DOE/EIS-0380D
June 2006

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

Volume I

National Nuclear Security Administration

Availability of the Draft 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:

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COVER SHEET

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

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

Location: Los Alamos, New Mexico

For additional information or for copies of this draft SWEIS, contact:

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This document is available on the NNSA Los Alamos Site Office website (http://www.doeal.gov/LASO) for viewing and downloading.

***Abstract*:** NNSA proposes to continue operating the Los Alamos National Laboratory (LANL) 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. Expanded Operations is NNSA's Preferred Alternative. In the No Action Alternative, NNSA would continue the historical mission support activities LANL has conducted at currently approved operational levels. Under the Reduced Operations Alternative, NNSA would eliminate selected activities and limit the operations of other selected activities. In the Expanded Operations Alternative, NNSA would operate LANL at the highest levels of activity currently foreseeable, including full implementation of the mission assignments. 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 among alternatives for 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.

Public Comments: In preparation of this Draft SWEIS, NNSA considered comments received from the public during the scoping period (January 19, 2005 to February 17, 2005). Locations and times of public hearings on this document will be announced in the *Federal Register* in June 2006. Comments on this Draft SWEIS will be accepted at the address listed above for a period of 60 days following its issuance and will be considered for preparation of the Final SWEIS. Any comments received after the 60-day period will be considered to the extent practicable for the preparation of the Final EIS.

DEPARTMENT OF ENERGY
National Nuclear Security Administration
Los Alamos Site Office
Los Alamos, New Mexico 87544

June 28, 2006

Dear Interested Party:

A copy of the *Draft Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (SWEIS) (DOE/EIS-0380D) and/or a Summary of the Draft SWEIS is enclosed with this letter. We welcome your comments on this document.

The National Nuclear Security Administration (NNSA), an agency within the Department of Energy, proposes to continue operating the Los Alamos National Laboratory (LANL). The Draft SWEIS evaluates the potential environmental impacts associated with a No Action Alternative and two action alternatives: a Reduced Operations Alternative and an Expanded Operations Alternative. Under the No Action Alternative, NNSA would continue the historical mission support activities at LANL at currently approved operational levels. Under the Reduced Operations Alternative, NNSA would eliminate selected activities and limit operations of other selected activities. In the Expanded Operations Alternative, NNSA would operate LANL at the highest levels of activity currently foreseeable, including full implementation of the mission assignments. NNSA's Preferred Alternative is the Expanded Operations Alternative.

In preparing the Draft SWEIS, NNSA considered comments received from the public during the scoping period (January 5 through February 27, 2005). Public hearings on the findings of the environmental impact analyses contained within the Draft SWEIS will be held at the following dates and locations in New Mexico: <u>Tuesday, August 8, 2006</u>, Fuller Lodge, Central Avenue, Los Alamos; <u>Wednesday, August 9, 2006</u>, Eagles Memorial Sportsplex at the Northern New Mexico Community College, Española; and <u>Thursday, August 10, 2006</u>, Main Building at the Santa Fe Community College, Santa Fe. The doors will open at 6:00 p.m., with the hearings being held from 6:30 p.m. to 8:30 p.m. NNSA presentations will be made at 6:30 p.m. and oral comment opportunities will be scheduled thereafter starting at about 6:45 p.m.

Written comments on the Draft SWEIS will also be accepted at the public hearings, or may also be sent to one of the addresses listed on the following page. The comment period on the Draft SWEIS will extend through September 5, 2006. All comments received during the comment period will be considered during preparation of the Final SWEIS. Comments received after the close of the comment period will be considered to the extent practicable. Comments or requests for information can also be submitted by calling a toll free telephone number and leaving a message: 1-877-491-4957.

Individual names and addresses (including E-mail addresses) received as part of comment documents on this Draft SWEIS normally are part of the public record. NNSA plans to reproduce comment documents in their entirety in the Final SWEIS (as appropriate and to post all comment documents received in their entirety on the Website for this SWEIS at the close of the public comment period). Any person wishing to have his/her name, address, or other identifying information withheld from the public record of comment documents must state this request prominently at the beginning of any comment document. NNSA will honor the request to the extent allowable by law. All submissions from organizations and businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, will be included in the public record and open to public inspection in their entirety.

Written comments or requests for additional information should be submitted electronically by E-mail to: LANL_SWEIS@doeal.gov; or via facsimile by dialing: (505) 667-5948. Comments may also be mailed to:

Ms. Elizabeth Withers
U.S. DOE/NNSA
Los Alamos Site Office
528 35th Street
Los Alamos, New Mexico 87544-2201

Thank you for your continued interest in the NNSA's National Environmental Policy Act compliance program.

Sincerely,

Elizabeth R. Withers
Document Manager

Enclosure: Draft SWEIS and/or Summary

TABLE OF CONTENTS

Volume 1
Chapters 1 through 11

Chapter 1
Introduction and Purpose and Need for Agency Action

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

Chapter 6
Applicable Laws, Regulations, and Other Requirements

Chapter 7

Chapter 8

Chapter 9

Chapter 10

Chapter 11

Volume 2 Book 1
Appendices A through H

Appendix A
Federal Register Notices

Appendix B
Nonradiological Air Quality

Appendix C
Evaluation of Human Health Impacts from Normal Operations

Appendix D
Evaluation of Human Health Impacts from Facility Accidents

Appendix F
Environmental Sample Data

Appendix G
Impacts Analyses of Projects to Maintain Existing Los Alamos National Laboratory Operations and Capabilities

Appendix H

Impacts Analyses of Closure and Remediation Actions

Volume 2 Book 2
Appendices I through M

Appendix I
Major Material Disposal Area Remediation, Canyon Cleanups, and Other Consent Order Actions

Appendix J
Impacts Analyses of Projects Associated with New Infrastructure or Levels of Operation

Appendix K
Evaluation of Human Health Effects from Transportation

LIST OF FIGURES

Appendix D

Appendix E

Appendix F

Appendix G

Appendix H

Appendix I

Appendix J

Appendix K

LIST OF TABLES

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

Appendix B

Appendix C

Appendix D

Appendix E

Appendix F

Appendix G

Appendix H

Appendix I

Appendix J

Appendix K

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ALARA	as low as reasonably achievable
ATSDR	Agency for Toxic Substances and Disease Registry
CAP-88	Clean Air Act Assessment Package, 1988
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
CMR	Chemistry and Metallurgy Research (Building)
CMRR	Chemistry and Metallurgy Research Building Replacement Project
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
DHS	U.S. Department of Homeland Security
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 Guidelines
FFCA	Federal Facility Compliance Agreement
FONSI	finding of no significant impact
FR	*Federal Register*
FY	fiscal year
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
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
PM_n	particulate matter less than or equal to *n* microns in aerodynamic diameter
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
SST	safe secure transport
SWEIS	Site-Wide Environmental Impact Statement
SWMU	solid waste management unit
TA	technical area
TEDE	total effective dose equivalent
teraops	a trillion floating point operations per second
TFF	Target Fabrication Facility
TSFF	Tritium Science and Fabrication Facility
TSCA	Toxic Substances Control Act
TSTA	Tritium Systems Test Assembly
UCL	upper confidence limit
U.S.C.	United States Code
USGS	U.S. Geologic Survey
WETF	Weapons Engineering Tritium Facility
WIPP	Waste Isolation Pilot Plant

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 U.S. Department of Energy (DOE), National Nuclear Security Administration's (NNSA) missions and compliance with National Environmental Policy Act (NEPA) requirements, and how these requirements have been met through the preparation of Site-Wide Environmental Impact Statements (SWEISs). This chapter also includes a statement of NNSA's 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 DOE and NNSA 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.

NEPA Compliance

Site-wide NEPA documents are identified by 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 (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 and Implementing Procedures codified in the *Code of Federal Regulations* at 40 CFR 1500 to 1508 and 10 CFR 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 the 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 Appendix A to this document. In early 2004, NNSA undertook the required 5-year evaluation of

[1] *NNSA is a semiautonomous agency within DOE (see the 1999 National Nuclear Security Administration Act [Title 32 of the Defense Authorization Act for fiscal year 2000, Public Law 106-65]).*

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* (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 proposing new actions for implementation at LANL over 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 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 to implement forest thinning and watershed protection measures on the Pajarito Plateau since the Cerro Grande Fire.

> ***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 DOE's missions, including:

- National security as it relates to the safety and reliability of the nuclear weapons stockpile and its maintenance, the stemming of 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 waste 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 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 USC Chapter 41, § 2401(b)).

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, 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.

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 NNSA's modeling that was established to support 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 the next 5 years (2007 through 2011) are discussed and analyzed in this SWEIS.

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 (the 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 of Energy 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 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 entitled, *Recommendations for the Nuclear Weapons Complex of the Future*. 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. NNSA is developing a strategy for continuing the transformation of the weapons complex, which began with the cessation of manufacturing at the Rocky Flats Plant, the end of the Cold War, and the U.S.'s suspension of nuclear weapons testing. NNSA refers to this strategy as a "planning scenario for Complex 2030;" it will set NNSA's vision of the complex in 2030. Budgetary requests to Congress, beginning with the President's Budget for fiscal years 2007 through 2011, will influence the evolution of this strategy. When the strategy has become sufficiently defined so that proposed actions can be identified, NNSA will need to determine what NEPA analyses it needs to conduct for the proposals. In the short term, over the next 5 years, 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 purposes of proposed actions 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 the next 5 years. While uncertainty remains about the future work NNSA will assign to LANL to support NNSA missions, the overall need to continue operation of LANL is unlikely to change over the next several years.

NNSA and DOE assign mission element 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[2] production work takes place at LANL on a limited scale.

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. Prior to and including 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, will manage LANL for an initial 7-year period beginning in mid-2006. The identity of the management and operating contractor at LANL will not change the DOE and NNSA mission support work performed at LANL. The terms of the contract preclude that possibility, while allowing the contractor some flexibility to perform cost-reimbursable work for other entities.

1.1 Background

The LANL site is located in northern New Mexico, within the incorporated County of Los Alamos (also referred to locally as "the County," or "the County of Los Alamos") (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 13,000 people work at LANL, of which a little less than half reside within the County.

[2] 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.

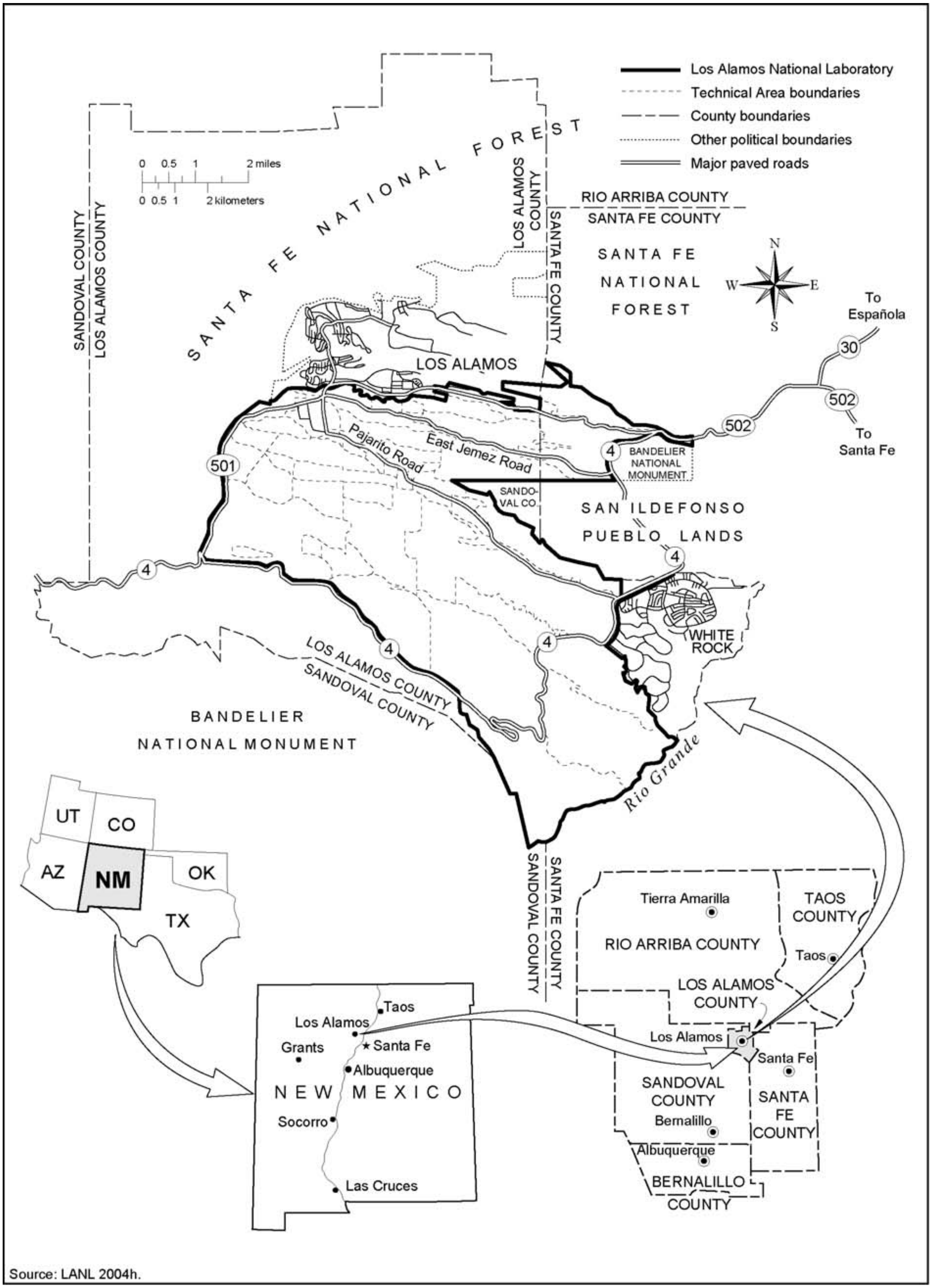

Figure 1–1 Location of Los Alamos National Laboratory Site

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 over 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 comprise 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 purposes 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.

