grow, though at a slower rate (about 1.5 percent versus 2.3 percent).	Additional housing units would be required in the tri-county area due to the projected increases in LANL's employment level and in the regional population. More LANL employees could be expected over time to reside in Rio Arriba, Santa Fe, or other surrounding counties, compared to Los Alamos County, where a shortage of available housing would likely continue. The number of housing units needed would depend on the number of workers relocating from outside the area. Overall, the number of units needed would likely be small compared to overall needs in the tri-county area.
Construction		
Completion of previously approved construction projects would likely draw workers already living in the region who historically work from job-to-job.	Same as No Action Alternative.	An increase in the number of construction projects would likely draw workers already in the region who historically work from job-to-job.
Local Government Finance		
Annual gross receipts tax yields would likely remain at current levels in real terms.	Annual gross receipts tax yields directly and indirectly associated with LANL employment could decrease by approximately 1.1 percent.	Annual gross receipts tax yields directly and indirectly associated with LANL employment are projected to increase by between 1.3 and 3.9 percent from 2007 through 2011 above 2005 levels in real terms due to increases in LANL's workforce during that timeframe.
Services		
Demand for services such as police, fire, and hospital beds would likely remain at current levels in proportion to LANL employment. The regional population is projected to increase even if LANL employment remains flat, so the demand for regional services would continue to increase, but the increase would not be driven by LANL employment growth.	Demand for services associated with LANL employment would likely decrease in proportion to the number of out-of-work LANL-related employees forced to leave the region. The regional population is still projected to increase, however, in spite of the small decreases in LANL employment envisioned in this alternative, so demand for services would likely increase as well, though at a slower pace than under the No Action Alternative.	Demand for services associated with LANL employment would likely increase in proportion to the number of additional LANL-related jobs added to the region. The number of additional school-age children associated with these increases is projected at between 440 and 1,400 in the tri-county area, resulting in an estimated need for increased public school funding from the state of $3.2 million to $11 million between 2007 and 2011. Most of the additional services would be required in Rio Arriba, Santa Fe, and other surrounding counties because the population in Los Alamos County is projected to increase by a very small rate compared to the other counties.

Completion of construction projects previously approved under completed NEPA compliance reviews would likely draw workers who already live in the region of influence and historically work from job-to-job in the region. Thus, this sector of employment associated with LANL is not expected to grow as a result of the No Action Alternative.

Housing

No new housing units beyond current regional trends are likely to be needed under the No Action Alternative, because LANL employment levels would be expected to stay at current levels.

Local Government Finance

Under this alternative, the tri-county area's annual gross receipts tax yields would be expected to grow at the same level as the population. Changes in tax rates are assumed to be driven by the need to increase service levels to meet public demand in the case of a tax increase or a determination that service levels can reduced in some way in the case of a tax cut.

Services

Annual school enrollment trends in the tri-county area would likely continue due to projected population growth that is unrelated to LANL. Demands for police, fire, and other municipal services directly resulting from LANL employment needs would be expected to remain at current levels, because LANL employment levels would be expected to stay at current levels.

5.8.1.2 Reduced Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

LANL Employment

Under the Reduced Operations Alternative, employment at LANL could decrease by approximately 3.7 percent, or 500 employees, as a result of closing LANSCE, reducing high explosives processing and testing by 20 percent, and cessation of TA-18 activities. This would equate to a projected employment level of about 13,000 in 2007 under this alternative. As a result of this decrease in employment at LANL, a loss of about 530 indirect jobs also is projected.

If all of these displaced workers remained in the region of influence in 2007 and were unable to find new employment immediately, regional unemployment rates would be expected to increase by approximately 0.8 percent. As these projected decreases are less than 1 percent of the total civilian labor force for the region of influence, the changes would not be expected to result in any significant change in the regional economy. Similar swings in LANL employment were seen recently with no apparent impacts on the regional economy. For example, employment levels at LANL decreased by approximately 3 percent from 1999 to 2000, while the number of persons employed in the region of influence increased by 4 percent during the same period. A similar decrease was seen from 2003 to 2004 when LANL employment decreased by 2.6 percent, while the number of persons employed in the region of influence increased by 1.2 percent.

Under this alternative, LANL would be expected to directly employ approximately 13,000 employees. It is estimated that approximately 11,140 of these employees would live within the region of influence based on existing residence rates (LANL 2006g). The existence of these direct jobs would be expected to result in another 11,790 indirect jobs for a total number of jobs related to LANL operations in the region of influence of approximately 22,920 jobs; about 20 percent of the total number of people expected to be employed in the region of influence in 2007. The anticipated construction impacts would be the same as under the No Action Alternative.

Housing

In the event all of the persons affected by the projected reduction in LANL's workforce moved out of the region, available housing units in the region of influence would likely increase. This would not be expected to have a significant adverse impact on the region, however, because the population is expected to grow at the same time, so available units would likely fill new demands. The immediate impacts on the housing market in Los Alamos County would likely be greater than in Santa Fe or Rio Arriba Counties because a greater percentage of LANL employees reside in Los Alamos County. Given the lack of available units in Los Alamos County, however, any available units would likely be desired by others who may have wanted to move into the county but were unable due to lack of available housing. Thus, any initial increase in available units would likely be offset by pent-up demand. (In 2000, only 5.5 percent of the housing units in Los Alamos County were vacant, compared to over 13 percent in the State of New Mexico and 9 percent across the United States [DOC 2006a]).

Local Government Finance

Under the Reduced Operations Alternative, the tri-county annual gross receipts tax yields associated with LANL operations (both direct and indirect) would be expected to decrease by approximately 1.1 percent if all of the affected employees relocated outside of the region. Any reduction in tax revenues associated with the potential loss of LANL employees, however, would likely be offset by the continued growth in the regional workforce outside of LANL, similar to the increases seen in 2000 and 2004.

Services

Annual school enrollment in the tri-county area could decrease due to out-migration of affected LANL employees and their families, as well as indirect personnel and their families. The potential loss would likely be offset by the continued influx of non-LANL employees into the region as the region is expected to continue to grow, though at a slower rate.

Demands for police, fire, and other municipal services are not expected to be impacted by the projected employment changes under this alternative because affected LANL employees and their families represent less than 1 percent of the regional demand.

5.8.1.3 Expanded Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

LANL Employment

Under the Expanded Operations Alternative, employment at LANL would continue to rise due to both increased pit production and increased remediation and DD&D activities. In addition, work at LANL would likely increase beyond current operations in areas that cannot be easily identified at this time, but could be tied to expanding research efforts such as homeland security. Similar increases have been seen in recent years.

If LANL's employment rate were to continue increasing at the same level experienced from 1996 through 2005 (2.2 percent annually), approximately 15,400 individuals could be employed at LANL by the end of 2011, as shown in **Table 5–31**, which would be an increase of about 1,890 above the 2005 level. In addition to direct employees associated with LANL, approximately 2,000 positions would likely be created indirectly as a secondary impact on the region's payrolls by the end of 2011.

Table 5–31 Projected Los Alamos National Laboratory Employment under the Expanded Operations Alternative

Year	*Projected LANL Employees*	*LANL Employees Residing in ROI*	*Number of Indirect Jobs in ROI Related to LANL Employment*	*Total Number of Jobs Related to LANL in ROI*	*ROI Employed*	*LANL as a Percent of ROI Employed*
2007	14,107	12,080	12,782	24,862	112,435	22.1
2008	14,418	12,347	13,065	25,412	115,207	22.1
2009	14,736	12,619	13,352	25,971	118,047	22.0
2010	15,061	12,898	13,648	26,546	120,957	21.9
2011	15,394	13,182	13,948	27,130	123,939	21.9

ROI = region of influence.

Under this alternative, LANL would be expected to directly employ between approximately 14,100 employees in 2007 and 15,400 employees in 2011. Between 12,080 and 13,182 of these employees would live within the region of influence based on existing residence rates (LANL 2006g). The existence of these direct jobs would be expected to result in another 12,782 to 13,948 indirect jobs for a total number of jobs related to LANL operations in the region of influence of approximately 24,862 to 27,130 jobs; about 22 percent of the total number of people expected to be employed in the region of influence from 2007 through 2011.

Under the Expanded Operations Alternative, construction and remediation efforts at LANL would increase; however, similar to the No Action Alternative, these projects would likely be staffed by workers who are already present in the region of influence and historically work construction jobs in the region. Thus, this sector of employment associated with LANL is expected to grow as a result of the Expanded Operations Alternative, but at a rate comparable with the operational growth rate.

Housing

An increase in LANL employment along with associated increase in indirect hires, would likely increase the need for housing in the region of influence. Although available housing is currently limited in Los Alamos County, construction of new housing is planned within the next year. These units would likely be filled quickly and a larger percentage of LANL-related housing needs would still need to be accommodated by workers relocating to Santa Fe, Rio Arriba, or other nearby counties, in keeping with the trend in recent years.

Additional housing needs would not be expected to exceed regional growth projections because the region is already expected to grow by approximately 2.3 percent annually between 2000 and 2010 (LANL 2004c).

Local Government Finance

Under this alternative, the tri-county area's annual gross receipts tax yields would be expected to increase by between 1.3 and 3.9 percent in real terms as a result of the addition of workers to LANL's workforce from 2007 through 2011. Any increases in tax revenues needed to offset the cost of additional services to support the associated increased population under the Expanded Operations Alternative would be covered by these new employees.

Services

Annual school enrollment in the tri-county area due to increases in LANL-related employment (direct and indirect) is projected to increase by between 435 and 1,360 students from 2007 to 2011 under the Expanded Operations Alternative. Additional annual funding assistance from the State of New Mexico of about $3.2 million to $11 million would be required for public school operations because of these enrollment increases, which would be part of an expected increase of about 6,000 to 10,000 in school-age children in the tri-county area during that period.

In Los Alamos County, the school district would likely be able to absorb the anticipated new enrollment levels because the levels would not be expected to change significantly from current levels due to the lack of available housing units. If Los Alamos County approves plans to build additional homes, the need for additional schools would need to be evaluated. In Rio Arriba County and the cities of Española and Santa Fe, this increase would be greater, as a larger portion of LANL's workforce would likely reside in these areas.

The demand for police, fire, and other municipal services would likely increase in proportion to the increase in population expected in each county.

5.8.2 Infrastructure

Site infrastructure includes the utility systems required to support construction and/or modification and operation of LANL facilities. It includes the capacities of the electric power transmission and distribution system, natural gas and liquid fuel (fuel oil, diesel fuel, and gasoline) supply systems, and the water supply system. The region of influence for utility infrastructure resources includes the LANL site, including the affected TAs and the individual facilities and utility systems (electric power, natural gas, and water) that serve LANL.

Descriptions of these utility systems, along with analyses of historic trends in LANL usage and other demands within the region of influence that supports this analysis, are provided in Chapter 4, Section 4.8.2.

In general, potential infrastructure impacts were assessed by comparing projections of utility resource requirements under each alternative against utility system capacities. While many LANL facilities do not meter utility use, annual site-wide demands are known and were used to make projections for each of the alternatives considered in this SWEIS. In addition, base trends in site-wide infrastructure requirements to date, as well as within the larger region of influence, were identified and extrapolated to make predictions for future years. The data were then adjusted for LANL project-specific actions within specific TAs and at Key Facilities considered under each alternative. Any projected demand for infrastructure resources exceeding its availability can be regarded as an indicator of impact. Where projected demand approaches or exceeds capacity, further analysis for that resource is warranted. It should be noted that utility projections include considerable inherent uncertainty as demands for electric power, natural gas, and water can be greatly affected by climate conditions from year to year. As such, the further into the future such projections are made, the greater the uncertainty in the projection.

Projected site utility infrastructure requirements under the Proposed Action and alternatives are summarized in **Table 5–32**.

5.8.2.1 No Action Alternative

Annual utility infrastructure requirements for current LANL operations and for other Los Alamos County users that rely upon the same utility system, along with current utility system capacities, are presented in **Table 5–33**. Values from 2005 are presented as a reference baseline for comparing projections for the three proposed alternatives in this SWEIS. Under the Expanded Operations Alternative analyzed in the *1999 SWEIS* (DOE 1999a) and selected in the subsequent ROD, LANL operations were projected to require 782,000 megawatt-hours of electricity (electrical energy) with a peak load demand of 113 megawatts, 1,840,000 decatherms of natural gas, and 759 million gallons (2.87 billion liters) of water annually. LANSCE alone was projected to require 437,000 megawatt-hours of electricity with a peak load demand of 63 megawatts, and 265 million gallons (1.03 billion liters) of water (DOE 1999a). LANSCE operations historically have accounted for up to one-quarter to one-half of LANL's total water and electrical power demand, respectively (LANL 2004c, 2006a). LANSCE projections in the *1999 SWEIS* included operation of the Low-Energy Demonstration Accelerator, which operated from late 1998 until it was shut down in December 2001 and later decommissioned (LANL 2006g). Operation of this facility was forecast to more than double LANSCE's electric peak load demand and its water demand for cooling tower operation (LANL 2006a), but it will not be a factor in future LANSCE operations. The *1999 SWEIS* did not project natural gas consumption for LANSCE or forecast utility infrastructure requirements for other Los Alamos County users.

Table 5–32 Summary of Environmental Consequences on Site Infrastructure

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
LANL Site			
Total Alternative (annual)	*Electricity requirements* 645,000 megawatt-hours total (495,000 megawatt-hours for LANL); 49 percent of system capacity. *Electric Peak Load* 111 megawatts total (91.2 megawatts for LANL); 74 percent of system capacity. *Natural gas requirements* 2,215,000 decatherms total (1,197,000 decatherms for LANL); 27 percent of system contract supply capacity. *Water requirements* 1,621 million gallons total (380 million gallons for LANL); 90 percent of system available water rights.	*Electricity requirements* 516,000 megawatt-hours total (366,000 megawatt-hours for LANL); 39 percent of system capacity. *Electric Peak Load* 80.6 megawatts total (60.4 megawatts for LANL); 54 percent of system capacity. *Natural gas requirements* 2,181,000 decatherms total (1,163,000 decatherms for LANL); 27 percent of system contract supply capacity. *Water requirements* 1,544 million gallons total (303 million gallons for LANL); 85 percent of system available water rights.	*Electricity requirements* 827,000 megawatt-hours total (677,000 megawatt-hours for LANL); 63 percent of system capacity. *Electric Peak Load* 144 megawatts total (124 megawatts for LANL); 96 percent of system capacity. *Natural gas requirements* 2,331,000 decatherms total (1,313,000 decatherms for LANL); 29 percent of system contract supply capacity. *Water requirements* 1,763 million gallons total (522 million gallons for LANL); 98 percent of system available water rights.
MDA Remediation (10-year total)	No change in utility demands	Same as No Action Alternative	Up to 70 million gallons of liquid fuels and 58 million gallons of water for remediation activities.
Security-Driven Transportation Modifications (project total)	No change in utility demands	Same as No Action Alternative	Up to 4.0 million gallons of liquid fuels and 20 million gallons of water for construction.
Affected Technical Areas			
TA-3	TA-3 Co-Generation Complex upgrades would have a positive incremental impact on site electrical energy and peak load capacity, but natural gas consumption could increase to support higher electricity generation. Negligible short-term increase in utility demands from constructing new office buildings, with no net increase in operational demands.	Same as No Action Alternative	Replacement Office Buildings–1.8 million gallons of liquid fuels and 9.6 million gallons of water for construction and an additional 0.356 million gallons of liquid fuels and 11.3 million gallons of water for DD&D; no net increase in utility demands for operations. Physical Science Research Complex–2.6 million gallons of liquid fuels and 14.4 million gallons of water for construction and an additional 0.129 million gallons of

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
			liquid fuels and 4.1 million gallons of water for DD&D; no net increase in utility demands for operations.
TA-18	No change in utility demands	Elimination of utility demands in TA-18 from Pajarito Site shutdown with a negligible decrease in site-wide demands.	DD&D of TA-18 Structures–activities are expected to require 0.273 million gallons of liquid fuels and 8.4 million gallons of water. As activities would be staggered over an extended period of time, overall increase in utility demands would be minimal.
TA-21	No change in utility demands	Same as No Action Alternative	DD&D of TA-21 Structures–activities are expected to require 0.043 million gallons of liquid fuels and 1.3 million gallons of water. As activities would be staggered over an extended period of time, overall increase in utility demands would be minimal.
TA-54	Negligible short-term increase in utility demands from MDA H closure activities.	Same as No Action Alternative	Same as No Action Alternative
TA-61	No change in utility demands	Same as No Action Alternative	Negligible temporary increase in utility demands, especially liquid fuels and water, from excavation.
Key Facilities			
Chemistry and Metallurgy Research Building (TA-3, TA-48, and TA-55)	Negligible short-term increase in utility demands from DD&D of old facility at TA-3 and construction of new facility at TA-55. Little or no change in utility demands from CMRR Facility operation when moved to TA-55.	No incremental change from transfer of nonnuclear activities to TA-55.	Same as No Action Alternative
Sigma Complex (TA-3)	No change in utility demands	Same as No Action Alternative	Same as No Action Alternative
Machine Shops	No change in utility demands	Same as No Action Alternative	Same as No Action Alternative
Materials Science Laboratory	No change in utility demands	Same as No Action Alternative	Same as No Action Alternative
Metropolis Center	No change in utility demands	Same as No Action Alternative	Moderate to major increase in electrical energy, peak load, and water demands over the No Action due to increased operational levels.
High Explosives Processing Facilities (TA-16)	Negligible short-term increase in utility demands from TA-16 Engineering Complex activities and demolition of structures.	Same as No Action Alternative	Potential negligible increase in operational utility demands.
High Explosives Testing Facilities (TA-6, TA-22, and TA-40)	Negligible to minor short-term increase in utility demands from construction of 15 to 25 new structures within the Twomile Mesa Complex and removal or demolition of vacated structures.	Same as No Action Alternative	Same as No Action Alternative

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
Pajarito Site (TA-18)	No change in utility demands	Elimination of utility demands in TA-18 from Pajarito Site shutdown with a negligible decrease in site-wide demands.	DD&D of TA-18 Structures–activities are expected to require 0.273 million gallons of liquid fuels and 8.4 million gallons of water. As activities would be staggered over an extended period of time, overall increase in utility demands would be minimal.
Tritium Facilities (TA-21)	No change in utility demands	Same as No Action Alternative	TA-21 Structures DD&D activities are expected to require 0.043 million gallons of liquid fuels and 1.3 million gallons of water. As activities would be staggered over an extended period of time, overall increase in utility demands would be minimal.
Target Fabrication Facility	No change in utility demands	Same as No Action Alternative	Same as No Action Alternative
Bioscience Facilities	No change in utility demands	Same as No Action Alternative	Science Complex–4.3 million gallons of liquid fuels and 23 million gallons of water for construction; no net increase in utility demands for operations.
Radiochemistry Facility (TA-48)	No change in utility demands	Same as No Action Alternative	Radiological Science Institute–4.2 million gallons of liquid fuels and 22.4 million gallons of water for construction and an additional 0.101 million gallons of liquid fuels and 3.1 million gallons of water for DD&D; no net increase in utility demands for operations.
Radioactive Liquid Waste Treatment Facility (TA-50)	No change in utility demands	Same as No Action Alternative	Radioactive Liquid Waste Treatment Facility–1.04 million gallons of liquid fuels and 7.5 million gallons of water for construction and related DD&D; no net increase in utility demands for operations.
LANSCE (TA-53)	Moderate increase in operational utility demands from increase in annual hours of operation.	Moderate to major decrease in infrastructure utility demands in TA-53 and sitewide due to shut down of operations with a minor reduction within the Los Alamos region.	LANSCE Refurbishment–Negligible, short-term increase in utility demands from refurbishment. Moderate increase in electrical energy, peak load, and water demands over the No Action due to increased operational levels.
Solid Radioactive and Chemical Waste Facilities (TA-50 and TA-54)	No change in utility demands	Same as No Action Alternative	Waste Management Facilities Transition–Up to 0.893 million gallons of liquid fuels and 4.9 million gallons of water for TRU Waste Facility construction; negligible incremental increase in utility demands for operations.

	No Action Alternative	***Reduced Operations Alternative***	***Expanded Operations Alternative***
Plutonium Facility Complex (TA-55)	No change in utility demands	Negligible increase in utility demands from transfer of nonnuclear activities at CMR Building to TA-55.	Plutonium Facility Complex Refurbishment Negligible short-term increase in utility demands for construction and related DD&D; minor incremental increase in utility demands for operations to support increased pit production. Radiography Facility–0.042 million gallons of liquid fuels and 0.234 million gallons of water for construction; no net increase in utility demands for operations.
Remote Warehouse and Truck Inspection Station (TA-72)	No change in utility demands	Same as No Action Alternative	Up to 0.420 million gallons of liquid fuels and 2.0 million gallons of water for construction; negligible incremental increase in utility demands for operations.

MDA = material disposal area; TA = technical area, DD&D = decontamination, decommissioning, and demolition; CMRR = Chemistry and Metallurgy Research Replacement; LANSCE = Los Alamos Neutron Science Center, CMR = Chemistry and Metallurgy Research.
Note: To convert gallons to liters, multiply by 3.78533.

Table 5–33 Baseline Infrastructure Requirements and System Capacities for the Los Alamos National Laboratory Region of Influence

Resource	System Capacity	Current Requirement (2005 [a])		Total Requirement
		LANL	Other Los Alamos County Users	
Electricity				
Energy (megawatt-hours per year)	1,314,000 [b]	421,413	129,457	550,870
Peak load demand (megawatts)	150 [b]	69.5	18.3	87.8
Fuel				
Natural gas (decatherms per year)	8,070,000 [c]	1,187,855	943,559	2,131,414
Water (million gallons per year)	1,806 [d]	359	1,034	1,393

[a] Electric and fuel data for 2005 are fiscal year basis while water data are calendar year basis (see Sections 4.8.2.1, 4.8.2.2, and 4.8.2.3).
[b] Electrical energy and peak load capacity reflect the current import capacity of the electric transmission lines that deliver electric power to the Los Alamos Power Pool, as well as completion of upgrades at the TA-3 Co-Generation Complex, which will add 40 megawatts (350,400 megawatt-hours) of generating capacity. Values do not reflect completion of a new transmission line and other ongoing electrical power system upgrades.
[c] Reflects contractually limited capacity of the natural gas system serving the Los Alamos area (see Section 4.8.2.2).
[d] Equivalent to the total water rights from the regional aquifer managed by Los Alamos County.
Note: A decatherm is equivalent to 1,000 cubic feet.
Sources: Arrowsmith 2006, LANL 2006g.

While demand for key infrastructure resources (electricity, natural gas, and water) within the region of influence has generally followed an upward trend, there are notable exceptions. For electricity, total LANL demand increased by approximately 14 percent between 1999 and 2005, while other Los Alamos County user demands increased by 22 percent. In contrast, LANL natural gas consumption declined by nearly 17 percent between 1999 and 2005, but demand within the County increased by about 8 percent over roughly the same period. The decline at LANL is attributable to warmer-than-normal seasonal temperatures that have persisted since the early 1990s and a switch from district heating plants to more efficient systems at individual LANL facilities. Total LANL demand for water also decreased by nearly 21 percent between 1999 and 2005, but this was offset by an approximately 18 percent increase in demand among other Los Alamos County users, who account for the largest portion of total water use in the region of influence.

Los Alamos National Laboratory Site-Wide Impacts

Projected annual utility infrastructure requirements under the No Action Alternative are presented in **Table 5–34**. The No Action Alternative represents a future baseline that includes projects that have already been implemented to some degree (and may already be reflected in the current baseline values), are in the process of being implemented, or would be implemented fully between now and 2011. These projects are independent of subsequent project decisions at LANL, and their ongoing activities add to the overall increasing trend in utility infrastructure demand in the Los Alamos area as a whole.

Table 5–34 Projected Site Infrastructure Requirements under the No Action Alternative

Resource	*LANL Requirements*	*Other Requirements* [a]	*Total Requirements*	*Percent of Capacity* [b]
Electricity				
Energy (megawatt-hours per year)	495,000	150,000	645,000	49
Peak load demand (megawatts)	91.2	20.2	111	74
Fuel				
Natural gas (decatherms per year)	1,197,000	1,018,000	2,215,000	27
Water (million gallons per year)	380	1,241	1,621	90

[a] Projections through 2011 for electrical energy, peak load, natural gas, and water also include projected usage for other Los Alamos County users that rely upon the same utility system as LANL.
[b] A calculation based on the system capacity as shown in Table 5–33.
Note: A decatherm is equivalent to 1,000 cubic feet.
Sources: Projections based on Arrowsmith 2005, 2006, Glasco 2005, DOE 2002i, LANL 2000f, 2001e, 2002e, 2003h, 2004c, 2005f, 2006a, 2006g.

These infrastructure resource projections are made for operations levels at LANL Key Facilities actually approaching the operational levels forecast in the *1999 SWEIS* and associated ROD. The levels of operations forecast in the *1999 SWEIS* have not been realized to date, however, and LANL operational demands have trended well below the *1999 SWEIS* projections as a result (see Table 5–34). Some of the discrepancy between forecast and actual trends in infrastructure demands also reflect the rather conservative bounding approach used in the original estimates. As such, the projections made in this SWEIS, to the extent possible, account for those key factors that would prevent LANL operations from practically realizing the infrastructure resource demands forecast in the *1999 SWEIS*. Factors considered for LANSCE operations were previously discussed. While funding shortfalls have limited hours of operation at LANSCE and thus reduced utility demands, aging equipment physically limits the total operational availability of LANSCE such that the levels of operations forecast in the *1999 SWEIS* would not be reasonably foreseeable under the No Action Alternative for this SWEIS. Nonetheless, projections under the No Action Alternative do assume that easing of budgetary constraints and resumption of isotope production (as occurred in 2005) would result in an overall increase in annual hours of operation, with LANSCE utility demands approaching those recorded in years immediately prior to release of the *1999 SWEIS*.

No infrastructure capacity constraints are expected from implementation of the No Action Alternative in the short term because LANL operational and Los Alamos area demands on key infrastructure resources (electricity, natural gas, and water) have trended below previously forecasted levels. Under this alternative, total annual electricity, electric peak load, natural gas, and water requirements would be about 49 percent, 74 percent, 27 percent, and 90 percent, respectively, of the capacity of the utility systems that serve LANL.

Total peak load demand is projected to require 74 percent of the Los Alamos Power Pool's peak load capacity by 2011. This projection includes the generating capacity of the TA-3 Co-Generation Complex with an electric generating capacity of at least 40 megawatts after a new turbine became operational in September 2007. Ongoing upgrades to the electrical power transmission and distribution system, including construction of a third transmission line, would allow the import of additional power and support a higher electric peak load.

Natural gas is abundant in New Mexico, and the region has a high import capacity. Ongoing upgrades to the natural gas distribution system by the Public Service Company of New Mexico should ensure the adequacy and reliability of natural gas (see Chapter 4, Section 4.8.2.2). Completion of upgrades to the TA-3 Co-Generation Complex could make its use more attractive for electrical energy production by LANL than in the past; thus, the Complex could support an increase in natural gas consumption over time. Regardless, maintenance of an adequate capacity margin is forecast under the No Action Alternative.

Total water demand within the region of influence could approach 90 percent of Los Alamos County-managed rights to withdraw water from the regional aquifer, although projections indicate that LANL operational demands would remain within the site's annual water use ceiling quantity (542 million gallons [2,050 million liters]) under the No Action Alternative (see Chapter 4, Section 4.8.2.3). As described in Section 4.8.2.3, Los Alamos County has completed feasibility studies for accessing up to 391 million gallons (1,500 million liters) of water per year from the San Juan-Chama Transmountain Diversion Project; however, the earliest that this water could be made available for use would be 2010 (Glasco 2005).

Technical Areas Impacts

Under the No Action Alternative, construction and related DD&D requirements for electricity, fuels and water in the affected TAs are expected to be negligible, including those for Replacement Office Building construction, continued upgrades to the Co-Generation Complex in TA-3, and MDA H remediation and closure activities in TA-54. In the short term, these activities would entail short-term spikes in utility infrastructure resource demands on a TA basis, but would have negligible impacts on the capacities of affected utility systems and on the overall trend in utility resource demands.

Technical Area 3

New facility operations in TA-3 would likely have a negligible impact on overall trends in infrastructure resource requirements because the new facilities generally would replace older, less resource-efficient facilities. Further, upgrades at the TA-3 Co-Generation Complex would positively impact the Los Alamos Power Pool's electric power availability by increasing LANL's onsite generating capacity and improving the reliability of the complex, as discussed above. The completed upgrades, however, could contribute to higher natural gas consumption if the facility were required to provide more electricity in the future, as previously discussed.

Key Facilities Impacts

Completion of programmed construction projects and related DD&D activities, including the Chemistry and Metallurgy Research Replacement Facility at TA-55, the Weapons Manufacturing Support Facility at TA-16, and new Dynamic Experimentation Complex facilities within the Twomile Mesa Complex (part of TA-6, TA-22, and TA-40), would entail short-term spikes in utility resource demands. These activities would have a negligible impact on the capacity of affected utility systems and on the overall trend in utility resource demands.

Operation of these new facilities would not be expected to cause a measurable overall increase in utility infrastructure demands because modern facilities would replace antiquated, less resource-efficient facilities, creating an economy of scale in operational efficiency. For example, completing construction of the 15 to 25 new buildings within the Two-Mile Mesa Complex would replace about 59 structures currently used for such operations.

5.8.2.2 Reduced Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Projected annual utility infrastructure requirements under the Reduced Operations Alternative are presented in **Table 5–35**. Utility infrastructure demand resulting from actions under the No Action Alternative would continue, with certain operational reductions, under this alternative. Reductions in the levels of high explosives processing and testing activities would have negligible-to-minor impacts on overall utility infrastructure requirements, but most other ongoing projects and activities included under the No Action Alternative also would move forward under the Reduced Operations Alternative. The entire LANSCE complex and TA-18 Pajarito Site, however, would be placed into safe shutdown mode under this alternative, although not all activities and associated utility demands would cease. LANSCE accelerator and support operations currently demand a relatively large share (about 22 and 15 percent in 2005) of LANL's electricity and water, respectively. As such, shutdown of LANSCE as part of the Reduced Operations Alternative would measurably reduce site-wide infrastructure resource demands compared to both the No Action Alternative and current operations. Under this alternative, total annual electricity, electric peak load, natural gas, and water requirements would be reduced to about 39 percent, 54 percent, 27 percent, and 85 percent, respectively, of the capacity of the utility systems that serve LANL.

Table 5–35 Projected Site Infrastructure Requirements under the Reduced Operations Alternative

Resource	*LANL Requirements*	*Other Requirements* [a]	*Total Requirements*	*Percent of Capacity* [b]
Electricity				
Energy (megawatt-hours per year)	366,000	150,000	516,000	39
Peak load demand (megawatts)	60.4	20.2	80.6	54
Fuel				
Natural gas (decatherms)	1,163,000	1,018,000	2,181,000	27
Water (million gallons per year)	303	1,241	1,544	85

[a] Projections through 2011 for electrical energy, peak load, natural gas, and water also include projected usage for other Los Alamos County users that rely on the same utility system as LANL.
[b] A calculation based on the system capacity as shown in Table 5–33.
Note: A decatherm is equivalent to 1,000 cubic feet.
Sources: Projections based on Arrowsmith 2005, 2006, Glasco 2005, DOE 2002i, LANL 2000f, 2001e, 2002e, 2003h, 2004c, 2005f, 2006a, 2006g.

Technical Area Impacts

Operational demands on utility infrastructure under this alternative would be similar to those under the No Action Alternative on a TA basis (except for TA-53) because base requirements would not be appreciably reduced due to high explosives processing and testing reductions.

Key Facilities Impacts

Los Alamos Neutron Science Center

Shutdown of LANSCE operations is projected to result in a moderate-to-major reduction in electrical energy, electric peak load demand, and water use at TA-53 compared to the demand under the No Action Alternative. This would specifically represent reductions of approximately 125,000 megawatt-hours in total electricity, 30.3 megawatts in electric peak load, and 73 million gallons (276 million liters) in water demand annually at LANSCE as compared to operational levels projected for the No Action Alternative. This action alone would result in a minor overall reduction in utility demands within the region of influence. Natural gas demand within the region would not be measurably affected on a percentage basis because LANSCE's operational demand for natural gas is a small percentage of that used by LANL as a whole and usage by LANL and other Los Alamos County users is affected more by weather and onsite electricity generation needs.

Pajarito Site

Shutdown of the Pajarito Site (TA-18) would result in a negligible site-wide decrease in operational utility needs.

5.8.2.3 Expanded Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Projected annual utility infrastructure requirements under the Expanded Operations Alternative are presented in **Table 5–36**. On a site-wide basis, numerous additional projects involving new facility construction, facility renovation, facility DD&D, and site closure activities affecting many TAs would occur under this alternative. Infrastructure requirements for these actions would be additive to those for actions identified as part of the No Action Alternative. Although these new activities collectively would result in a spike in utility resource demands, principally for liquid fuels and water, their contribution to the overall trend in site-wide or Los Alamos area demands would be minor due to the extended timeframe over which projects such as the MDA Remediation Project would be implemented. Liquid fuels, mainly diesel fuel and gasoline, would be required to operate heavy equipment, vehicles, and other worksite equipment; however, unlike natural gas, which is the principal heating fuel used at LANL, liquid fuels are not considered limiting resources because they can be procured from offsite sources and supplied at the point of use as needed.

For a number of new projects at LANL that involve DD&D of existing facilities whose capabilities would be replaced by newly constructed facilities, an economy of scale in operational efficiency would be achieved, resulting in a net decrease in utility demands. This economy of scale would tend to moderate the overall trend toward increasing utility demands at LANL and by Los Alamos County users that rely upon the same utility systems. Still, other projects would entail operational expansions that would result in a minor-to-moderate overall increase in demand for electricity, particularly in electric peak load demand, as well as water compared to projected demand under the No Action Alternative. Only minor increases in natural gas demand are forecast. Under the Reduced Operations Alternative, total annual electricity, electric peak load, natural gas, and water requirements would be about 63 percent, 96 percent, 29 percent, and 98 percent, respectively, of the capacity of the utility systems that serve LANL.

Table 5–36 Projected Site Infrastructure Requirements under the Expanded Operations Alternative

Resource	*LANL Requirements*	*Other Requirements* [a]	*Total Requirements*	*Percent of Capacity* [b]
Electricity				
Energy (megawatt-hours per year)	677,000	150,000	827,000	63
Peak load demand (megawatts)	124	20.2	144	96
Fuel				
Natural gas (decatherms)	1,313,000	1,018,000	2,331,000	29
Water (million gallons per year)	522	1,241	1,763	98

[a] Projections through 2011 for electrical energy, peak load, natural gas, and water also include projected usage for other Los Alamos County users that rely upon the same utility system as LANL.
[b] A calculation based on the system capacity as shown in Table 5–33.
Note: A decatherm is equivalent to 1,000 cubic feet.
Sources: Projections based on Arrowsmith 2005, 2006, Glasco 2005, DOE 2002i, LANL 2000f, 2001e, 2002e, 2003h, 2004c, 2005f, 2006a, 2006g.

The electric peak load capacity of the Los Alamos Power Pool could be approached due to increased operational demands at LANL combined with the trend of increasing demand that is forecast to persist for other Los Alamos County users. The predicted spike in electric peak load demand at LANL is primarily attributable to the Metropolis Center Increase in Levels of Operations and the proposed LANSCE Refurbishment Projects. Under the Expanded Operations Alternative, LANSCE operations would potentially require 208,000 megawatt-hours of electricity annually with a peak load demand of 51 megawatts, as compared to about 139,000 megawatt-hours of electricity with a peak load demand of 34 megawatts under the No Action Alternative. The Metropolis Center would require about 131,400 megawatt-hours of electricity annually with a peak load demand of 18 megawatts, as compared to about 44,000 megawatt-hours of electricity with a peak load demand of 6 megawatts under the No Action Alternative. As discussed for the No Action Alternative, ongoing upgrades to the electrical power transmission and distribution system, including construction of a third transmission line, would allow the import of additional power and support a higher electric peak load.

As previously described, heating demand and associated natural gas consumption at LANL has steadily declined in recent years despite higher overall activity levels at the site, mainly due to higher-than-normal seasonal temperatures. While this trend could be partly reversed by implementing the Expanded Operations Alternative for this SWEIS, including operation of the TA-3 Co-Generation Complex for electric power generation, the capacity of the Los Alamos area natural gas delivery system is expected to be adequate for the foreseeable future.

In recent years, combined LANL and county water demands have consumed between 80 and 90 percent of the currently developed water rights. Under the Expanded Operations Alternative, increased operations at LANL, combined with projected growth in the rest of Los Alamos County, could approach the county-managed rights to withdraw water from the regional aquifer. LANSCE operations would potentially require 119 million gallons (450 million liters) of water annually, as compared to up to about 77 million gallons (291 million liters) under the No Action

Alternative. The Metropolis Center could require up to 51 million gallons (193 million liters) of water annually, as compared to about 19 million gallons (72 million liters) under the No Action Alternative. Nevertheless, LANL operational demands are projected to remain within the site's annual water use ceiling quantity (542 million gallons [2,050 million liters]) under the Expanded Operations Alternative. As discussed under the No Action Alternative (see Section 5.8.2.1) and detailed in Chapter 4, Section 4.8.2.3, supplementing the Los Alamos County water supply system with San Juan-Chama water will be essential to ensuring that the region has adequate water supplies under this alternative and in the future.

Technical Area Impacts

Construction and related DD&D requirements for utility infrastructure resources, including electricity, fuels, and water, are expected to be negligible to minor for most actions, including construction of the Physical Science Research Complex and Replacement Office Buildings projects in TA-3 and the TA-18 and TA-21 Structure DD&D Projects. Implementation of the TA-21 Structure DD&D Project, which would include the natural-gas fired TA-21 steam plant, also would result in a negligible-to-minor reduction in LANL natural gas consumption because the plant's natural gas demand historically was smaller than 10 percent of site-wide demand and has decreased appreciably in recent years as NNSA missions in TA-21 have been relocated or discontinued.

Key Facilities Impacts

A number of project actions undertaken as part of this alternative would enhance the operational capabilities of Key Facilities, causing a net increase in infrastructure resource demands to support the increased level of operations. Specifically, the Metropolis Center Increase in Levels of Operations and LANSCE Refurbishment Projects would result in a minor-to-moderate increase in LANL infrastructure resource requirements and requirements within the region of influence to support higher levels of operations as described above. Increased pit production at TA-55 under this alternative would cause a minor increase in LANL infrastructure requirements because existing Plutonium Facility Complex operations currently constitute a relatively small percentage (generally 3 to 5 percent) of LANL's total demands. A very conservative estimate is that increased pit production at TA-55 could require an additional 8,500 megawatt-hours of electricity, 1.4 megawatts in electric peak load, 28,000 decatherms of natural gas, and 8.2 million gallons (31 million liters) of water annually.

5.9 Waste Management

Waste management impacts were evaluated based on the quantities of waste generated by Key Facilities, non-Key Facilities, and LANL's environmental restoration activities. Waste generation rates were used to measure the impacts on the LANL waste management infrastructure and local environment. Other impacts associated with waste management are addressed in the following sections: Air Quality (Section 5.4); Worker Health (Section 5.6.3); Transportation (Section 5.10); and Facility Accidents (Section 5.12). Waste management practices related to handling, treating, storing, and preparing for transport and disposal are described in Chapter 3 of this SWEIS.

Waste quantities were compiled by waste type and included process wastewaters (sanitary liquid waste, high-explosives-contaminated liquid waste, and industrial effluents); solid waste; and radioactive (including radioactive liquid) and chemical wastes. Due to the large number of construction and demolition projects now underway or planned at LANL, additional categories of construction and DD&D waste were included in the impacts analysis. LANL's environmental restoration wastes are presented as a separate category in this SWEIS.

Impacts associated with waste management were evaluated in the *1999 SWEIS* based on historical waste generation rates, projections of future waste generation, and the infrastructure in place to manage the wastes. With the exception of liquid waste, solid (sanitary) waste, and low-level radioactive waste, all LANL wastes were assumed to be disposed of offsite. For purposes of the transportation analysis (see Section 5.10) all wastes are assumed to be disposed of offsite.

In this analysis, the *1999 SWEIS* projections were reviewed and adjusted as needed to develop bounding values for the waste quantities associated with each alternative. As discussed in Chapter 4, Section 4.9, the *1999 SWEIS* projections adequately covered waste generated through facility operations; exceedances were the result of one-time events such as chemical cleanouts, maintenance, remediation, and cleanup following the Cerro Grande Fire.

In addition to wastes generated onsite, LANL historically has received small quantities of low-level radioactive and transuranic waste from offsite locations. Some of these wastes are generated by LANL activities at other locations and some by other DOE facilities that do not have the capability to manage the wastes. Receipt of these wastes by LANL is expected to continue at the historical rate of 5 to 10 waste shipments per year. The expected quantities of offsite waste would be small compared to the onsite waste generated and would be easily accommodated by the existing LANL waste management infrastructure.

In the sections that follow, waste generation rates for each facility are evaluated for the three alternatives. Bounding waste generation rates were projected for the No Action Alternative, considering the actions covered by the *1999 SWEIS* and any subsequent actions that have received independent NEPA analysis. Under the Reduced Operations Alternative, waste projections were selectively reduced to correspond to a lower level of operations. For the Expanded Operations Alternative, planned additional activities were considered and waste projections were increased as necessary to adequately bound the impacts. **Table 5–37** summarizes the waste management impacts associated with each of the alternatives.

5.9.1 No Action Alternative

Los Alamos National Laboratory Site-Wide Impacts

The types and quantities of wastes expected to be generated by LANL operations under the No Action Alternative are generally the same as those presented for the Expanded Operations Alternative in the *1999 SWEIS,* but modified for a lower level of pit production.

Table 5–37 Summary of Total (Operations, Decontamination, Decommissioning, and Demolition, and Remediation) Waste Generation Projections by Alternative (Cumulative 2007 through 2016)

Waste Type	*No Action Alternative*	*Reduced Operations Alternative*	*Expanded Operations Alternative*
Low-Level Radioactive Waste [a, b]			
Bulk low-level radioactive waste (cubic yards)	39,000	39,000	196,000 to 884,000
Packaged low-level radioactive waste (cubic yards)	33,000 to 128,000	33,000 to 110,000	80,000 to 183,000
High activity low-level radioactive waste (cubic yards)	–	–	0 to 347,000
Remote-handled low-level radioactive waste (cubic yards)	–	–	480 to 1,700
Mixed low-level radioactive waste (cubic yards)	1,800 to 2,800	1,800 to 2,800	3,900 to 183,000
Transuranic Waste			
Contact-handled (cubic yards) [a]	3,500 to 5,900	3,500 to 5,900	5,300 to 33,000
Remote-handled (cubic yards)	–	–	11 to 61
Construction and demolition debris [c] **(cubic yards)**	198,000	197,000	642,000 to 722,000
Chemical waste [d] **(pounds)**	19,000,000 to 37,000,000	19,000,000 to 36,000,000	64,000,000 to 129,000,000
Liquid Radioactive Waste			
Liquid transuranic waste (gallons)	300,000	300,000	500,000
Liquid low-level radioactive waste (at TA-50) (gallons)	40,000,000	40,000,000	50,000,000
Liquid low-level radioactive waste (at TA-53) (gallons)	1,400,000	50,000 [e]	1,400,000

TA = technical area.

[a] Operations waste volumes are assumed to be contact-handled transuranic waste and packaged low-level radioactive waste, although small volumes of other types could be generated.

[b] The subcategories of low-level radioactive waste do not necessarily meet precise definitions, but are used to assist in the analysis of disposal and transportation options and impacts.
- Bulk low-level radioactive waste = wastes that can be transported in large volumes in soft-sided containers.
- Packaged low-level radioactive waste = typical low-level radioactive waste packaged in drums or boxes.
- High-activity low-level radioactive waste = waste exceeding 10 CFR 61.55 Class A concentrations (greater than 10 nanocuries per gram of transuranic nuclides) and therefore is not accepted at certain facilities.
- Remote-handled low-level radioactive waste = waste with a dose rate exceeding 200 millirem per hour at the surface of the container.

[c] Construction and demolition debris includes uncontaminated wastes such as steel, brick, concrete, pipe, and vegetative matter from land clearance.

[d] Chemical waste includes wastes regulated under the Resource Conservation and Recovery Act, Toxic Substance Control Act, or state hazardous waste regulations.

[e] Under the Reduced Operations Alternative, operations at LANSCE would cease. Approximately 5,000 gallons (20,000 liters) of radioactive liquid waste per year from TA-50 would continue to be treated at TA-53.

Note: To convert cubic yards to cubic meters, multiply by 0.76456; gallons to liters, multiply by 3.78533; for pounds to kilograms, multiply by 0.45359. Values have been rounded to the nearest hundred, thousand, or million.

Wastewaters are collected and managed in systems designed for each specific category of wastewater – sanitary liquid waste, high explosives-contaminated liquid waste, and industrial effluent. Sanitary wastes from across the LANL facility are delivered by dedicated pipeline to the Sanitary Wastewater System Plant at TA-46. The Sanitary Wastewater System Plant design capacity of 600,000 gallons (2.3 million liters) per day (DOE 1999a) is expected to be adequate for demand under the No Action Alternative. The treated wastewater is pumped to TA-3 for recycling in the Steam Plant cooling towers or is discharged into Outfall 001. Reuse of treated sanitary wastewater is expected to continue. Sludge from the treatment of sanitary wastewater will continue to be disposed of offsite as a New Mexico special waste. Offsite disposal capacity is expected to be adequate. (See Chapter 4, Section 4.9.1, for more details on sanitary wastewater treatment.)

Wastewaters containing high explosives compounds are generated by high explosives testing and processing activities. The High Explosives Wastewater Treatment Facility, located in TA-16, treats process waters containing high explosives compounds. Under the No Action Alternative, the High Explosives Wastewater Treatment Facility is expected to continue to operate within the 170,000-gallon (640,000-liter) projection for annual discharges included in the *1999 SWEIS* (DOE 1999a). (See Chapter 4, Section 4.9.1.3, for additional discussion of high explosives treatment.)

Industrial effluent is discharged to a number of NPDES-permitted outfalls across LANL. Currently, LANL facilities discharge wastewater to a total of 21 outfalls, down from the 55 identified in the *1999 SWEIS* (LANL 2005h). LANL's projected industrial effluent discharges would be approximately 280 million gallons (1.1 billion liters) per year under the No Action Alternative (see Section 5.3.1). (See Chapter 4, Section 4.9.1.4, for more details on industrial effluents.)

Sanitary waste generated at LANL is generally managed at a transfer station, where solid waste is sorted and consolidated for transport to an offsite landfill (LANL 2005a, 2006a. LANL conducts an aggressive waste minimization and recycling program, which greatly reduces the amount of sanitary waste requiring disposal (LANL 2004l). Sanitary solid waste includes both routine and nonroutine wastes. Routine waste is waste produced from any type of periodic or recurring work, including waste produced from production operations; analytical, and/or research and development laboratory operations; and treatment, storage, and disposal facility operations. Under the No Action Alternative, routine sanitary waste quantities are expected to be bounded at 5,000 tons (4,500 metric tons) per year.

Nonroutine waste is defined as one-time operations waste, including waste produced from construction, environmental restoration, and DD&D activities (LANL 2003e). Nonroutine waste quantities are projected for construction, DD&D, and environmental restoration wastes in the sections that follow. (Solid wastes from environmental restoration may be sent directly to an offsite facility rather than being processed through the transfer station.) Under the No Action Alternative, three major construction projects would generate significant quantities of construction wastes: TA-16 Refurbishment, Chemistry and Metallurgy Research Replacement Facility at TA-55, and consolidation of certain activities at the Dynamic Experimentation Complex at TA-6, TA-22, and TA-40. Construction wastes associated with these projects are expected to total about 12,000 cubic yards (9,200 cubic meters) (DOE 2002l, 2003d, 2003e). Generally, construction wastes may be disposed of in a solid waste landfill or a construction and demolition debris landfill; offsite disposal capacity is expected to be adequate.

Under the No Action Alternative, DD&D wastes would be generated by six projects, as detailed in **Table 5–38**. Although large quantities of demolition debris and low-level radioactive waste could be generated under this alternative, most wastes could be disposed of offsite and offsite capacity is expected to be sufficient. Chemistry and Metallurgy Research Building DD&D would likely not occur until after 2015, after the new Chemistry and Metallurgy Research Replacement Facility is operational. Waste generated by the demolition process for that structure would likely involve both onsite and offsite disposal capacity.

Table 5–38 Wastes from Decontamination, Decommissioning, and Demolition Activities – No Action Alternative (cubic yards)

Decontamination, Decommissioning, and Demolition Project	*Bulk Low-Level Radioactive Waste*	*Packaged Low-Level Radioactive Waste*	*Mixed Low-Level Radioactive Waste*	*Demolition Debris*	*Chemical Waste [a] (pounds)*
TA-16	8	3	–	5,800	51,000
Los Alamos Site Office	–	–	–	10,000	486,000
General Excess Facilities	13,900	4,600	26	128,000	246,000
Dynamic Experimentation Buildings [b]	–	20	–	21,000	781,000
Chemistry and Metallurgy Research Building [c]	12,000	4,000	280	20,000	280,000
LANSCE Area A [d]	4,000	–	89	520	3,000
Total [e]	30,000	8,700	400	186,000	1,847,000

TA = technical area, RCRA = Resource Conservation and Recovery Act, TSCA = Toxic Substances Control Act, LANSCE = Los Alamos Neutron Science Center.

[a] Chemical waste includes RCRA hazardous waste and TSCA waste (asbestos).

[b] Values from *Dynamic Experimentation EA* (DOE 2003e).

[c] Values from the *Chemistry and Metallurgy Research Building Replacement EIS* (DOE 2003d) and *Preliminary Chemistry and Metallurgy Research Building Disposition Study* (LANL 2003a).

[d] Values from the *1999 SWEIS* (DOE 1999a) and *National Environmental Policy Act Review LAN-05-018* (LANL 2006a).

[e] Totals may not add due to rounding.

Note: To convert cubic yards to cubic meters, multiply by 0.76456.

Wastes generated by LANL's environmental restoration activities are presented separately from operational wastes. These nonroutine waste quantities vary widely from year to year and could differ significantly from projections due to selection of remedies and actual site-specific conditions encountered during field activities. Low-level radioactive waste generated by LANL's environmental restoration activities could be disposed of onsite at TA-54 Area G or offsite at a commercial or DOE disposal facility. Chemical waste quantities generated by LANL's environmental restoration activities are expected to be substantial (LANL 2004g); however, offsite capacity for all waste types is expected to be sufficient.

The expected impacts of waste generation are discussed below for each category of chemical and radioactive waste. Projections of chemical and radioactive waste quantities are presented in **Table 5–39**. The information presented is based on the *1999 SWEIS* projections, which were updated with information from the *Waste Volume Forecast* prepared in June 2003 (LANL 2003e) and updated in September 2004 (LANL 2004g) and information from LANL staff (LANL 2006a). The *Forecast* integrates historical generation data with near- and long-term program plans (LANL 2003e). To aid the analysis, waste categories were further characterized as routine or nonroutine.

Table 5–39 Radioactive and Chemical Waste Projections from Routine Operations – No Action Alternative

Key and Non-Key Facilities	Waste Projections (cubic yards per year) [a]			
	Low-Level Radioactive Waste	Mixed Low-Level Radioactive Waste	Transuranic Waste	Chemical Waste (pounds per year)
Chemistry and Metallurgy Research Building [b]	2,400 [b]	25	55 [b]	24,000
Sigma Complex	1,300	5	0	22,000
Machine Shops	790	0	0	1,045,000
Materials Science Laboratory	0	0	0	1,300
Metropolis Center [c]	0	0	0	0
High Explosives Processing Facilities	20	<1	0	29,000
High Explosives Testing Facilities	1,200	10 [d]	<1	78,000
Tritium Facilities	630	4	0	3,800
Pajarito Site	190	2	0	8,800
Target Fabrication Facility	13	<1	0	8,400
Bioscience Facilities	45	4	0	29,000
Radiochemistry Facility	350	5	0	7,300
Radioactive Liquid Waste Treatment Facility [e]	330	3	13	880
Los Alamos Neutron Science Center	1,400	1	0	37,000
Solid Radioactive and Chemical Waste Facilities [f]	300 [g]	10 [g]	35	2,000
Plutonium Facility Complex	990	20	440	19,000
Non-Key Facilities	2,000 [h]	40	30 [h]	1,435,000
TOTAL [i]	12,000	130	570	2,749,000

[a] Projected values from *1999 SWEIS* ROD, as documented in the *2004 SWEIS Yearbook* (LANL 2005f), unless otherwise noted. Projections are based upon expected, routine facility operations and do not include wastes from nonroutine events such as chemical cleanouts and construction projects.
[b] Values reflect a pit production level of 20 pits per year.
[c] Value was not projected in the *1999 SWEIS* ROD. The Metropolis Center was not a designated Key Facility at that time. No wastes are projected for this facility.
[d] Value adjusted upward from *1999 SWEIS* projection based on projected waste volumes resulting from hydrotesting activities (LANL 2006a).
[e] Values adjusted from *1999 SWEIS* projections based on historical generation rates and new projections (LANL 2006a).
[f] This Key Facility includes the Legacy Transuranic Waste Retrieval Program and the Off-Site Source Recovery Project.
[g] Value adjusted upward from *1999 SWEIS* ROD projection based on projections in the 2004 revision to the *Waste Volume Forecast* (LANL 2004g).
[h] Value adjusted upward from *1999 SWEIS* projection based on historical generation rates and projections in the 2004 revision to the *Waste Volume Forecast* (LANL 2004g). Low-level radioactive waste increases are attributable to heightened activities and new construction. Transuranic waste increases are attributable to waste generated by the Off-Site Source Recovery Project; because this waste comes from shipping and receiving, it is attributed to non-Key Facilities (LANL 2006g).
[i] Totals may not add because all values have been rounded.

Note: To convert pounds to kilograms, multiply by 0.45359; for cubic yards to cubic meters, multiply by 0.76456. Values have been rounded to the nearest hundred, thousand, or million.

Low-Level Radioactive Wastes—Routine low-level radioactive waste generation has been declining (LANL 2003e) and is expected to continue in this direction under the No Action Alternative. Some fluctuations in facility-specific generation rates are expected. For example, the High Explosives Testing Key Facilities, due to increased numbers of hydrotests, are projected to double their average low-level radioactive waste generation (LANL 2004g). In addition, relocating the actinide processing and recovery capability to the Chemistry and Metallurgy Research Replacement Facility may increase low-level radioactive waste quantities by up to 24 cubic yards (18 cubic meters) per year (DOE 2003d). Table 5–39 presents the projected annual low-level radioactive waste quantities from routine operations at Key and non-Key Facilities. The TA-54 Area G expansion into Zone 4 is designed to provide 40 years of disposal capacity for operational low-level radioactive waste, assuming a disposal rate of about 3,900 cubic yards (3,000 cubic meters) per year. In addition, offsite disposal capacity is available and, together with onsite capacity, is expected to be adequate for wastes generated under the No Action Alternative.

Mixed Low-Level Radioactive Wastes—The pattern for mixed low-level radioactive waste generation is similar to that for low-level radioactive waste, with routine generation declining and LANL's environmental restoration-generated quantities varying widely (LANL 2004g). Table 5–39 presents the projected annual mixed low-level radioactive waste quantities from routine operations at Key and non-Key Facilities.

Transuranic and Mixed Transuranic Wastes—In the *Waste Volume Forecast*, transuranic and mixed transuranic categories have been combined for discussion; both waste categories are managed for disposal at WIPP. Higher generation rates, up to about 1600 cubic yards (1,200 cubic meters) per year LANL-wide, are projected for the short term (2005 through 2007), primarily due to activities under the Legacy Transuranic Waste Retrieval Program and several nuclear materials programs (LANL 2004g). The Nuclear Materials Technology vault cleanout would contribute nonroutine transuranic wastes for the short term. Pit production activities (up to 20 pits per year) are expected to yield quantities of transuranic and mixed transuranic wastes at the Plutonium Facility Complex. Relocating the actinide processing and recovery capability to the Chemistry and Metallurgy Research Replacement Facility may increase transuranic waste quantities by 8 cubic yards (6.1 cubic meters) per year (DOE 2003c). After 2007, most transuranic wastes would be generated through routine activities (LANL 2003e). The WIPP capacity attributed to newly-generated transuranic waste from LANL is about 14,000 cubic yards (10,800 cubic meters) (DOE 2002f), which is expected to be adequate for wastes generated under the No Action Alternative. Table 5–39 presents the projected annual transuranic quantities from routine operations at Key and non-Key Facilities.

Chemical Wastes—Routine chemical waste generation has been trending downward (LANL 2003e) and is expected to continue in this direction under the No Action Alternative. Bulk chemical wastes generated by LANL operations and environmental restoration activities make up approximately 90 percent of the chemical and hazardous waste generated across LANL (LANL 2003e). Although LANL's environmental restoration waste quantities are highly variable, operational bulk chemical waste is generated primarily at the Sanitary Wastewater Systems Plant in steady quantities. Nonbulk chemical and hazardous wastes are generated by a wide range of operations at LANL (LANL 2004g). Approximately half of the nonbulk chemical waste is not regulated as hazardous by the State of New Mexico, but this waste does not meet waste acceptance criteria for disposal at a solid waste landfill (LANL 2003e). Generation rates for nonbulk chemical and hazardous wastes from operations are expected to remain steady under the No Action Alternative (LANL 2003e). Scheduled cleanouts of outdated or unused chemicals periodically could increase annual quantities for specific facilities (LANL 2004g). Table 5–39 presents the projected annual chemical waste quantities from routine operations at Key and non-Key Facilities.

Radioactive Liquid Waste Treated at LANL—Radioactive liquid waste is treated at three locations, TA-21, TA-50 and TA-53. Treatment at TA-21 would continue only until all DD&D activities at this TA are complete. The Radioactive Liquid Waste Treatment Facility at TA-50 continues to treat the majority of radioactive liquid wastes generated at LANL. Treated radioactive liquid waste quantities at the Radioactive Liquid Waste Treatment Facility, including acid and caustic radioactive liquid waste treated in Room 60, are projected in **Table 5–40**. If hydrotesting activities at the High Explosives Testing Facilities continue to use foam as a containment matrix, up to 66,000 gallons (250,000 liters) of additional radioactive liquid waste annually may be treated at the Radioactive Liquid Waste Treatment Facility, but these quantities are well within projected treatment volumes. Quantities of radioactive liquid wastes at TA-53 are also included in Table 5–40.

Table 5–40 Radioactive Liquid Waste Treated at Los Alamos National Laboratory – No Action Alternative

Waste Treatment Activity	*Projection*
Pretreatment of radioactive liquid waste at TA-21	(a)
Pretreatment of transuranic liquid waste from TA-55 in Room 60	30,000 gallons (110,000 liters) per year
Solidification of transuranic sludge at TA-50	16 cubic yards (12 cubic meters) per year
Radioactive liquid waste treated at TA-50	4,000,000 gallons (15,000,000 liters) per year
Secondary treatment of radioactive liquid waste at TA-50	260,000 gallons (1,000,000 liters) per year
De-water low-level radioactive waste sludge at TA-50	70 cubic yards (50 cubic meters) per year
Radioactive liquid waste treated at TA-53	140,000 gallons (520,000 liters) per year [b]
Transport evaporator bottoms to Tennessee	66,000 gallons (250,000 liters) per year
Receive solidified evaporator bottoms from Tennessee [c]	25 cubic yards (20 cubic meters) per year

TA = technical area, LANSCE = Los Alamos Neutron Science Center.
[a] No new radioactive liquid waste is being generated at TA-21, and all inventory that existed in tanks and equipment was processed or transported to TA-54 in 2006.
[b] Radioactive liquid waste treated at TA-53 includes waste volumes from LANSCE plus approximately 5,000 gallons (20,000 liters) per year from TA-50.
[c] This is solid low-level radioactive waste that is disposed of at TA-54.
Source: LANL 2006a.

Summary—Waste management impacts from LANL operations under the No Action Alternative are expected to remain within the capacity of the LANL waste management infrastructure. **Table 5–41** summarizes the waste quantities estimated for operations, DD&D, and environmental restoration activities under the No Action Alternative. Although the summary table provides waste projections only through 2016, impacts from operations are expected to continue at comparable rates for the longer term. For operational waste, waste projections are presented as a range, with the lower end of the range representing the quantity projected in the *Waste Volume Forecast* (LANL 2004g) and the upper end representing the *1999 SWEIS* projection, except as noted. For this summary table, the transuranic and low-level radioactive waste categories have been further subdivided (contact- and remote-handled transuranic) to facilitate identification of offsite disposal options and analysis of transportation impacts.

Table 5–41 Summary of Waste Types by Generator Category – No Action Alternative (Cumulative 2007 through 2016) (in cubic yards)

Waste Type	*Operational Waste* [a]	*DD&D Waste* [b]	*Remediation Waste* [c]	*Total*
Low-Level Radioactive Waste [d]				
Bulk low-level radioactive waste	–	30,000	8,800	39,000
Packaged low-level radioactive waste	25,000 to 120,000	8,700	–	33,000 to 128,000
High Activity low-level radioactive waste	–	–	–	–
Remote-handled low-level radioactive waste	–	–	–	–
Mixed Low-Level Radioactive Waste	270 to 1,300	400	1,100	1,800 to 2,800
Transuranic Waste				
Contact-handled	3,300 to 5,700	0	210	3,500 to 5,900
Remote-handled	–	–	–	–
Construction and Demolition Debris [e]	12,000 [f]	186,000	–	198,000
Chemical Waste [g] **(pounds)**	9,997,000 to 27,000,000	1,847,000	7,513,000	19,000,000 to 37,000,000

DD&D = decontamination, decommissioning, and demolition; TA = technical area; LANSCE = Los Alamos Neutron Science Center; MDA = material disposal area; CMRR = Chemistry and Metallurgy Research Replacement.

[a] Operations waste volumes are represented as a range, with the lower end represented by best-estimate values documented in the Waste Volume Forecasts (LANL 2003e, 2004g), and the upper end represented by the bounding *1999 SWEIS* projections (DOE 1999a), adjusted as detailed in Table 5–39. These wastes are assumed to be contact-handled transuranic waste and packaged low-level radioactive waste, although small volumes of other types could be generated.

[b] DD&D waste quantities were estimated for the following projects: TA-16 Refurbishment, Los Alamos Site Office Building Replacement, General Excess Facilities, CMRR Facility, LANSCE Area A Renovation, and consolidation of certain activities at the Dynamic Experimentation Complex at TA-6, TA-22, and TA-40.

[c] Details of LANL's environmental restoration activities and resulting wastes are provided in Appendix I.

[d] The subcategories of low-level radioactive waste do not necessarily meet precise definitions, but are used to assist in the analysis of disposal and transportation options and impacts.
– Bulk low-level radioactive waste = wastes that can be transported in large volumes in soft-sided containers.
– Packaged low-level radioactive waste = typical low-level radioactive waste packaged in drums or boxes.
– High-activity low-level radioactive waste = waste exceeding 10 CFR 61.55 Class A concentrations (greater than 10 nanocuries per gram of transuranic nuclides), which is not accepted at certain facilities.
– Remote-handled low-level radioactive waste = waste with a dose rate exceeding 200 millirem per hour at the surface of the container.

[e] Construction and demolition debris includes uncontaminated wastes such as steel, brick, concrete, pipe, and vegetative matter from land clearance.

[f] Construction debris quantities were estimated for the following projects: TA-16 Refurbishment, Chemistry and Metallurgy Research Replacement Facility, and consolidation of certain activities at the Dynamic Experimentation Complex at TA-6, TA-22, and TA-40.

[g] Chemical waste includes wastes regulated under Resource Conservation and Recovery Act, Toxic Substance Control Act, or state hazardous waste regulations.

Note: To convert cubic yards to cubic meters, multiply by 0.76456; for pounds to kilograms, multiply by 0.45359. Totals may not add because values have been rounded to the nearest hundred, thousand, or million.

Most wastes, with the exception of some low-level radioactive waste, are disposed of offsite at permitted facilities designed for specific categories of wastes. The expansion of TA-54 Area G into Zone 4 is expected to provide onsite low-level radioactive waste disposal capacity for operations waste through the 2016 timeframe and beyond. Because of the difficulties in accurately predicting the volumes of wastes generated by LANL's environmental restoration activities, some variances from projections are possible in future years. The waste management infrastructure at LANL has adequate staffing and facilities to manage the quantities of waste expected to be generated under the No Action Alternative.

5.9.2 Reduced Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Many of the waste management impacts under the Reduced Operations Alternative would be the same as those under the No Action Alternative. Wastewaters, including sanitary liquid waste, high explosives-contaminated liquid waste, and industrial effluent, would be collected and managed in systems designed for each category of waste. High explosive-contaminated waste quantities would be reduced by about 20 percent as operations are scaled back at the High Explosives Processing and Testing Facilities. Sanitary waste generated at LANL would generally be managed at a transfer station, where solid waste is sorted and consolidated for transport to an offsite landfill (LANL 2005a). (Solid waste from environmental restoration may be sent directly to an offsite facility rather than through the transfer station.) As discussed under the No Action Alternative, waste minimization and recycling activities would reduce the quantities of solid waste disposed of. Waste management impacts associated with construction and DD&D activities would be similar to those for the No Action Alternative. Construction waste from the Chemistry and Metallurgy Research Replacement Facility would be about 500 cubic yards (382 cubic meters) smaller than that for the No Action Alternative, and DD&D of the Chemistry and Metallurgy Research Building may be further delayed beyond 2015.

Under the Reduced Operations Alternative, smaller quantities of some radioactive and chemical wastes would be generated due to shutdown of the Pajarito Site and LANSCE, as well as reductions in high explosives processing and testing. Projections of chemical and radioactive waste quantities from routine operations at Key and non-Key Facilities are presented in **Table 5–42**.

Radioactive liquid waste treatment would be the same as under the No Action Alternative, with the exception of limited treatment at TA-53 as LANSCE operations are halted; some liquid wastes with high tritium content from TA-50 could continue to be processed at TA-53. Radioactive liquid waste treatment quantities are presented in **Table 5–43**.

Table 5–42 Radioactive and Chemical Waste Projections from Routine Operations – Reduced Operations Alternative

Key and Non-Key Facilities	***Waste Projections (cubic yards per year)*** [a]			
	Low-Level Radioactive Waste	***Mixed Low-Level Radioactive Waste***	***Transuranic Waste***	***Chemical Waste (pounds per year)***
Chemistry and Metallurgy Research Building [b]	2,400	25	55	24,000
Sigma Complex	1,300	5	0	22,000
Machine Shops	790	0	0	1,045,000
Materials Science Laboratory	0	0	0	1,300
Metropolis Center [c]	0	0	0	0
High Explosives Processing Facilities	15 [d]	<1 [d]	0	23,000 [d]
High Explosives Testing Facilities	980 [d]	8	<1 [d]	62,000 [d]
Tritium Facilities	630	4	0	3,800
Pajarito Site [f]	0	0	0	0
Target Fabrication Facility	13	<1	0	8,400
Bioscience Facilities	45	4	0	29,000
Radiochemistry Facility	350	5	0	7,300
Radioactive Liquid Waste Treatment Facility [g]	330	3	13	880
Los Alamos Neutron Science Center [h]	5	1	0	0
Solid Radioactive and Chemical Waste Facilities [i]	300 [j]	10 [j]	35	2,000
Plutonium Facility Complex	990	20	440	19,000
Non-Key Facilities	2,000 [k]	40	30 [k]	1,435,000
Total [l]	10,000	130	570	2,682,000

[a] Projected values are from the *1999 SWEIS* ROD, as documented in the *2004 SWEIS Yearbook* (LANL 2005f), unless otherwise noted. Projections are based upon expected, routine facility operations and do not include wastes from nonroutine events such as chemical cleanouts and construction projects.
[b] Values reflect a pit production level of 20 pits per year.
[c] Value was not projected in *1999 SWEIS* ROD. The Metropolis Center was not a designated Key Facility at that time.
[d] A 20 percent reduction from No Action levels is projected, based on a 20 percent reduction in operations.
[e] Value adjusted upward from 1999 SWEIS projection based on projected waste volumes from hydrotesting activities (LANL 2006a).
[f] No wastes would be generated at TA-18 as activities are ceased.
[g] Values adjusted from *1999 SWEIS* projections based on historical generation rates and new projections (LANL 2006a).
[h] Only small quantities of waste would be generated as LANSCE operations are halted and the facility is maintained in standby mode.
[i] This Key Facility includes the Legacy Transuranic Waste Retrieval Program and the Off-Site Source Recovery Project.
[j] Value adjusted upward from *1999 SWEIS* ROD projection based on projections in the 2004 revisions to the *Waste Volume Forecast* (LANL 2004g).
[k] Value adjusted upward from *1999 SWEIS* projection based on historical generation rates and projections in the 2004 revisions to the *Waste Volume Forecast* (LANL 2004g). Low-level radioactive waste increases are attributable to heightened activities and new construction. Transuranic waste increases are attributable to waste generated by the Off-Site Source Recovery Project; because this waste comes from shipping and receiving, it is attributed to non-Key Facilities.
[l] Totals may not add due to rounding. Values have been rounded to the nearest hundred, thousand, or million.
Note: To convert cubic yards to cubic meters, multiply by 0.76456; for pounds to kilograms, multiply by 0.45359.

Table 5–43 Radioactive Liquid Waste Treated at Los Alamos National Laboratory – Reduced Operations Alternative

Waste Treatment Activity	*Projection*
Pretreatment of radioactive liquid waste at TA-21	(a)
Pretreatment of transuranic liquid waste from TA-55 in Room 60	30,000 gallons (110,000 liters) per year
Solidification of transuranic sludge at TA-50	16 cubic yards (12 cubic meters) per year
Radioactive liquid waste treated at TA-50	4,000,000 gallons (15,000,000 liters) per year
Secondary treatment of radioactive liquid waste at TA-50	260,000 gallons (1,000,000 liters) per year
De-water low-level radioactive waste sludge at TA-50	70 cubic yards (50 cubic meters) per year
Radioactive liquid waste treated at TA-53	5,000 gallons (20,000 liters) per year [b]
Transport evaporator bottoms to Tennessee	66,000 gallons (250,000 liters) per year
Receive solidified evaporator bottoms from Tennessee [c]	25 cubic yards (20 cubic meters) per year

TA = technical area.
[a] No new radioactive liquid waste is being generated at TA-21, and all inventory that existed in tanks and equipment was processed or transferred to TA-54 in 2006.
[b] Under the Reduced Operations Alternative, operations at the LANSCE facility would cease. Approximately 5,000 gallons (20,000 liters) of radioactive liquid waste per year from TA-50 would continue to be treated at TA-53.
[c] This is solid low-level radioactive waste that is disposed of at TA-54.
Source: LANL 2006a.

Summary—Waste management impacts from LANL operations under the Reduced Operations Alternative are expected to be similar to those under the No Action Alternative, with some reductions in waste quantities due to the closure of LANSCE and the Pajarito Site and reduced operational levels at the High Explosives Facilities. **Table 5–44** summarizes the waste quantities estimated for operations, DD&D, and environmental restoration activities under the Reduced Operations Alternative. Although the summary table provides waste projections only through 2016, impacts from operations are expected to continue at comparable rates for the longer term. For operational waste, waste projections are presented as a range, with the lower end of the range representing the quantity projected in the *Waste Volume Forecast* (LANL 2004g) and the upper end representing the *1999 SWEIS* projection, except as noted. The waste management infrastructure at LANL has adequate staffing and facilities to manage the quantities of waste expected to be generated under the Reduced Operations Alternative.

5.9.3 Expanded Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Many of the waste management impacts under the Expanded Operations Alternative would be the same as under the No Action Alternative although certain waste volumes would periodically increase. Wastewaters, including sanitary liquid waste, high explosives-contaminated liquid waste, and industrial effluent, would be collected and managed in systems designed for each category of waste. Sanitary waste generated at LANL would generally be managed at a transfer station where solid waste is sorted and consolidated for transport to an offsite landfill (LANL 2005a). (Large quantities of solid wastes from construction, DD&D, and environmental restoration may be shipped directly to an offsite disposal facility rather than being processed through the transfer station.) Waste minimization and recycling activities would reduce the quantities of solid waste disposed of.

Table 5–44 Summary of Waste Types by Generator Category – Reduced Operations Alternative (Cumulative 2007 through 2016) (in cubic yards)

Waste Type	*Operational Waste* [a]	*DD&D Waste* [b]	*Remediation Waste* [c]	*Total*
Transuranic Waste				
Contact-handled	3,300 to 5,700	–	210	3,500 to 5,900
Remote-handled	–	–	–	–
Low-Level Radioactive Waste [d]				
Bulk low-level radioactive waste	–	30,000	8,800	39,000
Packaged low-level radioactive waste	25,000 to 101,000	8,700	–	33,000 to 110,000
High-activity low-level radioactive waste	–	–	–	–
Remote-handled low-level radioactive waste	–	–	–	–
Mixed Low-Level Radioactive Waste	270 to 1,300	400	1,100	1,800 to 2,800
Construction and Demolition Debris [e]	12,000 [f]	186,000	–	198,000
Chemical Waste [g] **(pounds)**	9,997,000 to 27,000,000	1,847,000	7,513,000	19,000,000 to 36,000,000

DD&D = decontamination, decommissioning, and demolition.

[a] Operations waste volumes are represented as a range, with the lower end represented by best-estimate values documented in the *Waste Volume Forecasts* (LANL 2003e, 2004g) and the upper end represented by the bounding *1999 SWEIS* projections (DOE 1999a), adjusted as detailed in Table 5–42. These wastes are assumed to be contact-handled transuranic waste and packaged low-level radioactive waste, although small volumes of other types could be generated.

[b] DD&D waste quantities are the same as those under the No Action Alternative.

[c] Environmental restoration-related waste quantities are the same as those under the No Action Alternative. These waste estimates do not include an additional 600 cubic yards of chemical waste, and 4,800 cubic yards of bulk low-level radioactive waste may be generated by a removal action.

[d] The subcategories of low-level radioactive waste do not necessarily meet precise definitions, but are used to assist in the analysis of disposal and transportation options and impacts.
- Bulk low-level radioactive waste = wastes that can be transported in large volumes in soft-sided containers.
- Packaged low-level radioactive waste = typical low-level radioactive waste packaged in drums or boxes.
- High-activity low-level radioactive waste = waste exceeding 10 CFR 61.55 Class A concentrations (greater than 10 nanocuries per gram of transuranic nuclides), which is not accepted at certain facilities.
- Remote-handled low-level radioactive waste = waste with a dose rate exceeding 200 millirem per hour at the surface of the container.

[e] Construction and demolition debris includes uncontaminated wastes such as steel, brick, concrete, pipe, and vegetative matter from land clearance.

[f] Construction debris quantities are about 500 cubic yards (382 cubic meters) smaller than those for the No Action Alternative.

[g] Chemical waste includes wastes regulated under RCRA, TSCA, or state hazardous waste regulations.

Note: To convert cubic yards to cubic meters, multiply by 0.76456; for pounds to kilograms, multiply by 0.45359. Totals may not add because values have been rounded to the nearest hundred, thousand, or million.

Waste management impacts associated with DD&D activities would increase under the Expanded Operations Alternative, as detailed in **Table 5–45**. Large quantities of demolition debris and bulk low-level radioactive waste wastes are expected from DD&D actions, along with smaller quantities of transuranic and mixed low-level radioactive waste and sanitary, asbestos, and hazardous wastes. Most of the waste would be disposed of offsite. Demolition debris may be sent to any solid waste landfill permitted to accept it. Low-level radioactive waste may be disposed of at TA-54 Area G or sent offsite to DOE or commercial facilities. Additional construction waste would be generated as new facilities are constructed under this alternative. **Table 5–46** summarizes the quantities of construction wastes associated with major new construction under the Expanded Operations Alternative.

Table 5–45 Wastes from Decontamination, Decommissioning, and Demolition Activities – Expanded Operations Alternative (cubic yards)

DD&D Project	*Contact-Handled Transuranic Waste*	*Bulk Low-Level Radioactive Waste*	*Packaged Low-Level Radioactive Waste*	*Mixed Low-Level Radioactive Waste*	*Demolition Debris*	*Chemical Waste* [a] *(pounds)*
No Action Total [b]	–	30,000	8,700	400	186,000	1,847,000
Physical Science Research Complex	–	13,000	4,300	< 1	177,000	314,000
Replacement Office Buildings	–	23	8	–	6,900	–
Radiological Sciences Institute	1,100 [c]	72,000	23,000 [c]	1,000	77,000	988,000
Radioactive Liquid Waste Treatment Facility Upgrade [d]	230	7,700	2,600	150	1,800	212,000
Plutonium Refurbishment	340	970	320	220	2,100	2,000
TA-18 Closure	–	4,700	–	5	17,000	75,000
TA-21 Structure	1	26,000	8,600	65	47,000	422,000
Waste Management Facilities Transition	–	23,000	7,600	8	54,000	566,000
Total [e]	1,700	177,000	56,000	1,900	569,000	4,425,000

DD&D = decontamination, decommissioning, and demolition; RCRA = Resource Conservation and Recovery Act; TSCA = Toxic Substances Control Act.

[a] Chemical waste includes RCRA hazardous waste and TSCA waste (asbestos).

[b] Details of the DD&D waste volumes generated under the No Action Alternative are provided in Table 5–38.

[c] In addition to these volumes, DD&D associated with the Radiological Sciences Institute is expected to generate 479 cubic yards of remote-handled low-level radioactive waste and 11 cubic yards of remote-handled transuranic waste.

[d] Waste volumes reflect the option that generates the most waste.

[e] Totals may not add because all values have been rounded to the nearest hundred, thousand, or million.

Note: To convert cubic yards to cubic meters, multiply by 0.76456.

Table 5–46 Construction Wastes [a] – Expanded Operations Alternative

Construction Project	*Waste Generated (cubic yards)*
No Action Total	12,000
Physical Science Research Complex	1,600
Replacement Office Buildings	1,700
Radiological Sciences Institute	2,800
Radioactive Liquid Waste Treatment Facility Upgrade	1,200
TA-55 Radiography Facility	24
Plutonium Facility Complex Refurbishment	690
Science Complex	3,300
Remote Warehouse and Truck Inspection Station	610
Waste Management Facilities Transition	500
Security-Driven Transportation Modifications	1,500
Total	26,000

TA = technical area.

[a] Construction debris includes uncontaminated wastes such as steel, brick, concrete, pipe and vegetative matter from land clearance.

Note: Totals may not add because values have been rounded to the nearest hundred, thousand, or million.

The type and extent of many environmental restoration activities that would be required by the New Mexico Environment Department are not yet known. To assess impacts under this uncertainty, LANL's MDA remediation activities were analyzed under two scenarios, the Capping Option and the Removal Option. The waste management impacts associated with both scenarios are presented here.

MDA remediation wastes would be generated under the Capping Option, with substantial quantities of demolition and low-level radioactive waste expected. Variations in actual versus projected waste quantities are expected for these wastes due to the difficulty in predicting selected environmental remedies and waste types and quantities. In addition, no credit was taken for waste volume reduction techniques, such as sorting.

Much greater quantities of MDA remediation wastes would be generated under the Removal Option than under the No Action Alternative because of the substantial quantities of demolition debris and low-level radioactive waste expected. The closure of some TA-54 Area G facilities and the subsequent remediation of the area would generate large quantities of demolition debris and low-level radioactive waste. Industrial, hazardous, and low-level radioactive liquid wastes also would be generated by remedial actions. These liquid wastes would be treated onsite at existing LANL facilities.

Under the Expanded Operations Alternative, larger quantities of some radioactive and chemical wastes would be generated due to increased levels of operations at various facilities. Expanded actinide activities at the Chemistry and Metallurgy Research Replacement Facility, increased pit production (up to 80 pits per year) at the Plutonium Facility Complex, and increased recovery of sealed sources under the Off-Site Source Recovery Project would result in larger quantities of transuranic and low-level radioactive wastes. Increased pit production is projected to annually result in about 240 cubic yards (180 cubic meters) of additional contact-handled transuranic waste. In addition, activities at TA-55 in support of mixed oxide fuel fabrication could generate additional quantities of transuranic waste (LANL 2004g). Projections of chemical and radioactive waste quantities from routine operations at Key and non-Key Facilities are presented in **Table 5–47**.

Radioactive liquid waste treatment volumes are expected to increase under the Expanded Operations Alternative due to increased pit production and activities in support of mixed oxide fuel fabrication. The TA-21 demolition work is expected to generate about 8,400 gallons (32,000 liters) of low-level radioactive liquid waste, which would be treated at the Radioactive Liquid Waste Treatment Facility in TA-50. Radioactive liquid waste treatment quantities are presented in **Table 5–48**.

Table 5–47 Radioactive and Chemical Waste Projections from Routine Operations – Expanded Operations Alternative

Key and Non-Key Facilities	*Waste Projections (cubic yards per year)* [a]			
	Low-Level Radioactive Waste	*Mixed Low-Level Radioactive Waste*	*Transuranic Waste*	*Chemical Waste (pounds per year)*
Chemistry and Metallurgy Research Building	2,600 [b]	30 [b]	90 [b]	25,000 [b]
Sigma Complex	1,300	5	0	22,000
Machine Shops	790	0	0	1,045,000
Materials Science Laboratory	0	0	0	1,300
Metropolis Center [c]	0	0	0	0
High Explosives Processing Facilities	20	<1	0	29,000
High Explosives Testing Facilities	1,200	10 [d]	<1	78,000
Tritium Facilities	630	4	0	3,800
Pajarito Site	190	2	0	8,800
Target Fabrication Facility	13	<1	0	8,400
Bioscience Facilities	45	4	0	29,000
Radiochemistry Facility	350	5	0	7,300
Radioactive Liquid Waste Treatment Facility [e]	390	3	18	1,100
Los Alamos Neutron Science Center	1,400	1	0	37,000
Solid Radioactive and Chemical Waste Facilities [f]	300 [g]	10 [g]	35	2,000
Plutonium Facility Complex	1,400 [h]	20	690 [i]	19,000
Non-Key Facilities	2,000 [j]	40	30 [j]	1,435,000
Total [k]	13,000	140	860	2,750,000

[a] Projected values are from the *1999 SWEIS* ROD, as documented in the *2004 SWEIS Yearbook* (LANL 2005f), unless otherwise noted. Projections are based upon expected, routine facility operations and do not include wastes from nonroutine events such as chemical cleanouts and construction projects.
[b] Value taken from *CMRR EIS* (DOE/EIS-0350).
[c] Values not projected in *1999 SWEIS* ROD. The Metropolis Center was not a designated Key Facility at that time.
[d] Value adjusted upward from *1999 SWEIS* projection based on projected waste volumes resulting from hydrotesting activities (LANL 2006a).
[e] Values adjusted from *1999 SWEIS* projections are based on historical generation rates and new projections (LANL 2006a).
[f] This Key Facility includes the Transuranic Waste Retrieval Project and the Off-Site Source Recovery Project.
[g] Value was adjusted upward from *1999 SWEIS* projection based on projections in *Waste Volume Forecast* (LANL 2004g).
[h] Projections for transuranic and low-level radioactive waste assume pit production of up to 80 pits per year, based on *1999 SWEIS* projections (DOE 1999a) and more recent waste estimates (LANL 2005d).
[i] Projections for transuranic and low-level radioactive waste assume pit production of up to 80 pits per year, based on *1999 SWEIS* projections (DOE 1999a) and more recent waste estimates (LANL 2005d). In addition, 46 cubic yards of transuranic waste per year are projected due to activities in support of mixed oxide fuel fabrication (LANL 2004g).
[j] Value was adjusted upward from the *1999 SWEIS* projection based on historical generation rates and projections in the *Waste Volume Forecast* (LANL 2004g). Low-level radioactive waste increases are attributable to heightened activities and new construction. Transuranic waste increases are attributable to waste generated by the Off-Site Source Recovery Project; because this waste comes from shipping and receiving, it is attributed to non-Key Facilities.
[k] Totals may not add because values have been rounded to the nearest hundred, thousand, or million.
Note: To convert cubic yards to cubic meters, multiply by 0.76456; for pounds to kilograms, multiply by 0.45359.

Table 5–48 Radioactive Liquid Waste Treated at Los Alamos National Laboratory – Expanded Operations Alternative

Waste Treatment Activity	*Projection* [a]
Pretreatment of radioactive liquid waste at TA-21	(a)
Pretreatment of transuranic liquid waste from TA-55 in Room 60	50,000 gallons (190,000 liters) per year
Solidification of transuranic sludge at TA-50	22 cubic yards (17 cubic meters) per year
Radioactive liquid waste treated at TA-50	5,000,000 gallons (20,000,000 liters) per year
Secondary treatment of radioactive liquid waste at TA-50	320,000 gallons (1,200,000 liters) per year
De-water low-level radioactive waste sludge at TA-50	80 cubic yards (60 cubic meters) per year
Radioactive liquid waste treated at TA-53	140,000 gallons (520,000 liters) per year [b]
Transport evaporator bottoms to Tennessee	80,000 gallons (300,000 liters) per year
Receive solidified evaporator bottoms from Tennessee [c]	30 cubic yards (23 cubic meters) per year

TA = technical area, LANSCE = Los Alamos Neutron Science Center.
[a] No new radioactive liquid waste is being generated at TA-21, and all inventories that existed in tanks and equipment was processed or transferred to TA-54 in 2006.
[b] Radioactive liquid waste treated at TA-53 includes waste volumes from LANSCE plus approximately 5,000 gallons (20,000 liters) per year from TA-50.
[c] This is solid low-level radioactive waste that is disposed of at TA-54.
Source: LANL 2006a.

Summary—**Table 5–49** summarizes the waste quantities estimated for operations, DD&D, and LANL's environmental restoration activities under the Expanded Operations Alternative. Although the summary table provides waste projections only through 2016, impacts from operations are expected to continue at comparable rates for the longer term. For this summary table, the transuranic and low-level radioactive waste categories have been further subdivided (for example, contact- and remote-handled transuranic) to facilitate identification of offsite disposal options and analysis of transportation impacts. In addition, for the Operational Waste and Remediation Waste categories, the quantities are presented as ranges rather than discrete values. For Operational Waste, the lower end of the range represents the quantity projected in the *Waste Volume Forecast* (LANL 2004g) and the upper end represents the *1999 SWEIS* projection, except as noted.

Waste management impacts from LANL operations under the Expanded Operations Alternative are expected to increase compared to those under the No Action Alternative due to heightened operations at the Plutonium Facility Complex and increased characterization and management activities associated with legacy waste retrieval. Although operational transuranic waste quantities are higher under the Expanded Operations Alternative, waste disposal capacity at WIPP is expected to be adequate, assuming the best estimates are realized. Operational low-level radioactive waste quantities also are expected to increase under this alternative, and use of both onsite and offsite disposal options can be used to manage this waste. As detailed in Appendix H, Section H.3, improvements to the LANL waste management infrastructure would be implemented to ensure safe and efficient management of wastes.

Table 5–49 Summary of Waste Types by Generator Category – Expanded Operations Alternative (Cumulative 2007 through 2016) (in cubic yards)

Waste Type	*Operational Waste* [a]	*DD&D Waste* [b]	*Remediation Waste* [c]	*Total*
Transuranic Waste				
Contact-handled	3,300 to 8,600	1,700	280 to 22,000	5,300 to 33,000
Remote-handled	–	11	0 to 50	11 to 61
Low-Level Radioactive Waste [d]				
Bulk low-level radioactive waste	–	177,000	20,000 to 710,000	196,000 to 884,000
Packaged low-level radioactive waste	25,000 to 127,000	56,000	–	80,000 to 183,000
High-activity low-level radioactive waste	–	–	0 to 347,000	0 to 347,000
Remote-handled low-level radioactive waste	–	480	0 to 1,200	480 to 1,700
Mixed Low-Level Radioactive Waste	270 to 1,400	1,900	1,800 to 180,000	3,900 to 183,000
Construction and Demolition Debris [e]	26,000	569,000	47,000 to 126,000	642,000 to 722,000
Chemical Waste [g] **(pounds)**	9,997,000 to 27,500,000	4,425,000	50,000,000 to 97,000,000	64,000,000 to 129,000,000

DD&D = decontamination, decommissioning, and demolition; RCRA = Resource Conservation and Recovery Act; TSCA = Toxic Substances Control Act.

[a] Operations waste volumes are represented as a range, with the lower end represented by best-estimate values documented in the *Waste Volume Forecasts* (LANL 2003e, 2004g) and the upper end represented by the bounding *1999 SWEIS* projections (DOE 1999a), adjusted as detailed in Table 5–47. These wastes are assumed to be contact-handled transuranic waste and packaged low-level radioactive waste, although small volumes of other types could be generated.

[b] DD&D waste quantities include those under the No Action Alternative, as well as all DD&D wastes estimated to arise from new projects under the Expanded Operations Alternative, as detailed in Table 5–45.

[c] The low and high ends of the ranges correspond to the MDA Capping Option and Removal Option, respectively. See Appendix I for details.

[d] The subcategories of low-level radioactive waste do not necessarily meet precise definitions, but are used to assist in the analysis of disposal and transportation options and impacts.
– Bulk low-level radioactive waste = wastes that can be transported in large volumes in soft-sided containers.
– Packaged low-level radioactive waste = typical low-level radioactive waste packaged in drums or boxes.
– High-activity low-level radioactive waste = waste exceeding 10 CFR 61.55 Class A concentrations (greater than 10 nanocuries per gram of transuranic nuclides), which is not accepted at certain facilities.
– Remote-handled low-level radioactive waste = waste with a dose rate exceeding 200 millirem per hour at the surface of the container.

[e] Construction and demolition debris includes uncontaminated wastes such as steel, brick, concrete, pipe, and vegetative matter from land clearance.

[f] Construction debris quantities include those under the No Action Alternative, as well as all construction wastes estimated to arise from new projects under the Expanded Operations Alternative, as detailed in Table 5–46.

[g] Chemical waste includes waste regulated under RCRA, TSCA, or state hazardous waste regulations.

Note: To convert cubic yards to cubic meters, multiply by 0.76456; for pounds to kilograms, multiply by 0.45359. Totals might not add because values have been rounded to the nearest hundred, thousand, or million.

DD&D activities also are expected to generate large quantities of waste, particularly low-level radioactive waste and uncontaminated debris. The quantities of low-level radioactive waste would exceed the Area G capacity and some portion would require offsite disposal. Uncontaminated debris would be sent offsite for disposal.

For remediation waste, the range is intended to reflect the uncertainty associated with site cleanups. Final decisions on cleanup of MDAs and other PRSs will be made after DOE and LANL investigate the sites and propose remedies to the New Mexico Environment Department, which will then solicit public comment on the proposed remedies and decide what remedies will be implemented. For many of LANL's MDAs and PRSs, investigation is still ongoing and the remedy selection process has not begun. Thus, the remediation process, including the amount of waste generated as a result of the process, is not clearly defined. To adequately address impacts, the remediation process was analyzed under a Capping Option, which would produce relatively small amounts of waste, and a Removal Option, which would involve significant excavations and would produce significantly more waste. These two options, Capping and Removal, represent the lower and upper values, respectively, in the remediation waste summary.

Under the MDA Capping Option, remedial actions would take place at PRSs such as high explosives testing sites and outfalls. Actions at most MDAs would be limited to installing an engineered cover, with the wastes remaining in place. Under this option, moderate quantities of bulk low-level radioactive waste, uncontaminated debris, and chemical wastes would be expected, as well as small quantities of transuranic waste. Offsite disposal of most waste could occur, although some portion of low-level radioactive waste could be disposed of onsite depending upon available capacity and disposal priorities.

Under the MDA Removal Option, the same remedial activities as those under the MDA Capping Option would take place, with one important addition: all MDAs would be exhumed, which would generate very large quantities of waste including transuranic, low-level radioactive, mixed low-level radioactive, uncontaminated debris, and chemical waste. For the uncontaminated debris (managed as solid waste) and chemical waste categories, offsite disposal capacity is expected to be adequate. Quantities of low-level radioactive waste would exceed the planned annual rate of disposal at Area G; decisions regarding onsite or offsite disposal would depend on available capacity, decisions about changes to disposal operations, if any, and disposal priorities.

The transuranic waste volumes projected for the MDA Removal Option involve waste, most of which DOE buried before 1970. These projected volumes are conservative, and may be smaller than that assumed depending on future regulatory decisions by the New Mexico Environment Department. Also, no credit was taken for use of waste volume reduction techniques such as sorting. It was assumed for this SWEIS that all transuranic waste would be disposed of at WIPP. WIPP disposal capacity is expected to be sufficient for disposal of all retrievably stored waste and all newly generated transuranic waste from the DOE complex over the next few decades, but not sufficient for this waste and all transuranic waste buried before 1970 across the complex (63 FR 3624). Decisions about disposal of transuranic waste generated by remediation at LANL, will be based on the needs of the entire DOE complex. If necessary, any transuranic waste that is generated without a disposal pathway would be safely stored until disposal capacity becomes available.

The large quantities of waste resulting from the Removal Option may exceed LANL's waste handling and processing capacity. As needed, additional, augmented, or mobile waste management equipment or facilities could be developed similar to those described in Appendix H, Section H.3.2.2, and Appendix I, Section I.3.3.2.8, of this SWEIS. Modular mobile facilities could be sited at appropriate LANL locations, and moved between remediation sites as needed. These modular facilities could include capacity for safety inspections of removed waste, waste processing and temporary storage, radioactive and chemical analyses, or other support services.

5.10 Transportation

This section summarizes the potential impacts associated with shipping materials to and from LANL to various locations (such as waste disposal sites and other DOE or commercial sites) under both incident-free and accident conditions. For incident-free transportation, the potential human health impacts from the radiation field surrounding the radioactive packages were estimated for transportation workers and populations along the route (off-traffic, or off-link), people sharing the route (in-traffic or on-link), and people at rest areas and stops along the route. The RADTRAN 5 computer program (Neuhauser and Kanipe 2003) was used to estimate the impacts for transportation workers and populations, as well as the impact to an MEI (for example, a person stuck in traffic, a gas station attendee, or an inspector), who may be a worker or a member of the public.

Human heath impacts could result from transportation accidents. The impact of a specific radiological accident is expressed in terms of probabilistic risk, which is defined as the accident probability (accident frequency) multiplied by the accident consequences. The overall risk is obtained by summing individual risks from all reasonably conceivable accidents. The analysis of accident risks accounts for a spectrum of accidents ranging from high-probability accidents of low severity (a fender bender) to hypothetical high-severity accidents that have a corresponding low probability of occurrence. Only as a result of a severe fire or a powerful collision, which are of extremely low probability, could a transportation package of the type used to transport radioactive material be damaged to the extent that radioactivity could be released to the environment with significant consequences.

In addition to calculating the radiological risks that would result from all reasonably conceivable accidents during transportation of radioactive wastes, NNSA assessed the consequences of maximum reasonably foreseeable accidents with a probability greater than 1×10^{-7} (1 in 10 million) per year. These latter consequences were determined for the atmospheric conditions that would likely prevail during accidents. The analysis used the RISKIND computer program to estimate doses to individuals and populations (Yuan et al. 1995).

Incident-free radiological health impacts are expressed as additional LCFs. Radiological accident health impacts are also expressed as additional LCFs, and nonradiological accident risks are expressed in terms of additional immediate (traffic) fatalities. LCFs associated with radiological exposure were estimated by multiplying the occupational (worker) and public dose by 6.0×10^{-4} LCFs per person-rem of exposure. Transportation impacts of radioactive wastes were calculated assuming that all wastes are transported by truck.

In determining the transportation risks, per-shipment risk factors were calculated for the incident-free and accident conditions using the RADTRAN 5 computer program (Neuhauser and Kanipe 2003) in conjunction with the Transportation Rating Analysis Geographic Information System (TRAGIS) computer program (Johnson and Michelhaugh 2003) to choose transportation routes in accordance with U.S. Department of Transportation regulations. The TRAGIS program provides population estimates based on the 2000 census along the routes for determining the population radiological risk factors. For incident-free operations, the affected population includes individuals living within 0.5 miles (800 meters) of each side of the road. For accident conditions, the affected population includes individuals living within 50 miles (80 kilometers) of the accident, and the MEI is assumed to be an individual located 330 feet (100 meters) directly downwind from the accident.

For determining traffic accident fatalities from offsite commercial truck transportation, separate accident rates and accident fatality risks were used for rural, suburban, and urban population zones. These accident and fatality rates were taken from data provided in *State-Level Accident Rates for Surface Freight Transportation: A Reexamination*, ANL/ESD/TM-150 (Saricks and Tompkins 1999). The values selected were the “mean” accident and fatality rates given in ANL/ESD/TM-150 for “interstate,” “primary,” and “total.” These values were assigned to rural, suburban, and urban population zones, respectively. Accident rates are generically defined as the number of accident involvements (or fatalities) in a given year per unit of travel in that same year. Therefore, the rate is a fractional value, with accident involvement count as the numerator of the fraction and vehicular activity (total travel distance in truck-kilometers) as its denominator. The accident rates for rural, suburban, and urban zones were 3.15, 3.52, and 3.66 per 10 million truck-kilometers, respectively; and the fatality rates were 0.88, 1.49, and 2.32 per 100 million truck kilometers, respectively.

For determining traffic accident fatalities from safe secure trailer (SST) transport, DOE operational experience between 1984 and 1999 was used. The mean probability of an accident requiring towing of a disabled trailer truck was about 6 per 100 million kilometers (DOE 2000g). The number of historical SST accidents is too small to support allocating this overall rate among the various types of routes (interstate, primary, others) used in the accident analysis. Therefore, data for the relative rate of accidents on these route types, or influence factor, as provided in *Determination of Influence Factor and Accident Rates for Armored Tractor/Safe Secure Trailer* (Phillips, Clauss, and Blower 1994), were used to estimate accident frequencies for rural, urban, and suburban transports. Traffic accident fatalities for the SST transports were estimated using the commercial truck transport fatality per accident ratios within each zone.

For determining traffic accident fatalities from local and regional transportation of industrial and hazardous waste, New Mexico State accident and fatality rates, which also are given in ANL/ESD/TM-150, were used. The rates used were 1.13 accidents per 10 million truck-kilometers and 1.18 fatalities per 100 million truck-kilometers. For assessment purposes, the total number of expected accidents or fatalities was calculated by multiplying the total shipment distance for a specific waste by the accident or fatality rate. Additional details on the analysis approach and on modeling and parameter selection are provided in Appendix K.

In summary, at LANL, radioactive materials (special nuclear material, low-level radioactive waste, transuranic waste, etc.) are transported both onsite (between the TAs) and offsite to multiple locations. Onsite transportation constitutes the majority of activities that are part of routine operations in support of various programs. The radioactive materials transported onsite between TAs are mainly limited quantities that are transported over short distances and mostly on closed roads. The impacts of these activities are part of the impacts of normal operations at these areas. For example, worker dose from handling and transporting radioactive materials is included as part of the worker dose from operational activities. Specific analyses performed in the *1999 SWEIS* (DOE 1999a) indicated that the projected collective radiation dose for LANL drivers from a projected 10,750 onsite shipments was 10.3 person-rem per year, or on average, less than 1 millirem per transport. A review of recent onsite radioactive materials transportation indicates a much smaller number of shipments than those projected in the *1999 SWEIS*. Therefore, the *1999 SWEIS* projection of impacts would envelop the impacts for routine onsite transportation. The impacts of nonroutine onsite transportation activities, such as waste transportation associated with facility DD&D or MDA remediation, were evaluated and are presented in this SWEIS where applicable.

Offsite transportation of radioactive materials would occur using both trucks and airfreight. Materials transported by airfreight would be similar in number, type, and forms to those considered in the *1999 SWEIS*, and hence would result in similar impacts. The aircrew dose from airfreight radioactive transportation was estimated at 2.4 person-rem per year (DOE 1999a).

Truck (both commercial and DOE SST) transportation is analyzed further in this SWEIS. The *1999 SWEIS* provides a comprehensive list of various radioactive material types, forms, origins and destinations, and quantities, as well as a projected number of shipments. The radioactive materials transported included tritium, plutonium, uranium (both depleted and enriched), offsite source recovery materials, medical isotopes, small quantities of activation products, low-level radioactive waste, and transuranic waste. The specific origins and destinations, except for Rocky Flats, are expected to be applicable to future transports. For analyses purposes in this SWEIS, the destinations were limited to those that could be significantly affected, namely offsite waste disposal sites (such as the Nevada Test Site, a commercial waste disposal site in Utah, and WIPP in New Mexico) and the DOE and NNSA sites supporting nuclear weapons production and mixed oxide fuel fabrication (such as the Pantex Plant in Texas, Oak Ridge National Laboratory and Y-12 Complex in Tennessee, Lawrence Livermore National Laboratory in California, and Savannah River Site in South Carolina). Impacts from the transportation of other radioactive materials would remain similar to those projected in the *1999 SWEIS*.

Table 5–50 provides the estimated number of material shipments under each alternative over a 10-year period. This table also provides the estimated number of shipments resulting from activities for proposed MDA remediation options such as removal or capping, and those from activities related to increasing pit production from 20 to up to 80 pits per year.

Table 5–50 10-Year Total Number of Offsite Shipments under Each Alternative and Selected Activities

Alternative (Activities)	Number of Shipments										
	Radioactive Materials									Miscellaneous	
	LSA	DD&D Bulk	LLW [a]	High Activity [b]	LLW-RH [c]	Mixed LLW	TRU [d]	SNM	PuO_2	Hazardous	Others [e]
No Action	624	812	9,217	312	0	196	1,460	958	20	946	10,778
Reduced Operations	624	812	7,883	312	0	196	1,460	958	20	932	10,778
Expanded Operations [f]	1,436-49,940	9,538	9,919	3,418-36,521	196-856	297-9,019	2,405-5,044	1,558	50	2,781-4,749	35,419-41,506
Expanded Operations (without MDA Remediation) [g]	681	9,538	9,919	3,418	196	240	2,397	1,558	50	1,000	31,856
(MDA Remediation) [h]	755-49,259	0	0	0-33,103	0-660	57-8,779	8-2,647	0	0	1,781-3,749	3,563-9,650
(Increase in Pit Production) [i]	0	0	701	0	0	6	246	600	0	0	0

LSA = low specific activity, DD&D = decontamination, decommissioning, and demolition, LLW = low-level radioactive waste, RH = remote handled, TRU = transuranic waste, SNM = special nuclear material, PuO_2 = plutonium dioxide.

[a] Low-level radioactive waste transported in drums or Type A, B-25 boxes. The values here also include shipments of evaporator bottoms from Radioactive Liquid Waste Treatment Facility to an offsite location and the returned dried wastes.

[b] High activity low-level radioactive waste containing more than 10 nanocuries per gram of transuranic waste transported in Type A, B-25 boxes. This waste is comparable to Class B or Class C of 10 CFR Part 61 waste classification. This waste is generated during MDA waste retrieval, and from decontamination and demolishing of some of the buildings. The shipments also include one shipment of strontium-90 radioisotope thermoelectric generators under all alternatives.

[c] Remote-handled low-level radioactive waste transported in 55-gallon (208-liter) drums.

[d] The sum of remote-handled and contact-handled transuranic waste shipments.

[e] Others include industrial, sanitary, and asbestos wastes.

[f] The range of values represent the estimated number of shipments for options of capping and remediation and removal and remediation of all MDAs.

[g] Expanded Operations with baseline MDA remediation (without capping or removal).

[h] The range values represent the estimated number of shipments for options of capping and removal of all MDAs.

[i] The waste shipment values presented are based on the differences between the No Action Alternative and the Expanded Operations Alternative projected waste volumes for routine operation.

Table 5–51 summarizes the total transportation impacts, as well as the transportation impacts on two nearby LANL transportation routes: LANL to Pojoaque, New Mexico, the route segment that trucks from LANL use, and Pojoaque to Santa Fe, New Mexico, the route segment that all trucks using Interstate-25 (such as trucks traveling to WIPP) use. For analysis purposes in this SWEIS, two sites, the DOE Nevada Test Site and a commercial facility in Utah, were selected as possible disposal sites for all low-level radioactive wastes should the decision be made to dispose low-level radioactive waste offsite rather than onsite. The differences in distance from LANL and the affected population along the different transportation routes between these two sites result in a range of impacts under each alternative. Transuranic waste was assumed to be disposed of at WIPP.

Table 5–51 Risks of Transporting Radioactive Materials under Each Alternative and Selected Activities

Transport Segments	Offsite Disposal Option [a]	Number of Shipments	Round Trip Kilometers Traveled (million)	Incident-Free: Crew Dose (person-rem)	Incident-Free: Crew Risk [b]	Incident-Free: Population Dose (person-rem)	Incident-Free: Population Risk [b]	Accident: Radiological Risk [b]	Accident: Nonradiological Risk [b]
No Action									
LANL to Pojoaque	NTS	13,599	0.85	5.0	0.0030	1.8	0.0011	3.9×10^{-6}	0.0093
Pojoaque to Santa Fe		13,599	1.15	8.8	0.0053	3.3	0.0020	7.1×10^{-6}	0.016
Total		13,599	31.9	163.8	0.098	58.4	0.0350	0.00017	0.30
LANL to Pojoaque	Commercial	13,599	0.85	5.0	0.0030	1.8	0.0011	3.9×10^{-6}	0.009
Pojoaque to Santa Fe		2,893 [c]	0.30	3.9	0.0023	1.9	0.0011	1.1×10^{-6}	0.003
Total		13,599	28.2	147.3	0.088	53.0	0.032	0.00014	0.26
Reduced Operations									
LANL to Pojoaque	NTS	12,265	0.76	4.6	0.0028	1.7	0.0010	3.4×10^{-6}	0.009
Pojoaque to Santa Fe		12,265	1.1	8.1	0.0049	3.1	0.0019	6.2×10^{-6}	0.015
Total		12,265	28.6	147.2	0.088	53.1	0.032	0.00015	0.27
LANL to Pojoaque	Commercial	12,265	0.76	4.63	0.0029	1.7	0.0010	3.4×10^{-6}	0.009
Pojoaque to Santa Fe		2,893 [c]	0.30	3.9	0.0023	1.9	0.0011	1.1×10^{-6}	0.0032
Total		12,265	25.3	133.1	0.08	48.5	0.029	0.00013	0.24
Expanded Operations (with MDA Removal Option)									
LANL to Pojoaque	NTS	122,439	7.6	25.9	0.016	8.1	0.0049	0.000032	0.089
Pojoaque to Santa Fe		122,439	9.7	43.5	0.026	13.3	0.0080	0.000047	0.11
Total		122,439	299.9	910.1	0.55	286.8	0.17	0.0016	2.96
LANL to Pojoaque	Commercial	122,439	7.6	25.9	0.016	8.1	0.0049	0.000032	0.089
Pojoaque to Santa Fe		44,205 [c]	3.5	30.4	0.018	9.8	0.0059	0.000024	0.040
Total		122,439	272.8	866.2	0.52	273.6	0.16	0.0014	2.66
Expanded Operations (with MDA Capping Option)									
LANL to Pojoaque	NTS	28,817	1.8	8.0	0.0048	2.8	0.0017	5.7×10^{-6}	0.021
Pojoaque to Santa Fe		28,817	2.3	13.5	0.0081	4.6	0.0028	9.8×10^{-6}	0.034
Total		28,817	69.3	255.9	0.15	89.1	0.053	0.00025	0.66
LANL to Pojoaque	Commercial	28,817	1.8	8.0	0.0048	2.8	0.0017	5.7×10^{-6}	0.021
Pojoaque to Santa Fe		7,803 [c]	0.7	7.7	0.0046	3.0	0.0018	3.1×10^{-6}	0.0085
Total		28,817	62.0	236.3	0.142	82.9	0.050	0.00022	0.58
Expanded Operations (without MDA Removal or Capping Options)									
LANL to Pojoaque	NTS	27,997	1.7	8.0	0.0048	2.8	0.0017	5.5×10^{-6}	0.020
Pojoaque to Santa Fe		27,997	2.2	13.4	0.0080	4.6	0.0028	9.6×10^{-6}	0.033
Total		27,997	67.2	254.0	0.15	88.6	0.053	0.00024	0.64
LANL to Pojoaque	Commercial	27,997	1.7	8.0	0.0048	2.8	0.0017	5.5×10^{-6}	0.020
Pojoaque to Santa Fe		7,795 [c]	0.6	7.6	0.0046	3.0	0.0018	3.1×10^{-6}	0.0065
Total		27,997	60.2	234.6	0.14	82.4	0.049	0.00021	0.57
MDA Removal Option Activities									
LANL to Pojoaque	NTS	94,448	5.9	18.0	0.011	5.3	0.0032	0.000026	0.070
Pojoaque to Santa Fe		94,448	7.5	30.1	0.018	8.7	0.0052	0.000037	0.088
Total		94,448	232.7	656.4	0.400	198.2	0.12	0.0013	2.32
LANL to Pojoaque	Commercial	94,448	5.9	18.0	0.011	5.3	0.0032	0.000026	0.070
Pojoaque to Santa Fe		36,410 [c]	2.9	22.8	0.014	6.8	0.0041	0.000021	0.034
Total		94,448	212.5	631.6	0.38	191.2	0.120	0.0012	2.10

Transport Segments	Offsite Disposal Option [a]	Number of Shipments	Round Trip Kilometers Traveled (million)	Incident-Free				Accident	
				Crew		Population			
				Dose (person-rem)	Risk [b]	Dose (person-rem)	Risk [b]	Radio-logical Risk [b]	Nonradio-logical Risk [b]
MDA Capping Option Activities									
LANL to Pojoaque	NTS	820	0.05	0.05	0.00003	0.01	0.00001	1.7×10^{-7}	0.0006
Pojoaque to Santa Fe		820	0.06	0.09	0.00005	0.02	0.00001	2.0×10^{-7}	0.0008
Total		820	2.04	1.9	0.0012	0.49	0.00029	0.00001	0.020
LANL to Pojoaque	Commercial	820	0.05	0.05	0.00003	0.01	0.00001	1.7×10^{-7}	0.00060
Pojoaque to Santa Fe		8	0.0006	0.02	0.00001	0.005	0.000003	3.9×10^{-11}	0.00001
Total		820	1.76	1.70	0.0010	0.042	0.00025	0.000008	0.017
Increase in Pit Production Activities									
LANL to Pojoaque	NTS	1,553	0.1	0.68	0.00041	0.36	0.00022	2.7×10^{-7}	0.00075
Pojoaque to Santa Fe		1,553	0.15	1.14	0.00068	0.59	0.00035	1.9×10^{-6}	0.0013
Total		1,553	3.63	18.0	0.011	8.95	0.0054	0.000011	0.024
LANL to Pojoaque	Commercial	1,553	0.1	0.68	0.00041	0.36	0.00022	2.7×10^{-7}	0.00075
Pojoaque to Santa Fe		879 [c]	0.08	0.79	0.00047	0.49	0.00029	1.4×10^{-6}	0.00043
Total		1,553	3.39	16.87	0.010	8.56	0.0051	9.6×10^{-6}	0.021

NTS = Nevada Test Site, MDA = material disposal area.

[a] Under this option, low-level radioactive waste would be shipped to either the Nevada Test Site or a commercial site in Utah. Transuranic wastes would be shipped to WIPP. Pantex, Y-12, Oak Ridge, Nevada Test site, Lawrence Livermore and the Savannah River Site would ship or receive special nuclear materials. Also note that the number of shipments along the Pojoaque to Santa Fe segment would be lower when the commercial site in Utah is used as an offsite disposal option for low-level radioactive waste.

[b] Risk is expressed in terms of latent cancer fatalities, except for the nonradiological risk, where it refers to the number of traffic accident fatalities.

[c] Shipments of low-level radioactive waste to a commercial disposal site in Utah would not pass along the Pojoaque to Santa Fe segment of highway.

Note: The values in this table are rounded in comparison to those provided in Appendix K.

The following conclusions can be drawn from the results presented in Table 5–51. The maximum total 10-year dose to the public would be 287 person-rem from all shipments under the Expanded Operations Alternative – MDA Removal Option with all low-level radioactive waste being sent to the Nevada Test Site for disposal. The expected excess LCFs among the exposed population would be less than 1 (0.17 LCF). The total dose to the public along the LANL to Pojoaque route under this option would be 8.1 person-rem, with less than 1 excess LCF (0.0049 LCF) among the exposed population. The total dose to the public along the Pojoaque to Santa Fe route would be up to 13.3 person-rem, with less than 1 excess LCF (0.008 LCF) among the exposed population. The maximum dose to the transportation crew (truck drivers) would be 910 person-rem over 10 years, with a potential of less than 1 (0.55) LCF among the exposed crew. It should be noted that DOE regulations limit the maximum annual dose to a transportation worker to 100 millirem per year unless the individual is a trained radiation worker, which would have an administrative control annual dose limit of 2 rem (DOE 1999e). The potential for a trained radiation worker to develop a fatal latent cancer from the maximum annual exposure is 0.0012. Therefore, an individual transportation worker would not be expected to develop a lifetime latent fatal cancer from exposures during these activities.

Table 5–51 also presents the risk of traffic accident fatalities for each of the alternatives. The risk of a traffic accident fatality is greater than the risk of an excess LCF for each of the alternatives. For instance, excess LCFs among the exposed population from all shipments under the Expanded Operations Alternative-MDA Removal Option with all waste being sent to the Nevada Test Site for disposal would be less than 1 (0.17 LCF), while the number of traffic accident fatalities from these shipments would be nearly 3 (2.66).

Onsite traffic patterns were reviewed with respect to traffic flowing through the main access points onto the site. Based on the average traffic flows recorded in 2004 and 2005, an estimate of the daily number of trips per employee was made, assuming that 90 percent of all trips were related to employee trips and the remaining 10 percent were related to truck trips in support of normal LANL activities, not including construction or DD&D-related activities, which were calculated separately. The alternatives were then analyzed and traffic flows were assumed to fluctuate consistent with the employment levels estimated in Section 5.8.1. For example, under the Reduced Operations Alternative, employment at LANL is projected to decline; therefore, the number of daily trips associated with LANL activities are also projected to decline. Similarly, under the Expanded Operations Alternative, LANL employment is projected to increase; consequently, traffic would likely increase as well.

As shown in **Table 5–52**, local traffic flows would likely remain at current levels under the No Action Alternative because employment levels would stay at current levels. Under the Reduced Operations Alternative, a small decline in traffic through LANL would be expected mainly because of the projected decrease in employment under this alternative. Under the Expanded Operations Alternative, traffic would likely increase substantially due to the projected increases in employment and construction and remediation activities. This would be particularly true for Pajarito Road as remediation activities start on MDA G. The Expanded Operations Alternative – MDA Removal Option would have a larger traffic increase relative to the MDA – Capping Option due to the more numerous truck trips associated with MDA remediation and the greater number of remediation workers needed to implement this option.

Table 5–52 Summary of Changes in Annual Traffic Flow at the Entrances to Los Alamos National Laboratory

Alternative	*Average Daily Vehicle Trips*				
	Diamond Drive Across Los Alamos Canyon	*Pajarito Road at NM 4*	*East Jemez Road at NM 4*	*West Jemez Road at NM 4*	*DP Road at Trinity Drive*
No Action	24,545	4,984	9,502	2,010	1,255
Reduced Operations - Estimated Daily Trips - Percent Change from No Action (%)	 23,600 -4	 4,800 -4	 9,100 -4	 1,900 -5	 1,200 -4
Expanded Operations – MDA Removal Option – Estimated Daily Trips - Percent Change from No Action (%)	26,000 +6	9,200 +85	10,700 +13	2,200 +9	1,700 +35

MDA = material disposal area.

5.10.1 No Action Alternative

Los Alamos National Laboratory Site-Wide Impacts

Under this alternative, about 13,600 offsite shipments of radioactive materials would be made between 2007 and 2016 to the Nevada Test Site (or a commercial site in Utah), WIPP, and the

NNSA sites supporting nuclear weapons. Maximum transportation impacts would be realized if low-level radioactive waste were shipped to either the Nevada Test Site or a commercial site in Utah instead of being disposed of onsite. Transuranic waste would be shipped to WIPP, and special nuclear material would be shipped mainly between LANL and Pantex. The total projected (one-way) distance traveled on public roads transporting radioactive materials to various locations would range from about 8.5 million to 10 million miles (13.75 million to 16 million kilometers).

Impacts of Incident-free Transportation

The dose to the transportation crew from all offsite transportation activities under this alternative was estimated to range from about 147 person-rem for disposal at the commercial low-level radioactive waste disposal site in Utah to about 164 person-rem for disposal at the Nevada Test Site. The dose to the general population would range from 53 to 58 person-rem for the commercial site in Utah and the Nevada Test Site options, respectively. Accordingly, incident-free transportation would result in a maximum of 0.098 excess LCFs among the transportation workers and 0.035 excess LCFs in the affected population. The estimated dose associated with disposal of low-level radioactive waste at the Nevada Test Site is higher because of the longer distance traveled and larger affected population. The differences in estimated doses under either option are very small, however, as shown above.

It should be noted that DOE regulations limit the maximum annual dose to a transportation worker to 100 millirem per year unless the individual is a trained radiation worker. Trained radiation workers have an administrative control dose level of 2 rem per year (DOE 1999e). The potential for a trained radiation worker to develop a fatal latent cancer from an annual dose at the maximum annual exposure is 0.0012. Therefore, an individual transportation worker would not be expected to develop a lifetime fatal latent cancer from exposure during these activities.

The doses to the general populations along the routes from LANL to Pojoaque and from Pojoaque to Santa Fe were estimated to be a maximum of 1.8 and 3.3 person-rem, respectively. These doses would result in 0 (0.0011 and 0.0020) excess LCFs among the exposed populations.

Impacts of Accidents during Transportation

As stated earlier, two sets of analyses were performed for the evaluation of transportation accident impacts: impacts of maximum reasonably foreseeable accidents (accidents with probabilities greater than 1 in 10 million per year [1×10^{-7}]) and impacts of all conceivable accidents (total transportation accidents).

For radioactive materials transported under this alternative, the maximum reasonably foreseeable offsite truck transportation accident with the greatest consequence would involve a truck carrying contact-handled transuranic waste. The probability of such an accident occurring would be about 1 in 5.3 million (1.9×10^{-7}) per year in an urban area. If such an accident were to occur, the consequences in terms of general population dose would be 310 person-rem. Such an exposure could result in 0.19 excess LCFs among the exposed population. This accident, if it occurred, would result in a dose of 6.2 millirem to a hypothetical MEI located at a distance of 330 feet (100 meters) and exposed to the accident plume for 2 hours, with a corresponding risk of developing a latent fatal cancer of about 1 in 270,000 (3.7×10^{-6}).

Under the No Action Alternative, estimates of the total offsite transportation accident risks for all projected accidents involving radioactive shipments, regardless of type, are a maximum radiological dose-risk[5] to the general population of 0.28 person-rem, resulting in 0.00017 LCFs, and a maximum nonradiological accident risk of 0 (0.30) fatalities.

The maximum radiological transportation accident dose-risk to the general populations along the LANL to Pojoaque and the Pojoaque to Santa Fe routes would be 0.0065 and 0.012 person-rem, respectively. These doses would result in 0 (3.9×10^{-6} and 7.1×10^{-6}) excess LCFs among the exposed populations. The maximum expected traffic accident fatalities along these routes would be 0 (0.0093 and 0.016, respectively).

Impacts of Construction, Operations, and Hazardous Material Transportation

The impacts of transporting various nonradiological materials were evaluated. These impacts are presented in terms of distance traveled and numbers of expected traffic accidents and fatalities. The transportation impacts under this alternative would be, for 3.4 million miles (5.5 million kilometers) traveled, 1 (0.62) traffic accident and 0 (0.07) fatalities.

Local Traffic

Under the No Action Alternative, the impacts of LANL activities on local traffic flow and roadway infrastructure would be approximately the same as current conditions, as described in Chapter 4, Section 4.10.1. Efforts being undertaken to enhance site security, such as the Security Perimeter Project, would be implemented as planned. These modifications would alter traffic patterns in and around LANL, but would likely have only minor impacts on traffic flow during normal security conditions. In the case of heightened security, traffic entering the site would be delayed as vehicles were subjected to greater scrutiny.

Management of construction fill could result in up to 15,000 round trips on LANL roads from LANL construction sites to borrow areas for storage or to sites using construction fill. This traffic could be mitigated by scheduling trips during off-peak hours, as appropriate.

5.10.2 Reduced Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Under this alternative, about 12,270 offsite shipments of radioactive materials would be made to the Nevada Test Site (or a commercial disposal site in Utah), WIPP, and the NNSA sites supporting nuclear weapons production between 2007 and 2016. Similar to the No Action Alternative, the maximum transportation impacts would result from shipments of low-level radioactive waste to either the Nevada Test Site or a commercial disposal site in Utah, transuranic waste to WIPP, and special nuclear material between LANL and Pantex. The total projected (one-way) distance traveled on public roads while transporting radioactive materials to

---

[5] Dose-risk includes the probability of an accident occurring. Here, these values are calculated by dividing the radiological risks in terms of LCFs given in Table 5–51 (column 9) by 0.0006, which is a risk of an LCF per person-rem of exposure.

various locations would range from 7.6 million to 8.9 million miles (12.3 million to 14.3 million kilometers).

Impacts of Incident-free Transportation

The dose to transportation workers from all offsite transportation activities under this alternative has been estimated to range from about 133 person-rem for the Utah commercial low-level radioactive waste disposal option to 147 person-rem for the Nevada Test Site disposal option. The dose to the general population would range from 49 to 53 person-rem for each option, respectively. Accordingly, incident-free transportation would result in a maximum of 0.088 excess LCFs among transportation workers and 0.032 excess LCFs in the affected population for the Nevada Test Site low-level radioactive waste disposal option because of the longer distance traveled and larger affected population.

The impact of this alternative on individual transportation workers would be the same as the impact discussed under the No Action Alternative. An individual transportation worker would not be expected to develop a lifetime latent fatal cancer from exposure during these activities.

The doses to the general populations along the routes from LANL to Pojoaque and from Pojoaque to Santa Fe under this alternative were estimated to be a maximum of 1.7 and 3.1 person-rem, respectively. These doses would respectively result in 0.0011 and 0.0019 excess LCFs among the exposed populations.

Impacts of Accidents during Transportation

Similar to the estimate forecast for No Action Alternative, for radioactive materials transported under this alternative, the maximum reasonably foreseeable offsite truck transportation accident with the highest consequence would involve a truck carrying contact-handled transuranic waste. The probability of such an accident occurring would be 1 in 5.3 million (1.9×10^{-7}) per year in an urban area. Should such an accident occur, the consequences would be similar to those projected for the No Action Alternative.

Under the Reduced Operations Alternative, the estimated maximum radiological dose-risk to the general population for all projected accidents involving radioactive shipments, regardless of type, would be about 0.25 person-rem, resulting in 0.00015 LCFs and a maximum nonradiological accident risk of 0 (0.27) fatalities.

The maximum radiological transportation accident dose-risk to the general populations along the LANL to Pojoaque and the Pojoaque to Santa Fe routes would be 0.0057 and 0.010 person-rem, respectively. These doses would result in 0 (3.4×10^{-6} and 6.2×10^{-6}) excess LCFs among the exposed populations. The maximum expected traffic accident fatalities along these routes would be 0 (0.009) and 0 (0.015), respectively.

Impacts of Construction, Operations, and Hazardous Material Transports

The impacts of transporting various nonradiological materials were evaluated. These impacts are presented in terms of distance traveled and numbers of expected traffic accidents and fatalities.

The transportation impacts under this alternative would be 1 (0.62) traffic accident and 0 (0.07) fatalities, for 3.4 million miles (5.5 million kilometers) traveled.

Local Traffic

Under the Reduced Operations Alternative, the impacts of LANL activities on local traffic flow and roadway infrastructure would be somewhat smaller than those expected under the No Action Alternative. The relatively small reduction in the number of employees associated with the reduction in high explosives processing and testing, cessation of TA-18 activities, and shutdown of LANSCE (see Section 5.8.1.2) would likely result in small decreases in local traffic flow and the impacts of site activities on local roadway infrastructure, as shown in **Table 5–53**.

Table 5–53 Estimated Changes in Traffic at the Entrances to Los Alamos National Laboratory under the Reduced Operations Alternative

Activity	*Average Daily Vehicle Trips*				
	Diamond Drive Across Los Alamos Canyon	***Pajarito Road at NM 4***	***East Jemez Road at NM 4***	***West Jemez Road at NM 4***	***DP Road at Trinity Drive***
No Action Alternative	24,545	4,984	9,502	2,010	1,255
Estimated Daily Vehicle Trips under Reduced Operations Alternative	23,600	4,800	9,100	1,900	1,200
Percent Change from Baseline	-4	-4	-4	-5	-4

5.10.3 Expanded Operations Alternative

The discussions in this section focus on the doses and risk impacts from activities under the Expanded Operations Alternative with the MDA Capping and Removal Options. For each receptor (transportation workers or population) a range of impacts is provided reflecting those activities associated with the MDA Capping and MDA Removal Options. Table 5–52 also provides similar information for the Expanded Operations Alternative without the MDA Capping or Removal Options; and those resulting from activities associated with the MDA Removal Option, the MDA Capping option, and increasing pit production from 20 to 80 pits per year.

Los Alamos National Laboratory Site-Wide Impacts

Under this alternative, under the MDA Capping and Removal Options respectively, approximately 28,820 to 122,440 offsite shipments of radioactive materials would be made between 2007 and 2016 to the Nevada Test Site (or a commercial disposal site in Utah), WIPP, and the NNSA sites supporting nuclear weapons production and mixed oxide fuel fabrication. Maximum transportation impacts would be realized if low-level radioactive waste were shipped to either the Nevada Test Site or a commercial site in Utah instead of being disposed of onsite. Transuranic waste would be shipped to WIPP, and special nuclear material would be shipped mainly between LANL and Pantex or Savannah River. The total projected (one-way) distance traveled on public roads while transporting radioactive materials to various locations would range from 18.9 million to 21.6 million miles (30.3 million to 34.7 million kilometers) under the MDA Capping Option, and 84.3 million to 93.2 million miles (135.6 million to 155 million kilometers) under the MDA Removal Option.

Impacts of Incident-free Transportation

The dose to transportation workers from all offsite transportation activities under this alternative would range from 223 to 770 person-rem for low-level radioactive waste disposal at a commercial facility in Utah, and from 256 to 910 person-rem for disposal at the Nevada Test Site for the MDA Capping and Removal Option. The corresponding dose to the general population would range from 82 to 274 person-rem for disposal at a commercial facility and from 89 to 287 person-rem for disposal at the Nevada Test Site. The doses for options involving disposal of low-level radioactive waste at the Nevada Test Site are larger because of the longer distances traveled and larger affected population. Accordingly, incident-free transportation would result in a maximum of 0.15 excess LCFs among transportation workers and 0.053 excess LCFs in the affected population for the MDA Capping Option, and a maximum of 0.55 LCFs among transportation workers and 0.17 excess LCFs in the affected population for the MDA Removal Option.

The impact of this alternative on individual transportation workers would be the same as the impact discussed under the No Action Alternative. An individual transportation worker would not be expected to develop a lifetime latent fatal cancer from exposure during these activities.

Under the MDA Capping Option, doses to the general populations along the LANL to Pojoaque and the Pojoaque to Santa Fe routes were estimated to be a maximum of 2.8 and 4.6 person-rem, respectively. These doses would result in 0 (0.0017 and 0.0028) excess LCFs among the exposed populations. Under the MDA Removal Option, doses to the general populations along the LANL to Pojoaque and the Pojoaque to Santa Fe routes were estimated to be a maximum of 8.1 and 13.3 person-rem, respectively. These doses would result in 0 (0.0049 and 0.0080) excess LCFs among the exposed populations.

Impacts of Accidents during Transportation

Similar to the projection under the No Action Alternative, for radioactive materials transported under this alternative, the maximum reasonably foreseeable offsite truck transportation accident with the highest consequence would involve a truck carrying contact-handled transuranic waste. The probability of such an accident occurring would be about 1 in 3.7 million (2.7×10^{-7}) per year in an urban area under the MDA Capping Option and 1 in 1.9 million (5.2×10^{-7}) per year in an urban area under the MDA Removal Option. If this accident occurred, the consequences would be similar to those projected for the No Action Alternative.

The estimated maximum radiological dose-risk to the general population for all projected accidents involving radioactive shipments, regardless of type, would be 0.42 person-rem, resulting in 0.00025 LCFs and a maximum nonradiological accident risk of 1 (0.66) fatality under the MDA Capping Option. Under the MDA Removal Option, the estimated maximum radiological dose-risk to the general population for all projected accidents involving radioactive shipments, regardless of type, would be 2.7 person-rem, resulting in 0.0016 LCFs, and a maximum nonradiological accident risk of 3 (2.96) fatalities.

The maximum radiological transportation accident dose-risk to the general populations along the LANL to Pojoaque and the Pojoaque to Santa Fe routes would be about 0.0095 and 0.016 person-rem under the MDA Capping Option, and about 0.053 and 0.078 person-rem under the MDA Removal Option. These doses would result in excess LCFs among the exposed populations of 0 under either MDA remediation option (5.7×10^{-6} and 9.8×10^{-6} for the MDA Capping Option and 3.2×10^{-5} and 4.7×10^{-5} for the MDA Removal Option). The maximum expected traffic fatalities along these routes would be 0 (0.021 and 0.026, respectively) under the MDA Capping Option. Under the MDA Removal Option, the maximum expected traffic accident fatalities along these routes also would be 0 (0.089 and 0.11, respectively).

Impacts of Construction, Operations, and Hazardous Material Transports

The impacts of transporting various nonradiological materials were also evaluated. These impacts are presented in terms of distance traveled and numbers of expected traffic accidents and fatalities. The transportation impacts under this alternative for the MDA Capping Option would be, for 15.2 million miles (24.5 million kilometers) traveled, 3 (2.8) traffic accidents and 0 (0.29) fatalities. For the MDA Removal Option, the nonradiological transportation impacts would be, for 17.4 million miles (28.1 million kilometers) traveled, 3 (3.2) traffic accidents and 0 (0.33) fatalities.

Local Traffic

Under the Expanded Operations Alternative, the impacts of LANL activities on local traffic flow and roadway infrastructure could be substantial without changes to current conditions. The potential addition of thousands of new employees combined with an increased number of trucks traveling to and from the site associated with increased construction, DD&D, and MDA remediation activities could impact local transportation. As shown in **Table 5–54**, a number of intersections could see large increases in daily traffic flow.

Table 5–54 Estimated Changes in Traffic at the Entrances to Los Alamos National Laboratory under the Expanded Operations Alternative

Activity	*Average Daily Vehicle Trips*				
	Diamond Drive Across Los Alamos Canyon	*Pajarito Road at NM 4*	*East Jemez Road at NM 4*	*West Jemez Road at NM 4*	*DP Road at Trinity Drive*
No Action Alternative	24,545	4,984	9,502	2,010	1,255
Estimated Daily Vehicle Trips under Expanded Operations Alternative	26,000	9,200	10,700	2,200	1,700
Percent Change from Baseline	+6	+85	+13	+9	+35

Areas of concern include increased truck traffic along East Jemez Road at NM 4 if it continues to be the route for trucks traveling to LANL or from the Los Alamos townsite. With the number of construction projects and MDA remediation efforts occurring along Pajarito Road that are expected to be underway in TA-18, TA-54, TA-55 and TA-3 under this alternative, it may be necessary to consider an alternate truck entry point for trucks working on these projects along Pajarito Road at NM 4 to alleviate some of the truck traffic on East Jemez.

Under the proposal to construct a new warehouse on East Jemez Road, a traffic study concluded that the level of service on East Jemez would lead to a breakdown in traffic flow during the afternoon rush hour without changes to the current road (LSC 2005). The study concluded that left turn lanes would be needed, as well as acceleration lanes for east- and west-bound traffic on

East Jemez Road (see Appendix G.9). These concerns would likely be further exacerbated by increased remediation activities under the Expanded Operations Alternative. For example, there would be a substantial increase in truck traffic into and out of the TA-61 borrow pit under the MDA Capping Option. Under this option, an average of about 60 truckloads of fill could be transported daily out of this borrow pit over a 10-year period. Trucks coming in and out of the pit would likely delay traffic flow on East Jemez Road and add to the noise level around this area.

The intersection of Trinity Drive and DP Road is already an area of concern. As discussed in Chapter 4, Section 4.10.2, the New Mexico Department of Transportation is planning improvements to this intersection that would improve the ability of trucks to leave DP Road and turn onto Trinity Drive. Expected increases in traffic during the period that TA-21 is undergoing DD&D and MDAs A, B, T, and U are being remediated would increase the need for these improvements. The concerns about additional trucks entering and leaving DP Road and the affect of increased truck traffic on the local road infrastructure may result in the need for another entry point to TA-21 during periods of heavy activity.

Large increases beyond those discussed under the No Action Alternative also are expected on Pajarito Road; however, usage of this road is much lower than that of other main access points into and out of LANL. Further traffic studies may be needed to determine whether any changes would be required if all of the planned projects progressed on the current schedules set under the Expanded Operations Alternative. Pajarito Road would experience the largest increase in traffic once remediation efforts start at MDA G. It may be necessary to regulate traffic flow at its intersection with NM 4 during peak travel hours under this alternative.

Furthermore, although some of the traffic on Pajarito Road is associated with staff that work in technical areas along Pajarito Road, other traffic is through traffic – for instance, people traveling from White Rock to TA-3 or the Los Alamos townsite. Implementation of the proposed Security-Driven Transportation Modifications to the Pajarito Corridor would occasionally restrict private vehicles from this section of Pajarito Road, and result in increased traffic on other local roads such as the Truck Route (NM 501) and NM 502. Additional traffic information would be needed to fully assess the impacts that the Security Driven Transportation Modification would have on local traffic.

5.11 Environmental Justice

The environmental justice analysis assesses the potential for disproportionately high and adverse human health or environmental effects on minority and low-income populations that could result from normal operations resulting from implementing the alternatives considered in this SWEIS. In assessing the impacts, the following definitions of minority individuals and populations and low-income population were used:

- *Minority individuals:* Individuals who identify themselves as members of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African-American, Native Hawaiian or Other Pacific Islander, or two or more races (meaning individuals who identified themselves on the census form as being a member of two or more races, such as both Hispanic and Asian).

- *Minority populations*: Minority populations are identified where either: (1) the minority population of the affected area exceeds 50 percent, or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

- *Low-income population*: Low-income populations in an affected area are identified using the annual statistical poverty thresholds from the Census Bureau's Current Population Reports, Series PB60, on Income and Poverty.

Consistent with the impact analysis for the public and occupational health and safety, the affected populations are defined as those minority and low-income populations that reside within a 50-mile (80-kilometer) radius centered on the LANL LANSCE Facilities at TA-53 and the High Explosives Testing Sites at TA-36 (see **Table 5–55**). A 50-mile (80-kilometer) radius was chosen because impacts are not typically significant beyond 50 miles (80 kilometers). If it is determined that impacts could be significant beyond a 50-mile (80-kilometer) radius, additional analysis would be performed. In the case of this LANL SWEIS, it was determined that impacts beyond a 50-mile (80-kilometer) radius were not expected to be significant. For example, projected radiation doses drop dramatically with increasing distance from the source. For LANL, the highest projected dose to the public would be to persons residing north-northeast of LANSCE as discussed in Section 5.6.1. Under this scenario, individuals residing 0.5 miles (0.8 kilometers) from LANSCE would receive a dose of approximately 7.5 millirem annually while those residing 50 miles (80 kilometers) away in the same direction would receive a dose of 0.035 millirem annually. For additional information on the analysis of impacts beyond a 50-mile (80-kilometer) radius see Appendix C, Section C.1.3.3.

Table 5–55 Potentially Affected Populations

Source Location	*Total Population*	*Total Minority Population*	*Hispanic Population*	*American Indian Population*	*Low-Income Population*
TA-53	283,766	155,261	127,641	17,811	35,826
TA-36	375,495	185,474	151,110	21,263	39,206

Based on the analysis of impacts for other resource areas, NNSA expects no high and adverse impacts from the continued operation of LANL under any of the alternatives. NNSA also analyzed the potential risk due to radiological exposure through the consumption patterns of special pathways receptors, including subsistence consumption of native vegetation (pinyon nuts and Indian Tea [Cota]), locally grown produce and farm products, groundwater, surface water, fish (game and nongame), game animals, other foodstuffs, and incidental consumption of soils and sediments (on produce, in surface water, and ingestion of inhaled dust); absorption of contaminants in sediments through the skin; and inhalation of plant materials. The special pathways receptors analysis is important to the environmental justice analysis because this consumption pattern may reflect the traditional or cultural practices of members of minority populations in the area. See Section 5.6.1.1 and Appendix C, Section C.1.4 for more information on special pathways receptors.

Subsistence Consumption of Fish and Wildlife

Section 4–4 of Executive Order 12898 directs Federal agencies "whenever practical and appropriate, to collect and analyze information on the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence and that Federal governments communicate to the public the risks of these consumption patterns." In the *1999 SWEIS*, DOE considered whether there were any means for minority or low-income populations to be disproportionately affected by examining impacts to American Indian, Hispanic, and other traditional lifestyle special pathway receptors. Consideration of special pathways took into account the levels of contaminants in native vegetation (pinyon nuts and Indian Tea [Cota]), locally grown produce and farm products, groundwater, surface water, fish (game and nongame), game animals (including organ meats), and soils and sediments on or near LANL (DOE 1999a).

Based on recent monitoring results, concentrations of contaminants in native vegetation, produce, surface water, fish, game animals, other foodstuffs, soils and sediments in areas surrounding LANL have been quite low (at or near the threshold of detection) and seldom above background levels (see Appendix C, Section C.1.4). For a person whose diet and lifestyle reflect all of the special pathways considered, his or her annual dose would be expected to increase by between 4.5 millirem (0.0045 rem) and 10.7 millirem (0.0107 rem) annually. Using a risk estimator value of 0.0006 lifetime probability of fatal cancer per person-rem, an increased dose of between 4.5 millirem (0.0045 rem) and 10.7 millirem (0.0107 rem) per year would equate to an increased annual risk of developing a fatal cancer of between 1 in 370,000 (2.7×10^{-6}) and 1 in 156,000 (6.4×10^{-6}). By comparison, the average resident of New Mexico receives a dose of approximately 400 millirem (0.4 rem) per year from background sources. Therefore, for those individuals participating in all of the special pathways, their average annual dose and risk of developing a fatal cancer would increase by approximately 1.1 to 2.7 percent due to these special pathways.

Ingestion pathway calculations focused on concentrations of radionuclides in environmental media from natural background sources, weapons testing fallout, and previous radiological releases from LANL, as reported in LANL environmental surveillance reports for 2001 through 2004. The actual contribution from recent operations at LANL is only a small fraction of this value. The overall risk to the special pathway receptor would not differ among the alternatives considered in this new SWEIS because most of the risk would be attributed to the existing low levels of radiological contamination in water and soils in the area around LANL. Consequently, no disproportionately high and adverse human health impacts would be expected in special pathway receptor populations in the region as a result of subsistence consumption of fish and wildlife.

5.11.1 No Action Alternative

Los Alamos National Laboratory Site-Wide Impacts

There would be no disproportionately high and adverse environmental impacts on minority and low-income populations due to construction activities at LANL under the No Action Alternative. This conclusion is a result of investigations in this SWEIS that determined there were no significant impacts on human health, ecological, cultural, paleontological, socioeconomic, and other resource areas described in other subsections of this chapter.

Under the No Action Alternative, all current nuclear production operations would be conducted in existing or replacement facilities at LANL and no new nuclear operations would be conducted. As discussed in Sections 5.6.1 and 5.6.2, radiological and hazardous chemical risks to the public resulting from normal operations would be small and are not considered significant. In summary, implementation of the No Action Alternative would pose no disproportionately high and adverse health and safety risks to low-income or minority populations living in the potentially affected area surrounding LANL.

As shown in Table 5–18, the total population within 50 miles (80 kilometers) of LANL for the No Action Alternative is projected to receive an annual dose of about 30 person-rem. Because the majority of this dose results from operations at LANSCE, the environmental justice analysis for this alternative uses the 50-mile (80-kilometer) population centered on LANSCE in TA-53. As shown in **Table 5–56**, the dose from LANSCE along with the dose associated with High-Explosive Testing firing site operations ascribed to TA-36 would result in an annual dose of approximately 29.2 person-rem to the affected population and an average annual individual dose of 0.10 millirem. These two locations account for approximately 97 percent of the total estimated dose from all sites at LANL under the No Action Alternative.

Table 5–56 Comparison of Total Minority, Hispanic, American Indian and Low-Income Population and Average Individual Doses Under the No Action Alternative [a]

	Annual Dose in Person-rem	*Annual Dose in Millirem*
Total Population [b]	29.2	
Average Individual		0.10
White (non-Hispanic) Population	15.0	
Non-Minority Average Individual		0.11
Total Minority Population	14.1	
Minority Average Individual		0.088
Hispanic Population [c]	11.3	
Hispanic Average Individual		0.086
American Indian Population [d]	1.8	
American Indian Average Individual		0.092
Non-Low-Income Population	25.9	
Non-Low-Income Average Individual		0.10
Low-Income Population	3.0	
Low-Income Average Individual		0.082

[a] The total population dose displayed in this table, accounts for the estimated dose from LANSCE at TA-53 and the High-Explosive Testing firing site operations at TA-36 for the No Action Alternative.

[b] The total population dose for this environmental justice analysis differs by 3 percent from that in Table 5–18. This difference is due to different models used to estimate the populations; both estimates are based on data drawn from the 2000 decennial census. The SECPOP computer program used for the analysis for Table 5–18 does not allow for the identification of minority and low-income populations. Therefore an alternate method that uses a more refined distribution of the population is used for this analysis. The minor differences do not affect the conclusions supported by the analyses.

[c] The Hispanic population includes all Hispanic persons regardless of race.

[d] The American Indian population may include persons who also indicated that they were of Hispanic ethnicity in the 2000 census.

Similar population doses are estimated for the following populations: white (non-Hispanic), all (total) minorities, American Indians, and Hispanic of any race. The white (non-Hispanic) population would be expected to receive the largest annual collective dose (15 person-rem) and annual average individual dose (0.11 millirem). This compares to a total minority annual collective dose of 14.1 person-rem and an average annual dose of 0.088 millirem to a member of the minority population. American Indians living within 50 miles (80 kilometers) of LANL would receive a collective dose of 1.8 person-rem annually and an average annual individual dose of 0.092 millirem. The Hispanic population would receive a collective dose of 11.3 person-rem annually; the annual average dose to a member of the Hispanic population would be 0.086 millirem.

Population doses to persons living below the poverty level are also analyzed in Table 5–56. Low-income populations surrounding LANL would receive an annual dose of 3.0 person-rem and an annual average individual dose of 0.082 millirem. Persons living above the poverty level would receive an annual collective dose of 25.9 person-rem and an annual average individual dose of 0.10 millirem. These data show that the total minority, American Indian, Hispanic, and low-income populations would not be subjected to disproportionately high and adverse dose impacts from normal operations at LANL under the No Action Alternative.

As shown in Table 5–17, the MEI for the No Action Alternative is projected to receive a dose of 7.8 millirem (0.0078 rem). As explained in Chapter 4, Section 4.6.1.2, the offsite MEI is a hypothetical member of the public who would receive the largest dose from LANL operations. For this SWEIS, that person would be located at LANL's East Gate along NM 502. Since no one actually resides at this location, the MEI dose is considered a conservative estimate with all members of the public expected to receive a dose that would be smaller than the estimated MEI dose. Therefore, doses to members of minority or low-income populations would not be considered significant because the dose to the MEI under this Alternative is not considered significant. As discussed earlier in Section 5.11, the average resident of New Mexico receives a dose of approximately 400 millirem (0.4 rem) per year from background sources. Therefore, for any individual under the No Action Alternative, his or her average annual dose and risk of developing a fatal cancer from the dose received would be expected to increase by a maximum of approximately 2.0 percent as a result of LANL operations.

As discussed in Section 5.6.2.1, the maximum public risk of developing a cancer as a result of chemical releases under the No Action Alternative would be below the guideline value of 1 in a million (1.0×10^{-6}) for the major carcinogenic pollutants that could be released from LANL under normal operations. In other words, one person in a population of a million would develop cancer if this population were exposed to this concentration over a lifetime, a level of concern established in the Clean Air Act. Therefore, the impact of potential chemical releases on minority or low-income individuals under this alternative would not be considered significant.

For nonradiological air quality impacts, as shown in Table 5–8, the concentrations of criteria pollutants as a result of LANL operations under the No Action Alternative would remain well below the ambient standards established to protect human health. Therefore, the impact of potential nonradiological air pollutant releases on minority or low-income individuals under this alternative would not be considered significant.

As shown in Table 5–62, the accident with the highest risk to the offsite MEI is a lightning strike at the Radioassay and Nondestructive Testing Facility in TA-54 that leads to a catastrophic fire. This accident represents the highest risk to an offsite MEI for all alternatives under consideration including the No Action Alternative. Under this accident scenario, the risk to the MEI of developing a fatal cancer as a result of radiation exposure from this accident is conservatively estimated to be 1 chance in 17 per year (0.06). For this accident, the MEI would be at the site boundary on the San Ildefonso Pueblo; however, the likelihood of an individual being at this location at the time of the accident would be highly unlikely since no one resides in the area adjacent to LANL. The accident with the highest risk to the offsite public for all alternatives under consideration, shown in Table 5–78, is a wildfire that would consume the waste storage domes in TA-54. Under this accident, the risk to the public is estimated to be 3 (2.7) latent cancer fatalities in the general public. Given the proximity of the more heavily populated areas of Los Alamos and White Rock to TA-54, these areas would be the most heavily impacted in the event of such an accident. Since neither of these is a minority or low-income community, this accident would not have a disproportionate high and adverse impact on low income or minority populations. For more information on the demographics of Los Alamos County, see Chapter 4, Section 4.8.1.2.

Key Facilities Impacts

Routine normal operations at Key Facilities would not be expected to cause fatalities or illness among the general population, including minority and low-income populations living within the potentially affected area.

The annual radiological risks to the offsite population that could result from the maximum potential accident at a Key Facility is estimated to be smaller than 0.76 LCFs (see Table 5–62). Thus, the risk of an excess LCF in the entire offsite population would be less than 1 under the No Action Alternative.

5.11.2 Reduced Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Implementation of the Reduced Operations Alternative would pose no disproportionately high and adverse health and safety risks to low-income or minority populations living in the potentially affected area surrounding LANL. Under the Reduced Operations Alternative, the risks of disproportionately high and adverse environmental impacts on minority and low-income populations in the vicinity of LANL would be no higher than those described under the No Action Alternative; in some cases, they would be lower.

As shown in Table 5–18, the total population within 50 miles (80 kilometers) of LANL for the Reduced Operations Alternative is projected to receive an annual dose of about 6.4 person-rem. Because the majority of this dose results from operations at the High Explosive Testing firing sites in TA-36, the environmental justice analysis for this alternative uses the 50-mile (80-kilometer) population centered on TA-36. As shown in **Table 5–57**, the dose from High Explosive Testing would result in an annual dose of approximately 4.9 person-rem to the affected population and an average annual individual dose of 0.013 millirem. The High Explosive

Testing firing site operations account for approximately 77 percent of the total estimated dose from all sites at LANL under the Reduced Operations Alternative.

Table 5–57 Comparison of Total Minority, Hispanic, American Indian and Low-Income Population and Average Individual Doses Under the Reduced Operations Alternative [a]

	Annual Dose in Person-rem	*Annual Dose in Millirem*
Total Population [b]	4.9	
Average Individual		0.013
White (non-Hispanic) Population	2.7	
Non-Minority Average Individual		0.014
Total Minority Population	2.2	
Minority Average Individual		0.012
Hispanic Population [c]	1.9	
Hispanic Average Individual		0.012
American Indian Population [d]	0.20	
American Indian Average Individual		0.0094
Non-Low-Income Population	4.4	
Non-Low-Income Average Individual		0.013
Low-Income Population	0.44	
Low-Income Average Individual		0.011

[a] The collective population dose displayed in this table, accounts for the estimated dose from the High Explosive Testing firing site operations at TA-36 for the Reduced Operations Alternative.
[b] The collective population doses for this environmental justice analysis differs by 6 percent from that in Table 5–18. This difference is due to different models used to estimate the populations; both estimates are based on data drawn from the 2000 decennial census. The SECPOP computer program used for the analysis for Table 5–18 does not allow for the identification of minority and low-income populations. Therefore an alternate method that uses a more refined distribution of the population is used for this analysis. The minor differences do not affect the conclusions supported by the analyses.
[c] The total Hispanic population includes all Hispanic persons regardless of race.
[d] The American Indian population may include persons who also indicated that they were of Hispanic ethnicity in the 2000 census.

The white (non-Hispanic) population would be expected to receive the largest annual collective dose (2.7 person-rem) and annual average individual dose (0.014 millirem). This compares to a total minority annual collective dose of 2.2 person-rem and an average annual dose of 0.012 millirem to a member of the minority population. American Indians living within 50 miles (80 kilometers) of LANL would receive a collective dose of 0.20 person-rem annually and an annual average individual dose of 0.0094 millirem. The Hispanic population would receive a collective dose of 1.9 person-rem annually; the annual average dose to a member of the Hispanic population would be 0.012 millirem.

Population doses to persons living below the poverty level are also presented in Table 5–57. Low-income populations surrounding LANL would receive an annual dose of 0.44 person-rem and an average annual individual dose of 0.011 millirem. Persons living above the poverty level would receive an annual collective dose of 4.4 person-rem and an average annual individual dose of 0.013 millirem. These data show that the total minority, American Indian, Hispanic, and low-income populations would not be subjected to disproportionately high and adverse dose impacts from normal operations at LANL under the Reduced Operations Alternative.

As shown in Table 5–17, the MEI for the Reduced Operations Alternative is projected to receive a dose of 0.79 millirem (0.00079 rem), about 10 times smaller than the dose projected for the

MEI under the No Action Alternative. As discussed in Section 5.11.1, doses to members of minority or low-income populations would not be considered significant because the dose to the MEI under the No Action Alternative is not considered significant and this remains true for the Reduced Operations Alternative. As discussed earlier in Section 5.11, the average resident of New Mexico receives a dose of approximately 400 millirem (0.4 rem) per year from background sources. Therefore, for the MEI under the Reduced Operations Alternative, his or her average annual dose and risk of developing a fatal cancer from the dose received would be expected to increase by a maximum of approximately 0.2 percent as a result of LANL operations.

As discussed in Section 5.6.2.2, the maximum public risk of developing a cancer as a result of chemical releases under the Reduced Operations Alternative would be approximately the same as those cited for the No Action Alternative and below the guideline value of 1 in a million (6.4×10^{-6}) for the major carcinogenic pollutants that could be released from LANL under normal operations. In other words, one person in a population of a million would develop cancer if this population were exposed to this concentration over a lifetime, a level of concern established in the Clean Air Act. Therefore, the impact of potential chemical releases on minority or low-income individuals under this alternative would not be considered significant.

For nonradiological air quality impacts, as discussed in Section 5.4.1.2, the concentrations of criteria pollutants as a result of LANL operations under the Reduced Operations Alternative would likely be smaller than those expected under the No Action Alternative and would remain well below the ambient standards established to protect human health. Therefore, the impact of potential nonradiological air pollutant releases on minority or low-income individuals under this alternative would not be considered significant.

The impact of potential accidents on the minority or low-income populations under the Reduced Operations Alternative would be the same as those discussed above for the No Action Alternative in Section 5.11.1.

5.11.3 Expanded Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Based on the analysis of impacts for other resource areas in this chapter, there would be no high and adverse impacts from continued operation of LANL under the Expanded Operations Alternative. No disproportionately high and adverse environmental impacts on minority or low-income populations would occur due to construction activities at LANL or to the project-specific activities discussed in Appendices G, H, I, and J under this alternative. As stated in other subsections of this chapter, environmental impacts from construction under this alternative would be small and would not be expected to be significant and adverse beyond the LANL site boundary.

No disproportionately high and adverse environmental impacts on minority or low-income populations would occur under this alternative. This conclusion results from analyses presented in this SWEIS that determined there would be no significant impacts on human health, ecological, cultural, paleontological, socioeconomic, and other resource areas described in other subsections of this chapter.

As shown in Table 5–18, the total population within 50 miles (80 kilometers) of LANL for the Expanded Operations Alternative is projected to receive an annual dose of about 36 person-rem. Because the majority of this dose results from operations at LANSCE, the environmental justice analysis for this alternative uses the 50-mile (80-kilometer) population centered on LANSCE in TA-53. As shown in **Table 5–58**, the dose from LANSCE along with the dose associated with High Explosive Testing firing site operations ascribed to TA-36 would result in an annual dose of 29.2 person-rem to the affected population and an average annual individual dose of 0.10 millirem. These two locations account for approximately 81 percent of the total estimated dose from all sites at LANL under the Expanded Operations Alternative.

Table 5–58 Comparison of Total Minority, Hispanic, American Indian and Low-Income Population and Average Individual Doses Under the Expanded Operations Alternative [a]

	Annual Dose in Person-rem	*Annual Dose in Millirem*
Total Population [b]	29.2	
Average Individual		0.10
White (non-Hispanic) Population	15.0	
Non-Minority Average Individual		0.11
Total Minority Population	14.1	
Minority Average Individual		0.088
Hispanic Population [c]	11.3	
Hispanic Average Individual		0.086
American Indian Population [d]	1.8	
American Indian Average Individual		0.092
Non-Low-Income Population	25.9	
Non-Low-Income Average Individual		0.10
Low-Income Population	3.0	
Low-Income Average Individual		0.082

[a] The total population dose displayed in this table, accounts for the estimated dose from LANSCE at TA-53 and the High-Explosive Testing firing site operations at TA-36 for the Expanded Operations Alternative.
[b] The total population dose for this environmental justice analysis differs by 3 percent from that in Table 5–18. This difference is due to different models used to estimate the populations; both estimates are based on data drawn from the 2000 decennial census. The SECPOP computer program used for the analysis for Table 5–18 does not allow for the identification of minority and low-income populations. Therefore an alternate method that uses a more refined distribution of the population is used for this analysis. The minor differences do not affect the conclusions supported by the analyses.
[c] The total Hispanic population includes all Hispanic persons regardless of race.
[d] The American Indian population may include persons who also indicated that they were of Hispanic ethnicity in the 2000 census.

The white (non-Hispanic) population would be expected to receive the largest annual collective dose (15 person-rem) and annual average individual dose (0.11 millirem). This compares to a total minority annual collective dose of 14.1 person-rem and an average annual dose of 0.088 millirem to a member of the minority population. American Indians living within 50 miles (80 kilometers) of LANL would receive a collective dose of 1.8 person-rem annually and an annual average individual dose of 0.092 millirem. The Hispanic population would receive a collective dose of 11.3 person-rem annually; the annual average dose to a member of the Hispanic population would be 0.086 millirem.

Population doses to persons living below the poverty level are also analyzed in Table 5–58. Annually, low-income populations surrounding LANL would receive a collective dose of

3.0 person-rem and an average individual dose of 0.082 millirem. Persons living above the poverty level would receive an annual collective dose of 25.9 person-rem and an annual average individual dose of 0.10 millirem. These data show that the total minority, American Indian, Hispanic, and low-income populations would not be subjected to disproportionately high and adverse dose impacts from normal operations at LANL under the Expanded Operations Alternative.

As discussed in Sections 5.6.1 and 5.6.2, radiological and hazardous chemical risks to the public resulting from normal operations would be small and not considered significant. As shown in Table 5–17, the MEI for the Expanded Operations Alternative is projected to receive a dose of approximately 8.2 millirem (0.00082 rem), about a 5 percent increase in the dose projected for the MEI under the No Action Alternative. This increase in the MEI dose would not be considered significant and therefore doses to members of minority or low-income populations that would be lower than the increase in dose to the MEI would not be considered significant. As discussed earlier in Section 5.11, the average resident of New Mexico receives a dose of approximately 400 millirem (0.4 rem) per year from background sources. Therefore, for the MEI under the Expanded Operations Alternative, his or her average annual dose and risk of developing a fatal cancer from the dose received would be expected to increase by a maximum of approximately 2.1 percent as a result of LANL operations.