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 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.

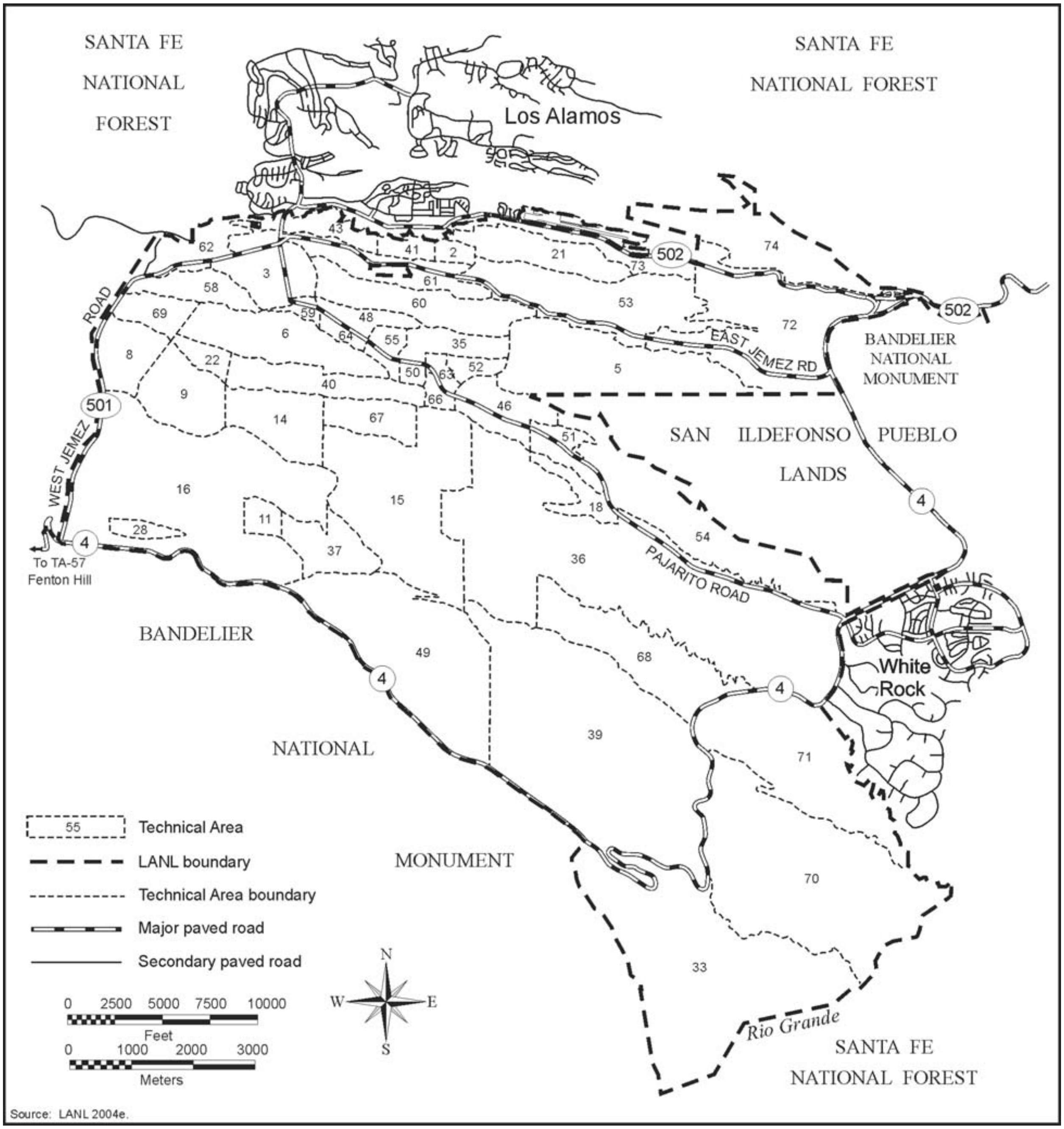

Figure 1–2 Identification and Location of Technical Areas Comprising Los Alamos National Laboratory

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 Facility Hazards Categorization

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 830)

Nuclear and radiological facilities at LANL are identified by hazard category in accordance with their potential consequences in the event of an accident (10 CFR 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 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).

1.2 Purpose and Need for Agency Action

DOE's stated purpose and need for agency action in the *1999 SWEIS* is presented in the text box to the right. The NNSA purpose and need for agency action with regard to the continued operation of LANL remains unchanged. With the creation of NNSA in 2000, the President and Congress reaffirmed the Nation's need for ongoing operations at LANL by assigning the administration of LANL to NNSA and 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 agencies, 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 NNSA 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 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 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 to meet the purpose and need. As defined in 40 CFR 1508.28, this new SWEIS impact analysis tiers from the *1999 SWEIS*. The *1999 SWEIS* covers broad general matters related to operation of LANL at the selected *1999 SWEIS* Preferred Alternative level. This SWEIS considers more focused environmental impact analyses of three alternatives to implement the Proposed Action: a No Action Alternative (continued implementation of the selected *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[3], are considered in the cumulative impacts analyses for LANL operations in this SWEIS.

In March 2005, the State of New Mexico, NNSA, and the University of California, as the management and operating contractor, entered into a "Compliance Order on Consent" (Consent

[3] *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).*

Order) (NMED 2005) that is currently being implemented to address the investigation and remediation of environmental contamination at LANL. NNSA is not legally obligated to include the Consent Order impacts analysis, but for purposes of this SWEIS only, NNSA is including this information in support of collateral decisions that NNSA must make to facilitate implementation of Consent Order activities. The activities and potential impacts of Consent Order related activities are included in the Expanded Operations Alternative.

Due to certain 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 2004q). 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 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 buildings that were constructed during the days after the fire as part of the recovery effort. Postfire 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 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 (2,254 acres [912 hectares]) of land in response to the requirements of Public Law 105-119. 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 from about 43 square miles (27,520 acres [11,137 hectares] to about 40 square miles (25,600 acres [10,360 hectares]) to date. DOE anticipates conveying additional land before the end of 2007, which is the deadline for conveyance and transfer of lands prescribed in Public Law 105-119.

The terrorist events 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 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 actions. Within the next 5 years, detailed planning for these proposed actions, or in some cases, the proposed actions themselves, could be initiated. The decisions to be made based upon 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[4] 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 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 by NNSA. 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 2002h) 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.

Special Nuclear Material Safeguards and Security

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.

[4] *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.*

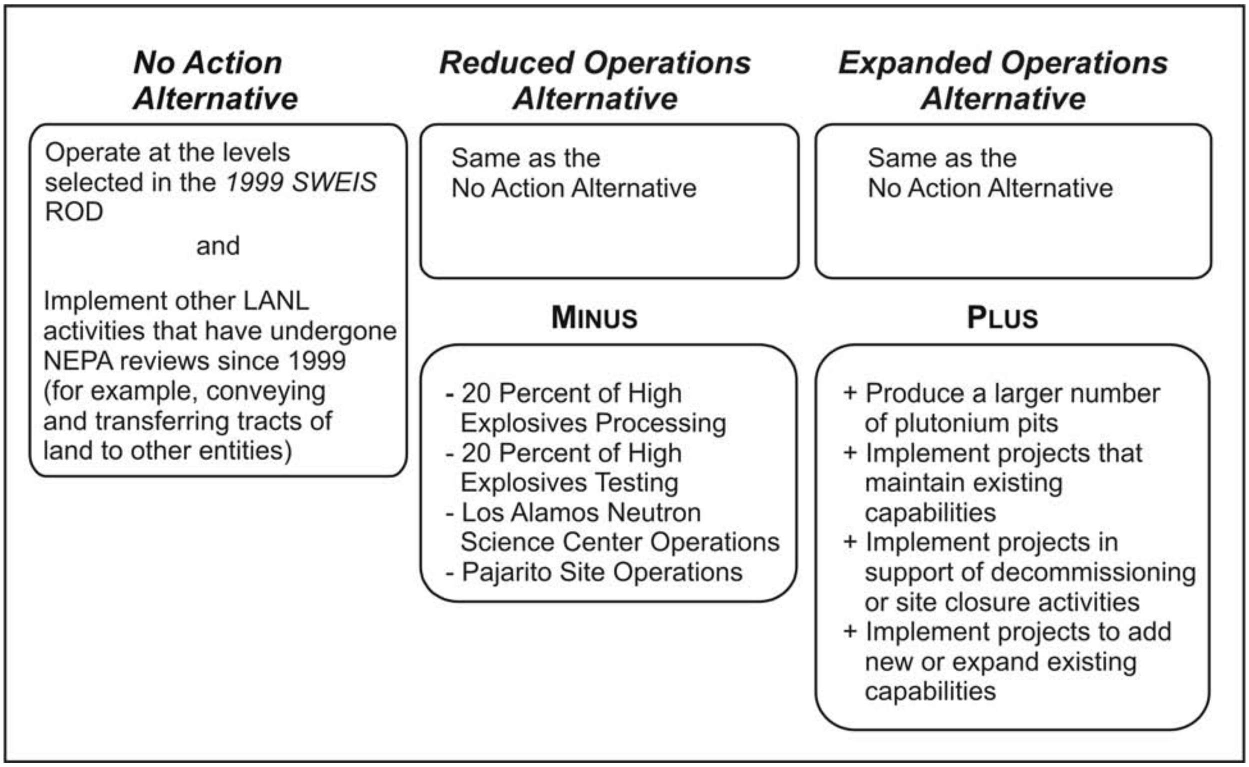

Figure 1–3 Summary Comparison of Alternatives Considered in this New Site-Wide Environmental Impact Statement

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 actions 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:

- 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 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 2002h) 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).

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 up to 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 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.[5]

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 50 certified pits at LANL under the Expanded Operations Alternative. The production of certified pits includes the activities needed to fabricate new pits, to modify the internal features of existing pits, and to recertify or requalify pits. This process may result in the production of pits that cannot be certified. NNSA intends to produce up to 50 certified pits annually to meet the near-term needs of the Stockpile Stewardship Program, and may need to produce more than 50 pits in order to obtain 50 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 sufficient flexibility to obtain up to 50 certified pits each year. NNSA does not believe it would need to produce 80 pits per year in order to obtain 50 certified pits. In any event, the annual production rate of 80 pits analyzed in the Expanded Operations Alternative would bound the actual annual production rate at LANL. Although NNSA has proposed a new pit manufacturing facility in order to meet the long-term requirements for maintaining the anticipated nuclear weapons stockpile (*Draft Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility [Modern Pit Facility EIS]* [DOE 2003b]), NNSA has not completed that EIS and therefore has not made a decision whether it would build such a facility, and, if such a facility were built, where it would be located, the size and type of facility that would be built, or its production level.

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 expects to attain this production level in 2007. 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 produce 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* and the No Action Alternative in the *Modern Pit Facility EIS*, this SWEIS bases the analysis of impacts for its Expanded Operations Alternative on a maximum annual production rate of up to 80 pits using multiple shifts. The No Action Alternative for this SWEIS uses the same scaling process used to develop the Preferred Alternative for the *1999 SWEIS*.

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[5] 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) (67 FR 79906). Where quantitative adjustments were not possible, a qualitative discussion of the important differences in impacts was provided.

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 decontamination, decommissioning, and demolition (DD&D) of excess buildings and implementation of the Consent Order[6] (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 actions 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 activities 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 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 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, 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;

[6] NNSA is not legally obligated to include the Consent Order impacts analysis, but for purposes of this SWEIS, NNSA is including this information in support of collateral decisions that NNSA may make to facilitate implementation of Consent Order activities.

- Construction and operation of a replacement Radioactive Liquid Waste Treatment Facility 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. DOE 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 DOE 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 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 on 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;
- DD&D of TA-21 buildings and structures;

- Provision of waste management facilities necessitated by closure of the TA-54 Material Disposal Area[7] (MDA) G; and
- Remediation of major MDAs and other contaminated sites at LANL required by 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 2002h). 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 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 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 by DOE or NNSA. In the case of the MDAs and other potential release sites, remedial actions will be decided in accordance with the Consent Order (NMED 2005). NNSA and LANL 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

[7] *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.*

construction and operation of the following replacement buildings and structures has been proposed and is analyzed in this SWEIS:

- A new Transuranic Waste[8] 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 select 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:

- Construction of new vehicle parking lots and roads, realignment of existing roads, and alteration 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[9] (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 Chemistry and Metallurgy Research Replacement Project, are proposed locations for managing sealed sources. The Metropolis Center in TA-3 is identified as a new Key Facility in this new SWEIS.

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[8] *"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).*

[9] *"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 835).*

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 2002j). 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 now underway. 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. Actions that would supplement 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 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-teraops platform (a teraop is a trillion floating point operations per second). The Metropolis Center has been constructed and is currently operating a 30-teraops platform; however, NNSA is considering 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 teraops before 2009, with dramatic increases thereafter. The proposed increase in the operating platform beyond 50 teraops 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 within LANL's waste management system. 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, 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 nonactinides.[10] Management of these sealed sources could require their indefinite storage at LANL until alternate storage or disposal facilities are available. In 2005, DOE issued an advanced NOI as a prelude to preparing a Programmatic EIS to support a decision regarding the disposal of Greater-Than-Class C waste,[11] such as some of the sealed sources managed at LANL.