As discussed in Section 5.6.2.3, the maximum public risk of developing a cancer as a result of chemical releases under the Expanded Operations Alternative would be approximately the same as those cited for the No Action Alternative with the exception of a small increase in high explosives processing that would not be expected to substantially change the risks. Therefore, the impact of potential chemical releases on minority or low-income individuals under this alternative would not be considered significant.

For nonradiological air quality impacts, as discussed in Section 5.4.1.3, the concentrations of criteria pollutants as a result of LANL operations under the Expanded Operations Alternative would likely be larger than those expected under the No Action Alternative but would remain below the ambient standards established to protect human health. Therefore, the impact of potential nonradiological air pollutant releases on minority or low-income individuals under this alternative would not be considered significant.

The impact of potential accidents on the minority and low-income populations under the Expanded Operations Alternative would be the same as those discussed above for the No Action Alternative in Section 5.11.1.

Key Facilities Impacts

Routine normal operations at Key Facilities would not be expected to cause fatalities or illness among the general population, including minority and low-income populations living within the potentially affected area.

Annual radiological risk to the offsite population that could result from the maximum potential accident at a Key Facility is estimated to be less than 0.76 LCFs (see Table 5–65). Thus, the risk of an excess LCF in the entire offsite population under the Expanded Operations Alternative would be less than 1.

5.12 Facility Accidents

The estimated impacts of potential accidents are described in this section for the No Action, Reduced Operations, and Expanded Operations Alternatives. A summary of the risks from radiological and chemical operations, potential seismic events, and a potential wildfire is provided in **Table 5–59**. Radiological impacts from facility accidents are addressed in Section 5.12.1. Chemical impacts from facility accidents are addressed in Section 5.12.2. Impacts from postulated earthquake events that could simultaneously affect multiple facilities are addressed in Section 5.12.3. Wildfire, another natural event that can also impact multiple facilities, is addressed in Section 5.12.4. Additional accident analysis details are provided in Appendix D. For all accident scenarios, the noninvolved worker is a hypothetical individual located 110 yards (100 meters) from the site of the accident, the MEI is a hypothetical individual located at the nearest site boundary, and the population includes residents within 50 miles (80 kilometers) of the site of the accident.

Table 5–59 Summary of Worker and Public Radiological Risks and Chemical Consequences from Potential Accidents

Maximum Potential Accident	*No Action Alternative*	*Reduced Operations Alternative*	*Expanded Operations Alternative*
Facility Radiological Release • Offsite Population (LCF per year) • MEI (LCF per year) • Noninvolved Worker (LCF per year)	 0.8 0.06 0.1	Same as No Action Alternative	Same as No Action Alternative
Facility Chemical Release [a] • Concentrations above which life-threatening health effects could result (ERPG-3 [t] limit) • ERPG-3 distance • Distance to the site boundary	 5 parts per million 962 yards 537 yards	Same as No Action Alternative	Same as No Action Alternative
Site-Wide Seismic Event Radiological • Offsite Population (LCF per year) • MEI (LCF per year) • Noninvolved Worker (LCF per year)	 0.009 0.0003 0.001	Same as No Action Alternative	Same as No Action Alternative
Site-Wide Seismic Event Chemical [a] • Concentrations above which life-threatening health effects could result (ERPG-3 [t] limit) • ERPG-3 distance • Distance to the site boundary	 25 parts per million 122 yards 13 yards	Same as No Action Alternative	Same as No Action Alternative
Wildfire Radiological • Offsite Population (LCF per year) • MEI (LCF per year) • Noninvolved Worker (LCF per year)	 2.7 0.05 0.05	Same as No Action Alternative	Same as No Action Alternative
Wildfire Chemical [a] • Concentrations above which life-threatening health effects could result (ERPG-3 [t] limit) • ERPG-3 distance • Distance to the site boundary	 25 parts per million 97 yards 13 yards	Same as No Action Alternative	Same as No Action Alternative

LCF = latent cancer fatality, MEI = maximally exposed individual, ERPG = Emergency Response Planning Guideline.
[a] ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects (DOE 2005e).
Note: To convert yards to meters, multiply by 0.9144.

5.12.1 Facility Radiological Impacts

Estimated radiological accident consequences and risks associated with the No Action, Reduced, and Expanded Alternatives are shown in Tables 5–60 through 5–65.

5.12.1.1 No Action Alternative

The accident with the highest estimated consequences to the offsite population, as shown in **Table 5–60**, is a lightning strike fire at the Radioassay and Nondestructive Testing Facility.[6] If this accident were to occur, there could be 6 additional LCFs in the offsite population. The accident with the highest estimated consequences to the MEI and a noninvolved worker is a waste storage dome fire at TA-54 as shown in Tables 5–60 and **5–61**. If this accident were to occur as modeled, the noninvolved worker and the MEI would receive large radiation doses. Depending on the specific radionuclides released and the route of human exposure, radiation doses of this magnitude would result in near-term health effects or even death from causes other than cancer. In some cases, medical intervention may be effective in reducing the dose to the exposed individual, mitigating health impacts, or both. In addition to the conservative assumptions used to develop the source term (amount of radioactive material released) for this accident, the calculated doses are based on the assumptions that no protective action is taken during the entire time of exposure and that no subsequent medical intervention occurs. The MEI for all of the scenarios is located at the nearest site boundary.

The potential exists for exposures in excess of the above in the vicinity of the Chemistry and Metallurgy Research Building because of public access to Diamond Drive, which is approximately 50 meters from the building. The Chemistry and Metallurgy Building is expected to be operational until transition to the Chemistry and Metallurgy Research Replacement Facility is completed. The consequences to an individual at this Diamond Drive location during the HEPA Filter Fire would be 8.1 rem, resulting in an increased individual LCF risk of 0.0049 (approximately 1 in 210). Appendix D, Section D.3.2.1, contains further discussion of the Chemistry and Metallurgy Research Building exposures.

After accounting for the frequency of the postulated accidents (see Appendix D), the estimated highest risk accident would be a Radioassay and Nondestructive Testing Facility lightning strike fire (TA-54-38). **Table 5–62** shows the annual risk of an increased likelihood of an LCF for this accident to be 0.059 (about 1 in 17 years) for the MEI. The offsite population annual risk of additional LCFs is estimated to be 0.76 for an LCF in any one member of the total offsite population. Table 5–62 shows the annual risk of an increased likelihood of an LCF for this accident to be 0.12 (about 1 in 8 years) for a noninvolved worker.

---

[6] The lightning fire accident scenario conservatively assumes that any lightning striking the Radioassay and Nondestructive Testing Facility would result in a fire that affects and releases radioactive material located inside the facility regardless of the lightning energy or the specific location at the facility subject to the lightning strike.

Table 5–60 Radiological Accident Offsite Population Consequences for the No Action and Reduced Operations Alternatives

Accident Scenario	*Maximally Exposed Individual*		*Population to 50 Miles (80 kilometers)*	
	Dose [a] (rem)	*Latent Cancer Fatality [b]*	*Dose (person-rem)*	*Latent Cancer Fatalities [c, d]*
Radioassay and Nondestructive Testing Facility Lightning Strike Fire (TA-54-38)	410	0.49	11,000	6 (6.3)
Weapons Engineering Tritium Facility Fire (TA-16-205)	5.9	0.0036	190	0 (0.11)
Waste Characterization, Reduction, and Repackaging Facility Lightning Strike Fire (TA-50-69)	46	0.055	4,800	3 (2.9)
Waste Storage Dome Fire (TA-54)	420	0.50	4,200	3 (2.5)
Onsite Transuranic Waste Fire (TA-54)	190	0.22	5,700	3 (3.4)
Plutonium Facility Material Staging Area Fire (TA-55-4)	73	0.087	9,000	5 (5.4)
Decontamination and Volume Reduction System Operational Spill (TA-54-412)	20	0.012	190	0 (0.11)
Decontamination and Volume Reduction System Building Fire and Spill due to Forklift Collision (TA-54-412)	320	0.39	6,100	4 (3.7)
SHEBA Hydrogen Detonation (TA-18-168) [e]	0.88	0.00053	69	0 (0.041)
Chemistry and Metallurgy Research Building HEPA Filter Fire (TA-3-29)	0.77	0.00046	200	0 (0.12)

TA = technical area, SHEBA = Solution High-Energy Burst Assembly, HEPA = high-efficiency particulate air (filter).

[a] Individual radiation doses in excess of a few hundred rem would result in acute (near-term) health effects or even death from causes other than cancer. In some cases, medical intervention may be effective in reducing the dose, mitigating health impacts, or both. The listed doses are calculated assuming that the exposed individual takes no protective action during the period of exposure and that no subsequent medical intervention occurs.

[b] Increased risk of an LCF to an individual, assuming the accident occurs.

[c] Increased number of LCFs for the offsite population, assuming the accident occurs; value in parentheses is the calculated result.

[d] Offsite population size out to a 50-mile (80-kilometer) radius is approximately 297,000 (TA-3-29), 404,900 (TA-16-205), 334,100 (TA-18-168), 271,600 (TA-21-155, -209), 302,000 (TA-50-69), 343,100 (TA-54-38, TA-54-412, Domes), 301,900 (TA-55-4).

[e] The SHEBA accident scenario is applicable only to the No Action Alternative. Operation of SHEBA would cease under the Reduced Operations Alternative.

Table 5–61 Radiological Accident Onsite Worker Consequences for the No Action and Reduced Operations Alternatives

Accident Scenario	*Noninvolved Worker at 110 Yards (100 meters)*	
	Dose [a] (rem)	*Latent Cancer Fatality [b]*
Radioassay and Nondestructive Testing Facility Lightning Strike Fire (TA-54-38)	1,900	1.0 [c]
Weapons Engineering Tritium Facility Fire (TA-16-205)	8.92	0.00535
Waste Characterization, Reduction, and Repackaging Facility Lightning Strike Fire (TA-50-69)	1,100	1.0 [c]
Waste Storage Dome Fire (TA-54)	2,000	1.0 [c]
Onsite Transuranic Waste Fire (TA-54)	760	0.91
Plutonium Facility Material Staging Area Fire (TA-55-4)	1,600	1.0 [c]
Decontamination and Volume Reduction System Operational Spill (TA-54-412)	51	0.062
Decontamination and Volume Reduction System Building Fire and Spill due to Forklift Collision (TA-54-412)	890	1.0 [c]

Accident Scenario	Noninvolved Worker at 110 Yards (100 meters)	
	Dose [a] (rem)	Latent Cancer Fatality [b]
SHEBA Hydrogen Detonation (TA-18-168) [d]	15	0.0092
Chemistry and Metallurgy Research Building HEPA Filter Fire (TA-3-29)	5.4	0.0032

TA = technical area, SHEBA = Solution High-Energy Burst Assembly, HEPA = high-efficiency particulate air (filter).
[a] Individual radiation doses in excess of a few hundred rem would result in acute (near-term) health effects or even death from causes other than cancer. In some cases, medical intervention may be effective in reducing the dose, mitigating health impacts, or both. The listed doses are calculated assuming that the exposed individual takes no protective action during the period of exposure and that no subsequent medical intervention occurs.
[b] Increased risk of an LCF to an individual, assuming the accident occurs.
[c] The indicated dose yields a risk value greater than 1.0. This means that it is likely that an individual exposed to the indicated dose would develop a latent fatal cancer. For this reason, a value of 1.0 is shown.
[d] The SHEBA accident scenario is applicable only to the No Action Alternative. Operation of SHEBA would cease under the Reduced Operations Alternative.

Table 5–62 Radiological Accident Offsite Population and Worker Risks for the No Action and Reduced Operations Alternatives

Accident Scenario	Frequency (per year)	Onsite Worker	Offsite Population	
		Noninvolved Worker at 110 Yards (100 meters) [a]	Maximally Exposed Individual [a]	Population to 50 Miles (80 kilometers) [b, c]
Radioassay and Nondestructive Testing Facility Lightning Strike Fire (TA-54-38)	0.12 [d]	0.12	0.059	0.76
Weapons Engineering Tritium Facility Fire (TA-16-205)	1.1×10^{-5}	5.9×10^{-8}	4.0×10^{-8}	1.3×10^{-6}
Waste Characterization, Reduction, and Repackaging Facility Lightning Strike Fire (TA-50-69)	0.14 [d]	0.14	0.0077	0.4
Waste Storage Dome Fire (TA-54)	0.001	0.001	0.0005	0.0025
Onsite Transuranic Waste Fire (TA-54)	0.001	0.00091	0.00022	0.0034
Plutonium Facility Material Staging Area Fire (TA-55-4)	0.01	0.01	0.00087	0.054
Decontamination and Volume Reduction System Operational Spill (TA-54-412)	0.02	0.0012	0.00024	0.0022
Decontamination and Volume Reduction System Building Fire and Spill due to Forklift Collision (TA-54-412)	0.001	0.001	0.00039	0.0037
SHEBA Hydrogen Detonation (TA-18-168) [e]	0.0054	0.00005	2.8×10^{-6}	0.00022
Chemistry and Metallurgy Research Building HEPA Filter Fire (TA-3-29)	0.01	0.000032	4.6×10^{-6}	0.0012

TA = technical area, SHEBA = Solution High-Energy Burst Assembly, HEPA = high-efficiency particulate air (filter).
[a] Increased risk of an LCF to an individual per year.
[b] Increased number of LCFs for the offsite population per year.
[c] Offsite population size out to a 50-mile (80-kilometer) radius is approximately 297,000 (TA-3-29), 404,900 (TA-16-205), 334,100 (TA-18-168), 271,600 (TA-21-155, -209), 302,000 (TA-50-69), 343,100 (TA-54-38, DVRS, Domes), 301,900 (TA-55-4).
[d] The lightning strike fire accident scenarios conservatively assumes that any lightning strike on the facility would result in a source term equivalent to a structure fire.
[e] The SHEBA accident scenario is applicable only to the No Action Alternative. Operation of SHEBA would cease under the Reduced Operations Alternative.

5.12.1.2 Reduced Operations Alternative

The accident impacts from the Reduced Operations Alternative are the same as those from the No Action Alternative and are presented in Tables 5-60 through 5-62. Activities at TA-18, including operation of SHEBA, would cease under this alternative. Inspection of the tables shows that SHEBA operations are a small component of the facility impacts at LANL; its elimination would not significantly alter the overall risk profile of individual facility operations. All other impacts in the tables are equally applicable for this alternative.

5.12.1.3 Expanded Operations Alternative

Accident impacts under the Expanded Operations Alternative are shown in **Tables 5–63** through **5–65**. SHEBA operations would cease under the Expanded Operations Alternative, so its impacts, although relatively small, have been eliminated from the tables below. Additional or replacement risks from accident impacts would result from expanded waste management activities. Transuranic waste storage would be consolidated in a new facility, the TRU Waste Facility located in TA-50 or a generic site along the Pajarito Road corridor. The impacts from this new facility would be smaller than those of the existing facilities because of its new location and because less material would be stored and the rest would be moved offsite. The entries in Tables 5–63 through 5–65 reflect present Decontamination and Volume Reduction System and waste storage domes operations because they would bound the impacts of the new facility. Accident impacts for the new facility are described in Appendix H.

MDA cleanup is a component of the Expanded Operations Alternative. A number of scenarios were considered for this activity and an explosion or fire during removal operations that breaches the MDA enclosure and bypasses the HEPA filtration was chosen. MDA G, because of its relatively large inventory, bounds the accident impacts from MDA removal. The consequences and risks from this scenario are included in Tables 5–63 through 5–65. As with the No Action Alternative, TA-54 operations generally dominate the accident risks from Expanded Operations. Possible removal of MDA G in TA-54 adds a component to this risk. Appendix I includes more details about MDA cleanup accident impacts.

The accident with the largest consequences to the offsite population is a fire at Chemistry and Metallurgy Research Building involving sealed sources, as shown in Table 5–63. If this accident were to occur, there could be 7 additional LCFs in the offsite population. The accident with the highest consequences to the MEI and the noninvolved worker is a waste storage dome fire at TA-54.

The potential exists for exposures in excess of those above at the Chemistry and Metallurgy Research Building because of public access to Diamond Drive, approximately 50 meters from the facility. The Chemistry and Metallurgy Research Building is expected to be operational until the transition to the Chemistry and Metallurgy Research Replacement Facility is completed. The consequences to an individual at this Diamond Drive location during a fire impacting sealed sources (applicable to only the Expanded Operations Alternative) or a HEPA filter fire would be 4.3 rem and 8.1 rem, respectively. These doses would result in an increased risk of a latent fatal cancer during the lifetime of the individual of 0.0026 (approximately 1 in 390) and 0.0049 (approximately 1 chance in 210), respectively. Appendix D, Section D.3.2.1, contains further discussion of the Chemistry and Metallurgy Research Building exposures.

Table 5–63 Radiological Accident Offsite Population Consequences for the Expanded Operations Alternative

Accident Scenario	*Maximally Exposed Individual*		*Population to 50 Miles (80 kilometers)*	
	Dose [a] (rem)	*LCF [b]*	*Dose (person-rem)*	*LCF [c, d]*
Radioassay and Nondestructive Testing Facility Lightning Strike Fire (TA-54-38)	410	0.49	11,000	6 (6.3)
Weapons Engineering Tritium Facility Fire (TA-16-205)	5.9	0.0036	190	0 (0.11)
Waste Characterization, Reduction, and Repackaging Facility Lightning Strike Fire (TA-50-69)	46	0.055	4,800	3 (2.9)
Waste Storage Dome Fire (TA-54)	420	0.50	4,200	3 (2.5)
Onsite Transuranic Waste Fire (TA-54)	190	0.22	5,700	3 (3.4)
Plutonium Facility Material Staging Area Fire (TA-55-4)	73	0.087	9,000	5 (5.4)
Decontamination and Volume Reduction System Operational Spill (TA-54-412)	20	0.012	190	0 (0.11)
Explosion at Material Disposal Area G (TA-54)	55	0.066	770	0 (0.46)
Decontamination and Volume Reduction System Building Fire and Spill due to Forklift Collision (TA-54-412)	320	0.39	6,100	4 (3.7)
Chemistry and Metallurgy Research Building Fire Involving Sealed Sources (TA-3-29)	0.099	0.000059	12,000	7 (7.0)
Chemistry and Metallurgy Research Building HEPA Filter Fire (TA-3-29)	0.77	0.00046	200	0 (0.12)

LCF = latent cancer fatality, TA = technical area, HEPA = high-efficiency particulate air (filter).

[a] Individual radiation doses in excess of a few hundred rem would result in acute (near-term) health effects or even death from causes other than cancer. In some cases, medical intervention may be effective in reducing the dose, mitigating health impacts, or both. The listed doses are calculated assuming that the exposed individual takes no protective action during the period of exposure and that no subsequent medical intervention occurs.

[b] Increased risk of an LCF to an individual, assuming the accident occurs.

[c] Increased number of LCFs for the offsite population, assuming the accident occurs; value in parentheses is the calculated result.

[d] Offsite population size out to a 50-mile (80-kilometer) radius is approximately 297,000 (TA-3-29), 404,900 (TA-16-205), 271,600 (TA-21-155, -209), 302,000 (TA-50-69), 343,100 (TA-54-38, DVRS, Domes), 301,900 (TA-55-4).

After accounting for the frequency of the postulated accidents, the estimated highest risk accident would be a Radioassay and Nondestructive Testing Facility lightning strike fire (TA-54-38). Table 5–65 shows the annual risk of an increased likelihood of an LCF for this accident to be 0.059 (about 1 in 17 years) for the MEI. The offsite population annual risk of additional LCFs is shown to be 0.76 for any one member of the offsite population. Table 5–65 shows the annual risk of an increased likelihood of an LCF for this accident to be 0.12 (about 1 chance in 8 years) for a noninvolved worker.

Table 5–64 Radiological Accident Onsite Worker Consequences for the Expanded Operations Alternative

Accident Scenario	Noninvolved Worker at 110 Yards (100 meters)	
	Dose (rem) [a]	LCF [b]
Radioassay and Nondestructive Testing Facility Lightning Strike Fire (TA-54-38)	1,900	1.0 [c]
Weapons Engineering Tritium Facility Fire (TA-16-205)	8.9	0.0054
Waste Characterization, Reduction, and Repackaging Facility Lightning Strike Fire (TA-50-69)	1,100	1.0 [c]
Waste Storage Dome Fire (TA-54)	2,000	1.0 [c]
Onsite Transuranic Waste Fire (TA-54)	760	0.91
Plutonium Facility Material Staging Area Fire (TA-55-4)	1,600	1.0 [c]
Decontamination and Volume Reduction System Operational Spill (TA-54-412)	51	0.062
Explosion at Material Disposal Area G (TA-54)	410	0.49
Decontamination and Volume Reduction System Building Fire and Spill due to Forklift Collision (TA-54-412)	890	1.0 [c]
Chemistry and Metallurgy Research Building Fire Involving Sealed Sources (TA-3-29)	1.2	0.00073
Chemistry and Metallurgy Research Building HEPA Filter Fire (TA-3-29)	5.4	0.0032

LCF = latent cancer fatality, TA = technical area, HEPA = high-efficiency particulate air (filter).
[a] Individual radiation doses in excess of a few hundred rem would result in acute (near-term) health effects or even death from causes other than cancer. In some cases, medical intervention may be effective in reducing the dose, mitigating health impacts, or both. The listed doses are calculated assuming that the exposed individual takes no protective action during the period of exposure and that no subsequent medical intervention occurs.
[b] Increased risk of an LCF to an individual, assuming the accident occurs.
[c] The indicated dose yields a risk value greater than 1.0. This means that it is likely that an individual exposed to the indicated dose would develop a fatal latent cancer. For this reason, a value of 1.0 is shown.

Table 5–65 Radiological Accident Offsite Population and Worker Risks for the Expanded Operations Alternative

Accident Scenario	Frequency (per year)	Risk to Onsite Worker	Offsite Population	
		Noninvolved Worker at 110 Yards (100 meters) [a]	Maximally Exposed Individual [a]	Population to 50 Miles (80 kilometers) [b, c]
Radioassay and Nondestructive Testing Facility Lightning Strike Fire (TA-54-38)	0.12 [d]	0.12	0.059	0.76
Weapons Engineering Tritium Facility Fire (TA-16-205)	1.1×10^{-5}	6.0×10^{-8}	4.0×10^{-8}	1.3×10^{-6}
Waste Characterization, Reduction, and Repackaging Facility Lightning Strike Fire (TA-50-69)	0.14 [d]	0.14	0.0077	0.4
Waste Storage Dome Fire (TA-54)	0.001	0.001	0.0005	0.0025
Onsite Transuranic Waste Fire (TA-54)	0.001	0.00091	0.00022	0.0034
Plutonium Facility Material Staging Area Fire (TA-55-4)	0.01	0.01	0.00087	0.054
Decontamination and Volume Reduction System Operational Spill (TA-54-412)	0.02	0.0012	0.00024	0.0022
Explosion at Material Disposal Area G (TA-54)	0.01	0.0049	0.00066	0.0046
Decontamination and Volume Reduction System Building Fire and Spill due to Forklift Collision (TA-54-412)	0.001	0.001	0.00039	0.0037
Chemistry and Metallurgy Research Building Fire Involving Sealed Sources (TA-3-29)	0.00024	1.7×10^{-7}	1.4×10^{-8}	0.0017

Accident Scenario	Frequency (per year)	Risk to Onsite Worker	Offsite Population	
		Noninvolved Worker at 110 Yards (100 meters) [a]	Maximally Exposed Individual [a]	Population to 50 Miles (80 kilometers) [b, c]
Chemistry and Metallurgy Research Building HEPA Filter Fire (TA-3-29)	0.01	0.000032	4.6×10^{-6}	0.0012

TA = technical area, HEPA = high-efficiency particulate air (filter).

a Increased risk of an LCF to an individual per year.

b Increased number of LCFs for the offsite population per year.

c Offsite population size out to a 50-mile (80-kilometer) radius is approximately 297,000 (TA-3-29), 404,900 (TA-16-205), 334,100 (TA-18-168), 271,600 (TA-21-155, -209), 302,000 (TA-50-69), 343,100 (TA-54-38, DVRS, Domes), 301,900 (TA-55-4).

d The lightning strike fire accident scenarios conservatively assumes that any lightning strike on the facility would result in a source term equivalent to a structure fire.

5.12.2 Facility Hazardous Chemical Impacts

5.12.2.1 No Action Alternative

The chemicals of concern at LANL facilities under the No Action Alternative are shown in **Table 5–66**. They were selected from a database of chemicals used onsite based on their quantities, chemical properties, and human health effects. The table shows the Emergency Response Planning Guideline (ERPG) values. ERPG-2 and ERPG-3 values are the concentrations that, if an accident were to occur, could result in serious health effects or life-threatening implications for exposed individuals.

Table 5–66 also shows the risk of worker and public exposure in the event of a chemical release from site-wide events only (seismic- and wildfire-related releases are discussed in their respective sections). The cause of a chemical release could be mechanical failure, corrosion, mechanical impact, or natural phenomena. The estimated frequency of each accident is shown in the table. The direction traveled by the chemical plume, which would depend on meteorological conditions at the time of the accident, would determine what segment of the worker and offsite populations would be at risk of exposure.

For selenium hexafluoride located at TA-54-216, there is an annual risk of 0.0041 (1 in 240 years) that workers and the public within a distance of 962 yards (880 meters) of the release would be exposed to concentrations in excess of ERPG-3 values. The workers and the public within a distance of 3,062 yards (2,800 meters) of the release face the same risk of being exposed to concentrations in excess of ERPG-2 values.

For sulfur dioxide located at TA-54-216, there is an annual risk of 0.00051 (1 in 1,950 years) that workers and the public within a distance of 755 yards (690 meters) of the release would be exposed to concentrations in excess of ERPG-3 values. The workers and the public within a distance of 1,804 yards (1,650 meters) of the release face the same risk of being exposed to concentrations in excess of ERPG-2 values.

Table 5–66 Chemical Accident Risks under the No Action and Reduced Operations Alternatives

Chemical	Frequency (per year)	Quantity Released	ERPG-2 [a]		ERPG-3 [b]	
			Value (ppm)	Annual Risk	Value (ppm)	Annual Risk
Selenium hexafluoride from waste cylinder storage at TA-54-216	0.0041	19.8 gallons (75 liters)	0.6 [c]	1 chance in 240 years of workers or public within 3,062 yards (2,800 meters) of facility receiving exposures in excess of limit. Nearest public access is at 537 yards (491 meters).	5 [c]	1 chance in 240 years of workers or public within 962 yards (880 meters) of facility receiving exposures in excess of limit. Nearest public access is at 537 yards (491 meters).
Sulfur dioxide from waste cylinder storage at TA-54-216	0.00051	300 pounds (136 kilograms)	3	1 chance in 1,950 years of workers or public within 1,804 yards (1,650 meters) of facility receiving exposures in excess of limit. Nearest public access is at 537 yards (491 meters).	15	1 chance in 1,950 years of workers or public within 755 yards (690 meters) of facility receiving exposures in excess of limit. Nearest public access is at 537 yards (491 meters).
Chlorine gas released outside of Plutonium Facility Complex (TA-55-4)	0.063	150 pounds (68 kilograms)	3	1 chance in 15 years of workers within 1,181 yards (1,080 meters) of facility receiving exposures in excess of limit. Nearest public access is at 1,111 yards (1,016 meters).	20	1 chance in 15 years of workers within 416 yards (380 meters) of facility receiving exposures in excess of limit. Nearest public access is at 1,111 yards (1,016 meters).
Helium at TA-55-41	0.063	9,230,000 cubic feet (at STP) (261,366 cubic meters)	280,000 ppm [c]	1 chance in 15 years of workers within 203 yards (186 meters) of facility receiving exposures in excess of limit. Nearest public access is at 1,146 yards (1,048 meters).	500,000 ppm [c]	1 chance in 15 years of workers within 152 yards (139 meters) of facility receiving exposures in excess of limit. Nearest public access is at 1,146 yards (1,048 meters).

ERPG = Emergency Response Planning Guideline, ppm = parts per million, TA = technical area, STP = standard temperature and pressure.

[a] ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action (DOE 2005e).

[b] ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects (DOE 2005e).

[c] The Temporary Emergency Exposure Limit value is used. ERPGs have not been issued for this substance.

For chlorine gas located outside of TA-55-4, there is an annual risk of 0.063 (1 in 15 years) that workers within a distance of 416 yards (380 meters) of the release would be exposed to concentrations in excess of ERPG-3 values. Workers and the public within a distance of 1,181 yards (1,080 meters) of the release face the same risk of being exposed to concentrations in excess of ERPG-2 values.

For helium gas located at TA-55-41, there is an annual risk of 0.063 (1 in 15 years) that workers within 152 yards (139 meters) of the release would be exposed to concentrations in excess of ERPG-3 values. Workers within a distance of 203 yards (186 meters) of the release face the same risk of being exposed to concentrations in excess of ERPG-2 values.

5.12.2.2 Reduced Operations Alternative

The chemicals of concern that could be released in a facility accident are the same for the Reduced Operations Alternative as for the No Action Alternative. None of the chemicals identified for the latter is eliminated in this alternative. The information in Table 5–66, therefore, also applies to the Reduced Operations Alternative.

5.12.2.3 Expanded Operations Alternative

The chemicals of concern that could be released in a facility accident for the No Action Alternative apply equally to the Expanded Operations Alternative. In addition, MDA cleanup, a component of the Expanded Operations Alternative, also includes a potential for accidental releases of toxic chemicals. A fire during removal operations that breaches any MDA enclosure and bypasses the HEPA filtration was chosen for analysis. There is a great deal of uncertainty regarding how much and which chemicals were disposed of in the MDAs. For the most conservative analysis, MDA B, the MDA closest to the public (and thus with the potential for the greatest impact on the public), was chosen to represent the chemical accident impacts of MDA cleanup. Two chemicals, sulfur dioxide (a gas) and beryllium (assumed to be in powder form), were chosen based on their restrictive ERPG values to bound the impacts of an extensive list of possible chemicals disposed of in the MDAs. **Table 5–67** shows, if present in MDA B in the quantities assumed, both of these chemicals would dissipate to below the ERPG-3 value very close to the release, but would continue to be a risk to the public due to the short distance to the nearest public access point for this MDA. Appendix I includes more details about MDA cleanup chemical accident impacts.

5.12.3 Site-Wide Seismic Impacts

As addressed in more detail in Appendix D, Section D.4, two site-wide seismic events, referred to as Seismic 1 and Seismic 2, were postulated to estimate the potential effects of radiological and chemical releases during an earthquake. In the event of a site-wide seismic event, radiological and chemical hazardous materials could be simultaneously released. Seismic events are categorized by their performance category (PC), which is numbered from PC-0 through PC-4. A higher performance category has a smaller annual frequency of occurrence, but a larger associated ground acceleration. A higher performance category has more severe consequences and structures would require a more resilient engineering design to survive.

The seismic accident scenarios (Seismic 1 and 2) analyzed in the SWEIS were based on the February 24, 1995, *Seismic Hazards Evaluation of the Los Alamos National Laboratory*. Seismic 1 – the seismic event characterized by a peak horizontal ground acceleration of 0.22g (0.22 times the acceleration due to gravity) – had an estimated annual probability of exceedance of 0.001 (1 in 1,000). Seismic 2 – a more severe seismic event characterized by a peak ground acceleration of 0.31g – had an estimated annual probability of exceedance of 0.0005 (1 in 2,000).

Table 5–67 Chemical Accident Risks under the Expanded Operations Alternative

Chemical	Frequency (per year)	Quantity Released	ERPG-2 [a]		ERPG-3 [b]	
			Value	Annual Risk	Value	Annual Risk
Selenium hexafluoride from waste cylinder storage at TA-54-216	0.0041	19.8 gallons (75 liters)	0.6 ppm [c]	1 chance in 240 years of workers or public within 3,062 yards (2,800 meters) of facility receiving exposures in excess of limit. Public access is at 537 yards (491 meters).	5 ppm [c]	1 chance in 240 years of workers or public within 962 yards (880 meters) of facility receiving exposures in excess of limit. Nearest public access is at 537 yards (491 meters).
Sulfur dioxide from waste cylinder storage at TA-54-216	0.00051	300 pounds (136 kilograms)	3 ppm	1 chance in 1,950 years of workers or public within 1,804 yards (1,650 meters) of facility receiving exposures in excess of limit. Public access is at 537 yards (491 meters).	15 ppm	1 chance in 1,950 years of workers or public within 755 yards (690 meters) of facility receiving exposures in excess of limit. Nearest public access is at 537 yards (491 meters).
Chlorine gas released outside of Plutonium Facility Complex (TA-55-4)	0.063	150 pounds (68 kilograms)	3 ppm	1 chance in 15 years of workers within 1,181 yards (1,080 meters) of facility receiving exposures in excess of limit. Public access is at 1,111 yards (1,016 meters).	20 ppm	1 chance in 15 years of workers within 416 yards (380 meters) of facility receiving exposures in excess of limit. Nearest public access is at 1,111 yards (1,016 meters).
Helium at TA-55-41	0.063	9,230,000 cubic feet (261,366 cubic meters) (at STP)	280,000 ppm [c]	1 chance in 15 years of workers within 203 yards (186 meters) of facility receiving exposures in excess of limit. Nearest public access is at 1,146 yards (1,048 meters).	500,000 ppm [c]	1 chance in 15 years of workers within 152 yards (139 meters) of facility receiving exposures in excess of limit. Nearest public access is at 1,146 yards (1,048 meters).
Sulfur Dioxide (MDA B)	No frequency established; performed as an enveloping analysis	1 pound (0.45 kilogram)	3 ppm	Risk of workers or public within 90 yards (83 meters) of facility receiving exposures in excess of limit. Nearest public access is at 49 yards (45 meters).	15 ppm	Risk of workers or public within 37 yards (34 meters) of facility receiving exposures in excess of limit. Nearest public access is at 49 yards (45 meters).
Beryllium Powder (MDA B)	No frequency established; performed as an enveloping analysis	22 pounds [d] (10 kilograms)	0.025 milligram per cubic meter	Risk of workers within 25 yards (23 meters) of facility receiving exposures in excess of limit. Public access is at 49 yards (45 meters).	0.1 milligram per cubic meter	Risk of workers within 10 yards (9 meters) of facility receiving exposures in excess of limit. Nearest public access is at 49 yards (45 meters) and beyond this limit.

ERPG = Emergency Response Planning Guideline, TA = technical area, ppm = parts per million, MDA = material disposal area.

[a] ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action (DOE 2005e).

[b] ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects (DOE 2005e).

[c] The Temporary Emergency Exposure Limit value is used. ERPGs have not been issued for this substance.

[d] This quantity represents the total material at risk. A fraction of this solid (0.00006) would be released as respirable particles under the hypothesized scenario.

An updated probabilistic seismic hazard analysis providing an improved understanding of the seismic characteristics of LANL was completed in 2007 (LANL 2007a). The new study indicates that the seismic hazard is higher than previously understood; the annual probability of exceedance for the previously analyzed peak ground accelerations is now estimated to be about 1 in 700 (rather than 1 in 1,000) for the Seismic 1 event, and 1 in 1,250 (rather than 1 in 2,000) for the Seismic 2 event. The revised annual probabilities of exceedance are thus 0.0015 and 0.0008, respectively. Using these larger probabilities, however, the seismic accident risks for the MEI, the noninvolved worker, and the population are less than 1 percent of accident risks for other types of accidents in the SWEIS such as fires at the Radioassay and Nondestructive Testing Facility, the Waste Characterization, Reduction, and Repackaging Facility, and the TA-54 waste storage domes.

For many facilities involved in the SWEIS Seismic 1 and 2 accident scenarios, a conservative assumption was made that there was complete failure of structures, systems, and components (given the Seismic 1 and 2 ground shaking), thereby resulting in the maximum possible radioisotope or chemical release. Higher seismic accelerations at the same annual frequency of exceedance would result in identical consequences for these facilities. Therefore, the larger seismic peak ground accelerations associated with the updated probabilistic seismic hazard analysis would not increase the consequence of these accident scenarios.[7] Furthermore, structures are typically designed with considerable factors of safety that provide large margins before failure would occur. For those facilities that were not assumed to completely fail, it is not possible to state the impacts of different peak horizontal ground accelerations without detailed structural analyses of LANL facilities using the updated probabilistic seismic hazard analysis results. Therefore, a bounding analysis was used to estimate the maximum expected effect of the updated seismic hazard analysis on the SWEIS seismic accident risks.

Using the accident source terms that were developed for the SWEIS Seismic 1 and 2 accident scenarios, the effect of the revised estimates of annual probability of exceedance would be an increase in the radiological risk of 50 percent for Seismic 1 scenarios and 60 percent for Seismic 2 scenarios. For this assessment, no credit was taken for facilities for which complete failure was already assumed and therefore no larger accident source term would be expected at larger seismic ground accelerations. Furthermore, the number of LCFs calculated for these two postulated seismic events should be considered within the context of the nonradiological human health impacts expected from these seismic events, which would cause widespread failures of non-nuclear LANL structures and structures outside of LANL. A much larger number of fatalities and injuries from structure collapse would be expected for these seismic events in the area surrounding LANL.

Just as the updated probabilistic seismic hazards analysis used new data and advanced methods to calculate LANL seismic hazards, revised structural analysis methods tied to damage states

---

[7] *The facilities for which the consequences would be the same include: the Chemistry and Metallurgy Research Building, the Weapons Engineering Test Facility, the Tritium Science and Fabrication Facility, the Tritium System Test Assembly, and Radioactive Liquid Waste Treatment Facility, the Waste Characterization, Reduction, and Repackaging Facility, and the Radioassay and Nondestructive Testing Facility. Facilities for which the consequences of higher ground acceleration may be greater include: the Plutonium Facility, the TA-55 Storage Facility, the Decontamination and Volume Reduction System, Waste Storage Domes, and the Safe Secure Transport Facility.*

credited in safety assessment documents will be used to update the seismic structural integrity evaluation of LANL facilities. The effect of the higher values of peak horizontal ground acceleration on accident consequences and risks will be analyzed in future facility safety analyses and incorporated as appropriate into future NEPA documents. NNSA and the LANL management and operating contractor will undertake an evaluation of LANL facility performance in terms of the updated seismic hazard information. Until that revised analysis is completed, operations would be authorized based on NNSA approval of a contractor-prepared justification for continued operation.

The LANL management and operating contractor has developed and NNSA has accepted a site-wide justification for continued operation as a result of the estimates of increased seismic event frequency and acceleration associated with the updated probabilistic seismic hazards analysis. The justification for continued operation presents a qualitative evaluation of the effect of this increased seismic hazard on site-wide transportation and on the following LANL facilities: Chemistry and Metallurgy Research Building, Beryllium Technology Facility, Dual-Axis Radiographic Hydrodynamic Test Facility, Weapons Engineering Test Facility, Radioactive Liquid Waste Treatment Facility, Waste Characterization, Reduction, and Repackaging Facility, TA-53 underground spent resin tank, LANSCE, Area G waste operations, Radioassay and Nondestructive Testing Facility, Plutonium Facility, Safe and Secure Transport Facility, and the nuclear environmental sites (MDA A, MDA B, MDA C, MDA H, MDA T, MDA W, TA-35 Wastewater Treatment Plant, TA-35 Pratt Canyon, and MDA AB). The justification for continued operation determined that existing bounding seismic accident analyses; new facility safety analyses; compensatory measures of limiting radioactive material inventory, new programs, and procedures; and the low probability of a seismic event during the anticipated time period for detailed quantitative analysis of each facility's safety documentation provide the basis for an acceptable risk for continued operation of LANL (LANL 2007a, NNSA 2007c).

The Los Alamos Site Office directed the LANL management and operating contractor to develop a draft project execution plan to perform specific detailed facility seismic analyses; incorporate necessary changes to facility safety bases; and develop a list of potential facility modifications to address deficiencies identified in the seismic analyses (NNSA 2007c). If necessary, facility-specific justifications for continued operation will be developed as part of this process. This project will provide for the evaluation of each LANL facility using the updated probabilistic seismic hazard analysis seismic accelerations and frequencies and in accordance with appropriate LANL structural engineering standards for seismic events using all applicable industry, federal government, and international standards, codes, and criteria.

5.12.3.1 No Action Alternative

Site-Wide Seismic 1 – Radiological

Site-wide Seismic 1 is represented by a PC-2 seismic event. Referring to **Tables 5–68** through **5–70** and noting that all of the listed facilities could contribute to offsite population impacts, the facility with generally the highest contribution to worker and public risk is the Chemistry and Metallurgy Research Building. In the event of this seismic event, it is estimated that there would be four LCFs in the offsite population from a Chemistry and Metallurgy Research Building release. As a result of such a release, the noninvolved worker would receive a large radiation dose. There is also a potential for an individual at publicly accessible Diamond Drive, approximately 55 yards (50 meters) from the Chemistry and Metallurgy Research Building, to receive an exposure in excess of the offsite MEI exposure. The calculated dose to such an individual is 6,400 rem, or about 100 times the MEI dose. Depending on the specific radionuclides released and the route of human exposure, radiation doses calculated for the individual on Diamond Drive and the noninvolved worker would result in near-term health effects or even death from causes other than cancer. In some cases, medical intervention may be effective in reducing the dose to the exposed individual, mitigating health impacts, or both. In addition to the conservative assumptions used to develop the source term (the amount of radioactive material released) for this accident, the calculated dose is based on the assumptions that no protective action is taken during the entire time of exposure and that no subsequent medical intervention occurs. Since the annual probability of this seismic event is 0.001, the increased risk of an additional LCF occurring in the population is estimated to be 0.0037 per year; the increased risk of a health effect for an individual on Diamond Drive or the noninvolved worker is estimated to be 0.001 or 1 chance in 1,000.

Table 5–68 Site-Wide Seismic 1 Radiological Accident Offsite Population Consequences for the No Action, Reduced Operations, and Expanded Operations Alternatives

	Maximally Exposed Individual		***Population to 50 Miles (80 kilometers)***	
Facility Impacted by Seismic 1 Event	***Dose (rem)***	***Latent Cancer Fatality*** [a]	***Dose (person-rem)***	***Latent Cancer Fatalities*** [b, c]
Chemistry and Metallurgy Research Building (TA-3-29)	62	0.075	6,100	4 (3.7)
SHEBA (TA-18-168) [d]	0.03	0.000018	0.77	0 (0.00046)
Tritium System Test Assembly (TA-21-155)	0.0015	8.8×10^{-7}	0.049	0 (0.00003)
Tritium Science and Fabrication Facility (TA-21-209)	0.013	7.5×10^{-6}	0.43	0 (0.00026)
Radioactive Liquid Waste Treatment Facility (TA-50-1)	3	0.0018	520	0 (0.31)
Radioassay and Nondestructive Testing Facility (TA-54-38)	64	0.077	1,100	1 (0.67)
Storage Facility (TA-55-185)	6	0.0036	590	0 (0.35)
Decontamination and Volume Reduction System (TA-54-412) (PC-2 Seismic)	2.8	0.0017	49	0 (0.03)
	Max 64	Max 0.077	Total or sum 8,400	Total 5 (5.01)

TA = technical area, SHEBA = Solution High-Energy Burst Assembly, PC = performance category.

[a] Increased risk of an LCF to an individual, assuming the accident occurs.

[b] Increased number of LCFs for the offsite population, assuming the accident occurs.

[c] Offsite population size out to a 50-mile (80-kilometer) radius is approximately 297,000 (TA-3-29), 334,100 (TA-18-168), 271,600 (TA-21-155, -209), 302,000 (TA-50-1), 343,100 (TA-54-38, DVRS).

[d] The SHEBA accident scenario is applicable only to the No Action Alternative. Operation of SHEBA would cease under the Reduced Operations and Expanded Operations Alternatives.

Table 5–69 Site-Wide Seismic 1 Radiological Accident Onsite Worker Consequences for the No Action, Reduced Operations, and Expanded Operations Alternatives

Facility Impacted by Seismic 1 Event	*Noninvolved Worker at 110 Yards (100 meters)*	
	Dose (rem) [a]	*Latent Cancer Fatality* [b]
Chemistry and Metallurgy Research Building (TA-3-29)	2,000	1.0 [c]
SHEBA (TA-18-168) [d]	1.1	0.00064
Tritium System Test Assembly (TA-21-155)	0.011	6.7×10^{-6}
Tritium Science and Fabrication Facility (TA-21-209)	0.097	0.000058
Radioactive Liquid Waste Treatment Facility (TA-50-1)	120	0.15
Radioassay and Nondestructive Testing Facility (TA-54-38)	580	0.69
Storage Facility (TA-55-185)	240	0.29
Decontamination and Volume Reduction System (TA-54-412) (PC-2 Seismic)	10	0.0061

TA = technical area, SHEBA = Solution High-Energy Burst Assembly, PC = performance category.
[a] Individual radiation doses in excess of a few hundred rem would result in acute (near-term) health effects or even death from causes other than cancer. In some cases, medical intervention may be effective in reducing the dose, mitigating health impacts, or both. The listed doses are calculated assuming that the exposed individual takes no protective action during the period of exposure and that no subsequent medical intervention occurs.
[b] Increased risk of an LCF to an individual, assuming the accident occurs.
[c] The indicated dose yields a risk value greater than 1.0. This means that it is likely that an individual exposed to the indicated dose would develop a latent fatal cancer. For this reason, a value of 1.0 is shown.
[d] The SHEBA accident scenario is applicable only to the No Action Alternative. Operation of SHEBA would cease under the Reduced Operations and Expanded Operations Alternatives.

Table 5–70 Site-Wide Seismic 1 Radiological Accident Offsite Population and Worker Risks for the No Action, Reduced Operations, and Expanded Operations Alternatives

Facility Impacted by Seismic 1 Event	*Frequency (per year)*	*Onsite Worker*	*Offsite Population*	
		Noninvolved Worker at 110 Yards (100 meters) [a]	*Maximally Exposed Individual* [a]	*Population to 50 Miles (80 kilometers)* [b, c]
Chemistry and Metallurgy Research Building (TA-3-29)	0.001	0.001	0.000075	0.0037
SHEBA (TA-18-168) [d]	0.001	6.4×10^{-7}	1.8×10^{-8}	4.6×10^{-7}
Tritium System Test Assembly (TA-21-155)	0.001	6.7×10^{-9}	8.8×10^{-10}	3×10^{-8}
Tritium Science and Fabrication Facility (TA-21-209)	0.001	5.8×10^{-8}	7.5×10^{-9}	2.6×10^{-7}
Radioactive Liquid Waste Treatment Facility (TA-50-1)	0.001	0.00015	1.8×10^{-6}	0.00031
Radioassay and Nondestructive Testing Facility (TA-54-38)	0.001	0.00069	0.000077	0.00067
Storage Facility (TA-55-185)	0.001	0.00029	3.6×10^{-6}	0.00035
Decontamination and Volume Reduction System (TA-54-412) (PC-2 Seismic)	0.001	6.1×10^{-6}	1.7×10^{-6}	0.00003
		Maximum 0.001	Maximum 0.000077	Total 0.0051

TA = technical area, SHEBA = Solution High-Energy Burst Assembly, PC = performance category.
[a] Increased risk of an LCF to an individual per year; new seismic data increases the risk by about 50 percent.
[b] Increased number of LCFs for the offsite population per year; new seismic data increases the risk by about 50 percent.
[c] Offsite population size out to a 50-mile (80-kilometer) radius is approximately 297,000 (TA-3-29), 334,100 (TA-18-168), 271,600 (TA-21-155, -209), 302,000 (TA-50-1), 343,100 (TA-54-38, DVRS).
[d] The SHEBA accident scenario is applicable only to the No Action Alternative. Operation of SHEBA would cease under the Reduced Operations and Expanded Operations Alternatives.

All site facilities containing hazardous radiological materials that are susceptible to structural failure during this event could potentially contribute to the exposure of LANL workers and the public in the event of a site-wide seismic event. As a result, the population risks given in Table 5–70 can be summed as shown to provide a meaningful estimate of worker and public impacts. The individual risks to the MEI and noninvolved worker cannot be summed, however, because the risk at a specific location depends on the meteorology during the event. The direction that the wind carries the release from each facility would not impact one location in the same manner for multiple accidents at the same time. As a result, Table 5–70 shows the maximum risk of the individual receptors. The total impact to these individuals could be somewhat greater than indicated if more than one release affects these locations. Table 5–70 only provides estimated impacts for facilities with the highest potential impacts. If all facilities were taken into account, the sum of offsite population impacts from all LANL facilities with radiological materials would be somewhat larger.

As discussed in Section 5.12.3, an updated seismic hazard analysis has been developed for the LANL site (LANL 2007a). Because it is not possible to state the impacts of the different peak horizontal ground accelerations indicated in the updated seismic hazard analysis without detailed structural analyses of LANL facilities, a bounding approach was used to estimate the expected effect of the updated seismic hazard analysis on the SWEIS seismic accident risks. The effect of the revised estimate on the annual probability of exceedance of the Seismic 1 accident would be an increase in radiological risk of 50 percent. This results in a maximum risk of an LCF of 0.00012 for the MEI, 0.0015 for the noninvolved worker, and 0.0077 for the population. These estimated higher seismic accident risks do not take credit for facilities in which complete failure has already been assumed (including the Chemistry and Metallurgy Research Building and Radioassay and Nondestructive Testing Facility in Tables 5–68 through 5–70) and therefore no larger accident source term would be expected at higher seismic ground accelerations. Although these seismic risks have increased due to the results of the updated seismic analysis, they remain less than 1 percent of the highest MEI, noninvolved worker, and population risks for other types of accidents analyzed in the SWEIS.

Site-Wide Seismic 2 – Radiological

Site-Wide Seismic 2 is represented by a PC-3 seismic event. Referring to **Tables 5–71** through **5–73** and noting that all of the listed facilities could contribute to offsite population impacts, the facility with the highest contribution to public consequence is the Plutonium Facility at TA-55. In the event of this seismic event, it is estimated that there would be 9 LCFs in the offsite population from this TA-55 release. The waste storage domes at TA-54 holding transuranic waste would result in the highest contribution to the MEI’s radiological consequences. A TA-55 release would result in the highest contribution to the noninvolved worker’s radiological consequences. As discussed above for the Seismic 1 scenario, depending on the specific radionuclides released and the route of human exposure, radiation doses calculated for the MEI and the noninvolved worker would result in near-term health effects or even death from causes other than cancer. In some cases, medical intervention may be effective in reducing the dose to the exposed individual, mitigating health impacts, or both. In addition to the conservative assumptions used to develop the source term (the amount of radioactive material released) for this accident, the calculated dose is based on the assumptions that no protective action is taken during the entire time of exposure and that no subsequent medical intervention occurs. The risk of additional LCFs from the TA-55 release would be estimated at 0.0035 per year in the offsite population. The next highest risk of an LCF to the general population would be from the waste storage domes. The increased risk of an LCF for the MEI and noninvolved worker are estimated at 1 in 3,600 (0.00028) and 1 in 2,000 (0.0005) per year, respectively.

Table 5–71 Site-Wide Seismic 2 Radiological Accident Offsite Population Consequences for the No Action, Reduced Operations, and Expanded Operations Alternatives

Facility Impacted by Seismic 2 Event	Maximally Exposed Individual		Population to 50 Miles (80 kilometers)	
	Dose (rem) [a]	Latent Cancer Fatality [b]	Dose (person-rem)	Latent Cancer Fatality [c, d]
Chemistry and Metallurgy Research Building (TA-3-29)	62	0.075	6,100	4 (3.7)
Weapons Engineering Tritium Facility (TA-16-205)	17	0.01	110	0 (0.063)
SHEBA (TA-18-168) [e]	0.03	0.000018	0.77	0 (0.00046)
Tritium System Test Assembly (TA-21-155)	0.0015	8.8×10^{-7}	0.049	0 (0.00003)
Tritium Science and Fabrication Facility (TA-21-209)	0.013	7.5×10^{-6}	0.43	0 (0.00026)
Radioactive Liquid Waste Treatment Facility (TA-50-1)	3	0.0018	520	0 (0.31)
Waste Characterization, Reduction, and Repackaging Facility (TA-50-69)	43	0.052	5,400	3 (3.1)
Radioassay and Nondestructive Testing Facility (TA-54-38)	64	0.077	1,100	1 (0.67)
Plutonium Facility (TA-55-4)	150	0.17	14,000	9 (8.6)
Storage Facility (TA-55-185)	6	0.0036	590	0 (0.35)
Decontamination and Volume Reduction System (TA-54-412) (PC-3 Seismic)	34	0.04	600	0 (0.36)
Waste Storage Domes (TA-54)	460	0.55	7,400	5 (4.5)
Safe, Secure Transport Facility (TA-55-355)	3.9	0.0024	290	0 (0.18)
	Max 460	Max 0.55	Total 36,000	Total 22

TA = technical area, SHEBA = Solution High-Energy Burst Assembly, PC = performance category.

[a] Individual radiation doses in excess of a few hundred rem would result in acute (near-term) health effects or even death from causes other than cancer. In some cases, medical intervention may be effective in reducing the dose, mitigating health impacts, or both. The listed doses are calculated assuming that the exposed individual takes no protective action during the period of exposure and that no subsequent medical intervention occurs.

[b] Increased risk of an LCF to an individual, assuming the accident occurs.

[c] Increased number of LCFs for the offsite population, assuming the accident occurs.

[d] Offsite population size out to a 50-mile (80-kilometer) radius is approximately 297,000 (TA-3-29), 404,900 (TA-16-205), 334,100 (TA-18-168), 271,600 (TA-21-155, -209), 302,000 (TA-50-1, -69), 343,100 (TA-54-38, 4-12, Domes), 301,900 (TA-55-4, -185, -355).

[e] The SHEBA accident scenario is applicable only to the No Action Alternative. Operation of SHEBA would cease under the Reduced Operations and Expanded Operations Alternatives.

Table 5–72 Site-Wide Seismic 2 Radiological Accident Onsite Worker Consequences for the No Action, Reduced Operations, and Expanded Operations Alternatives

Facility Impacted by Seismic 2 Event	Noninvolved Worker at 110 Yards (100 meters)	
	Dose (rem) [a]	Latent Cancer Fatality [b]
Chemistry and Metallurgy Research Building (TA-3-29)	2,000	1.0 [c]
Weapons Engineering Tritium Facility (TA-16-205)	156	0.17
SHEBA (TA-18-168) [d]	1.1	0.00064
Tritium System Test Assembly (TA-21-155)	0.011	6.7×10^{-6}
Tritium Science and Fabrication Facility (TA-21-209)	0.097	0.000058
Radioactive Liquid Waste Treatment Facility (TA-50-1)	120	0.15
Waste Characterization, Reduction, and Repackaging Facility (TA-50-69)	1,100	1.0 [b]
Radioassay and Nondestructive Testing Facility (TA-54-38)	580	0.69
Plutonium Facility (TA-55-4)	2,700	1.0 [c]

Facility Impacted by Seismic 2 Event	Noninvolved Worker at 110 Yards (100 meters)	
	Dose (rem) [a]	Latent Cancer Fatality [b]
Storage Facility (TA-55-185)	240	0.29
Decontamination and Volume Reduction System (TA-54-412) (PC-3 Seismic)	120	0.15
Waste Storage Domes (TA-54)	2,200	1.0 [c]
Safe, Secure Transport Facility (TA-55-355)	130	0.16

TA = technical area, SHEBA = Solution High-Energy Burst Assembly, PC = performance category.

[a] Individual radiation doses in excess of a few hundred rem would result in acute (near-term) health effects or even death from causes other than cancer. In some cases, medical intervention may be effective in reducing the dose, mitigating health impacts, or both. The listed doses are calculated assuming that the exposed individual takes no protective action during the period of exposure and that no subsequent medical intervention occurs.

[b] Increased risk of an LCF to an individual, assuming the accident occurs.

[c] The indicated dose yields a risk value greater than 1.0. This means that it is likely that an individual exposed to the indicated dose would develop a fatal latent cancer. For this reason a value of 1.0 is shown.

[d] The SHEBA accident scenario is applicable only to the No Action Alternative. Operation of SHEBA would cease under the Reduced Operations and Expanded Operations Alternatives.

Table 5–73 Site-Wide Seismic 2 Radiological Accident Offsite Population and Worker Risks for the No Action, Reduced Operations, and Expanded Operations Alternatives

Facility Impacted by Seismic 2 Event	Frequency (per year)	Onsite Worker	Offsite Population	
		Risk to Noninvolved Worker at 110 Yards (100 meters) [a]	Maximally Exposed Individual [a]	Population to 50 Miles (80 kilometers) [b, c]
Chemistry and Metallurgy Research Building (TA-3-29)	0.0005	0.0005	0.000037	0.0018
Weapons Engineering Tritium Facility (TA-16-205)	0.0005	8.7×10^{-5}	5×10^{-6}	0.000032
SHEBA (TA-18-168) [d]	0.0005	3.2×10^{-7}	9×10^{-9}	2.3×10^{-7}
Tritium System Test Assembly (TA-21-155)	0.0005	3.3×10^{-9}	4.4×10^{-10}	1.5×10^{-8}
Tritium Science and Fabrication Facility (TA-21-209)	0.0005	2.9×10^{-8}	3.8×10^{-9}	1.3×10^{-7}
Radioactive Liquid Waste Treatment Facility (TA-50-1)	0.0005	0.000073	9.1×10^{-7}	0.00016
Waste Characterization, Reduction, and Repackaging Facility (TA-50-69)	0.0001 [e]	0.0001	5.2×10^{-6}	0.00031
Radioassay and Nondestructive Testing Facility (TA-54-38)	0.0005	0.00035	0.000039	0.00034
Plutonium Facility (TA-55-4)	0.0004 [e]	0.0004	7×10^{-5}	0.0035
Storage Facility (TA-55-185)	0.0005	0.00014	1.8×10^{-6}	0.00018
Decontamination and Volume Reduction System (TA-54-412) (PC-3 Seismic)	0.0005	0.000074	0.00002	0.00018
Waste Storage Domes (TA-54)	0.0005	0.0005	0.00028	0.0022
Safe, Secure Transport Facility (TA-55-355)	0.0005	0.000077	1.2×10^{-6}	0.000088
		Maximum 0.0005	Maximum 0.00028	Total 0.009

TA = technical area, SHEBA = Solution High-Energy Burst Assembly, PC = performance category.

[a] Increased risk of an LCF to an individual per year; new seismic data increases the risk by about 60 percent.

[b] Increased number of LCFs for the offsite population per year; new seismic data increases the risk by about 60 percent.

[c] Offsite population size out to a 50-mile (80-kilometer) radius is approximately 297,000 (TA-3-29), 404,900 (TA-16-205), 334,100 (TA-18, -168), 271,600 (TA-21-155, -209), 302,000 (TA-50-1, -69), 343,100 (TA-54-38, DVRS, Domes), 301,900 (TA-55-4, -185, -355).

[d] The SHEBA accident scenario is applicable only to the No Action Alternative. Operation of SHEBA would cease under the Reduced Operations and Expanded Operations Alternatives.

[e] Different frequency than other seismic events due to assumption of other addition failures.

All site facilities containing hazardous radiological materials that are susceptible to structural failure during this event could potentially contribute to the exposure of LANL workers and the public in the event of a site-wide seismic event. As a result, the offsite population risks given in Table 5–73 can be summed as shown to provide a meaningful estimate of worker and public impacts. The individual risks to the MEI and noninvolved worker cannot be summed because the risk at a specific location depends on the meteorology during the event. The direction that the wind carries the release from each facility would not impact one location in the same manner as for multiple accidents at the same time. As a result, Table 5–73 shows the maximum risk of the individual receptors. The total impact to these individuals could be somewhat greater than indicated if more than one release were to affect these locations. Table 5–73 only provides estimated impacts for facilities with the highest potential impacts. If all facilities were taken into account, the sum of worker and offsite population risks from all LANL facilities with radiological materials could be somewhat higher.

As discussed in Section 5.12.3, an updated seismic hazard analysis has been developed for the LANL site (LANL 2007a). Because it is not possible to state the impacts of the different peak horizontal ground accelerations indicated in the updated seismic hazard analysis without detailed structural analyses of LANL facilities, a bounding approach was used to estimate the expected effect of the updated seismic hazard analysis on the SWEIS seismic accident risks. The effect of the revised estimate of the probability of exceedance of the Seismic 2 accident would be an increase in radiological risk of 60 percent. This results in a maximum risk of an LCF of 0.00045 for the MEI, 0.0008 for the noninvolved worker, and 0.014 for the population. These estimated higher seismic accident risks do not take credit for facilities in which complete failure has already been assumed (including the Chemistry and Metallurgy Research Building and Radioassay and Nondestructive Testing Facility in Tables 5–71 through 5–73) and therefore no larger accident source term would be expected at higher seismic ground accelerations. Although these seismic risks have increased due to the results of the updated seismic analysis, they remain less than 1 percent of the highest MEI, noninvolved worker, and population risks for other types of accidents analyzed in the SWEIS.

Site-Wide Seismic 1 – Chemical

The facilities and chemicals of concern under site-wide Seismic 1 conditions are shown in **Table 5–74**. There are numerous chemicals in small quantities onsite that may be released under these conditions. The listed chemicals were selected from a complete set of chemicals used onsite, based on their larger quantities, chemical properties, and human health effects. Exposure to concentrations in excess of the ERPG values could result in serious health effects or life-threatening implications to the exposed individuals.

Table 5–74 also shows the estimated annual risks for workers and the public in the event of an accidental release of each chemical. The annual frequency of this accident is 0.001 based on the *Seismic Hazards Evaluation of the Los Alamos National Laboratory (February 24, 1995)*. Based on the 2007 update of the seismic hazard analysis (LANL 2007a), the annual frequency is estimated to be 0.0015. Because this accident is a site-wide seismic event, all of the chemicals shown in the table would be released almost simultaneously. The annual risk of exposure to workers and the public to chemical concentrations in excess of ERPG-2 and ERPG-3 values is 1 in 1,000 based on the previous seismic hazard analysis and 1 in 700 based on the 2007 update of the seismic hazard analysis. The nearest public access relative to each facility is shown for each chemical. For some chemicals, the nearest public access point is beyond the distance at which concentrations would be at ERPG values. In these instances, there would likely be no serious health affects to the public in the event of an accident. For formaldehyde, as shown in Table 5–74, the nearest public access point is closer than the distance at which concentrations would be at the ERPG values. If this accident were to occur, members of the public could be exposed to harmful and possibly fatal concentrations of formaldehyde.

Table 5–74 Chemical Accident Risks under Seismic 1 Conditions for the No Action, Reduced Operations, and the Expanded Operations Alternatives

Chemical	*Frequency*[a] *(per year)*	*Quantity Released*	*ERPG-2*[a, b]		*ERPG-3*[a, c]	
			Value (ppm)	*Annual Risk*	*Value (ppm)*	*Annual Risk*
Hydrogen cyanide at TA-3-66 (Sigma Complex)	0.001	13.5 pounds (6.1 kilograms)	10	1 chance in 1,000 years of workers within 150 yards (137 meters) of facility receiving exposures in excess of limit. Nearest public access is at 260 yards (238 meters).	25	1 chance in 1,000 years of workers within 94 yards (86 meters) of facility receiving exposures in excess of limit. Nearest public access is at 260 yards (238 meters).
Phosgene at TA-9-21	0.001	1 pound (0.45 kilograms)	0.2	1 chance in 1,000 years of workers within 302 yards (276 meters) of facility receiving exposures in excess of limit. Nearest public access is at 900 yards (823 meters).	1	1 chance in 1,000 years of workers within 129 yards (118 meters) of facility receiving exposures in excess of limit. Nearest public access is at 900 yards (823 meters).
Formalde-hyde at TA-43-1 (Bioscience Facilities)	0.001	3.7 gallons (14.1 liters)	10	1 chance in 1,000 years of workers or public within 195 yards (178 meters) of facility receiving exposures in excess of limit. Nearest public access is at 13 yards (12 meters).	25	1 chance in 1,000 years of workers or public within 122 yards (112 meters) of facility receiving exposures in excess of limit. Nearest public access is at 13 yards (12 meters).

ERPG = Emergency Response Planning Guideline, ppm = parts per million, TA = technical area.

[a] A conservative estimate of the frequency based on the 2007 probabilistic seismic hazard analysis (LANL 2007a) is 0.0015. The corresponding annual risk would be 1 chance in 700 years.

[b] ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action (DOE 2005e).

[c] ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects (DOE 2005e).

Site-Wide Seismic 2 - Chemical

The facilities and chemicals of concern under Site-Wide Seismic 2 conditions are shown in **Table 5–75**. There are numerous chemicals in small quantities onsite that could be released under these conditions. The listed chemicals were selected from a complete set of chemicals used onsite based on their larger quantities, chemical properties, and human health effects.

Table 5–75 Chemical Accident Risks under Seismic 2 Conditions for the No Action, Reduced Operations, and Expanded Operations Alternatives

			ERPG-2 [a, b]		*ERPG-3* [a, c]	
Chemical	***Frequency*** [a] ***(per year)***	***Quantity Released***	***Value (ppm)***	***Annual Risk***	***Value (ppm)***	***Annual Risk***
Hydrogen cyanide at TA-3-66 (Sigma)	0.0005	13.5 pounds (6.1 kilograms)	10	1 chance in 2,000 years of workers within 150 yards (137 meters) of facility receiving exposures in excess of limit. Nearest public access is at 260 yards (238 meters).	25	1 chance in 2,000 years of workers within 94 yards (86 meters) of facility receiving exposures in excess of limit. Nearest public access is at 260 yards (238 meters).
Phosgene at TA-9-21	0.0005	1 pound (0.45 kilograms)	0.2	1 chance in 2,000 years of workers within 302 yards (276 meters) of facility receiving exposures in excess of limit. Nearest public access is at 900 yards (823 meters).	1	1 chance in 2,000 years of workers within 129 yards (118 meters) of facility receiving exposures in excess of limit. Nearest public access is at 900 yards (823 meters).
Formaldehyde at TA-43-1 (Bioscience Facilities)	0.0005	3.7 gallons (14.1 liters)	10	1 chance in 2,000 years of workers or public within 195 yards (178 meters) of facility receiving exposures in excess of limit. Nearest public access is at 13 yards (12 meters).	25	1 chance in 2,000 years of workers or public within 122 yards (112 meters) of facility receiving exposures in excess of limit. Nearest public access is at 13 yards (12 meters).
Chlorine gas released outside of Plutonium Facility Complex (TA-55-4)	0.0005	150 pounds (68 kilograms)	3	1 chance in 2,000 years of workers within 1,181 yards (1,080 meters) of facility receiving exposures in excess of limit. Nearest public access is at 1,111 yards (1,016 meters).	20	1 chance in 2,000 years of workers within 416 yards (380 meters) of facility receiving exposures in excess of limit. Nearest public access is at 1,111 yards (1,016 meters).
Nitric acid spill at Plutonium Facility Complex (TA-55-4)	0.0005	6,100 gallons (23,090 liters)	6	1 chance in 2,000 years of workers within 53.6 yards (49 meters) of facility receiving exposures in excess of limit. Nearest public access is at 1,111 yards (1,016 meters).	78	1 chance in 2,000 years of workers within 7.2 yards (6.6 meters) of facility receiving exposures in excess of limit. Nearest public access is at 1,111 yards (1,016 meters).
Hydrochloric acid spill at TA-55-249	0.0005	5,200 gallons (19,684 liters)	20	1 chance in 2,000 years of workers or public within 220 yards (185 meters) of facility receiving exposures in excess of limit. Nearest public access is at 1,221 yards (1,117 meters).	150	1 chance in 2,000 years of workers or public within 70 yards (64 meters) of facility receiving exposures in excess of limit. Nearest public access is at 1,221 yards (1,117 meters).
Beryllium at TA-3-141 (Beryllium Technology Facility)	0.0005	110 pounds (49 kilograms) (powder) [d]	0.025 [d]	1 chance in 2,000 years of workers or public within 309 yards (282 meters) of facility receiving exposures in excess of limit. Nearest public access is at 963 yards (880 meters).	0.1 [d]	1 chance in 2,000 years of workers or public within 127 yards (116 meters) of facility receiving exposures in excess of limit. Nearest public access is at 963 yards (880 meters).

ERPG = Emergency Response Planning Guideline, ppm = parts per million, TA = technical area.

[a] A conservative estimate of the frequency based on the 2007 probabilistic seismic hazard analysis (LANL 2007a) is 0.0008. The corresponding annual risk would be 1 chance in 1,250 years.

[b] ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action (DOE 2005e).

[c] ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects (DOE 2005e).

[d] Units for beryllium are in milligrams per cubic meter.

Table 5–75 also shows the estimated annual risks for workers and the public in the event of an accidental release of each chemical. The annual frequency of this accident is 0.0005 based on the *Seismic Hazards Evaluation of the Los Alamos National Laboratory (February 24, 1995)*. Based on the 2007 update of the seismic hazard analysis (LANL 2007a), the annual frequency is estimated to be 0.0008. As this accident is a site-wide seismic event, all of the chemicals shown in the table would be released almost simultaneously. The annual risk of exposure to workers and the public to chemical concentrations in excess of ERPG-2 and ERPG-3 values is 1 in 2,000 per year based on the previous seismic hazard analysis and 1 in 1,250 based on the 2007 update of the seismic hazard analysis. The nearest public access point relative to each facility is shown for each chemical. For some chemicals, the nearest public access point is beyond the distance at which concentrations would be at ERPG values. In these instances, there would likely be no serious health affects to the public in the event of an accident. As shown in Table 5–75, for formaldehyde at the Bioscience Facilities and chlorine gas at the Plutonium Facility Complex, the nearest public access points are closer than the distance at which concentrations would be at the ERPG values. If these accidents were to occur, members of the public could be exposed to harmful and possibly fatal concentrations of these chemicals.

5.12.3.2 Reduced Operations Alternative

Site-Wide Seismic 1 and 2 – Radiological

The site-wide Seismic 1 and 2 radiological accident impacts under the Reduced Operations Alternative are similar to those under the No Action Alternative, as shown in Tables 5–68 through 5–73. Activities at TA-18, including operation of SHEBA, would cease under this alternative. SHEBA operations are a small component of the site-wide seismic accident impacts at LANL; its elimination would not significantly alter the overall site risk profile from such an event. All other impacts in the tables are equally applicable for this alternative.

Site-Wide Seismic 1 and 2 – Chemical

The chemicals of concern that could be released in a site-wide Seismic 1 or 2 event are the same under the Reduced Operations Alternative as those under the No Action Alternative. None of the chemicals identified for the latter is eliminated in this alternative. The information in Tables 5–74 and 5–75, then, is applicable to the Reduced Operations Alternative.

5.12.3.3 Expanded Operations Alternative

Site-Wide Seismic 1 and 2 – Radiological

The Seismic 1 and 2 accident impacts under the Expanded Operations Alternative are similar to those under the No Action Alternative, as shown in Tables 5–68 through 5–73. SHEBA operations would cease under the Expanded Operations Alternative. Because the potential impacts are relatively small, deleting this accident does not change the overall risk profile of this alternative. Additional accident risks would result from expanded waste management activities. Transuranic waste storage would be consolidated in a new facility, the TRU Waste Facility, which would be located in TA-50 or a generic site along the Pajarito Road corridor. The TRU Waste Facility would carry fewer potential accident impacts than the existing facility because of its new location and because less material would be stored onsite. The entries in Tables 5–68 through 5–73 reflect present Decontamination and Volume Reduction System Facility operations because the system would be active for most of the period of interest. Present accident impacts bound the impacts of the replacement facility. The potential accident impacts for the new facility are described in Appendix H.

Site-Wide Seismic 1 and 2 – Chemical

The chemicals of concern that could be released in a site-wide Seismic 1 or 2 event are the same under the Expanded Operations Alternative as those under the No Action Alternative. No additional chemicals were identified under this alternative that would have impacts exceeding those under the No Action Alternative. The information in Tables 5–74 and 5–75, therefore, also applies to the Expanded Operations Alternative.

5.12.4 Wildfire Accident Impacts

Wildfire accident scenarios were postulated as a method of evaluating potential impacts to onsite workers and the offsite population. Details of these scenarios are provided in Appendix D, including a discussion of the LANL buildings that could be affected by wildfire, an inventory of hazardous radiological materials, and the source term factors and estimated source terms.

5.12.4.1 Wildfire – Radiological

The estimated radiological consequences of a wildfire to workers and the public are shown in **Tables 5–76** and **5–77** for each listed facility. The values shown assume that a wildfire has occurred and therefore do not reflect any credit for the probability of a wildfire occurrence. The estimated annual risks for each wildfire scenario are shown in **Table 5–78**. These values take credit for the probability of a wildfire's occurrence. The wildfire accident scenario consequences and risks in Table 5–76 through 5–78 apply to the No Action, Reduced Operations and Expanded Operations Alternatives.

As shown in Table 5–76, the results indicate that radiological releases from the TA-54 waste storage domes dominate the impacts to workers and the public. In the event of this accident, the consequence to the MEI is a likelihood of developing an LCF during his or her lifetime and an additional 55 LCFs for the population. As shown in Table 5–77, an onsite worker located 110 yards (100 meters) from the facility would be likely to develop an LCF as a result of this accident occurring at TA-54.

The risks for this accident, which takes credit for its low frequency of occurrence, are estimated to be about 1 chance in 20 (0.05) of an increased likelihood of an LCF per year for the MEI and an additional 2.7 LCFs per year of operations in the offsite population. An onsite worker located 110 yards (100 meters) from the facility would experience an increased likelihood of an LCF of about 1 chance in 20 (0.05) per year of operations. These risks assume that the receptors do not take evasive action in the event of a wildfire. Because releases from the TA-54 domes dominate the consequences and risks from a wildfire, they represent the total impacts on the offsite and worker populations.

Table 5–76 Radiological Accident Offsite Population Consequences for a Wildfire Accident for the No Action, Reduced Operations, and Expanded Operations Alternatives

Facility Impacted by Wildfire	*Maximally Exposed Individual*		*Population to 50 Miles (80 kilometers)*	
	Dose (rem)	*Latent Cancer Fatality Risk* [a]	*Dose (person-rem)*	*Latent Cancer Fatalities* [b, c]
Sigma Complex (TA-3-66/451)	0.0039	2.3×10^{-6}	4.8	0 (0.0029)
Weapons Engineering Tritium Facility (TA-16-205)	0.061	0.000036	110	0 (0.067)
Radiochemistry Facility (TA-48-1)	0.0011	6.4×10^{-7}	0.44	0 (0.00026)
Waste Storage Domes (TA-54)	1,900	1.0 [d]	91,000	55 (54.8)
Device Assembly (TA-16-411)	1.6×10^{-6}	8.9×10^{-10}	0.00017	0 (1×10^{-7})
Decontamination and Volume Reduction System (TA-54-412)	4.9	0.003	1,200	0 (0.7)
Radiography (TA-8-23)	0.00033	2×10^{-7}	0.56	0 (0.00034)
Waste Characterization, Reduction, and Repackaging Facility (TA-50-69)	27	0.032	6,900	4 (4.2)

TA = technical area.
[a] Increased risk of an LCF to an individual, assuming the accident occurs.
[b] Increased number of LCFs for the offsite population, assuming the accident occurs; value in parentheses is the calculated result.
[c] Offsite population size is approximately 297,030 for TA-3-66/451; 404,913 for TA-16-205 and TA-16-411; 299,508 for TA-48-01; 343,069 for Domes, and TA-54-412; and 349,780 for TA-8-23.
[d] The indicated dose yields a risk greater than 1.0. This means that it is likely that an individual exposed to the indicated dose would develop a latent fatal cancer. For this reason, a value of 1.0 is shown.

Table 5–77 Radiological Accident Onsite Worker Consequences for a Wildfire Accident for the No Action, Reduced Operations, and Expanded Operations Alternatives

Accident	*Noninvolved Worker at 110 Yards (100 meters)*	
	Dose (rem)	*Latent Cancer Fatality* [a]
Sigma Complex (TA-3-66/451)	0.076	0.000046
Weapons Engineering Tritium Facility (TA-16-205)	0.33	0.0002
Radiochemistry Facility (TA-48-1)	0.016	9.3×10^{-6}
Waste Storage Domes (TA-54)	8,700	1.00 [b]
Device Assembly (TA-16-411)	0.000017	1×10^{-8}
Decontamination and Volume Reduction System (TA-54-412)	16	0.0098
Radiography (TA-8-23)	0.0019	1.2×10^{-6}
Waste Characterization, Reduction, and Repackaging Facility (TA-50-69)	440	0.53 [b]

TA = technical area.
[a] Increased risk of an LCF to an individual, assuming the accident occurs.
[b] The indicated dose yields a risk greater than 1.0. This means that it is likely that an individual exposed to the indicated dose would develop a latent fatal cancer. For this reason, a value of 1.0 is shown.

Table 5–78 Radiological Accident Offsite Population and Worker Risks for a Wildfire Accident for the No Action, Reduced Operations, and Expanded Operations Alternatives

Accident	Frequency (per year)	Onsite Worker	Offsite Population	
		Noninvolved Worker at 110 Yards (100 meters) [a]	Maximally Exposed Individual [a]	Population to 50 Miles (80 kilometers) [b, c]
Sigma Complex (TA-3-66/451)	0.05	2.3×10^{-6}	1.2×10^{-7}	0.00014
Weapons Engineering Tritium Facility (TA-16-205)	0.05	1×10^{-5}	1.8×10^{-6}	0.0034
Radiochemistry Facility (TA-48-1)	0.05	4.7×10^{-7}	3.2×10^{-8}	1.3×10^{-5}
Waste Storage Domes (TA-54)	0.05	0.05	0.05	2.7
Device Assembly (TA-16-411)	0.05	5.2×10^{-10}	4.4×10^{-11}	5.2×10^{-9}
Decontamination and Volume Reduction System (TA-54-412)	0.05	0.00049	0.00015	0.035
Radiography (TA-8-23)	0.05	5.7×10^{-8}	1×10^{-8}	1.7×10^{-5}
Waste Characterization, Reduction, and Repackaging Facility (TA-50-69)	0.01 [d]	0.0053	0.00032	0.042

TA = technical area.
[a] Increased risk of an LCF to an individual per year.
[b] Increased number of LCFs for the offsite population per year; value in parentheses is the calculated result.
[c] Offsite population size is approximately 297,030 for TA-3-66/451; 404,913 for TA-16-205 and TA-16-411; 299,508 for TA-48-01; 343,069 for Domes and TA-54-412; and 349,780 for TA-8-23.
[d] Assumes additional failures.

5.12.4.2 Wildfire – Chemical

The chemicals of concern at LANL facilities under wildfire conditions are shown in **Table 5–79**. They were selected from a database of chemicals used onsite based on their quantities, chemical properties, and human health effects. The table shows the ERPG-2 and ERPG-3 values for which, were an accident to occur, concentrations in excess of these values could result in serious health effects or life-threatening implications for exposed individuals.

Table 5–79 also shows the risks of worker and public exposure in the event of a chemical release, as well as the estimated frequency of each release. The direction traveled by the chemical plume would depend on the meteorological conditions at the time of the accident and would determine which segment of the worker and offsite populations would be at risk of exposure. The wildfire chemical accident impacts in Table 5–79 apply to the No Action, Reduced Operations, and Expanded Operations Alternatives.

For formaldehyde at TA-43-1, there is an annual risk of 0.05 (once in 20 years) that workers and the public within a distance of 97 yards (89 meters) of the release would be exposed to concentrations in excess of ERPG-3 values. The workers and public within a distance of 154 yards (141 meters) of the release would face the same risk of being exposed to concentrations in excess of ERPG-2 values.

Table 5–79 Chemical Accident Risks under Wildfire Conditions for the No Action, Reduced Operations, and Expanded Operations Alternatives

Chemical	Frequency (per year)	Quantity Released	ERPG-2 [a]		ERPG-3 [b]	
			Value (ppm)	Annual Risk	Value (ppm)	Annual Risk
Formaldehyde at TA-43-1	0.05	3.7 gallons (14.1 liters)	10	1 chance in 20 years of workers or public within 154 yards (141 meters) of facility receiving exposures in excess of limit. Nearest public access is at 13 yards (12 meters).	25	1 chance in 20 years of workers or public within 97 yards (89 meters) of facility receiving exposures in excess of limit. Nearest public access is at 13 yards (12 meters).
Hydrogen cyanide from TA-3-66	0.05	13.5 pounds (6.1 kilograms)	10	1 chance in 20 years of workers within 118 yards (108 meters) of facility receiving exposures in excess of limit. Nearest public access is at 260 yards (238 meters).	25	1 chance in 20 years of workers within 77 yards (70 meters) of facility receiving exposures in excess of limit. Nearest public access is at 260 yards (238 meters).

ERPG = Emergency Response Planning Guideline, ppm= parts per million, TA = technical area.
[a] ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action (DOE 2005e).
[b] ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects (DOE 2005e).

For hydrogen cyanide released from TA-3-66, there is an annual risk of 0.05 (once in 20 years) that workers within a distance of 77 yards (70 meters) of the release would be exposed to concentrations in excess of ERPG-3 values. The workers within a distance of 118 yards (108 meters) of the release would face the same risk of being exposed to concentrations in excess of ERPG-2 values. There would be no risk that the public would receive an exposure in excess of ERPG-2 or ERPG-3 values because the nearest public access is 260 yards (238 meters) from the location of this chemical release.

5.12.5 Construction Accidents

The construction of new facilities includes the risk of accidents that could impact workers. Because construction activities do not involve radioactive materials, there would be no radiological impacts. The presence of hazardous flammable, explosive, and other chemical substances, however, could initiate accident conditions that could impact the health and safety of workers. In addition, in the course of their work, construction and site personnel could receive serious or fatal injuries as a result of incidents that fall in the category of industrial accidents. DOE’s construction contractors are required to adhere to strict safety standards and procedures to promote a working environment that minimizes the possibility of such accidents.

5.12.6 Terrorist Incidents

The analysis of the impacts of terrorist incidents is described in a classified appendix to this SWEIS. The impacts of some terrorist incidents would be similar to the accident impacts described earlier in this section, while some terrorist incidents may have more severe impacts.

This section describes how NNSA assesses the vulnerability of its sites to terrorist threats and then designs its response systems.

5.12.6.1 Assessment of Vulnerability to Terrorist Threats

In accordance with DOE Order 470.3A, "Design Basis Threat Policy," and DOE Order 470.4, "Safeguards and Security Program," NNSA conducts vulnerability assessments and risk analyses of the facilities and sites under its management to evaluate the possible threats and the protection elements, technologies, and administrative controls used to protect against these threats. DOE Order 470.4 establishes the roles and responsibilities for the conduct of DOE's Safeguards and Security Program. DOE Order 470.3A establishes requirements designed to prevent unauthorized access, theft, diversion, or sabotage (including unauthorized detonation or destruction) of all nuclear weapons, nuclear weapons components, and special nuclear material under DOE's control. Among other provisions, the Order (a) specifies those national security assets that require protection; (b) outlines threat considerations for safeguards and security programs to provide a basis for planning, design, and construction of new facilities or modifications to existing facilities; and (c) provides an adversary threat basis for evaluating the performance of safeguards and security systems. NNSA also protects against espionage, sabotage, and theft of radiological, chemical, or biological materials; classified matter; non-nuclear weapon components; and critical technologies.

NNSA's safeguards and security programs and systems employ state-of-the-art technologies to:

- Deny access to nuclear weapons, nuclear test devices, and completed nuclear assemblies;
- Prevent theft, sabotage, or an unauthorized nuclear yield (criticality) of special nuclear materials and credible rollup quantities of special nuclear materials.
- Protect the public and employees from unacceptable impacts resulting from an adversary's use of radiological, chemical, or biological materials; and
- Protect classified matter and designated critical facilities and activities from sabotage, espionage, and theft.

NNSA's vulnerability assessments employ a rigorous methodology based on guidance from the *DOE Vulnerability Assessment Process Guide* (September 2004), and the Vulnerability Assessment Certification course. Typically, a vulnerability assessment involves analyses of modeling, simulation, and performance testing results by subject matter experts to determine the effectiveness of a safeguard and security system against an adversary's objectives. Vulnerability assessments generally include the following activities.

Characterizing the threat. Threat characterization provides a detailed description of a physical threat by a malevolent adversary to a site's physical protection systems. Usually the description includes information about potential adversary types, motivations, objectives, actions, physical capabilities, and site-specific tactical considerations. Much of the information required to develop a threat characterization is described in DOE Order 470.3A and the Adversary Capabilities List. DOE also issues additional site-specific threat clarification and guidance.

Determining the target. Target determination involves identifying, describing, and prioritizing potential targets among NNSA's security interests that meet the criteria outlined in DOE Order 470.3A. Target determination results are used to help characterize potential threats and target facilities, as well as protective force and neutralization requirements.

Defining the scope. The scope of a vulnerability assessment is determined by agreement among DOE Headquarters and Field staff and contractor personnel. In addition to defining the threat and applicable targets to be assessed, the scope establishes the key assumptions and interpretations that will guide the analyses, as well as the objectives, methods, schedule, personnel responsibilities, and format for documenting the results of the assessment.

Characterizing the facility or site. This activity requires defining and documenting aspects of the facility or site, particularly existing security programs (personnel security, information security, physical security, material control and accountability, etc.), to assist in identifying strengths and weaknesses. Results are used as inputs to the pathway analyses used to develop representative case scenarios for evaluating the security system. Facility and site characterization modeling tools include Analytical System and Software for Evaluating Safeguards and Security (ASSESS), Adversary Time-Line Analysis System (ATLAS), VISA, tabletop analysis, and others.

Characterizing the protective force. To assess a facility or site's vulnerability, analysts must accurately characterize the associated protective force's capabilities against a defined threat and objective, particularly the force's ability to detect, assess, respond to, interrupt, and neutralize an adversary. Specific data used for this activity include special nuclear materials categorization; configuration, flow, and movement of special nuclear materials within or from a facility or site; defined threats; detection and assessment times; and adversary delay and task time. The protective force's equipment, weapons, number, and locations also are considered in the characterization. The characterization information is validated and verified via observation, alarm response assessments, limited scope performance tests, force-on-force exercises, joint conflict and tactical simulations (JCATS), and tabletop analyses. The JCATS software tool is used for training, analysis, planning, and mission rehearsal, as well as characterization of the protective force. It employs detailed graphics and models of buildings, natural terrain features, and roads to simulate realistic operations in urban and rural environments.

Analyzing adversary pathways. This activity identifies and analyzes base case adversary pathways based on the results of threat, target, facility, and protective force characterization, as well as ancillary analyses such as explosives analysis. ASSESS and ATLAS are two primary tools that are used in this analysis. Analysts also conduct insider analysis as part of this activity.

Developing base case scenarios. Base case scenarios are developed for use in performance testing and to determine the effectiveness of the security system in place against a potential adversary's capabilities and objectives. As part of this activity, data from the base case adversary pathways analyses are used to identify applicable threats, threat strategies, and objectives, and combined with protective force strategies and capabilities to develop scenarios that include specific adversary resources, capabilities, and projected task times to successfully complete their objectives. Specialists also work with the vulnerability assessment team to develop realistic scenarios that provide a structured, intellectually honest analysis of the strengths and weaknesses of the terrorist adversary.

Determining the probability of neutralization. The probability of neutralization is a numeric value representing the probability that the protective force can prevent an adversary from achieving their objectives. The calculated number is derived from more than one source, one of which must be based on Joint Tactical Simulation, JCATS analysis, or force-on-force exercises.

Determining system effectiveness. System effectiveness is determined by applying an equation that reflects the capabilities of a multi-layered protection system. Analysis data derived from the various vulnerability assessment activities are used to calculate this equation, which reflects the security system's effectiveness against each of the scenarios developed for the vulnerability assessment. If system effectiveness is unacceptable for a scenario, the root cause of the weakness must be analyzed and security upgrades must be identified. The scenarios are reanalyzed with the upgrades, and the successful upgrades are documented in the vulnerability analysis report.

Implementation. The culmination of the vulnerability assessment is development of a report documenting the analyses and results and a plan for implementing any necessary upgrades to achieve the required security system effectiveness. NNSA verifies the results of the vulnerability assessment report and the conclusions of the implementation plan. NNSA also provides management oversight of the actual implementation of security system upgrades.

5.12.6.2 Terrorist Impacts Analysis

Substantive details of terrorist attack scenarios and security countermeasures are not released to the public because disclosure of this information could be exploited by terrorists to plan attacks. Depending on the malevolent, terrorist, or intentionally destructive acts, impacts may be similar to or could exceed bounding accident impact analyses prepared for the SWEIS. A separate classified appendix to this Final SWEIS has been prepared that considers the underlying facility threat assumptions with regard to malevolent, terrorist, or intentionally destructive acts. Based on these threat assumptions, the classified appendix evaluates the potential human health impacts using appropriate analytical models, similar to the methodology used in this SWEIS to analyze accident impacts. These data provide NNSA with information upon which to base, in part, decisions regarding activities at LANL.

5.13 Cumulative Impacts

In accordance with the Council on Environmental Quality regulations, a cumulative impact analysis includes, "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 1508.7).

The cumulative impact analysis for this SWEIS includes (1) an examination of cumulative impacts presented in the *1999 SWEIS*; (2) impacts since the *1999 SWEIS* was issued, which are presented in this chapter; and (3) a review of the environmental impacts of past, present, and reasonably foreseeable actions for other Federal and non-Federal agencies in the region.

Reasonably foreseeable future actions that are likely to occur at LANL are described in Chapter 3, Section 3.3 under the Expanded Operations Alternative. Additional DOE or NNSA actions that could impact LANL include consolidation of nuclear operations related to production of radioisotope power systems; proposed operation of a Biosafety Level 3 Facility; a potential advanced fuel cycle facility; implementation of NNSA's complex transformation planning; and a disposal facility for Greater-Than-Class C waste.

Consolidation of DOE plutonium-238 activities at the Idaho National Laboratory as proposed in the *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems* (DOE/EIS-0373D) (*Consolidation EIS*) (DOE 2005c) would reduce plutonium-238 operations at LANL. Regardless of the decision on the *Consolidation EIS*, some plutonium-238 operations would continue at LANL. Therefore, very small changes in the impacts from plutonium-238 activities at LANL would be realized.

If current plutonium-238 operations were continued at the LANL Plutonium Facility Complex, as described under the *Consolidation EIS* No Action Alternative, manufacturing of up to 80 pits per year could still be accomplished within the LANL Plutonium Facility Complex. This production rate would be accomplished by consolidating a number of plutonium processing and support activities (such as analytical chemistry and materials characterization at the Chemistry and Metallurgy Research Replacement Facility). The impacts of the 80-pit-per-year production rate and plutonium-238 processing (at levels far above the level identified in the *Consolidation EIS*) were evaluated in both the LANL *1999 SWEIS* and this new SWEIS. These evaluations indicate there would be no additional cumulative effects from these activities.

NNSA is preparing an *Environmental Impact Statement for the Operation of a Biosafety Level-3 Facility at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EIS-0388D). Operation of the Biosafety Level 3 Facility would be consistent with the land use designation of Research & Development for Experimental Science. The facility is visually compatible with surrounding structures, therefore there are no impacts to visual resources. There would be no impacts to geology and soils and water resources from operations. Air emissions from the Biosafety Level 3 Facility laboratories would be HEPA-filtered, resulting in very minor air quality effects. Noise impacts would be limited to sounds from heating, ventilation, and air conditioning operations, consistent with other buildings in the area. Facility operations would have no effect upon ecological resources or prehistoric, historic, traditional or paleontological resources in the area. Facility personnel would come primarily from the existing LANL workforce, resulting in no socioeconomic impacts. Operations would be well within LANL infrastructure capability to provide utilities requirements such as electricity, water, and natural gas. There would be no discernable effects on local traffic conditions. There have been no reported cases of illnesses in the United States due to the release of diagnostic specimens during transport (Cummings 2007).

There would be a low potential risk of illness to site workers or visitors from routine operations involving biohazardous material and no public human health effect. Accident conditions would result in minimal or no impact to the public primarily because there would be severely limited opportunity for transport of an infectious dose of a biohazardous material to the public. Biohazardous material would be handled in open cultures only in a biosafety cabinet, where a spill would be contained. In addition, biohazardous material would be handled in a liquid or solid culture container that would release very few organisms to the air if dropped or spilled. This means that one of the most critical risk factors, public exposure to an infectious dose from a biohazardous material, is greatly minimized, and therefore, the potential risk of disease would be very low. The EIS will evaluate slope stability at the Biosafety Level 3 Facility based on the recent update to the LANL probabilistic seismic hazard analysis (Cummings 2007, LANL 2007a).

DOE issued a Notice of Intent (NOI) to prepare the *Global Nuclear Energy Partnership Programmatic Environmental Impact Statement (GNEP PEIS)* (DOE/EIS-0396) on January 4, 2007 (72 FR 331). The Global Nuclear Energy Partnership (GNEP) would encourage expansion of domestic and international nuclear energy production while reducing nuclear proliferation risks, and reduce the volume, thermal output, and radiotoxicity of spent nuclear fuel before disposal in a geologic repository. The *GNEP PEIS* includes evaluation of a proposed advanced fuel cycle facility that would support research and development associated with the GNEP program. LANL is one of the DOE sites being considered for the research facility. The advanced fuel cycle facility would be a large shielded facility (approximately 1 million square feet [92,900 square meters]) (DOE 2008). Construction would begin in about 2014 with full operations planned for 2020. Potential cumulative impacts at LANL associated with the proposed advanced fuel cycle facility were addressed in the *Complex Transformation SPEIS* cumulative impacts analysis based on preliminary data (DOE 2007b). Where available, the cumulative impacts analyses in this SWEIS are based on more recent, but still preliminary data (DOE 2008). Impacts analyses for the *GNEP PEIS* are still underway so data for some resource areas are not available at this time and data that are included in this SWEIS could change prior to public release of the draft *GNEP PEIS*.

In 2006, NNSA outlined a comprehensive proposal, called Complex Transformation, for a smaller, more efficient nuclear weapons complex that would be better able and more suited to respond to future national security challenges (NNSA 2006b). On October 19, 2006, NNSA issued an NOI (71 FR 61731) to prepare a *Supplement to the Stockpile Stewardship and Management Programmatic Environmental Impact Statement - Complex 2030* (now called the *Complex Transformation Supplemental Programmatic Environmental Impact Statement* [*Complex Transformation SPEIS*]). This NOI also announced the cancellation of NNSA's previous proposal to build a modern pit facility for which NNSA issued a draft Supplemental EIS in June 2003 (68 FR 33487). LANL had been one of the sites under consideration for a modern pit facility. The NOI outlined some alternatives for transforming the nuclear weapons complex to better meet future national security requirements, including a proposal to construct and operate a consolidated plutonium center within the complex. Another proposal, to construct and operate a consolidated nuclear production center, was added during the scoping period, which ended in January 2007. Both of these proposals are analyzed in the Draft *Complex Transformation SPEIS* (DOE 2007b).

Implementation of the alternatives analyzed through the *Complex Transformation SPEIS* could result in changes to facilities and operations at LANL; for instance, NNSA is reconsidering construction of the nuclear facility portion of the Chemistry and Metallurgy Research Replacement project, and the impacts of not constructing that facility have been addressed in the Reduced Operations Alternative in this SWEIS. LANL is one of the sites under consideration for a consolidated plutonium center or a consolidated nuclear production center. The Preferred Alternative in the Draft *Complex Transformation SPEIS* is to site a consolidated plutonium center at LANL with a capacity of up to 80 pits per year, based on the use of the existing and planned infrastructure already described in the SWEIS Expanded Operations Alternative. This SWEIS cumulative impacts analysis addresses the impacts of construction and operation of a consolidated nuclear production center at LANL; the center would include primarily new plutonium, highly enriched uranium, and weapons assembly/disassembly facilities.

On July 23, 2007, DOE issued an NOI to prepare an *Environmental Impact Statement for the Disposal of Greater-Than-Class-C Low-Level Radioactive Waste (GTCC EIS)* (72 FR 40135). The *GTCC EIS* will address the disposal of low-level radioactive waste that contains radionuclides in concentrations exceeding 10 CFR Part 61 Class C limits, generated by activities licensed by the U.S. Nuclear Regulatory Commission or an Agreement State, as well as DOE waste having similar characteristics. Certain sealed sources that would be managed at LANL under the Off-Site Source Recovery Project would be addressed in the *GTCC EIS*. LANL is being considered as one of eight candidate DOE disposal sites for Greater-Than-Class C waste, along with generic commercial disposal facility options in arid and humid environments. In addition, DOE is evaluating several disposal technologies in the *GTCC EIS* including geologic repositories, intermediate depth boreholes, and enhanced near-surface disposal facilities. The alternatives in the *GTCC EIS* could result in changes to facilities or operations at LANL, but because the changes have yet to be developed and evaluated, they are not included in the cumulative impacts analysis.

Primary sources of information on LANL contributions to cumulative impacts, other than the current and the *1999 SWEIS*, are listed below:

- *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0250 (DOE 2002b).

- *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*, DOE/EIS-0026-S-2 (DOE 1997a).

- *Environmental Surveillance at Los Alamos during 2005*, LA-14304-ENV (LANL 2006h).

- *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems*, DOE/EIS-0373D (DOE 2005c).

- *Final Environmental Impact Statement for the Conveyance and Transfer of Certain Land Tracts Administered by the U.S. Department of Energy and Located at the Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico*, DOE/EIS-0293 (DOE 1999d).

- NOI to Prepare an Environmental Impact Statement for the Operation of a Biosafety Level 3 Facility at Los Alamos National Laboratory, Los Alamos, New Mexico, 70 FR 228, November 29, 2005.

- *Draft Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0250F-S1D (*Draft Yucca Mountain SEIS*) (DOE 2007a)
- *Draft Complex Transformation Supplemental Programmatic Environmental Impact Statement*, DOE/EIS-0236-S4 (DOE 2007b).

It is also necessary to consider activities implemented by other Federal, state, and local agencies and individuals outside LANL, but within the its region of influence, including state or local development initiatives; new residential development; new industrial or commercial ventures; clearing land for agriculture; new utility or infrastructure construction and operation; and new waste treatment and disposal activities.

Sandia National Laboratories' main facility in Albuquerque is located approximately 60 miles from LANL. Due to this distance, cumulative impacts other than air emissions are not expected to be influenced by Sandia National Laboratories. For air emissions, the 2005 Sandia National Laboratories dose to the offsite MEI is estimated to be 0.0001 millirem and the 2005 population dose is estimated to be 0.00017 person-rem (SNL 2006). The Sandia National Laboratories MEI dose is 0.0012 percent of the LANL MEI dose, and the Sandia National Laboratories population dose is 0.00047 percent of the LANL population dose. Because the combined impacts would be very small, there would be no significant impact from Sandia National Laboratories and it is not considered in this cumulative impacts section.

The city of Santa Fe; Los Alamos, Mora, Rio Arriba, Sandoval, San Miguel, Santa Fe, and Taos Counties; the Santa Clara and San Ildefonso Pueblos; the New Mexico Department of Transportation; the Bureau of Land Management; and the U.S. Forest Service were contacted for information regarding expected future activities that could contribute to cumulative impacts. The city of Santa Fe and Mora, Sandoval, and San Miguel Counties did not identify any major future actions (Gallegos 2006, Pino 2006, Scales 2006, Tafoya 2006). Rio Arriba County and the Santa Clara and San Ildefonso Pueblos did not provide information for the cumulative impacts analysis. The following activities in the region surrounding LANL were identified.

- Los Alamos County identified residential, commercial, and industrial development on areas transferred from DOE to the county. Residential development will include about 120 homes on 70 acres (28 hectares) in White Rock, with a goal to build approximately 1,000 new homes in Los Alamos County within the next 5 years (Jeppson 2006).
- Taos County identified about 20 subdivisions scheduled for review this year, including 150 to 750 new homes on 300 to 1,500 acres (121 to 607 hectares) (Trujillo 2006). Many of these homes would be located more than 50 miles (80 kilometers) from LANL.

In addition, Los Alamos County is closing the Los Alamos County Landfill and considering use of the San Juan-Chama water allotment. The existing Los Alamos County Landfill will close in 2008. Solid wastes will be shipped out of the county via a new transfer station (LAC 2007). The Bayo Wastewater Treatment Facility in Santa Fe County was replaced in 2007 with an advanced wastewater treatment facility in Pueblo Canyon (Glasco 2008). The San Juan-Chama Project includes examining the feasibility of pumping 1,200 acre-feet of Rio Grande water up the mesa to Los Alamos County (LAC 2004b).

A number of projects were identified that would affect the Santa Fe National Forest, including invasive plant control, road closure, thinning and prescribed fire, fire salvage, mineral extraction; and grazing allotment (USFS 2005b).

The Bureau of Land Management identified smaller projects that would affect the Bureau of Land Management lands such as continued road maintenance, timber harvesting, and grazing permit renewals, as well as larger projects such as the Power Project; New Mexico Products Pipeline; Mid-America Pipeline Western Expansion Project; Santa Domingo Pueblo-Bureau of Land Management land exchange; San Pedro Rock Quarry; treatment of saltcedar and other noxious weeds; and the Buckman Water Diversion Project (BLM 2006a). These larger projects are described below.

– The Power Project involves upgrading and enhancing the electrical power transmission line system in the Santa Fe and Las Vegas, New Mexico, area and widening the existing right-of-way (BLM 2004b).

– The New Mexico Products Pipeline involves adding two additional segments to an existing petroleum products pipeline. Neither of the new segments would be within 50 miles (80 kilometers) of LANL (BLM 2006b).

– The Mid-America Pipeline Western Expansion Project would add 12 separate loop sections to the existing liquefied natural gas pipeline to increase system capacity. A 23-mile (37-kilometer) segment would be placed in Sandoval County, 30 miles (48 kilometers) from the LANL boundary (BLM 2006c). This segment would be constructed parallel to and 25 feet (7.6 meters) away from the existing pipeline right-of-way.

– The Santa Domingo Pueblo-Bureau of Land Management land exchange involves an equal-value exchange of approximately 7,376 acres (2,985 hectares) of the Bureau of Land Management lands for 645 acres (261 hectares) of Santa Domingo Pueblo land in Santa Fe and Taos Counties (BLM 2002). A record of decision has not been issued for this land exchange.

– The San Pedro Mountains Rock Quarry Project has been delayed and will be incorporated into the revised Taos Field Office Resource Management Plan (BLM 2006a).

– The treatment of saltcedar and other noxious weeds is an ongoing adaptive management program for control of exotic weeds. An EA was prepared for this project that resulted in a Finding of No Significant Impact (FONSI) (BLM undated). The project area is approximately 40 miles (64 kilometers) from the LANL boundary.

– The Buckman Water Diversion Project would divert water from the Rio Grande for use by the city of Santa Fe and Santa Fe County (BLM 2006a). The diversion project would withdraw water from the Rio Grande approximately 3 miles downstream from where Route 4 crosses the river. The pipelines for this project would largely follow existing roads and utility corridors. Decreased water withdrawals from the Buckman Well Field would benefit groundwater levels. Potential impacts on fish and aquatic habitats below the proposed project due to effects on water flow would be minimal (BLM and USFS 2007).

Another project would upgrade the existing 46-kilovolt transmission loop system that serves central Santa Fe County with a 115-kilovolt system (PNM 2005). No major new transmission lines are planned for the region around LANL (WAPA 2006).

No new Federal highways are planned within 50 miles (80 kilometers) of LANL (CFLHD 2005). A number of state transportation projects are ongoing or planned. Many of these are relatively minor maintenance, upgrading, widening, and resurfacing projects. Some of the more substantial transportation projects in the region include (NMDOT 2007):

- U.S. Route 84 reconstruction - Pojoaque to Española
- NM 502 reconstruction
- NM 344 four-lane road construction near Interstate 40
- NM 585 Reconstruction Project.

Although maintenance of the transportation infrastructure in the region would continue and a number of upgrade, expansion, and widening projects are scheduled over the next 5 years or so, no new major highway projects are scheduled that could substantially contribute to cumulative impacts at LANL.

The list of EPA National Priorities List sites (also known as Superfund sites) was reviewed to determine whether these sites could contribute to cumulative impacts at LANL. Only one site is within 50 miles (80 kilometers) of LANL. The North Railroad Avenue groundwater contamination plume is located over 12 miles (19 kilometers) from the LANL boundary in Rio Arriba County (EPA 2005b).

Most of these actions at other sites are not expected to affect the cumulative impacts of LANL activities because of their distance from LANL, their routine nature, their relatively small size, and the zoning, permitting, environmental review, and construction requirements they must meet. Available documentation reviewed to assess cumulative impacts include the following sources:

Bureau of Land Management

- *Final Environmental Impact Statement for the Buckman Water Diversion Project* (BLM and USFS 2007).
- Factsheet: "San Juan Public Lands (San Juan Field Center & San Juan National Forest) Draft Environmental Impact Statement (EIS) Northern San Juan Basin Coalbed Methane Project," (BLM 2004a).

- *Farmington Proposed Resource Management Plan and Final Environmental Impact Statement*, BLM-NM-PL-03-014-1610 (BLM 2003b).
- *Farmington Resource Management Plan with Record of Decision* (BLM 2003c).
- Final Air Dispersion Analysis Technical Report, "Revision to the BLM Farmington Resource Management Plan and Amendment of the Rio Puerco Resource Management Plan," (BLM 2003a).

U.S. Forest Service

- "Schedule of Proposed Action 01/01/2006 to 03/31/2006, Santa Fe National Forest," (USFS 2006).
- *Record of Decision for Invasive Plant Control Project Carson and Santa Fe National Forests in Colfax, Los Alamos, Mora, Rio Arriba, San Miguel, Santa Fe, Sandoval, and Taos Counties, New Mexico* (USFS 2005a).

U.S. Bureau of Reclamation

- *Upper Rio Grande Basin Water Operations Review Draft Environmental Impact Statement* (ACE, Reclamation, and ISC 2006).
- *Final Environmental Impact Statement City of Albuquerque Drinking Water Project* (Reclamation 2004).

National Park Service

- "Fire Management Plan for Bandelier National Monument," (NPS 2005b).

State of New Mexico

- *2004-2006 State of New Mexico Integrated Clean Water Act §303(d) §305(b) Report* (NMED 2004a).
- *State of New Mexico Standards for Interstate and Intrastate Surface Waters* (NMAC 20.6.4).

Each resource area in this SWEIS was reviewed to identify potential cumulative impacts and the analyses are summarized in the following paragraphs. The level of detail provided for each resource area depends on the extent of the potential cumulative impacts.

Land Resources

Land resources include impacts to land use and the visual environment. LANL actions proposed under this SWEIS would not likely result in any incompatible land uses. Under the *Land Conveyance and Transfer Environmental Impact Statement (Land Conveyance and Transfer EIS)* (DOE/EIS-0293), land conveyed and transferred by LANL to Los Alamos County and conveyed to the U.S. Department of the Interior in trust for the San Ildefonso Pueblo, could be developed.

Up to 826 acres (334 hectares) of this land could be developed after the transfer and conveyance, representing a potential introduction of incompatible land uses (land in adjacent areas that have land use designations that interfere with or restrict one another) and a loss of recreational opportunities such as hiking or fishing. Under the Expanded Operations Alternative, cumulative impacts would include fewer restrictions on future use of lands remaining part of LANL under the MDA Removal Option than the MDA Capping Option. For the Removal Option, the wastes currently buried in the MDAs would be removed completely and shipped offsite or consolidated in onsite disposal areas, which would allow use of some of these MDAs for other purposes. The Expanded Operations Alternative also would include the Security-Driven Transportation Modification Project, which would not conflict with current land use designations except for an option to construct a bridge over Sandia Canyon. Construction of the Sandia Canyon Bridge would depart from current site development plans. Overall cumulative impacts to land use in the region, however, would be small.

Transfer and conveyance of LANL land could result in visual impacts such as diminished viewsheds and increased ambient light from residential, industrial, and commercial development on previously undeveloped land. For example, Los Alamos County has indicated there are proposals to develop approximately 1,000 new residences on land adjacent to LANL and to develop land for light industry along the Los Alamos Canyon rim across from the airport.

LANL is one of the sites under consideration for a consolidated nuclear production center in the *Complex Transformation SPEIS.* Construction of the consolidated nuclear production center facilities could require up to 545 acres (221 hectares) of land in TA-16 or in TA-16 and TA-55. This proposal is consistent with current land use plans for these TAs. The total land area required for the GNEP advanced fuel cycle facility would be approximately 373 acres (151 hectares) with 144 acres (58 hectares) inside a property protection fence, including approximately 62 acres (25 hectares) within a perimeter intrusion, detection, and assessment system (DOE 2008).

Geology and Soils

Projects proposed under the Expanded Operations Alternative in this SWEIS combined with the *Complex Transformation SPEIS* consolidated nuclear production center facilities and GNEP advanced fuel cycle facility would impact mineral resources at LANL and the surrounding region. Primary impacts would be due to the proposed closures of the MDAs under the Consent Order through either waste containment in place (the MDA Capping Option) or waste removal by excavation and subsequent disposal (the MDA Removal Option).

If the waste at the MDAs remains in place, and some small contaminated areas in TA-49 are capped, the final covers would require 750,000 to 2,000,000 cubic yards (570,000 to 1,500,000 cubic meters) of crushed tuff through fiscal year (FY) 2016. Up to 460,000 cubic yards (350,000 cubic meters) of additional rock, gravel, topsoil, and other bulk materials would be required for the final surface and erosion control. The total quantity of crushed tuff, rock and other bulk materials would range from 1.2 to 2.5 million cubic yards (0.92 to 1.9 million cubic meters). If the waste were removed, approximately 1,300,000 cubic yards (1,000,000 cubic meters) of backfill would be needed to replace the excavated waste and contaminated soil, as well as 61,000 cubic yards (47,000 cubic meters) of rock, gravel, topsoil, and other bulk materials for erosion control and site restoration. In addition, from 220,000 to 600,000 cubic yards (170,000 to 460,000 cubic meters) of crushed tuff and about 160,000 cubic yards (120,000 cubic meters) of topsoil, rock, and other bulk materials would be needed for capping the remaining disposal units at Area G in TA-54, and for capping other landfills and contaminated areas such as those in TA-49. A total of 1.8 to 2.2 million cubic yards (1.4 to 1.7 cubic meters) of crushed tuff, rock, and other bulk materials would be needed.

For economic and feasibility reasons, these materials would need to be excavated from borrow pits and quarries in the LANL area (Stephens and Associates 2005). Obtaining the materials locally would minimize transportation impacts. The only borrow pit now in use at LANL is the East Jemez Road Borrow Pit in TA-61. There would be sufficient tuff available at the pit to provide the needed volumes of crushed tuff. Other sources, however, would be required to provide the other materials (such as soil and coarse material for erosion control) needed to complete the MDA remediation. There are 24 stone and aggregate mines or quarries in the surrounding counties (Rio Arriba, Sandoval, and Santa Fe Counties) producing sand, gravel, base course, caliche, crushed rock, rip-rap, scoria, fill dirt and top soil (Pfeil et al. 2001). Borrow materials also could be collected from onsite areas of opportunity such as facility construction or DD&D areas where excess uncontaminated soils that meet the backfill or capping criteria have been excavated. Use of excavated soils as fill or cap material would minimize the need to import geologic materials from outside the immediate LANL area.

Water Resources

Activities at LANL, in combination with other activities in the vicinity, could affect regional water resources. To assess the cumulative effects on surface water, current and reasonably foreseeable future activities within the watersheds and streams that receive surface water from LANL were considered. The effects of past projects are reflected in the description of the affected environment and current surface water conditions. Most watersheds have headwaters on Santa Fe National Forest or Bandelier National Monument land. The region of consideration for cumulative impacts on groundwater extends from LANL further east toward Santa Fe and focuses on impacts on the regional aquifer due to the activities of landowners and managers other than LANL.

Past effluent discharges from LANL activities, in some cases occurring at least 50 years ago, have contaminated sediments in several canyons and continue to affect the quality of stormwater runoff and stream flows (LANL 2005h). As described in Chapter 4, Section 4.3.1, of this SWEIS, however, current monitoring documents that regional water quality does not exceed state standards downstream from LANL and the existing contamination is expected to diminish over time regardless of the SWEIS alternative selected. The reach of the Rio Grande between San Ildefonso Pueblo and Cochiti Reservoir, which receives surface water flows from LANL, has been identified by the New Mexico Environment Department (NMED 2004a) as impaired because it does not support its designated uses as a cold water or warm water fishery. Turbidity is identified as the probable cause of impairment, but the impairment stems from unknown natural sources. Although turbidity could be exacerbated by earthmoving activities anywhere in the watershed, planned mitigation measures for Federal and state projects would keep soil erosion to a minimum and ensure that additional turbidity is not a reasonably foreseeable cumulative impact.

Fire and Vegetation Management

Fire and fuels management is an annual activity within the Santa Fe National Forest and Bandelier National Monument. Management of the areas within the watersheds upstream from LANL are of primary interest because activities such as prescribed burns, mechanical and manual thinning, native plant revegetation, and establishment of fire breaks could accelerate erosion and sediment delivery to streams, which would affect surface water quality and quantity.

Since 1981, areas within Bandelier National Monument along the southern LANL boundary have been treated with prescribed burns. An area parallel to the southern LANL boundary was thinned from 2002 to 2004 (NPS 2005b). The Fire Management Plan (NPS 2005b), the working document for guiding wildland fire management actions and activities in Bandelier National Monument, identifies two primary fire management areas. Most of the area near LANL falls within the Wildland Fire Use unit where most natural ignitions will be allowed to burn. A small area including the entire Upper Frijoles watershed near the southern LANL boundary and the detached Tsankawi unit located east of State Highway 4 and near San Ildefonso Pueblo fall within the Fire Suppression unit. In the Fire Suppression unit, all natural ignitions are declared unwanted wildland fires and are suppressed, but prescribed burns are utilized as needed.

The Santa Fe National Forest Schedule of Planned Operations does not list specific fire management or other actions in the watersheds that cross LANL over the next year (USFS 2006), but some actions are likely to occur within the next 5 to 10 years. The Santa Fe National Forest and Bandelier National Monument fire management policies and procedures include requirements for mitigation and stabilization measures to ensure that vegetation is re-established and offsite erosion and sedimentation are minimized. For this reason, fire management activities in the region, together with those planned at LANL, are not expected to adversely affect surface water quality or quantity. Instead, these actions may benefit surface water bodies by reducing the potential for the impacts of severe wildfires like the Cerro Grande Fire.

An estimated 300 to 800 acres (121 to 324 hectares) will be treated annually in the Santa Fe National Forest to control invasive weeds (USFS 2005a). Treatments will combine biological, chemical, and mechanical methods. Some of the areas to be treated are likely to be within watersheds that cross LANL, but mitigation measures will be implemented to ensure that there are no adverse effects to water resources. These activities, combined with those planned for LANL, will not affect surface water resources.

Cerro Grande Fire Structures

Structures installed in and around LANL after the Cerro Grande Fire altered surface water flows to retain sediment. The Northern Rio Grande Resource Conservation and Development Council led an effort to rebuild fences, bridges, culverts, and other structures on private land that were destroyed by the Cerro Grande Fire (NRCS 2004). On the Santa Clara and San Ildefonso Pueblos, 15 flood prevention projects were implemented by the U.S. Army Corps of Engineers, including strengthening an existing levee system, installing grade control structures, upgrading water crossings, and installing protection around facilities (ACE 2000). Most private structures are likely to remain in place, but removal of some structures is planned by the U.S. Army Corps of Engineers, in addition to removal of those at LANL; their removal could increase sediment loads temporarily. Where structures are removed, the responsible agencies will likely install temporary sediment traps to minimize downstream sediment transport that would adversely affect surface water quality.

Land Conveyance and Transfer

The *Land Conveyance and Transfer EIS* projected minor increases in the amount of surface water runoff entering the stream system and an approximate 30 percent increase in groundwater withdrawals from the regional aquifer due to new residential development (DOE 1999d).

Rio Grande Flows

Proposed changes in the operations of Abiquiu Dam, Cochiti Dam, and other water structures downstream are currently under consideration by the U.S. Army Corps of Engineers, Bureau of Reclamation, and New Mexico Interstate Stream Commission (ACE, Reclamation, ISC 2006). These changes would slightly affect stream flows in the Rio Chama and Rio Grande, depending on which alternative is selected for implementation, but none would affect the surface water flows of the tributaries that flow through and immediately downstream of LANL. Changes to flows below Abiquiu Dam are not projected to affect hydropower generation used to supplement electricity in Los Alamos County (ACE, Reclamation, ISC 2006).

The city of Albuquerque is currently constructing a dam across the Rio Grande at Albuquerque to divert as much as 94,000 acre-feet per year (11,600 hectare-meters per year) to fully consume their San Juan-Chama Project water. A Final EIS evaluating the impacts of this action was published on March 5, 2004 (Reclamation 2004) and the ROD was issued on June 1, 2004. Direct effects on hydrology from any of the action alternatives were projected to include a constant increase of about 60 to 70 cubic feet per second (1.7 to 2.0 cubic meters per second) from flows of the city's San Juan-Chama Project water between Abiquiu Reservoir and Albuquerque at any time the diversion system is operating (Reclamation 2004). Contamination from canyons flowing through LANL that outlet into the Rio Grande and any potential changes in Rio Grande flows from proposed changes at LANL under any action alternative are not likely to affect Albuquerque's water quality or quantity because any contaminated sediments would be trapped behind the dam and flows would be regulated by water operations at Cochiti Dam.

The city of Santa Fe is proposing to install a diversion dam on the east bank of the Rio Grande across from San Ildefonso Pueblo and upstream from White Rock. The purpose of this project is to seek "sustainable means of accessing surface water supplies that would use the applicants' water rights by diverting San Juan-Chama Project water and native Rio Grande water while reducing their reliance on over-taxed ground water resources" (BLM and USFS 2007). The Buckman Well Field currently consists of thirteen wells that draw from the regional aquifer, but well yields have been reduced and groundwater levels have declined since its inception, depleting nearby streamflows (BLM and USFS 2007). The diversion, which would divert up to 5,230 acre-feet per year from the river (BLM and USFS 2007), would be located in the Rio Grande near the area where Mortandad Canyon outlets on the west side of the river and downstream from the outlets of Pueblo, Sandia, and Los Alamos Canyons.

Santa Fe proposes to continue providing residual offsets from past pumping of the Buckman Well Field (currently about 2,500 acre-feet per year). Under this proposal, pumping from the

Buckman Well Field would be scaled back to a long-term average of approximately 1,000 acre-feet per year. The cone of depression in the regional aquifer from current pumping of the well field has been modeled to extend to the west side of the Rio Grande, encompassing White Rock and the eastern part of LANL (BLM and USFS 2007). The *Final Environmental Impact Statement for the Buckman Well Field Project* predicts that, if the proposed project were implemented, direct diversions with reduced pumping from the Buckman Well Field would result in a 1 percent reduction in Rio Grande flows below the diversion and a significantly smaller cone of depression after the diversion project is established because pumping and aquifer depletions would be greatly reduced (BLM and USFS 2007). The projected reductions of aquifer depletions from reduced pumping of the Buckman Well Field would help offset projected increases in water use by LANL and Los Alamos County.

Under the Radioactive Liquid Waste Treatment Facility action to construct liquid effluent evaporation tanks with the goal of zero discharges from the facility into Mortandad Canyon, reduction of contaminant contributions by eliminating the outfall would positively impact surface water quality and possibly benefit Santa Fe’s project. Improved water quality monitoring would also have positive impacts.

Los Alamos County and the San Ildefonso Pueblo are considering diverting Rio Grande water. There also may be other projects similar to the Buckman Project that would divert San Juan-Chama and native waters from the Rio Grande in the vicinity of LANL. The San Ildefonso Pueblo installed a single unit infiltration collector well as a pilot project in 2001. These projects may contribute to cumulative effects on the regional surface water system, but are less well defined, so the effects are impossible to predict at this time (BLM and USFS 2007).

Groundwater Quality

Additional modeling and monitoring wells are being installed to determine the foreseeable future impacts on the regional aquifer from radionuclides and other contaminants that are thought to be migrating through the bedrock. Questions about the rate and direction of contaminant movement must be more thoroughly investigated before the cumulative effects on water resources can be evaluated. LANL will conduct future data collection activities and analyze existing data to better define the interaction between groundwater and the rock matrix. This understanding of the hydrologic and chemical components at the site will aid in developing sound conceptual models of flow and transport through the fractures and matrix of the vadose zone into the saturated zone. The new data, coupled with improvements in numerical flow and transport models and improved calculational techniques, will enable better prediction of flow and transport of groundwater in the LANL region and more accurately define the ultimate impacts on the regional groundwater resources below LANL. Recent news of chromium in the regional aquifer (Snodgrass 2006) also will require additional research to determine the source of the contaminant.

The North Railroad Avenue groundwater contamination plume located over 12 miles (19 kilometers) from the LANL boundary is undergoing remediation. Tetrachloroethylene (perchloroethylene) is the leading concern from this plume because it is the most widespread and is found in the highest concentrations in groundwater. Other contaminants present with possible health effects include trichloroethylene, cis-1,2dichloroethylene, and trans-1,2dichloroethylene (EPA 2006b). For this plume, bioremediation pilot testing began in May 2007 (NMED 2007a).

Because this contamination plume will be remediated to protect drinking water and the Rio Grande from future chlorinated groundwater solvents, it is not expected to migrate into groundwater and surface water impacted by past or present LANL operations.

Air Quality and Noise

Table 5–80 presents the estimated maximum cumulative air quality concentrations offsite or at the site boundary from operations of both the Expanded Operations Alternative and the Complex Transformation consolidated nuclear production center. No data are available at this time related to operation of the GNEP advanced fuel cycle facility. Cumulative concentrations of all of the criteria pollutants except the 24-hour standard for nitrogen dioxide and total suspended particulates are expected to remain in compliance with Federal and state ambient air quality standards. The 24-hour standard for nitrogen dioxide and total suspended particulates could be exceeded on occasion. Based on these potential exceedances, more detailed site-specific analyses would need to be performed if LANL is selected as the site for construction of the consolidated nuclear production center. Cumulative air quality impacts for the No Action Alternative or the Reduced Operations Alternative in combination with the proposed consolidated nuclear production center would be lower than those shown in the table.

Table 5–80 Estimated Maximum Cumulative Air Quality Concentrations at the Site Boundary (micrograms per cubic meter)

Criteria Pollutant	*Averaging Period*	*LANL SWEIS Expanded Operations and Consolidated Nuclear Productions Center* [a]	*Most Stringent Standard or Guideline* [a]
Carbon monoxide	8 Hours 1 Hour	286 1,349	7,900 11,900
Nitrogen dioxide	Annual 24 Hours	26 161	75 150
Sulfur dioxide	Annual 24 Hours 3 Hours	13 93 480	42 209 1,050
Total suspended particulates	Annual 24 Hours	9.7 202	60 150
PM_{10}	Annual 24 Hours	26 143	50 150

PM_{10} = particulate matter less than or equal to 10 microns in diameter, TA = technical area.

[a] Data from Table 5–8 of this *LANL SWEIS* and Table 5.1.4-12 of the Draft *Complex Transformation SPEIS* (DOE 2007b). Criteria pollutants released from LANL operations are emitted primarily from combustion sources such as boilers and emergency generators. Although motor vehicle emissions have an impact on local air quality, no quantitative analysis of vehicle emissions was performed as part of the *LANL SWEIS*. The contribution of vehicle emissions was assumed to be included in the background monitoring concentrations discussed in the current and *1999 SWEIS*. The results of the modeling demonstrate that simultaneous operation of LANL's air emission sources at maximum capacity as described in the Title V permit application would not exceed any state or Federal ambient air quality standards. All of the equipment at the TA-3 Co-Generation Complex, including additional combustion turbine generators that would be constructed in the 2007 to 2013 timeframe, would operate within the emission limits specified in the air quality permit.

Effects on air quality from construction, excavation, and remediation activities could result in temporary increases in air pollutant concentrations at the site boundary and along roads to which the public has access. These impacts would be similar to the impacts that would occur during construction of a housing project or a commercial complex. Emissions of fugitive dust from these activities would be controlled with water sprays and other engineering and management practices as appropriate. The maximum ground-level concentrations offsite and along roads to which the public has regular access would be below the ambient air quality standards, except for possible short-term concentrations of nitrogen oxides and carbon monoxide for certain projects that could occur near the site boundary. Appropriate management controls and scheduling would be used to minimize impacts on the public and to meet regulatory requirements. The impact on the public would likely be minor.

The increase in employee vehicles and the increase in other vehicles resulting from the population increase projected by the state would result in increases in vehicle emissions along the routes used to access the site. As discussed in Section 4.4.2.1 the area around Los Alamos and most of New Mexico is designated as attaining for the National Ambient Air Quality Standards for carbon monoxide, nitrogen oxides, ozone, and the other criteria pollutants (40 CFR 81.332). Even with the continuing growth in population there has been a decreasing or steady trend in concentrations in the region of carbon monoxide, nitrogen oxides, and ozone. Carbon monoxide and nitrogen oxides concentrations are well below the ambient standards (EPA 2006a).

The impacts of toxic air pollutants were assessed based on the analysis in the *1999 SWEIS* and the emission estimates in the LANL Yearbooks. In all but two cases, the estimated toxic pollutant emissions were below the corresponding guideline values established for the screening analysis in the *1999 SWEIS*. Guideline values are the levels established to screen emission rates for further analysis. The two cases where estimated emission rates were above guideline values and were referred to the human health and ecological risk assessment processes were: (1) emissions from High Explosives Firing Facilities operations at TA-14, TA-15, TA-36, TA-39, and TA-40; and (2) additive emissions from all pollutants from all TAs on receptor sites located near the Los Alamos Medical Center. The risk assessment analysis demonstrated that the pollutants released for these two cases would not be expected to cause air quality impacts that would affect human health and the environment.

Cumulative air quality impacts from offsite construction and operation activities were also evaluated. The maximum impacts from construction activities (including fugitive dust) for oil and gas development in the region were shown to occur very close to the source, with concentrations decreasing rapidly with distance (BLM 2003b). Therefore, it is expected that offsite air emissions from disturbance and construction would not contribute substantially to cumulative impacts at LANL.

Impacts of inert pollutants (pollutants other than ozone and its precursors) are generally limited to a few miles downwind from a source (BLM 2003b). For emissions from the well fields analyzed in the *Farmington Proposed Resource Management Plan and Final Environmental Impact Statement* (BLM 2003b), the distance where the nitrogen dioxide concentrations drop below their significance levels would be 15.6 to 24.9 miles (25 to 40 kilometers). Therefore, it is expected that emissions from operation of offsite facilities would not contribute substantially to cumulative impacts at LANL, which is about 100 miles (160 kilometers) away.

In contrast, the maximum effects of volatile organic compounds and nitrogen oxides emissions on ozone levels usually occur several hours after they are emitted and many miles from the sources (BLM 2003b). Although LANL is outside the study areas for the Northern San Juan Basin Coalbed Methane Project, the EIS for this project (BLM 2004a) determined that the cumulative impacts of oil and gas development combined with regional emissions from other sources could exceed visibility thresholds (9 to 25 days annually) in the Class I Areas of the Weminuche Wilderness and Mesa Verde National Park. These impacts could be reduced to 1 to 17 days annually if stricter emissions controls are required for new emission sources of nitrogen oxide (BLM 2004a). LANL is approximately 100 miles (161 kilometers) from the Bloomfield Farmington and San Juan Basin Coalbed Methane Project areas, and it is unclear whether such distant emissions could contribute to cumulative visibility impacts at the Bandelier National Monument.

The air quality analysis in the *Farmington Proposed Resource Management Plan and Final Environmental Impact Statement* (BLM 2003b) included consideration of air emissions from the highly industrialized Bloomfield gas corridor, El Paso Blanco compressor station, Conoco San Juan Gas Plant, and Four Corners and San Juan Power Plants (BLM 2003a). Although LANL is outside the study areas for the *Farmington Proposed Resource Management Plan and Final Environmental Impact Statement* (BLM 2003b), the ROD for this study (BLM 2003c) included a number of mitigation measures designed to reduce cumulative air quality impacts from gas and oil wells and pipelines. One of the more significant mitigation measures requires that new and replacement wellhead compressors limit nitrogen oxide emissions to levels less than 10 grams per horsepower-hour, and that each pipeline compressor station limit its total nitrogen oxide emissions to levels less than 1.5 grams per horsepower-hour. This requirement would apply to all new and replacement compressor engines unless the proponent can demonstrate (using air pollutant dispersion modeling) that a specific higher emission rate would not cause or contribute to exceedance of any ambient air quality standard. This measure is intended to substantially reduce the level and extent of emissions that form ozone throughout the region and to reduce visibility impacts on Class I Areas such as Mesa Verde National Park and Bandelier National Monument (BLM 2003b).

The incremental increase in criteria and toxic pollutant emissions identified in the *Conveyance and Transfer EIS* would not be major and would not cause or contribute to exceedance of any ambient air quality standard.

Ecological Resources

The continuing conveyance and transfer of LANL land would result in the cumulative impacts of the conveyance and transfer of 770 acres (312 hectares) of undeveloped habitat that could be developed. A transfer of resource protection responsibility may also result in a less rigorous environmental protection review process. Electrical power system upgrades would have minimal effects on vegetation and temporary impacts on wildlife. The Wildfire Hazard Reduction Program would have short-term impacts on wildlife, create historic forest conditions, and positively affect the Mexican spotted owl by providing a healthier habitat. Disposition of flood retention structures would have short-term impacts on wildlife and its habitat and potentially on downstream wetlands as well due to possible habitat disturbance and changes in the water flow rate. The Trails Management Program would have short-term impacts on wildlife and increase the diversity of wildlife where trails are closed. Section 5.5 of this SWEIS has a detailed discussion of the effects of each alternative on ecological resources.

Impacts associated with construction of the *Complex Transformation SPEIS* consolidated nuclear production center or the GNEP advanced fuel cycle facility at LANL would include the loss of habitat and of less mobile wildlife, such as reptiles and small mammals. More mobile species, such as birds or large mammals, would be displaced as a result of construction activities; however, these species could relocate to adjacent less developed areas. Successful relocation of more mobile species may not occur due to competition for resources and the carrying capacity limitations of areas outside the proposed development. Best management practices and implementation measures set forth in the LANL *Threatened and Endangered Species Habitat Management Plan* would be used during construction activities to minimize the potential for adverse effects to plant and animal communities and on threatened and endanger or special interest species. Proposed construction sites would be surveyed for the presence of special status species before construction begins, and mitigation actions would be developed. After construction, temporary structures would be removed and the sites reclaimed.

Human Health

Table 5–81 presents the estimated cumulative impacts from radiological emissions and radiation exposure from the LANL SWEIS alternatives and the Complex Transformation consolidated nuclear production center (the GNEP advanced fuel cycle facility is not represented in the table because available preliminary data do not include offsite radiological impacts). Cumulative impacts to the public would likely remain within the maximum level of impacts forecast under the SWEIS Expanded Operations Alternative. The offsite impacts from the addition of the consolidated nuclear production center would be essentially unchanged due to the assumed closure of existing LANL facilities whose functions would be included in the new center. No LCFs would be expected for the MEI or in the general population. The dose to the offsite MEI would be expected to remain within the 10 millirem per year limit required by 40 CFR 61, Subpart H, National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities. There would be no increase in the risk of LCFs among the general public.

Collective worker doses would increase if the Expanded Operations Alternative MDA Removal Option were to be implemented. Collective worker doses would increase from about 280 person-rem per year to an annual average of 540 person-rem per year. The 540 person-rem dose corresponds to an annual risk of an LCF in the worker population of 0.3 (or for each 3 years of operation, 1 chance of an LCF in the worker population). Worker doses would decrease by about 140 person-rem per year after the MDA remediation work was completed. Individual worker dose would be maintained ALARA and within applicable regulatory limits. Worker doses would be expected to increase from operation of the consolidated nuclear production center at LANL. The net increase in collective worker dose would be approximately 105 person-rem per year. The increased annual risk of an LCF in the worker population would be 0.06 (or for each 17 years of operation, 1 additional LCF might be expected in the worker population). The most recent preliminary data for the GNEP advanced fuel cycle facility do not include a worker population dose estimate.

Table 5–81 Estimated Cumulative Radiological Impacts

Activity	General Public				Worker Population	
	MEI		Population Within 50 Miles			
	Dose (millirem per year)	LCF Risk per Year	Collective Dose (person-rem per year)	Excess LCFs per Year	Collective Dose (person-rem per year)	Excess LCFs per Year
LANL SWEIS Alternatives						
No Action	7.8	4.7×10^{-6}	30	0.018	280	0.17
Reduced Operations	0.78	4.7×10^{-7}	6.1	0.0037	257	0.15
Expanded Operations	8.2	4.9×10^{-6}	36	0.022	543	0.33
Complex Transformation SPEIS [a]						
Consolidated Nuclear Production Center	NC	NC	0.38	2.3×10^{-4}	386	0.23
Minus Plutonium Facilities Complex	NC	NC	-0.20	-1.2×10^{-4}	-220	-0.13
Minus CMR Building	NC	NC	-0.43	-2.6×10^{-4}	-61	-0.04
Total (SPEIS and Expanded Operations)	8.2	4.9×10^{-6}	36	0.022	648	0.39
Dose Limit [b]	10	NA	NA	NA	NA	NA

MEI = maximally exposed individual, LCF = latent cancer fatality, NA = not applicable, NC = no change, CMR = Chemistry and Metallurgy Research.

[a] *Complex Transformation SPEIS*, Tables 5.1.11-2 and 5.1.11-3 (DOE 2007b).

[b] 10 millirem per year limits as required by 40 CFR 61, Subpart H.

Monitoring results for radioisotopes and chemicals in groundwater, surface water, sediments, and soil in and around LANL (see Appendix F, Section F.3) account for any contaminants that have accumulated since the beginning of operations at LANL. Appendix C presents detailed LANL radiological emissions and radiation dose data; all doses are a very small fraction of the normal background dose received by the population in and around LANL. Section 4.6.1 of this SWEIS provides detailed information on cancer mortality and incidence rates in New Mexico and all counties surrounding LANL. These data, along with the final LANL Public Health Assessment, issued on August 31, 2006 by the U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry (ATSDR 2006), show that, "there is no evidence of contamination from LANL that might be expected to result in ill health to the community" and "[o]verall, cancer rates in the Los Alamos area are similar to cancer rates found in other communities." The Centers for Disease Control and Prevention is in the early phase of the dose reconstruction efforts at LANL. As described in their January 2006 publication titled *Interim Report of the Los Alamos Historical Document Retrieval and Assessment Project* (CDC 2006), dose reconstruction is a five phase process involving: (1) retrieval and assessment of data; (2) initial source term development and pathway analysis; (3) screening dose and exposure calculations; (4) development of methods for assessing environmental doses; and (5) calculation of environmental exposures, doses, and risks. The Centers for Disease Control and Prevention project at LANL is still in the initial information gathering phase. Therefore, this information is not available to include in the cumulative impacts analysis.

Cultural Resources

Actions proposed under the *Land Conveyance and Transfer EIS* would result in the cumulative impacts of the conveyance and transfer of cultural resources out of the responsibility and protection of the DOE. A consequence of this conveyance and transfer would be potential damage to cultural resources due to future development and impacts to the protection and accessibility of Native American sacred sites. The environmental justice cumulative impacts section contains additional information regarding cultural resources with respect to environmental justice.

Proposed sites for the *Complex Transformation SPEIS* consolidated nuclear production center facilities in TA-16 or TA-55 and the GNEP advanced fuel cycle facility in TA-36 that involve undisturbed lands are likely to contain archaeological resources due to the high density of these resources in the region. The potential impacts to cultural resources would not be known until a specific footprint on the ground is selected for the proposed facilities. Prior to any ground-disturbing activity, DOE would identify and evaluate any cultural resources that could potentially be impacted by construction activities. Methods for identification could include archival research and consultation with interested Native American tribes. DOE would determine the possibility for impacts to National Register of Historic Places-eligible resources and implement appropriate measures to avoid, reduce, or mitigate the impacts. Identification, evaluation, determination of impact, and implementation of measures would be conducted in consultation with the New Mexico State Historic Preservation Officer and in accordance with *A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico* (LANL 2006f). If previously unknown cultural or paleontological resources, such as subsurface resources, were discovered during construction, activities in the area of the discovery would stop and the discovery would be evaluated and treated appropriately, as determined by DOE in consultation with the New Mexico State Historic Preservation Officer and other interested parties.

Socioeconomics

Important cumulative socioeconomic impacts occur when the net effect of regional projects or activities would substantially alter the location and distribution of regional populations, substantially raise the unemployment rate, substantially affect the local housing market, or result in the need for new social services. Past and present economic conditions associated with continued operations of LANL are described in Chapter 4, Section 4.8.1, of this SWEIS.

As shown in **Table 5–82**, there are four other major activities that could have significant socioeconomic impacts on the region in the future. These include operation of the Los Alamos Research Park, the conveyance and transfer of land from LANL in accordance with the provisions of Public Law 105-119, the potential siting of a new consolidated nuclear production center, and the potential siting of a GNEP advanced fuel cycle facility at LANL.

By 2011, LANL operations under the No Action Alternative could account for approximately 20 percent of employment in the tri-county area (Los Alamos, Rio Arriba, and Santa Fe Counties) and an even higher percentage of wages due to the large difference in average wages for LANL employees versus the county averages. Under the Expanded Operations Alternative, direct employment at LANL could increase by another 14 percent by 2011 leading to the creation of approximately 1,890 direct and 2,000 indirect jobs. About 1,600 direct jobs and 1,700 indirect jobs would be held by residents of the tri-county area, increasing the estimated percentage of the population employed in the tri-county area as a result of LANL operations activities to 22 percent.

Table 5–82 Estimated Cumulative Socioeconomic Impacts

Activity	*Direct Employment Residing in the Tri-County Area*	*Projected Indirect Jobs*	*LANL-Related Jobs*	*Projected Employment in the Tri-County Area in 2011*
LANL Operations (through 2011)				
– No Action Alternative	11,564	12,236	23,800	120,609
– Reduced Operations Alternative	11,138	11,785	22,923	119,732
– Expanded Operations Alternative	13,182	13,948	27,130	123,939
Research Park [a]	1,600	1,693	3,293	+ 3,293
Conveyance & Transfer of Lands [b]	6,080	6,433	12,513	+ 12,513
Consolidated Nuclear Production Center [c]	1,528	1,617	3,145	+ 3,145
Advanced Fuel Cycle Facility [d]	1,138	1,204	2,342	+ 2,342
Maximum LANL-Related Activity	23,528	24,895	48,423	145,232

[a] DOE 1997b.
[b] DOE 1999d.
[c] DOE 2007b.
[d] DOE 2008.

The Los Alamos Research Park was created on land within LANL that has been leased to Los Alamos County for private sector use as discussed in the *Research Park EA* (DOE 1997b). Under this proposal, one 83,000-square-foot building was completed in 2001, and industry has been leasing space in the building and collaborating with LANL on research activities in the hopes of accelerating economic development in the region. As estimated in the Research Park EA, up to 1,600 direct jobs could eventually be created at the Park (DOE 1997b). If this were to happen, it could lead to the creation of another 1,700 indirect jobs in the region. As of January 2007, there were 19 companies employing approximately 150 individuals working in the Research Park (Holsapple 2007). There is land available within the Research Park for additional buildings and other buildings are expected to be constructed as the demand for available space increases.

In addition, LANL is conveying land to Los Alamos County that may be used for commercial and residential uses as discussed in Section 4.1.1 of this LANL SWEIS. As estimated in the *Land Transfer and Conveyance EIS*, approximately 6,100 direct jobs could be created on these lands (DOE 1999d). This could lead to the creation of another 6,400 indirect jobs in the region. To date, 152 acres of approximately 1,803 acres of land to be conveyed to the County have been conveyed.

If the maximum number of jobs estimated to be created under the *Research Park EA* and the *Land Transfer and Conveyance EIS* were also created by 2011, there could be additional socioeconomic impacts in the region of influence. Cumulatively, the Expanded Operations Alternative and these activities could result in nearly 21,000 direct and 22,000 indirect jobs in the region. This scenario would increase the estimated percentage of the population employed by LANL-related activity to 31 percent of the region of influence. Under this scenario, the rate of population growth in the region would likely exceed current rates placing additional strain on regional infrastructure and social services. For example, additional demand would be placed on regional water and electrical systems, roads would be more heavily traveled, additional housing would need to be constructed, and there may be demands for additional schools and hospitals.

There would also be beneficial gains in terms of average wages and benefits flowing into the local economy since many of these jobs should be relatively higher paying jobs (for example, research jobs), and the unemployment rate would be likely to fall.

At this time, the level of direct employment related to the Research Park and the land conveyances is very low compared to the estimates analyzed in the earlier NEPA documents and it is too early to accurately predict whether these estimates will actually be reached. If they are not reached, the cumulative socioeconomic impacts for the region would be closer to those described in Section 5.8.1 for LANL operations.

It is assumed that approximately 86 percent of the new employees needed to operate the consolidated nuclear production center (1,785) and the advanced fuel cycle facility (1,330) would reside in Los Alamos, Rio Arriba, or Santa Fe County in keeping with current LANL employee preferences. Together with the Research Park and the jobs that could be created as a result of the land transfer and conveyance, these activities could result in the addition of up to 10,300 new direct employees related to LANL and another 10,900 indirect jobs in the tri-county area. Cumulatively these activities could increase the LANL-related jobs in the tri-county area by 78 percent over the levels expected under the Expanded Operations Alternative. Employment in the tri-county area could increase by approximately 17 percent over the levels projected under the Expanded Operations Alternative and the LANL-related jobs would increase to 33 percent of the worker population in the region of influence.

Increases in employment related to the proposed consolidated nuclear production center and the advanced fuel cycle facility would occur further in the future because these facilities would need to be constructed and are not expected to begin operating until at least 2020. In the meantime, regional planning could be undertaken in anticipation of projected increases associated with these facilities to alleviate potential shortfalls such as the need for additional housing, schools, or improved public transportation.

Infrastructure

Table 5–83 presents the estimated cumulative infrastructure requirements within the LANL region of influence for electricity, natural gas, and water. Cumulative infrastructure requirements include usage projections through 2011 for LANL and other Los Alamos County users that rely on the same utility system. Therefore, the projections provided in Section 5.8.2 and adopted here already consider cumulative future usage of these utilities by DOE and non-DOE entities. Projections of future utility use in Los Alamos County are largely related to increased usage due to population growth and associated industrial and commercial development.

As shown in Table 5–83, total combined electric power and water demands under the Expanded Operations Alternative could approach the electric-peak load capacity and total available water rights, respectively. Electrical energy capacity at LANL would not be exceeded under any of the proposed SWEIS alternatives. If the consolidated nuclear production center facilities were sited at LANL, the system capacities for electric-peak load and water could be exceeded and additional resources might need to be identified to satisfy the projected demand. The additional 45 megawatts electric-peak load and 117 million gallons of water usage from the GNEP advanced fuel cycle facility (DOE 2008) would further exacerbate the availability issues. The projection of electric-peak load system capacity does not take into account completion of a new transmission line and other ongoing power grid upgrades that could help offset potential deficits in peak load capacity and ensure electrical energy availability for operations. Also, LANL has provisions to install a second new turbine at the TA-3 Co-Generation Complex that would add an additional 20 megawatts (175,200 megawatt-hours per year) of generating capacity, if needed. A study of the Los Alamos County water system would be required to determine whether the current water supply and distribution systems are adequate to meet additional projected annual water demand due to consolidated nuclear production center operations, the GNEP advanced fuel cycle facility, or both. It is likely that significant modifications would be required and LANL would need to obtain greater water resources, or significantly reduce its potable water use through mitigative measures. Overall LANL work assignments might have to be revamped, reduced, or eliminated so that existing potable water supplies would be adequate to support the assigned LANL work load.

Table 5–83 Estimated Cumulative Infrastructure Requirements for the Los Alamos National Laboratory Region of Influence

Activity	*Electricity*		*Natural Gas (decatherms per year)*	*Water (millions of gallons per year)*
	(megawatt-hours per year)	*Peak load (megawatts)*		
LANL SWEIS Alternatives Projected through 2011 [a]				
No Action	645,000	111	2,215,000	1,621
Reduced Operations	516,000	80.6	2,181,000	1,544
Expanded Operations	827,000	144	2,331,000	1,763
Complex Transformation SPEIS				
Consolidated Nuclear Production Center [b]	264,000	41	Information not available	395
Minus 80 pit manufacturing capability [c] under Expanded Operations	-9,000	- 1	- 28,000	- 8
GNEP PEIS				
Advanced Fuel Cycle Facility [d]	Information not available	45	Information not available	117
Total (Expanded Operations, Consolidated Nuclear Production Center, and Advanced Fuel Cycle Facility)	Information not available	229	Information not available	2,267
System Capacity [e]	1,314,000	150	8,070,000	1,806

[a] Data from Table 5–34, 5–35, and 5–36. Projections through 2011 for electrical energy, peak load, natural gas, and water also include projected usage for other Los Alamos County users that rely upon the same utility system.
[b] Data from Draft *Complex Transformation SPEIS* Tables 5.1.3-2 and 5.1.5-2.
[c] Rounded estimates from Section 5.8.2.3.
[d] Preliminary data for GNEP advanced fuel cycle facility (DOE 2008).
[e] Data from Table 5–33. Electrical energy and peak load capacity reflect the current import capacity of the electric transmission lines that deliver electric power to the Los Alamos Power Pool and completion of upgrades at the TA-3 Co-Generation Complex adding 40 megawatts (350,400 megawatt-hours) of generating capacity. Water system capacity reflects the total water rights from the regional aquifer managed by Los Alamos County.
Note: A decatherm is equivalent to 1,000 cubic feet.

Los Alamos County, as owner and operator of the Los Alamos Water Supply System, is currently pursuing the use of San Juan-Chama Transmountain Diversion Project water to secure additional water rights and supply for its water customers, including LANL. This would supply the Los Alamos area with up to an additional 391 million gallons (1,500 million liters) of water per year. Without the San Juan-Chama water, demand could exceed the available water supply in the future.

In the near term, no infrastructure capacity constraints are anticipated. LANL operational demands on key infrastructure resources, including electricity and water, have been below projected levels and within site capacities. Any potential shortfalls in available capacity would be addressed as increased site requirements are more fully understood.

Waste Management

Table 5–84 presents the estimated amount of radioactive and chemical waste that would be generated by the LANL SWEIS Alternatives (through 2016). Cumulative waste generation rates for all waste types are expected to be substantial, largely due to future remediation and DD&D of facilities. Although this is the case under all of the proposed LANL SWEIS Alternatives, the quantities of wastes projected under the Expanded Operations Alternative are significantly greater than those projected under the other alternatives due to the extensive environmental restoration cleanup projects associated with the MDAs and DD&D activities. Actual waste volumes from environmental remediation may be smaller, depending on regulatory decisions by the New Mexico Environment Department, and on use of waste volume reduction techniques.

Table 5–84 Estimated Cumulative Waste Generation at Los Alamos National Laboratory (2007 to 2016)

Activity	*Transuranic (cubic yards)*	*Low-Level Radioactive (cubic yards)*	*Mixed Low-Level Radioactive (cubic yards)*	*Construction and Demolition Waste (cubic yards)*	*Chemical (pounds)*
LANL SWEIS Alternatives (2007-2016) [a]					
No Action	3,500 to 5,900	72,000 to 167,000	1,800 to 2,800	198,000	19,000,000 to 37,000,000
Reduced Operations	3,500 to 5,900	72,000 to 148,000	1,800 to 2,800	197,000	19,000,000 to 36,000,000
Expanded Operations	5,300 to 33,000	277,000 to 1,414,000	3,900 to 183,000	642,000 to 722,000	64,000,000 to 129,000,000
Total (range) [c]	3,500 to 33,000	72,000 to 1,414,000	1,800 to 183,000	198,000 to 722,000	19,000,000 to 129,000,000

[a] Data rounded from Table 5–37.
[b] The total range includes the minimum and maximum values from the LANL SWEIS Alternatives. The total may not equal the sum of the contributions due to rounding.

The waste estimates under the Expanded Operations Alternative in this SWEIS include waste generated from expanding pit production to up to 80 pits per year from 20 pits per year under the No Action Alternative.

Increases in the cumulative waste generation rate may require construction of additional facilities and assignment of additional staff to manage the wastes. All waste categories are expected to increase generation rates, including solid, chemical, low-level radioactive, transuranic, and mixed wastes. Substantial quantities of low-level radioactive wastes and solid wastes (primarily uncontaminated debris from excavation, construction, and demolition activities) are projected. Efforts will be made to recycle as much of the uncontaminated fill as reasonably possible to reduce the need to bring additional fill from offsite sources to satisfy LANL's ongoing requirement. Most wastes, with the exception of some low-level radioactive wastes, are disposed of offsite at permitted facilities.

Low-level radioactive waste generation rates would increase under all alternatives, but the most significant increase would be under the Expanded Operations Alternative if all waste from MDAs were removed. Depending on the actual volumes generated by remediation, the expansion of TA-54 Area G into Zone 4, and eventually Zone 6, is expected to provide onsite low-level radioactive waste disposal capacity for operations waste through the 2016 timeframe and beyond. In addition, offsite disposal options for low-level radioactive waste include NNSA's Nevada Test Site and commercial facilities. For commercial facilities, some restrictions apply to acceptance of waste based on the origin (state of origin, and DOE or non-DOE generated) and radiological characteristics of the waste. Mixed low-level radioactive waste generation also is expected to increase, but the quantity is projected to be less than two percent of the quantity of low-level radioactive waste. Mixed low-level radioactive wastes may be sent offsite for treatment of the hazardous component and possibly returned to LANL (or disposed of elsewhere) as low-level radioactive waste.[8]

The ROD for the *WIPP SEIS* allows for disposal of 175,600 cubic meters (229,667 cubic yards) of transuranic waste at WIPP (63 FR 3624), of which 21,000 cubic meters (27,466 cubic yards) of contact-handled transuranic waste and 230 cubic meters (301 cubic yards) of remote-handled transuranic waste were anticipated to originate from LANL (DOE 1997a). Transuranic waste generated under the Expanded Operations Alternative and the total cumulative transuranic generation shown in Table 5–84 could exceed the amount assumed to come from LANL. About two-thirds of the projected transuranic waste in Table 5–84, however, is from the assumed removal of transuranic waste, most of which was buried before 1970 in certain MDAs. As noted above, actual transuranic waste volumes will depend on regulatory decisions and on implementation of volume reduction techniques. WIPP disposal capacity is expected to be sufficient for disposal of all retrievably stored waste and all newly generated transuranic waste from the DOE complex over the next few decades, but not sufficient for this waste plus all transuranic waste buried before 1970 across the DOE complex (63 FR 3624). Decisions about disposal of transuranic waste from full removal of LANL MDAs, if generated, will be based on the needs of the entire DOE complex.

Transuranic waste from MDA removal without a disposal pathway would be safely stored onsite until additional disposal capacity at WIPP or elsewhere was identified. The impacts of disposal of transuranic waste at WIPP are evaluated in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997a).

Although routine generation of chemical wastes is expected to decline under all alternatives compared to current operations at LANL, significant quantities of this waste type are expected due to environmental restoration activities, and to a lesser extent, DD&D activities. This increase would be particularly evident under the Expanded Operations Alternative, if all wastes were removed from MDAs. Offsite treatment options are available at commercial facilities across the country, including treatment and disposal facilities in Nevada, Colorado, Utah, and Texas (ACE 2006).

---

[8] *Mixed waste that is successfully treated for a characteristic would no longer be mixed waste. Listed mixed waste is always mixed. No mixed waste is currently disposed of onsite at LANL.*

Significant quantities of nonradioactive solid wastes, including construction and demolition debris, would be generated under all alternatives. The most significant increase would occur under the Expanded Operations Alternative, if all wastes were removed from MDAs. The planned closure of the Los Alamos County Landfill by the end of 2008 means that, in the future, solid wastes will be disposed of via the Los Alamos County Transfer Station, where wastes would be segregated and then transported to an appropriately permitted solid waste landfill. Construction and demolition wastes would be recycled and reused to the extent practicable. Debris that cannot be recycled would be disposed of at solid waste landfills or construction and demolition debris landfills. Los Alamos County is currently evaluating regional solid waste landfills within 120 miles of LANL for a possible contract for disposal of LANL and Los Alamos County waste, including the Rio Rancho, Sandoval County, and Torrance County/Bernalillo County Landfills. In 2006, the New Mexico Environment Department Solid Waste Bureau estimated that the state had approximately 30 years of landfill capacity remaining (NMED 2006b).

Wastes would be generated during construction of the consolidated nuclear production center if it were sited at LANL. Wastes anticipated from proposed construction would include up to 10,000 cubic yards (7,600 cubic meters) of low-level waste that would be processed and packaged for disposal at TA-54. Other construction wastes that could be generated include hazardous waste and nonhazardous solid and liquid waste. The quantities of hazardous waste that could be generated from construction are small compared to the amount of hazardous waste disposal capacity available in the region. Nonhazardous solid wastes would be recycled to the extent practicable and the remainder would be shipped offsite for disposal at approved commercial landfills located within the state. Nonhazardous liquid waste generated during construction would be processed at the TA-46 Sanitary Wastewater System Plant.

Operation of the consolidated nuclear production center at LANL would result in the generation of additional radioactive waste. Up to 850 cubic yards (650 cubic meters) of transuranic waste and 310 cubic yards (240 cubic meters) of mixed transuranic waste could be generated annually. This waste would be packaged in accordance with the WIPP WAC, placed in TRUPACT-II shipping containers, and shipped to WIPP for disposal. In addition, operations would generate up to 11,640 cubic yards (8,900 cubic meters) of low-level radioactive waste and up to 72 cubic yards (55 cubic meters) of mixed low-level radioactive waste annually. Low-level radioactive waste would be processed and packaged for disposal at TA-54. Mixed low-level radioactive waste could require permitted treatment and disposal in an appropriate facility. Treatment could occur at one of the new facilities that is proposed to have a RCRA-permitted mixed waste treatment capability. Operations could also generate up to 8,925 gallons (33,785 liters) of liquid low-level radioactive waste and up to 3,622 gallons (13,710 liters) of liquid mixed low-level radioactive waste annually. These wastes would be solidified, processed, and packaged for disposal at the waste processing portion of the proposed new consolidated nuclear production center, or at existing facilities in TA-54, and then disposed of in accordance with their regulatory status. Approximately 1,370 cubic yards (1,050 cubic meters) of solid hazardous waste and 8,850 gallons (33,500 liters) of liquid hazardous waste could be generated annually at LANL as a result of consolidated nuclear production center operation. The capacity to collect these wastes, accumulate them at existing storage facilities, solidify the liquid waste, and ship these wastes offsite for treatment and disposal at a commercial facility, presently exists and would be sufficient to handle these volumes. Because operation of the proposed consolidated nuclear production center would not be expected to start until after 2016, these waste quantities have not been included in Table 5–84.

The volumes of low-level (up to 3,450 cubic yards [2,640 cubic meters]) and mixed low-level radioactive waste (up to 4.4 cubic yards [3.4 cubic meters]) projected to be generated annually by the GNEP advanced fuel cycle facility (DOE 2008) would be managed within the current waste management program. The facility could generate up to 928 cubic yards (710 cubic meters) annually of nondefense transuranic waste (DOE 2008), which is not eligible for disposal at WIPP. Transuranic waste without a disposal pathway would be safely stored until a disposal facility became available. The project could also generate up to 34 cubic yards (26 cubic meters) of high-level radioactive waste annually (DOE 2008). Facilities to safely manage high-level radioactive waste until it could be sent to a geologic repository would have to be provided by the project since no high-level radioactive waste is currently managed at LANL.

Transportation

The collective doses, cumulative health effects, and traffic fatalities resulting from approximately 130 years of radioactive material and waste transport across the United States are estimated in **Table 5–85**. The total collective worker doses from all types of shipments (general transportation, historical DOE shipments, reasonably foreseeable actions, and the LANL SWEIS Alternatives) were estimated to be 381,700 to 382,400 person-rem, which would result in about 229 LCFs among the affected transportation workers. The total collective doses to the general public were estimated to be 343,680 to 343,900 person-rem, which would result in about 206 excess LCFs among the affected general population. The total estimated traffic fatalities associated with accidents involving radioactive material and waste transports would be up to 119. The majority of the collective doses for workers and the general population are associated with the general transportation of radioactive material. Examples of these activities are shipments of radiopharmaceuticals to nuclear medicine laboratories and shipments of commercial low-level waste to commercial disposal facilities. The majority of the traffic fatalities are due to the general transportation of radioactive materials (28 fatalities) and reasonably foreseeable actions (85 fatalities).