1.3.4 Preferred Alternative

At this time, NNSA identifies its Preferred Alternative for the level of operation of LANL as the Expanded Operations Alternative, which is discussed in detail in Chapter 3 of this SWEIS. Given the uncertainty regarding the nuclear weapons missions that will be assigned to LANL in the future, NNSA might issue two or more RODs to implement its decisions. As discussed later in Section 1.4 of this chapter, NNSA may ultimately choose not to implement all of the Expanded Operations Alternative contingent on the new Complex strategy direction.

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 Transuranic Waste Consolidation 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. Additional decisions that might also be included in the first ROD are: enhancements of the operating levels at the Metropolis Center in TA-3; expansion of the types of radionuclides managed by the Off-Site Source Recovery Project; and an increase up to 50 certified pits per year (80 pits using multiple shifts) 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. Projects to maintain existing capabilities at LANL that may be included in the first ROD include construction and operation of the TA-3 Center for Weapons Physics Research; construction and operation of replacement office buildings in TA-3**;** construction and operation of the Institute for Nuclear Nonproliferation Science and Technology, the first component of the new Radiological Sciences Institute at TA-48; construction and operation of the TA-50 Radioactive Liquid Waste Treatment Facility upgrade; facility

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[10] 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.

[11] Greater-Than-Class C waste is waste regulated by the U.S. Nuclear Regulatory Commission or an agreement state in which the concentration of radionuclides exceeds the 10 CFR 61.55 Table 1 or Table 2 limits for classification of waste as Class C; thus, requiring 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.

refurbishments that make up the TA-55 Plutonium Facility Complex Refurbishment Project; construction and operation of a radiography facility at TA-55; construction and operation of the new Science Complex in TA-62; 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); the LANSCE Refurbishment Project; Security-Driven Transportation Modifications; and elevated operations at the High Explosives Processing Facilities. 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 National Nuclear Security Administration Decisions To Be Supported by the Site-Wide Environmental Impact Statement

This SWEIS updates the *1999 SWEIS* analysis and evaluates the impacts of newly-proposed projects. The ROD(s) 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-year period, 2007 through 2011. 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 has reduced the land areas that provide distance buffering between LANL operations and the public, resulting in changes to the locations used to assess potential 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 be considered by the NNSA Administrator in making informed decisions about the continued operation of LANL over the next 5 years. At this time, a 5-year period has been selected, recognizing that a meaningful level of detail is not possible when trying to project over a long period of time. Focusing on LANL operations over the next 5-year window of time allows the NNSA Administrator 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. The NNSA Administrator could choose to implement the alternatives either in whole or in part; that is, the Administrator could select the level of operations for a Key Facility or whether to implement individual projects. NNSA plans to implement actions necessary to comply with the Consent Order, regardless of whether it implements other actions analyzed as part of the Expanded Operations Alternative, the alternative that includes the analysis of the actions needed to comply with that order. Choosing to delay making an action decision for a particular Key Facility or specific project would constitute a decision to implement the No Action Alternative for that facility or project. NNSA could issue a ROD or RODs to document its decisions regarding the level of operations or the implementation of a project no sooner than 30 days after the Environmental Protection Agency Notice of Availability of the Final SWEIS.

The decisions the NNSA Administrator may make regarding the operation of LANL are:

- *Whether to implement the No Action Alternative for LANL operations either in whole or in part*. The NNSA Administrator may choose to implement the No Action Alternative in its entirety, thereby deciding to continue LANL operations for 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 the Administrator 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 would result 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 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 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 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). The NNSA Administrator, 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. 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 1500-1508).

There are decisions related to the operation of LANL that the NNSA Administrator 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, changes to the DOE nuclear weapons complex would be the subject of separate NEPA impact analysis if and when specific proposals become ready for decision. At this time, a shutdown alternative is not considered 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 actions 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). 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). 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). 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). This SA was prepared to evaluate a proposal to recover, store, and manage as waste certain radioisotope thermal electric generators 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). 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). 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). 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). 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). 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 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). 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). 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 a degraded building to a new modern building (or buildings). The ROD selected a location for a Chemistry and Metallurgy Research Building Replacement Project adjacent to the Plutonium Facility Complex in TA-55.

- *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). 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). 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). 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). 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). 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). 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). 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). 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). 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). 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). 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). 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). 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). 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). 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). 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). 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). 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). 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.

- *Environmental Assessment for the Proposed Los Alamos National Laboratory Trails Management Program, Los Alamos, New Mexico* (DOE/EA-1431). 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). 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). 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). 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). 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 other interim actions that NNSA could contemplate 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 currently being contemplated and are undergoing separate NEPA review during the timeframe that 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*. 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). Subsequently, 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 as it has been constructed. The new EIS is being prepared during the same timeframe as this SWEIS. The outcome of that EIS would not affect NNSA's ability to implement any of the alternatives analyzed in this SWEIS.

- *Draft Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility* (DOE/EIS-0236-S2). This Draft Supplemental EIS provides the environmental impact analysis for a proposed modern pit facility at one of five potential sites around the DOE nuclear weapons complex. LANL is one of the five sites considered in the analysis. Different levels of operations are also considered. Plutonium pit production levels of 125, 250, and 450 pits per year are evaluated in that document. The Final EIS has been delayed pending congressional support and adequate funding. Consequently, a decision is not expected that would prejudice the decisions to be made based on this SWEIS.

- *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems* (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 would remove radioisotope power system nuclear operations work from TA-55; under the 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 would 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:

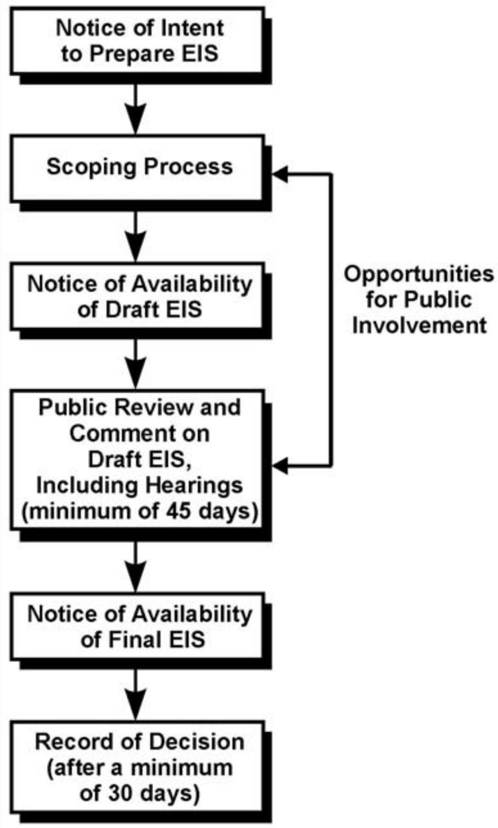
- *Environmental Impact Statement on the Disposal of Greater-Than-Class-C Low-Level Radioactive Waste* (*GTCC EIS*). In May 2005, DOE issued an advanced NOI to prepare an EIS to address disposal of low-level radioactive waste generated by activities licensed by the Nuclear Regulatory Commission or an Agreement State that have concentrations of radionuclides that exceed Class C limits (70 FR 24775). This EIS would also consider DOE waste with similar characteristics. Currently there is no location for disposal of Greater-Than-Class C waste. As directed by the Low-Level Radioactive Waste Policy Amendments Act, DOE is responsible for providing such a disposal facility. Certain of the sealed sources being managed by LANL under the Off-Site Source Recovery Project qualify as Greater-Than-Class C waste and 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

During the development of an EIS, there are opportunities for public involvement (see **Figure 1–4**). 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). In the NOI, NNSA invited public comment on the Supplemental SWEIS proposal and listed the issues initially identified by NNSA for evaluation in the Supplemental SWEIS. Public citizens, civic leaders, and other interested parties were invited to comment on these issues and to suggest additional issues that should be considered in the Supplemental SWEIS. The NOI advised the public that comments on the Proposed Action could be communicated via the U.S. Postal Service, a special DOE Internet address, a toll-free phone line, a facsimile phone line, and in person at the public meeting held in the vicinity of LANL. The public scoping period ended February 17, 2005.

A public scoping meeting was held on January 19, 2005, in Pojoaque, New Mexico. As a result of previous experience and positive responses from attendees of other NNSA NEPA public meetings and hearings, NNSA chose an interactive format for the scoping meeting. The meeting began with a short presentation by an NNSA representative who explained the Proposed Action for the Supplemental SWEIS and the No Action Alternative. Afterwards, the attendees were encouraged to meet and talk with NNSA and LANL subject matter experts and to voice their concerns and make comments. The public was encouraged to submit written comments at the scoping meeting or record their comments for transcription as part of the formal meeting transcript. The proceedings and formal comments presented at the meeting were recorded verbatim, and a transcript of the meeting was produced and placed in DOE Reading Rooms in Los Alamos and Albuquerque, New Mexico. Comments were also accepted following the meeting by the toll-free phone line or in written form via letters, the NNSA Internet address, or facsimile transmission until the end of the scoping period. All comments received were reviewed for consideration by NNSA in proceeding with this NEPA analysis.



EIS = environmental impact statement.

Figure 1–4 National Environmental Policy Act Process

It should be noted that, for EIS public scoping purposes, a comment is defined as a single opinion concerning a specific issue. An individual commentor's public statement may contain several such comments. Most of the verbal and written comment statements submitted during the Supplemental SWEIS scoping period contained multiple comments on various specific issues. The major issues are summarized in the following section.

Summary of Major Scoping Comments and National Nuclear Security Administration Responses

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. NNSA reviewed all of the comments. Where possible, comments on similar or related topics were grouped into common categories as a means of summarizing them. After the issues were identified, they were evaluated to determine whether they were in the scope of the SWEIS. Issues found to be within the scope of the SWEIS are addressed in the appropriate chapters or appendices of this Draft SWEIS.

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. Leak path factors used at LANL and calculation errors were cited as concerns affecting the quality of analyses. One commentor requested that the latest software be used to calculate risks from accidents. Regarding the scope of the document, comments included the desire to see Reduced Operations 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.

Commenting on the scope of the facilities to be included in the analysis, commentors stated that the operation of the Chemistry and Metallurgy Research Building Replacement Facility and a modern pit facility should not be analyzed as part of the No Action Alternative or potential Expanded Operations Alternative, but nonetheless, the environmental impacts should be analyzed in the Supplemental SWEIS. Similar opinions were expressed about the Biosafety Level 3 Facility while other commentors requested that operation of the Biosafety Level 3 Facility be addressed in a separate EIS. Commentors requested an accounting of potential impacts of continued storage of radioactive transuranic waste destined for WIPP, as well as the impacts of any precautions taken to mitigate the potential risk posed by the waste. A couple of commentors requested that the SWEIS analyze environmental impacts of decontaminating and decommissioning TA-18, including the special nuclear material remaining at the site, storm water runoff, and the impacts of natural and manmade disasters.

The alternatives described in Chapter 3 and the impacts described in Chapter 5 include the operation of the Chemistry and Metallurgy Research Building Replacement Facility, the continued management of transuranic waste at LANL, and the decontamination and decommissioning of TA-18, the Pajarito Site. A decision on the construction or location of a modern pit facility has not been made by NNSA; however, the potential impacts of such a facility being constructed and operated at LANL are addressed as part of the cumulative impacts in Chapter 5, Section 5.13.

NNSA has decided that preparation of an EIS is the appropriate level of NEPA analysis for operation of the Biosafety Level 3 Facility and that the analysis should be conducted separately from this SWEIS (70 FR 71490). The global situation with regard to bioterrorism continues to evolve. The ability to provide cutting-edge technology and resources to address the situation grows more important and increases the urgency to decide whether to operate the Biosafety Level 3 Facility.

Some of the operational issues proposed for analysis included plans for the Reliable Replacement Warhead Project, work on the Robust Nuclear Earth Penetrator, consolidation of plutonium activities, "accelerated aging" studies, creation of a "nuclear campus," production of qualified war reserve pits, enhanced test readiness, increase in directed stockpile work, Area G, industrial use areas of LANL, the Advanced Hydrotest Facility, DARHT, LANSCE upgrades, and "Work-for-Others." This SWEIS does not address each of these programs or projects individually. Certain projects are included in the analyses to the extent that they support NNSA missions or other LANL customers and would be undertaken within the capabilities and activities described in Chapter 3 of this SWEIS.

A range of comments on environmental changes since the release of the *1999 SWEIS* were received. These included general questions on New Mexico's drought, and the impacts of the Cerro Grande Fire, especially with respect to erosion, contaminated runoff, and depleted uranium released into the plume, and the presence and monitoring of environmental contaminants in groundwater, surface water, soil, and biota. Recommendations were made to include monitoring strategies and data reporting in the SWEIS, as well as lessons learned at other DOE sites. Chapter 4 of this SWEIS presents updated information regarding environmental monitoring and provides summary information regarding environmental contamination. Chapter 4 also 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. In addition, Appendix F presents a comparison of levels of environmental contamination based on composite samples of groundwater, storm water runoff, sediments, and soil as measured over the years since the Cerro Grande Fire, compared to similar sample results presented in the *1999 SWEIS*.

LANL's impact on water resources was a key issue among commentors who wanted the SWEIS to incorporate the most recent hydrogeological data available. Key hydrological issues included the presence of fast-moving contaminants such as tritium and perchlorate in groundwater, hydrological impacts on groundwater in the vicinity of the site, as well as the potential impacts on drinking water sources in the region. This SWEIS includes updated information regarding the current understanding of the hydrogeologic regime at LANL. This includes descriptions in Chapter 4 and Appendix E of the current understanding of groundwater at LANL based on recent studies, as well as discussions of the uncertainties that remain regarding the groundwater flow and the transport of contaminants. Chapter 4 and Appendix F include results from the groundwater sampling program conducted at LANL and in the vicinity of the site.