Table 5–85 presents the transportation impacts over ten years for each of the SWEIS alternatives. The data show that the impacts of each of the alternatives evaluated in this LANL SWEIS are quite small compared with the overall transportation impacts associated with radioactive materials and waste shipments across the United States. LANL SWEIS Alternatives are expected to result in no worker or public cancer deaths (LCFs) and no more than three traffic fatalities (through 2016); therefore, they would not substantially contribute to cumulative impacts. For perspective, in 2004, there were 522 traffic fatalities in New Mexico and 58 in the three neighboring counties (Los Alamos, Rio Arriba, and Santa Fe) (see Chapter 4, Table 4–56). Nationwide, in 2004, there were more than 42,000 traffic fatalities (NCSA 2006).

Table 5–85 Cumulative Impacts of Radioactive Material and Waste Transport (1943 to 2073) [a]

Activity	Worker		General Public		Traffic Fatalities
	Collective Dose (person-rem)	*Latent Cancer Fatality*	*Collective Dose (person-rem)*	*Latent Cancer Fatality*	
LANL SWEIS Alternatives [b]					
No Action	Up to 164	0.098	53 to 58	0.035	0.27
Reduced Operations	Up to 147	0.088	49 to 53	0.032	0.24
Expanded Operations	Up to 910	Up to 0.15	Up to 287	Up to 0.17	Up to 2.7
Other Past, Present, and Reasonably Foreseeable Future Actions					
General Transportation (1943 to 2073) [c]	350,000	210	300,000	180	28
Historical DOE Shipments [c]	330	0.20	230	0.14	No data
Reasonably Foreseeable Actions [c]	25,300	15.2	42,200	25.3	85
High Level Waste and Spent Nuclear Fuel Disposal at Yucca Mountain (up to 2073) [c, d]	5,900	3.5	1,200	0.72	2.8
Total [e]	381,700 to 382,400	229	343,680 to 343,900	206	~119

[a] Collective dose, health effects, and traffic fatalities associated with transporting radioactive materials and waste.
[b] From Table 5–51.
[c] From *Draft Yucca Mountain SEIS* (DOE 2007a) and Table K–10 of this SWEIS.
[d] From *Draft Yucca Mountain SEIS* (DOE 2007a), Proposed Action; mostly rail alternative.
[e] Total is a range that includes the minimum and maximum values from the LANL SWEIS Alternatives. Total may not equal the sum of the contributions due to rounding.
Note: LCFs calculated using a conversion of 0.0006 LCFs per person-rem.

The major radiological transportation actions involving Category I/II special nuclear material related to the Complex Transformation consolidated nuclear production center at LANL would be:

- Pits currently stored at the Pantex Plant would be transported to LANL; and
- Highly enriched uranium currently stored at the Y-12 Complex would be transported to LANL.

After completion of these shipments, there would be no annual shipment of pits and secondaries. The estimated radiological health impacts of the one-time transportation of pits from Pantex, and highly enriched uranium from Y-12, to LANL under this proposal would:

- The general public would receive a collective dose of approximately 118 person-rem from incident-free transportation, resulting in approximately 0.071 LCFs.
- The collective dose to workers handling pits and highly enriched uranium materials for transportation would be about 1,100 and 4,420 person-rem, respectively; this corresponds to an estimated 3.3 LCFs. It should be noted that the annual maximum individual dose is administratively limited to 2 rem (DOE 1999e); this would be a risk of 0.001 of developing an LCF.

Nonradiological impacts associated with this transportation would be expected to result in zero fatalities (0.018) as a result of traffic accidents.

The major transportation actions involving radioactive materials related to the *GNEP PEIS* advanced fuel cycle facility at LANL would be (DOE 2008):

- 39 shipments of light-water reactor spent fuel;
- 50 shipments of transmutation fuel;
- 50 shipments of fast reactor spent fuel; and
- approximately 1,430 waste shipments.

Local Transportation

Potential impacts to traffic at the main access points to LANL are estimated in **Table 5–86**. The No Action Alternative would not be expected to result in an increase in traffic over current levels. If the Reduced Operations Alternative were chosen for this SWEIS, traffic would be expected to decrease by 4 percent compared to the No Action Alternative. The largest estimated daily traffic increase would occur if the SWEIS Expanded Operations Alternative – MDA Removal Option were selected. Under this scenario, daily traffic could increase by up to 18 percent (averaged across all LANL entrances).

Table 5–86 Summary of Changes in Traffic Flow at the Entrances to Los Alamos National Laboratory

Alternative	*Average Daily Vehicle Trips*				
	Diamond Drive Across Los Alamos Canyon	*Pajarito Road at NM 4*	*East Jemez Road at NM 4*	*West Jemez Road at NM 4*	*DP Road at Trinity Drive*
Baseline	24,545	4,984	9,502	2,010	1,255
LANL SWEIS					
Reduced Operations Alternative	-900	-200	-400	-90	-50
Expanded Operations – MDA Removal Option – Increase in Daily Trips	+1,400	+4,200	+1,200	+200	+440
Total Change in Daily Vehicle Trips	-900 to +1,400	-200 to +4,200	-400 to +1,200	-90 to +200	-50 to +440
Percent Change from Baseline	-4 to + 6	- 4 to +84	-4 to +13	-4 to +10	-4 to +35

MDA = material disposal area.
Note: Incremental changes for LANL SWEIS Alternatives may not match earlier tables due to rounding.

Some temporary and intermittent disruption of traffic flow is expected to occur during construction of the Security Driven Transportation Modification Project (DOE 2002k) as well as under the Expanded Operations Alternative of this SWEIS. These traffic disruptions are not expected to affect recreation, habitat management, or timber production in U.S. Forest Service and Bandelier National Monument areas adjacent to LANL.

Development of land conveyed under the *Land Conveyance and Transfer EIS* ROD could, after the land was remediated, increase traffic in the vicinity of the airport and TA-21 based on current Los Alamos County plans for light industry, retail, and residential development on these tracts. This action, combined with increased traffic due to DD&D activities at TA-21, could cause excessive traffic loads on NM 502. Similarly, increases in employment levels at the Los Alamos Research Park could increase traffic, but currently only 150 are employed there.

The addition of proposed facilities and an increased number of workers for the consolidated nuclear production center in TA-16 as analyzed in the *Complex Transformation SPEIS* would likely result in increased traffic along NM 4 from White Rock to West Jemez Road and on West Jemez Road to the center of the LANL. The option to consolidate the facilities in TA-16 would help to alleviate current concerns related to increased traffic along Pajarito Road under the Expanded Operations Alternative somewhat, because there could be a corresponding decrease in traffic along Pajarito Road from NM 4 to TA-55 if the activities at the TA-55 Plutonium Facilities Complex were relocated to TA-16. Conversely, the proposed location of the GNEP advanced fuel cycle facility in TA-36 could lead to increased traffic along Pajarito Road from NM 4.

Environmental Justice

Environmental justice impacts would occur when the net effect of regional projects or activities would result in disproportionately high adverse human and environmental effects to minority or low-income populations. The previous analysis indicates no high and adverse cumulative human health and environmental impacts, including economic impacts and impacts from special pathways. Therefore, no disproportionately high and adverse human and environmental effects to minority or low-income populations are expected as a result of implementing any of the three alternatives under consideration for continued LANL operations in the SWEIS.

Under the Expanded Operations Alternative, as discussed in Section 5.8.1, employment at LANL and in the surrounding region is expected to increase thus creating additional employment opportunities for local individuals. As additional funding flows into the regional economy, increased opportunities for low-income and minority populations should be realized. Also, under the *Land Conveyance and Transfer EIS*, lands currently considered part of LANL would be transferred to the U.S. Department of the Interior to be held in trust for the Pueblo of San Ildefonso, thus benefiting these people.

As discussed in the *Land Conveyance and Transfer EIS*, there is the possibility that transfer activities may impact traditional cultural properties that could be present on the tracts of land being transferred or in adjacent areas (DOE 1999d). This is also true for areas that LANL is cleaning up under its ongoing environmental restoration program. In 2005 and 2006 the Los Alamos Site Office reaffirmed the 1992 accords with the four Pueblos (the Santa Clara, San Ildefonso, Jemez and Cochiti Pueblos) that recognize the Pueblos as sovereign entities that can interact with the Los Alamos Site Office on a government-to-government basis. Los Alamos Site Office has also signed the LANL Pueblo Cooperative Agreements which provide a procedural framework for consultation, as well as committing to provide information and input in long-term planning and decision making. In addition, the LANL management and operating contractor has prepared *A Plan for the Management of the Cultural Heritage at Los Alamos National*

Laboratory, New Mexico (LANL 2006f) in which specific aspects of the consultation process are spelled out. NNSA is committed to continuing to interface with the Pueblos in accordance with these agreements and plan. When a project is planned at LANL, archaeological records are searched to determine if any cultural resource sites are known to exist at the project area. If archaeological records do not exist for the project area, LANL personnel conduct the necessary surveys prior to any work taking place. If it is determined that traditional cultural properties are present on any of the lands to be transferred or those being cleaned-up, the consultations called for under the appropriate accord and the management plan will be undertaken.

Based on the impacts for resource areas, few high and adverse impacts are expected from the construction and operation of a consolidated nuclear production center or the GNEP advanced fuel cycle facility at LANL. To the extent that any impacts may be high and adverse, NNSA expects the impacts to affect all populations in the area equally (DOE 2007b).

5.14 Mitigation Measures

The regulations promulgated by the Council on Environmental Quality to implement the procedural provisions of NEPA (42 U.S.C. §4321) require that an EIS include a discussion of appropriate mitigation measures (40 CFR 1502.14[f]; 40 CFR 1502.16[h]). The term “mitigation” includes the following:

- Avoiding an impact by not taking an action or parts of an action;
- Minimizing impacts by limiting the degree of magnitude of an action and its implementation;
- Rectifying an impact by repairing, rehabilitating, or restoring the affected environment;
- Reducing or eliminating the impact by preservation and maintenance operations during the life of the action; and
- Compensating for the impact by replacing or providing substitute resources or environments (40 CFR 1508.20).

This section describes mitigation measures that are built into the alternatives analyzed as well as additional measures that will be considered by DOE to further mitigate the adverse impacts identified earlier in this chapter. These measures address the range of potential impacts of continuing to operate LANL (including those areas where lack of information regarding resources and mechanisms for assessing impacts to resources result in substantial uncertainty in the impact analyses). The mitigation measures built into the alternatives analyzed (see Section 5.14.1 and 5.14.2) are of two types: (1) existing programs and controls (including regulations, policies, contractual requirements, and administrative procedures); and (2) specific measures built into the alternatives that serve to minimize the effects of activities under the alternatives. The existing programs and controls are too numerous to list here; but a general description is provided, as well as the role of existing programs in operating LANL and pertinent examples of how these programs mitigate adverse impacts. Additional mitigation measures that could further reduce the adverse impacts identified in this chapter are discussed in Section 5.14.3. The description of these measures in this chapter does not constitute a commitment to undertake any of these measures. Any such commitments would be reflected in the ROD following this SWEIS, with a more detailed description and implementation plan provided in a Mitigation Action Plan following the ROD.

5.14.1 Existing Programs and Controls

The activities undertaken at LANL are performed within the constraints of applicable regulations, applicable DOE orders, contractual requirements, and approved policies and procedures. Laws and regulations applicable to Federal facilities are discussed in Chapter 6; many of these requirements are established to protect human health and the environment. It is assumed that these or similar regulatory controls will continue to be in place. When complied with, these regulations mitigate the potentially adverse impacts of operations to the public, the worker, and the environment. For example, the Clean Air Act (42 U.S.C. §7401) regulates air emissions and the Clean Water Act (33 U.S.C. §1251) regulates liquid effluent discharges in a manner designed to protect human health and reduce the adverse environmental effects of routine operations. In addition to the regulations applicable to LANL, Chapter 6 also discusses other requirements (including DOE Orders and external standards and regulations that would not otherwise apply to Federal facilities) that apply to operations at LANL through the contract between DOE and its management and operating contractor. As discussed in Chapter 6, these requirements are established and enforced through contractual mechanisms. As with the regulations that apply to LANL, it is assumed that these or similar controls will continue. These requirements also mitigate the potential for adverse impacts. For example, the application of DOE design standards results in facility designs for modern nuclear facilities that reduce the potential for catastrophic releases from these facilities in the event of earthquakes, high winds, or other natural phenomena. Similarly, the application of occupational safety and health regulations in 29 CFR Part 1900, et seq, and other standards promulgated by the American National Standards Institute, the U.S. Department of Defense, and DOE, as well as the use of other life safety and fire safety codes and manuals, limit worker exposures to workplace hazards, which reduces the potential for adverse worker health effects. DOE and LANL also have instituted policies and procedures applicable to work conducted at LANL to mitigate potentially adverse effects of operations. It is assumed that these or similar policies and procedures will continue. These policies and procedures are numerous and include, but are not limited to:

- Procedures that institute integrated safety management to control work conducted at LANL (to ensure that work conducted is planned and reviewed, funded, within the applicable regulations and requirements, within the range of risks accepted by DOE and its management and operating contractor, and is otherwise authorized);

- Policies regarding the knowledge, skills, and abilities of personnel assigned to perform hazardous work (including required training);

- Policies reflected in agreements with other entities (such as the Accords with the four Pueblos located nearest to LANL) that establish policies and protocols regarding consultations and other discussions regarding LANL activities;

- Policies and procedures regarding stoppage and restart of work where unexpected hazards or resources are identified (for example, policies regarding recovery of information from archaeological sites uncovered by excavation).

Work controls reduce potential impacts by ensuring that work conducted falls within the range of activities that have been studied for potential environmental and human health effects. Policies regarding the knowledge, skills, and abilities of personnel conducting work at LANL reduce potential impacts by ensuring that only personnel having an appropriate understanding of the work and its potential hazards may undertake that work (which minimizes the potential for adverse human health and environmental effects from inadvertent actions due to a lack of such understanding). Policies for consultations and discussions with other entities mitigate effects by providing an opportunity to avoid or change actions that could cause adverse impacts. For example, consultation with the Pueblos could identify a potential for impacts to traditional cultural properties prior to implementing a construction project or operations, as well as identify alternative siting or operational approaches that would avoid the impacts. Policies and procedures regarding the stoppage and restart of work are similar in effect to work controls; when unexpected situations occur that impose unexpected hazards or reveal unexpected resources (for example, cultural resources), work is stopped as soon as stoppage can be accomplished safely until work plans and authorizations can be modified in consideration of the new information. This reduces potential impacts in a manner similar to work controls, as discussed above.

DOE also has established programs and projects at LANL to increase the level of knowledge regarding the environment around LANL, the health of LANL workers, the health of the public around LANL, and the effects of LANL operations on these elements, as well as to avoid or reduce impacts and remediate contamination from previous LANL activities. These programs and projects reduce potentially adverse impacts by providing a heightened understanding of the resources that could be impacted; avoidance of some impacts (where mechanisms for impacts to specific resources are known and avoidable); early identification of impacts (which can enable stoppage or mitigation of the impacts); reduction of ongoing impacts; or beneficial management opportunities for natural, cultural, and sensitive resources, where appropriate. It is assumed that such activities will continue at LANL. Examples of these programs and projects include:

- The Environmental Surveillance and Compliance Program at LANL monitors LANL for permit and environmental management requirements. This program also includes evaluations of samples from various environmental media for radioactive materials and other hazardous materials locally and regionally (see Chapter 4, Section 4.6.1.2). The data generated under this program are collected routinely, publicly reported at least annually, and analyzed to determine regulatory compliance and environmental trends over long periods.

- The Threatened and Endangered Species Habitat Management Plan is intended to provide long-range planning information for future LANL projects and to protect the habitats of endangered species at LANL (see Chapter 4, Section 4.5.4).

- A recently completed *Cultural Heritage Management Plan* for LANL (see Chapter 4, Section 4.7) has undergone public review and is being implemented through a programmatic agreement between DOE, the New Mexico State Historic Preservation Office, and the Advisory Council on Historic Preservation.

- Flue gas recirculation equipment installed in 2002 on the boilers at the TA-3 power plant has reduced nitrogen oxides emissions by 64 percent. Such equipment and administrative controls are applied to the steam plant and other sources to comply with the emission source limitations and the facility-wide emission limitations specified in LANL's air permit (see Chapter 4, Section 4.4.2).

- Studies of public and worker health in and around LANL have been conducted (some by DOE and some by other agencies) to assess both human health in the region and the potential for adverse human health effects due to LANL operations (see Chapter 4, Section 4.6).

- The Health, Safety, and Radiation Protection Program is conducted by LANL to promote the health and safety of its workers. This program addresses the possible impacts that could result from working with ionizing and non-ionizing radiation, hazardous and chemical materials, and biohazard materials. Appropriate controls that protect the health and safety of workers are determined primarily by the type of hazard and the work environment. The level or amount of controls is commensurate with the risk associated with the hazards that would be encountered by the workers for each job activity.

- LANL's NPDES Industrial Stormwater Permit Program regulates stormwater runoff from industrial activities under a Multi-Sector General Permit. Stormwater monitoring and erosion controls are required at these sites. An integrated Stormwater Monitoring Program monitors stormwater runoff on a watershed basis and at individual solid waste management units. LANL recently began to implement these programs in response to the 2004 Federal Facility Compliance Agreement between the EPA and DOE. The NPDES Construction Stormwater Program regulates stormwater from construction activities disturbing 1 acre (0.4 hectares) or more (see Chapter 4, Section 4.3.1.3).

- LANL's Groundwater Protection Management Program assesses current groundwater conditions and monitors and protects groundwater. A Hydrogeologic Work Plan also supplements and verifies existing information on the environmental setting at LANL and collects analytical data on groundwater contamination (see Chapter 4, Section 4.3.2). An Interim Facility-wide Groundwater Monitoring Plan has been submitted to the New Mexico Environment Department as required by the 2005 Consent Order (LANL 2006g).

- The Safeguards and Security Program restricts unauthorized access to areas of LANL that have a high potential for impacts to human health and the environment. Such access restrictions limit the potential for intentional or inadvertent actions that could result in environmental or human health effects.

- LANL's Emergency Management and Response Program effectively combines Federal and local emergency response capabilities and provides planning, preparedness, and response capabilities that can aid in containing and remediating the effects of accidents or adverse operational impacts (see Chapter 4, Section 4.6.4).

- LANL's Fire Protection Program ensures that personnel and property are adequately protected against fire or related incidents, including fire protection and life safety (see Chapter 4, Section 4.6.4).

- An Interagency Wildfire Management Team has been established to coordinate activities related to reducing the fuel loading surrounding the site (see Chapter 4, Section 4.5.1). On the site, LANL is implementing actions around individual facilities that have moderate or higher vulnerability to burning as a result of wildfire.

- Waste minimization and pollution prevention efforts at LANL are coordinated by the Pollution Prevention Program, which works to reduce wastes generated and to some extent effluents and emissions from facilities (see Chapter 4, Section 4.9).

- Water and energy conservation programs at LANL are intended to reduce use of these resources, which should assist in mitigating the effects of water withdrawal and electrical consumption that occasionally exceed supply (see Chapter 4, Section 4.8.2).

- The LANL environmental restoration program (which includes DD&D) assesses and remediates contaminated sites that either were or still are under LANL control (see Chapter 4, Section 4.12). The LANL environmental restoration program serves an important role in reducing the potential for future impacts to human health and the environment due to legacy contaminants in the environment. This analysis assumes that current mitigation practices used in remediation actions will continue.

While this list is not all-inclusive, it reflects the importance of these programs in mitigating the potentially adverse impacts of operating LANL.

5.14.2 Mitigation Measures Incorporated in the SWEIS Alternatives

Several specific mitigation measures are included in the SWEIS alternatives. Unless otherwise noted below, the analyses in this chapter assume that the following measures would be implemented.

- NNSA intends to implement actions necessary to comply with the Consent Order, regardless of decisions it makes on other actions analyzed in the SWEIS; however, specific remediation actions have not been selected. Removal of contamination from MDAs and other PRSs, if necessary, would be conducted in a manner that protects the environment and public and worker health and safety. Removal of waste from some large MDAs may require use of temporary enclosures to limit possible releases of contaminated material to the environment to levels within applicable standards and ALARA. The MDAs where use of enclosures or equivalent measures may be required for safe removal operations include MDAs A, B, T, AB, and G (Expanded Operations Alternative – MDA Removal Option).

- Under all alternatives, nonradioactive air emissions, such as from construction equipment, would be controlled by proper maintenance of equipment.

- Under the Expanded Operations Alternative, noise impacts on sensitive wildlife species during MDA remediation, DD&D, and construction activities would be mitigated by planning activities outside of the breeding season for sensitive species, if any sensitive species' habitat is identified in the area and if the habitat is occupied or the status is uncertain. If appropriate, other protective measures could be employed, such as hand digging.

- Under the No Action and Expanded Operations Alternatives, radiological air emissions would be monitored and tracked to maintain the annual dose to the public from LANSCE emissions under the administrative limit.

- Under the Expanded Operations Alternative, the Science Complex would be constructed on a site in Northwest TA-62, located west of the Research Park area. This site is bounded to the north by an unpaved utility corridor access road with forested land beyond. The utility corridor access road may be paved in the future to provide all-weather access to areas of the Santa Fe National Forest and a local recreational ski facility.

- Under the Expanded Operations Alternative, traffic improvements would be implemented for operation of the new Science Complex on West Jemez Road in TA-62 and the consolidated Warehouse and Truck Inspection Station on East Jemez Road in TA-72 to mitigate the effect of these facilities on traffic flow.

- Under all alternatives, actions would be taken to mitigate the risks of a wildfire on waste storage domes in TA-54. In 2000, the Cerro Grande Fire burned a heavily forested canyon area to within about 0.75 miles (1.2 kilometers) of the waste storage domes in TA-54, but none were burned and there were no radiological releases from domes. Additional fuel reduction has been conducted since the Cerro Grande Fire, both to the vegetation surrounding the TA-54 area and within the domes themselves (for example, wooden pallets have been replaced with metal pallets), to further decrease the potential for a waste storage dome fire occurring as a result of a site wildfire. The LANL management and operating contractor would continue its wildfire management activities (for example, forest thinning) and further reduce risks by shipping legacy transuranic waste, currently stored in the domes, to WIPP.

5.14.3 Other Mitigation Measures Considered

In addition to those mitigation measures described above, other feasible mitigation measures considered in the preparation of this SWEIS are presented below.

- Expanded sealed source program procedures would be instituted under the Expanded Operations Alternative that would ensure adequate controls on the quantities and methods of storing sealed sources containing cobalt-60, iridium-192, or cesium-137 to mitigate the effects of potential accidents. This would reduce the potential direct gamma radiation-streaming dose from a postulated accident that could compromise the shielding around these gamma-emitting radioisotopes.

- Los Alamos County has recently completed a 40-year water plan (Stephens 2006) to address water service needs, balance the uses of water resources, and make recommendations for a water conservation program tailored to meet specific water supply customer needs in the county, including LANL. Only the Expanded Operations Alternative is projected to have water demands that would approach the available water rights from the regional aquifer. Los Alamos County's plans to use up to 391 million gallons (1,500 million liters) of water per year from the San Juan-Chama Transmountain Diversion Project as early as 2010 would alleviate any potential shortfall between future demand and current groundwater rights. LANL's water use would be mitigated somewhat by the use of recycled water from the Sanitary Effluent Recycle Facility for cooling water.

− Ongoing upgrades are being made to the electrical power transmission and distribution system, including construction of a third transmission line to allow import of additional power into the Los Alamos Power Pool and to support a higher electric peak load beyond 2006. In addition, an EA (DOE/EA 1430) was prepared and a FONSI was issued in December 2002 for a project to install two new (20 megawatt) gas-fired combustion turbine generators and to upgrade the existing steam turbines at the TA-3 Co-Generation Complex (DOE 2000f). As discussed in Chapter 4, Section 4.8.2, upgrades and installation of one new combustion turbine generator were completed in September 2007. Although DOE currently has no timeframe for installing a second combustion turbine generator, its installation in the future would add 20 megawatts (equivalent to 175,200 megawatt-hours) of electrical power generating capacity at LANL.

− Under all of the alternatives, particulate matter (fugitive dust) emissions from exposed soil and roadways during construction activities would be controlled using routine watering as appropriate. As necessary, air pollutant emissions from construction activities and MDA remediation activities would be controlled using standard construction emissions controls. Application of chemical stabilizers to exposed areas and administrative controls such as planning, scheduling, and use of special equipment could further reduce emissions under all of the alternatives.

− Use of containment vessels for high explosives testing under all of the alternatives could further reduce air pollutant emissions, such as beryllium and depleted uranium, from this activity. The use of vessels for certain tests could reduce emissions from these tests by close to 100 percent.

− The possibility exists that traffic into and out of LANL could increase over the next several years. Additional traffic studies should be undertaken to determine if activities under consideration in the SWEIS would increase traffic to unacceptable levels and to identify possible solutions in the event such problems are identified.

− Traffic and noise impacts on residents of the Royal Crest Mobile Home Park and Los Alamos Town Center due to increased truck traffic under the Expanded Operations Alternative could be mitigated by scheduling activity for off-peak hours, rerouting truck traffic, using multiple shifts, using alternative entries and exits, and, in the case of TA-21 remediation and DD&D, possible construction of a bridge or another road off of DP Mesa to allow alternate routing of traffic. Stockpiling fill and cover materials on the sites during off-peak hours also could be considered to avoid frequent trips during peak hours.

- To alleviate concerns associated with additional employees commuting to LANL from areas such as Rio Arriba and Santa Fe Counties, it may be necessary to expand the park-and-ride bus services that are currently offered from Española and Santa Fe.

5.15 Resource Commitments

This section describes the unavoidable adverse environmental impacts that could result from changes in ongoing activities at LANL; the relationship between short-term uses of the environment and maintenance and enhancement of long-term productivity; and irreversible and irretrievable commitments of resources. Unavoidable adverse environmental impacts are impacts that would occur after implementation of all feasible mitigation measures. The relationship between short-term uses of the environment and maintaining and enhancing long-term productivity addresses issues associated with the condition and maintenance of existing environmental resources used to support the Proposed Action and the utility of these resources after their use. Resources that would be irreversibly and irretrievably committed are those that cannot be recovered or recycled and those that are consumed or reduced to unrecoverable forms.

5.15.1 Unavoidable Adverse Environmental Impacts

Ongoing activities at LANL under any of the three alternatives analyzed in this SWEIS could result in unavoidable adverse impacts on the human environment. In general, these impacts would be minimal and would come from incremental impacts attributed to ongoing LANL operations.

Ongoing activities at LANL will continue to result in unavoidable radiation and chemical exposure to workers and the public. Generation of radioactive isotopes under any of the three alternatives is unavoidable. Radioactive waste generated during operations would be collected, treated, stored, and eventually removed for suitable recycling or disposal in accordance with applicable DOE and EPA regulations.

Operations at LANL under any of the three alternatives would have minimal unavoidable adverse impacts from air emissions. Air emissions include various chemical or radiological constituents in the routine emissions typical of nuclear facility operations. Decontamination and decommissioning of buildings could result in the one-time generation of radioactive and nonradioactive waste material that could affect storage requirements. This could produce unavoidable impacts on the amount of available and anticipated storage space and the requirements of disposal facilities at LANL.

Temporary construction impacts associated with the construction of new facilities at LANL also would be unavoidable. These impacts would include generation of fugitive dust, and noise, as well as increased construction vehicle traffic.

5.15.2 Relationship Between Local Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity

Ongoing operations at LANL under any of the three alternatives would require short-term commitments of resources and permanent commitments of certain resources (such as energy). Environmental resources have already been committed to continuing operations at LANL.

Additional commitments would serve to maintain existing environmental conditions with little or no impact on the long-term productivity of the environment.

Short-term commitments of resources would include space and materials required to construct new buildings; new operations support facilities; transportation; and disposal resources and materials for continued LANL operations. Workers, the public, and the environment could be exposed to increased amounts of hazardous and radioactive materials over the period of this SWEIS analysis due to relocation of materials, including process emissions, and handling of radioactive waste.

Regardless of changes in the location and levels of activities at LANL Key Facilities, additional air emissions could introduce small amounts of radiological and nonradiological constituents to the air in the region around LANL. These emissions would result in additional loading and exposure, but would not be expected to impact compliance with air quality or radiation exposure standards at LANL. There would be no significant residual environmental effects on long-term environmental viability.

Management and disposal of additional sanitary solid waste and nonrecyclable radiological waste would require the use of energy and space at LANL treatment, storage, or disposal facilities or at replacement offsite disposal facilities. Regardless of location, the land required to meet solid waste needs at LANL would require a long-term commitment of terrestrial resources. Activities being considered at LANL, such as consolidation of new facilities, could result in further disturbance, use, and commitment of previously undisturbed land. Ultimately, after closure of facilities at LANL, NNSA plans to decontaminate and decommission the buildings and equipment and restore them to brownfield sites that could be made available for future reuse.

5.15.3 Irreversible and Irretrievable Commitments of Resources

Irreversible and irretrievable commitments of resources unanticipated in the *1999 SWEIS* would include mineral resources consumed during the life of certain projects and energy and water used to operate buildings and facilities at LANL. Commitments of capital, energy, labor, and materials are generally irreversible.

Energy expended would be in the form of fuel for equipment and vehicles, electricity for facility operations, and human labor. Changes in LANL operations could generate nonrecyclable waste streams such as radiological and nonradiological solid waste and some wastewater. Certain materials and equipment used during operations, however, could be recycled when buildings are decontaminated and decommissioned.

Operations at LANL require water, electricity, and diesel fuel. These resources are discussed in Section 5.8.2.

Disposal of hazardous and radioactive wastes also would cause irreversible and irretrievable commitments of land, mineral, and energy resources.

CHAPTER 6
APPLICABLE LAWS, REGULATIONS, AND OTHER REQUIREMENTS

6.0 APPLICABLE LAWS, REGULATIONS, AND OTHER REQUIREMENTS

Chapter 6 provides an update to the laws, regulations, agreements, and consultations that relate to environmental protection at the Los Alamos National Laboratory (LANL).

As part of the National Environmental Policy Act (NEPA) process, an agency must consider whether an action could threaten a violation of any Federal, state, or local law or requirement (40 *Code of Federal Regulations* [CFR] 1508.27) or require a permit, license, or other entitlement (40 CFR 1502.25). This chapter identifies and summarizes the major environmental requirements, agreements, and permits that could be required to support the *Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (SWEIS).

A number of Federal environmental laws affect environmental protection, health, safety, compliance, and consultation at every U.S. Department of Energy (DOE) location. In addition, certain environmental requirements have been delegated to state authorities for enforcement and implementation and state legislatures have passed laws to protect human health and safety and the environment. It is DOE policy to conduct its operations in a manner that ensures the protection of public health, safety, and the environment through compliance with all applicable Federal and state laws, regulations, DOE Orders, and other requirements.

The alternatives analyzed in this SWEIS involve either the operation of existing DOE facilities or the construction and operation of new DOE facilities. Actions required to comply with laws, regulations, and other Federal and State of New Mexico requirements may depend on whether a facility is newly built (preoperational), operational, undergoing decontamination and decommissioning, or incorporated in whole or in part into an existing facility.

Requirements governing the continuation of LANL operations arise primarily from six sources: the Congress, Federal agencies, Executive Orders, legislatures of the affected states, state agencies, and local governments. In general, Federal statutes establish national policies, create broad legal requirements, and authorize Federal agencies to create regulations that conform to the statutes. Detailed implementation of these statutes is delegated to various Federal agencies such as DOE, the U.S. Department of Transportation (DOT), and the U.S. Environmental Protection Agency (EPA). For many environmental laws under EPA jurisdiction, state agencies may be delegated responsibility for the majority of program implementation activities, such as permitting and enforcement, but EPA usually retains oversight of the delegated program.

Some applicable laws such as NEPA, the Endangered Species Act, and the Emergency Planning and Community Right-To-Know Act require specific reports and consultations rather than ongoing permits or activities. These are satisfied through the legal and regulatory process, including the preparation of this SWEIS.

Other applicable laws establish general requirements that must be satisfied, but do not include processes (such as the issuance of permits or licenses) that consider compliance prior to specific violations or other events that trigger their provisions. These include the Toxic Substances Control Act (TSCA) (affecting polychlorinated biphenyl transformers and other designated substances); the Federal Insecticide, Fungicide, and Rodenticide Act (affecting pesticide and herbicide applications); the Hazardous Materials Transportation Act; and (in the event of a spill of a hazardous substance) the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund).

Executive Orders establish policies and requirements for Federal agencies. Executive Orders are applicable to Executive branch agencies, but do not have the force of law or regulation.

In addition to implementing some Federal programs, state legislatures develop their own laws to supplement as well as implement Federal laws for protection of air and water quality and groundwater. State legislation in New Mexico addresses solid and hazardous waste management programs, locally rare or endangered species, and local resource, historic, and cultural values. The laws of local governments add a further level of protection of the public, often focusing on zoning, utilities, and public health and safety concerns.

Regulatory agreements and compliance orders also may be initiated to establish responsibilities and timeframes for Federal facilities to comply with provisions of applicable Federal and state laws. Other agreements, memoranda of understanding, and formalized arrangements also establish cooperative relationships and requirements.

The actions being considered in this SWEIS would be all located on LANL property controlled by the National Nuclear Security Administration (NNSA). NNSA has authority to regulate some environmental activities, as well as the health and safety aspects of nuclear facilities operations. The Atomic Energy Act of 1954, as amended, is the principal authority for DOE regulatory activities not externally regulated by other Federal or state agencies. Regulation of DOE activities is primarily established through the use of DOE Orders and regulations.

External environmental laws, regulations, and Executive Orders can be categorized as applicable to either broad environmental planning and consultation requirements or regulatory environmental protection and compliance activities, although some requirements are applicable to both planning activities and ongoing operations.

Section 6.1 of this chapter discusses major applicable Federal laws, regulations, and permits that impose nuclear safety and environmental protection requirements on the activities conducted at LANL. Each of the applicable regulations and statutes establishes how activities are to be conducted or how potential releases of pollutants are to be controlled or monitored. They include requirements for issuing permits or licenses for new operations or new emission sources and for amending existing permits or licenses to allow new types of operations at existing sources.

Section 6.2 discusses new or revised Executive Orders that may be applicable to LANL activities. Section 6.3 identifies DOE Orders for compliance with the Atomic Energy Act, the Occupational Safety and Health Act, and other environmental, safety, and health requirements that may be applicable to LANL activities. Section 6.4 identifies state and local laws, regulations, permits and ordinances, as well as local agreements that potentially impact LANL. Consultations with applicable agencies and federally recognized Native American Nations are discussed in Section 6.5.

6.1 Applicable Federal Laws, Regulations, and Permits

This section describes the Federal environmental, safety, and health laws and regulations and permits that could apply to LANL. These regulations address such areas as energy conservation, administrative requirements and procedures, nuclear safety, and classified information. Activities under all alternatives would need to be conducted in compliance with applicable Federal laws, regulations, and permits. Chapter 4 describes the resources at LANL that are potentially addressed by these laws, regulations, and permits. Chapter 5 discusses the potential impacts to those resources under each alternative. Consultations with applicable agencies and federally recognized Native American Nations as required by Federal laws and regulations are discussed in Section 6.5.

The major Federal laws and regulations, Executive Orders, and other requirements that currently apply or could apply in the future to the various alternatives analyzed in this SWEIS are identified in **Table 6–1**. For ease of identification, laws are identified in the table with a *United States Code* (U.S.C.) or Public Law citation; regulations are identified with a CFR citation; and Executive Orders are listed in italics. This table does not include DOE Orders, which are provided in Section 6.3, nor does it include state requirements, which are provided in Section 6.4.

American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996)—This Act reaffirms American Indian religious freedom under the First Amendment and sets U.S. policy to protect and preserve the inherent and constitutional right of American Indians to believe, express, and exercise their traditional religions. The Act requires that Federal actions avoid interfering with access to sacred locations and traditional resources that are integral to the practice of religions.

Antiquities Act of 1906, as amended (16 U.S.C. 431 *et seq*.)—This Act protects historic and prehistoric ruins, monuments, and antiquities, including paleontological resources, on federally controlled lands from appropriation, excavation, injury, and destruction without permission.

Archaeological and Historic Preservation Act of 1960, as amended (16 U.S.C. 469 *et seq.* 469c-1)—The purpose of this Act is to preserve historical and archaeological data (including relics and specimens) that might otherwise be irreparably lost or destroyed as the result of Federal actions.

Table 6–1 Potentially Applicable Environmental, Safety, and Health Laws, Regulations, and Executive Orders

Laws, Regulations, Orders, Other Requirements	***Citation***
Radioactive Materials and Waste Management	
Atomic Energy Act of 1954, as amended	42 U.S.C. 2011 *et seq.*
"Byproduct Material"	10 CFR Part 962
"Environmental Radiation Protection Standards for Management of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Materials"	40 CFR Part 191
Low-Level Radioactive Waste Policy Act of 1980, as amended	42 U.S.C. 2021 *et seq.*
Waste Isolation Pilot Plant Land Withdrawal Act, as amended	Public Law 102-579
Ecological Resources	
Bald and Golden Eagle Protection Act of 1973, as amended	16 U.S.C. 668 *et seq*.
Endangered Species Act of 1973, as amended	16 U.S.C. 1531 *et seq.*
Fish and Wildlife Coordination Act	16 U.S.C. 661 *et seq.*
Invasive Species	Executive Order 13112
Migratory Bird Treaty Act of 1918, as amended	16 U.S.C. 703 *et seq.*
Protection of Wetlands	Executive Order 11990
Cultural and Paleontological Resources	
American Indian Religious Freedom Act of 1978	42 U.S.C. 1996
Antiquities Act of 1906, as amended	16 U.S.C. 431 *et seq.*
Archaeological and Historic Preservation Act of 1960, as amended	16 U.S.C. 469 *et seq.*
Archaeological Resources Protection Act of 1979, as amended	16 U.S.C. 470aa *et seq.*
Consultation and Coordination with Indian Tribal Governments	Executive Order 13175
Department of Commerce, Justice, and State, the Judiciary, and Related Agencies Appropriations Act, 1998	Public Law 105-119
Indian Sacred Sites	Executive Order 13007
Manhattan Project National Historical Park Study Act	Public Law 108-340
National Historic Preservation Act of 1966, as amended	16 U.S.C. 470 *et seq.*
National Historic Preservation	Executive Order 11593
Native American Graves Protection and Repatriation Act of 1990	25 U.S.C. 3001 *et seq.*
Preserve America	Executive Order 13287
"Protection of Historic and Cultural Properties"	36 CFR Part 800
Worker Safety and Health	
"Occupational Radiation Protection"	10 CFR Part 835
"Chronic Beryllium Disease Prevention Program"	10 CFR Part 850
"Worker Health and Safety Program"	10 CFR Part 851
Occupational Safety and Health Act of 1970	29 U.S.C. 651 *et seq.*
Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction	Executive Order 12699
Radiological Safety Oversight and Radiation Protection	
"Nuclear Safety Management"	10 CFR Part 830
Transportation	
Hazardous Materials Transportation Act of 1975, as amended	49 U.S.C. 5101 *et seq.*
"Packaging and Transportation of Radioactive Material"	10 CFR Part 71

Laws, Regulations, Orders, Other Requirements	***Citation***
Emergency Planning, Pollution Prevention, and Conservation	
Assignment of Emergency Preparedness Responsibilities	Executive Order 12656
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (also known as Superfund)	42 U.S.C. 9601 *et seq.*
Emergency Planning and Community Right-to-Know Act	42 U.S.C. 11001 *et seq.*
Energy Efficiency and Water Conservation at Federal Facilities	Executive Order 12902
Federal Compliance with Pollution Control Standards, as amended by Executive Order 12580, *Superfund Implementation*	Executive Order 12088
Federal Emergency Management, as amended	Executive Order 12148
Greening the Government through Efficient Energy Management	Executive Order 13123
Greening the Government through Leadership in Environmental Management	Executive Order 13148
Greening the Government through Waste Prevention, Recycling, and Federal Acquisition	Executive Order 13101
Pollution Prevention Act of 1990	42 U.S.C. 13101 et *seq.*
Proliferation of Weapons of Mass Destruction	Executive Order 12938
Right-to-Know Laws and Pollution Prevention Requirements	Executive Order 12856
Environmental Justice and Protection of Children	
Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations	Executive Order 12898
Protection of Children from Environmental Health Risks and Safety Risks	Executive Order 13045
Environmental Quality	
"Council on Environmental Quality National Environmental Policy Act Regulations"	40 CFR Part 1500 *et seq.*
National Environmental Policy Act of 1969	42 U.S.C. 4321 *et seq.*
"National Environmental Policy Act Implementing Procedures"	10 CFR Part 1021
Protection and Enhancement of Environmental Quality	Executive Order 11514
Air Quality and Noise	
Clean Air Act of 1970, as amended	42 U.S.C. 7401 *et seq.*
"National Emission Standards for Hazardous Air Pollutants"	40 CFR Part 61
"National Emission Standards for Hazardous Air Pollutants for Source Categories"	40 CFR Part 63
Noise Control Act of 1972, as amended	42 U.S.C. 4901 *et seq.*
Water Resources	
Clean Water Act of 1972, as amended	33 U.S.C. 1251 *et seq.*
"Compliance with Floodplain/Wetlands Environmental Review Requirements"	10 CFR Part 1022
"EPA-Administered Permit Programs: The National Pollutant Discharge Elimination System"	40 CFR Part 122
Floodplain Management	Executive Order 11988
"National Primary Drinking Water Regulations"	40 CFR Part 141
Safe Drinking Water Act of 1974, as amended	42 U.S.C. 300(f) *et seq.*
Hazardous Waste and Materials Management	
Federal Facility Compliance Act of 1992	42 U.S.C. 6961 *et seq.*
"Select Agents and Toxins"	42 CFR Part 73 (see Appendix C of this SWEIS)
Solid Waste Disposal Act of 1965, as amended, including Resource Conservation and Recovery Act of 1976, as amended	42 U.S.C. 6901 *et seq.*)
Toxic Substances Control Act of 1976	15 U.S.C. 2601 *et seq.*

U.S.C. = *United States Code*, CFR = *Code of Federal Regulations*.

Archaeological Resources Protection Act of 1979, as amended (16 U.S.C. 470aa *et seq*.)— This Act requires a permit for any excavation or removal of archaeological resources from Federal or American Indian lands. Excavation must be undertaken to further archaeological knowledge in the public interest, and resources removed are to remain the property of the United States. The law requires that whenever any Federal agency finds that its activities may cause irreparable loss or destruction of significant scientific, prehistoric, or archaeological data, the agency must notify the U.S. Department of the Interior and may request that the Department of Interior undertake the recovery, protection, and preservation of such data. Consent must be obtained from the American Indian Tribe or Federal agency that has authority over the land on which a resource is located before issuance of a permit, and the permit must contain the terms and conditions requested by the Tribe or Federal agency.

Atomic Energy Act of 1954 (42 U.S.C. 2011 *et seq*.) as amended by the Price-Anderson Act and the Bob Stump National Defense Authorization Act—The Act provides fundamental jurisdictional authority to DOE and the U.S. Nuclear Regulatory Commission (NRC) over governmental and commercial use of nuclear materials. The Atomic Energy Act authorizes DOE to establish standards to protect health or minimize dangers to life or property for activities under DOE jurisdiction. DOE has issued a series of Departmental Orders to establish an extensive system of standards and requirements to ensure safe operation of DOE facilities (see Section 6.3).

DOE regulations are found in Title 10 of the CFR. The DOE regulations that are most relevant to radioactive materials, waste management, and worker health and safety include:

- "Nuclear Safety Management" (10 CFR Part 830),
- "Occupational Radiation Protection" (10 CFR Part 835),
- "Chronic Beryllium Disease Prevention Program" (10 CFR Part 850),
- "Worker Health and Safety Program" (10 CFR Part 851), and
- "Byproduct Material" (10 CFR Part 962).

The Atomic Energy Act also gives EPA the authority to develop generally applicable standards for protection of the general environment from radioactive materials. EPA has promulgated several regulations under this authority. The EPA regulation that is relevant to the radioactive waste and materials management activities addressed by this SWEIS is the "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes" (40 CFR Part 191). This regulation establishes radiation standards for the management and storage of spent nuclear fuel, high-level radioactive waste, and transuranic waste at facilities regulated by NRC or Agreement States, as well as radiation standards for management and storage of spent nuclear fuel, high-level radioactive waste, and transuranic waste at disposal facilities operated by DOE that are not regulated by NRC or Agreement States. The regulation also establishes limitations on radiation doses that might occur after closure of the disposal system. These standards include both individual protection requirements and groundwater protection standards.

The Price-Anderson Act – signed into law in 1957 as an amendment to the Atomic Energy Act of 1954—provides for payment of public liability claims in the event of a nuclear incident. The following are key features of this Act:

- Assures the availability of billions of dollars to compensate members of the public who suffer a loss as the result of a nuclear incident;
- Establishes a simplified claim process for the public to expedite recovery for losses;
- Provides for immediate emergency reimbursement for costs associated with any evacuation that may be ordered;
- Establishes liability limits for each nuclear incident involving commercial nuclear energy and government use of nuclear materials; and
- Guarantees that the Federal Government will review the need for compensation beyond that provided (NEI 2005).

The Bob Stump National Defense Authorization Act, enacted by the Congress in 2002, amended the Atomic Energy Act to add Section 234C requiring DOE to promulgate worker health and safety regulations to cover contractors with Price-Anderson indemnification agreements in their contracts. DOE promulgated regulations under this Act in February 2006 (71 FR 6857) as 10 CFR Part 851, “Worker Safety and Health Program.” The regulations codified and enhanced the DOE worker protection program.

Bald and Golden Eagle Protection Act of 1973, as amended (16 U.S.C. 668 *et seq.*)—The Bald and Golden Eagle Protection Act, as amended, makes it unlawful to take, pursue, molest, or disturb bald (American) and golden eagles, their nests, or their eggs anywhere in the United States. A permit must be obtained from the U.S. Department of the Interior to relocate a nest that interferes with resource development or recovery operations.

Clean Air Act of 1970, as amended (42 U.S.C. 7401 *et seq*.)—The Clean Air Act is intended to “protect and enhance the quality of the Nation’s air resources so as to promote the public health and welfare and the productive capacity of its population.” Section 118 of the Clean Air Act (42 U.S.C. 7418) requires that each Federal agency with jurisdiction over any property or facility engaged in any activity that might result in the discharge of air pollutants comply with “all Federal, state, interstate, and local requirements” regarding the control and abatement of air pollution.

Section 109 of the Clean Air Act (42 U.S.C. 7409 *et seq*.) directs EPA to set national ambient air quality standards for criteria pollutants. EPA has identified and set national ambient air quality standards under 40 CFR Part 50 for the following criteria pollutants: particulate matter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead. Section 111 of the Clean Air Act (42 U.S.C. 7411) requires establishment of national standards of performance for new or modified stationary sources of atmospheric pollutants. Section 160 of the Clean Air Act (42 U.S.C. 7470 *et seq*.) requires that specific emission increases be evaluated prior to permit approval to prevent significant deterioration of air quality. Section 112 of the Clean Air Act (42 U.S.C. 7412) requires specific standards for releases of hazardous air pollutants (including radionuclides).

Emissions of air pollutants are regulated by EPA under 40 CFR Parts 50 through 99. Emissions of radionuclides and hazardous air pollutants from DOE facilities are regulated under the

National Emissions Standards for Hazardous Air Pollutants Program (40 CFR Part 61 and 40 CFR Part 63**,** respectively).

Clean Water Act of 1972, as amended (33 U.S.C. 1251 *et seq*.)—The Clean Water Act, which amended the Federal Water Pollution Control Act, was enacted to "restore and maintain the chemical, physical, and biological integrity of the Nation's water." The Clean Water Act prohibits the "discharge of toxic pollutants in toxic amounts" to navigable waters of the United States. Section 313 of the Clean Water Act requires all branches of the Federal Government engaged in any activity that might result in a discharge of runoff of pollutants to surface waters to comply with Federal, state, interstate, and local requirements.

Section 404 of the Clean Water Act gives the U.S. Army Corps of Engineers permitting authority over activities that discharge dredge or fill materials into waters of the United States, including wetlands.

The Clean Water Act also provides guidelines and limitations for effluent discharges from point-source discharges and establishes the National Pollutant Discharge Elimination System (NPDES) permit program. The NPDES program is administered by EPA, pursuant to regulations in 40 CFR Part 122 *et seq.*, and authority may be delegated to states. Sections 401 through 405 of the Water Quality Act of 1987 added Section 402(p) to the Clean Water Act, which requires EPA to establish regulations for permits for stormwater discharges associated with industrial activities, including construction activities disturbing 5 or more acres (2 hectares) (64 *Federal Register* [FR] 68721). After March 2003, the threshold for obtaining a permit was lowered to 1 acre (0.4 hectare). Stormwater provisions of the NPDES program are set forth at 40 CFR 122.26. Permit modifications are required if discharge effluent is altered. The State of New Mexico is now seeking authorization for the NPDES program so that it will have authority to administer the program instead of EPA. Currently, New Mexico is not authorized, and EPA Region 6 administers all LANL NPDES issues and permits. The State is expecting to be authorized by the end of 2006.

Many water-related permits for LANL have been issued or are awaiting approval (see **Table 6–2**). The EPA and DOE entered into a Federal Facility Compliance Agreement (Agreement) pursuant to the Clean Water Act (EPA 2005a). The purpose of the Agreement is to establish a compliance program for the regulation of stormwater discharges from Solid Waste Management Units and Areas of Concern at LANL until those sources are regulated by an individual stormwater permit issued by EPA pursuant to the NPDES. The purpose of the compliance program is to provide a schedule to ensure compliance with the NPDES stormwater-permitting program. The scope of this Agreement is limited to providing a compliance program for the regulation of stormwater discharges from solid waste management units (SWMUs) and Areas of Concern at LANL in lieu of LANL's Stormwater Multi-Sector General Permit (EPA 2005a).

The discharge of stormwater at LANL is regulated by NPDES Stormwater Multi-Sector General Permit Numbers NMR05A734 (University of California) and NMR05A735 (DOE) (the "General Permit"), which became effective on December 23, 2000, pursuant to 65 FR 64746 (October 30, 2000). The point source discharges of stormwater regulated by the General Permit include LANL's SWMUs (EPA 2005a).

Table 6–2 Federal Permits

Category	*Approved Activity*	*Issue Date*	*Expiration Date*
Clean Water Act/NPDES - Permit Number NM0028355	Discharge of industrial and sanitary liquid effluents. (This is a single permit covering many of LANL's industrial and sanitary discharges. The permit covers 17 total outfalls.)	August 1, 2007	July 31, 2012
Clean Water Act/NPDES Multi-Sector General Permit Number NMR05A734 (University of California) and NMR05A735 (DOE)	Multi-Sector General Permit- Stormwater discharges from industrial activities.	October 30, 2000	October 30, 2005 (Permit has been administratively continued pending issuance of a new permit, expected in 2007.)
Clean Water Act/NPDES	General Permit for Stormwater discharges from construction activities	Varies. A new General Construction Permit will be needed after 2008.	July 1, 2008
Clean Water Act Sections 404/401	Individual Dredge and Fill permits for work within perennial, intermittent, or ephemeral watercourses.	Varies	Varies
Toxic Substances Control Act Disposal Authorization	Disposal of polychlorinated biphenyls at Technical Area 54, Area G	June 25, 1996	June 25, 2001 (Permit has been administratively continued.)

NPDES = National Pollutant Discharge Elimination System.
Sources: EPA 2005a, LANL 2006h.

Since 2003, the General Permit has been in transition. Stormwater discharges from LANL SWMUs ultimately will be regulated under an individual NPDES permit specific to the SWMUs. LANL submitted the first part of the individual permit application in late 2004. When granted, this individual permit will replace existing SWMU coverage under the General Permit (see Table 6–2).

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 U.S.C. 9601 *et seq*.) (also known as Superfund)—CERCLA provides among other things: (1) a program for emergency response to and reporting of a release or threat of a release of a hazardous substance to the environment; and (2) a statutory framework for remediation of hazardous substance releases from private, state, and Federal sites. Using the Hazard Ranking System, contaminated sites are ranked and may be included on the National Priorities List. Section 120 of CERCLA specifies requirements for investigations, remediation, and natural resource restoration, as necessary, at Federal facilities, and also provides reporting requirements for hazardous substance contamination on properties to be transferred. LANL is not on the National Priorities List. Potential release sites at LANL are investigated and remediated under state authorities (see Section 6.4 for further discussion).

Department of Commerce, Justice, and State, the Judiciary, and Related Agencies Appropriations Act, 1998 (Public Law 105-119)—Section 632 of the Act directed the Secretary of Energy to identify and convey to the Incorporated County of Los Alamos, New Mexico, or to the designee of Los Alamos County, and to transfer to the Secretary of the Interior in trust for the Pueblo of San Ildefonso, parcels of land under the jurisdictional administrative control of the Secretary at or in the vicinity of LANL that meet certain identified criteria. DOE prepared the *Final Environmental Impact Statement for the Conveyance and*

Transfer of Certain Land Tracts Administered by the U.S. Department of Energy and Located at Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico (DOE 1999d) to examine potential environmental impacts associated with conveyance and transfer of identified land parcels. A Record of Decision for this action was issued in December 1999. Remedial actions (required in some parcels) and conveyances and transfers are ongoing.

Emergency Planning and Community Right-to-Know Act (42 U.S.C. 11001 *et seq*.)—This amendment to CERCLA requires that facilities provide notice to and coordinate emergency planning with communities and government agencies concerning inventories and any unplanned releases of specific hazardous chemicals. EPA implements this Act under regulations found in 40 CFR Parts 355, 370, and 372. Under Subtitle A of this Act, Federal facilities are required to provide information to and coordinate with local and state emergency response planning authorities, to ensure that emergency plans are sufficient to respond to unplanned releases of hazardous substances. Implementation of the provisions of this Act at LANL began voluntarily in 1987, and chemical inventories and emissions have been reported annually since 1988.

Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.*)—This Act is intended to prevent the further decline of endangered and threatened species and to restore these species and their habitats. Section 7 of the Act requires Federal agencies that have reason to believe that a prospective action may affect an endangered or threatened species or its habitat to consult with the U.S. Fish and Wildlife Service of the U.S. Department of the Interior or the National Marine Fisheries Service of the U.S. Department of Commerce to ensure the action does not jeopardize the species or destroy its habitat. If, despite reasonable and prudent measures to avoid or minimize such impacts, the species or its habitat would be jeopardized by the action, a review process is specified to determine whether the action may proceed as an incidental taking (50 CFR Part 17).

Federal Facility Compliance Act of 1992 (42 U.S.C. 6961 *et seq*.)—The Federal Facility Compliance Act, enacted on October 6, 1992, amended the Resource Conservation and Recovery Act (RCRA). The Act made Federal facilities subject to potential fines and penalties for violations of RCRA, the law that sets requirements for management of hazardous waste. Prior to its passage, mixed waste stored at DOE sites generally did not comply with RCRA mixed waste land-disposal restrictions because of a lack of treatment options. The Act required DOE to: (1) prepare and submit a national inventory report identifying its mixed waste volume, characteristics, treatment capacity, and available technologies; and (2) prepare and submit (to the appropriate state or EPA regulators) Site Treatment Plans for developing or using the needed treatment capacity along with schedules for treating the mixed waste at each DOE site.

LANL's approved Site Treatment Plan is enforced by a Compliance Order issued by the New Mexico Environment Department in October 1995. It is available for review at the DOE Headquarters reading room, the DOE Center for Environmental Management Information, and the LANL reading room (see Section 6.4 for further discussion).

Fish and Wildlife Coordination Act (16 U.S.C. 661 *et seq*.)—The Fish and Wildlife Coordination Act promotes effective planning and cooperation between Federal, state, public, and private agencies for the conservation and rehabilitation of the Nation's fish and wildlife and authorizes the U.S. Department of the Interior to provide assistance. This Act requires consultation with the U.S. Fish and Wildlife Service on the possible effects to wildlife from construction, projects, or activities affecting bodies of water in excess of 10 acres (approximately 4 hectares) in surface area. This Act also requires consultation with the head of the state agency that administers wildlife resources in the affected state.

Hazardous Materials Transportation Act of 1975, as amended (49 U.S.C. 5101 *et seq*.)—The Hazardous Materials Transportation Act of 1975, as amended, requires the U.S. Department of Transportation to prescribe uniform national regulations for transportation of hazardous materials (including radioactive materials). Most state and local regulations regarding such transportation that are not substantively the same as the U.S. Department of Transportation regulations are preempted (49 U.S.C. 5125). This, in effect, allows state and local governments to enforce only the Federal regulations, not to change or expand upon them.

This program is administered by the Research and Special Programs Administration of the U.S. Department of Transportation, which, when covering the same activities, coordinates its regulations with NRC (under the Atomic Energy Act) and EPA (under RCRA). The U.S. Department of Transportation regulations, which may be found under 49 CFR Parts 171 through 178 and 49 CFR Parts 383 through 397, contain requirements for identifying a material as hazardous or radioactive. These regulations interface with the NRC regulations for identifying material, but U.S. Department of Transportation hazardous material regulations govern the hazard communication (such as marking, labeling, vehicle placarding, and emergency response information) and shipping requirements. Requirements for transport by rail, air, and public highway are included. In addition, EPA regulations at 40 CFR Part 262 apply to offsite transportation of hazardous wastes from LANL.

Public access to many portions of the LANL facility is controlled at all times through the use of gates and guards. Onsite transportation of hazardous materials, wastes, and contaminated equipment that is conducted entirely on DOE property is subject to applicable DOE directives and safety requirements set forth in 10 CFR Part 830 Subpart B. Offsite transportation of hazardous materials, wastes, and contaminated equipment from LANL over public highways is subject to applicable U.S. Department of Transportation and EPA regulations, as well as to applicable DOE directives.

The NRC Packaging and Transportation of Radioactive Material (10 CFR Part 71) regulations include detailed packaging design requirements and package certification testing requirements. Complete documentation of design and safety analysis and the results of required certification tests are submitted to NRC to certify the package for use. This certification testing involves the following components: heat, physical drop onto an unyielding surface, water submersion, puncture by dropping the package onto a steel bar, and gas tightness.

Low-Level Radioactive Waste Policy Act of 1980, as amended (42 U.S.C. 2021 *et seq.*)—This Act amended the Atomic Energy Act to specify that the Federal Government is responsible for disposal of low-level radioactive waste generated by certain activities, and that each state is responsible for disposal of other low-level radioactive waste generated within its borders. It provides for and encourages interstate compacts to carry out state responsibilities. As a result of this Act, low-level radioactive waste owned or generated by DOE remains the responsibility of the Federal Government.

Manhattan Project National Historical Park Study Act (Public Law 108-340)—This Act was written to direct the Secretary of the Interior to conduct a study on the preservation and interpretation of the historic sites of the Manhattan Project for potential inclusion in the National Park System (October 18, 1998).

Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703 *et seq*.)—The Migratory Bird Treaty Act, as amended, is intended to protect birds that follow common migration patterns across the United States, Canada, Mexico, Japan, and Russia. It regulates the harvest of migratory birds by specifying conditions such as mode of harvest, hunting seasons, and bag limits. The Act stipulates that it is unlawful, unless permitted by regulations, to "pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, …any migratory bird…or any part, nest, or egg of any such bird." Although no permit for this project is required under the Act, DOE is required to consult with the U.S. Fish and Wildlife Service regarding impacts on migratory birds and to avoid or minimize these effects in accordance with the U.S. Fish and Wildlife Service Mitigation Policy. A split of authority currently exists between Federal courts regarding whether this Act applies to Federal agencies.

National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 *et seq*.)—The purposes of NEPA of 1969, as amended, are to: (1) declare a national policy that will encourage productive and enjoyable harmony between man and his environment, (2) promote efforts that will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man, (3) enrich the understanding of the ecological systems and natural resources important to the Nation, and (4) establish a Council on Environmental Quality (CEQ). NEPA establishes a national policy requiring that Federal agencies consider the environmental impacts of major Federal actions significantly affecting the quality of the human environment before making decisions and taking actions to implement those decisions. Implementation of NEPA requirements in accordance with CEQ regulations (40 CFR Parts 1500 to 1508) can result in a categorical exclusion, an environmental assessment and Finding of No Significant Impact, or an environmental impact statement. This SWEIS was prepared in accordance with NEPA requirements, CEQ regulations (40 CFR Part 1500 *et seq.*), and DOE provisions for implementing the procedural requirements of NEPA (10 CFR Part 1021; DOE Order 451.1B, Change 1). It discusses reasonable alternatives and their potential environmental consequences.

National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 *et seq*.)—The Act provides that sites with significant national historic value be placed on the National Register of Historic Places, which is maintained by the Secretary of the Interior. The major provisions of the Act for DOE consideration are Sections 106 and 110. Both sections aim to ensure that historic properties are appropriately considered in planning Federal initiatives and actions. Section 106 is a specific, issue-related mandate to which Federal agencies must adhere. It is a reactive mechanism driven by a Federal action. Section 110, in contrast, sets out broad Federal agency responsibilities with respect to historic properties. It is a proactive mechanism that emphasizes ongoing management of historic preservation sites and activities at Federal facilities. No permits or certifications are required under the Act.

Section 106 requires the head of any Federal agency with direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking to ensure compliance with the provisions of the Act. It compels Federal agencies to "take into account" the effect of their projects on historical and archaeological resources and to give the Advisory Council on Historic Preservation the opportunity to comment on such effects. Section 106 mandates consultation during Federal actions if the undertaking has the potential to affect a historic property. This consultation normally involves State or Tribal Historic Preservation Officers, or both, and may include other organizations and individuals such as local governments and American Indian Tribes. If an adverse effect is found, the consultation often ends with the execution of a memorandum of agreement that states how the adverse effect will be resolved.

The regulations implementing Section 106, found in 36 CFR Part 800, were revised on December 12, 2000, to modify the process by which Federal agencies consider the effects of their undertakings on historic properties and provide the Advisory Council on Historic Preservation with a reasonable opportunity to comment on such undertakings, as required by Section 106 of the Act. In promulgating the new regulations, the Council sought to better balance the interests and concerns of various users of the Section 106 process, including Federal agencies, State Historic Preservation Officers, Tribal Historic Preservation Officers, American Indians and Native Hawaiians, industry, and the public.

Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001 *et seq*.)— This Act establishes a means for Native Americans to request the return or repatriation of human remains and other cultural items presently held by Federal agencies or federally assisted museums or institutions. The Act also contains provisions regarding the intentional excavation and removal of, inadvertent discovery of, and illegal trafficking in Native American human remains and cultural items. Major actions under this law include: (1) establishing a review committee with monitoring and policymaking responsibilities; (2) developing regulations for repatriation, including procedures for identifying lineal descent or cultural affiliation needed for claims; (3) providing oversight of museum programs designed to meet the inventory requirements and deadlines of this law; and (4) developing procedures to handle unexpected discoveries of graves or grave goods during activities on Federal or Tribal lands. All Federal agencies that manage land or are responsible for archaeological collections obtained from their lands or generated by their activities must comply with the Act. DOE managers of ground-disturbing activities on Federal and Tribal lands are to be aware of the statutory provisions treating inadvertent discoveries of Native American remains and cultural objects. Regulations implementing the Act are found at 43 CFR Part 10.

Noise Control Act of 1972, as amended (42 U.S.C. 4901 *et seq*.)—Section 4 of the Noise Control Act of 1972, as amended, directs all Federal agencies to carry out "to the fullest extent within their authority" programs within their jurisdictions that further the national policy of promoting an environment free from noise that jeopardizes health and welfare. Federal, state, and local agencies enforce the standards and requirements of this Act to regulate noise at facilities such as LANL. DOE must comply with the Act for any of the activities being considered under this SWEIS.

Occupational Safety and Health Act of 1970 (29 U.S.C. 651 *et seq*.)—Section 4(b)(1) of the Occupational Safety and Health Act exempts DOE and its contractors from the occupational safety requirements of the Occupational Safety and Health Administration. However, 29 U.S.C. 668 requires Federal agencies to establish their own occupational safety and health programs for their places of employment, consistent with Occupational Safety and Health Administration standards. DOE Order 440.1A, "Worker Protection Management for DOE Federal and Contractor Employees," states that DOE will implement a written worker protection program that: (1) provides a place of employment free from recognized hazards that are causing or are likely to cause death or serious physical harm to their employees, and (2) integrates all requirements contained in paragraphs 4a to 4l of DOE Order 440.1A; 29 CFR Part 1960, "Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters;" and other related site-specific worker protection activities.

Pollution Prevention Act of 1990 (42 U.S.C. 13101 *et seq*.)—The Pollution Prevention Act establishes a national policy for waste management and pollution control. Source reduction is given first preference, followed by environmentally safe recycling, with disposal or releases to the environment as a last resort. In response to the policies established by the Pollution Prevention Act, DOE committed to participation in the Superfund Amendments and Reauthorization Act, Section 313, EPA 33/50 Pollution Prevention Program. The goal for facilities involved in compliance with Section 313 was to achieve a 33-percent reduction (from a 1993 baseline) in the release of 17 priority chemicals by 1997. On November 12, 1999, then-U.S. Secretary of Energy Bill Richardson established 14 pollution prevention and energy efficiency goals for DOE to build environmental accountability and stewardship into DOE's decisionmaking process. Under these goals, DOE will strive to minimize waste and maximize energy efficiency as measured by continuous cost-effective improvements in the use of materials and energy, using the years 2005 and 2010 as interim measurement points.

Safe Drinking Water Act of 1974, as amended (42 U.S.C. 300(f) *et seq*.)—The primary objective of the Safe Drinking Water Act is to protect the quality of public drinking water supplies and sources. The implementing regulations, administered by EPA unless delegated to the states, establish standards applicable to public water systems. These regulations include maximum contaminant levels (including those for radioactivity) in public water systems, which are defined as water systems with at least 15 service connections that are used by year-round residents or regularly serve at least 25 year-round residents. EPA regulations implementing the Safe Drinking Water Act are found in 40 CFR Parts 141 through 149. For radioactive material, the regulations specify that the average annual concentration of beta particles and photon energy from manmade radionuclides in drinking water, as delivered to the user by such a system, shall not produce a dose equivalent to the total body or an internal organ greater than 4 millirem per year. They further specify a concentration limit for gross alpha particle activity (excluding radon and uranium) of 15 picocuries per liter and for uranium of 0.03 milligrams per liter (40 CFR 141.66). Other programs established by the Safe Drinking Water Act include the Sole Source Aquifer Program, the Wellhead Protection Program, and the Underground Injection Control Program.

Solid Waste Disposal Act of 1965, as amended by the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments of 1984 (42 U.S.C. 6901 *et seq.*)—The Solid Waste Disposal Act of 1965, as amended, governs the transportation, treatment, storage, and disposal of hazardous waste and nonhazardous waste (that is, municipal solid waste). Under the RCRA of 1976, which amended the Solid Waste Disposal Act of 1965, EPA defines and identifies hazardous waste; establishes standards for its transportation, treatment, storage, and disposal; and requires permits for persons engaged in hazardous waste activities. Section 3006 of RCRA (42 U.S.C. 6926) allows states to establish and administer these permit programs with EPA approval.

The EPA regulations implementing RCRA are found in 40 CFR Parts 260 through 283. The New Mexico Environment Department is authorized to administer the RCRA program in New Mexico and issued LANL's RCRA operating permit (see Section 6.4). Regulations imposed on a generator or on a treatment, storage, or disposal facility vary according to the type and quantity of hazardous waste generated, treated, stored, or disposed of and the methods of treatment, storage, and disposal.

Toxic Substances Control Act of 1976 (15 U.S.C. 2601 *et seq*.)—TSCA provides EPA with the authority to require testing of chemical substances entering the environment and to regulate them as necessary. The law complements and expands existing toxic substance laws, such as Section 112 of the Clean Air Act and Section 307 of the Clean Water Act. The Act requires compliance with the inventory reporting and chemical control provisions of the legislation to protect the public from risks of exposure to chemicals.

The Act also imposes strict limitations on the use and disposal of polychlorinated biphenyls, chlorofluorocarbons, asbestos, dioxins, certain metal-working fluids, and hexavalent chromium. EPA issued the disposal authorization documents to LANL for management of its polychlorinated biphenyls waste disposal facility at Technical Area 54.

Waste Isolation Pilot Plant Land Withdrawal Act (Public Law 102-579) and the Waste Isolation Pilot Plant Land Withdrawal Act Amendments (Public Law 104-201)—The Waste Isolation Pilot Plant Land Withdrawal Act withdrew land from the public domain for the purpose of creating and operating the Waste Isolation Pilot Plant (WIPP), the geologic repository in New Mexico designated as the national disposal site for defense transuranic waste. The Act also defined the characteristics and amount of waste that will be disposed of at the facility. Amendments to the Act exempt waste to be disposed of at WIPP from the RCRA land disposal restrictions. Prior to sending any transuranic waste from LANL to WIPP, DOE would have to determine whether the waste meets all statutory and regulatory requirements for disposal at WIPP.

6.2 Executive Orders

This section identifies environment-, health-, and safety-related Executive Orders applicable to LANL operations. Activities under all alternatives would need to be conducted in compliance with applicable Executive Orders. Chapter 4 describes the resources at LANL that are addressed by Executive Orders, and Chapter 5 discusses the potential impacts to those resources under each alternative. Consultations with applicable agencies and federally recognized Native American Nations as required by these Executive Orders are discussed in Section 6.5.

Executive Order 11514, *Protection and Enhancement of Environmental Quality* (March 5, 1970)—This Executive Order requires Federal agencies to continually monitor and control their activities to: (1) protect and enhance the quality of the environment, and (2) develop procedures to ensure the fullest practicable provision of timely public information and understanding of the Federal plans and programs that may have potential environmental impact so that views of interested parties can be obtained. DOE has issued regulations (10 CFR Part 1021) and DOE Order 451.1B to comply with this Executive Order.

Executive Order 11593, *National Historic Preservation* (May 13, 1971)—This Order directs Federal agencies to locate, inventory, and nominate properties under their jurisdiction or control to the National Register of Historic Places if they qualify. This process requires DOE to provide the Advisory Council on Historic Preservation an opportunity to comment on the possible impacts of proposed activities on any potentially eligible or listed resources.

Executive Order 11990, *Protection of Wetlands* (May 24, 1977)—This Order (implemented by DOE in 10 CFR Part 1022) requires Federal agencies to avoid any short- or long-term adverse impacts on wetlands wherever there is a practicable alternative. Each agency must also provide opportunities for early public review of any plans or proposals for new construction in wetlands.

Executive Order 11988, *Floodplain Management* (May 24, 1977)—This Order (implemented by DOE in 10 CFR Part 1022) requires Federal agencies to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for any action undertaken in a floodplain, and that floodplain impacts are avoided to the extent practicable.

Executive Order 12088, *Federal Compliance with Pollution Control Standards*, (October 13, 1978) as amended by Executive Order 12580, *Superfund Implementation* (January 23, 1987)—This Order directs Federal agencies to comply with applicable administrative and procedural pollution control standards established by, but not limited to, the Clean Air Act, the Noise Control Act, the Clean Water Act, the Safe Drinking Water Act, TSCA, and RCRA.

Executive Order 12148, *Federal Emergency Management* (July 20, 1979), as amended by the Homeland Security Act of 2002 (Public Law 107-296) and Section 301 of Title 3 U.S.C.—This Order transfers functions and responsibilities associated with Federal emergency management to the Director of the Federal Emergency Management Agency. The Order assigns the Director the responsibility to establish Federal policies for, and to coordinate all civil defense and civil emergency planning, management, mitigation, and assistance functions of, Executive branch agencies. The amendment replaces the name, Federal Emergency Management Agency, wherever it appears with the name, Department of Homeland Security.

Executive Order 12656, *Assignment of Emergency Preparedness Responsibilities* (November 18, 1988)—This Order assigns emergency preparedness responsibilities to Federal departments and agencies.

Executive Order 12699, *Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction* (January 5, 1990)—This Order requires Federal agencies to reduce risks to occupants of buildings owned, leased, or purchased by the Federal Government, or buildings constructed with Federal assistance, and to persons who would be affected by failures of Federal buildings in earthquakes; to improve the capability of existing Federal buildings to function during or after an earthquake; and to reduce earthquake losses of public buildings, all in a cost-effective manner. Each Federal agency responsible for the design and construction of a Federal building shall ensure that the building is designed and constructed in accordance with appropriate seismic design and construction standards.

Executive Order 12856, *Right-to-Know Laws and Pollution Prevention Requirements* (August 3, 1993)—Executive Order 12856 directs Federal agencies to reduce and report toxic chemicals entering any waste stream; improve emergency planning, response, and accident notification; and meet the requirements of the Emergency Planning and Community Right-to-Know Act.

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (February 11, 1994)—This Order requires each Federal agency to identify and address the disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations.

The CEQ, which oversees the Federal Government's compliance with Executive Order 12898 and NEPA, has developed guidelines to assist Federal agencies in incorporating the goals of Executive Order 12898 into the NEPA process. This guidance, published in 1997, is intended to "…assist Federal agencies with their NEPA procedures so that environmental justice concerns are effectively identified and addressed." As part of this process, DOE conducted an analysis to determine whether implementing any of the proposed alternatives would result in disproportionately high or adverse impacts on minority and low-income populations. The results of this analysis are discussed in the environmental justice sections of Chapter 4 of this SWEIS for each of the alternatives under consideration.

Executive Order 12902, *Energy Efficiency and Water Conservation at Federal Facilities* (March 8, 1994)—This Order requires Federal agencies to develop and implement a program to conserve energy and water resources. As part of this program, agencies are required to conduct comprehensive facility audits of their energy and water use.

Executive Order 12938, *Proliferation of Weapons of Mass Destruction* (November 14, 1994)—This Order states that the proliferation of nuclear, biological, and chemical weapons ("weapons of mass destruction") and the means of delivering such weapons constitute an unusual and extraordinary threat to the national security, foreign policy, and economy of the United States, and that a national emergency would be declared to deal with that threat.

Executive Order 13007, *Indian Sacred Sites* (May 24, 1996)—This Order directs Federal agencies, to the extent practicable, as permitted by law, and not clearly inconsistent with essential agency functions, to: (1) accommodate access to and ceremonial use of American Indian sacred sites by their religious practitioners, and (2) avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies are to maintain the confidentiality of sacred sites.

Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks* (April 21, 1997), as amended by Executive Order 13229 (October 9, 2001)—This Order requires each Federal agency to give high priority to identifying and assessing environmental health risks and safety risks that may disproportionately affect children and to ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

Executive Order 13101, *Greening the Government through Waste Prevention, Recycling, and Federal Acquisition* (September 14, 1998)—This Order requires each Federal agency to incorporate waste prevention and recycling in its daily operations and to work to increase and expand markets for recovered materials. This Order states that it is national policy to prefer pollution prevention, whenever feasible. Pollution that cannot be prevented should be recycled; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner. Disposal should be employed only as a last resort.

Executive Order 13112, *Invasive Species* (February 3, 1999)—This Order requires Federal agencies to prevent the introduction of invasive species, to provide for their control, and to minimize their economic, ecological, and human health impacts.

Executive Order 13123, *Greening the Government through Efficient Energy Management* (June 8, 1999)—This Order sets goals for agencies to expand their use of renewable energy sources and to reduce greenhouse gas emissions from facility energy use, energy consumption per gross square foot of facilities, energy consumption per gross square foot or unit of production, use of petroleum within facilities, overall energy use, and water consumption and associated energy requirements.

Executive Order 13148, *Greening the Government through Leadership in Environmental Management* (April 21, 2000)—This Order requires agencies to integrate environmental accountability into day-to-day decisionmaking and long-term planning processes. The Order sets goals for implementing environmental management systems and audits, reporting pollution releases to the public, preventing pollution or reducing it at the source, and reducing toxic releases and transfers of toxic chemicals, use of toxic chemicals and hazardous substances, and generation of hazardous and radioactive waste types. It also sets goals for phasing out the use of Class I ozone-depleting substances and promoting environmentally sound landscaping practices.

Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments* (November 6, 2000)—This Order supplements the Executive Memorandum (dated April 29, 1994) entitled, “Government-to-Government Relations with Tribal Governments,” and states that each Executive branch department and agency shall consult, to the greatest extent practicable and to the extent permitted by law, with Tribal Governments prior to taking actions that affect federally recognized Tribal Governments. This Order also states that each Executive branch department and agency shall assess the impact of Federal Government plans, projects, programs, and activities on Tribal trust resources and assure that Tribal Government rights and concerns are considered during the development of such plans, projects, programs, and activities.

Executive Order 13287, *Preserve America* (March 3, 2003)—The goals of the initiative addressed by this Order include a greater shared knowledge about the Nation's past, strengthened regional identities and local pride, increased local participation in preserving cultural and natural heritage assets, and support for the economic vitality of our communities. The Order establishes Federal policy to provide leadership in preserving America's heritage by actively advancing the protection, enhancement, and contemporary use of the historic properties owned by the Federal Government and by promoting intergovernmental cooperation and partnerships for the preservation and use of historic properties.

6.3 Applicable DOE Orders

The Atomic Energy Act authorizes DOE to establish standards to protect health and minimize the dangers to life or property from activities under DOE’s jurisdiction. Through a series of DOE Orders and regulations, an extensive system of standards and requirements has been established to ensure safe operation of DOE facilities. A number of DOE Orders have been issued in support of environmental, safety, and health programs. Many of these were revised and reorganized to reduce duplication and eliminate obsolete provisions. The new DOE Directives System is organized by series, with each Order identified by three digits, and is intended to include all DOE Orders, policies, manuals, requirement documents, notices, and guides. Existing DOE Orders (identified by four digits) are expected to be revised and converted to the new DOE numbering system. The major DOE Orders pertaining to the alternatives in this SWEIS are listed in **Table 6–3**.