Comments were also received regarding the impacts of the Clean Water Act Federal Facilities Compliance Agreement and DOE water rights. The new Federal Facilities Compliance Agreement requirements for monitoring are discussed in Chapter 4 of this SWEIS. Chapters 4 and 5 present information on DOE's water rights and water usage at LANL, as well as in Los Alamos County.

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. Similar comments received from the public expressed a need for the SWEIS to explore the possible health impacts of radiation other than latent cancer fatalities, including premature aging, excess tumors (not necessarily cancerous), genetic and fetal effects, and increased cardiovascular diseases and renal failure. Tribal comments additionally expressed a need for independent monitoring studies funded by NNSA.

Chapter 4 of this SWEIS provides recent information on cancer incidence and mortality in New Mexico and in the counties around LANL. It also reports on the results of independent studies that have been conducted to evaluate potential impacts of radioactive and chemical contaminants from LANL. In assessing possible health impacts from exposure to radiation, this SWEIS conforms to the established NEPA practice of expressing the impacts as latent cancer fatalities; these analyses are presented in Chapter 5 and Appendices C and D. Appendix C also discusses the relationship between radiation exposure and genetic effects. The analysis in the *1999 SWEIS* of potential impacts to special receptors that could be exposed to contaminants in the soil and foodstuffs affected by LANL operations was reviewed and determined to be appropriate and technically correct. An update of these analyses based on more recent data regarding the concentrations of contaminants in the environment and foodstuffs is described in detail in Appendix C.

The impacts of LANL operations on cultural and ancestral sites and Tribal access to those sites are important to Native Americans. The SWEIS includes discussion of the process undertaken to ensure that cultural resources at LANL are explicitly considered and protected, particularly when new projects are undertaken. The project-specific analyses in Appendices G through I identify whether there are known cultural resources in the areas of the projects that would potentially be impacted.

Concerns were expressed about LANL's recent reduction in air monitoring. The public wanted to see the environmental impacts of reduced air monitoring activities analyzed in the SWEIS. Chapter 4 discusses the air monitoring program and summarizes the results of and rationale for ending a portion of the program concerned with nonradioactive constituents.

One commentor wanted to see analysis of pit manufacturing removed from the SWEIS in favor of a more detailed analysis of air quality. Other commentors requested analysis of soil monitoring and contamination in the SWEIS, including impacts on downwind and downgradient communities up to 100 miles (160 kilometers) from the facility. Several comments asked that the SWEIS address whether the effects of the *1999 SWEIS* accident scenarios or new accident scenarios have been reduced or mitigated as a result of the $345 million granted to LANL following the Cerro Grande Fire.

Potential impacts associated with normal operations at LANL, including pit manufacturing, and postulated accidents have been reanalyzed; the details of these analyses are presented in Appendices C and D. The new analyses reflect the changes that have occurred at the site and updated methodologies and data. This includes accounting for changes in LANL's borders, restriction on travel along Pajarito Road, and using current computer codes and dose conversion or risk factors. The SWEIS evaluates potential impacts to the offsite public from normal operations and accident conditions within a region of influence defined as up to 50 miles (80 kilometers) from the site. Operational and accident impacts of LANL would be greatest within a few miles of the site boundary; extending the region of influence out to 100 miles (160 kilometers) would change the calculated results only a few percent for the accidents with the highest potential for widespread impacts. Additionally, the potential impacts to a maximally exposed individual near the site boundary are evaluated. Results of these analyses do not indicate the need to evaluate impacts beyond a distance of 50 miles (80 kilometers). Potential impacts of contaminated soils being transported downwind are evaluated in conjunction with the option of exhuming MDAs as discussed in Appendix I. The wildfire analysis in the SWEIS has been updated to reflect changes that have been made at the site since the Cerro Grande Fire; it includes revised assessments of fuel loadings and vulnerabilities of buildings.

An issue was raised in comments regarding the threat of terrorism at LANL. Chapter 4 of the SWEIS addresses the readiness of the LANL protective force to respond to terrorist activities. Additionally, although not attributed to terrorist actions, accident analyses evaluate the potential impacts of releases from LANL facilities as a result of catastrophic failure.

Some commentors believe recommendations made in DOE Inspector General reports regarding stabilization of nuclear materials at LANL should be incorporated into the SWEIS. One commentor wanted the SWEIS to address mitigation of environmental effects caused by the leak in a primary waste storage tank at TA-50 and the impacts of the waste backlog, the condition of the effluent released to Mortandad Canyon, and the risk to the public caused by bad welds. In addition, it was requested that the SWEIS list the administrative controls for all nuclear and hazardous materials. The analyses in the SWEIS, in particular the accident analyses, consider a range of possible incidents that could result in the release of materials to the environment. Detailed analysis is then focused on the most significant of those accidents based on potential consequences and risks. Thus, although the above actions, accidents, or failures may not be addressed specifically, impacts from the accidents analyzed in Appendix D are expected to result in impacts that bound those that would result from other reasonably foreseeable events.

Some commentors requested a discussion of the environmental impacts of LANL cleanup, expressing strong feelings of disappointment over the lack of discussion of the subject in the *1999 SWEIS*. They requested a detailed cleanup plan and thorough analysis of its impacts, including impacts on cleanup worker health and safety, air emissions, surface and groundwater discharges, geography, and soil disturbance. Commentors also requested analysis of the impact of the Consent Order (NMED 2005) that would include NNSA's plan to separate cleanup from the main LANL management contract in 2007 and the transfer of cleanup responsibility from DOE's Office of Environmental Management to NNSA.

This SWEIS describes implementation of, and compliance with, the most recent changes in the regulatory environment at LANL. Specifically, the requirements of the Consent Order (NMED 2005) are reflected in the actions described for environmental restoration. Consequently, Appendix I of this SWEIS includes a project-specific analysis that evaluates the impacts of options for remediating areas of LANL in accordance with the Consent Order. The environmental impacts are assessed independent of the organization within DOE (Office of Environmental Management or NNSA) that would implement the Consent Order.

Another commentor requested that the SWEIS discuss categorical exclusions. The comment asserted that there should be a statement of why each categorical exclusion does not have a significant impact on the environment, and that the SWEIS should analyze the cumulative impacts of all such exclusions from all LANL NEPA documents. Chapter 3 of this SWEIS discusses the use of categorical exclusions in accordance with DOE NEPA Implementing Procedures (10 CFR 1021.410 Subpart D). LANL activities that are typically excluded from the need for detailed NEPA analysis are described in Appendix L.

Comments related to land use and land conveyance and transfer issues were raised in the scoping comments. The key issue was how safe the land would be for use after cleanup has been completed. DOE evaluated the impacts and controls associated with the conveyance or transfer of land in the *Conveyance and Transfer EIS*, and information from that EIS is incorporated into this SWEIS by reference. The *Conveyance and Transfer EIS* describes mitigation measures that could be taken prior to conveying or transferring a piece of property. As appropriate, easements are maintained on conveyed or transferred lands so that DOE can continue to access monitoring wells and collect samples. A commentor also suggested that the SWEIS address conveyance and transfer of additional lands. This SWEIS focuses on the impacts associated with those parcels of land that have already been or are expected to be conveyed or transferred by the end of 2007, when the authorizing legislation expires; however, it should be noted that the *Conveyance and Transfer EIS* addresses a larger suite of properties that could potentially be conveyed or transferred if additional authorization were received.

A commentor suggested redevelopment of existing areas should be undertaken when needed instead of breaking ground on undeveloped sites. Project-specific analyses are included in this SWEIS that involve construction of new facilities. As shown in Appendices G through J, many of these proposed projects would occur in previously developed areas. Impacts of projects that could affect undeveloped areas are also included in the analysis.

Other issues raised in comments included LANL safety as related to seismic activity, including the possible effects on LANL facilities that do not meet current seismic codes and the Jemez Volcano, and impacts on endangered species such as the Mexican spotted owl (*Strix occidentalis lucida*). The Jemez Volcano is accounted for in the accident analyses in Appendix D which include consideration of the potential impacts of seismic activities on facilities. Potential impacts of new construction and operations on the Mexican spotted owl and other endangered species are addressed in the project-specific analyses in Appendices G through I and in Chapter 5.

Certain groups of comments are not included in the analysis of this SWEIS. Comments regarding accountability of LANL management, the transfer of LANL management, worker turnover, and worker morale related to those changes are not recognized as being within the scope of NEPA. Similarly, historical differences in the plutonium inventory[12] are not analyzed in this SWEIS; the analysis of accidents involving plutonium is based on established limits on inventories of plutonium, or other materials, that are allowed in a building. Road closures and realignments that have already undergone NEPA evaluations are not reanalyzed in this SWEIS, but the environmental impacts of these prior analyses are incorporated where appropriate. Chapter 4 of this SWEIS provides a description of the current socioeconomic conditions in the LANL region; however, it is not possible, as requested by one commenter, to verify the

[12] 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."

1999 SWEIS projection of socioeconomic benefits, such as creation of jobs, due to a lack of available data tied specifically to LANL's economic influence over the region.

Major issues raised by the public or identified by NNSA during the scoping process are addressed in the chapters and appendices of this SWEIS as described above. They are included in the descriptions and analyses of 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;
- Emergency preparedness and security; and
- Environmental justice.

In addition to these areas, the SWEIS addresses monitoring and mitigation, unavoidable impacts, irreversible and irretrievable commitment of resources, and impacts on long-term productivity.

The next major opportunity for public involvement is now underway, as comments are being sought regarding the information in this Draft SWEIS. After reading the Draft SWEIS, a member of the public may want to submit comments to point out potential errors in analysis, or provide new information that would change an analysis, clarify something in the Draft SWEIS, or propose a substantially different alternative or mitigation that has not been considered.

1.7 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 2004 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 over the next 5-year period. 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 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.

The remaining chapters contain supporting information. Chapter 6 of this SWEIS updates information on applicable laws, regulations, and other similar requirements. 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. 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. 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.

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 the 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) altered baseline environmental conditions at LANL, among other changes.

Chapter 2 describes the changes that have occurred at LANL since the publication of the *1999 SWEIS*. It highlights major physical and operational changes that have occurred to the overall LANL site, as well as the 49 individual Technical Areas (TAs) and 15 Key and several important non-Key Facilities. 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 the 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 concludes 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 fell 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 these activities could have 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 which: (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; at the TA level; or at 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 because this allows the greatest level of detail. However, 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, 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.

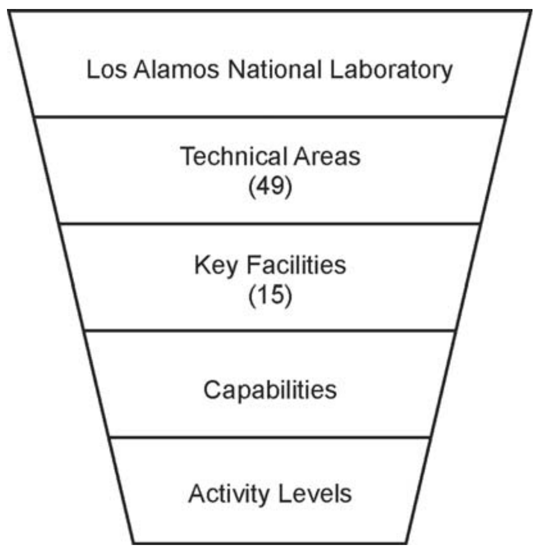


Figure 2–1 Conceptual Framework for Analysis

2.2 Site-Wide Changes at the 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 2004 and have been incorporated by reference. *SWEIS Yearbooks* from calendar years 1999 through 2004 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 2003g) is a special edition that was prepared to assist DOE and 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, with additional text and 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 *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 level operational levels (LANL 2004h).

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 will serve 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 2003, only 16 of the 21 outfalls sustained effluent flows (LANL 2005g).

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 in calendar years 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 2003g, 2004h, 2005g). 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, Reporting Requirements for the New Mexico Administrative Code, Title 20, Chapter 2, Part 73 (20 NMAC 2.73) for Calendar Year 2003* (LANL 2005b).

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 or CMR Building) in 2004, where it will stay until the CMR 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 and 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 2004h).

In addition, following the events of September 11, 2001, the Department of Homeland Security (DHS) requested that LANL be used to provide support to its missions. Activities undertaken at LANL for DHS are primarily the same actions 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 CMR 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 2003g).

During 1999, 91 capabilities were active. The five inactive capabilities were Fabrication and Metallography at the CMR 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 2003g).

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 CMR 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 2003g).

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[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 CMR 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 2003g).

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 CMR 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 2003g, 2004h).

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 CMR 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 2005g).

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 1,435 hours in 2004 at an average current of 115.5 microamps, compared to 6,400 hours at 200 microamps projected by the ROD. Similarly, a total of 164 criticality experiments were conducted at the Pajarito Site, compared to the 1,050 experiments projected by the ROD (LANL 2005g).

In calendar years 1999 through 2004, 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 2005g).

2.2.1 Cerro Grande Fire

The period between 1999 and 2004 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) with about 7,700 acres (3,110 hectares) (27 percent of LANL land) 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 thinned to reduce the wildland fire potential and to make the forest viable and self-sustaining. The following is a brief 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 no longer inhabitable, 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 on the following Key Facilities were minimal: the CMR 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. These effects are detailed for each Key Facility 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 mostly due to terrain restraints. Increases in available lands through cleanup performed by the environmental restoration projects and demolition of vacated buildings could have an effect on strategic planning. To date, however, the environmental restoration projects have not substantially added to available land for reuse (for further information, see Section 4.1.1).

In 2002, the first Congressionally-mandated conveyances of land to Los Alamos County and the transfer of land to the Department of the Interior in trust for the Pueblo of San Ildefonso were accomplished. To date, these disbursals have effectively removed 2,255 acres (913 hectares) from LANL and made them unavailable for LANL operations or use. In addition, these conveyances and transfers resulted in changes to LANL's boundaries (see 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*. There were no additional land conveyances and transfers during 2003 or 2004. The following is an overview of land conveyances and transfers at LANL since the *1999 SWEIS*.

Tract A-6, conveyed to Los Alamos County, was located between the western boundary of TA-21 and the major commercial districts of the Los Alamos townsite. Tracts A-19 (conveyed to Los Alamos County) and B-1 (transferred to the Department of the Interior in trust for the Pueblo of San Ildefonso) were part of the LANL boundary changes affecting TA-54 and its proximity to White Rock and the San Ildefonso Pueblo. The TA-74 tracts (A-17 and B-2) were conveyed to Los Alamos County and transferred to the San Ildefonso Pueblo respectively and are part of a large undeveloped area that borders the Pueblo. They contain a large number of archaeological sites and an endangered species breeding area. For further information on land conveyances and transfers, see Chapter 4.

2.2.3 LANL Security Enhancements

In response to the events that occurred on September 11, 2001, security at LANL has been 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 is the Access Control and Traffic Improvement Project that created a change in public access due to heightened security. The public is currently allowed limited access to certain areas along State Routes 4, 501, and 502. Access to most of Pajarito Road is now restricted by DOE (LANL 2003g) and is allowed only if there is an extreme medical emergency and a person needs to be transported to the Los Alamos Medical Center.

Currently, bicyclists without a valid LANL or DOE security badge are not allowed to use Pajarito Road (LANL 2004s). In addition, walkers, joggers, work crews, and others on foot on Pajarito Road must display a valid security badge.

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 DOE and 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 implemented by the end of January 2005 (LANL 2004r).

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 the 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. The Off-Site Source Recovery Project has been operating at the following Key Facilities at various times since the issuance of the *1999 SWEIS*: the CMR Building, the Pajarito Site, the Solid Radioactive and Chemical Waste Facility and the Plutonium Facility Complex.

2.2.6 Environmental Restoration Project

DOE established the 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 site operations. Many of the potential release sites remain under DOE and NNSA 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 Project activities include drafting and finalizing characterization and remediation reports, conducting characterization and remediation field work and formally tracking 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), 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 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 and a Corrective Measures Evaluation Work Plan must be prepared. After NMED authorizes a corrective measure for a potential release site, the corrective measures must be implemented. Upon completing the remedy, a remedy completion report must be prepared and then submitted to NMED for approval.

The Environmental Restoration Project may generate a large amount of waste during cleanup activities, which are scattered over the entire LANL reserve. The *1999 SWEIS* forecast that the environmental restoration projects 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 Module VIII of LANL hazardous waste permit, originally issued by EPA in 1990, originally identified 2,124 potential release sites, consisting of 1,099 potential release sites listed in Module VIII of LANL's Hazardous Waste Facility Permit and 1,025 potential release sites not listed in Module VIII. By the end of 2005, only 829 potential release sites remain. Approximately 774 units have been approved for no further action, including 146 units that have been removed from LANL's Hazardous Waste Facility Permit. Some of the major remediation activities are shown in **Table 2–1**.

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

Waste quantities generated since issuance of the *1999 SWEIS* ROD have generally been below the projections made in the 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 the Environmental Restoration Project was the threat of erosion at burned-over potential release sites and the movement of contaminants downstream. The Environmental Restoration Project 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.

- *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 on June 24, 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 of 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. The Cerro Grande Fire put nearly 100 of the Environmental Restoration Project potential release sites at increased risk of contaminant release and transport either through direct burning or through vulnerability to increased surface water runoff or erosion. Since the fire, these sites have had controls installed and they continue to be inspected and maintained as part of the LANL Storm Water Program.

2.3 Technical Areas

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 have been 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 the LANL's Technical Areas.

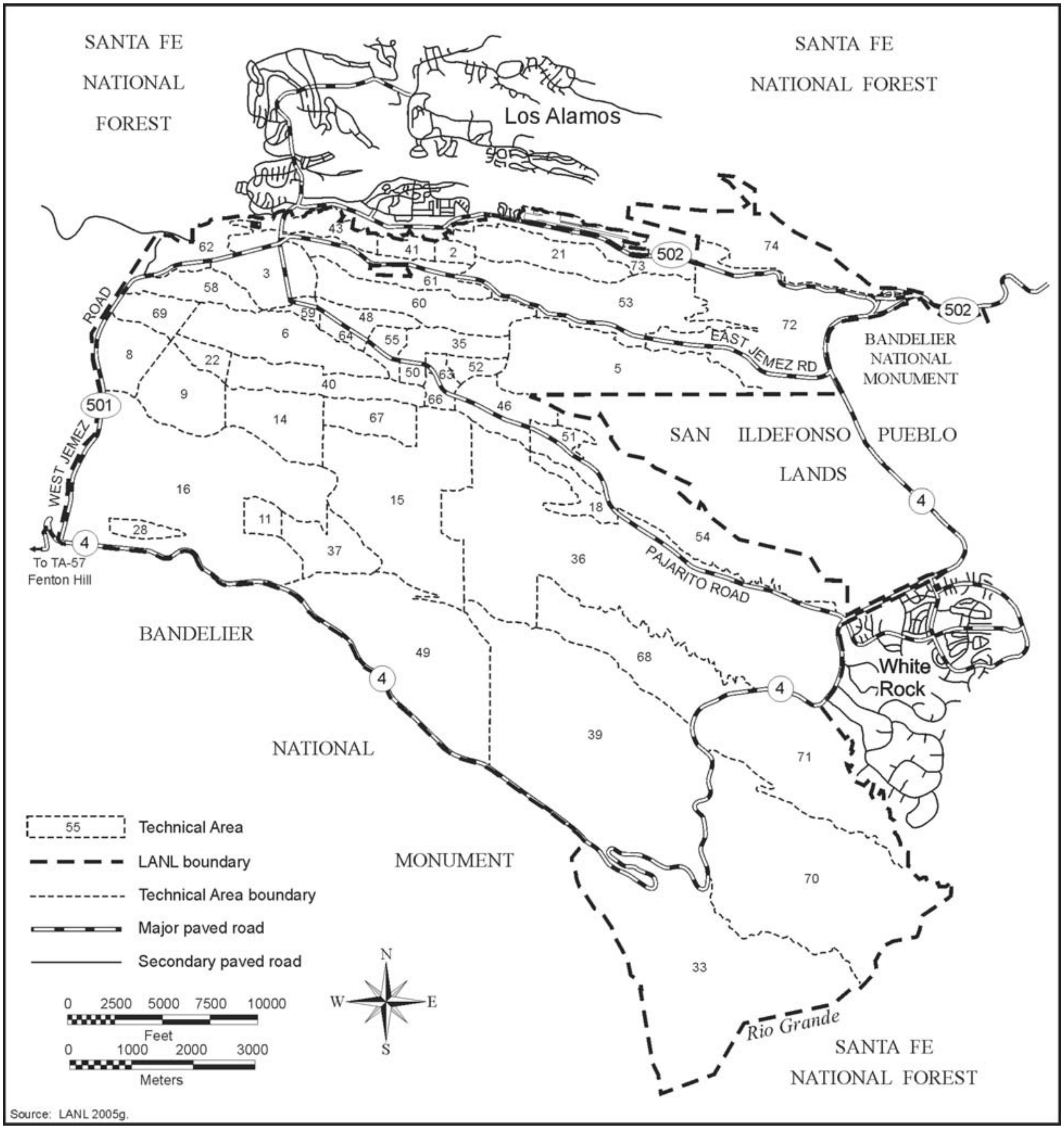

Figure 2–2 Technical Areas at Los Alamos National Laboratory

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 CMR 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 CMR Building capabilities will be moved to TA-55 as a part of the CMR Building Replacement Project. It is also the location proposed for operating a Biosafety Level 3 laboratory.
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 for the purpose of ensuring 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 potential 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 fourteen 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; decontamination and decommissioning of this facility is planned for 2009. 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, as well as 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 applications of radiation detection and instrumentation. In December 2002, DOE decided to relocate all TA-18 Security Category I and II materials and activities to the Nevada Test Site.
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 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 Tritium Science and Fabrication Facility operations will end 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.
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.

Technical Area	***Activities***
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, which includes the Los Alamos Neutron Science Center (LANSCE), is located in the northern portion of LANL. LANSCE, which houses one of the largest research linear accelerators in the world, 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 contributes 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 technical areas 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 CMR 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 will be provided at the site through the CMR Building Replacement Project currently under construction.
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.

Technical Area	***Activities***
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 Highway 502. The County of Los Alamos 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, CMR = Chemistry and Metallurgy Research.

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 for the purpose of allowing 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 DOE 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 NNSA 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 of 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 1997a), up to five buildings and two parking structures may eventually be constructed, consuming an estimated 1.3 megawatts peak electric demand, 39 billion British Thermal Unit 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 (formerly called the Strategic Computing Complex, 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 (93 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 teraops (50 trillion floating point operations per second). DOE has subsequently determined that a capability of at least 100 teraops would be required to effectively support the mission requirements of this facility, and estimates that an operational level as high as 200 teraops 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 new LANL Medical Facility; and the Biosafety Level 3 Facility, which is not yet operational. Construction also has started on the National Security Sciences Building replacing the old Administration Building and three parking structures (NNSA 2001). Several buildings also have been 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.

- **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 DOE 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 for closure by 2007 under the direction of NMED.

2.4 Key Facilities

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 2005g). However, facility cleanouts and DD&D, and environmental restoration activities account for large quantities of waste requiring management. **Figure 2–3** shows the location of the 15 Key Facilities at LANL.

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 2004. Each of these three aspects is given perspective by comparing them to projections made in the *1999 SWEIS* ROD. This comparison provides an evaluation of whether or not data resulting from LANL operations continue to fall within the environmental envelope established in the SWEIS ROD. The remainder of LANL facilities were called "non-Key," not to imply that these facilities were any less important to accomplishment of critical research and development, but because they did not fit the SWEIS 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 over about 14,200 acres (5,750 hectares) of LANL's 25,600 acres (10,360 hectares). Non-Key Facilities also house about half the LANL workforce. Non-Key Facilities include such important buildings and operations as the Center for Integrated Nanotechnology, the TA-46 Sanitary Wastewater System Plant, and the National Security Sciences Building.

Nuclear and Radiological Facility Designations

As previously noted in Chapter 1, Key Facilities in the *1999 SWEIS* comprised 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.

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[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 DOE Los Alamos Site Office as of October 2005 (DOE and LANL 2005).

Table 2–3 presents the Key Facilities identified in the *1999 SWEIS*, the structures currently listed by DOE as nuclear facilities, and their nuclear hazard categories (DOE and LANL 2005). There are now 16 structures or areas, eleven potential release sites and the site-wide transportation capability, for 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 decommissioned and decontaminated. 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 have also had reductions in their security hazard categorizations. 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 (10 CFR 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 DOE approved safety analysis (LANL 2003g).

Key Facility Overview

The following are brief descriptions and overviews of capabilities and changes that have occurred at each Key Facility 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 categorization. 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 would potentially impact the level of activity within each Key Facility capability, as well as major projects planned at any non-Key Facility.

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[6] *Radiological facilities are defined as areas or activities that contain or use less than 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 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 are excluded. The identification of radiological facilities is based upon the official list maintained by DOE Los Alamos Site Office as of November 2002 (LANL 2002e).*

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

Key Facility and Location	*1999 SWEIS* Facility or Structure	*1999 SWEIS* Nuclear Hazard Category	*2005 Listing* Facility or Structure	*2005 Listing* Nuclear Hazard Category
CMR Building (TA-3)	CMR Building	2	CMR Building	2
Machine Shops (TA-3)				
Materials Science Laboratory (TA-3)				
Sigma Complex (TA-3)	Depleted Uranium Storage	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
LANSCE (TA-53)	Experimental Science	3		
			1 L Target	Radiological
			Lujan Center ER-1/2 Actinide	3
			Area A-East	3

Key Facility and Location	1999 SWEIS		2005 Listing	
	Facility or Structure	***Nuclear Hazard Category***	***Facility or Structure***	***Nuclear Hazard Category***
Solid Radioactive and Chemical Waste Facilities (TA-50 and TA-54)	Radioactive Materials, Research, Operations, and Demonstration	2	Actinide Research Technology Instruction Center	
	Waste Characterization, Reduction, and Repackaging Facility Building	2	Waste Characterization, Reduction, and Repackaging Facility	2
	Nondestructive Analysis Mobile Activities		External nondestructive analysis mobile activities outside TA-50-69	2
	Low-Level Radioactive Waste Storage and Disposal Area G	2	Storage and Disposal Facility (Area G) [a]	2
	Transuranic Waste Drum Preparation	2	Transuranic waste storage fabric dome with transuranic waste drum	2
	Radioactive Assay Nondestructive Testing Facility	2	Radioactive Assay Nondestructive Testing Facility	2
	Transuranic waste storage drum	2		2
	Transuranic Storage Drum	2		2
	Sheds	2	Sheds	2
	Dome	2	Dome	2
	Temporary Retrieval Dome	2	Temporary Retrieval Dome	2
	Tension Support Domes	2	Tension Support Dome	2
	Decontamination and Volume Reduction Glovebox		Decontamination and Volume Reduction System	2
	Storage Pad	2	Pad 10 (previously pads 2 and 4)	2
	Storage Pad	2	Storage Pad	2
	Transuranic Storage	2		
Plutonium Complex (TA-55)	Plutonium Facility	2	Plutonium Facility	2
	Nuclear Material Storage	2		

Key Facility and Location	1999 SWEIS		2005 Listing	
	Facility or Structure	Nuclear Hazard Category	Facility or Structure	Nuclear Hazard Category
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
			MDA A	2
			MDA B	3
			MDA T	2
			MDA W Sodium Storage Tanks	3
			Wastewater Treatment Plant	3
			Wastewater Treatment Plant (Pratt Canyon)	3
			MDA AB	2
			MDA C	2
			Underground tank with spent resin	2
			MDA H	3

CMR = Chemistry and Metallurgy Research Building, TA = Technical Area, LANSCE = Los Alamos Neutron Science Center, MDA = material disposal area.