DOE Order 151.1C, *Comprehensive Emergency Management System* (November 2, 2005)— This Order establishes policy to assign and describe roles and responsibilities for the DOE Emergency Management System. The Emergency Management System provides the framework for development, coordination, control, and direction of all emergency planning, preparedness, readiness assurance, response, and recovery actions. The Emergency Management System applies to DOE and to NNSA.

DOE Order 231.1A, *Environment, Safety, and Health Reporting* (August 19, 2003; Change 1, June 3, 2004)—This Order establishes responsibilities and requirements to ensure timely collection, reporting, analysis, and dissemination of information on environment, safety, and health issues as required by law or regulations or as needed to ensure that DOE and NNSA are kept fully informed on a timely basis about events that could adversely affect the health and safety of the public, the workers, or the environment; the intended purpose of DOE facilities; or the credibility of DOE.

Table 6–3 Applicable DOE Orders and Directives (as of December 8, 2006)

DOE Order/Number	Subject (date)
Leadership/Management/Planning	
O 151.1C	Comprehensive Emergency Management System (11/02/05)
Information and Analysis	
O 231.1A	Environment, Safety, and Health Reporting (08/19/03; Change 1, 06/03/04)
Work Process	
O 413.3A	Program and Project Management for the Acquisition of Capital Assets (07/28/06)
O 414.1C	Quality Assurance (06/17/05)
O 420.1B	Facility Safety (12/22/05)
O 425.1C	Startup and Restart of Nuclear Facilities (03/13/03)
O 430.1B	Real Property Assessment Management (09/24/03)
O 433.1	Maintenance Management Program for DOE Nuclear Facilities (06/01/01)
O 435.1	Radioactive Waste Management (07/09/99; Change 1, 08/28/01)
O 440.1B	Worker Protection Management for DOE Federal and Contractor Employees (05/17/07)
O 450.1	Environmental Protection Program (01/15/03; Change 2, 12/07/05; Admin. Change 1, 01/03/07)
O 451.1B	National Environmental Policy Act Compliance Program, (10/26/00; Change 1, 09/28/01)
O 460.1B	Packaging and Transportation Safety (04/04/03)
O 460.2A	Departmental Materials Transportation and Packaging Management (12/22/04)
O 461.1A	Packaging and Transfer or Transportation of Materials of National Security Interest (04/26/04)
O 470.2B	Independent Oversight and Performance Assurance Program (10/31/02)
O 470.4	Safeguards and Security Program (08/26/05)
External Relationships	
O 1230.2	American Indian Tribal Government Policy (04/08/92) – as revised by DOE Notice 144.1 (10/20/06)
Environmental Quality and Impact	
O 5400.5	Radiation Protection of the Public and the Environment (02/08/90; Change 2, 01/07/93)
O 5480.19	Conduct of Operations Requirements for DOE Facilities (07/09/90; Change 1, 05/18/92; Change 2, 10/23/01)
O 5480.20A	Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities (11/15/94; Change 1, 07/12/01)
Emergency Preparedness	
O 5530.3	Radiological Assistance Program (01/14/92; Change 1, 04/10/92)
O 5530.5	Federal Radiological Monitoring and Assessment Center (07/10/92; Change 1, 12/02/92)
Office of National Nuclear Security Administration	
O 5660.1B	Management of Nuclear Materials (05/26/94)

DOE Order 413.3A, *Program and Project Management for the Acquisition of Capital Assets* (July 28, 2006)—This Order provides DOE, including NNSA, project management direction for the acquisition of capital assets that are delivered on schedule, within budget, and fully capable of meeting mission performance and environmental, safety, and health standards.

DOE Order 414.1C, *Quality Assurance* (June 17, 2005)—The objectives of this Order are to ensure that DOE, including NNSA, products and services meet or exceed customers' expectations and to achieve quality assurance for all work based upon the following principles:

- That quality is assured and maintained through a single, integrated, effective quality assurance program (management system);
- That management support for planning, organization, resources, direction, and control is essential to quality assurance;
- That performance and quality improvement require thorough, rigorous assessment and corrective action;
- That workers are responsible for achieving and maintaining quality; and
- That environmental, safety, and health risks and impacts associated with work processes can be minimized while maximizing reliability and performance of work products.

DOE Order 420.1B *Facility Safety* (December 22, 2005)—This Order establishes facility safety requirements related to nuclear safety design, criticality safety, fire protection, and mitigation of hazards related to natural phenomena.

DOE Order 425.1C, *Startup and Restart of Nuclear Facilities* (March 13, 2003)—This Order establishes DOE requirements for startup of new nuclear facilities and restart of existing nuclear facilities that have been shut down. The requirements specify a readiness review process that must demonstrate that it is safe to start (or restart) the subject facility. The facility must be started (or restarted) only after documented independent reviews of readiness have been conducted and the approvals specified in the Order have been received.

DOE Order 430.1B, *Real Property Asset Management* (September 24, 2003)—This Order establishes a corporate, holistic, and performance-based approach to real property life-cycle asset management that links real property asset planning, programming, budgeting, and evaluation to program mission projections and performance outcomes. This Order also identifies requirements and establishes reporting mechanisms and responsibilities for real property asset management. Planning for disposition must be initiated when real property assets are identified as no longer required for current or future programs. Disposition includes stabilizing, preparing for reuse, deactivating, decommissioning, decontaminating, dismantling, demolishing, and disposing of real property assets.

DOE Order 433.1, *Maintenance Management Program for DOE Nuclear Facilities* (June 1, 2001)—This Order defines the program for the management of cost-effective maintenance of DOE nuclear facilities. Guidance for compliance with this Order is contained in

DOE Guide 433.1-1, "Nuclear Facility Maintenance Management Program Guide for Use with DOE Order 433.1," which references Federal regulations, DOE directives, and industry best practices using a graded approach to clarify requirements and guidance for maintaining DOE-owned government property.

DOE Order 435.1, *Radioactive Waste Management* (July 9, 1999)—This Order and its associated manual and guidance establish responsibilities and requirements for the management of DOE high-level radioactive waste, transuranic waste, low-level radioactive waste, and the radioactive component of mixed waste. These documents provide detailed radioactive waste management requirements, including waste incidental to reprocessing determinations; waste characterization, certification, and treatment, storage, and disposal; and radioactive waste facility design and closure.

DOE Order 440.1B, *Worker Protection Management for DOE Federal and Contractor Employees* (May 17, 2007)—This Order establishes the framework for an effective worker protection program that reduces or prevents injuries, illnesses, and accidental losses by providing safe and healthful DOE Federal and contractor workplaces.

DOE Order 450.1, *Environmental Protection Program* (January 15, 2003; Change 2, December 7, 2005; Admin. Change 1, January 3, 2007)—Under DOE Order 450.1, it is DOE policy to conduct its operations in a manner that ensures the protection of public health, safety, and the environment through compliance with applicable Federal and state laws, regulations, Orders, and other requirements. The objective of this Order is to implement sound stewardship practices that protect the air, water, land, and other natural and cultural resources impacted by DOE operations. This objective is to be accomplished by implementing environmental management systems at DOE sites. An environmental management system is a continuing cycle of planning, implementing, evaluating, and improving processes and actions undertaken to achieve environmental goals.

DOE Order 451.1B, *National Environmental Policy Act Compliance Program* (October 26, 2000; Change 1, September 28, 2001; DOE Notice 451.1, October 10, 2006)— The purpose of this Order is to establish DOE internal requirements and responsibilities for implementing NEPA, the CEQ Regulations Implementing the Procedural Provisions of NEPA (40 CFR Parts 1500 to 1508), and the DOE NEPA Implementing Procedures (10 CFR Part 1021). The goal is to ensure efficient and effective implementation of DOE NEPA responsibilities through teamwork. A key responsibility for all participants is to control the cost and time for the NEPA process while maintaining its quality.

DOE Order 460.1B, *Packaging and Transportation Safety* (April 14, 2003)—This Order sets forth DOE policy and assigns responsibilities for proper packaging and transporting of DOE offsite shipments and onsite transfers of hazardous materials and for modal transport.

DOE Order 460.2A, *Departmental Materials Transportation and Packaging Management* (December 22, 2004)—This Order requires DOE operations to comply with all applicable international, Federal, state, local, and Tribal laws, rules, and regulations governing materials transportation that are consistent with Federal regulations, unless exemptions or alternatives are approved. This Order also states that it is DOE policy that shipments will comply with the

U.S. Department of Transportation 49 CFR 100 through 185 requirements, except those that infringe on maintenance of classified information.

DOE Order 461.1A, *Packaging and Transfer or Transportation of Materials of National Security Interest* (April 26, 2004)—This Order establishes requirements and responsibilities for offsite shipments of naval nuclear fuel elements, Security Category I and II special nuclear material, nuclear explosives, nuclear components, special assemblies, and other materials of national security interest; onsite transfers of naval nuclear fuel elements, Security Category I and II special nuclear material, nuclear components, special assemblies and other materials of national security interest; and certification of packages for Security Category I and II special nuclear material, nuclear components, and other materials of national security interest.

DOE Order 470.2B, *Independent Oversight and Performance Assurance Program* (October 31, 2002)—This Order establishes the Independent Oversight Program to enhance DOE safeguards and security; cyber security; emergency management; and environment, safety, and health programs by providing DOE, contractor managers, the Congress, and other stakeholders with an independent evaluation of the adequacy of DOE policy and the effectiveness of line management performance in these and other critical functions as directed by the Secretary.

DOE Order 470.4, *Safeguards and Security Program* (August 26, 2005)—This Order establishes the roles and responsibilities for the DOE Safeguards and Security Program, which consists of six key elements: (1) program planning and management, (2) physical protection, (3) protective force, (4) information security, (5) personnel security, and (6) nuclear material control and accountability. Specific requirements for each of the key elements are contained in their respective programmatic manuals. The requirements identified in these manuals are based on national policy promulgated in laws, regulations, and Executive Orders to prevent unacceptable adverse impacts on national security, the health and safety of DOE and contractor employees, the public, and the environment.

DOE Order 1230.2, *American Indian Tribal Government Policy* (April 8, 1992) as revised by DOE Notice 144.1 (October 20, 2006)—This Order establishes responsibilities and transmits the DOE American Indian and Alaska Native Policy. The policy outlines the principles to be followed by DOE in its interactions with federally recognized American Indian Tribes. It is based on Federal policy treaties, Federal law, and DOE's responsibilities as a Federal agency to ensure that Tribal rights and interests are identified and considered pertinent during decisionmaking.

DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (February 8, 1990; Change 2, January 7, 1993)—This Order establishes standards and requirements for DOE operations to protect members of the public and the environment against undue risk from radiation. It is DOE policy to implement legally applicable radiation protection standards and to consider and adopt, as appropriate, recommendations by authoritative organizations; for example, the National Council on Radiation Protection and Measurements and the International Commission on Radiological Protection. It is also DOE policy to adopt and implement standards generally consistent with those of NRC for DOE facilities and activities that are not subject to NRC licensing authority.

DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities* (July 9, 1990; Change 1, May 18, 1992; Change 2, October 23, 2001)—This Order provides requirements and guidelines for Departmental Elements including NNSA, to use in developing directives, plans, or procedures relating to the conduct of operations at DOE facilities.

DOE Order 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities* (November 15, 1994; Change 1, July 12, 2001)—This Order establishes the selection, qualification, and training requirements for DOE contractor personnel involved in the operation, maintenance, and technical support of DOE nuclear reactors and nonreactor nuclear facilities. DOE objectives under this Order are to ensure the development and implementation of contractor-administered training programs that provide consistent and effective training for personnel at DOE nuclear facilities. The Order contains minimum requirements that must be included in training and qualification programs.

DOE Order 5530.3, *Radiological Assistance Program* (January 14, 1992; Change 1, April 10, 1992)—This Order establishes DOE policy, procedures, authorities, and responsibilities for its Radiological Assistance Program. Through this program, DOE provides assistance to state, local, and Tribal jurisdictions in preparing for a radiological emergency. The Order requires DOE to establish response plans, maintain resources, and assist Federal, state, local, and Tribal governments in the event of a real or potential emergency.

DOE Order 5530.5, *Federal Radiological Monitoring and Assessment Center* (July 10, 1992; Change 1, December 2, 1992)—This Order establishes DOE policy, procedures, authorities, and requirements for the establishment of a Federal Radiological Monitoring and Assessment Center, as set forth in the Federal Radiological Emergency Response Plan (50 FR 46542).

DOE Order 5660.1B, *Management of Nuclear Materials* (May 26, 1994)—This Order establishes requirements and procedures for the management of nuclear materials within the DOE.

6.4 Applicable State of New Mexico and Local Statutes, Regulations, and Agreements

Certain environmental requirements have been delegated to state authorities for implementation and enforcement. It is DOE policy to conduct its operations in an environmentally safe manner that complies with all applicable statutes, regulations, and standards, including state laws and regulations. A list of applicable State of New Mexico and local statutes, regulations, agreements, and Orders are provided in **Table 6–4**.

Since the last SWEIS was published, the State of New Mexico has entered into a Compliance Order on Consent (Consent Order) with DOE and the University of California pursuant to Section 74-4-10 of the Hazardous Waste Act and 74-9-36(D) of the Solid Waste Act. The Consent Order requires DOE and the University of California (or its successor) to conduct a site-wide investigation and cleanup of contamination at LANL in accordance with the procedures and schedules set forth in the Consent Order. The Consent Order sets forth requirements to investigate and remediate a large number of potential release sites and areas of concern, including, but not limited to, several former material disposal areas.

Table 6–4 State and Local Requirements

Activity	*Citation*	*Requirements*
Endangered Plant Species	New Mexico Administrative Code (NMAC), Title 19, Chapter 21, Endangered Plants (revised November 30, 2006).	Establishes plant species list and rules for collection.
Environmental Oversight and Monitoring Agreement	Agreement in Principle Between DOE and the State of New Mexico, November 2000.	Provides DOE support for state activities in environmental oversight, monitoring, access, and emergency response.
Federal Facility Compliance Order	October 1995 (issued to both DOE and LANL).	Order used by the New Mexico Environment Department to enforce the Federal Facility Compliance Act. It requires compliance with the approved LANL Site Treatment Plan, which documents the development and use of treatment capacities and technologies, as well as use of offsite facilities for treating mixed radioactive waste stored at LANL.
Los Alamos County Noise Restrictions	Los Alamos County Code, Chapter 8.28.	Imposes noise restrictions and makes provisions for exceedances.
Environmental Improvement Act	New Mexico Statutes Annotated (NMSA) 1978, Sections 74-1-1 through 74-1-15; NMAC, 20.5.1 through 20.5.17, August 15, 2003. The New Mexico Environment Department recently changed their regulations for storage tanks, combining the regulations for aboveground and underground storage tanks into the Petroleum Storage Tank regulations. Petroleum Storage Tank regulations found in 20.5.1 NMAC through 20.5.17 NMAC; filed for publication in the *New Mexico Register* on July 16, 2003; effective August 15, 2003.	Aboveground tank regulations were modified to include requirements for the registration, installation, modification, repair, and closure or removal of aboveground storage tanks, as well as release detection, record-keeping, and financial responsibility in the State of New Mexico.
New Mexico Air Quality Control Act	NMSA, Chapter 74, “Environmental Improvement,” Article 2, “Air Pollution” (revised 10/31/02), and implementing regulations at NMAC Title 20, “Environmental Protection,” Chapter 2, “Air Quality” (revised October 31, 2002).	Establishes air quality standards and requires a permit prior to construction or modification of an air contaminant source. Also requires an operating permit for major producers of air pollutants and imposes emission standards for hazardous air pollutants.
New Mexico Cultural Properties Act	NMSA, Chapter 18, “Libraries and Museums,” Article 6, “Cultural Properties.”	Establishes the State Historic Preservation Office and requirements to prepare an archaeological and historic survey and consult with the State Historic Preservation Office.
New Mexico Groundwater Protection Act	NMSA, Chapter 74, Article 6B, “Groundwater Protection.”	Establishes state standards for protection of groundwater from leaking underground storage tanks.
New Mexico Hazardous Chemicals Information Act	NMSA, Chapter 74, Article 4E-1, “Hazardous Chemicals Information.”	Implements the hazardous chemical information and toxic release reporting requirements of the Emergency Planning and Community Right-to-Know Act of 1986 (SARA Title III) for covered facilities.

Activity	*Citation*	*Requirements*
New Mexico Hazardous Waste Act	NMSA, Chapter 74, Article 4, "Hazardous Waste," and implementing regulations found in NMAC Title 20, "Environmental Protection," Chapter 4, "Hazardous Waste" (revised June 14, 2000).	Establishes permit requirements for construction, operation, modification, and closure of a hazardous waste management facility and establishes state standards for cleanup of releases from leaking underground storage tanks.
New Mexico Endangered Plant Species Act	NMSA, Chapter 75, Miscellaneous Natural Resource Matters, Article 6, "Endangered Plants."	Requires coordination with the State.
New Mexico Night Sky Protection Act	NMSA, Chapter 74, Article 12 "Night Sky Protection:" 74-12-1 to 74-12-10) (House Bill 39/A, March 1, 1999).	Regulates outdoor night lighting fixtures to preserve and enhance the State's dark sky while promoting safety, conserving energy, and preserving the environment for astronomy.
New Mexico Radiation Protection Act	NMSA, Chapter 74, Article 3, "Radiation Control" and implementing regulations found in NMAC Title 20 Chapter 3, "Radiation Protection" (revised April 15, 2004) "Environmental Protection."	Establishes state requirements for worker protection.
New Mexico Raptor Protection Act	NMSA, Chapter 17, Article 2-14.	Makes it unlawful to take, attempt to take, possess, trap, ensnare, injure, maim, or destroy any of the species of hawks, owls, and vultures.
New Mexico Solid Waste Act	NMSA, Chapter 74, Article 9, Solid Waste Act, and implementing regulations found in NMAC Title 20, "Environmental Protection," Chapter 9, Solid Waste (revised November 27, 2001).	Requires permit prior to construction or modification of a solid waste disposal facility.
New Mexico Water Quality Act	NMSA, Chapter 74, Article 6, "Water Quality," and implementing regulations found in NMAC, Title 20, "Environmental Protection," Chapter 6, "Water Quality" (revised February 16, 2006).	Establishes water quality standards and requires a permit prior to the construction or modification of a water discharge source.
New Mexico Wildlife Conservation Act	NMSA, Chapter 17, Game and Fish, Article 2, Hunting and Fishing Regulations, Part 3, Wildlife Conservation Act.	Requires a permit and coordination if a project may disturb habitat or otherwise affect threatened or endangered species.
Compliance Order on Consent	March 1, 2005 (entered into by the State of New Mexico, DOE, and the University of California) (NMED 2005).	Requires site investigations of known or potentially contaminated sites at LANL and cleanup in accordance with a specified process and schedule.
Pueblo Accords	DOE 2006 Restatement of Accords with each of four Pueblos (Pueblos of Cochiti, Jemez, Santa Clara, and San Ildefonso).	Set forth the specifications for maintaining a government-to-government relationship between DOE and each of the four Pueblos closest to LANL.
Threatened and Endangered Species of New Mexico	NMAC Title 19, "Natural Resources and Wildlife," Chapter 33, "Threatened and Endangered Species," 19.33.6.8 (revised December 29, 2006).	Establishes the list of threatened and endangered species.

Table 6–5 lists the state permits that have been issued to LANL. Certain open burning permits that were previously included on this table were withdrawn from the regulatory authority (LANL 2006c).

Table 6–5 State Environmental Permits

Category/Approved Activity	*Permit*	*Date Issued*	*Expiration Date*
Air Permits			
Facilities with emissions greater than 100 tons per year of nitrogen oxide, volatile organic compound, and carbon monoxides (NMAC Operating Permit)	Operating Permit Number P100 M1	June 15, 2006	April 30, 2009
Beryllium Machining at TA-3-141	Construction Permit Number 634-M2	October 30, 1998	None
Beryllium Machining at TA-35-213	Construction Permit Number 632	December 26, 1985	None
Beryllium Machining at TA-55-4	Construction Permit Number 1081-M1-R6	July 1, 1994 (revised May 12, 2006)	None
TA-3 Power Plant	Construction Permit Number 2195-B-M1	July 30, 2004	None
TA-33 Generator	Construction Permit Number 2195-F	October 10, 2002	None
Asphalt Plant	Construction Permit Number GCP-3-2195G	October 29, 2002	None
Data Disintegrator	Construction Permit Number 2195-H	October 22, 2003	None
Chemistry and Metallurgy Research Replacement Facility, Radiological Laboratory, Office Building, and Utility Building	Construction Permit Number 2195-N	September 16, 2005	None
Hazardous Waste Permits			
Hazardous Waste Facility Permit and Mixed-Waste Storage and Treatment Permit	Permit Number NM0890010515	November 1989	November 1999 (Permit has been administratively continued)
TA-50 Part B Permit Renewal Application Revision 3.0	Permit Number NM0890010515	August 2002	None
General Part B Permit Renewal Application, Revision 2.0	Permit Number NM0890010515	August 2003	None
TA-54 Part B Permit Renewal Application, Revision 3.0	Permit Number NM0890010515	June 2003	None
TA-16 Part B Permit Renewal Application, Revision 4.0	Permit Number NM0890010515	June 2003	None
TA-55 Part B Permit Application, Revision 2.0	Permit Number NM0890010515	September 2003	None
General Part A Permit Application, Revision 4.0	Permit Number NM0890010515	December 2004	None
RCRA Corrective Activities	Permit Number NM0890010515	March 1990	December 1999 (Permit has been administratively continued)
Groundwater Discharge Permits			
Groundwater Discharge Plan, TA-46 Sanitary Wastewater Systems Plant	Not applicable	January 7, 1998	January 7, 2003 (Permit has been administratively continued)
Groundwater Discharge Plan, TA-50, Radioactive Liquid Waste Treatment Facility	Not applicable	Submitted August 20, 1996, approval pending	None

NMAC = New Mexico Administrative Code, TA = technical area, RCRA = Resource Conservation and Recovery Act.
Source: LANL 2006h.

6.5 Consultations

6.5.1 Consultation Requirements

Certain laws, such as the Endangered Species Act, the U.S. Fish and Wildlife Coordination Act, and the National Historic Preservation Act, require DOE to consult and coordinate with other governmental entities including other Federal agencies, state and local agencies, and federally recognized Native American Governments. In addition, the DOE American Indian and Alaska Native Tribal Government Policy requires DOE to consult with any Native American or Alaska Native Tribal Government regarding any property to which the Tribe attaches religious or cultural importance that might be affected by a DOE action. The following sections describe consultations and other interactions that took place during the preparation of this SWEIS.

6.5.1.1 Ecological Resources

Biotic resource consultations generally pertain to the potential for activities to disturb sensitive species or habitats. Under the terms of the LANL *Threatened and Endangered Species Habitat Management Plan* (LANL 2000b), NNSA submitted a *Biological Assessment of the Continued Operation of Los Alamos National Laboratory on Federally Listed Threatened and Endangered Species* (LANL 2006b) to the U.S. Fish and Wildlife Service on February 22, 2006. The U.S. Fish and Wildlife Service response to NNSA's consultation request is presented in Section 6.5.2.

6.5.1.2 Cultural Resources

Cultural resource consultations relate to the potential for disruption of important cultural resources and archaeological sites. As required by NEPA and Section 106 of the National Historic Preservation Act, DOE consults with the Advisory Council on Historic Preservation, the appropriate State Historic Preservation Officers, and Tribal Historic Preservation Officers. Under the terms of the *Programmatic Agreement for Management of Historic Properties at Los Alamos National Laboratory* (DOE 2006b), a copy of the Draft SWEIS was submitted to the State Historic Preservation Officer. The response to NNSA's request for consultation with the New Mexico State Historic Preservation Officer is presented in Section 6.5.2.

6.5.1.3 Tribal Consultations

Native American consultations are concerned with the potential for impacts on any rights and interests, including disturbance of Native American ancestral sites, sacred sites, and traditional and religious practices, or natural resources of importance to Native Americans. DOE is committed to meeting its responsibilities in maintaining its government-to-government relationships with federally recognized Native American Tribes. **Table 6–6** lists Executive Memoranda and DOE direction regarding government-to-government relations with Native American Tribal Governments.

Table 6–6 Government-to-Government Relationships with Tribal Governments

Date	***Title***
January 20, 2006	Memorandum for the Head of Departmental Elements from Secretary Samuel W. Bodman. DOE reaffirms government-to-government relationships with Tribal Governments (references American Indian and Alaska Natives Tribal Government Policy).
September 23, 2004	Memorandum for the Heads of Executive Departments and Agencies Government-to-Government Relationship with Tribal Governments (references Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, and Executive Order 13336, entitled "American Indian and Alaska Native Education"). This complements and partially supersedes the similar executive memorandum of April 29, 1994.
August 21, 2001	Secretary Abraham reaffirms DOE's Government-to-Government Relations with Native American Tribal Governments (references American Indian and Alaska Natives Tribal Government Policy).
April 29, 1994	Memorandum for the Heads of Executive Departments and Agencies, Government-to-Government Relations with Native American Tribal Governments.

DOE undertook an extensive effort to consult with Native American Tribal Governments during preparation of the 1999 *Site-Wide Environmental Impact Statement for the Continued Operation of the Los Alamos National Laboratory, Los Alamos, New Mexico (1999 SWEIS)* (DOE/EIS-0238). DOE has initiated consultations with the appropriate Native American Tribal Governments, as required by Executive Memoranda and DOE Order 1230.2, "American Indian Tribal Government Policy," as revised by DOE Notice 144.1. NNSA continued its consultations with the pueblos during the preparation of this SWEIS.

As part of its Government-to-Government interactions, restatements of four Pueblo Accords were signed by the Governor of each pueblo (Cochiti, San Ildefonso, Jemez, and Santa Clara) and the Secretary of Energy in 2005 and 2006. Twice yearly, executive meetings are held among the Los Alamos Site Office Manager, the LANL Director, and the respective Accord Pueblo Governors. In addition, the Los Alamos Site Office Manager meets monthly with each governor of the two pueblos closest to LANL (San Ildefonso and Santa Clara) and with the other Accord Pueblo Governors on a less frequent basis. In both the executive meetings and the private meetings, the Los Alamos Site Office Manager discussed the SWEIS and the importance of the pueblos participating in the SWEIS preparation process.

The NNSA NEPA Document Manager requested the involvement of pueblo representatives during the SWEIS preparation period. In the spring of 2004 the Document Manager notified the Four Accord Pueblos of NNSA's intention to prepare a Supplement Analysis of the *1999 SWEIS* to determine whether a new or supplemental SWEIS should be prepared, and attended meetings at the four Accord Pueblos to brief Pueblo representatives on how the Supplement Analysis would be prepared.

When NNSA made the decision in late 2004, to prepare a supplement to the *1999 SWEIS*, the NNSA NEPA Document Manager sent notification letters inviting each of the Four Accord Pueblos to become Cooperating Agencies. Two pueblos (San Ildefonso and Santa Clara) responded that they wished to be involved. While neither signed formal agreements, over the next year both pueblos continued to participate in internal working meetings during preparation of the Draft SWEIS including review of sections and chapters of the document.

On January 5, 2005, NNSA issued a *Federal Register* Notice of Intent to prepare a *Supplemental Environmental Impact Statement to the Final Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory (Supplemental SWEIS)* (70 FR 807). In the Notice of Intent, NNSA invited public comment on the *Supplemental SWEIS* proposal and listed the issues initially identified by NNSA for evaluation in the *Supplemental SWEIS*. The four Accord Pueblos were also invited to comment on the scope of the proposed action. A public scoping meeting was held in Pojoaque, New Mexico, on January 19, 2005. The public scoping period ended February 17, 2005.

A post-scoping internal working meeting was held on March 8, 2005, to discuss the scoping comments and proposed project reviews. The Four Accord Pueblos were invited to send representatives and two of the Accord Pueblos participated in the meeting.

The Draft SWEIS was issued to the public and LANL stakeholders, including approximately 23 American Indian Tribes who had expressed interest in LANL, on July 7, 2006, followed by a public comment period extending through September 20, 2006. During the review period, the Santa Clara Pueblo hosted a meeting to which the Eight Northern Pueblos and the two Accord Pueblos that are not members of the Eight Northern Pueblos (the Pueblo of Cochiti and the Pueblo of Jemez) were invited. The purpose of this meeting was for the Los Alamos Site Office Manager, the NNSA Document Manager, and LANL staff to discuss the Draft SWEIS. Several pueblos submitted comments on the Draft LANL SWEIS that were considered in completing the final document.

6.5.2 Consultation Letters

Consultation letters associated with this SWEIS are attached at the end of this section and include correspondence from the New Mexico Department of Cultural Affairs and the U.S. Fish and Wildlife Service. Letters from the latter organization are in response to the request for Section 7 consultation under the Endangered Species Act made by NNSA upon its transmittal of a biological assessment for continued operation of LANL (LANL 2006b).

Consultation Letters

STATE OF NEW MEXICO
DEPARTMENT OF CULTURAL AFFAIRS
HISTORIC PRESERVATION DIVISION

BATAAN MEMORIAL BUILDING
407 GALISTEO STREET, SUITE 236
SANTA FE, NEW MEXICO 87501
PHONE (505) 827-6320 FAX (505) 827-6338

BILL RICHARDSON
Governor

November 17, 2006

John Isaacson, Ph.D.
SWEIS and C&T Project leader
Environmental Division M887
Los Alamos National Laboratory
Los Alamos, NM 87544

Re: Draft SWEIS for Continued Operation of LANL, Los Alamos; HPD Log 78716.

Dear Dr. Isaacson:

Thank you for sending our office a copy of the June 2006 *Draft Site-Wide Environmental Impact Statement* [SWEIS] *for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico.* We look forward to receiving the Final document.

Currently, our Section 106 reviews follow the terms of the Programmatic Agreement (LA-UR-06-1975) between the U.S. Department of Energy, the National Nuclear Security Administration, the Los Alamos Site Office, the New Mexico State Historic Preservation Officer and the Advisory Council on Historic Preservation. This agreement and the management plan for cultural heritage at Los Alamos National Laboratory dated February 2006 guide the management for the historic properties of Los Alamos National Laboratory and our consultation process.

Thank you again, and we look forward to receiving the Final SWEIS.

Sincerely,

Katherine Slick

Katherine A. Slick
State Historic Preservation Officer

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services Field Office
2105 Osuna NE
Albuquerque, New Mexico 87113
Phone: (505) 346-2525 Fax: (505) 346-2542

March 20, 2006

Cons. # 22420-2006-I-0066

Ms. Elizabeth R. Withers
ESA Program Manager
National Nuclear Security Administration
Los Alamos Site Office
Los Alamos, New Mexico 87544

Dear Ms. Withers:

Thank you for your February 22, 2006, Biological Assessment (BA) of the Continued Operation of Los Alamos National Laboratory (LANL) on Federally Listed Threatened and Endangered Species. LANL reviewed eighteen projects that had not received U.S. Fish and Wildlife Service (Service) consultation or concurrence, as well as the two aspects of ongoing operations, ecological risk from legacy contaminants and the Outfall Reduction Project were determined to have the potential to affect Federally Listed species. Your letter requesting consultation for the proposed projects and their effects on the threatened Mexican spotted owl (owl) (*Strix occidentalis lucida*) and the threatened bald eagle (*Haliaeetus leucocephalus*) and the endangered southwestern willow flycatcher (flycatcher) (*Empidonax trailii extimus*) was received by the Service on February 22, 2006. You determined that proposed projects listed on Tables 1 and 2 "may affect, is not likely to adversely affect" the bald eagle, the flycatcher, and the owl, and requested concurrence.

LANL produced a Threatened and Endangered Species Habitat Management Plan (HMP) (LANL 1999). The HMP is a comprehensive plan that balances current LANL operations and future development with habitat of listed species. The HMP facilitates Department of Energy compliance with the Endangered Species Act of 1973, as amended (Act). The HMP defines site plans and monitoring plans for species that may occur on LANL. The owl, bald eagle, and flycatcher habitat is labeled areas of environmental interest (AEIs). As such, the HMP provides a list of activities named reasonable and prudent alternatives (RPAs), which, if they are conducted, will not adversely affect these species. The projects listed below adhere to the activities identified in the HMP. Our concurrences are listed for the owl, bald eagle, and flycatcher (Tables 1 and 2).

Table 1. LANL project determinations and concurrences for the bald eagle and flycatcher.

Project	Bald Eagle determination	Concurrence rationale:	Flycatcher determination	Concurrence rationale:
Ecological risk from legacy contaminants	May affect, not likely to adversely affect	1) RPAs will be applied. 2) LANL may consider a new bald eagle risk assessment.	May affect, not likely to adversely affect	1) LANL will continue to monitor/survey potential breeding sites, and evaluate areas that could develop into suitable habitat. 2) Available evidence indicates LANL does not contribute excess adverse risk to the flycatcher from environmental contaminants. 3) RPAs will be applied.
Science complex	May affect, not likely to adversely affect	1) The proposed project site is not near the bald eagle AEI. 2) Bald eagle foraging habitat RPAs will be applied.		
TA-3 Replacement Office Buildings	May affect, not likely to adversely affect	1) The proposed project site is more than 4.6 miles from the bald eagle AEI. 2) Bald eagle foraging		

Ms. Elizabeth R. Withers 3

Project	Bald Eagle determination	Concurrence rationale:	Flycatcher determination	Concurrence rationale:
		habitat RPAs will be applied.		
Nuclear Materials Safeguards and Security Upgrade	May affect, not likely to adversely affect	1) The proposed project site is 6.6 miles from the bald eagle AEI. 2) Bald eagle foraging habitat RPAs will be applied.		
Security-Driven Transportation Modification	May affect, not likely to adversely affect	1) The proposed project site is more than 5.5 miles from the bald eagle AEI. 2) Bald eagle foraging habitat RPAs will be applied		
Security-Driven Transportation Modifications Options	May affect, not likely to adversely affect	1) The proposed project site is more than 5.9 miles from the bald eagle AEI. 2) Bald eagle foraging habitat RPAs will be applied.		
TA-48 Radiological Science Institute	May affect, not likely to adversely affect	1) The proposed project site is more than 4 miles from the bald eagle AEI. 2) Bald eagle foraging habitat RPAs will be applied.		
Radioactive	May affect, not	1) The		

Ms. Elizabeth R. Withers 4

Project	Bald Eagle determination	Concurrence rationale:	Flycatcher determination	Concurrence rationale:
Liquid Waste Treatment Facility Replacement	likely to adversely affect	proposed project site is not near the bald eagle AEI. 2) Bald eagle foraging habitat RPAs will be applied.		
TA-72 Warehouse and Truck Inspection Station	May affect, not likely to adversely affect	1) The proposed project site is more than 4.3 miles from the bald eagle AEI. 2) Bald eagle foraging habitat RPAs will be applied.		
Disposition of the Flood Retention Structure and Steel Diversion Wall in Pajarito Canyon			May affect, not likely to adversely affect	1) The flycatcher AEI is 0.75 miles (downstream) from the proposed project site. 2) An RPA will ensure implementation of storm water protection plan measures to mitigate downstream impacts. 3) The proposed actions will not remove flycatcher foraging habitat.
Decontamination, Decommissioning,			May affect, not likely to	1) The proposed

Ms. Elizabeth R. Withers 5

Project	**Bald Eagle determination**	**Concurrence rationale:**	**Flycatcher determination**	**Concurrence rationale:**
and Demolition of TA-18			adversely affect	project is 890 feet from flycatcher AEI. 2) The proposed action will not remove any flycatcher foraging habitat. 3) An RPA will ensure that erosion does not occur into wetlands downstream.
Remediation of MDAs G, H, and L at TA-54			May affect, not likely to adversely affect	1) No suitable foraging or nesting habitat will be lost or compromised due to the proposed action. 2) Predicted noise levels are not likely to exceed 6 decibels above background in flycatcher AEI. 3) Surveys will be conducted and if a flycatcher is found, work will cease and the Service will be contacted and consultation reinitiated if

Ms. Elizabeth R. Withers 6

Project	Bald Eagle determination	Concurrence rationale:	Flycatcher determination	Concurrence rationale:
				needed. 4) RPAs will be followed.
DynEX Assembly Chamber	May affect, not likely to adversely affect	1) The proposed project site is not near the bald eagle AEI. 2) Bald eagle foraging habitat RPAs will be applied.		
Remediation of MDA D at TA-33	May affect, not likely to adversely affect	1) The proposed project site is in core and buffer habitat but it is already developed. 2) No roost trees will be disturbed. 3) Back-up indicators on trucks will be muted within safety standards. 3) Reseeding and erosion protection will follow where needed. 4) Bald eagle foraging habitat RPAs will be applied		

Table 2. LANL project determinations and concurrences for the owl.

Project	Owl determination	Concurrence rationale:

Ms. Elizabeth R. Withers 7

Project	Owl determination	Concurrence rationale:
Ecological risk from legacy contaminants	May affect, not likely to adversely affect	RPAs will be applied.
Science complex	May affect, not likely to adversely affect	1) No suitable nesting habitat would be removed. 2) Owls have not been detected in Los Alamos Canyon. 3) Consultation will be reinitiated if owls are found.
TA-3 Replacement Office Buildings	May affect, not likely to adversely affect	1) RPAs will be applied. 2) The project would remove approximately 11 acres of buffer habitat. 3) Owls have not been detected in Los Alamos Canyon
Nuclear Materials Safeguards and Security Upgrade	May affect, not likely to adversely affect	1) RPAs plus additions and qualifications identified in the BA for this project would be implemented. 2) The project would remove approximately7 acres of buffer habitat. 3) Owls were detected in Mortandad Canyon (2004 and 2005). 4) No core habitat would be developed.
TA-48 Radiological Science Institute	May affect, not likely to adversely affect	1) RPAs will be applied. 2) Most of the new construction would not be in owl habitat.
Characterization and Remediation of MDA C	May affect, not likely to adversely affect	1) Proposed project would not remove suitable roosting or nesting habitat.
Radioactive Liquid Waste Treatment Facility Replacement	May affect, not likely to adversely affect	1) Approximately 75 percent of the project area has been disturbed

Ms. Elizabeth R. Withers 8

Project	Owl determination	Concurrence rationale:
		by other construction. 2) RPAs will be applied. 3) Noise levels should attenuate below limits set in the HMP. 4) Project activities would take place within or adjacent to developed areas.
Disposition of the Flood Retention Structure and Steel Diversion Wall in Pajarito Canyon	May affect, not likely to adversely affect	RPAs will be applied. 2) Owls have not been detected within the proposed project area. 3) No trees greater than 8 inches diameter at breast height would be removed. 4) Owl core habitat is protected from disturbance by the mesa that separates Pajarito and Three-Mile canyons.
Decontamination, Decommissioning, and Demolition of TA-18	May affect, not likely to adversely affect	1) Noise disturbance would be temporary and short duration. 2) All disturbed soils would be reseeded with native seeds. 3) No trees greater than 8 inches diameter at breast height would be removed. 4) Back-up indicators on all trucks and heavy equipment would be muted consistent with the safety of human workers.
Remediation of MDAs A, T, and U at TA-21	May affect, not likely to adversely affect	1) RPAs from the BA (Appendix B) would be implemented. 2) No suitable foraging or

Ms. Elizabeth R. Withers 9

Project	Owl determination	Concurrence rationale:
		nesting habitat will be lost; 3) The proposed project area is already highly disturbed. 4) Owls have not been detected in Los Alamos Canyon. 5) If owls are detected the Service would be contacted and reinitiation would be needed.
Decontamination, Decommissioning, and Demolition of TA-21	May affect, not likely to adversely affect	1) RPAs from the BA (Appendix B) would be implemented. 2) No suitable foraging or nesting habitat will be lost. 3) The proposed project area is already highly disturbed. 4) Owls have not been detected in Los Alamos Canyon. 5) If owls are detected the Service would be contacted and reinitiation would be needed.
DynEX Assembly Chamber	May affect, not likely to adversely affect	1) No suitable roosting or nesting habitat will be lost. 2) Owl surveys in Canon de Valle would continue. 3) Approximately 2 acres would be developed. 4) RPAs from the BA (Appendix B) would be implemented. 5) If owls are detected within 0.25 mile of the construction site, activities would be suspended until September 1.

Ms. Elizabeth R. Withers 10

Project	Owl determination	Concurrence rationale:
Remediation of MDAs N and Z at TA-15	May affect, not likely to adversely affect	1) The proposed project would not remove nesting or roosting habitat. 2) Owl surveys would continue. 3) Approximately 2 acres of owl habitat would be disturbed. 4) RPAs from the BA (Appendix B) would be implemented. 5) If owls are detected within 0.25 mile of the construction site, activities would be suspended until September 1.

Cumulative effects were not analyzed by the Service for this letter of concurrence because under section 7 of the Act, those effects are future State and private activities, not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation. This definition applies only to section 7 analyses and should not be confused with the broader use of this term in the National Environmental Policy Act or other environmental laws. Cumulative effects under section 7 will be analyzed in a subsequent biological opinion for the Outfall Reduction Project, the Security-Driven Transportation Modifications Project, and the Security-Driven Transportation Modifications Options Project.

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. In the appendix, we enclose conservation recommendations for the bald eagle, the flycatcher, and other migratory birds.

This concludes the informal consultation for the Continued Operation of Los Alamos National Laboratory on Federally Listed Threatened and Endangered Species. Please contact the Service if: (1) new information reveals effects of the agency action that may affect the species to an extent not considered in this consultation; (2) the agency action is subsequently modified in a manner that causes an effect to the species that was not considered by the proposed action, (3) owls or bald eagles or flycatchers are detected within any project area, and (4) a new species is listed or critical habitat designated that may be affected by the proposed project.

Ms. Elizabeth R. Withers 11

We appreciate the thorough analyses provided in the letter and the EA and your efforts to protect endangered and threatened species. In future communications regarding this consultation please refer to consultation #22420-2006-I-0066. If we can be of further assistance, please contact Santiago R. Gonzales or Nancy Baczek of my staff at (505) 761-4755 or (505) 761-4711, respectively.

Sincerely,

Russ Holder
Acting Field Supervisor

Enclosure
cc:
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico
Director, New Mexico Energy, Minerals, and Natural Resources Department, Forestry Division, Santa Fe, New Mexico

Ms. Elizabeth R. Withers 12

Appendix A.

Species Specific Conservation Recommendations for BA of Continued Operation of Los Alamos National Laboratories

Flycatcher

- Cease project activity during May, the time period in which flycatchers most frequently migrate through LANL.
- Develop a habitat management plan to eradicate and control non-native invasive riparian/wetland vegetation. (Tamarisk sp., Russian Olive, and Siberian Elm)
- Enhance native riparian/wetland vegetation following drought and project impacts.
- A new state-wide assessment is recommended for the flycatcher and contaminants, considering that contaminant data, safe limits, and other modeling parameters have changed considerably. (RE: p.170 of BA)

Bald Eagle

- Develop an avian protection plan for power lines and towers. (RE: p. 171of BA)
- Because contaminant data reflective of the terrestrial portion (mostly carrion) of resident bald eagles diets have changed considerably since the last modeling assessment, and safe limits and other modeling parameters have changed considerably, consideration should be made for a new risk assessment on the bald eagle.

Migratory Birds

- Use "bird-glass" in new buildings and replacement of old glass.
- Use window blinds to shut out lab/office-light from night environment.
- Habitat disruption/removal should only take place during migratory bird non-nesting season, or following negative surveys.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services Field Office
2105 Osuna NE
Albuquerque, New Mexico 87113
Phone: (505) 346-2525 Fax: (505) 346-2542

June 20, 2006

Cons. # 22420-2006-I-0091

Ms. Elizabeth R. Withers
ESA Program Manager
National Nuclear Security Administration
Los Alamos Site Office
Los Alamos, New Mexico 87544

Dear Ms. Withers:

Thank you for your February 22, 2006, biological assessment (BA) of the Continued Operation of Los Alamos National Laboratory on Federally Listed Threatened and Endangered Species – Outfall Reduction Project. The Los Alamos National Laboratory (LANL) proposes to eliminate seven industrial effluent outfalls. Your letter requesting consultation for the proposed project and its effects for the threatened Mexican spotted owl (owl) (*Strix occidentalis lucida*) was received by the U.S. Fish and Wildlife Service (Service) on February 22, 2006. The LANL has determined that proposed project "may affect, is likely to adversely affect" the owl.

You concluded that the Outfall Reduction Project may adversely affect the abundance and diversity of prey species along approximately 400 feet of perennial and intermittent stream by eliminating outfall discharges. It is our understanding that your determination is centered upon potential indirect impacts (eliminating outfalls may impact prey species habitat). We appreciate that you are taking a conservative approach for this project in your determination of "may affect likely to adversely affect" the owl. Nevertheless, we respectfully disagree with your conclusion for the following reasons: 1) the proposed elimination of an outfall is located within restricted habitat and will not directly affect owl; 2) nesting has not been documented in Mortandad-Sandia Canyon; 3) a perennial stream is present in the action area; 4) the closure of outfall 03A027 is not likely to have a substantial negative impact on the Sandia wetland; 5) outfall 03A130 contributes to a wetland that has no perennial streams or other outfalls; 6) reasonable and prudent alternatives would be implemented to reduce or avoid potential impacts; 7) effects from the proposed project are not expected to be adverse in the Canon de Valle Area of Environmental Interest (AEI); and 8) although 1.36 acres of wetland and 400 feet of perennial stream would be impacted in Mortandad-Sandia Canyon, we do not anticipate the owl or its prey will be adversely affected. For these reasons we conclude that, as described, the effects to the owl from the elimination of outfalls in Mortandad-Sandia Canyon will be insignificant and discountable, and will not result in adverse effects to the owl.

This concludes the informal consultation for the Outfall Reduction Project. Please contact the Service if: (1) new information reveals effects of the agency action that may affect the species to

Ms. Elizabeth R. Withers 2

an extent not considered in this consultation; (2) the agency action is subsequently modified in a manner that causes an effect to the species that was not considered by the proposed action, and (3) a new species is listed or critical habitat designated that may be affected by the proposed project.

We appreciate the thorough analyses provided in the letter and the BA and your efforts to protect endangered and threatened species. In future communications regarding this consultation please refer to consultation #22420-2006-I-0091. If we can be of further assistance, please contact Santiago R. Gonzales of my staff at (505) 761-4755.

Sincerely,

for Wally Murphy
Acting Field Supervisor

cc:
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico
Director, New Mexico Energy, Minerals, and Natural Resources Department, Forestry Division, Santa Fe, New Mexico

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services Field Office
2105 Osuna NE
Albuquerque, New Mexico 87113
Phone: (505) 346-2525 Fax: (505) 346-2542

June 20, 2006

Cons. # 22420-2006-I-0092

Ms. Elizabeth R. Withers
ESA Program Manager
National Nuclear Security Administration
Los Alamos Site Office
Los Alamos, New Mexico 87544

Dear Ms. Withers:

Thank you for your February 22, 2006, biological assessment (BA) of the Continued Operation of Los Alamos National Laboratory on Federally Listed Threatened and Endangered Species – Security-Driven Transportation Modifications Project. The Los Alamos National Laboratory (LANL) proposes to upgrade and enhance security in the Pajarito Corridor West area. Construction of parking lots, pedestrian walkways, roads, and bridges associated with the proposed project would result in some temporary noise levels near new roads from construction equipment and activities and permanent increases in noise levels from vehicular and pedestrian traffic. There would be permanent light sources associated with the parking lots, walkways and roads. Your letter requesting consultation for the proposed project and its effects for the threatened Mexican spotted owl (owl) (*Strix occidentalis lucida*) was received by the U.S. Fish and Wildlife Service (Service) on February 22, 2006.

You concluded that the Security-Driven Transportation Modifications Project may adversely affect the owl foraging and nesting habitat. It is our understanding that your determination is centered upon potential indirect impacts (removal of approximately 20 acres of undeveloped habitat). We appreciate that you are taking a conservative approach for this project in your determination of "may affect likely to adversely affect" the owl. Nevertheless, we respectfully disagree with your conclusion for the following reasons: 1) the parking lot in TA-48 would be approximately 11 acres and would not be located in listed species habitat; 2) the parking lot at TA-63 would total approximately 20 acres and currently consists on open field and junipers and ponderosa pine woodland; and 3) reasonable and prudent alternatives would be implemented to reduce or avoid potential impacts. For these reasons we conclude that, as described, the effects to the owl from the construction activities associated with the proposed project will be insignificant and discountable, and will not result in adverse effects to the owl.

This concludes the informal consultation for the Security-Driven Transportation Modifications Project. Please contact the Service if: (1) new information reveals effects of the agency action that may affect the species to an extent not considered in this consultation; (2) the agency action is subsequently modified in a manner that causes an effect to the species that was not considered

Ms. Elizabeth R. Withers 2

by the proposed action, and (3) a new species is listed or critical habitat designated that may be affected by the proposed project.

We appreciate the thorough analyses provided in the letter and the BA and your efforts to protect endangered and threatened species. In future communications regarding this consultation please refer to consultation #22420-2006-I-0092. If we can be of further assistance, please contact Santiago R. Gonzales of my staff at (505) 761-4755.

Sincerely,

for Wally Murphy
Acting Field Supervisor

cc:
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico
Director, New Mexico Energy, Minerals, and Natural Resources Department, Forestry Division, Santa Fe, New Mexico

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services Field Office
2105 Osuna NE
Albuquerque, New Mexico 87113
Phone: (505) 346-2525 Fax: (505) 346-2542

June 22, 2006

Cons. # 22420-2006-I-0093

Ms. Elizabeth R. Withers
Document Site-wide EIS Manager
National Nuclear Security Administration
Los Alamos Site Office
Los Alamos, New Mexico 87544

Dear Ms. Withers:

Thank you for your February 22, 2006, biological assessment (BA) of the Continued Operation of Los Alamos National Laboratory on Federally Listed Threatened and Endangered Species – Security Transportation Modifications (Optional Actions) Project. The Los Alamos National Laboratory (LANL) proposes Option A: Paving Sigma Mesa Road with a bridge over Mortandad Canyon and Option B: Bridge Over Sandia Canyon. Your letter requesting formal consultation for the proposed options and their effects on the threatened Mexican spotted owl (owl) (*Strix occidentalis lucida*) was received by the U.S. Fish and Wildlife Service (Service) on February 22, 2006.

The BA describes two options: 1) Paving Sigma Mesa Road with a bridge over Mortandad Canyon and 2) a bridge over Sandia Canyon. However, the BA does not identify which alternative LANL has selected. The BA also does not identify a specific location of the bridge crossing, nor does it describe the design of the bridge over Mortandad Canyon or Sandia Canyon. The Service cannot analyze the affects of these two options because LANL has not selected the preferred alternative. When LANL determines, through a biological assessment or other review, which action will be proposed, LANL should submit to the Service a request for consultation. The BA should only analyze the effects of your preferred alternative, not both alternatives.

The Service recommends bridge placement over Sandia Canyon and not over Mortandad Canyon. We believe that a bridge placement over Sandia Canyon would avoid adverse affects to the owl, whereas a bridge over Motandad Canyon would be place directly over the area where resident owls have been located and could cause adverse affects to the owl. Please contact the Service when you decide on the bridge placement and timetable for implementation of the proposed bridge project.

We appreciate the analyses provided in the BA and your efforts to protect endangered and threatened species. In future communications regarding this consultation please refer to

Ms. Elizabeth R. Withers 2

consultation #22420-2006-I-0093. If we can be of further assistance, please contact Santiago R. Gonzales of my staff at (505) 761-4755.

Sincerely,

Wally Murphy
Acting Field Supervisor

cc:
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico
Director, New Mexico Energy, Minerals, and Natural Resources Department, Forestry Division, Santa Fe, New Mexico

CHAPTER 7
REFERENCES

7. REFERENCES

ACE (U.S. Army Corps of Engineers), 2000, "Corps builds flood control structures for Los Alamos", Engineer Update, (accessed January 16, 2006, www.hq.usace.army.mil/cepa/pubs/nov00/story7.htm), November.

ACE (U.S. Army Corps of Engineers), 2005, *Wetlands Delineation Report, Los Alamos National Laboratory, Los Alamos, New Mexico*, Albuquerque District, Albuquerque, New Mexico, October.

ACE (U.S. Army Corps of Engineers), 2006, "Commercial Hazardous Waste Landfills," in *Hazardous, Toxic, and Radioactive Waste (HTRW) Center of Expertise Information – Treatment, Storage and Disposal Facilities (TSDF)* (accessed at www.environmental.usace.army.mil/library/pubs/tsdf/sec2-3/sec2-3.html).

ACE, Reclamation, and ISC (U.S. Army Corps of Engineers, Bureau of Reclamation, and New Mexico Interstate Stream Commission), 2006, *Upper Rio Grande Basin Water Operations Review and Draft Environmental Impact Statement*, Albuquerque District; Albuquerque Area Office, January.

AHA (American Hospital Association), 2007, "PHS Santa Fe Indian Hospital," *U.S. News & World Report* (available at health.usnews.com/usnews/health/hospitals/directory/glance_6850400.htm), July 31.

All Aboard America, 2005, *All Aboard America! Park and Ride, Northern New Mexico Park & Ride* (available at www.allaboardamerica.com/santafe/index.html), October 31.

Arrowsmith, J., 2005, Los Alamos County, Deputy Utilities Manager, Los Alamos, New Mexico, Personal communication (e-mail) to K. Folk, Science Applications International Corporation, Germantown, Maryland, "Response to Los Alamos County Gas and Water Consumption," November 3 and November 10.

Arrowsmith, J., 2006, Los Alamos County, Deputy Utilities Manager, Los Alamos, New Mexico, Personal communication (e-mail) to K. Folk, Science Applications International Corporation, Germantown, Maryland, "Response to Data Needs for Los Alamos County Water, Natural Gas, and Electric Power and Peak Load Use for FY/CY 2005-2006," October 18 and October 19.

Athas, W. F., 1996, *Investigation of Excess Thyroid Cancer Incidence in Los Alamos County*, Division of Epidemiology, Evaluation, and Planning, New Mexico Department of Health, Santa Fe, New Mexico, April.

Athas, W. F. and C. R. Key, 1993, *Los Alamos Cancer Rate Study: Phase I – Cancer Incidence in Los Alamos County, 1970-1990, Final Report*, Division of Epidemiology, Evaluation, and Planning, New Mexico Department of Health, March.

ATSDR (Agency for Toxic Substances and Disease Registry), 1997, *Dioxin and Dioxin-Like Compounds in Soil, Part 1: ATSDR Interim Policy Guideline*, Toxicology and Industrial Health, Vol. 13, No. 6, pp. 759-768, Atlanta, Georgia, August 21.

ATSDR (Agency for Toxic Substances and Disease Registry), 2006, *Public Health Assessment, Final, Los Alamos National Laboratory*, EPA Facility ID: NM0890010515, Site and Radiological Assessment Branch, Division of Health Assessment and Consultation, Atlanta, Georgia, August 31.

Balice, R. G., K. D. Bennett, and M. A. Wright, 2004, *Burn Severities, Fire Intensities, and Impacts to Major Vegetation Types from the Cerro Grande Fire*, LA-14159, Los Alamos National Laboratory, Los Alamos, New Mexico, December.

BEA (Bureau of Economic Analysis), 2007, "New Mexico Per Capita Personal Income," Regional Economic Information System, Washington, DC (available at www.bea.gov), April.

Bearzi, J. P., 2005, New Mexico Environmental Department, Letter to Mat Johansen and David McInroy, Los Alamos National Laboratory, Los Alamos, New Mexico, *Interim Measures Work Plan Requirement Groundwater Contaminants Detected In The Regional Aquifer at R-28 Los Alamos National Laboratory,* December 23.

Birdsell, K. H., B. D. Newman, D. E. Broxton, and B. A. Robinson, 2005, "Conceptual Models of Vadose Zone Flow and Transport beneath the Pajarito Plateau, Los Alamos, New Mexico," *Vadose Zone Journal*, 4, pp. 620-636.

BLM (Bureau of Land Management), (Undated) Environmental Assessment for the Treatment of Saltcedar and Other Noxious Weeds in the Chico Arroyo Watershed, EA-NM-010-02-032, Albuquerque Field Office, Albuquerque, New Mexico.

BLM (Bureau of Land Management), 1986, *Visual Resource Contrast Rating*, BLM Manual Handbook 8431-1, Washington, DC, January 17.

BLM (Bureau of Land Management), 2002, *Final Environmental Impact Statement for Santo Domingo Pueblo/Bureau of Land Management Land Exchange*, BLM/NM/PL-02-004-7122, Albuquerque Field Office, Albuquerque, New Mexico, March 3.

BLM (Bureau of Land Management), 2003a, *Final Air Dispersion Analyses Technical Report, Revision to the BLM Farmington Resource Management Plan and Amendment of the Rio Puerco Resource Management Plan*, Farmington Field Office, Farmington, New Mexico, February.

BLM (Bureau of Land Management), 2003b, *Farmington Proposed Resource Management Plan and Final Environmental Impact Statement*, BLM-NM-PL-03-014-1610, Farmington Field Office, Farmington, New Mexico, March.

BLM (Bureau of Land Management), 2003c, *Farmington Resource Management Plan with Record of Decision*, Farmington Field Office, Farmington, New Mexico, December.

BLM (Bureau of Land Management), 2004a, Factsheet: *San Juan Public Lands (San Juan Field Center & San Juan National Forest) Draft Environmental Impact Statement (EIS) Northern San Juan Basin Coalbed Methane Project*, San Juan Public Land Center, Durango, Colorado.

BLM (Bureau of Land Management), 2004b, Final Bureau of Land Management Finding of No Significant Impact and Decision Record, Taos Field Office, Taos, New Mexico, June 3.

BLM (Bureau of Land Management), 2006a, Rio Puerco Field Office Information (accessed at www.nm.blm.gov/aufo/aufo_home.html), and Taos Field Office Information (accessed at www.nm.blm.gov/tafo/tafo_home.html), February 15.

BLM (Bureau of Land Management), 2006b, *Mid-America Pipeline Company Western Expansion Project EA, Project Description* (accessed at www.nm.blm.gov/nmso/midam-pipline/project_description.html), February 15.

BLM (Bureau of Land Management), 2006c, *New Mexico Products Pipeline Environmental Impact Statement* (accessed at www.nm.blm.gov/aufo/nmpp/nmpp_index.html), February 15.

BLM and USFS (U.S. Department of the Interior, Bureau of Land Management and U.S. Department of Agriculture, Forest Service), 2007, *Final Environmental Impact Statement for the Buckman Water Diversion Project, Santa Fe National Forest and Taos Field Office of the BLM in Santa Fe County, New Mexico*, May 24.

BLS (Department of Labor, Bureau of Labor Statistics), 2005, "Workplace Injuries and Illnesses in 2004," Washington, DC, November 17.

Broxton, D. E., and D. T. Vaniman, 2004, "Geologic Framework of a Groundwater System on the Margin of a Rift Basin, Pajarito Plateau, North-Central New Mexico," *Vadose Zone Journal*, Vol. 4, p. 522-550, April 28.

Carter, K. E., and C. L. Winter, 1995, "Fractal natural and scaling of normal faults in the Española Basin, Rio Grande rift, New Mexico: implications for fault growth and brittle strain," *Journal of Structural Geology*, Vol. 17, No. 6, p. 863-873.

CDC (Centers for Disease Control and Prevention), 2006, *Interim Report of the Los Alamos Historical Document Retrieval and Assessment (LAHDRA) Project*, Version 4, National Center for Environmental Health, Division of Environmental Hazards and Health Effects, Radiation Studies Branch, Atlanta, Georgia, January.

CEQ (Council on Environmental Quality), 1997, *Environmental Justice, Guidance Under the National Environmental Policy Act*, Executive Office of the President, Washington, DC, December 10.

CFLHD (Central Federal Lands Highway Division), 2005, *CFLHD Projects (New Mexico)* (accessed at www.cflhd.gov/projects/NMHome.cfm), December 23.

Cummings, L., 2007, Los Alamos Site Office, Document Manager, *Environmental Impact Statement for the Operation of a Biosafety Level-3 Facility at Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EIS-0388D, Personal communication with K. Owens, Science Applications International Corporation, Germantown, Maryland, "BSL-3 Summary Update for LANL SWEIS," August 8.

Del Signore, J. C. and R. L. Watkins, 2005, *Radioactive Liquid Waste Treatment Facility Annual Report for 2004*, LA-UR-05-4395, Los Alamos National Laboratory, Los Alamos New Mexico, May.

Delucas, K., 2005, "Two Lab Employees Treated for Injuries", LANL News Bulletin (available at www.lanl.gov/news/index.php?fuseaction=nb.story&story_id=6682&nb_date=2005-06-01), June 1.

DOC (U.S. Department of Commerce), 2005, *Technical Documentation: Census 2000 Summary File 3 Technical Documentation*, SF3/10 (RV), Bureau of the Census, Washington, DC (available at www.census.gov), February.

DOC (U.S. Department of Commerce), 2006a, *DP-1, General Population and Housing Characteristics: 1990; Data Set: 1990 Summary Tape File 1 for New Mexico*, Bureau of the Census, Washington, DC (available at http://factfinder.census.gov), February.

DOC (U.S. Department of Commerce), 2006b, *Fact Sheet, Census 2000 Demographic Profile Highlights, New Mexico and Los Alamos, Rio Arriba, and Santa Fe Counties*, Bureau of the Census, Washington, DC (available at http://factfinder.census.gov), February.

DOC (U.S. Department of Commerce), 2006c, "Small Area Income & Poverty Estimates, Estimates for New Mexico Counties, 2004," Bureau of the Census, Washington, DC, (available at www.census.gov).

DOC (U.S. Department of Commerce), 2006d, Regional Input-Output Modeling System (RIMS II) "Total Multipliers for Output, Earnings, and Employment by Detailed Industry, Santa Fe, New Mexico, Region 2," Regional Economic Analysis Division, Bureau of Economic Analysis.

DOC (U.S. Department of Commerce), 2007, "New Mexico - County, GCT-T1 2006 Population Estimates," Bureau of the Census, Population Estimates Program, Washington, DC, (available at factfinder.census.gov).

DOE (U.S. Department of Energy), 1990, "Radiation Protection of the Public and the Environment," DOE Order 5400.5, Change 2: January 7, 1993, Washington, DC, February 8.

DOE (U.S. Department of Energy), 1995a, *Dual Axis Radiographic Hydrodynamic Test Facility Final Environmental Impact Statement*, DOE/EIS-0228, Albuquerque Operations Office, Los Alamos Area Office, Albuquerque, New Mexico, August.

DOE (U.S. Department of Energy), 1995b, *Environmental Assessment - Radioactive Source Recovery Program*, DOE/EA-1059, Los Alamos Area Office, Los Alamos, New Mexico, December 20.

DOE (U.S. Department of Energy), 1996, *Plutonium: The First 50 Years, United States Plutonium Production, Acquisition, and Utilization from 1944 through 1994,* DOE/DP-0137, Washington, DC, February.

DOE (U.S. Department of Energy), 1997a, *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*, DOE/EIS-0026-S-2, Carlsbad Area Office, Carlsbad, New Mexico, September.

DOE (U.S. Department of Energy), 1997b, *Environmental Assessment for Lease of Land for the Development of a Research Park at Los Alamos National Laboratory, Los Alamos, New Mexico,* DOE-EA-1212, Los Alamos Area Office, Los Alamos, New Mexico, October 7.

DOE (U.S. Department of Energy), 1998, *Environmental Assessment for the Proposed Strategic Computing Complex, Los Alamos National Laboratory, Los Alamos, New Mexico,* DOE/EA-1250, Los Alamos Area Office, Los Alamos, New Mexico, December 18.

DOE (U.S. Department of Energy), 1999a, *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EIS-0238, Albuquerque Operations Office, Albuquerque, New Mexico, January.

DOE (U.S. Department of Energy), 1999b, *Radioactive Waste Management Manual*, DOE M 435.1-1, Change 1: 6-19-01, Office of Environmental Management, Washington, DC, July 9.

DOE (U.S. Department of Energy), 1999c, *Environmental Assessment for the Proposed Construction and Operation of the Nonproliferation and International Security Center, Los Alamos National Laboratory, Los Alamos New Mexico*, DOE-EA-1238, Los Alamos Area Office, Los Alamos, New Mexico, July 21.

DOE (U.S. Department of Energy), 1999d, *Final Environmental Impact Statement for the Conveyance and Transfer of Certain Land Tracts Administered by the U.S. Department of Energy and Located at Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico*, DOE/EIS-0293, Los Alamos Area Office, Los Alamos, New Mexico, October.

DOE (U.S. Department of Energy), 1999e, *DOE Standard, Radiological Control*, DOE-STD-1098-99, Washington, DC, July.

DOE (U.S. Department of Energy), 2000a, *Environmental Assessment for Electrical Power System Upgrades at Los Alamos National Laboratory*, DOE/EA-1247, Los Alamos Area Office, Los Alamos, New Mexico, March 9.

DOE (U.S. Department of Energy), 2000b, *Preliminary Findings – Plutonium-238 Uptakes at Los Alamos National Laboratory*, Lessons Learned HQ-EH-2000-01, Washington, DC, May 24.

DOE (U.S. Department of Energy), 2000c, *Safety & Health Hazards Alert,* "Update June 28, 2000 – Preliminary Accident Investigation Findings from the Plutonium-238 Multiple Intake Event at the Los Alamos National Laboratory, Issue No, 2000-01A, DOE/EH-0518, Office of Environment, Safety and Health, Washington, DC, July.

DOE (U.S. Department of Energy), 2000d, *Supplement Analysis, Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Modification of Management Methods for Certain Unwanted Radioactive Sealed Sources at Los Alamos National Laboratory*, DOE/EIS-0238-SA-01, Albuquerque Operations Office, Los Alamos, New Mexico, August.

DOE (U.S. Department of Energy), 2000e, *Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory, Los Alamos, New Mexico,* DOE/EA-1329, Los Alamos Area Office, Los Alamos, New Mexico, August 10.

DOE (U.S. Department of Energy), 2000f, *Special Environmental Analysis for the Department of Energy, National Nuclear Security Administration, Actions Taken in Response to the Cerro Grande Fire at Los Alamos National Laboratory, Los Alamos, New Mexico,* DOE/SEA-03, Los Alamos Area Office, Los Alamos, New Mexico, September.

DOE (U.S. Department of Energy), 2000g, *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility*, DOE/EIS-0310, Office of Nuclear Energy, Science and Technology, Washington, DC, December.

DOE (U.S. Department of Energy), 2001, *Environmental Assessment for the Proposed Construction and Operation of a New Interagency Emergency Operations Center at Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EA-1376, Los Alamos Area Office, Los Alamos, New Mexico, July 26.

DOE (U.S. Department of Energy), 2002a, *DOE Standard, Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities,* DOE-STD-1020-2002, Washington, DC, January.

DOE (U.S. Department of Energy), 2002b, *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0250, Office of Civilian Radioactive Waste Management, Washington, DC, February.

DOE (U.S. Department of Energy), 2002c, *Environmental Assessment for the Proposed Construction and Operation of a Biosafety Level 3 Facility at Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EA-1364, National Nuclear Security Administration, Office of Los Alamos Site Operations, Los Alamos, New Mexico, February 26.

DOE (U.S. Department of Energy), 2002d, *Environmental Assessment of the Proposed Disposition of the Omega West Facility at Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EA-1410, National Nuclear Security Administration, Office of Los Alamos Site Operations, Los Alamos, New Mexico, March 28.

DOE (U.S. Department of Energy), 2002e, *Environmental Assessment for the Proposed TA-16 Engineering Complex Refurbishment and Consolidation at Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EA-1407, National Nuclear Security Administration, Office of Los Alamos Site Operations, Los Alamos, New Mexico, April 23.

DOE (U.S. Department of Energy), 2002f, National Transuranic Waste Management Plan, DOE/NTP-96-1204, Revision 3, July.

DOE (U.S. Department of Energy), 2002g, *DOE Standard, A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*, DOE-STD-1153-2002, Washington, DC, July.

DOE (U.S. Department of Energy), 2002h, *Environmental Assessment for the Proposed Issuance of an Easement to Public Service Company of New Mexico for the Construction and Operation of a 12-inch Natural Gas Pipeline within Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EA-1409, National Nuclear Security Administration, Office of Los Alamos Site Operations, Los Alamos, New Mexico, July 24.

DOE (U.S. Department of Energy), 2002i, *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory*, DOE/EIS-0319, National Nuclear Security Administration, Washington, DC, August.

DOE (U.S. Department of Energy), 2002j, *Proposed Future Disposition of Certain Cerro Grande Fire Flood and Sediment Retention Structures at Los Alamos National Laboratory, Los Alamos, New Mexico,* DOE/EA-1408, National Nuclear Security Administration, Los Alamos Site Office, Los Alamos, New Mexico, August 8.

DOE (U.S. Department of Energy), 2002k, *Environmental Assessment for Proposed Access Control and Traffic Improvements at Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EA-1429, National Nuclear Security Administration, Los Alamos Site Office, Los Alamos, New Mexico, August 23.

DOE (U.S. Department of Energy), 2002l, *Environmental Assessment for the Installation and Operation of Combustion Turbine Generators at Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EA-1430, LA-UR-02-6482, National Nuclear Security Administration, Los Alamos Site Office, Los Alamos, New Mexico, December 11.

DOE (U.S. Department of Energy), 2003a, *Supplement Analysis, Security Perimeter Project,* National Nuclear Security Administration, Los Alamos Site Office, Los Alamos, New Mexico, February 19.

DOE (U.S. Department of Energy), 2003b, *Environmental Assessment for the Proposed Los Alamos National Laboratory Trails Management Program, Los Alamos, New Mexico* DOE/EA-1431, National Nuclear Security Administration, Los Alamos Site Office, Los Alamos, New Mexico, September 2.

DOE (U.S. Department of Energy), 2003c, *Supplemental Analysis Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Supplement Analysis, Bolas Grande Project*, DOE/EIS-0238-SA-03, National Nuclear Security Administration, Los Alamos Site Office, Los Alamos, New Mexico, September 3.

DOE (U.S. Department of Energy), 2003d, *Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico,* DOE/EIS-0350, Los Alamos Site Office, Los Alamos, New Mexico, November.

DOE (U.S. Department of Energy), 2003e, *Final Environmental Assessment for the Proposed Consolidation of Certain Dynamic Experimentation Activities at the Two-Mile Mesa Complex, Los Alamos National Laboratory, Los Alamos, New Mexico,* DOE/EA-1447, National Nuclear Security Administration, Los Alamos Site Office, Los Alamos, New Mexico, November 3.

DOE (U.S. Department of Energy), 2003f, *DOE Occupational Radiation Exposure, 2003 Report*, DOE/EH-0688, Assistant Secretary for Environment, Safety and Health, Office of Corporate Performance Assessment, Washington, DC.

DOE (U.S. Department of Energy), 2004a, *Supplement Analysis, Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Recovery and Storage of Strontium-90 (Sr-90) Fueled Radioisotope Thermal Electric Generators at Los Alamos National Laboratory*, DOE/EIS-0238-SA-04, National Nuclear Security Administration, Los Alamos Site Office, Los Alamos, New Mexico, January.

DOE (U.S. Department of Energy), 2004b, *Degradation and Failure of Stored Radiological Material Containers and Packages*, Lessons Learned HQ-EH-2004-01, Washington, DC, January 1.

DOE (U.S. Department of Energy), 2004c, Memo for Ralph Erickson, Los Alamos Site Operations Manager from Paul Longsworth, Deputy Administrator, Defense Nuclear Nonproliferation, National Nuclear Security Administration, "Expanded Scope for the Off-Site Source Recovery Program," March 2.

DOE (U.S. Department of Energy), 2004d, *Lessons Learned from Type B Accident Investigation of the August 5, 2003 Plutonium-238 Multiple Uptake Event at the Plutonium Facility, Los Alamos National Laboratory, New Mexico*, Lorence, Joanne D., presented at 2004 Facility Representative Workshop, Las Vegas, Nevada, May 20.

DOE (U.S. Department of Energy), 2004e, *Environmental Assessment for the Proposed Corrective Measures at Material Disposal Area H within Technical Area 54 at Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EA-1464, National Nuclear Security Administration, Los Alamos Site Office, Los Alamos, New Mexico, June 14.

DOE (U.S. Department of Energy), 2004f, *Implementation Guide, Wildland Fire Management Program for Use with DOE 450.1, Environmental Protection Program*, DOE-G-450-1.4, Office of Environment, Safety and Health, Washington, DC.

DOE (U.S. Department of Energy), 2005a, *Modification of a Special Use Permit to the Incorporated County of Los Alamos for the Construction and Operation of a Solid Waste Transfer Station at TA-61*, Accession No: 11228, LASO 05-003, Los Alamos, New Mexico, February 8.

DOE (U.S. Department of Energy), 2005b, *Final Environmental Assessment for the Proposed Consolidation of Neutron Generator Tritium Target Loading Production*, DOE/EA-1532, National Nuclear Security Administration, Sandia Site Office, Albuquerque, New Mexico, June.

DOE (U.S. Department of Energy), 2005c, *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems* (DOE/EIS-0373D), Office of Nuclear Energy, Science and Technology, Washington, DC, June.

DOE (U.S. Department of Energy), 2005d, *Recommendations for the Nuclear Weapons Complex of the Future*, Secretary of Energy Advisory Board, Washington, DC, July 13.

DOE (U.S. Department of Energy), 2005e, "AEGLs, ERPGs, or Rev. 21 TEELs for Chemicals of Concern 2005, DKC-05-0002, Rev. 21," Washington, DC (accessed at www.eh.doe.gov/chem_safety/teeldef.html), September.

DOE (U.S. Department of Energy), 2005f, *Facility Safety*, DOE Order 420.1B, Washington, DC, December 22.

DOE (U.S. Department of Energy), 2006a, "DOE Strengthens Rules Governing Worker Safety," Office of Public Affairs, February 2.

DOE (U.S. Department of Energy), 2006b, "Programmatic Agreement for Management of Historic Properties at Los Alamos National Laboratory," LA-UR-06-1975, June 14.

DOE (U.S. Department of Energy), 2007a, *Draft Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0250F-S1D, Office of Civilian Radioactive Waste Management, Las Vegas, Nevada, October.

DOE (U.S. Department of Energy), 2007b, *Draft Complex Transformation Supplemental Programmatic Environmental Impact Statement*, DOE/EIS-0236-S4, National Nuclear Security Administration, Washington, DC, December.

DOE (U.S. Department of Energy), 2008, Memorandum from A. R. Griffith, Office of Nuclear Energy to E. Withers, Los Alamos National Laboratory Site-Wide Environmental Impact Statement Document Manager, Subject: Advanced Fuel Cycle Facility (AFCF) Data for the Los Alamos National Laboratory (LANL) Site-wide Environmental Impact Statement (SWEIS), March 31.

DOE and LANL (U.S. Department of Energy and Los Alamos National Laboratory), 2005, *DOE/LANL List of Los Alamos National Laboratory Nuclear Facilities*, PS-SBO-401 Rev. 7, National Nuclear Security Administration, Los Alamos Site Office, Los Alamos, New Mexico, October.

DOJ (U.S. Department of Justice), 2004, *Law Enforcement Management and Administrative Statistics, 2000: Data for Individual State and Local Agencies with 100 or More Officers*, Bureau of Justice Statistics, NCJ 203350, April.

Environment Canada, 2002, "Canadian Environmental Quality Guidelines, Summary Table Update 2002," Ottawa, Ontario.

Environmental Laboratory, 1987, *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, U.S. Army Waterway Experiment Station, Vicksburg, Mississippi, January.

EPA (U.S. Environmental Protection Agency), 1974, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, EPA 550/9-74-004 (PB-239429), Office of Noise Abatement and Control, March.

EPA (U.S. Environmental Protection Agency), 1980, *Effects of Noise on Wildlife and Other Animals, Review of Research Since 1971*, EPA 550/9-80-100, Washington, DC, July.

EPA (U.S. Environmental Protection Agency), 2002, "National Recommended Water Quality Criteria: 2002," EPA Office of Science and Technology Document EPA-822-R-02-047, Washington, DC.

EPA (U.S. Environmental Protection Agency), 2003, *Glossary*, Office of Research and Development, U.S. EPA Region III, Philadelphia, Pennsylvania, September 8.

EPA (U.S. Environmental Protection Agency), 2005a, United States Department of Energy and the Los Alamos National Laboratory, Federal Facility Compliance Agreement, Region 6, Docket No. CWA-06-2005-1701, February 3.

EPA (U.S. Environmental Protection Agency), 2005b, *National Priorities List Sites in New Mexico* (accessed on December 23, www.epa.gov/superfund/sites/npl/nm.htm), August 22.

EPA (U.S. Environmental Protection Agency), 2005c, *Terms of Environment, Glossary*, Office of Research and Development, EPA Region III, Philadelphia, Pennsylvania (available at www.epa.gov/OCEPAterms/bterms.html), August 29.

EPA (U.S. Environmental Protection Agency), 2006a, *Mid-Atlantic Integrated Assessment, Appendix C, Glossary*, Office of Research and Development, EPA Region III, Philadelphia, Pennsylvania (available at www.epa.gov/maia/html/glossary.html), March 3.

EPA (U.S. Environmental Protection Agency), 2006b, *North Railroad Avenue Plume (Rio Arriba County) New Mexico*, EPA Region 6, Española, New Mexico, November 7.

EPA (U.S. Environmental Protection Agency), 2007a, "Region 6 Human Health Medium Specific Screening Levels 2007," Dallas, TX, February 21.

EPA (U.S. Environmental Protection Agency), 2007b, Authorization to Discharge Under the National Pollutant Discharge Elimination System, NPDES Permit No. NM0028355, Region 6, Dallas, TX, August 1.

FICN (Federal Interagency Committee on Noise), 1992, *Federal Agency Review of Selected Airport Noise Analysis Issues*, August.

Ford-Schmid, R. and D. Englert, 2004, *Post Cerro Grande Fire Stream Channel Morphology In Lower Pueblo Canyon, Reach P-4 East, Los Alamos County, New Mexico*, Department of Energy Oversight Bureau, New Mexico Environment Department, Santa Fe, New Mexico, January.

Ford-Schmid, R. D. Englert, and K. Bransford, 2004, *Post Cerro Grande Fire Channel Morphology in Lower Pueblo Canyon, Reach P-4 West: and Storm Water Transport of Plutonium 239/240 in Suspended Sediments, Los Alamos County, New Mexico,* U.S. Department of Energy Oversight Bureau, New Mexico Environment Department, Santa Fe, New Mexico, October.