[a] 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.

Sources: LANL 2003g, 2004h, 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 titles 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, returned to TA-3 (the CMR Building) in 2004 and will stay there until the CMR 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.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, and
- Loss of Cryogenic Separation Capability at the Tritium Key Facilities in 2001 (LANL 2004h).

These changes are discussed in more detail in the following sections.

Facility Performance and Other Changes Since the 1999 SWEIS

To evaluate the environmental impacts, the *1999 SWEIS* estimated the levels of operation for each capability. The total of these operations levels would be expected to result in a certain level of radioactive emissions, releases, and waste volume. These projected parameters set the limits for the operations levels. However, the *1999 SWEIS* 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 operations level for one capability and still be within the operations limits for the facility.

The facility performance section of each of the following Key Facility descriptions summarizes the performance levels within these defined capabilities for the period since the *1999 SWEIS* was published (through the end of 2004). Emphasis is placed on whether any capabilities have been gained or lost and whether the levels of activity have been 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 changed over the past 6 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 CMR 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 CMR Building include:

- Analytical chemistry capabilities involving the study, evaluation, and analysis of radioactive materials;
- Various operations essential for the stewardship of uranium products, including uranium processing and the handling and storage of highly radioactive materials;
- Destructive and nondestructive analysis employing analytical chemistry, metallographic analysis, measurement on the basis of neutron or gamma radiation from an item, and other measurement techniques;
- Nonproliferation training utilizing measurement technologies and special nuclear material housed at the CMR 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.

Facility Performance and Other Changes since the *1999 SWEIS*

As discussed in the *1999 SWEIS*, extensive upgrades originally planned for the CMR 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 NNSA mission assignments at LANL. As a result, DOE reduced the number of CMR Building upgrade projects to those needed to ensure safe and reliable operations through about the year 2010. CMR Building operations and capabilities are currently restricted due to safety and security constraints; the CMR Building is not operational to the full extent needed to meet 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 2003e), which evaluated the potential environmental impacts resulting from activities associated with consolidating and relocating the mission-critical CMR Building capabilities at LANL and replacement of the CMR Building. In its ROD issued in February 2004, the NNSA decided to replace the CMR Building with a new CMR Replacement Facility at TA-55 and to completely vacate and demolish the CMR Building (69 FR 6967). The ROD stated that the new facility would be established as a Hazard Category 2 nuclear facility.

The principle capabilities and activities described for this Key Facility either operated within the bounds of the *1999 SWEIS* over the past 7 years or have not been active. 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 CMR 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. Within the fabrication and metallography capability, the project to produce molybdenum-99 was terminated in 1999 and 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 in support of the Bolas Grande Project. This project would provide for the 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 2003e). In 2004, 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 metallurgical microstructural and chemical analysis and compatibility testing of actinides capability analyzed and tested an average of 100 samples per year, meeting the projected SWEIS rate. The demonstration of actinide decontamination technology project was completed in 2001.

Radiological air emissions remain below *1999 SWEIS* projections, except for technetium-99 and strontium-90, which were each present one year in dosimetrically insignificant amounts and were not identified in the *1999 SWEIS*. The CMR 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 *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 CMR 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, which includes materials synthesis and processing work to address 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 properties caused by aging, chemical attack, mechanical stresses, and other agents; and
- Fabrication of metallic and ceramic items, which includes fabricating and working with metallic and ceramic materials and various combinations thereof.

Facility Performance and Other Changes since the *1999 SWEIS*

The 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. The Beryllium Technology Facility, a 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) will be used 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 from the Machine Shops Key Facility into the Beryllium Technology Facility in stages during calendar year 2000. The authorization to begin operations in the Beryllium Technology Facility was granted by DOE 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 contributing to the Sigma Building's overall air emission makeup, but were present in dosimetrically insignificant amounts (less than a microcurie). In early 2000, stack monitoring was discontinued because the potential emissions from the monitored stacks were sufficiently low that stack monitoring was no longer warranted for compliance. Since 1994, the facility has operated with two NPDES-permitted outfalls, but only one of the outfalls was used. Annual outfall discharge rates were within *1999 SWEIS* projections for 1999 through 2002. The facility's effluent exceeded NPDES permit levels by 4 percent in 2003; a dechlorination system was installed in October 2003 to prevent further noncompliance events (LANL 2004f). Chemical wastes exceeded projections in 2002 by 49,400 pounds (22,400 kilograms) per year 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 the past 4 years, 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 had accumulated. As a last resort, all the drums were disposed of in June 2004. At the current time, drums are being disposed of as they are filled, about five at a time. Also included in the chemical waste volume for 2004 were two 20-foot transportainers containing 32,000 pounds (about 14,500 kilograms) of beryllium waste that were disposed of by 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 the 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 Shop Operations (TA-3)

Facility Performance and Other 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-Type Room 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-Type Room 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.

The principal activities listed above operated below the levels projected in the *1999 SWEIS*, including specialty components and fabrication with unique materials. Dimensional inspection was also 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 are currently 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 about 30 laboratories, 60 offices, 20 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;
- Laboratories for mechanical testing to subject materials to a broad range of mechanical loadings for the purposes of studying their fundamental properties and characterizing 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.

Facility Performance and Other 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 a support 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 upon. Radiological air emissions from this Key Facility have been sufficiently small such that 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)

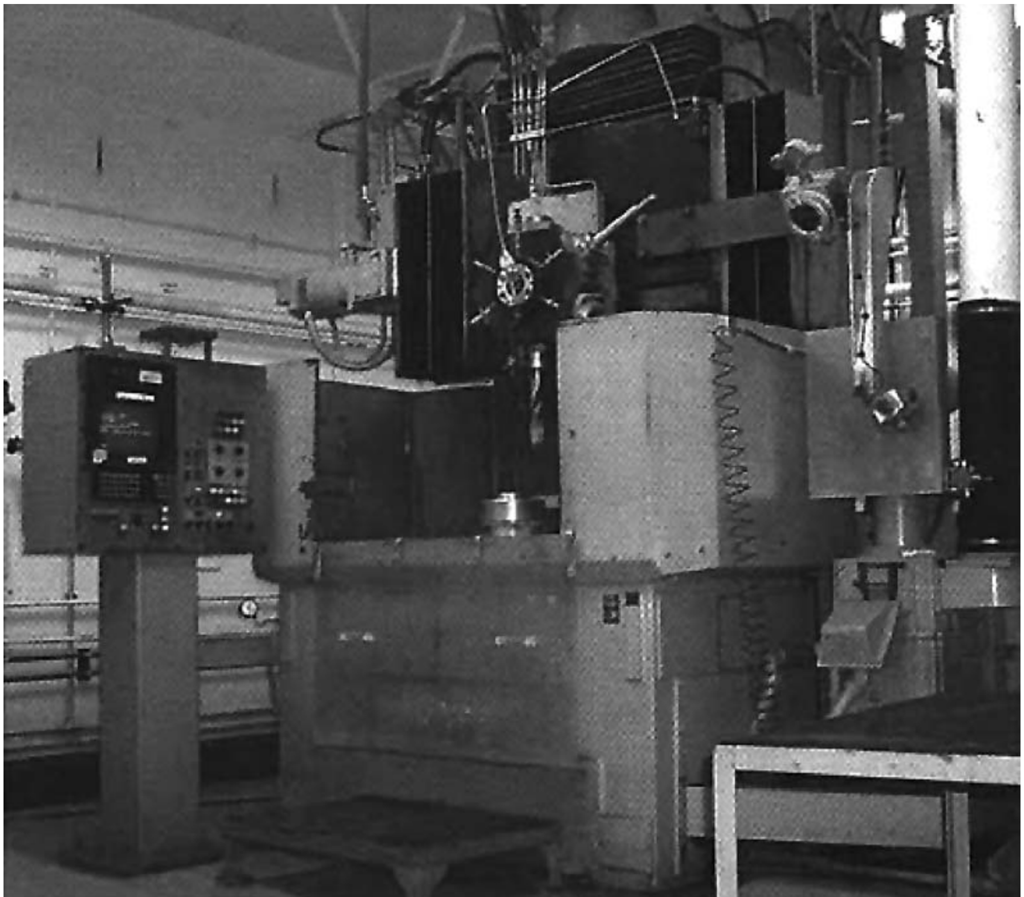
The High Explosives Research and Development and Processing Facilities are located in six TAs: TA-8, TA-9, TA-11, TA-16, TA-22, and TA-37. Most of these facilities were originally designed and built for production-scale operations during the early and mid-1950s and produced high explosives components 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 have 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.



Drill press used for machining high explosives

Facility Performance and Other 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 RCRA clean-closure and was dismantled and scrapped. RCRA closure has also been obtained for TA-16-401 and TA-16-406, units at the TA-16 Burn Ground. The 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 was 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. It 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 for the TA-16-394 burn tray, resulting in a total of about 860 cubic yards (660 cubic meters) of hazardous wastes being removed. A burn unit was upgraded, improving capacity and efficiency and minimizing 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 are generally limited to TA-16-388, although TA-16-399 is still available for burning of bulk high explosives.

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, as compared to the 11 outfalls projected in the *1999 SWEIS*. Annual NPDES discharge rates since 1999 have remained below levels projected in the *1999 SWEIS*. The quality of the NPDES effluent exceeded permit levels one time in March 2001 (LANL 2002c). 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: scrap metal for recycle placed in storage due to the DOE radiological area release moratorium; cleanup of MDA R Legacy Material Action Project activities; and the 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.

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 as opposed 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.

Facility Performance and Other 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 became fully operational in late 2004. 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] The 2000 Cerro Grande Fire destroyed or damaged equipment, materials, and storage structures within this Key Facility. Damaged buildings were subsequently decontaminated and demolished. 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.

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.

The principal activities, as stated above, have operated below the levels projected in the *1999 SWEIS*. During 2004, the use of foam to reduce particulate emissions during dynamic experiments was evaluated. Aqueous foam was used on explosive tests to mitigate emission of particulates such as beryllium and depleted uranium. Use of the foam continues for certain tests.

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 2 functional NPDES-permitted outfalls, as compared to 7 projected in the *1999 SWEIS*. Total NPDES discharge volumes for these 2 outfalls were within *1999 SWEIS* projections for 2002 through 2004 and exceeded projected levels for 3 years (1999 through 2001). It should be noted that, prior to 2002, discharge rates 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 2002c). In 2000, chemical wastes exceeded *1999 SWEIS* 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 chemical waste that was nonhazardous, and 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 2003. In 2004, mixed low-level wastes exceeded the *1999 SWEIS* projection 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

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

(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.

Weapons Engineering Tritium Facility at TA-16

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 radiological facility in June 2004. Programmatic activities at the Tritium Science and Fabrication Facility have been reduced and were 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 will continue into 2006. After these activities are completed the Tritium Science and Fabrication Facility will be placed in a surveillance and maintenance mode and eventually deactivated. NNSA prepared the *Environmental Assessment for the Proposed Consolidation of Neutron Generator Tritium Target Loading Production* (DOE 2005a); this project will relocate the Neutron Generator Tritium Target Loading operations currently at LANL 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 and, 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.

The principal capabilities and activities conducted at the Weapons Engineering Tritium Facility, the Tritium Systems Test Assembly, and Tritium Science and Fabrication Facility have 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,
- Storage of tritium gas and tritium oxide.

Facility Performance and Other 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. Between 1999 and 2004,[8] no new capabilities have been added to the Tritium Key Facility, and one, cryogenic separation, has been deleted. This capability was lost due to discontinuation of its operation in the Tritium Systems Test Assembly Facility, where it had been 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 2004, 8 high-pressure gas fill operations were conducted, compared to 65 fills projected by the SWEIS ROD, and approximately 9 gas boost system tests and gas processing operations were performed, compared to 35 projected (LANL 2005g).

The following summaries of operations data over the period 1999 through 2004 illustrate how activity levels are affecting the surrounding environment. All three buildings are served by ventilation systems that exhaust to stacks. Between 1999 and 2004, tritium air emissions were below the *1999 SWEIS* projections. There were two exceptions: a one-time release of elemental tritium in January 2001 at the Weapons Engineering Tritium Facility and exceedance of tritium

[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 TA-16 Weapons Engineering Tritium Facility operations.*

in water vapor released from the Tritium Systems Test Assembly during 2002, 2003, and 2004 (due to deactivation activities). The Key Facility has two NPDES-permitted outfalls, as projected in the *1999 SWEIS*.[9] Annual NPDES discharge rates exceeded *1999 SWEIS* projections 4 out of 6 years. The quality of the TA-21 effluent exceeded NPDES permit levels two times in 1999 (LANL 2000e). Chemical waste volumes exceeded *1999 SWEIS* projections in 2001 and 2002 due to refrigerant replacement at Building 16-450. The low-level radioactive waste, mixed low-level radioactive waste, and transuranic wastes were all below the projected amounts.

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;

[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.*

- 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 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.

Facility Performance and Other Changes since the *1999 SWEIS*

Since the publication of the *1999 SWEIS*, two office trailers (TA-18-300 and -301) have been installed at the Pajarito Site, security enhancements have been made, and a cable tray has been relocated within this site. The SWEIS ROD projected replacement of the portable linear accelerator; this has not been performed. 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 2002h). 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. Implementation of the ROD was initiated in 2004 (for further information see Appendix H). The SWEIS identified nine capabilities for this Key Facility, all of which are still operating. The Nuclear Measurements School, which had moved to the CMR 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 CMR 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. Since 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 year 2000 when approximately 280 cubic feet (8 cubic meters) of mixed low-level radioactive waste was generated as a result of maintenance activities.

2.4.9 Target Fabrication Facility (Technical Area 35)

The Target Fabrication Facility, located at TA-35, is comprised of 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 that 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.

Facility Performance and Other 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 projected levels 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 and wastes produced since 1999 were below levels identified in the *1999 SWEIS*, or were sufficiently small that measurement systems have not been deemed necessary to meet regulatory or facility requirements.

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 Key Facility currently includes 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. 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.


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

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). 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 1999).

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

- 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 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.

Facility Performance and Other 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 they mimic the functions of living systems based upon the relationships found between structure, function, and formation;
- Genomic studies using molecular and biochemical techniques to analyze the genes of humans and other animals, including the development of strategies to evaluate the specific sequence of individual genes and gene mapping;
- 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 including analysis of the genes of living things such as animals, humans, plants, and fungi, or genetic material of microbes and viruses;
- 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; 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 Key Facility have had negligible impacts on wastes and emissions produced by this facility. Most of the principle activities described above remained below *1999 SWEIS* projections and within the established environmental envelope. Activity levels within the environmental biology capability exceeded *1999 SWEIS* projections 1 year out of the 6. The research involving DNA and protein molecules exceeded *1999 SWEIS* projections all 5 years. A number of projects involving work with viruses also have been approved. Two changes to note are (1) radioactive material work is continually decreasing and (2) the animal colony was eliminated in 1999. 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 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. DOE is preparing an EIS to analyze the potential impacts of its operation. Bioscience 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.

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 Diagnostic Instrumentation and Development Building (48-28), the Advanced Radiochemical Diagnostics Building (48-45), the Analytical Facility (48-107), and the Machine and Fabrication Shop (48-8). Building (48-1) was downgraded to a radiological facility in 2003.

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

- 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 sitewide 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;

Radiochemistry Hot Cell (TA-48)

- 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.

Facility Performance and Other Changes since the *1999 SWEIS*

No facility changes were projected for the Radiochemistry Facility in the *1999 SWEIS*. 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 Advanced Radiochemical Diagnostics Building, however, suffered severe ash, dirt, and soot contamination and its interior was subsequently gutted and replaced.

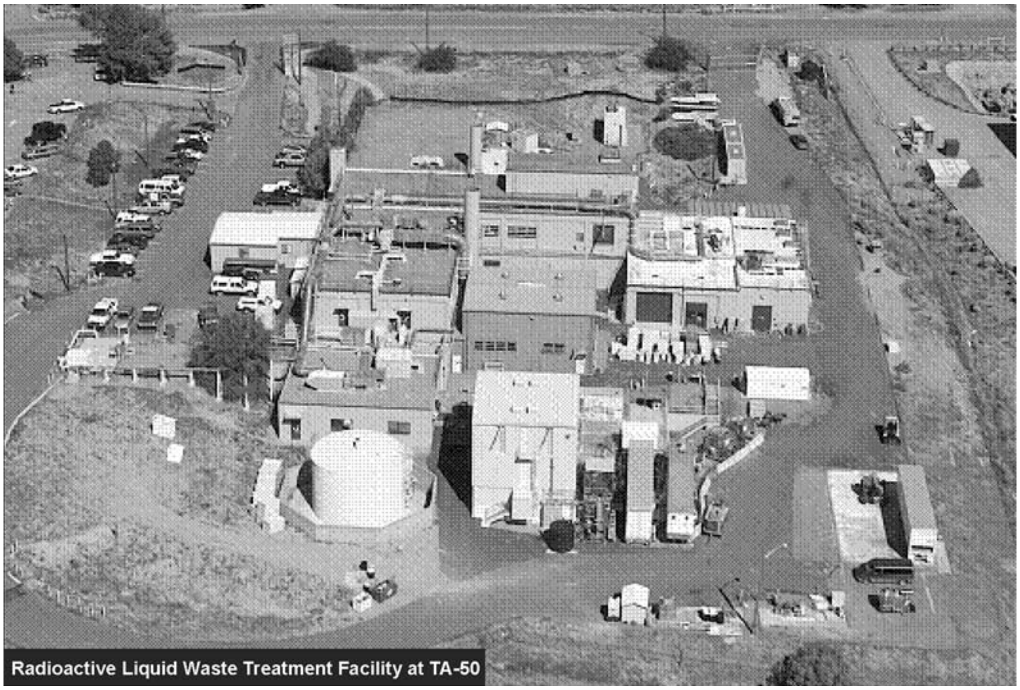
Many of the activities listed above operated at or below the levels projected in the *1999 SWEIS*. The environmental remediation capability decreased its level of operations to approximately half the projected level, and the structural analysis capability level of operations decreased by one-third of 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 and 2004. 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 2004. 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 6 (1999 through 2004). In other years, however, these radionuclides were below the projected levels or were not detected at all, including arsenic-73, arsenic-74, 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 2004 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 wastes treatment.

Facility Performance and Other Changes since the *1999 SWEIS*

The decontamination capability was transferred to the Solid Radioactive and Chemical Waste Key Facility in 2000. Between 1999 and 2004, 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, and currently, low-volume, high-nitrate liquid wastes are separated “upstream” by the waste generators and shipped to offsite commercial hazardous materials 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 processes and rendered other processes ineffective. 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 are currently present in microcurie quantities: 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 2002c). Since then, Radioactive Liquid Waste Treatment Facility has installed new or upgraded treatment processes to improve effluent quality and, 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 2004. 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 were below *1999 SWEIS* projections. Every year except 2001, the amount of chemical wastes generated at the Radioactive Liquid Waste Treatment Facility was below projections. In 2001, however, chemical waste exceeded generation projections due to the replacement of storage tanks and some associated plumbing. Since secondary wastes are generated during the treatment of radioactive liquid waste and as a result of decontamination operations at LANL, several waste streams exceeded their projections. Low-level radioactive waste volumes exceeded generation projections in 1999, 2001, 2002, 2003, and 2004. In 2004, the exceedance of the low-level radioactive waste volume projected in the *1999 SWEIS* was the result of about 9,200 gallons (35,000 liters) of water pumped out of manholes and processed at Radioactive Liquid Waste Treatment Facility. Also included in the annual low-level radioactive waste volumes are the aqueous evaporator bottoms shipped offsite for drying (190 cubic yards [148 cubic meters] in 2004). Mixed low-level radioactive waste generation at the Radioactive Liquid Waste Treatment Facility was not projected in the *1999 SWEIS*, but occurred during four of the five years 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. A new experimental facility for the production of ultracold neutrons is under construction in Experimental Area B. Experimental Area C is the location of proton radiography experiments for the Stockpile Stewardship Program.

This Key Facility has two Hazard Category 3 and no Hazard Category 2 nuclear facilities at TA-53. In September 2001, however, Buildings TA-53-945 and 53-954 were placed on the LANL radiological facility list (LANL 2002f).

The principal capabilities and activities conducted at LANSCE between 1999 and 2004 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.

Facility Performance and Other Changes since the *1999 SWEIS*

The 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 quadrupole 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 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. Preparations began in the spring of calendar year 1999 for construction of the new facility and construction started in calendar year 2000. The facility was completed in calendar year 2002. The Isotope Production Facility generated its first beam on December 23, 2003. Full production has not yet begun.

- Closure of two sanitary lagoons was started. 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 the 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 potential unacceptable risk to humans or the environment. Currently, the site is located within an industrial area under LANL (institutional) control. The site 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 is under review by NMED.

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 was constructed during 1999; and 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 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 and Flight Path 13 was constructed and completed in 2005.

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 since site power was lost during the fire. Systems and equipment were returned to power sequentially instead of simultaneously; this process 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 a new Ultracold Neutron Facility is under construction (DOE 2002h).

In the 6-year period from 1999 through 2004, 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.

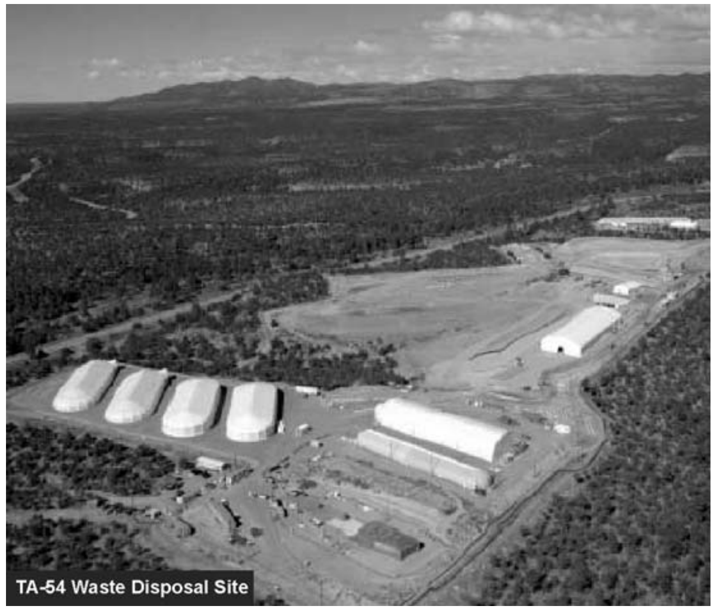
Because of the number of facilities that were not funded and therefore not completed, no accelerator waste transmutation tests were performed; no lead target tests were conducted; and no exotic, neutron-rich, and neutron-deficient isotopes were produced since issuance of the *1999 SWEIS* ROD. Ultra-cold neutron experiments ran only 3 of the 6 years.

The primary indicator of activity for LANSCE is production of the 800-million-electron-volt LANSCE proton beam. Between 1999 and 2004, 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*. There also was no production of medical isotopes during this period, although construction of a new isotope production facility was completed.

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. Total LANSCE air emissions have decreased with the inactivity of Area A resulting in radiological air emissions from LANSCE that were below projections from the *1999 SWEIS*. The following nuclides were not projected as radiological air emissions in the *1999 SWEIS*, but have since been present in measured air emissions (see Appendix B for additional information on air emissions): arsenic-72, arsenic-73, beryllium-7, bromine-76, bromine-82, cobalt-60, mercury-193, mercury-193m, mercury-195, mercury-195m, mercury-197, mercury-197m, mercury-203, osmium-191, sodium-94, sulfur-37, selenium-75, and tritium as water vapor. LANSCE currently has four NPDES-permitted outfalls, as 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 two times 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. In 1998, generation of chemical wastes exceeded *1999 SWEIS* projections due to the Legacy Material Action Project. All chemical, 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. 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

Currently the Hazard Category 2 nuclear facilities at this Key Facility include the Radioactive Assay Nondestructive Testing Facility (Building 54-38), the low-level radioactive waste disposal cells, shafts, and trenches and fabric domes in Area G; the transuranic waste storage domes 226 and 229-232; outdoor operations at the Waste Characterization, Reduction, and Repackaging Facility (50-69); and the Decontamination and Volume Reduction System (TA-54-412).

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 the Waste Isolation Pilot Plant (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 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; and
- Other waste processing such as storage of transuranic sludge (solidified and packaged by 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.

Facility Performance and Other 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, while execution of the other project, expansion of Area G, has not yet been completed, but DOE has authorized construction of a new pit and a design has been completed. Construction will begin in spring 2006. 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.

For the most part, overall waste volumes generated at LANL have been well within *1999 SWEIS* projections, with the exception of transuranic waste. In 2003, the volumes of transuranic waste and mixed transuranic waste processed by the Solid Chemical and Radioactive Waste Facility exceeded *1999 SWEIS* projections by approximately five times the projected volumes due to the repackaging of legacy transuranic waste for shipment to WIPP. There are no NPDES-permitted outfalls at this Key Facility. No stacks require monitoring for radiological air emissions at this key facility, all non-point sources are measured using ambient monitoring.

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 Nuclear Hazard Category 1 buildings. 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 and there are currently no plans to use this building for storage of nuclear materials.

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 the recovery, recycling, and blending of plutonium-238; and
- Storage, shipping, and receiving for the majority of the LANL special nuclear material inventory.

Facility Performance and Other 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 Improvements 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. 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 secured facilities at the Plutonium Facility Complex at TA-55 while awaiting transfer to other facilities. 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 is now scheduled to be completed by 2010 instead of 2007.

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 well 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*.