Gallaher, B. M., and D. W. Efurd, 2002, *Plutonium and Uranium from Los Alamos National Laboratory in Sediments of the Northern Rio Grande Valley*, LA-13974-PR, Los Alamos National Laboratory, Los Alamos, New Mexico, August.

Gallaher, B. M., and R. J. Koch, 2004, *Cerro Grande Fire Impacts to Water Quality and Stream Flow Near Los Alamos National Laboratory: Results of Four Years of Monitoring*, LA-14177, Los Alamos National Laboratory, Los Alamos, New Mexico, September.

Gallegos, F., 2006, *Interview Record – Future Actions for Cumulative Impacts*, City of Santa Fe, Planning and Land Use, Personal communication with C. Brandenburg, Science Applications International Corporation, January 26.

Gilliom, R. J., D. K. Mueller, and L. H. Nowell, 1997, "Methods for Comparing Water-Quality Conditions Among National Water-Quality Study Units, 1992-1995," U.S. Geological Survey Open-File Report 97-589 (available at http://ea.water.usgs.gov/pnsp/rep/cfr97589).

Glasco, T., 2005, Los Alamos County, Deputy Utilities Manager, Los Alamos, New Mexico, Personal communication (e-mail) to K. Folk, Science Applications International Corporation, Germantown, Maryland, "Response to Los Alamos County Water Supply Planning", November 1, and November 9.

Glasco, T., 2008, Los Alamos County, Deputy Utilities Manager, Los Alamos, New Mexico, Personal communication (e-mail) to M. Gorden, Science Applications International Corporation, Germantown, Maryland, "Response to Status of the Bayo Wastewater Treatment Plant," January 18.

HHS (U.S. Department of Health and Human Services), 2007, *Biosafety in Microbiological and Biomedical Laboratories*, Centers for Disease Control and Prevention, National Institutes of Health, Health and Human Services, Fifth Edition, February.

Holsapple, K., 2007, *Interview Record – Number of Employees in the Los Alamos Research Park*, Los Alamos Development Corporation Leasing Manager, Personal communication with S. Schatzel, Science Applications International Corporation, January 16.

IFRAT (Interagency Flood Risk Assessment Team, Risk Assessment Working Group), 2002, *Assessment of Potential Risks from Enhanced Surface Water Runoff in CY2001 due to the Cerro Grande Fire*, New Mexico Environment Department, Hazardous Waste Bureau, Santa Fe, New Mexico, May 28.

Jacobson, K., S. Johnson, and J. Rishel, 2003, *Facility-Wide Air Quality Impact Analysis*, LA-UR-03-3983, Los Alamos National Laboratory, Los Alamos, New Mexico, July.

Jeppson, G., 2006, *Interview Record – Future Actions for Cumulative Impacts,* Los Alamos County, Community Development Department, Planning and Zoning, Personal communication with C. Brandenburg, Science Applications International Corporation, January 18.

Johnson, P. E., and R. D. Michelhaugh, 2003, *Transportation Routing Analysis Geographic Information System (TRAGIS) – User's Manual*, ORNL/NTRC-006, Rev. 0, Oak Ridge National Laboratory, Oak Ridge, Tennessee (accessed through http://apps.ntp.doe.gov/ tragis/tragis.htm), June.

Keller, D., and S. Koch, 2001, *A Biological Information Document for the Potential Siting of the Advanced Hydrodynamic Facility at LANL*, LA-UR-01-1832, Los Alamos National Laboratory, Los Alamos, New Mexico, July 10.

Kraig, D., R. Ryti, D. Katzman, T. Buhl, B. Gallaher, and P. Fresquez, 2002, *Radiological and Nonradiological Effects After the Cerro Grande Fire,* LA-13914, Los Alamos National Laboratory, Los Alamos, New Mexico, March.

KSL (Kellog Brown and Root Government Services; Shaw Environmental and Infrastructure Inc.; and Los Alamos Technical Associates, Inc.), 2004, *LANL Roads/NM-4/502, 24 Hour Vehicular Traffic Counts, Directional AM and PM Peak Hour Traffic, September 12, 2004-September 18, 2004 and September 2003 (Map),* Los Alamos, New Mexico, November 17.

LAC (Los Alamos County), 2004a, *Los Alamos County Comprehensive Plan, 2004-2014*, Preliminary Draft – October 2003-April 2004, Los Alamos, New Mexico.

LAC (Los Alamos County), 2004b, *Los Alamos County Department of Public Utilities – San Juan Chama Project Water Utilization Study* (accessed on December 23, 2005, www.lac-nm.us), Los Alamos, New Mexico, October 20.

LAC (Los Alamos County), 2005, *Traffic Data*, Public Works Department, Traffic Division, Los Alamos, New Mexico, February 15.

LAC (Los Alamos County), 2006a, Los Alamos Fire Department Page (accessed at www.lac-nm.us), March 10.

LAC (Los Alamos County), 2006b, "Board Celebrates San Juan/Chama Contract Conversion," Los Alamos County New Mexico Website (accessed at www.losalamosnm.us/index.asp?Type=B_PR&SEC={40E7C209-CBE0-4386-941F-F392C2CBF502}&DE={88ED6579), September 22.

LAC (Los Alamos County), 2006c, *New Solid Waste Transfer Station: Moving Right Along* (accessed at www.lac-nm.us), News and Events, Los Alamos, New Mexico, October 27.

LAC (Los Alamos County), 2007, *Los Alamos County Department of Public Utilities – Los Alamos Solid Waste Transfer Station/Landfill Closure* (accessed on January 23, 2007, http://losalamos.govoffice.com), Los Alamos, New Mexico, February 16.

LAMC (Los Alamos Medical Center), 2006, Welcome Page (accessed at www.losalamosmedicalcenter.com/home.htm), March 10.

LANL (Los Alamos National Laboratory), 1996a, *Road Geology of Selected Sections in the Pajarito Plateau and the Jemez Mountains, North Central New Mexico*, Geology and Geochemistry Group (EES-1), Los Alamos, New Mexico (available at www.ees1.lanl.gov/roadgeology/RoadGeology.html).

LANL (Los Alamos National Laboratory), 1996b, *Environmental Surveillance at Los Alamos during 1995*, LA-13210-ENV, Los Alamos, New Mexico, October.

LANL (Los Alamos National Laboratory), 1997a, *Performance Assessment and Composite Analysis for Los Alamos National Laboratory Material Disposal Area G*, Report-54G-013, R.2.1, LA-UR-97-85, Los Alamos, New Mexico, March.

LANL (Los Alamos National Laboratory), 1997b, SWEIS Baseline and Alternatives Emission Rate Calculations for TA-50, ESH-17:97-175, April 15.

LANL (Los Alamos National Laboratory), 1997c, *Environmental Surveillance and Compliance at Los Alamos during 1996*, LA-13343-ENV, Los Alamos, New Mexico, September.

LANL (Los Alamos National Laboratory), 1998a, *Description of Technical Areas and Facilities at Los Alamos National Laboratory—1997*, LA-UR-97-4275, Site-Wide Environmental Impact Statement Project Office, Los Alamos, New Mexico, March.

LANL (Los Alamos National Laboratory), 1998b, *Storm Water/Surface Water Pollution Prevention Best Management Practices (BMPs) Guidance Document, Revision 1*, Los Alamos, New Mexico, August.

LANL (Los Alamos National Laboratory), 1998c, *Threatened and Endangered Species Habitat Management Plan, Overview*, LALP-98-112, Los Alamos, New Mexico, October.

LANL (Los Alamos National Laboratory), 1999a, *Material Disposal Area Core Document*, LA-UR-99-4423, Los Alamos, New Mexico, August.

LANL (Los Alamos National Laboratory), 1999b, *Environmental Surveillance at Los Alamos during 1998*, LA-13633-ENV, Los Alamos, New Mexico, September.

LANL (Los Alamos National Laboratory), 1999c, *SWEIS Yearbook—1998, Comparison of 1998 Data to Projections of the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, LA-UR-99-6391, Los Alamos, New Mexico, December.

LANL (Los Alamos National Laboratory), 2000a, *Comprehensive Site Plan 2000, Los Alamos National Laboratory Project Management and Planning*, LA-UR-99-6704, Los Alamos, New Mexico, January 31.

LANL (Los Alamos National Laboratory), 2000b, *Threatened and Endangered Species Habitat Management Plan*, LA-UR-00-4747, Los Alamos, New Mexico, April.

LANL (Los Alamos National Laboratory), 2000c, *A Review of Criticality Accidents, 2000 Revision*, LA-13638, Los Alamos, New Mexico, May.

LANL (Los Alamos National Laboratory), 2000d, *Effects of the Cerro Grande Fire (Smoke and Fallout Ash) on Soil Chemical Properties Within and Around Los Alamos National Laboratory*, LA-13769-MS, P. R. Fresquez, W. R. Velasquez, and L. Naranjo, Jr., Los Alamos, New Mexico, November.

LANL (Los Alamos National Laboratory), 2000e, *Environmental Surveillance at Los Alamos during 1999, 30th Anniversary Editi*on, LA-13775-ENV, Los Alamos, New Mexico, December.

LANL (Los Alamos National Laboratory), 2000f, *SWEIS Yearbook—1999, Comparison of 1999 Data to Projections of the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, LA-UR-00-5520, Los Alamos, New Mexico, December.

LANL (Los Alamos National Laboratory), 2001a, *LANL Site-Wide Water Conservation Program Plan*, LA-UR-01-6377, Los Alamos, New Mexico, January.

LANL (Los Alamos National Laboratory), 2001b, *Wildfire Hazard Reduction Project Plan*, LA-UR-01-2017, Ecology Group, Los Alamos, New Mexico, April.

LANL (Los Alamos National Laboratory), 2001c, *Comprehensive Site Plan 2001*, LA-UR-01-1838, Los Alamos, New Mexico, April 13.

LANL (Los Alamos National Laboratory), 2001d, *ESH-20 NEPA Determination Document 10, High Explosives Testing Facility*, LA-UR-01-3040, Los Alamos, New Mexico, May 24.

LANL (Los Alamos National Laboratory), 2001e, *SWEIS Yearbook—2000, Comparison of 2000 Data to Projections of the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, LA-UR-01-2965, Los Alamos, New Mexico, July.

LANL (Los Alamos National Laboratory), 2001f, *Environmental Surveillance at Los Alamos during 2000*, LA-13861-ENV, Los Alamos, New Mexico, October.

LANL (Los Alamos National Laboratory), 2001g, *Cerro Grande Fire One Year After: An Update on ER Activities to Reduce the Potential Movement of Contamination at Potential Release Sites*, LA-UR-01-4122, Water Quality & Hydrology Group (ESH-18), Environmental Restoration Project, Los Alamos, New Mexico, November 15.

LANL (Los Alamos National Laboratory), 2002a, *Site + Architectural Design Principles*, LA-UR-01-5383, Site Planning and Development Group, Los Alamos, New Mexico, January.

LANL (Los Alamos National Laboratory), 2002b, *Department of Energy Land Conveyance Data Recovery Plan and Research Design for the Excavation of Archaeological Sites Located within Selected Parcels to be Conveyed to the Incorporated County of Los Alamos, New Mexico, Cultural Resources Report No. 201*, LA-UR-02-1284, Los Alamos, New Mexico, March.

LANL (Los Alamos National Laboratory), 2002c, *A Floodplains and Wetlands Assessment of the Proposed Future Disposition of Certain Cerro Grande Fire Flood and Sediment Retention Structures at Los Alamos National Laboratory*, LA-UR-02-3919, Los Alamos, New Mexico, August 7.

LANL (Los Alamos National Laboratory), 2002d, *Environmental Surveillance at Los Alamos during 2001*, LA-13979-ENV, Los Alamos, New Mexico, September.

LANL (Los Alamos National Laboratory), 2002e, *SWEIS Yearbook—2001, Comparison of 2001 Data to Projections of the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, LA-UR-02-3143, Los Alamos, New Mexico, September.

LANL (Los Alamos National Laboratory), 2002f, "Dig that crazy bone!" *Los Alamos National Laboratory News*, Public Affairs Office, October 2.

LANL (Los Alamos National Laboratory), 2002g, *Cerro Grande Fire Assessment Project: An Assessment of the Impact of the Cerro Grande Fire on Cultural Resources at Los Alamos National Laboratory, New Mexico Cultural Resource Report No. 211*, Survey No. 818, LA-UR-02-5713, Los Alamos, New Mexico, November.

LANL (Los Alamos National Laboratory), 2002h, *Radiological Facility List*, PS-OAB-403, Rev. 1, Los Alamos, New Mexico, November 14.

LANL (Los Alamos National Laboratory), 2002i, *A Citizens Guide*, LALP-01-181, Environmental Restoration Project, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 2003a, *Preliminary Chemistry and Metallurgy Research Building Disposition Study*, LA-UR-03-1122, Los Alamos, New Mexico, February 11.

LANL (Los Alamos National Laboratory), 2003b, *Water Supply at Los Alamos 1998 – 2001,* LA-13985-PR, Los Alamos, New Mexico, March.

LANL (Los Alamos National Laboratory), 2003c, *Groundwater Annual Status Report for Fiscal Year 2002*, LA-UR-03-0244, Los Alamos, New Mexico, March.

LANL (Los Alamos National Laboratory), 2003d, *Corrective Measures Study Report for Material Disposal Area H, Solid Waste Management Unit 54-004, at Technical Area 54*, LA-UR-03-3354, Risk Reduction and Environmental Stewardship Division, Los Alamos, New Mexico, May.

LANL (Los Alamos National Laboratory), 2003e, *Waste Volume Forecast*, LA-UR-03-4009, Attachment G to *Information Document in Support of the Five-Year Review and Supplement Analysis for the Los Alamos National Laboratory Site-Wide Environmental Impact Statement (DOE/EIS-0238),* Los Alamos, New Mexico, June.

LANL (Los Alamos National Laboratory), 2003f, *Facility-Wide Air Quality Impact Analysis*, LA-UR-03-3983, Meteorology and Air Quality Group, Environmental Stewardship Division, Los Alamos, New Mexico, July.

LANL (Los Alamos National Laboratory), 2003g, *Noise and Temperature Stresses: Laboratory Implementation Requirements*, LIR 402-820-01.1, Los Alamos, New Mexico, Revised August 20.

LANL (Los Alamos National Laboratory), 2003h, *SWEIS Yearbook—2002, Comparison of 1998 to 2002 Data to Projections of the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, LA-UR-03-5862, Los Alamos, New Mexico, September.

LANL (Los Alamos National Laboratory), 2004a, *Environmental Surveillance at Los Alamos during 2002*, LA-14085-ENV, Los Alamos, New Mexico, January.

LANL (Los Alamos National Laboratory), 2004b, *LANL Engineering Standards Manual*, OST220-03-01-ESM, Section G10, Site Preparation, Rev. 1, Los Alamos, New Mexico, August 16.

LANL (Los Alamos National Laboratory), 2004c, *Information Document in Support of the Five-Year Review and Supplement Analysis for the Los Alamos National Laboratory Site-Wide Environmental Impact Statement (DOE/EIS-0238)*, LA-UR-04-5631, Los Alamos, New Mexico, August 17.

LANL (Los Alamos National Laboratory), 2004d, *Environmental Surveillance at Los Alamos during 2003*, LA-14162-ENV, Los Alamos, New Mexico, September.

LANL (Los Alamos National Laboratory), 2004e, *Nonradioactive Ambient Air Monitoring at Los Alamos National Laboratory 2001-2002*, LA-14169, Los Alamos, New Mexico, September.

LANL (Los Alamos National Laboratory), 2004f, *SWEIS Yearbook—2003, Comparison of 2003 Data Projections of the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, LA-UR-04-6024, Ecology Group, Los Alamos, New Mexico, September.

LANL (Los Alamos National Laboratory), 2004g, *Waste Volume Forecast, Revision 1*, LA-UR-04-6682, Los Alamos, New Mexico, September.

LANL (Los Alamos National Laboratory), 2004h, *LANL Investigation of a Laser Eye Injury*, Los Alamos, New Mexico (available at www.lanl.gov/news/index.php?fuseaction=home.story&story_id=5657&view=print), September 21.

LANL (Los Alamos National Laboratory), 2004i, *Findings, recommendations of laser incident investigation team presented at briefing*, Public Affairs Office, Los Alamos, New Mexico (available at www.lanl.gov/news/index.php?fuseaction=home.story&story_id=5896&view=print), November 18.

LANL (Los Alamos National Laboratory), 2004j, *LANL Master Construction Specifications*, Section 01560, Compliance Requirements, Rev 2, November 18.

LANL (Los Alamos National Laboratory), 2004k, *Environmental Division Performance Highlights*, Los Alamos, New Mexico, November 24.

LANL (Los Alamos National Laboratory), 2004l, *2004 Pollution Prevention Roadmap*, LA-UR-04-8973, Los Alamos, New Mexico, December.

LANL (Los Alamos National laboratory), 2004m, *Burn Severities, Fire Intensities, and Impacts to Major Vegetation Types from the Cerro Grande Fire*, LA-14159, Los Alamos, New Mexico, December.

LANL (Los Alamos National Laboratory), 2004n, "Memo Updates Work Force on Resumption of Operations," *Los Alamos National Laboratory News Bulletin* (accessed through www.lanl.gov/news/index.shtml), December 20.

LANL (Los Alamos National Laboratory), 2005a, *Siting Study for Los Alamos County Solid Waste Transfer Station*, Steven Booth, LA-UR-05-0338, Los Alamos, New Mexico, January.

LANL (Los Alamos National Laboratory), 2005b, *Site Screening Study for Los Alamos County Sanitary Landfill*, LA-UR-03-1349, Energy and Environmental Analysis (D-4) Infrastructure, Facilities, and Construction, Los Alamos, New Mexico, February.

LANL (Los Alamos National Laboratory), 2005c, *Los Alamos National Laboratory Storm Water Monitoring Plan*, Revision 1, LA-UR-05-2247, Environmental Stewardship Division, Los Alamos, New Mexico, March 31.

LANL (Los Alamos National Laboratory), 2005d, TRU Waste Processing Facility, INP Meeting Slide Presentation by Craig Bachmeier, PADNWP, May 18.

LANL (Los Alamos National Laboratory), 2005e, *Status Report for Integrated Closure Activities at Technical Area 54*, LA-UR-05-6767 (NWIS-DIV-REPORT-0202), NWIS-Division Office, Los Alamos, New Mexico, July.

LANL (Los Alamos National Laboratory), 2005f, *SWEIS Yearbook—2004, Comparison of 2004 Data Projections of the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, LA-UR-05-6627, Ecology Group, Los Alamos, New Mexico, August.

LANL (Los Alamos National Laboratory), 2005g, *Management Review Draft, Los Alamos National Laboratory Wildland Fire Management Plan*, LA-UR-05-0286, Los Alamos, New Mexico, September.

LANL (Los Alamos National Laboratory), 2005h, *Environmental Surveillance at Los Alamos during 2004*, LA-14239-ENV, September.

LANL (Los Alamos National Laboratory), 2005i, *Los Alamos National Laboratory's Hydrogeologic Studies of the Pajarito Plateau: A Synthesis of Hydrogeologic Workplan Activities (1998-2004)*, LA-14263-MS, Los Alamos, New Mexico, December.

LANL (Los Alamos National Laboratory), 2005j, *Water Quality and Stream Flow After the Cerro Grande Fire*, *A Summary*, LALP-05-009, Albuquerque, New Mexico.

LANL (Los Alamos National Laboratory), 2006a, *Los Alamos National Laboratory Site-Wide Environmental Impact Statement Information Document*, Data Call Materials, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 2006b, *Biological Assessment of the Continued Operation of Los Alamos National Laboratory on Federally Listed Threatened and Endangered Species*, LA-UR-06-6679, Ecology and Air Quality Group (ENV-EAQ), Los Alamos Site Office, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 2006c, "University of California and U.S. Department of Energy, NSR Air Quality Permit Nos. 2195-J and 2195-K," Letter from K. Hargis, Los Alamos National Laboratory and J. Ordaz, Los Alamos Site Office, to R. Goodyear, New Mexico Environment Department, Santa Fe, New Mexico, January 10.

LANL (Los Alamos National Laboratory), 2006d, *Interim Measures Work Plan for Chromium Contamination in Groundwater*, LA-UR-06-1961, Los Alamos, New Mexico, March.

LANL (Los Alamos National Laboratory), 2006e, *Storm Water Pollution Prevention Plan for SWMUs and AOCs (Sites) and Storm Water Monitoring Plan*, LA-UR-06-1840, Environmental Stewardship Division, Los Alamos, New Mexico, March.

LANL (Los Alamos National Laboratory), 2006f, *A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico*, LA-UR-04-8964, March.

LANL (Los Alamos National Laboratory), 2006g, *SWEIS Yearbook—2005, Comparison of 2005 Data Projections of the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, LA-UR-06-6020, Risk Reduction Office, Environmental Protection Division, Los Alamos, New Mexico, September.

LANL (Los Alamos National Laboratory), 2006h, *Environmental Surveillance at Los Alamos during 2005*, LA-14304-ENV, Environment and Remediation Support Services Division, Los Alamos, New Mexico, September.

LANL (Los Alamos National Laboratory), 2006i, *Emissions Inventory Report Summary for Los Alamos National Laboratory for Calendar Year 2005*, LA-14309-SR, Ecology and Air Quality Group, Los Alamos, New Mexico, September.

LANL (Los Alamos National Laboratory), 2006j, "WIPP shipment milestone highlights improved processes, productivity," *Los Alamos National Laboratory NewsLetter*, Week of October 23, 2006, Vol. 7, No. 22, Los Alamos, New Mexico, October 23.

LANL (Los Alamos National Laboratory), 2006k, *Interim Measures Investigation Report for Chromium Contamination in Groundwater*, LA-UR-06-8372, Los Alamos, New Mexico, November.

LANL (Los Alamos National Laboratory), 2006l, Los Alamos National Laboratory Transfer Map, LA-UR-06-8860, Land Transfer Project, Los Alamos, New Mexico, November 13.

LANL (Los Alamos National Laboratory), 2007a, *Update of the Probabilistic Seismic Hazard Analysis and Development of Seismic Design Ground Motions at the Los Alamos National Laboratory*, LA-UR-07-3965, Los Alamos, New Mexico, May.

LANL (Los Alamos National Laboratory), 2007b, Letter to J. Vozella, National Nuclear Security Administration, from R. McQuinn, Nuclear High Hazards Operations, Justification for Continued Operation, LANL Site-Wide Nuclear and High Hazard Operations, Reference No. AD-NHHO:07-145, Los Alamos, New Mexico, June 22.

LANL (Los Alamos National Laboratory), 2007c, *LANL Engineering Standards Manual*, ISD 341-2, Chapter 5 - Structural, Rev. 4, Los Alamos, New Mexico, June 19.

Lansford, R. R., L. D. Adcock, L. M. Gentry, and S. Ben-David, 1996, *The Economic Impact of Los Alamos National Laboratory on North-Central New Mexico and the State of New Mexico, Fiscal Year 1995*, U.S. Department of Energy, Albuquerque Operations Office, in cooperation with the University of New Mexico, Albuquerque, New Mexico, and New Mexico State University, Las Cruces, New Mexico, August.

Lenderman, A., 2005, *DOE Probes Another LANL Mishap*, "The New Mexican" (available at www.freenewmexican.com/news/31106.html), August 10.

Loftin, S. R., 2001, *A Biological Assessment of the Potential Effects of the Wildfire Hazard Reduction Project on Federally Listed Threatened and Endangered Species*, LA-UR-01-2253, Los Alamos National Laboratory, Los Alamos, New Mexico, May 3.

LSC (LSC Transportation Consultants, Inc.), 2004, *Average Weekday Traffic Counts, Figure 5 (Map)*, Colorado Springs, Colorado.

LSC (LSC Transportation Consultants, Inc.), 2005, *LANL Science Center Traffic Impact and Access Analysis*, November 15.

Malm, W. C., 1999, *Introduction to Visibility, Cooperative Institute for Research in the Atmosphere*, NPS Visibility Program, Colorado State University, Fort Collins, Colorado, May.

McKown, B., S. W. Koch, R. G. Balice, and P. Neville, 2003, *Land Cover Map for the Eastern Jemez Region*, LA-14029, Los Alamos National Laboratory, Los Alamos, New Mexico, June.

McLin, S. G., 1992, *Determination of 100-Year Floodplain Elevations at Los Alamos National Laboratory*, LA-12195-MS, Los Alamos National Laboratory, Los Alamos, New Mexico.

McLin, S. G., M. E. Van Eeckhout, and A. Earles, 2001, *Mapping 100-Year Floodplain Boundaries Following the Cerro Grande Wildfire*, LA-UR-01-5218, Los Alamos National Laboratory, Los Alamos, New Mexico.

NCI (National Cancer Institute), 2006, *NCI State Cancer Profiles* (available at http://statecancerprofiles.cancer.gov/index.html), November 10.

NCSA (National Center for Statistics and Analysis of the National Highway Traffic Safety Administration), 2006, *Traffic Safety Facts 2004, A Compilation of Motor Vehicle Crash Data from the Fatality Analysis Reporting System and the General Estimates System*, U.S. Department of Transportation, Washington, DC, January.

NEI (Nuclear Energy Institute), 2005, Renewal of Price-Anderson Act, Frequently Asked Questions (available at www.nei.org).

Neuhauser, K. S., and F. L. Kanipe, 2003, *RADTRAN 5 User Guide*, revised by R. F. Weiner SAND2003-2354, Sandia National Laboratories, Albuquerque, New Mexico (accessed through http://ttd.sandia.gov/risk/doc_list.htm), July.

Newman, D., 2006, "Water deal inked," *Los Alamos Monitor* (accessed at www.lamonitor.com/articles/2006/09/20/headline_news/news03.txt), September 20.

NMAC 19.21.2 (New Mexico Administrative Code, Title 19, Chapter 21, Part 2), "Endangered Plant Species List and Collection Permits," Energy Minerals and Natural Resource Department, Forestry and Resources Conservation Division.

NMAC 20.6.2 (New Mexico Administrative Code, Title 20, Chapter 6, Part 2), "Ground and Surface Water Protection," Water Quality Control Commission.

NMAC 20.6.4 (New Mexico Administrative Code, Title 20, Chapter 6, Part 4), "Standards for Interstate and Intrastate Surface Waters," Water Quality Control Commission.

NMAC 20.9.1 (New Mexico Administrative Code, Title 20, Chapter 9, Part 1), "Solid Waste Management Regulations," effective November 30.

NMAQB (New Mexico Air Quality Bureau), 2003, *Dispersion Modeling Guidelines*, July.

NMDGF (New Mexico Department of Game and Fish), 2004a, *Threatened and Endangered Species of New Mexico*, Santa Fe, New Mexico, (available at www.wildlife.state.nm.us/conservation/threatened_endangered_species/index.tm), November 30.

NMDGF (New Mexico Department of Game and Fish), 2004b, *New Mexico Species of Concern*, Santa Fe, New Mexico (available at www.wildlife.state.nm.us/conservation/share_with_wildlife/documents/speciesofconcern.pdf), December 2.

NMDOE (New Mexico Department of Education), 2002, Total Student Enrollment By District School Year 2000-2001, Data Collection and Reporting Unit, updated August 14.

NMDOL (New Mexico Department of Labor), 2005, *New Mexico Department of Labor, Economic Research and Analysis Table A - Civilian Labor Force, Employment, Unemployment and Unemployment Rate 2004*, Santa Fe, New Mexico (available at www.dol.state.nm.us/data.htm).

NMDOL (New Mexico Department of Labor), 2006a, "Table A - Civilian Labor Force, Employment, Unemployment and Unemployment Rate 2005," Economic Research and Analysis Bureau, Albuquerque, New Mexico, February 28.

NMDOL (New Mexico Department of Labor), 2006b, "Table D - Quarterly Census of Employment Annual Averages 2001-2005," Economic Research and Analysis Bureau, Albuquerque, New Mexico, February 28.

NMDOT (New Mexico Department of Transportation), 2001, *New Mexico Traffic Crash Information 1999*, New Mexico State Highway and Transportation Department, Transportation Programs Division, Traffic Safety Bureau, Santa Fe, New Mexico, March.

NMDOT (New Mexico Department of Transportation), 2002, *New Mexico Traffic Crash Information 2000*, New Mexico State Highway and Transportation Department, Transportation Programs Division, Traffic Safety Bureau, Santa Fe, New Mexico, March.

NMDOT (New Mexico Department of Transportation), 2003, *New Mexico Traffic Crash Information 2001*, New Mexico State Highway and Transportation Department, Transportation Programs Division, Traffic Safety Bureau, Santa Fe, New Mexico, January.

NMDOT (New Mexico Department of Transportation), 2004, *New Mexico Traffic Crash Information 2002*, New Mexico State Highway and Transportation Department, Transportation Programs Division, Traffic Safety Bureau, Santa Fe, New Mexico, February.

NMDOT (New Mexico Department of Transportation), 2005a, *New Mexico Traffic Crash Information 2003*, New Mexico State Highway and Transportation Department, Transportation Programs Division, Traffic Safety Bureau, Santa Fe, New Mexico, March.

NMDOT (New Mexico Department of Transportation), 2005b, *All Aboard America Ridership Data for October 24-28, 2005*, Santa Fe, New Mexico, e-mail from G. White, November 2.

NMDOT (New Mexico Department of Transportation), 2006, *New Mexico Traffic Crash Information 2004*, New Mexico State Highway and Transportation Department, Transportation Programs Division, Traffic Safety Bureau, Santa Fe, New Mexico, March.

NMDOT (New Mexico Department of Transportation), 2007, *NMDOT Projects, Road Construction Projects* (accessed January 18, 2008, http://nmshtd.state.nm.us/ mainpage.asp?Page=11531).

NMED (New Mexico Environmental Department), 2004a, *2004-2006 State of New Mexico Integrated Clean Water Act §303(d) §305(b) Report*, Appendix B: 303(d)/305(b) Integrated List for Assessed Surface Waters, Surface Water Quality Bureau, Santa Fe, New Mexico (available at www.nmenv.state.nm.us/wqcc/303d-305b/2004/AppendixB/index.html).

NMED (New Mexico Environment Department), 2004b, Operating Permit No: P100, Air Quality Bureau, Santa Fe, New Mexico, April.

NMED (New Mexico Environment Department), 2005, Compliance Order on Consent, Proceeding Under the New Mexico Hazardous Waste Act §74-4-10 and the New Mexico Solid Waste Act §74-9-36(D), March 1.

NMED (New Mexico Environment Department), 2006a, Operating Permit No. P100M1, Air Quality Bureau, Santa Fe, New Mexico, June 15.

NMED (New Mexico Environment Department), 2006b, *2006 New Mexico Solid Waste Annual Report*, Solid Waste Bureau, Santa Fe, New Mexico, July.

NMED (New Mexico Environment Department), 2007a, News Release: "Environment Department Completes Construction of Groundwater Remediation System for Superfund Site in Espanola", Santa Fe, New Mexico, May 1.

NMED (New Mexico Environment Department), 2007b, Factsheet Statement of Basis: Selection of a Remedy for Corrective Action at Material Disposal Area H, SWMU-004, at Technical Area 54, Los Alamos National Laboratory, Los Alamos New Mexico, EPA ID No. NM08990010515, Santa Fe, New Mexico, November 5.

NMNHP (New Mexico Natural Heritage Program), 2004, *NMNHP Tracking List* (available at http://nmnhp,unm,edu/tracking/tracking_results,php?output=html), November 30.

NMPED (New Mexico Public Education Department), 2006, Total Student Enrollment By District School Year 2005-2006, Data Collection and Reporting Bureau, January 12.

NMSF (New Mexico State Forestry), 2004, *Endangered Plant Protection, Agency Status of New Mexico Rare Plants* (available at www.emnrd.state.nm.us/forestry/olpages/endanger.cfm), December 3.

NNSA (National Nuclear Security Administration), 2001, *Environmental Assessment for Construction and Operation of a New Office Building and Related Structures within TA-3 at Los Alamos National Laboratory, Los Alamos, New Mexico*, NNSA/EA-1375, Los Alamos Area Office, Los Alamos, New Mexico, July 26.

NNSA (National Nuclear Security Administration), 2003, *Type B Accident Investigation of the August 5, 2003 Plutonium-238 Multiple Uptake Event at the Plutonium Facility, Los Alamos National Laboratory, New Mexico*, Washington, DC, December.

NNSA (National Nuclear Security Administration), 2004a, *NEPA Compliance Review for Proposed Modifications to the Security Perimeter Project at Los Alamos National Laboratory*, Los Alamos, New Mexico, March 9.

NNSA (National Nuclear Security Administration), 2004b, *Update on Multi-Sector General Storm Water Permit NMED Order and FFCA/AO Requirements*, PowerPoint Presentation by NNSA, Los Alamos Site Office, Los Alamos, New Mexico, March 16.

NNSA (National Nuclear Security Administration), 2004c, *Transitioning from Regulating Storm Water Discharges from SWMUs Under the MSGP to an Individual Permit at LANL through a FFCA*, Presentation by S. Veenis, CAB Briefing, November 17.

NNSA (National Nuclear Security Administration), 2005a, *NEPA Compliance Review Addendum for Proposed Modifications to the Security Perimeter Project at Los Alamos National Laboratory*, Los Alamos New Mexico, April 12.

NNSA (National Nuclear Security Administration), 2005b, *NEPA Compliance Review – DOE/EA 1409 for Modifications to the Proposed Project Analyzed in the Environmental Assessment for the Proposed Issuance of an Easement to Public Service Company of New Mexico for the Construction and Operation of a 12-inch Natural Gas Pipeline within Los Alamos National Laboratory, Los Alamos, New Mexico*, Los Alamos Site Office, Los Alamos, New Mexico, August 10.

NNSA (National Nuclear Security Administration), 2006a, Letter from L. Brooks, National Nuclear Security Administration, to A. Makhijani, Institute for Energy and Environmental Research, Response to "Accounting Discrepancy of Plutonium at LANL", February 28.

NNSA (National Nuclear Security Administration), 2006b, *Complex 2030, An Infrastructure Planning Scenario for a Nuclear Weapons Complex Able to Meet the Threats of the 21st Century*, DOE/NA-0013, Office of Defense Programs, Washington, DC, October.

NNSA (National Nuclear Security Administration), 2006c, Fact Sheet, "Myth vs. Fact: The Truth about Plutonium Aging" (accessed August 7, 2007, www.nnsa.doe.gov/docs/factsheets/2006/NA-06-FS-08A.pdf), Washington, DC, December.

NNSA (National Nuclear Security Administration), 2007a, *Report on the Plan for Transformation of the National Nuclear Security Administration Nuclear Weapons Complex*, Office of Transformation, Washington, DC, January 31.

NNSA (National Nuclear Security Administration), 2007b, Chemistry and Metallurgy Research Building Replacement Project, Senate Report (109-274), Washington, DC, May.

NNSA (National Nuclear Security Administration), 2007c, Memorandum to R. McQuinn, Nuclear and High Hazards Operations, from D. Winchell, Los Alamos Site Office, Response to Justification for Continued Operations Related to Seismic Hazards Assessment, Los Alamos, New Mexico, July 31.

NPS (National Park Service), 2005a, *Geology of Bandelier National Monument*, U.S. Department of the Interior, Water Resources Division (available at www2.nature.nps.gov/geology/parks/band.htm), January.

NPS (National Park Service), 2005b, *Fire Management Plan for Bandelier National Monument*, National Park Service.

NRCS (Natural Resources Conservation Service), 2004, Natural Resources Reporter. Natural Resources Conservation Service, U.S. Department of Agriculture, Albuquerque, New Mexico, Winter 2004.

Nylander, C. L., K. A. Bitner, G. Cole, E. H. Keating, S. Kinkead, P. Longmire, B. Robinson, D. B. Rogers, and D. Vaniman, 2003, *Groundwater Annual Status Report For Fiscal Year 2002*, LA-UR-03-0244, GPP-03-011, Los Alamos National Laboratory, Los Alamos, New Mexico.

Pfeil, J., A. Leavitt, M. Wilks, S. Azevedo, L. Hemenway, K. Glesener, and J. Barker, 2001, *Mines, Mills and Quarries in New Mexico 2001*, Mining and Minerals Division, New Mexico Energy, Minerals and Natural Resources Division, and New Mexico Bureau of Geology and Mineral Resources, New Mexico Institute of Mining and Technology, New Mexico.

Phillips, J. S., D. B. Clauss, and D. F. Blower, 1994, *Determination of Influence Factors and Accident Rates for the Armored Tractor/Safe Secure Trailer*, SAND93-0111, Sandia National Laboratories, Albuquerque, New Mexico, April.

Pino, R., 2006, *Interview Record – Future Actions for Cumulative Impacts*, Mora County, Planning and Zoning, Personal communication with Courtney Brandenburg, Science Applications International Corporation, January 18.

PNM, 2005, Public Invited to Comment on PNM Electric Transmission Line Routes (accessed at www.pnm.com/news/2005/0204_sfe.html), February 4.

PNM Resources, 2006, *2005 Sustainability Report*, Albuquerque, New Mexico.

Presbyterian, 2006, Española Hospital Page (accessed at www.phs.org/facilities/espanola/index.shtml), March 10.

PSCNM (Public Service Company of New Mexico), 2006, *Renewable Energy Portfolio Procurement Plan for 2007*, Filed Pursuant to 17.9.572 NMAC, Albuquerque, New Mexico, August 16.

RAC (Risk Assessment Corporation), 2002, *Analysis of Exposure and Risks to the Public from Radionuclides and Chemicals Released by the Cerro Grande Fire at Los Alamos,* Summary Report, New Mexico Environment Department, RAC Report No. 5-NMED-2002-FINAL, June.

Reclamation (U.S. Bureau of Reclamation), 2004, *City of Albuquerque Drinking Water Project Final Environmental Impact Statement,* Bureau of Reclamation, U.S. Department of the Interior, and City of Albuquerque. Albuquerque, New Mexico. March.

Robinson, B. A., D. E. Broxton, and D. T. Vaniman, 2004, *Observations and Modeling of Deep Perched Water Beneath the Pajarito Plateau*, Vadose Zone Journal, Vol. 4, p. 637-652.

Saricks, C., and M. M. Tompkins, 1999, *State-Level Accident Rates of Surface Freight Transportation: A Reexamination*, ANL/ESD/TM-150, Center for Transportation Research, Argonne National Laboratory, Argonne, Illinois, April.

Scales, M., 2006, *Interview Record – Future Actions for Cumulative Impacts,* Sandoval County, Planning and Zoning, Personal communication with Courtney Brandenburg, Science Applications International Corporation, January 9.

Schaull, D. A., D. Ortiz, M. R. Alexander, and R. P. Romero, 2004, *Surface Water Data at Los Alamos National Laboratory, 2003 Water Year,* LA-14131-PR, Los Alamos National Laboratory, Los Alamos, New Mexico, March.

Sherwood, S., J. Biggs, and L. Hansen, 2004, *Summary of Animal-Vehicle Collisions in Los Alamos County, 1990-2004*, RRES-Ecology Group, Los Alamos National Laboratory, Los Alamos, New Mexico, October.

SNL (Sandia National Laboratories), 2006, *Annual Site Environmental Report for Sandia National Laboratories, New Mexico*, Calendar Year 2005, SAND2006-4506P, Albuquerque, New Mexico, September.

Snodgrass, R., 2006, "Chromium source traced," in *Lamonitor.com* (accessed January 11, 2006, www.lamonitor.com/articles/2006/01/08/headline_news/news02.prt).

St. Vincent (St. Vincent Regional Medical Center), 2006, About Us Page (accessed at www.stvin.org), March 10.

Stephens (Daniel B. Stephens & Associates, Inc.), 2006, *Long-Range Water Supply Plan, Los Alamos County*, Albuquerque, New Mexico, August.

Stephens and Associates, 2005, *Borrow Source Survey for Evapotranspiration Covers at Los Alamos National Laboratory (Draft),* Prepared for Shaw Environmental, Inc., Los Alamos, New Mexico, January 18.

Tafoya, A., 2006, *Interview Record – Future Actions for Cumulative Impacts,* San Miguel County, Planning and Zoning, Personal communication with Courtney Brandenburg, Science Applications International Corporation, January 18.

TransCore, 2001, *Long Range Major Transportation Investment Study*, North Central Region, Final Report, No. 2300047, Albuquerque, New Mexico, July.

Trujillo, T., 2006, *Interview Record – Future Actions for Cumulative Impacts,* Taos County, Planning, Personal communication with C. Brandenburg, Science Applications International Corporation, January 9.

USFS (U.S. Forest Service), 2005a, *Record of Decision for Invasive Plant Control Project Carson and Santa Fe National Forests in Colfax, Los Alamos, Mora, Rio Arriba, San Miguel, Santa Fe, Sandoval, and Taos Counties, New Mexico*, Forest Service, U.S. Department of Agriculture, September.

USFS (U.S. Forest Service), 2005b, Santa Fe National Forest, Projects & Plans (accessed on February 15, 2006, www.fs.fed.us/r3/sfe/projects/projects/index.html), November 30.

USFS (U.S. Forest Service), 2006, "Schedule of Proposed Action (SOPA), 01/01/2006 to 03/31/2006, Santa Fe National Forest," Forest Service, U.S. Department of Agriculture, (accessed February 15, 2006, www.fs.fed.us/r3/sfe/projects/projects/index.html).

USFWS (U.S. Fish and Wildlife Service), 2002, *Birds of Conservation Concern, 2002*, (Table 42, USFWS Region 2 (Southwest Region) BCC 2002 List), Division of Migratory Bird Management, Arlington, Virginia (available at http://migratorybirds.fws.gov/reports/BCC2002.pdf), December.

USFWS (U.S. Fish and Wildlife Service), 2004a, *The Endangered Species Program* (available at http://endangered.fws.gov), December 1.

USFWS (U.S. Fish and Wildlife Service), 2004b, *Proposed and Candidate Species as of 12/02/2004* (available at http://ecos.fws.gov/tess_public/TESSWebpageNonlisted?listings=0&type=both), December 2.

Valles Caldera Trust, 2005, *Valles Caldera National Preserve*, Los Alamos, New Mexico (available at www.vallescaldera.gov/index.aspx), October 18.

WAPA (Western Area Power Administration), 2006, *Infrastructure Maintenance and Upgrades* (accessed at www.wapa.gov/transmission/infrastructure.htm), February 15.

Webb, D., and K. Carpenter, 2001, *The Cerro Grande Fire, Los Alamos New Mexico*, LA-UR-01-1630, Los Alamos National Laboratory, Los Alamos, New Mexico, March 26.

Yuan, Y. C., S. Y. Chen, B. M. Biwer, and D. J. LePoire, 1995, *RISKIND - A Computer Program for Calculating Radiological Consequences and Health Risks from Transportation of Spent Nuclear Fuel*, ANL/EAD-1, Argonne National Laboratory, Argonne, Illinois, November.

CHAPTER 8
GLOSSARY

8.0 GLOSSARY

absorbed dose—For ionizing radiation, the energy imparted to matter by ionizing radiation per unit mass of the irradiated material (such as biological tissue). The units of absorbed dose are the rad and the gray. (See rad and gray.)

accident sequence—With regard to nuclear facilities, an initiating event followed by system failures or operator errors, which can result in significant core damage, confinement system failure, and/or radionuclide releases.

actinide—Any member of the group of elements with atomic numbers from 89 (actinium) to 103 (lawrencium) including uranium and plutonium. All members of this group are radioactive.

activation products—Nuclei, usually radioactive, formed by the bombardment and absorption in material with neutrons, protons, or other nuclear particles.

administrative control level—A dose level that is established well below the regulatory limit to administratively control and help reduce individual and collective radiation doses. Facility management should establish an annual facility administrative control level that should, to the extent feasible, be more restrictive than the more general administrative control level.

air pollutant—Generally, an airborne substance that could, in high enough concentrations, harm living things or cause damage to materials. From a regulatory perspective, an air pollutant is a substance for which emissions or atmospheric concentrations are regulated, or for which maximum guideline levels have been established because of potential harmful effects on human health and welfare.

air quality control region—Geographic subdivisions of the United States, designed to deal with pollution on a regional or local level. Some regions span more than one state.

alluvium—Sediment deposited by flowing water, as in a riverbed, flood plain, or delta.

alpha activity—The emission of alpha particles by radioactive materials.

alpha particle—A positively charged particle ejected spontaneously from the nuclei of some radioactive elements. It is identical to a helium nucleus and has a mass number of 4 and an electrostatic charge of +2. It has low penetrating power and a short range (a few centimeters in air). (See alpha radiation.)

alpha radiation—A strongly ionizing, but weakly penetrating, form of radiation consisting of positively charged alpha particles emitted spontaneously from the nuclei of certain elements during radioactive decay. Alpha radiation is the least penetrating of the three common types of ionizing radiation (alpha, beta, and gamma). Even the most energetic alpha particle generally fails to penetrate the dead layers of cells covering the skin and can be easily stopped by a sheet of paper. Alpha radiation is most hazardous when an alpha-emitting source resides inside an organism. (See alpha particle.)

ambient—Surrounding.

ambient air—The surrounding atmosphere as it exists around people, plants, and structures.

ambient air quality standards—The level of pollutants in the air prescribed by regulations that may not be exceeded during a specified time in a defined area. Air quality standards are used to provide a measure of the health-related and visual characteristics of the air.

analytical chemistry—The branch of chemistry that deals with the separation, identification, and determination of the components of a sample.

aquatic—Living or growing in, on, or near water.

aquifer—An underground geological formation, group of formations, or part of a formation that is capable of yielding a significant amount of water to wells or springs.

archaeological sites (resources)—Any location where humans have altered the terrain or discarded artifacts during either prehistoric or historic times.

Area of Concern (AOC)—Any area that may have had a release of a hazardous waste or hazardous constituent, which is not a Solid Waste Management Unit.

artifact—An object produced or shaped by human workmanship of archaeological or historical interest.

as low as is reasonably achievable (ALARA)—An approach to radiation protection to manage and control worker and public exposures (both individual and collective) and releases of radioactive material to the environment to as far below applicable limits as social, technical, economic, practical, and public policy considerations permit. ALARA is not a dose limit but a process for minimizing doses to as far below limits as is practicable.

atmospheric dispersion—The process of air pollutants being dispersed in the atmosphere. This occurs by the wind that carries the pollutants away from their source, by turbulent air motion that results from solar heating of the Earth's surface, and air movement over rough terrain and surfaces.

Atomic Energy Act—A law originally enacted in 1946 and replaced in 1954 that placed nuclear production and control of nuclear materials within a civilian agency, originally the Atomic Energy Commission. The functions of the Atomic Energy Commission were replaced by the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy.

Atomic Energy Commission—A five-member commission, established by the Atomic Energy Act of 1946, to supervise nuclear weapons design, development, manufacturing, maintenance, modification, and dismantlement. In 1974, the Atomic Energy Commission was abolished, and all functions were transferred to the Nuclear Regulatory Commission and the Administrator of the Energy Research and Development Administration. The Energy Research and Development Administration was later terminated, and functions vested by law in the Administrator were transferred to the Secretary of Energy.

atomic number—The number of positively charged protons in the nucleus of an atom or the number of electrons on an electrically neutral atom.

attainment area—An area that the U.S. Environmental Protection Agency has designated as being in compliance with one or more of the National Ambient Air Quality Standards for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants but not for others. (See National Ambient Air Quality Standards, nonattainment area, and particulate matter.)

attractiveness level—A categorization of nuclear material types and compositions that reflects the relative ease of processing and handling required to convert that material to a nuclear explosive device.

backfill—The replacement of excavated earth or other material into an open trench, cavity, or other opening in the earth.

background radiation—Radiation from (1) cosmic sources, (2) naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material), and (3) global fallout as it exists in the environment (such as from the testing of nuclear explosive devices).

barrier—Any material or structure that prevents or substantially delays movement of pollutants or materials containing radionuclides toward the accessible environment.

basalt—The most common volcanic rock, dark gray to black in color, high in iron and magnesium and low in silica. It is typically found in lava flows.

baseline—The existing environmental conditions against which impacts of the Proposed Action and its alternatives can be compared. The environmental baseline is the site environmental conditions as they exist or are estimated to exist in the absence of the Proposed Action.

basin—Geologically, a circular or elliptical downwarp or depression in the Earth's surface that collects sediment. Younger sedimentary beds occur in the center of basins. Topographically, a depression into which water from the surrounding area drains.

becquerel—A unit of radioactivity equal to one disintegration per second. Thirty-seven billion becquerels is equal to 1 curie.

bedrock—The solid rock that lies beneath soil and other loose surface materials.

BEIR VII—Biological Effects of Ionizing Radiation; referring to the seventh in a series of committee reports from the National Research Council.

benthic—Plants and animals dwelling at the bottom of oceans, lakes, rivers, and other surface waters.

beryllium—An extremely light-weight element with the atomic number 4. It is metallic and is used in reactors as a neutron reflector.

best management practices—Structural, nonstructural, and managerial techniques, other than effluent limitations, to prevent or reduce pollution of surface water. They are the most effective and practical means to control pollutants that are compatible with the productive use of the resource to which they are applied. Best Management Practices are used in both urban and agricultural areas. Best Management Practices can include schedules of activities; prohibitions of practices; maintenance procedures; treatment requirements; operating procedures; and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

beta particle—A particle emitted in the radioactive decay of many radionuclides. A beta particle is identical to an electron. It has a short range in air and a small ability to penetrate other materials.

biomimetic—Imitating, copying, or learning from nature.

biota (biotic)—The plant and animal life of a region (pertaining to biota).

block—U.S. Bureau of the Census term describing small areas bounded on all sides by visible features or political boundaries; used in tabulation of census data.

boron-10—An isotope of the element boron that has a high capture cross section for neutrons. It is used in reactor absorber rods for reactor control.

borrow—Excavated material that has been taken from one area to be used as raw material or fill at another location.

bound—To use simplifying assumptions and analytical methods in analyzing potential impacts or risks such that the result provides an overestimate or upper limit that “bounds” the potential impacts or risks.

bounded—Producing the greatest consequences of any assessment of impacts associated with normal or abnormal operations.

Breccia—Rock composed of sharp-angled fragments embedded in a fine-grained matrix.

burial ground—In regard to radioactive waste, a place for burying unwanted radioactive materials in which the earth acts as a receptacle to prevent the escape of radiation and the dispersion of waste into the environment.

cancer—The name given to a group of diseases characterized by uncontrolled cellular growth, with cells having invasive characteristics such that the disease can transfer from one organ to another.

canister—A general term for a container, usually cylindrical, used in handling, storage, transportation, or disposal of waste.

capable fault—A fault that has exhibited one or more of the following characteristics: (1) movement at or near the ground surface at least once within the past 35,000 years, or movement of a recurring nature within the past 500,000 years; (2) macro-seismicity instrumentally determined with records of sufficient precision to demonstrate a direct relationship with the fault; (3) a structural relationship to a capable fault according to characteristic (1) or (2) above, such that movement on one could be reasonably expected to be accompanied by movement on the other.

carbon dioxide—A colorless, odorless gas that is a normal component of ambient air; it results from fossil fuel combustion, and is an expiration product.

carbon monoxide—A colorless, odorless, poisonous gas produced by incomplete fossil fuel combustion.

carcinogen—An agent that may cause cancer. Ionizing radiation is a physical carcinogen; there are also chemical and biological carcinogens, and biological carcinogens may be external (such as viruses) or internal (such as genetic defects).

cask—A heavily shielded container used to store or ship radioactive materials.

categories of special nuclear material (Categories I, II, III, and IV)—A designation determined by the quantity and type of special nuclear material or a designation of a special nuclear material location based on the type and form of the material and the amount of nuclear material present. A designation of the significance of special nuclear material based upon the material type, form of the material, and amount of material present in an item, grouping of items, or in a location

cation—A positively charged ion.

cavate—Consists of a room carved into a cliff face within the Bandelier Tuff geological formation. The category includes isolated cavates, multi-roomed contiguous cavates, and groups of adjacent cavates that together form a cluster or complex.

cell—See hot cell.

chain reaction—A reaction that initiates its own repetition. In nuclear fission, a chain reaction occurs when a neutron induces a nucleus to fission and the fissioning nucleus releases one or more neutrons which induce other nuclei to fission.

chemical wastes—Defined as hazardous waste (designated under the Resource Conservation and Recovery Act regulations); toxic waste (asbestos and polychlorinated biphenyls, designated under the Toxic Substances Control Act); and special waste (designated under the New Mexico Solid Waste Regulations and including industrial waste, infectious waste, and petroleum contaminated soils). In the past, LANL tracking efforts for chemical waste included construction and demolition debris and all other non-radioactive waste that managed through the Solid Chemical and Radioactive Waste Facilities. For waste projections in this SWEIS, construction and demolition debris are presented as a separate categories.

classified information—(1) Information that has been determined pursuant to Executive Order 12958, any successor order, or the Atomic Energy Act of 1954 (42 U.S.C. 2011) to require protection against unauthorized disclosure; (2) certain information requiring protection against unauthorized disclosure in the interest of national defense and security or foreign relations of the United States pursuant to Federal statute or Executive Order.

clay—The name for a family of finely crystalline sheet silicate minerals that commonly form as a product of rock weathering. Also, any particle smaller than or equal to about 0.002 millimeters (0.00008 inches) in diameter.

Clean Air Act—This Act mandates and provides for enforcement of regulations to control air pollution from various sources.

Clean Water Act of 1972, 1987—This Act regulates the discharge of pollutants from a point source into navigable waters of the United States in compliance with a National Pollutant Discharge Elimination System permit, and regulates discharges to or dredging of wetlands.

***Code of Federal Regulations* (CFR)—**All Federal regulations in effect are published in codified form in the CFR. References to the CFR usually take the form of XX CFR Part YY, where XX refers to Title (major division) and YY refers to Part (section).

collective dose—The sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation. Collective dose is expressed in units of person-rem or person-sievert.

colluvium (colluvial)—A loose deposit of rock debris accumulated at the base of a cliff or slope.

committed dose equivalent—The dose equivalent to organs or tissues that will be received by an individual during the 50-year period following the intake of radioactive material. It does not include contributions from radiation sources external to the body. Committed dose equivalent is expressed in units of rems or sieverts.

committed effective dose equivalent—The dose value obtained by—(1) multiplying the committed dose equivalents for the organs or tissues that are irradiated and the weighting factors applicable to those organs or tissues, and (2) summing all the resulting products. Committed effective dose equivalent is expressed in units of rem or sievert. (See committed dose equivalent and weighting factor.)

community (biotic)—All plants and animals occupying a specific area under relatively similar conditions.

community (environmental justice definition)—A group of people or a site within a spatial scope exposed to risks that potentially threaten health, ecology, or land values; or are exposed to industry that stimulates unwanted noise, smell, industrial traffic, particulate matter, or other nonaesthetic impacts.

Compliance Order on Consent (Consent Order)—An enforcement document signed by the New Mexico Environment Department, the U.S. Department of Energy, and the Regents of the University of California on March 1, 2005, which prescribes the requirements for corrective action at Los Alamos National Laboratory. The purposes of the Consent Order are (1) to define the nature and extent of releases of contaminants at, or from, the facility; (2) to identify and evaluate, where needed, alternatives for corrective measures to clean up contaminants in the environment and prevent or mitigate the migration of contaminants at, or from, the facility; and (3) to implement such corrective measures. The Consent Order supersedes the corrective action requirements previously specified in Module VIII of the LANL Hazardous Waste Facility Permit.

conformity—Conformity is defined in the Clean Air Act as the action's compliance with an implementation plan's purpose of eliminating or reducing the severity and number of violations of the National Ambient Air Quality Standards, and achieving expeditious attainment of such standards; and that such activities will not: (1) cause or contribute to any new violation of any standard in any area; (2) increase the frequency or severity of any existing violation of any standard in any area; or (3) delay timely attainment of any standard or any required interim emission reduction, or other milestones in any area.

contact-handled waste—Radioactive waste or waste packages whose external dose rate is low enough to permit contact handling by humans during normal waste management activities, (such as waste with a surface dose rate not greater than 200 millirem per hour). (See remote-handled waste.)

container—With regard to radioactive wastes, the metal envelope in the waste package that provides the primary containment function of the waste package.

contamination—The deposition of undesirable radioactive material on the surfaces of structures, areas, objects, or personnel.

control rod—A rod containing material such as boron that is used to control the power of a nuclear reactor. By absorbing excess neutrons, a control rod prevents the neutrons from causing further fissions that would increase power generation.

coolant—A substance, either gas or liquid, circulated through a nuclear reactor or processing plant to remove heat.

criteria pollutants—An air pollutant that is regulated by National Ambient Air Quality Standards. The U.S. Environmental Protection Agency must describe the characteristics and potential health and welfare effects that form the basis for setting, or revising, the standard for each regulated pollutant. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter, less than or equal to 10 micrometers (0.0004 inch) in diameter, and less than or equal to 2.5 micrometers (0.0001 inch) in diameter. New pollutants may be added to, or removed from, the list of criteria pollutants as more information becomes available. (See National Ambient Air Quality Standards.)

critical assembly—A critical assembly is a system of fissile material (uranium-233, uranium-235, plutonium-239, or plutonium-241) with or without a moderator in a specific proportion and shape. The critical assembly can be gradually built up by adding additional fissile material and/or moderator until this system achieves the dimensions necessary for a criticality condition. A continuous neutron source is placed at the center of this assembly to measure the fission rate of the critical assembly as it approaches and reaches criticality.

critical habitat—Habitat essential to the conservation of an endangered or threatened species that has been designated as critical by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures outlined in the Endangered Species Act and its implementing regulations (50 CFR Part 424). The lists of Critical Habitats can be found in 50 CFR 17.95 (fish and wildlife), 50 CFR 17.96 (plants), and 50 CFR Part 226 (marine species). (See endangered species and threatened species.)

critical mass—The smallest mass of fissionable material that will support a self-sustaining nuclear chain reaction.

criticality—The condition in which a system is capable of sustaining a nuclear chain reaction.

cultural resources—Archaeological materials (artifacts) and sites that date to the prehistoric, historic, and ethnohistoric periods and that are currently located on the ground surface or buried beneath it; standing structures and/or their component parts that are over 50 years of age and are important because they represent a major historical theme or era, including the Manhattan Project and the Cold War era and structures that have an important technological, architectural, or local significance; cultural and natural places, select natural resources, and sacred objects that have importance for American Indians; American folklife traditions and arts; "historic properties" as defined in the National Historic Preservation Act; "archaeological resource" as defined in the Archaeological Resources Protection Act; and "cultural items" as defined in the Native American Graves Protection and Repatriation Act.

cumulative impacts—The impacts on the environment that result from the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions, regardless of the agency or person who undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

curie—A unit of radioactivity equal to 37 billion disintegrations per second (37 billion becquerels); also a quantity of any radionuclide or mixture of radionuclides having 1 curie of radioactivity.

deactivation—The placement of a facility in a radiologically and industrially safe shutdown condition that is suitable for a long-term surveillance and maintenance phase prior to final decontamination and decommissioning.

decay (radioactive)—The decrease in the amount of any radioactive material with the passage of time due to spontaneous nuclear disintegration (the emission from atomic nuclei of charged particles, photons, or both).

decibel (dB)—A unit for expressing the relative intensity of sounds on a logarithmic scale where 0 is below human perception and 130 is above the threshold of pain to humans. For traffic and industrial noise measurements, the A-weighted decibel, a frequency-weighted noise unit, is widely used. The A-weighted decibel scale corresponds approximately to the frequency response of the human ear and thus correlates well with loudness.

decibel, A-weighted (dBA)—A unit of frequency-weighted sound pressure level, measured by the use of a metering characteristic and the "A" weighting specified by the American National Standards Institution (ANSI S1.4-1983 [R1594]) that accounts for the frequency response of the human ear.

decommissioning—Retirement of a facility, including any necessary decontamination and dismantlement.

decontamination—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 or chemical contamination, from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

decontamination, decommissioning, and demolition (DD&D) – actions taken at the end of the useful life of a building or structure to reduce or remove substances that pose a substantial hazard to human health or the environment, retire it from service, and ultimately eliminate all or a portion of the structure.

degrees C (degrees Celsius)—A unit for measuring temperature using the centigrade scale in which the freezing point of water is 0 degrees and the boiling point is 100 degrees.

degrees F (degrees Fahrenheit)—A unit for measuring temperature using the Fahrenheit scale in which the freezing point of water is 32 degrees and the boiling point is 212 degrees.

depleted uranium—Uranium whose content of the fissile isotope uranium-235 is less than the 0.7 percent (by weight) found in natural uranium, so that it contains more uranium-238 than natural uranium. (See enriched uranium, highly enriched uranium, natural uranium, low-enriched uranium, and uranium.)

deposition—In geology, the laying down of potential rock-forming materials; sedimentation. In atmospheric transport, the settling on ground and building surfaces of atmospheric aerosols and particles ("dry deposition") or their removal from the air to the ground by precipitation ("wet deposition" or "rainout").

design basis—For nuclear facilities, information that identifies the specific functions to be performed by a structure, system, or component, and the specific values (or ranges of values) chosen for controlling parameters for reference bounds for design. These values may be: (1) restraints derived from generally accepted state-of-the-art practices for achieving functional goals; (2) requirements derived from analysis (based on calculation and/or experiments) of the effects of a postulated accident for which a structure, system, or component must meet its functional goals; or (3) requirements derived from Federal safety objectives, principles, goals, or requirements.

dewatering—The removal of water. Saturated soils are "dewatered" to make construction of building foundations easier.

discharge—In surface water hydrology, the amount of water issuing from a spring or in a stream that passes a specific point in a given period of time.

disposition—The ultimate "fate" or end use of a surplus U.S. Department of Energy facility following the transfer of the facility to the Office of the Assistant Secretary for Environmental Management.

diversion—The unauthorized removal of nuclear material from its approved use or authorized location.

DOE Orders—Requirements internal to the U.S. Department of Energy (DOE) that establish DOE policy and procedures, including those for compliance with applicable laws.

dose (radiological)—A generic term meaning absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or committed equivalent dose, as defined elsewhere in this glossary. It is a measure of the energy imparted to matter by ionizing radiation. The unit of dose is the rem or rad.

dose equivalent—A measure of radiological dose that correlates with biological effect on a common scale for all types of ionizing radiation. Defined as a quantity equal to the absorbed dose in tissue multiplied by a quality factor (the biological effectiveness of a given type of radiation) and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert.

dose rate—The radiation dose delivered per unit of time (such as rem per year).

dosimeter—A small device (instrument) carried by a radiation worker that measures cumulative radiation dose (such as a film badge or ionization chamber).

drinking water standards—The level of constituents or characteristics in a drinking water supply specified in regulations under the Safe Drinking Water Act as the maximum permissible.

ecology—A branch of science dealing with the interrelationships of living organisms with one another and with their nonliving environment.

ecosystem—A community of organisms and their physical environment interacting as an ecological unit.

effective dose equivalent—The dose value obtained by multiplying the dose equivalents received by specified tissues or organs of the body by the appropriate weighting factors applicable to the tissues or organs irradiated, and then summing all of the resulting products. It includes the dose from radiation sources internal and external to the body. The effective dose equivalent is expressed in units of rems or sieverts. (See committed dose equivalent and committed effective dose equivalent.)

effluent—A waste stream flowing into the atmosphere, surface water, groundwater, or soil. Most frequently the term applies to wastes discharged to surface waters.

electron—An elementary particle with a mass of 9.107×10^{-28} gram (or 1/1,837 of a proton) and a negative charge. Electrons surround the positively charged nucleus and determine the chemical properties of the atom.

emission—A material discharged into the atmosphere from a source operation or activity.

emission standards—Legally enforceable limits on the quantities and/or kinds of air contaminants that can be emitted into the atmosphere.

endangered species—Plants or animals that are in danger of extinction through all or a significant portion of their ranges and that have been listed as endangered by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures outlined in the Endangered Species Act and its implementing regulations (50 CFR Part 424). The lists of endangered species can be found in 50 CFR 17.11 for wildlife, 50 CFR 17.12 for plants, and 50 CFR 222.23(a) for marine organisms. (See threatened species.)

enriched uranium—Uranium whose content of the fissile isotope uranium-235 is greater than the 0.7 percent (by weight) found in natural uranium. (See depleted uranium, uranium, natural uranium, low-enriched uranium, and highly enriched uranium.)

Environment, Safety, and Health Program—In the context of the U.S. Department of Energy (DOE), encompasses those requirements, activities, and functions in the conduct of all DOE and DOE-controlled operations that are concerned with impacts to the biosphere; compliance with environmental laws, regulations, and standards controlling air, water, and soil pollution; limiting the risks to the well-being of both operating personnel and the general public; and protecting property against accidental loss and damage. Typical activities and functions related to this program include, but are not limited to, environmental protection, occupational safety, fire protection, industrial hygiene, health physics, occupational medicine, process and facility safety, nuclear safety, emergency preparedness, quality assurance, and radioactive and hazardous waste management.

environmental impact statement (EIS)—The detailed written statement required by the National Environmental Policy Act (NEPA) section 102(2)(C) for a proposed major Federal action significantly affecting the quality of the human environment. A U.S. Department of Energy (DOE) EIS is prepared in accordance with applicable requirements of the Council on Environmental Quality National Environmental Policy Act regulations in 40 CFR Parts 1500 to 1508 and DOE NEPA regulations in 10 CFR Part 1021. The statement includes, among other information, discussions of the environmental impacts of the Proposed Action and all reasonable alternatives, adverse environmental effects that cannot be avoided should the proposal be implemented, the relationship between short-term uses of the human environment and enhancement of long-term productivity, and any irreversible and irretrievable commitments of resources.

environmental justice—The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, local, and tribal programs and policies. Executive Order 12898 directs Federal agencies to make achieving environmental justice part of their missions by identifying and addressing disproportionately high and adverse effects of agency programs, policies, and activities on minority and low-income populations. (See minority population and low-income population.)

ephemeral stream—A stream that flows only after a period of heavy precipitation.

epidemiology—Study of the occurrence, causes, and distribution of disease or other health-related states and events in human populations, often as related to age, sex, occupation, ethnicity, and economic status, to identify and alleviate health problems and promote better health.

excavation—A cavity in the Earth's surface formed by cutting, digging, or scooping by excavating, such as with the use of heavy construction equipment.

exposure limit—The level of exposure to a hazardous chemical (set by law or a standard) at which or below which adverse human health effects are not expected to occur.

fault—A fracture or a zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage has occurred. A normal fault occurs when the hanging wall has been depressed in relation to the footwall. A reverse fault occurs when the hanging wall has been raised in relation to the footwall.

fissile materials—An isotope that readily fissions after absorbing a neutron of any energy, either fast or slow. Fissile materials are uranium-235, uranium-233, plutonium-239, and plutonium-241. Uranium-235 is the only naturally occurring fissile isotope. Although sometimes used as a synonym for fissionable material, this term has acquired a more restricted meaning, namely, any material fissionable by thermal (slow) neutrons. The three primary fissile materials are uranium-233, uranium-235, and plutonium-239.

fission—The splitting of the nucleus of a heavy atom into two lighter nuclei. It is accompanied by the release of neutrons, gamma rays, and kinetic energy of fission products.

fission products—Nuclei (fission fragments) formed by the fission of heavy elements, plus the nuclides formed by the fission fragments' radioactive decay.

floodplain—The lowlands and relatively flat areas adjoining inland and coastal waters and the flood prone areas of offshore islands. Floodplains include, at a minimum, that area with at least a 1.0 percent chance of being inundated by a flood in any given year.

> The *base floodplain* is defined as the area that has a 1.0 percent or greater chance of being flooded in any given year. Such a flood is known as a 100-year flood.
>
> The *critical action floodplain* is defined as the area that has at least a 0.2 percent chance of being flooded in any given year. Such a flood is known as a 500-year flood. Any activity for which even a slight chance of flooding would be too great (such as storage of highly volatile, toxic, or water-reactive materials) should not occur in the critical action floodplain.
>
> The *probable maximum flood* is the hypothetical flood considered to be the most severe reasonably possible flood, based on the comprehensive hydrometeorological application of maximum precipitation and other hydrological factors favorable for maximum flood runoff (such as sequential storms and snowmelts). It is usually several times larger than the maximum recorded flood.

flux—Rate of flow through a unit area; in reactor operation, the apparent flow of neutrons in a defined energy range. (See neutron flux.)

formation—In geology, the primary unit of formal stratigraphic mapping or description. Most formations possess certain distinctive features.

fugitive emissions—(1) Emissions that do not pass through a stack, vent, chimney, or similar opening where they could be captured by a control device, or (2) any air pollutant emitted to the atmosphere other than from a stack. Sources of fugitive emissions include pumps; valves; flanges; seals; area sources such as ponds, lagoons, landfills, piles of stored material (such as coal); and road construction areas or other areas where earthwork is occurring.

gabions—Wire mesh boxes filled with rock used as a nonvegetative stabilization measure.

gamma radiation—High-energy, short wavelength, electromagnetic radiation emitted from the nucleus of an atom during radioactive decay. Gamma radiation frequently accompanies alpha and beta emissions and always accompanies fission. Gamma rays are very penetrating and are best stopped or shielded by dense materials, such as lead or depleted uranium. Gamma rays are similar to, but are usually more energetic than, x-rays.

genetic effects—Inheritable changes (chiefly mutations) produced by exposure to ionizing radiation or other chemical or physical agents of the parts of cells that control biological reproduction and inheritance.

genomics—The study of genes and their function.

geology—The science that deals with the Earth—the materials, processes, environments, and history of the planet, including rocks and their formation and structure.

glovebox—Large enclosure that separates workers from equipment used to process hazardous material, while allowing the workers to be in physical contact with the equipment; normally constructed of stainless steel, with large acrylic/lead glass windows. Workers have access to equipment through the use of heavy-duty, lead-impregnated rubber gloves, the cuffs of which are sealed in portholes in the glovebox windows.

graben—A usually elongated depression between geologic faults.

grading—Any stripping, cutting, filling, stockpiling, or combination thereof that modifies the land surface.

ground shine—The radiation dose received from an area on the ground where radioactivity has been deposited by a radioactive plume or cloud.

groundwater—Water below the ground surface in a zone of saturation.

habitat—The environment occupied by individuals of a particular species, population, or community.

half-life—The time in which one-half of the atoms of a particular radioactive isotope disintegrate to another nuclear form. Half-lives vary from millionths of a second to billions of years.

Hazard Index—The ratio of the potential exposure to a substance and the highest exposure level at which no adverse effects are expected. If the Hazard Index is calculated to be less than 1, then no adverse health effects are expected as a result of exposure. If the Hazard Index is greater than 1, then adverse health effects are possible.

hazardous air pollutants—Air pollutants not covered by ambient air quality standards but which may present a threat of adverse human health effects or adverse environmental effects. Those specifically listed in 40 CFR 61.01 are asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. More broadly, hazardous air pollutants are any of the 189 pollutants listed in or pursuant to the Clean Air Act, Section 112(b). Very generally, hazardous air pollutants are any air pollutants that may realistically be expected to pose a threat to human health or welfare.

hazardous chemical—Under 29 CFR Part 1910 Subpart Z, hazardous chemicals are defined as "any chemical which is a physical hazard or a health hazard." Physical hazards include combustible liquids, compressed gases, explosives, flammables, organic peroxides, oxidizers, pyrophorics, and reactives. A health hazard is any chemical for which there is good evidence that acute or chronic health effects occur in exposed employees. Hazardous chemicals include carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, agents that act on the hematopoietic system, and agents that damage the lungs, skin, eyes, or mucous membranes.

hazardous material—A material, including a hazardous substance, as defined by 49 CFR 171.8, that poses a risk to health, safety, and property when transported or handled.

hazardous waste—A category of waste regulated under the Resource Conservation and Recovery Act (RCRA). To be considered hazardous, a waste must be a solid waste under RCRA and must exhibit at least one of four characteristics described in 40 CFR 261.20-24 (ignitability, corrosivity, reactivity, or toxicity) or be specifically listed by the U.S. Environmental Protection Agency in 40 CFR 261.31-33.

hazards classification—The process of identifying the potential threat to human health of a chemical substance.

high-efficiency particulate air (HEPA) filter—An air filter capable of removing at least 99.97 percent of particles 0.3 micrometers (about 0.00001 inches) in diameter. High-efficiency particulate air filters include a pleated fibrous medium (typically fiberglass) capable of capturing very small particles.

high-level radioactive waste—High level waste is the highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation.

highly enriched uranium—Uranium whose content of the fissile isotope uranium-235 has been increased through enrichment to 20 percent or more (by weight). (See uranium, natural uranium, enriched uranium, highly enriched uranium, and depleted uranium.)

historic artifact scatter/trash scatter—A concentration of items produced and deposited after AD 1593 (but most typically in the Los Alamos area deposited after about AD 1900).

historic resources—Archaeological sites, architectural structures, and objects produced after the advent of written history, dating to the time of the first European-American contact in an area.

historic structure—A building or other structure constructed after AD 1593 (but most typically in the Los Alamos area constructed after about AD 1900).

Holocene—An epoch of the Quaternary period that began at the end of the Pleistocene, or the "Ice Age," about 10,000 years ago and continuing to the present. It is named from the Greek words "holos" (entire) and "ceno" (new).

hot cell—A shielded facility that requires the use of remote manipulators for handling radioactive materials.

hydrology—The science dealing with the properties, distribution, and circulation of natural water systems.

hydrophobic soils—Non-permeable soil areas created as a result of very high temperatures often associated with wild fires).

Idaho National Laboratory (INL)—Formerly the Idaho National Engineering and Environmental Laboratory and the Argonne National Laboratory-West, INL is a U.S. Department of Energy (DOE) laboratory complex located in southeast Idaho about 25 miles west of Idaho Falls, that is managed and operated by a private consortium under contract to DOE.

incident-free risk—The radiological or chemical impacts resulting from emissions during normal operations and packages aboard vehicles in normal transport. This includes the radiation or hazardous chemical exposure of specific population groups and workers.

injection wells—A well that takes water from the surface into the ground, either through gravity or by mechanical means.

ion—An atom that has too many or too few electrons, causing it to be electrically charged.

ion exchange—A unit physiochemical process that removes anions and cations, including radionuclides, from liquid streams (usually water) for the purpose of purification or decontamination.

ion exchange resin—An organic polymer that functions as an acid or base. These resins are used to remove ionic material from a solution. Cation exchange resins are used to remove positively charged particles (cations), and anion exchange resins are used to remove negatively charged particles (anions).

ionizing radiation—Alpha particles, beta particles, gamma rays, high-speed electrons, high-speed protons, and other particles or electromagnetic radiation that can displace electrons from atoms or molecules, thereby producing ions.

irradiated—Exposure to ionizing radiation. The condition of reactor fuel elements and other materials in which atoms bombarded with nuclear particles have undergone nuclear changes.

isolates—A population of bacteria or other cells that has been isolated.

isotope—Any of two or more variations of an element in which the nuclei have the same number of protons (and thus the same atomic number), but different numbers of neutrons so that their atomic masses differ. Isotopes of a single element possess almost identical chemical properties, but often different physical properties (for example, carbon-12 and -13 are stable; carbon-14 is radioactive).

joule—A metric unit of energy, work, or heat, equivalent to one watt-second, 0.737 foot-pound, or 0.239 calories.

landscape character—The arrangement of a particular landscape as formed by the variety and intensity of the landscape features (land, water, vegetation, and structures) and the four basic elements (form, line, color, and texture). These factors give an area a distinctive quality that distinguishes it from its immediate surroundings.

latent cancer fatalities (LCFs)—Deaths from cancer occurring some time after, and postulated to be due to, exposure to ionizing radiation or other carcinogens.

lithic scatter—The description of rocks on the basis of such characteristics as color, mineralogic composition, and grain size.

loam—Soil material that is composed of 7 percent to 27 percent clay particles, 28 percent to 50 percent silt particles, and less than 52 percent sand particles.

long-lived radionuclides—Radioactive isotopes with half-lives greater than 30 years.

long-term impact—In general, an impact that endures beyond the timeframe of the action or activity that causes the impact.

low-income population—Low-income populations, defined in terms of Bureau of the Census annual statistical poverty levels (Current Population Reports, Series P-60 on Income and Poverty), may consist of groups or individuals who live in geographic proximity to one another or who are geographically dispersed or transient (such as migrant workers or American Indians), where either group experiences common conditions of environmental exposure or effect. (See environmental justice and minority population.)

low-level radioactive waste—Waste that contains radioactivity but is not classified as high-level waste, transuranic waste, spent nuclear fuel, or byproduct material as defined by Section 11e (2) of the Atomic Energy Act of 1954, as amended. 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 radioactive waste, provided the concentration of transuranic waste is less than 100 nanocuries per gram.

material access area—A type of security area that is authorized to contain a security Category I quantity of special nuclear material and which has specifically defined physical barriers, is located within a Protected Area, and is subject to specific access controls.

material characterization—The measurement of basic material properties, and the change in those properties as a function of temperature, pressure, or other factors.

material control and accountability—The part of safeguards that detects or deters theft or diversion of nuclear materials and provides assurance that all nuclear materials are accounted for appropriately.

material disposal area (MDA)—An area used any time between the beginning of Los Alamos National Laboratory operations in the early 1940s and the present for disposing of chemically, radioactively, or chemically and radioactively contaminated materials.

maximally exposed individual (MEI)—A hypothetical individual whose location and habits result in the highest total radiological or chemical exposure (and thus dose) from a particular source for all exposure routes (inhalation, ingestion, direct exposure).

maximally exposed individual (transportation analysis)—A hypothetical individual receiving radiation doses from transporting radioactive materials on the road. For the incident-free transport operation, the maximally exposed individual would be an individual stuck in traffic next to the shipment for 30 minutes. For accident conditions, the maximally exposed individual is assumed to be an individual located approximately 33 meters (100 feet) directly downwind from the accident.

maximum contaminant level—The designation for U.S. Environmental Protection Agency standards for drinking water quality under the Safe Drinking Water Act. The maximum contaminant level for a given substance is the maximum permissible concentration of that substance in water delivered by a public water system. The primary maximum contaminant levels (40 CFR Part 141) are intended to protect public health and are federally enforceable. They are based on health factors, but are also required by law to reflect the technological and economic feasibility of removing the contaminant from the water supply. Secondary maximum contaminant levels (40 CFR Part 143) are set by the U.S. Environmental Protection Agency to protect the public welfare. The secondary drinking water regulations control substances in drinking water that primarily affect aesthetic qualities (such as taste, odor, and color) relating to the public acceptance of water. These regulations are not federally enforceable, but are intended as guidelines for the states.

megawatt—A unit of power equal to 1 million watts. Megawatt thermal is commonly used to define heat produced, while megawatt-electric defines electricity produced.

metabolomics—The study of the small molecules, or metabolites, contained in a human cell, tissue or organ (including fluids) and involved in primary and intermediary metabolism.

MeV (million electron volts)—A unit used to quantify energy. In this SWEIS, it describes a particle's kinetic energy, which is an indicator of particle speed.

micron—One-millionth of 1 meter.

migration—The natural movement of a material through the air, soil, or groundwater; also, seasonal movement of animals from one area to another.

Migratory Bird Treaty Act—This Act states that it is unlawful to pursue, take, attempt to take, capture, possess, or kill any migratory bird, or any part, nest, or egg of any such bird other than permitted activities.

millirem—One-thousandth of 1 rem.

minority population—Minority populations exist where either: (a) the minority population of the affected area exceeds 50 percent, or (b) the minority population percentage of the affected area is meaningfully greater than in the general population or other appropriate unit of geographic analysis (such as a governing body's jurisdiction, a neighborhood, census tract, or other similar unit). "Minority" refers to individuals who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic. "Minority populations" include either a single minority group or the total of all minority persons in the affected area. They may consist of groups of individuals living in geographic proximity to one another or a geographically dispersed/transient set of individuals (such as migrant workers or American Indians), where either group experiences common conditions of environmental exposure or effect. (See environmental justice and low-income population.)

mitigate—Mitigation includes: (1) avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action and its implementation; (3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action; or (5) compensating for an impact by replacing or providing substitute resources or environments.

mixed waste—Waste that contains both nonradioactive hazardous waste and radioactive waste, as defined in this glossary.

National Ambient Air Quality Standards—Standards defining the highest allowable levels of certain pollutants in the ambient air (the outdoor air to which the public has access). Because the U.S. Environmental Protection Agency must establish the criteria for setting these standards, the regulated pollutants are called *criteria* pollutants. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter (less than or equal to 10 micrometers [0.0004 inches] in diameter and less than or equal to 2.5 micrometers [0.0001 inches] in diameter). Primary standards are established to protect public health; secondary standards are established to protect public welfare (such as visibility, crops, animals, buildings). (See criteria pollutant.)

National Emission Standards for Hazardous Air Pollutants—Emissions standards set by the U.S. Environmental Protection Agency for air pollutants which are not covered by National Ambient Air Quality Standards and which may, at sufficiently high levels, cause increased fatalities, irreversible health effects, or incapacitating illness. These standards are given in 40 CFR Parts 61 and 63. National Emission Standards for Hazardous Air Pollutants are given for many specific categories of sources (such as equipment leaks, industrial process cooling towers, dry cleaning facilities, petroleum refineries). (See hazardous air pollutants.)

National Environmental Policy Act (NEPA) of 1969—This Act is the basic national charter for protection of the environment. It establishes policy, sets goals (Section 101), and provides means (Section 102) for carrying out policy. Section 102(2) contains "action-forcing" provisions to ensure that Federal agencies follow the letter and spirit of the act. For major Federal actions significantly affecting the quality of the human environment, Section 102(2)(C) of the National Environmental Policy Act requires Federal agencies to prepare a detailed statement that includes the environmental impacts of the Proposed Action and other specified information.

National Historic Preservation Act—This Act provides that property resources with significant national historic value be placed on the National Register of Historic Places. It does not require any permits, but pursuant to Federal code, if a Proposed Action might impact a historic property resource, it mandates consultation with the proper agencies.

National Pollutant Discharge Elimination System—A provision of the Clean Water Act which prohibits discharge of pollutants into waters of the United States unless a special permit is issued by the U.S. Environmental Protection Agency, a state, or, where delegated, a tribal government on an Indian reservation. The National Pollutant Discharge Elimination System permit lists either permissible discharges, the level of cleanup technology required for wastewater, or both.

National Register of Historic Places—The official list of the Nation's cultural resources that are worthy of preservation. The National Park Service maintains the list under direction of the Secretary of the Interior. Buildings, structures, objects, sites, and districts are included in the National Register for their importance in American history, architecture, archaeology, culture, or engineering. Properties included on the National Register range from large-scale, monumentally proportioned buildings to smaller-scale, regionally distinctive buildings. The listed properties are not just of nationwide importance; most are significant primarily at the state or local level. Procedures for listing properties on the National Register are found in 36 CFR Part 60.

natural phenomena accidents—Accidents that are initiated by phenomena such as earthquakes, tornadoes, floods, etc.

natural uranium—Uranium with the naturally occurring distribution of uranium isotopes (approximately 0.7-weight percent uranium-235, and the remainder essentially uranium-238). (See uranium, depleted uranium, enriched uranium, highly enriched uranium, and low-enriched uranium.)

neptunium-237—A manmade element, with the atomic number 93. Pure neptunium is a silvery metal. The neptunium-237 isotope has a half-life of 2.14 million years. When neptunium-237 is bombarded by neutrons, it is transformed to neptunium-238, which in turn undergoes radioactive decay to become plutonium-238. When neptunium-237 undergoes radioactive decay, it emits alpha particles and gamma rays.

neutron—An uncharged elementary particle with a mass slightly greater than that of the proton. Neutrons are found in the nucleus of every atom heavier than hydrogen-1.

neutron flux—The product of neutron number density and velocity (energy), giving an apparent number of neutrons flowing through a unit area per unit time.

nitrogen—A natural element with the atomic number 7. It is diatomic in nature and is a colorless and odorless gas that constitutes about four-fifths of the volume of the atmosphere.

nitrogen oxides—Refers to the oxides of nitrogen, primarily nitrogen oxide and nitrogen dioxide. These are produced in the combustion of fossil fuels and can constitute an air pollution problem. Nitrogen dioxide emissions contribute to acid deposition and formation of atmospheric ozone.

noise—Undesirable sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities (hearing, sleep), damage hearing, or diminish the quality of the environment.

noise pollution—Any sound that is undesirable because it interferes with speech and hearing, or is intense enough to damage hearing, or is otherwise annoying or undesirable.

nonattainment area—An area that the U.S. Environmental Protection Agency has designated as not meeting (not being in attainment of) one or more of the National Ambient Air Quality Standards for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants, but not for others. (See attainment area, National Ambient Air Quality Standards, and particulate matter.)

non-nuclear aboveground experimentation—Aboveground experimentation or testing in support of nuclear weapons programs that does not involve detonation of a nuclear explosive.

nonproliferation—Preventing the spread of nuclear weapons, nuclear weapon materials, and nuclear weapon technology.

normal operations—All normal (incident-free) conditions and those abnormal conditions that frequency estimation techniques indicate occur with a frequency greater than 0.1 events per year.

Notice of Intent (NOI)—Public announcement that an environmental impact statement will be prepared and considered. It describes the Proposed Action, possible alternatives, and scoping process, including whether, when, and where any scoping meetings will be held. The NOI is usually published in the *Federal Register* and local media. The scoping process includes holding at least one public meeting and requesting written comments on issues and environmental concerns that an environmental impact statement should address.

nuclear criticality—See criticality.

nuclear explosive—Any assembly containing fissionable and/or fusionable materials and main-charge high-explosive parts or propellants capable of producing a nuclear detonation.

nuclear facility—A facility that is subject to requirements intended to control potential nuclear hazards. Defined in U.S. Department of Energy directives as any nuclear reactor or any other facility whose operations involve radioactive materials in such form and quantity that a significant nuclear hazard potentially exists to the employees or the general public.

nuclear material—Composite term applied to—(1) special nuclear material; (2) source material such as uranium or thorium or ores containing uranium or thorium; and (3) byproduct material, which is any radioactive material that is made radioactive by exposure to the radiation incident to the process of producing or using special nuclear material.

nuclear reactor—A device that sustains a controlled nuclear fission chain reaction that releases energy in the form of heat.

Nuclear Regulatory Commission (NRC)—The Federal agency that regulates the civilian nuclear power industry in the United States.

nuclear weapon—The general name given to any weapon in which the explosion results from the energy released by reactions involving atomic nuclei, either fission, fusion, or both.

nuclear weapons complex—The sites supporting the research, development, design, manufacture, testing, assessment, certification, and maintenance of the Nation's nuclear weapons and the subsequent dismantlement of retired weapons.

nuclide—A species of atom characterized by the constitution of its nucleus and hence by the number of protons, the number of neutrons, and the energy content.

Oak Ridge National Laboratory (ORNL)—A U.S. Department of Energy (DOE) laboratory complex located in eastern Tennessee about 25 miles west of Knoxville, that is managed and operated by a private consortium under contract to DOE.

Occupational Safety and Health Administration—The U.S. Federal Government agency that oversees and regulates workplace health and safety; created by the Occupational Safety and Health Act of 1970.

offsite—The term denotes a location, facility, or activity occurring outside the site boundary.

One- to three-room structure/fieldhouse—The remains of a small surface structure constructed of adobe, jacal, or masonry. This site typically consists of square to rectangular-shaped rock alignments, with individual units being no more than 3 m in length. The majority of these sites are identical to what many researchers term fieldhouses. Also included in the one- to three-room structure category is one example of a single unusually large rectangular structure, along with several smallish structures that are unusual due to the presence of upright stones or because of their location. Some of these "unusual" structures may represent shrines or other purposes not directly related to agriculture.

onsite—The term denotes a location or activity occurring within the boundary of a DOE complex site.

oralloy—Introduced in early Los Alamos documents to mean enriched uranium (Oak Ridge alloy); now uncommon except to signify highly enriched uranium.

outfall—The discharge point of a drain, sewer, or pipe as it empties into the environment.

ozone—The triatomic form of oxygen; in the stratosphere, ozone protects the Earth from the sun's ultraviolet rays, but in lower levels of the atmosphere, ozone is considered an air pollutant.

package—For radioactive materials, the packaging, together with its radioactive contents, as presented for transport (the packaging plus the radioactive contents equals the package).

packaging—With regard to hazardous or radionuclide materials, the assembly of components necessary to ensure compliance with Federal regulations. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle tie-down system and auxiliary equipment may be designated as part of the packaging.

paleontological resources—The physical remains, impressions, or traces of plants or animals from a former geologic age; may be sources of information on ancient environments and the evolutionary development of plants and animals.

particulate matter (PM)—Any finely divided solid or liquid material, other than uncombined (pure) water. A subscript denotes the upper limit of the diameter of particles included. Thus, PM_{10} includes only those particles equal to or less than 10 micrometers (0.0004 inches) in diameter; $PM_{2.5}$ includes only those particles equal to or less than 2.5 micrometers (0.0001 inches) in diameter.

perennial stream—A stream that flows throughout the year.

permeability—In geology, the ability of rock or soil to transmit a fluid.

person-rem—A unit of collective radiation dose applied to populations or groups of individuals; that is, a unit for expressing the dose when summed across all persons in a specified population or group. One person-rem equals 0.01 person-sieverts. (See collective dose.)

Perimeter Intrusion Detection and Assessment System (PIDAS)—A mutually supporting combination of barriers, clear zones, lighting, and electronic intrusion detection, assessment, and access control systems constituting the perimeter of the Protected Area and designed to detect, impede, control, or deny access to the Protected Area.

pit—The central core of a primary assembly in a nuclear weapon typically composed of plutonium-239 and/or highly-enriched uranium and other materials.

Plaza Pueblo—Contains one or more pueblo roomblocks that partially or completely enclose a plaza. Plaza pueblos typically are much larger (in both room numbers and site size) than single pueblo roomblock sites.

Pleistocene—The geologic time period of the earliest epoch of the Quaternary period, spanning between about 1.6 million years ago and the beginning of the Holocene epoch at 10,000 years ago. It is characterized by the succession of northern glaciations and also called the "Ice Age."

plume—The elongated volume of contaminated water or air originating at a pollutant source such as an outlet pipe or a smokestack. A plume eventually diffuses into a larger volume of less contaminated material as it is transported away from the source.

plutonium—A heavy, radioactive, metallic element with the atomic number 94. It is produced artificially by neutron bombardment of uranium. Plutonium has 15 isotopes with atomic masses ranging from 232 to 246 and half-lives from 20 minutes to 76 million years.

plutonium-238—An isotope with a half-life of 87.74 years used as the heat source for radioisotope power systems. When plutonium-238 undergoes radioactive decay, it emits alpha particles and gamma rays. Plutonium-238 may fission if exposed to neutrons. The likelihood of plutonium-238 undergoing fission is dependent upon many factors including the number and energy of neutrons, temperature, plutonium-238 purity and shape, and the presence and proximity of other elements.

plutonium-239—An isotope with a half-life of 24,110 years that is the primary radionuclide in weapons-grade plutonium. When plutonium-239 decays, it emits alpha particles. Plutonium-239 may fission if exposed to neutrons. The likelihood of plutonium-239 undergoing fission is dependent upon many factors including the number and energy of neutrons, temperature, plutonium-239 purity and shape, and the presence and proximity of other elements.

population dose—See collective dose.

potential release site (PRS)—A site suspected of releasing or having the potential to release contaminants (radioactive, chemical, or both) into the environment. PRS is a generic term that includes solid waste management units and areas of concern that are cited and defined in the Compliance Order on Consent (Consent Order).

pounds per square inch—A measure of pressure; atmospheric pressure is about 14.7 pounds per square inch.

prehistoric resources—The physical remains of human activities that predate written records; they generally consist of artifacts that may alone or collectively yield otherwise inaccessible information about the past.

Prevention of Significant Deterioration—Regulations established to prevent significant deterioration of air quality in areas that already meet National Ambient Air Quality Standards. Specific details of Prevention of Significant Deterioration are found in 40 CFR 51.166. Among other provisions, cumulative increases in sulfur dioxide, nitrogen dioxide, and PM_{10} levels after specified baseline dates must not exceed specified maximum allowable amounts. These allowable increases, also known as increments, are especially stringent in areas designated as Class I areas (such as national parks, wilderness areas) where the preservation of clean air is particularly important. All areas not designated as Class I are currently designated as Class II. Maximum increments in pollutant levels are also given in 40 CFR 51.166 for Class III areas, if any such areas should be so designated by EPA. Class III increments are less stringent than those for Class I or Class II areas. (See National Ambient Air Quality Standards.)

prime farmland—Land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oil-seed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, without intolerable soil erosion, as determined by the Secretary of Agriculture (Farmland Protection Act of 1981, 7 CFR Part 7, paragraph 658).

probabilistic risk assessment—A comprehensive, logical, and structured methodology that accounts for population dynamics and human activity patterns at various levels of sophistication, considering time-space distributions and sensitive subpopulations. The probabilistic method results in a more complete characterization of the exposure information available, which is defined by probability distribution functions. This approach offers the possibility of an associated quantitative measure of the uncertainty around the value of interest.

process—Any method or technique designed to change the physical or chemical character of the product.

protactinium—An element that is produced by the radioactive decay of neptunium-237. The pure metal has a bright metallic luster. The protactinium-233 isotope has a half-life of 27 days and emits beta particles and gamma rays during radioactive decay.

Protected Area—A type of security area defined by physical barriers (walls or fences), to which access is controlled, used for protection of security Category II special nuclear materials and classified matter and/or to provide a concentric security zone surrounding a Material Access Area (security Category I nuclear materials) or a Vital Area.

Proteomics—The analysis of the expression, localizations, functions, and interactions of the proteins expressed by the genetic material of an organism.

proton—An elementary nuclear particle with a positive charge equal in magnitude to the negative charge of the electron; it is a constituent of all atomic nuclei, and the atomic number of an element indicates the number of protons in the nucleus of each atom of that element.

Pueblo roomblock—The remains of a contiguous, multi-room habitation structure (four or more rooms with no enclosed plaza) constructed of adobe, jacal, or masonry. In several cases, somewhat amorphous mounds containing evidence of stone rubble but no distinct alignments were included in this category.

Quaternary—The second geologic time period of the Cenozoic era, dating from about 1.6 million years ago to the present. It contains two epochs: the Pleistocene and the Holocene. It is characterized by the first appearance of human beings on Earth.

rad—See radiation absorbed dose.

radiation (ionizing)—See ionizing radiation.

radiation absorbed dose (rad)—The basic unit of absorbed dose equal to the absorption of 0.01 joules per kilogram (100 ergs per gram) of absorbing material.

radioactive waste—In general, waste that is managed for its radioactive content. Waste material that contains source, special nuclear, or byproduct material is subject to regulation as radioactive waste under the Atomic Energy Act. Also, waste material that contains accelerator-produced radioactive material or a high concentration of naturally occurring radioactive material may be considered radioactive waste.

radioactivity—

Defined as a *process*: The spontaneous transformation of unstable atomic nuclei, usually accompanied by the emission of ionizing radiation.

Defined as a *property*: The property of unstable nuclei in certain atoms to spontaneously emit ionizing radiation during nuclear transformations.

radioisotope or radionuclide—An unstable isotope that undergoes spontaneous transformation, emitting radiation. (See isotope.)

radioisotope power system—Any one of a number of technologies used in spacecraft and in national security technologies that produces heat or electricity from the radioactive decay of suitable radioactive substances such as plutonium-238. They are typically used in applications such as to enable the operation of instruments and sensors where energy sources such as solar power are undesirable or impractical due to the remoteness or extreme conditions of the operating environment.

radioisotope thermoelectric generator (RTG)—An electrical generator that derives its electric power from heat produced by the decay of radioactive strontium-90, plutonium-238, or other suitable isotopes. The heat generated is directly converted into electricity, in a passive process, by an array of thermocouples.

radon—A gaseous, radioactive element with the atomic number 86, resulting from the radioactive decay of radium. Radon occurs naturally in the environment and can collect in unventilated enclosed areas, such as basements. Large concentrations of radon can cause lung cancer in humans.

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.

reactor facility—Unless it is modified by words such as containment, vessel, or core, the term "reactor facility" includes the housing, equipment, and associated areas devoted to the operation and maintenance of one or more reactor cores. Any apparatus that is designed or used to sustain nuclear chain reactions in a controlled manner, including critical and pulsed assemblies and research, test, and power reactors, is defined as a reactor. All assemblies designed to perform subcritical experiments that could potentially reach criticality are also considered reactors.

Record of Decision (ROD)—A document prepared in accordance with the requirements of 40 CFR 1505.2 and 10 CFR 1021.315 that provides a concise public record of the U.S. Department of Energy's (DOE) decision on a Proposed Action for which an environmental impact statement was prepared. A ROD identifies the alternatives considered in reaching the decision; the environmentally preferable alternative; factors balanced by DOE in making the decision; and whether all practicable means to avoid or minimize environmental harm have been adopted, and, if not, the reason why they were not.

reference dose—The chronic-exposure dose (milligram or kilogram per day) for a given hazardous chemical at which or below which adverse human noncancer health effects are not expected to occur.

region of influence (ROI)—A site-specific geographic area in which the principal direct and indirect effects of actions are likely to occur.

rem (roentgen equivalent man)—A unit of dose equivalent. The dose equivalent in rem equals the absorbed dose in rad in tissue multiplied by the appropriate quality factor and possibly other modifying factors. Derived from "roentgen equivalent man," referring to the dosage of ionizing radiation that will cause the same biological effect as one roentgen of x-ray or gamma-ray exposure. One rem equals 0.01 sieverts. (See absorbed dose and dose equivalent.)

remediation—The process, or a phase in the process, of rendering radioactive, hazardous, or mixed waste environmentally safe, whether through processing, entombment, or other methods.

remote-handled waste—In general, refers to radioactive waste that must be handled at a distance to protect workers from unnecessary exposure (waste with a dose rate of 200 millirem per hour or more at the surface of the waste package). (See contact-handled waste.)

resin—See ion exchange resin.

Resource Conservation and Recovery Act (RCRA), as amended—A law that gives the U.S. Environmental Protection Agency the authority to control hazardous waste from "cradle to grave" (from the point of generation to the point of ultimate disposal), including its minimization, generation, transportation, treatment, storage, and disposal. The Resource Conservation and Recovery Act also sets forth a framework for the management of nonhazardous solid wastes. (See hazardous waste.)

riparian—Of, on, or relating to the banks of a natural course of water.

risk—The probability of a detrimental effect of exposure to a hazard. Risk is often expressed quantitatively as the probability of an adverse event occurring multiplied by the consequence of that event (in other words, the product of these two factors). However, separate presentation of probability and consequence is often more informative.

risk assessment (chemical or radiological)—The qualitative and quantitative evaluation performed in an effort to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemical or radiological materials.

rock shelter—An overhang, indentation, or alcove formed naturally in a rock face or large boulder, or alternatively, a partly enclosed area created by rock falls leaning against a rock face or large boulder, and which exhibits evidence of human use. Rock shelters generally are not of great depth, in contrast to caves.

roentgen—A unit of exposure to ionizing x- or gamma radiation equal to or producing one electrostatic unit of charge per cubic centimeter of air.

runoff—The portion of rainfall, melted snow, or irrigation water that flows across the ground surface, and eventually enters streams.

Safe Drinking Water Act—This Act protects the quality of public water supplies, water supply and distribution systems, and all sources of drinking water.

safeguards—An integrated system of physical protection, material accounting, and material control measures designed to deter, prevent, detect, and respond to unauthorized access, possession, use, or sabotage of nuclear materials.

Safety Analysis Report—A report that systematically identifies potential hazards within a nuclear facility, describes and analyzes the adequacy of measures to eliminate or control identified hazards, and analyzes potential accidents and their associated risks. Safety analysis reports are used to ensure that a nuclear facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations. Safety analysis reports are required for U.S. Department of Energy nuclear facilities and as a part of applications for U.S. Nuclear Regulatory Commission licenses. The U.S. Nuclear Regulatory Commission regulations or DOE Orders and technical standards that apply to the facility type provide specific requirements for the content of safety analysis reports. (See nuclear facility.)

sand—Loose grains of rock or mineral sediment formed by weathering that range in size from 0.0625 to 2.0 millimeters (0.0025 to 0.08 inches) in diameter, and often consists of quartz particles.

sandstone—A sedimentary rock composed mostly of sand-size particles cemented usually by calcite, silica, or iron oxide.

sanitary waste—Wastes generated by normal housekeeping activities, liquid or solid (includes sludge), that are not hazardous or radioactive.

Savannah River Site (SRS)—A U.S. Department of Energy (DOE) industrial complex located in southwestern South Carolina about 20 miles southeast of Augusta, Georgia, that is managed and operated by a private consortium under contract to DOE.

scope—In a document prepared pursuant to the National Environmental Policy Act of 1969, the range of actions, alternatives, and impacts to be considered.

scoping—An early and open process, including public notice and involvement, for determining the scope of issues to be addressed in an environmental impact statement (EIS) and for identifying the significant issues related to a Proposed Action. The scoping period begins after publication in the *Federal Register* of a Notice of Intent to prepare an EIS. The public scoping process is that portion of the process where the public is invited to participate. The U.S. Department of Energy's scoping procedures are found in 10 CFR 1021.311.

security—An integrated system of activities, systems, programs, facilities, and policies for the protection of Restricted Data and other classified information or matter, nuclear materials, nuclear weapons and nuclear weapons components, and/or U.S. Department of Energy or contractor facilities, property, and equipment.

sediment—Soil, sand, and minerals washed from land into water that deposit on the bottom of a water body.

seismic—Pertaining to any Earth vibration, especially an earthquake.

seismicity—The frequency and distribution of earthquakes.

select agent—A select agent is defined as an agent, virus, bacteria, fungi, rickettsiae or toxin listed in Appendix A of *Federal Register* 29327 (42 CFR Part 72) titled, *Additional Requirements for Facilities Transferring or Receiving Select Agents*. Select Agents also includes (a) genetically modified micro-organisms or (b) genetic elements that contain nucleic acid sequences associated with pathogenicity from organisms listed in Appendix A, (c) genetically modified micro-organisms listed in Appendix A, and (d) genetically modified micro-organisms or genetic elements that contain nucleic acid sequences coding for any of the toxins in Appendix A, or their toxic subunits.

severe accident—An accident with a frequency rate of less than 10^{-6} per year that would have more severe consequences than a design-basis accident, in terms of damage to the facility, offsite consequences, or both. Also called a beyond-design-basis accident.

sewage—The total organic waste and wastewater generated by an industrial establishment or a community.

shielding—With regard to radiation, any material of obstruction (bulkheads, walls, or other construction) that absorbs radiation to protect personnel or equipment.

short-lived nuclides—Radioactive isotopes with half-lives no greater than about 30 years (such as cesium-137 and strontium-90).

short-term impact—In general, an impact that occurs during or for a short time after the action or activity that causes the impact.

silt—A sedimentary material consisting of fine mineral particles, intermediate in size between sand and clay. In general, soils categorized as silt show greater rates of erosion than soils categorized as sand.

soils—All unconsolidated materials above bedrock. Natural earthy materials on the Earth's surface, in places modified or even made by human activity, containing living matter, and supporting or capable of supporting plants out of doors.

solid waste management unit (SWMU)—Any discernible unit at which solid waste has been placed at any time, and from which the New Mexico Environment Department determines there may be a risk of a release of hazardous waste or hazardous waste constituents, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at the Facility (LANL) at which solid wastes have been routinely and systematically released; they do not include one-time spills. See 61 FR 19431 (May 1, 1996).

somatic effect—Any effect that may manifest in the body of the exposed individual over his or her lifetime.

source material—Depleted uranium, normal uranium, thorium, or any other nuclear material determined, pursuant to Section 61 of the Atomic Energy Act of 1954, as amended, to be source material, or ores containing one or more of the foregoing materials in such concentration as may be determined by regulation.

source term—The amount of a specific pollutant (chemicals, radionuclides) emitted or discharged to a particular environmental medium (air, water, earth) from a source or group of sources. It is usually expressed as a rate (amount per unit time).

spallation—A nuclear reaction in which the energy of the incident particle is so high that more than two or three particles are ejected from the target nucleus, and both its mass number and atomic number are changed.

special nuclear material(s)—A category of material subject to regulation under the Atomic Energy Act, consisting primarily of fissile materials. It is defined to mean plutonium, uranium-233, uranium enriched in the isotopes of uranium-233 or -235, and any other material that the Nuclear Regulatory Commission determines to be special nuclear material, but it does not include source material.

spectral characteristics—The natural property of a structure as it relates to the multidimensional temporal accelerations.

staging—The process of using several layers to achieve a combined effect greater than that of one layer.

stockpile—The inventory of active nuclear weapons for the strategic defense of the United States.

stockpile stewardship program—A program that ensures the operational readiness (safety and reliability) of the U.S. nuclear weapons stockpile by the appropriate balance of surveillance, experiments, and simulations.

straw wattles—Tubes of rice straw used for erosion control, sediment control and stormwater runoff control.

sulfur oxides—Common air pollutants (primarily sulfur dioxide), a heavy, pungent, colorless gas (formed in the combustion of fossil fuels, considered a major air pollutant) and sulfur trioxide. Sulfur dioxide is involved in the formation of acid rain. It can also irritate the upper respiratory tract and cause lung damage.

supernatant—The liquid that stands over a precipitated material.

surface water—All bodies of water on the surface of the Earth and open to the atmosphere, such as rivers, lakes, reservoirs, ponds, seas, and estuaries.

target—A tube, rod, or other form containing material that, on being irradiated in a nuclear reactor or an accelerator, would produce a desired end product.

technical area (TA)—Geographically distinct administrative units established for the control of LANL operations. There are currently 49 active TAs; 47 in the 41 square miles of the LANL site, one at Fenton Hill, west of the main site, and one comprising leased properties in town.

tectonic—Of or relating to motion in the Earth's crust and occurring on geologic faults.

Tertiary—The first geologic time period of the Cenozoic era (after the Mesozoic era and before the Quaternary period), spanning between about 66 million and 1.6 million years ago. During this period, mammals became the dominant life form on Earth.

threatened species—Any plants or animals that are likely to become endangered species within the foreseeable future throughout all or a significant portion of their ranges and which have been listed as threatened by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures set out in the Endangered Species Act and its implementing regulations (50 CFR Part 424). (See endangered species.)

threshold limit values—The recommended highest concentrations of contaminants to which workers may be exposed according to the American Conference of Governmental Industrial Hygienists.

total effective dose equivalent—The sum of the effective dose equivalent from external exposures and the committed effective dose equivalent from internal exposures.

Toxic Substances Control Act of 1976—This Act authorizes the U.S. Environmental Protection Agency (EPA) to secure information on all new and existing chemical substances and to control any substances determined to cause an unreasonable risk to public health or the environment. This law requires that the health and environmental effects of all new chemicals be reviewed by the EPA before they are manufactured for commercial purposes.

transmutation—The transformation of one isotope into another isotope by changing its nuclear structure. It can occur naturally through radioactive decay, or the fission and neutron capture processes can be hastened by using nuclear reactors or particle accelerators. By converting long-lived hazards into materials that are, or soon will be, sable and harmless, the nuclear cycle is effectively complete.

transuranic—Refers to any element whose atomic number is higher than that of uranium (atomic number 92), including neptunium, plutonium, americium, and curium. All transuranic elements are produced artificially and are radioactive.

transuranic waste—Radioactive waste containing more than 100 nanocuries (3,700 becquerels) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for: (1) high-level radioactive waste; (2) waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the Environmental Protection Agency, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations; of (3) waste that the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61 (DOE 435.1).

tuff—A fine-grained rock composed of ash or other material formed by volcanic explosion or aerial expulsion from a volcanic vent.

Type B packaging—A regulatory category of packaging for transportation of radioactive material. The U.S. Department of Transportation and U.S. Nuclear Regulatory Commission require Type B packaging for shipping highly radioactive material. Type B packages must be designed and demonstrated to retain their containment and shielding integrity under severe accident conditions, as well as under the normal conditions of transport. The current U.S. Nuclear Regulatory Commission testing criteria for Type B package designs (10 CFR Part 71) are intended to simulate severe accident conditions, including impact, puncture, fire, and immersion in water. The most widely recognized Type B packages are the massive casks used for transporting spent nuclear fuel. Large-capacity cranes and mechanical lifting equipment are usually needed to handle Type B packages.

Type B shipping cask—A U.S. Nuclear Regulatory Commission-certified cask with a protective covering that contains and shields radioactive materials, dissipates heat, prevents damage to the contents, and prevents criticality during normal shipment and accident conditions. It is used for transport of highly radioactive materials and is tested under severe, hypothetical accident conditions that demonstrate resistance to impact, puncture, fire, and submersion in water.

unconfomably—Refers to a break or gap in the geological time of deposited materials.

uranium—A radioactive, metallic element with the atomic number 92; one of the heaviest naturally occurring elements. Uranium has 14 known isotopes, of which uranium-238 is the most abundant in nature. Uranium-235 is commonly used as a fuel for nuclear fission. (See natural uranium, enriched uranium, highly enriched uranium, and depleted uranium.)

Vadose zone—The portion of Earth between the land surface and the water table.

vault (special nuclear material)—A penetration-resistant, windowless enclosure having an intrusion alarm system activated by opening the door and which also has—walls, floor, and ceiling substantially constructed of materials that afford forced-penetration resistance at least equivalent to that of 20-centimeter- (8-inch-) thick reinforced concrete; and a built-in combination-locked steel door, which for existing structures is at least 2.54-centimeters (1-inch) thick exclusive of bolt work and locking devices, and which for new structures meets standards set forth in Federal specifications and standards.

viewshed—The extent of an area that may be viewed from a particular location. Viewsheds are generally bounded by topographic features such as hills or mountains.

volatile organic compounds—A broad range of organic compounds, often halogenated, that vaporize at ambient or relatively low temperatures, such as benzene, chloroform, and methyl alcohol. With regard to air pollution, any organic compound that participates in atmospheric photochemical reaction, except for those designated by the U.S. Environmental Protection Agency Administrator as having negligible photochemical reactivity.

waste acceptance criteria—The requirements specifying the characteristics of waste and waste packaging acceptable to a disposal facility, and the documents and processes the generator needs to certify that the waste meets applicable requirements.

waste classification—Wastes are classified according to DOE Order 435.1, Radioactive Waste Management, and include high-level, transuranic, and low-level wastes.

Waste Isolation Pilot Plant (WIPP)—A U.S. Department of Energy facility designed and authorized to permanently dispose of defense-related transuranic waste in a mined underground facility in deep geologic salt beds. It is located in southeastern New Mexico, 42 kilometers (26 miles) east of the city of Carlsbad.

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.

waste minimization and pollution prevention—An action that economically avoids or reduces the generation of waste and pollution by source reduction, reducing the toxicity of hazardous waste and pollution, improving energy use, or recycling. These actions will be consistent with the general goal of minimizing present and future threats to human health, safety, and the environment.

water table—The boundary between the unsaturated zone and the deeper, saturated zone. The upper surface of an unconfined aquifer.

watt—A unit of power equal to 1 joule per second. (See joule.)

wetland—Wetlands are "... those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR 328.3).

whole-body dose—In regard to radiation, dose resulting from the uniform exposure of all organs and tissues in a human body. (See effective dose equivalent.)

wind rose—A circular diagram showing, for a specific location, the percentage of the time the wind is from each compass direction. A wind rose for use in assessing consequences of airborne releases also shows the frequency of different wind speeds for each compass direction.

yield—The force in tons of TNT of a nuclear or thermonuclear explosion.

CHAPTER 9
INDEX

9. INDEX

A

B

C

D

E

F

G

H

I

J

L

M

N

O

P

R

S

T

U

V

W

X

Z

CHAPTER 10
LIST OF PREPARERS

10.0 LIST OF PREPARERS

ELIZABETH WITHERS, U.S. DEPARTMENT OF ENERGY, NATIONAL NUCLEAR SECURITY ADMINISTRATION (NEPA COMPLIANCE OFFICER, NNSA SERVICE CENTER)
EIS RESPONSIBILITIES: EIS DOCUMENT MANAGER, CHAPTER 1

Education: M.S., Life Sciences, Louisiana Tech University
B.S., Botany, Louisiana Tech University

Experience/Technical Specialty:
Twenty-four years. Environmental investigations and NEPA compliance.

KIRK OWENS, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: PROJECT MANAGER

Education: B.S., Environmental Resource Management, The Pennsylvania State University

Experience/Technical Specialty:
Twenty-six years. Radioactive waste management, regulatory, and environmental compliance and assessment, radiological assessment.

STEPHEN R. ALCORN, TIME SOLUTIONS CORP.
EIS RESPONSIBILITIES: GROUNDWATER, GEOCHEMISTRY, EVAPOTRANSPIRATIVE COVERS

Education: Ph.D., Geology, University of Georgia
M.S., Geology, University of South Carolina
A.B., Geology, Lafayette College

Experience/Technical Specialty:
Twenty-seven years. Geology and geochemistry, transport behavior of radionuclides, geochemical and hydrological modeling and analysis, performance assessment, environmental compliance.

KAREN ANTIZZO, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: PROJECT-SPECIFIC ANALYSES

Education: M.S., Technology/Environmental Management, University of Maryland
B.S., Education, Towson University

Experience/Technical Specialty:
Sixteen years. Infrastructure, radioactive waste management, regulatory review, public participation.

TERRI L. BINDER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: APPENDIX C, RADIOLOGICAL AIR EMISSIONS AND HUMAN HEALTH

Education: M.A., Organizational Learning and Instructional Technology
B.A., Mathematics

Experience/Technical Specialty:
Fifteen years. Radiological facility site-specific training, DOE compliance, computer programming.

KENNETH F. BRINSTER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: GROUNDWATER

Education: M.S., Geology, University of North Dakota
B.S., Biology and Education, Dickinson State University

Experience/Technical Specialty:
Twenty-eight years. Professional Geologist, Minnesota. Geology, hydrology, groundwater modeling, air permitting, solid and hazardous waste management, stormwater permitting, pollution prevention.

STEVEN P. CONNER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: GEOLOGY AND SOILS

Education: Ph.D., Geology, Texas A&M University
M.S., Geology, Texas A&M University
B.S. Geology, University of Delaware

Experience/Technical Specialty:
Seventeen years. Professional Geologist, South Carolina and Alabama. Environmental studies, risk assessment, earth resources and geologic characterization, contaminant fate and transport.

RICHARD D. CUNNINGHAM, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: APPENDIX J LEAD, PROJECT-SPECIFIC ANALYSES

Education: M.U.R.P., Urban and Regional Planning, University of Pittsburgh
Graduate Diploma in Social Science, Political Science, University of Stockholm
B.A., Political Science and History, Fairfield University

Experience/Technical Specialty:
Thirty-four years. NEPA, ES&H, environmental policy and regulations, facilities planning, land use, cultural resources, transportation.

M. J. DAVIS, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: WASTE MANAGEMENT

Education: J.D., Law, Georgetown University
B.S., Nuclear Engineering, University of Cincinnati

Experience/Technical Specialty:
Twenty-one years. Regulatory compliance and legal analysis, specializing in environmental protection.

ELLEN R. DIETRICH, SCIENCE APPLICATIONS INTERNATIONAL CORP.
EIS RESPONSIBILITIES: SUMMARY, WATER RESOURCES

Education: B.A., Anthropology, University of Illinois
Graduate school programs in Archaeology and Soil Science, The Pennsylvania State University

Experience/Technical Specialty:
Thirty years. Soil science, NEPA, soil and water resource planning and management.

JOHN DIMARZIO, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: CUMULATIVE IMPACTS

Education: M.S., Geology, George Washington University
B.S., Geology, University of Maryland

Experience/Technical Specialty:
Twenty-three years. NEPA compliance, geology, water resources, waste management, and cumulative impacts.

JOHN EICHNER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: CHAPTER 5 MANAGER, SOCIOECONOMICS

Education: B.S., Accounting, Syracuse University
B.S., Finance, Syracuse University

Experience/Technical Specialty:
Twenty-six years. Project management, impact analysis, socioeconomics, cost-benefit analyses.

SUSAN ENGELKE, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: APPENDIX G, PROJECT-SPECIFIC ANALYSES

Education: B.S., Environmental Science/Geology, University of California at Sacramento

Experience/Technical Specialty:
Four years. Environmental analyst on NEPA/CEQA documents.

SANDRA B. ENYEART, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: APPENDIX G LEAD, CUMULATIVE IMPACTS, PROJECT-SPECIFIC ANALYSES

Education: B.S., Civil Engineering, Georgia Institute of Technology
B.F.A., Art, Idaho State University

Experience/Technical Specialty:
Thirty-one years. Professional Engineer (Civil Engineer), Idaho. NEPA analysis, cumulative impacts, safety analyses, environmental monitoring, water resources management and impact analysis.

BETH FARRELL HALE, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: PUBLIC AFFAIRS LEAD, EMERGENCY MANAGEMENT

Education: B.A., Liberal Arts, University of New Mexico

Experience/Technical Specialty:
Seventeen years. Public affairs, public involvement, and risk communication.
Fifteen years. Emergency management.

DEBBIE J. FINFROCK, TIME SOLUTIONS CORP.
EIS RESPONSIBILITIES: WATER RESOURCES

Education: M.S., Civil Engineering (Environmental Emphasis), University of New Mexico
B.S., Mechanical Engineering, University of Kentucky

Experience/Technical Specialty:
Twenty-four years. Professional Engineer, New Mexico. Waste management and pollution prevention, water resources management, landfill closure design and modeling.

KEVIN T. FOLK, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: INFRASTRUCTURE, PROJECT-SPECIFIC ANALYSES

Education: M.S., Environmental Biology, Hood College
B.A., Geoenvironmental Studies, Shippensburg University

Experience/Technical Specialty:
Seventeen years. Water resources management, utility infrastructure analysis, NPDES permitting and regulatory analysis, earth resources and geologic hazards assessment.

STEVE GEIGER, URS CORPORATION
EIS RESPONSIBILITIES: SCIENCE COMPLEX AND WAREHOUSE FACILITY PROJECT-SPECIFIC ANALYSES (WASTE AND WATER RESOURCES)

Education: Ph.D., Environmental/Agricultural Engineering, The Colorado State University
B.S., M.S. Civil Engineering, The University of New Mexico

Experience/Technical Specialty:
Sixteen years. Professional Engineer, New Mexico. Civil engineering, hydrology, and environmental engineering design, risk management, remediation, compliance, project management.

MILTON E. GORDEN, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: APPENDIX H CO-LEAD, PROJECT-SPECIFIC ANALYSES

Education: B.S., Nuclear Engineering, North Carolina State University

Experience/Technical Specialty:
Sixteen years. Engineer-in-training (Georgia). Waste management, transportation, human health impacts, socioeconomics, environmental remediation technologies.

TENA A. GRABEN, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: MATERIAL DISPOSAL AREAS CHARACTERIZATION AND HAZARD ASSESSMENT

Education: B.S., Professional Biology, University of North Alabama

Experience/Technical Specialty:
Twenty years. Applied health physics, occupational and environmental radiological hazards assessment and dose modeling, regulatory compliance, emergency management.

KATIE A. GRASTY, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: GENERAL SUPPORT

Education: M.E.M., Conservation Science and Policy, Duke University
B.S., Geography, Radford University

Experience/Technical Specialty:
Two years. Environmental law and compliance, ecosystem and natural resource science.

CHADI D. GROOME, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: DEPUTY PROJECT MANAGER, CHAPTER 3 MANAGER

Education: M.S., Environmental Engineering Sciences, University of Florida
B.S., Zoology, Clemson University

Experience/Technical Specialty:
Twenty-six years. Environmental and nuclear regulatory compliance, permitting, and licensing, NPDES permitting, radioactive and hazardous waste management.

CATHY G. HAUPT, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: CHAPTER 6 MANAGER

Education: M.S., Science Education (Biology), Clarion University
B.S., Secondary Education (Geography/Environmental Science), Clarion State College

Experience/Technical Specialty:
Twenty-five years. Regulatory compliance, technical research, quality control.

ROBERT G. HOFFMAN, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: APPENDIX H CO-LEAD, PROJECT-SPECIFIC ANALYSES

Education: B.S., Environmental Resource Management, The Pennsylvania State University

Experience/Technical Specialty:
Twenty years. NEPA compliance, regulatory review, land use planning.

ROBERT W. HULL, LOS ALAMOS TECHNICAL ASSOCIATES, INCORPORATED
EIS RESPONSIBILITIES: ENVIRONMENTAL REMIDIATION DATA AND ACCIDENT ANALYSIS

Education: M.S., Civil Engineering (focus Environmental Engineering), Stanford University
M.S., Geochemistry and Environmental Geology, Florida State University
B.S., Geology, Florida State University

Experience/Technical Specialty:
Thirty-five years. Environmental impacts assessments, environmental baseline surveys, human health risk assessment, environmental remediation.

JAMES D. JAMISON, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: HUMAN HEALTH IMPACTS, SPECIAL PATHWAYS ASSESSMENTS

Education: B.A., Physics, Doane College

Experience/Technical Specialty:
Thirty-six years. Certified Health Physicist. Occupational and environmental radiation safety, accident analysis, assessment of impacts from release of radioactive materials and toxic chemicals.

CHARLES M. JOHNSON, JR., SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: MATERIAL DISPOSAL AREAS CHARACTERIZATION AND HAZARD ASSESSMENT

Education: M.S., Chemistry, Western Carolina University
B.S., Geology, Western Carolina University

Experience/Technical Specialty:
Twenty-two years. Radiochemistry, radiochemical data analysis, validation, and interpretation, site characterization.

CANDI L. JONES, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: BIOLOGICAL SCIENCES

Education: B.S., Cell and Molecular Biology, Minor, Chemistry, University of Montana

Experience/Technical Specialty:
Nine years. Biochemistry, biological warfare and biological warfare agents, risk assessments, biological containment, threat analysis.

ROY KARIMI, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: PROJECT ENGINEER, TRANSPORTATION AND RISK ASSESSMENT

Education: Sc.D., Nuclear Engineering, Massachusetts Institute of Technology
N.E., Nuclear Engineering, Massachusetts Institute of Technology
M.S., Nuclear Engineering, Massachusetts Institute of Technology
B.Sc., Chemical Engineering, Abadan Institute of Technology

Experience/Technical Specialty:
Twenty-nine years. Nuclear power plant safety, risk and reliability analysis, design analysis, criticality analysis, accident analysis, consequence analysis, spent fuel dry storage safety analysis, probabilistic risk assessments.

JULIE KUTZ, URS CORPORATION
EIS RESPONSIBILITIES: SCIENCE COMPLEX AND WAREHOUSE FACILITY PROJECT-SPECIFIC ANALYSES (BIOLOGICAL RESOURCES, FLOODPLAINS AND WETLANDS, VISUAL RESOURCES, AND SOCIOECONOMICS)

Education: B.S., Biology, University of New Mexico

Experience/Technical Specialty:
Six years. Environmental and natural resources.

DALE LYONS, URS CORPORATION

EIS RESPONSIBILITIES: SCIENCE COMPLEX AND WAREHOUSE FACILITY PROJECT-SPECIFIC ANALYSES (SOILS, HUMAN HEALTH, TRANSPORTATION, AND GENERAL ENVIRONMENTAL RESOURCE CONSIDERATIONS)

Education: M.S., Soil Chemistry and Land Rehabilitation, The Montana State University
B.S., Soils and Environmental Science, The Montana State University

Experience/Technical Specialty:
Fourteen years. Environmental consulting, scientific research, and project management.

JASPER G. MALTESE, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

EIS RESPONSIBILITIES: ACCIDENT ANALYSIS, RADIOLOGICAL AND CHEMICAL IMPACTS

Education: M.S., Operations Research, George Washington University
B.S., Mathematics, Fairleigh Dickinson University

Experience/Technical Specialty:
Forty-two years. NEPA assessments, accident analyses, safety analysis report reviews, facility safety audits, system reliability analyses.

GREGORY F. MARTIN, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

EIS RESPONSIBILITIES: HUMAN HEALTH IMPACTS, SPECIAL PATHWAYS ASSESSMENTS

Education: M.S., Radiological Physics, San Diego State University
B.S., Physics, San Diego State University

Experience/Technical Specialty:
Twenty-four years. Hazards assessment, accident analysis, environmental transport of hazardous materials, and assessment of human impacts.

PAUL MINK, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

EIS RESPONSIBILITIES: MATERIAL DISPOSAL AREAS CHARACTERIZATION AND HAZARD ASSESSMENT

Education: M.S., Nuclear (Radiological) Engineering (coursework completed, thesis in progress), University of Tennessee
B.S., Industrial Engineering, University of Tennessee

Experience/Technical Specialty:
Thirteen years. Health physics, evaluation of survey data and radiological engineering analysis.

STEVEN M. MIRSKY, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: HUMAN HEALTH LEAD, APPENDIX D LEAD, ACCIDENT ANALYSIS

Education: M.S., Nuclear Engineering, The Pennsylvania State University
B.S., Mechanical Engineering, Cooper Union

Experience/Technical Special:
Thirty years. Professional Engineer (Mechanical) Maryland. Safety analysis, nuclear powerplant design, operations, foreign nuclear powerplant system analysis, accident analysis, thermal hydraulics, shielding and dose assessment, spent nuclear fuel dry storage safety analysis.

STEVEN E. MIXON, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: TECHNICAL EDITOR

Education: B.S., Communications, University of Tennessee

Experience/Technical Specialty:
Eighteen years. Program analyst, technical writer and editor, speechwriter, publications specialist.

SHEA NELSON, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: GENERAL SUPPORT, QUALITY ASSURANCE

Education: M.E., Environmental Engineering, University of Maryland
B.A., Environmental Science, University of Virginia

Experience/Technical Specialty:
Six years. Regulatory compliance, environmental remediation, technical writing, quality assurance/quality control.

ARIS PAPADOPOULOS, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: WORKER AND PUBLIC HEALTH AND SAFETY

Education: M.S., Nuclear Engineering, University of Utah
B.S., Physics, Hamline University

Experience/Technical Specialty:
Thirty-seven years. NEPA compliance, nuclear facilities regulatory compliance, radiological risk analysis, health physics, radioactive waste management.

WILDA E. PORTNER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: PUBLIC INVOLVEMENT, TECHNICAL EDITOR

Education: A.A., Business Administration, Frederick Community College

Experience/Technical Specialty:
Sixteen years. Public information, Tribal relations, technical writing and editing.

JEFFREY J. RIKHOFF, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: DEPUTY PROJECT MANAGER, CHAPTER 2, ENVIRONMENTAL JUSTICE

Education: M.R.P., Regional/Environmental Planning, University of Pennsylvania
M.S., International Economic Development and Appropriate Technology, University of Pennsylvania
B.A., English, DePauw University

Experience/Technical Specialty:
Nineteen years. NEPA compliance, regulatory compliance and permitting, socioeconomics, environmental justice, comprehensive land-use and development planning, cultural resources.

JOSEPH F. ROBBINS, U.S. DEPARTMENT OF ENERGY, NATIONAL NUCLEAR SECURITY ADMINISTRATION (NEPA COMPLIANCE OFFICER, ALBUQUERQUE SERVICE CENTER)
EIS RESPONSIBILITIES: DOCUMENT REVIEW

Education: B.S., Biology, University of Maine
Graduate Studies, University of Massachusetts and Utah State University

Experience/Technical Specialty:
Thirty-one years. Environmental investigations, NEPA compliance.

NESETARI A. ROBINSON, SCIENCE APPLICATION INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: ENVIRONMENTAL DATA ANALYSES

Education: B.S., Chemical Engineer, University of Maryland Baltimore County

Experience/Technical Specialty:
Nine months. Engineer-in-training (Maryland). Technical writer and compiling data into graphs and charts.

GARY W. ROLES, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: MATERIAL DISPOSAL AREA REMEDIATION, CANYON CLEANUPS, AND OTHER COMPLIANCE ORDER ACTIONS LEAD

Education: M.S., Nuclear Engineering, University of Arizona
B.S., Mechanical Engineering, Arizona State University

Experience/Technical Speciality:
Twenty-eight years. Radioactive waste management; regulatory and compliance analysis.

THOMAS L. RUCKER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: MATERIAL DISPOSAL AREAS CHARACTERIZATION AND HAZARD ASSESSMENT

Education: Ph.D., Analytical Chemistry, Health Physics Minor, University of Tennessee
M.S., Environmental Chemistry, University of Tennessee
B.S., Chemistry, David Lipscomb University

Experience/Technical Specialty:
Thirty-three years. Analytical chemistry, radiochemistry, radiological monitoring, dose and risk assessment, and environmental and waste characterization.

PETER C. SANFORD, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: PROJECT-SPECIFIC ANALYSES, DD&D AND CONSTRUCTION PARAMETER ESTIMATES

Education: M.S., Metallurgical Engineering, Colorado School of Mines
B.S.E., Chemical Engineering/Material Science, University of Connecticut

Experience/Technical Specialty:
Twenty-six years. Project management, actinide recovery and processing, health physics, decontamination and decommissioning, waste management, and environmental compliance.

JAMES R. SCHINNER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: CHAPTER 4 MANAGER, LAND, VISUAL, ECOLOGICAL, AND CULTURAL RESOURCES

Education: Ph.D., Wildlife Management, Michigan State University
M.S., Zoology, University of Cincinnati
B.S., Zoology, University of Cincinnati

Experience/Technical Specialty:
Thirty-three years. Ecological field assessments, NEPA documentation, regulatory reviews.

JENNIFER C. SMITH, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: PAST PERFORMANCE AND DESCRIPTION OF ALTERNATIVES

Education: M.S., Natural Resources and Environment, University of Michigan
B.A., Environmental Studies, University of Vermont

Experience/Technical Specialty:
Two years. Environmental education and public awareness, risk communication.

MARY ALICE SPIVEY, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: LAWS AND REGULATIONS

Education: B.S., Environmental Science, Florida Institute of Technology

Experience/Technical Specialty:
Twenty-three years. Regulatory analysis and compliance, waste management, NEPA compliance.

ELLEN TAYLOR, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: CHAPTER 5, PROJECT-SPECIFIC ANALYSES

Education: Ph.D., Biology, University of Pennsylvania
B.A., Zoology, University of Vermont

Experience/Technical Specialty:
Twenty-four years. Environmental compliance and NEPA assessments.

ALAN L. TOBLIN, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: ACCIDENT ANALYSIS, RADIOLOGICAL AND CHEMICAL IMPACTS

Education: M.S., Chemical Engineering, University of Maryland
B.E., Chemical Engineering, Cooper Union

Experience/Technical Specialty:
Thirty-five years. Contaminant transport through air, groundwater, and surface water, accident risk analysis.

TOBY WALTERS, URS CORPORATION
EIS RESPONSIBILITIES: SCIENCE COMPLEX AND WAREHOUSE FACILITY PROJECT-SPECIFIC ANALYSES (GEOLOGIC AND ENVIRONMENTAL RESOURCES)

Education: M.S., Water Resources Management, The University of New Mexico
B.S., Geology, The University of New Mexico

Experience/Technical Specialty:
Twenty-six years. Environmental consulting and project management.

ROBERT H. WERTH, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: NOISE ANALYSIS, AIR QUALITY MODELING

Education: B.A., Physics, Gordon College

Experience/Technical Specialty:
Thirty years. Acoustics and air quality analysis, regulatory reviews, and NEPA documentation.

JACK YOUNG, URS CORPORATION

EIS RESPONSIBILITIES: SCIENCE COMPLEX AND WAREHOUSE FACILITY PROJECT-SPECIFIC ANALYSES (ARCHAEOLOGICAL DATA ANALYSIS)

Education: M.A., Archaeological Survey and Cultural Resource Planning, Durham
B.A., History, The University of New Mexico

Experience/Technical Specialty:

Nine years. Cultural resource management and planning throughout the greater Southwestern USA and Britain; New Mexico State Land Use Permit for Archaeology 2005 NM-05-187; 2005 Laboratory of Anthropology curation agreement and ARMS user agreement.

Chapter 11
Distribution List

11. DISTRIBUTION LIST

The U.S. Department of Energy (DOE) provided copies of the *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (SWEIS) to Federal, state, and local elected and appointed officials; Native American representatives; public interest groups; and other organizations and individuals listed in this chapter. Approximately 400 copies of the Final SWEIS and 400 copies of the Final SWEIS Summary were distributed. Copies will be provided to others on request.

United States Congress

U.S. House of Representatives

Steve Pearce, R-New Mexico
Tom Udall, D-New Mexico
Heather A. Wilson, R-New Mexico

U.S. House of Representatives Committees

David Obey, Committee on Appropriations
Jerry Lewis, Committee on Appropriations
Peter J. Visclosky, Committee on Appropriations
 Subcommittee on Energy and Water Development, and Related Agencies
David L. Hobson, Committee on Appropriations
 Subcommittee on Energy and Water Development, and Related Agencies
John D. Dingell, Committee on Energy and Commerce
Joe Barton, Committee on Energy and Commerce
Rick Boucher, Committee on Energy and Commerce
 Subcommittee on Energy and Air Quality
Fred Upton, Committee on Energy and Commerce
 Subcommittee on Energy and Air Quality
Albert R. Wynn, Committee on Energy and Commerce
 Subcommittee on Environment and Hazardous Materials
John B. Shadegg, Committee on Energy and Commerce
 Subcommittee on Environment and Hazardous Materials
Bart Gordon, Committee on Science and Technology
Ralph M. Hall, Committee on Science and Technology
Nick Lampson, Committee on Science and Technology
 Subcommittee on Energy and Environment
Bob Inglis, Committee on Science and Technology
 Subcommittee on Energy and Environment

U.S. Senate

Jeff Bingaman, D-New Mexico

Pete V. Domenici, R-New Mexico

U.S. Senate Committees

Robert C. Byrd, Committee on Appropriations
Thad Cochran, Committee on Appropriations
Byron L. Dorgan, Committee on Appropriations
  Subcommittee on Energy and Water Development
Pete V. Domenici, Committee on Appropriations
  Subcommittee on Energy and Water Development
Barbara Mikulski, Committee on Appropriations
  Subcommittee on Commerce, Justice, Science, and Related Agencies
Richard Shelby, Committee on Appropriations
  Subcommittee on Commerce, Justice, Science, and Related Agencies
Daniel K. Inouye, Committee on Commerce, Science and Transportation
Ted Stevens, Committee on Commerce, Science and Transportation
John Ensign, Committee on Commerce, Science and Transportation
  Subcommittee on Science, Technology and Innovation
John F. Kerry, Committee on Commerce, Science and Transportation
  Subcommittee on Science, Technology and Innovation
Jeff Bingaman, Committee on Energy and Natural Resources
Pete V. Domenici, Committee on Energy and Natural Resources
Bryon L. Dorgan, Committee on Energy and Natural Resources, Subcommittee on Energy
Lisa Murkowski, Committee on Energy and Natural Resources, Subcommittee on Energy
Barbara Boxer, Committee on Environment and Public Works
James M. Inhofe, Committee on Environment and Public Works
Thomas R. Carper, Committee on Environment and Public Works
  Subcommittee on Clean Air and Nuclear Safety
George V. Voinovich, Committee on Environment and Public Works
  Subcommittee on Clean Air and Nuclear Safety

Federal Agencies

Advisory Council on Historic Preservation
Bandelier National Monument
Defense Nuclear Facilities Safety Board
Santa Fe National Forest
U.S. Department of the Interior
U.S. Environmental Protection Agency
U.S. Nuclear Regulatory Commission
U.S. Fish and Wildlife Service

Local Government

New Mexico

Mayors
Martin J. Chavez, Albuquerque
Joseph Maestas, Española
David Coss, Santa Fe

City Officials
Danielle Duran, City of Espanola, City Councilor
Miguel Chavez, City of Santa Fe, City Councilor

County Officials

Los Alamos County
Max Baker, County Administrator
Anthony Mortillaro, Assistant County Administrator
Rick Bohn, Director, Community Development
Regina Wheeler, Los Alamos County Landfill, Manager, Solid Waste Division

Rio Arriba County
Lorenzo Valdez, County Manager

Taos County
Acequia Abajo de El Valle, Mark Schiller, Commissioner

NEPA State Point of Contact

Ron Curry, New Mexico

State Government

New Mexico Governor
Bill Richardson

New Mexico Senators
Lynda M. Lovejoy
Richard C. Martinez
John Pinto
James G. Taylor

New Mexico Representatives
Richard J. Berry
Rhonda S. King
Ben Lujan
Patricia A. Lundstrom
Alfred A. Park
Debbie A. Rodella
Henry Saavedra
Nick L. Salazar
Jeannette O. Wallace

New Mexico Environment Department
Bill Bartels
James Bearzi
Ron Curry
William Moats
John Parker
Dennis Pepe
Steve Yanicak

Citizen Advisory Boards

J. D. Campbell, Northern New Mexico Citizens' Advisory Board
Menice Santistevan, Northern New Mexico Citizens' Advisory Board
Christina Houston, Northern New Mexico Citizens' Advisory Board

Native American Representatives

New Mexico

Joe Garcia, Chairman, All Indian Pueblo Council
Greg Ortiz, Vice Chairman, All Indian Pueblo Council
James Roger Madalena, Director, Five Sandoval Indian Pueblos
Executive Director, Eight Northern Indian Pueblos Council
Levi Pesata, President, Jicarilla Apache Nation
Ty Vicenti, Vice President, Jicarilla Apache Nation
Carleton Naiche-Palmer, President, Mescalero Apache Tribe
Jackie D. Blaylock, Sr., Vice President, Mescalero Apache Tribe
Holly Houghten, Tribal Historic Preservation Officer, Mescalero Apache Tribe
Robert Gruenig, National Tribal Environmental Council
Ben Shelly, Vice President, Navajo Nation
Lawrence Morgan, Speaker of the House, Navajo Nation Council
Joe Shirley, Jr., President, Navajo Nation
Herman Shorty, Director, Commission on Emergency Management, Navajo Nation
Hope MacDonald Lone Tree, Public Safety Committee, 21st Navajo Nation Council
Chandler Sanchez, Governor, Pueblo of Acoma
Mark Thompson, 1st Lieutenant Governor, Pueblo of Acoma
Stanley Paytiamo, EPA Office, Pueblo of Acoma
Ron Charlie, 2nd Lieutenant Governor, Pueblo of Acoma
Mike Pecos, Lieutenant Governor, Pueblo of Cochiti
Ernest Suina, Governor, Pueblo of Cochiti
Robert Benavides, Governor, Pueblo of Isleta
Frank Lujan, 2nd Lieutenant Governor, Pueblo of Isleta
Max Zuni, 1st Lieutenant Governor, Pueblo of Isleta
Paul Chinana, Governor, Pueblo of Jemez
Joshua Madalena, 1st Lieutenant Governor, Pueblo of Jemez
Delbert Tafoya, 2nd Lieutenant Governor, Pueblo of Jemez
John Antonio, Sr., Governor, Pueblo of Laguna
Pete Kasero, 2nd Lieutenant Governor, Pueblo of Laguna
Richard Luarkie, 1st Lieutenant Governor, Pueblo of Laguna
Arnold Garcia, Lieutenant Governor, Pueblo of Nambe
Ernest Mirabal, Governor, Pueblo of Nambe
Johnny Abeyta, 1st Lieutenant Governor, Ohkay Owingeh
Larry Phillips, Jr., 2nd Lieutenant Governor, Ohkay Owingeh
Earl Salazar, Governor, Ohkay Owingeh
Julia Geffroy, Associate Director, Environment Department, Pueblo of Picuris
Richard Mermejo, Lieutenant Governor, Pueblo of Picuris
Craig Quanchello, Governor, Pueblo of Picuris
Linda Diaz, Lieutenant Governor, Pueblo of Pojoaque
George Rivera, Governor, Pueblo of Pojoaque
Robert Montoya, Governor, Pueblo of Sandia
Ryan Paisano, Lieutenant Governor, Pueblo of Sandia
Fred Armijo, Lieutenant Governor, Pueblo of Santa Ana

Ulysses Leon, Governor, Pueblo of Santa Ana
J. Michael Chavarria, Governor, Pueblo of Santa Clara
Stanley Tafoya, Lieutenant Governor, Pueblo of Santa Clara
Bernie L. Chavez, Lieutenant Governor, Pueblo of San Felipe
Ronald L. Tenorio, Governor, Pueblo of San Felipe
Leon Roybal, Governor, Pueblo of San Ildefonso
Paul Rainbird, 1st Lieutenant Governor, Pueblo of San Ildefonso
Terrence Garcia, 2nd Lieutenant Governor, Pueblo of San Ildefonso
Neil Weber, Director, Environmental and Cultural Preservation, Pueblo of San Ildefonso
David F. Garcia, Lieutenant Governor, Pueblo Santo Domingo
Sisto Quintana, Governor, Pueblo Santo Domingo
Tom Lujan, Sr., Lieutenant Governor, Pueblo of Taos
Paul T. Martinez, Governor, Pueblo of Taos
Anthony Dorame, Lieutenant Governor, Pueblo of Tesuque
Robert Mora, Governor, Pueblo of Tesuque
Fred Medina, Lieutenant Governor, Pueblo of Zia
Ivan Pino, Governor, Pueblo of Zia
Norman Cooeyate, Governor, Pueblo of Zuni
Dancy Simplicio, Lieutenant Governor, Pueblo of Zuni

Public Interest Groups

Dorelen Bunting, Albuquerque Center for Peace and Justice
Judith Kidd, Albuquerque Center for Peace and Justice
Susan Gordon, Alliance for Nuclear Accountability
Alfred Meyer, Alliance for Nuclear Accountability
Laura Harris, Americans for Indian Opportunity
Brian Shields, Amigos Bravos
J. Berde, Carson Forest Watch
Maureen Houlihan, Catholic Charities of Gallup, Catholic Indian Center
Sue Dayton, Citizen Action New Mexico
David McCoy, Citizen Action New Mexico
Janet Greenwald, Citizens for Alternatives to Radioactive Dumping
Bradley Schiro, Citizens Against Radioactive Waste
Kamara O'Connor, Coalition to Demilitarize Education
Susan Dayton, Citizen Action New Mexico
Joni Arends, Concerned Citizens for Nuclear Safety
Sadaf Cameron, Concerned Citizens for Nuclear Safety
Kalliroi Matsakis, Concerned Citizens for Nuclear Safety
Sheri Kotowski, Embudo Valley Environmental Monitoring Group
Tom Carpenter, Government Accountability Project
Jim Riccio, Greenpeace International
Lois Chalmers, Institute for Energy and Environmental Research
Arjun Makhijani, Institute for Energy and Environmental Research
Peter Malmgren, Los Alamos Oral History Project
Robert Long, Los Alamos Study Group
Greg Mello, Los Alamos Study Group
Blake Trask, Los Alamos Study Group
Robert Holden, National Congress of American Indians
Jacqueline Johnson, National Congress of American Indians
Libby Fayad, National Parks Conservation Association
Thomas Cochran, Natural Resources Defense Council
Denise Gonzales, New Mexico Community Foundation

Doug Melklejohn, New Mexico Environmental Law Center
Jay Coghlan, Nuclear Watch of New Mexico
Scott Kovac, Nuclear Watch of New Mexico
Geoff Petrie, Nuclear Watch of New Mexico
John Witham, Nuclear Watch of New Mexico
Ilse Bleck, Pajarito Group of the Sierra Club
Peggy Prince, Peace Action New Mexico
Virginia Miller, People for Peace
Will Callaway, Physicians for Social Responsibility
LeRoy Moore, Rocky Mountain Peace and Justice Center
Juan Montes, Rural Alliance for Military Accountability
Alice Roos, Sanctuary Foundation
Bernard Foy, Sangre de Cristo Audubon Society
Tom Taylor, Sangre de Cristo Audubon Society
Patricia McCormick, Sisters of Loretto
Penelope McMullen, Sisters of Loretto
Sharon Palma, Sisters of Loretto
Sylvia Sedillo, Sisters of Loretto
Jeremy Maxand, Snake River Alliance
Michael Guerrero, Southwest Organizing Project
William Paul Robinson, Southwest Research and Information Center
Don Hancock, Southwest Research and Information Center
Clifton Bain, Taos Rio Arriba County Green Party
Kathy Sanchez, TEWA Women United
Jay Gilbert Sanchez, Tribal Environmental Watch Alliance
Alden Meyer, Union of Concerned Scientists
TE Origer, Veterans for Peace
Matthew Bishop, Western Environmental Law Center

Public Reading Rooms and Libraries

A complete copy of the Final SWEIS along with the reference materials may be reviewed at any of the Public Reading Rooms and Libraries listed below.

Freedom of Information Reading Room
U.S. Department of Energy
1000 Independence Avenue, SW, 1E-90
Washington, DC 20585-0001
(202) 586-5955

Los Alamos National Laboratory
Research Library
TA-3-207
Los Alamos, NM 87545
(505) 667-0216

Mesa Public Library
2400 Central Avenue
Los Alamos, NM 87544
(505) 662-8240

New Mexico State Library
1209 Camino Carlos Rey
Santa Fe, NM 87507
(505) 476-9700

Santa Fe Main Library
145 Washington Avenue
Santa Fe, NM 87501
(505) 955-6780

Santa Fe Public Library
Oliver La Farge Branch
1730 Llano Street
Santa Fe, NM 87501
(505) 955-4862

Española Public Library
313 N. Paseo de Oñate
Española, NM 87532
(505) 747-6087

Government Information Department
Zimmerman Library
University of New Mexico
Albuquerque, NM 87131-1466
(505) 277-5441

Individuals

Jessica Aberly
Marylin Abesir
John Acker
Rodney Adams
Cecelia Albert
Bob Aly
Robert Anderson, PhD
Ann Anthony
Ivan Archuleta
Jodie Arellano
Navrose D. Armaria
Richard Arthure
Linda Aspenwind
Sage Asplund
Mr. Avdas
Elaine Baker
MJ Baker
Darrell Baldwin
Caron Balkany, Esq.
Josephine Ball
Donald Baltz
Susan Bardes
Steven Barela
Chloe Barrett
Floy Barrett
S. Cabrini Bartolo
Michael and Julie Bechko
Kathryn Becker
Leslie Behn
Richard Belanger
Jeffrey Birnbaum
A Bittson
Tiska Blankenship
Hans Bleiker
Jim Bock
Beatrice Boles
Lorrie Bonds Lopez
Bonnie Bonneau
Jan Boyer
Keri Boynt
Mark Bremer
Marcia Brenden
Jeanne Bridge
Ellen Brodsky
Mary Bronsteter
James Brosnan
Christina Hope Brown
Don Brown
Joan Brown
Karen Browne
Phyllis Browne, PhD
Norm Budow
Mark Bundy
Amy Bunting
Patrick Burns
Beverly Busching
Martha Bushnell PhD
Cleo Byers
Beverley Sheena Cameron
Marilyn Campbell
Alice Campion
Elizabeth Carson
Teresa Chavez
Ann Chew
William Christison
Joseph Ciddio

Doug Clark
Phil Clark
Grace Clearson
Evelyn Cole
Phylis Collier
Lori Colt
Barbara Conroy
Wendy Courtemanche
Theresa Coyle
Joan Coyote
Daniel Craig, DOM
Gary Cronin
Jesse Cross
Peggy Cross
Priscilla Cross
Virginia Cross
Tim Curry
Hilary Cushing-Murray
Aaron Czerny
Phil and Kathy Dahl-Bredine
Glory Dassi
Andrew Davis
Rev. John Dear, SJ
Steve Dees
Janet Degan
Maria Demmin
Michele Desgroseilliers
Laurie Dickerson Moreau
Mark Dilg
Trish Doherty
Jody Donaldson
Kevin Doyle
Nora Drosin
Carolyn Dukeminier
Jackie Dulle
Clarissa Duran
Ann Eberlein
George Emery
M Jane Engel
Daniel Erdman
Jay Ertel
Oliver Esch
Gary and Dianne Eschman
Rosamund Evans
Erich Evered
Bernard and Melinda Ewell
Sky Fabin
Stevie Famulari
Toni Feder
Bernadette & Sierra Fernandez
Barbara Ferry
Raymond Finck
Dee and Doris Finney
Jim and Mary Finney
Mary Flaherty
John Fleck
Bobbie Fleming
Nancy Florsheim
Ann Fonfa
Felicity Fonsera
Patricia Forman
Antoinette Fox
Lisa Fox
Paulette Frankl
Ellen Franklin, PhD
Harvey Frauenglass
Jack Frenkel
Carla Friedman
David Fuehne
Aurelia Fule
Graciela Garcia
Jade Garcia
Myra Garcia
Percyne Gardner
Heather Gaudet
John Geddie
Georgiana Geerds
Jim and Jean Genasci
David Genth
Jane German
Daniel Gibson
Travis Gibson
Gregg Giesler
Carl Gilbert
Pamela Gilchrist
Joe and Janice Gildea
Beth Ann Gillian
Katie Gillis
Sylvia Ginder
Diane and Arthur Gledhill
Michael Gold
Barbara Gonzales
Sally Goodknight
Emily Graeser
Kim Granzow
Mary Grathwol
Glen Graves
Connie Green
Jeanne Green
Patricia Green
Janet Greenwald
Nona Lee Gregg
Ellen Gregor
Patricia Griffin
Linda Griffth
Ed Grothus
Saul and Jennet Grover
Irene Grygorowicz
Jane Hanna
Berta Hanna
Patricia Hannigan
Linda Hardman
Jonathan Hare
Faith Harmony
Bob Harris
Wendell Harris
Selma Harwell
Hallie Hayden
Ann Hendrie
Diane Hiel
Jack High
Elizabeth Hinds
Dorothy Hoard
Marie Hoare
Gabriel Hoare, SL
Linda Hobbs
Marilyn Hoff
Sue Holmes
David Holmstron
Kevin Holsapple
Laura Holt
Dee Homans
Helenty Homans
Cynthia Homire
Sharon Horne
Robert Hull
Madeleine Hurd
Mimi Hurd
Virginia Ikeda
Dorothy Jensen
Norma Jette
Jose Jimenez
Ed Johnson
Karin Johnson
Richard Johnson
Thomas Johnson
Marjorie Jones
Velva Jones
Myron Kaczmarsky
Kathryn Keith, MD
C Keller
Jean Kelley
Susan Kemper Bryant
Diane and Mike Kenny
Amy Kepfer

Richard Khanlian
Joy Kincaid
Nancy King
Donal Kinney
Kim Kirkpatrick
Karen Kleeman
Terry Klein
Linda Klosky
Andrew Koehler
Terrence Kopet
Eleanor and John Krebs
Erich Kuerschner
Hildegard Kurz
Paul LaBeaume
Dennis and Eleanor Lacoss
Alice Ladas
Paula Lake
Leslie LaKind, DDS
Shaphan Laos
Rick Lass
Lisa Law
Patricia Leahan
Beatrice Lewis
Edwina Lieb
Mark Lind
Debra Link
Lucy Lippard
Susannah Lippman
Becky Lo Dolce
Ashana Lobody
Ross Lockridge
Joan Logghe
Timothy Long
Sabine Lucas
Jane Lumsden
Jan Lustig
Ronald Lynn
Sue Shen Lyons
Donald and Judith Machen
Anne MacNaughton
Carol Macomber
Sue Malec
Peter Malmgren
Richard & Elizabeth Malmgren
Patricia Manion SL PhD
John Marin
Jon Marin
Christina Maris
Albert Marshall
Betsy and Robert Martinez
Cheryl Martinez
Susan Martinez
Alison and Tony Martinez
Tyla Matteson
Rachel McCarthy
Doug McClellen
Anne McConnell
Beverly McCrary
Rita McElmury
Amy McFall
Joan McGrane
Keith McHenry
Kristin McNamara
Chris Mechels
Dorothy Mendelson
Arlene Mestas
Edgar and Catherine Meyer
Sarah Meyer
Leslie Michaels
Carol Miller
Iria Miller
Larry Miller
Matt Miller
Michael Miller
Rima Miller
Tonya Miller
Sharon Millstein
Ian Mion
Betsy Mitchell
Ignacio Montano
Carlos Mora
Luis Morales
Laurie Dickerson Moreau
Ann Morgan, PhD
Amanda Murchison
Frank Murchison
David Murnion
Vincent Murphy
Ann Murray
Ethel Nachlinger
Marian Naranjo
Linda Naranjo-Huebl
Margaret Nes
David and Renze Nesbit
Shel Neymark
Jean Nichols
Corina Nolting
Sandra O'Kelly
Kathleen O'Malley
Michael and Jodi Odland
Fancesca Oldeni-Neff
James Oliver
Cheryl Olson
Alan Osborne
Mark Oswald
Dennis and Eileen Overman
Miguel Pacheco
Jane Padberg
Jeanne Pahls
Claudia Parker
Kathleen Parker
Joseph Parko
Ruth Parrish
David and Therese Patton
Bobbie Paul
Jeannie Pearle
Robert Pearson
Charles Pergler
Mia Perotta
Valerie Peterson
Suzanne Phillips
Giselle Piburn
Mary Pickett
Dave Pierce
Steve Piersol
James Pigg
Gaye and Henry Pollitt
Dan and Barbara Pollock
Robin Poole
Marjorie Popp
Donivan Porterfield
Jean Porteus
Ira and Doris Pottenger
Peter Prandoni
Rebecca Procter
Sasha Pyle
Donna Quasthoff
Giuseppe Quinn
Michael Quintana Jr
Adam Rankin
Elizabeth Raby
Thomas Ray
Adam Read
Deborah Reade
Steven Reneau
Mauna Richardson
Nausika Richardson
Elizabeth Riedel
Sophia Ritchie
Gayanne Robinson
Carmen Rodriguez
Earl Rohleder
Robert Romeo
Carmella Romero
Ryan and Amanda Rose

Stanley Rosen
Tamara Roske
Jasmine Roske-Jones
Richard Rowe
Katherine Roxlau
Bud Ryan
Meena Sachdeva
Miriam Sagan
Gregory Sagemiller
Mr. and Mrs. Sant
William Santelmann Jr
Emile Sawyer
Sharon Scarlett
Peter Scherm
R Schmidt
Mellis Schmidt, PhD
Don Schrader
Michael Scofield
Alice Sealey
Paula Seaton
Anne Sensenig
Robert Seton
Marion Seymour
Lexie Shabel
Lorenna Shalev
Colleen Shanahan
Thomas and Rebecca Shankland
Sandra Shaw
Michael Shorr
Robert Siebert
Alan Siegel
Raymond and Wendy Singer
Lisa Sipp
Deborah Smith-Davis
Roger Snodgrass
Shannyn Sollitt
Helen South
Paul Sowanick
Thea Spaeth
Steven Spencer, MD
Jeff Spicer
Zane Spiegel
Elana Sue St Pierre
David Stephenson
Dwight Stephenson
Roy Stephenson
Jasmine Stewart
Steve and Barbara Stoddard
Adam Stone
Ron Strauch
Sonia Stromberg
John Stroud
Martin Suazo, Sr.
Cathie Sullivan
Martina Sullivan
Marie Sutton
Simone Withers Swan
Cathy Swedlund
Roxanne Swentzell
Brooke Tatum
Patricia Ellen Taylor
Simon Teolis
Carroll Thomas
Judy Thompson
Laura Thompson
David Thomson
Alicia Tietje
Elizabeth Timken
Christopher Timm, PE
Bob Tirk
Jeff Tollefson
Andrew Tongate
Beth Tori
Aileen Torres-Hughes
Patrick Travers
Jeanne Treadway
Kathryn Tretter
Calvin Tribby
Barbara Turner
Janet Urian
Ernest Valdez
Marcia Valdez
Jonathan Ventura
Susan Verkamp
Mimi Voegelin
Sue Vorenburg
Eleanore Voutselas
David Wagoner
Robin Gay Wakeland
Jennifer Walters
Sally Warnick
Marion Wasserman
LuAnn Watkins
Deanna and Mark Watson
Kimberly Webber
Max Weber
Robert Weber
John Martin West
Rev. Dr. Judi West
Patricia Whalen
Paul White
Linda Wiener
Michel Wiggs-West
Chrysa Wikstrom
Amy Williams
Holly Ann Williams
Marjorie Williams
Dean Williamson
Natasha Williamson
Marilyn Winter-Tamkin
Scott Wiseman
Richard and Evelyn Witt
Hollis Wood
Ray Wood
Keith Wuertz
George Yankura
Landon Young
Richard Yunker
Jay Zeiger
Cecile Zeigler
Nina Zelenunsky
Tiffin Zellers
Bonnie Zirkel
Alice Zorthian