Between 1999 and 2004, the actinide research and development capability processed less than the *1999 SWEIS* projected 881 pounds (400 kilograms) per year, and the number of pits that were disassembled or converted was below the projected amount. Research supporting DOE actinide cleanup activities continued at low levels, and no plutonium residues originating from Rocky Flats were processed. The study of nuclear fuels used in terrestrial and radioisotope power systems has been minimal during the 6 years 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 well below *1999 SWEIS* projections in the years up to and including 2004 except for releases of elemental tritium that exceeded projections in 2002 and 2003. The facility has one NPDES-permitted outfall, consistent with the *1999 SWEIS* projections, and the NPDES discharge rate has consistently been below projected amounts. The quality of effluent exceeded NPDES permit levels one time in 2003 before being corrected (LANL 2004f). Transuranic, low-level radioactive, and mixed low-level radioactive wastes were all below *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).

Some of the LANL non-Key Facilities are designated as nuclear or moderate hazard facilities, but do not meet the criteria for Key Facilities. In addition, some of these non-Key Facilities are operating, and several are now nonoperable surplus and are awaiting DD&D following removal of special nuclear material and hazardous materials. At the present time, 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 occurring since the issuance of the *1999 SWEIS* and includes 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 has been demolished along with a major portion of Building 41-4. The Ice House, Building 41-1, an underground storage vault, is categorized as a radiological facility, although no special nuclear material is now stored in the vault.
- The Sewage Treatment Plants (Building 46-340) were designated as moderate chemical hazard facilities prior to 1999. Since 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 continuous operation at the Nevada Test Site, Atlas continues its mission of supporting stockpile stewardship as a tri-laboratory (Lawrence Livermore National Laboratory, Sandia National Laboratories, and LANL) resource and as a state-of-the-art research facility.

In addition to Atlas, DOE and NNSA 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. The Cerro Grande Fire impacted 86 structures or buildings, damaging 31 and destroying 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 DOE's Office of Science, 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 for Integrated Nanotechnologies. 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 $18.2 million building was completed in December 2005, with initial operations planned to begin in April 2006 and full operations by May 2007.
- 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 (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.

- The Information Management Office Building is currently undergoing detailed design. This building will consolidate various personnel into a centralized, more efficient office building. This building will be located at the northeast corner of the intersection of Diamond Drive and Pajarito Road within TA-3. The facility will be two-stories, and approximately 15,000 to 18,000 square feet (1,390 to 1,670 square meters). Construction is expected to be complete by the end of 2006.

- The National Security Sciences Building, currently under construction within TA-3 at LANL, will provide 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 will be 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 is near the National Security Sciences Building. A third structure is now under construction.

- 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 State Road 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. However, in 2004, 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 SWEIS ROD.

Non-Key Facilities currently operate five NPDES-permitted outfalls, as 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 three of the five 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, with only three events where NPDES permit requirements were exceeded: effluent from the 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 2004, radioactive airborne emissions from point sources (stacks) have varied from a low of 1,900 curies during 1999 to a high of approximately 15,400 curies during 2001 (70 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 1.84 millirem during 2001 (compared to a 5.44 millirem projected dose for this period of time). This dose rate is well under 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. However, the apparent decrease in flows is primarily due to the methodology by which flow was measured and reported in the past. Historically, instantaneous flow was 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 flow is 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 2003g, 2004h). 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 2005g). **Table 2–4** summarizes LANL emissions, doses, discharges, and radioactive waste generation and compares them to the *1999 SWEIS* projections.

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

	SWEIS ROD	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*
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**
Percent of 21,700 curies	–	*9*	*15*	*70*	*30*	*9*	*25*
- MEI dose in millirem per year	**5.44**	**0.32**	**0.65**	**1.84**	**1.69**	**0.65**	**1.68**
Percent of 5.44 millirem	–	*6*	*12*	*34*	*31*	*12*	*30*
NPDES discharges in million gallons per year	**278**	**317**	**265**	**124**	**178**	**210**	**162**
Percent of 278 million gallons per year	–	*114*	*95*	*45*	*64*	*76*	*0.5*
Chemical waste in 1,000 kilograms per year	**3,250**	**15,441**	**27,674**	**27,583**	**1,734**	**689**	**1,210**
Percent of 3,250,000 kilograms per year	–	*475*	*852*	*849*	*53*	*21*	*37*
Low-level radioactive waste in cubic meters per year	**12,200**	**1,678**	**4,229**	**2,597**	**7,310**	**5,625**	**14,839**
Percent of 12,200 cubic meters per year	–	*13.8*	*34.7*	*21.3*	*59.9*	*46.1*	*122*
Mixed low-level radioactive waste in cubic meters per year	**632**	**21**	**598**	**58**	**21**	**36**	**33**
Percent of 632 cubic meters per year	–	*3.3*	*94.6*	*9.2*	*3.3*	*5.7*	*5*
Transuranic in cubic meters per year	**333**	**143**	**125**	**117**	**119**	**403**	**40**
Percent of 333 cubic meters per year	–	*42.9*	*37.5*	*35.1*	*35.7*	*121*	*12*
Mixed transuranic in cubic meters per year	**115**	**87**	**87**	**48**	**87**	**157**	**23**
Percent of 115 cubic meters per year	–	*75.7*	*75.7*	*41.7*	*75.7*	*136.5*	*20*

ROD = Record of Decision, MEI = maximally exposed individual, NPDES = National Pollutant Discharge Elimination System.
Note: To convert gallons to liters, multiply by 3.378533, kilograms to pounds, multiply by 2.2046, cubic meters to cubic yards, multiply by 1.3079.
Sources: LANL 2003g, 2004h.

The LANL workforce has been maintained above *1999 SWEIS* projections since 1999. The 13,261 employees at the end of 2004 represent 1,910 more employees than projected, but a decrease of 355 employees from 2003. Since 1999, the peak electricity consumption was 394 gigawatt-hours during 2002, and the peak demand was 85 megawatts during 2001 compared to *1999 SWEIS* projections of 782 gigawatt-hours with a peak demand of 113 megawatts. The peak water usage was 461 million gallons (1.7 billion liters) during 1998 (compared to 759 million gallons [2.9 billion liters] projected), and the peak natural gas consumption was 1.49 million decatherms (1.57 trillion kilojoules) during 2001 (compared to 1.84 million decatherms [1.94 trillion kilojoules] projected in the *1999 SWEIS*). Between 1999 and 2004, 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 2004h).

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. Also, construction was completed on 44 acres (18 hectares) of land being developed along West Jemez Road for the Los Alamos Research Park.

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.) However, excavations did occur at the Airport East and White Rock tracts from June 2002 through March 2003. These two land tracts are now available for conveyance to the County of Los Alamos for future development (LANL 2004h). Also, a total of 11 cultural sites were excavated in Rendija Canyon in 2004 (LANL 2005g).

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 in the 1999 through 2004 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. 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 2004h, 2005g).

For the most part, operations at LANL remained within the projections made in the *1999 SWEIS*. Operations that exceeded projections, such as number of employees or amount of chemical waste generated from cleanup activities, produced a neutral or beneficial impact on northern New Mexico. A larger number of employees increases the tax base and results 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 accomplished treatment and disposal of these wastes in accordance with applicable regulations. Overall, data on operations during the period 1999 through 2004 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 presents a summary of the actual impacts and performance changes by resource or impact area from 1999 through 2004 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 2004 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 2004)

Resource or Impact Area	*1999 SWEIS Projected Impacts*	*Actual Impacts and Performance Changes (1999 to 2004)*	*Assessment*
Land Resources	LANL covered 43 square miles (111 square kilometers), with about 5 percent of the site being 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 at 41 acres. 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 4,820 acres (1,951 hectares) were designated for conveyance to Los Alamos County and transfer to the Department of the Interior for the Pueblo of San Ildefonso, of which 2,255 acres (913 hectares) have been turned over (as of the end of 2005), including nearly all lands to be transferred to the Pueblo of San Ildefonso. Conveyance of 635 acres (257 hectares) to the county has been deferred. 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 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. Projected temporary and minor impacts included changes resulting from construction and environmental restoration activities.	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. 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.	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. The Cerro Grande Fire and bark beetle infestation altered the viewscape beyond that analyzed in the *1999 SWEIS* or other subsequent NEPA review documents.

[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 2004)***	***Assessment***
		Bark beetles have killed thousands of evergreen trees, opening the forest and making LANL facilities more visible.	
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 CMR 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 CMR Building operations to TA-55, an area of no observed seismic faulting (DOE 2003e).	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 5 of 6 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 three Key Facilities exceeded their individual 1999 projections. • Tritium Facility: discharges exceeded annual projections each year, ranging from 0.4 to 22 million gallons per year (1.5 to 85 million liters per year), compared to *1999 SWEIS* projections of 0.3 million gallons (1.1 million liters) per year. • CMR Building exceeded projections 5 of 6 years, ranging from 0.02 to 4.5 million gallons (0.08 to 17 million liters) per year, compared to *1999 SWEIS* projections of 0.5 million gallons (1.9 million liters) per year. • High Explosives Testing Facility exceeded projections 3 years, ranging from 9 to 16.1 million gallons (34 to 61 million liters) per year, compared to *1999 SWEIS* projections of 3.6 million gallons (14 million liters) per year.	The number of NPDES outfalls were within *1999 SWEIS* projections. The number of permitted NPDES outfalls and the total flow were consistent with or below *1999 SWEIS* projections. However, the distribution of flow from individual Key and non-Key Facilities 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) outfalls and measuring stations, providing more accurate information.

Resource or Impact Area	***1999 SWEIS Projected Impacts***	***Actual Impacts and Performance Changes (1999 to 2004)***	***Assessment***
		Non-Key Facilities: Flow exceeded *1999 SWEIS* projections 3 out of 6 years, in part due to extrapolation from instantaneous flow measurements.	
- NPDES Outfall Quality	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*, the Radioactive Liquid Waste Treatment Facility 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; number of events where permit levels were exceeded ranged from 0 to 16 (of about 1,100 samples per year). Exceedances resulted in preparation and implementation of corrective action plans. The Radioactive Liquid Waste Treatment Facility has improved the quality of effluent, reducing annual levels of nitrates and radionuclides. Since 2002, 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 outfall of 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 Storm Water and Construction Sources	Water quality projected to be similar or better than recent experience. The following LANL operations were identified in the *1999 SWEIS* as impacting surface water quality: • Storm water 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 Environment Department (Section 404 and 401 permits).	LANL still requires Storm Water Pollution Prevention Plans and best management practices to protect surface waters from pollutants from industrial storm water sources and construction projects. The number of industrial facilities requiring individual Storm Water Pollution Prevention Plans has ranged from 15 to 22. Storm Water 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 Storm Water 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.
- 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	Several actions and best management practices were implemented to manage, control, and minimize storm water 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 6. The annual flow discharged to the individual watersheds exceeded *1999 SWEIS* projections 10 times from 1998 to 2000 and 0 times 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	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.

Resource or Impact Area	1999 SWEIS Projected Impacts	Actual Impacts and Performance Changes (1999 to 2004)	Assessment
	radionuclides, metals, organics, polychlorinated biphenyls, and high explosives residue.	*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, storm water runoff increased (2 to 4 times for average flow, and 10 to 100 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.	
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 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 having little effect on groundwater quantities.	LANL discharges have had little effect on groundwater quantities in the last 5 years.	Impacts of LANL discharges on groundwater quantities continue to be bounded by the impacts analyzed in the *1999 SWEIS*.
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 = 1.5	Annual emissions of criteria pollutants from LANL operations reported in the *Annual Emissions Inventories Through 2004* 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*.
- Nonradiological Toxic Pollutants	A screening analysis of toxic pollutants indicated that levels of potential consequence to the public would not be exceeded for most toxic air pollutants. Further detailed analysis demonstrated that concentrations of other toxics 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	Reported toxic pollutant emissions have been generally less than guideline values. Carcinogenic emissions have been generally 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 15 additional toxic pollutants were emitted and emissions of 37 toxic pollutants exceeded *1999 SWEIS* projections. Seventy-eight toxic pollutants were not emitted that were projected.	The amounts of toxic materials 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.

<table>
<tr><th>Resource or Impact Area</th><th colspan="2">1999 SWEIS Projected Impacts</th><th colspan="2">Actual Impacts and Performance Changes (1999 to 2004)</th><th>Assessment</th></tr>
<tr><td></td><td colspan="2">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 toxic pollutants were not reported in detail for all facilities, the details presented for TA-3, as an example, indicate emissions of 153 toxic pollutants.

The 1999 SWEIS did not address toxic emissions from combustion sources.</td><td colspan="2"></td><td></td></tr>
<tr><td>- Nonradiological Construction Activities</td><td colspan="2">Air quality impacts of construction activities were not quantified in the 1999 SWEIS. However, the 1999 SWEIS 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.</td><td colspan="2">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.</td><td>Construction at LANL is an ongoing activity with temporary and localized air quality impacts.</td></tr>
<tr><td>- Radiological</td><td></td><td><u>Annual Average (curies per year)</u></td><td><u>Annual Average (curies per year)</u></td><td><u>Peak Year (curies)</u></td><td rowspan="9">Annual average air emissions continue to be below levels projected in the 1999 SWEIS, with the exception of tritium. The exceptions were due to deactivation activities at TA-21 and a single event at the Weapons Engineering Tritium Facility (TA 16).</td></tr>
<tr><td></td><td>Actinides</td><td>0.000798</td><td>0.0000106</td><td>0.0000302</td></tr>
<tr><td></td><td>Fission Products</td><td>0.00014</td><td>Not reported</td><td>Not reported</td></tr>
<tr><td></td><td>Activation Products</td><td>16,000</td><td>2,760</td><td>5,970</td></tr>
<tr><td></td><td>Tritium (water vapor)</td><td>1,260</td><td>851</td><td>1,200</td></tr>
<tr><td></td><td>Tritium (gas)</td><td>1,920</td><td>2,050</td><td>8,740</td></tr>
<tr><td></td><td>Argon-41</td><td>870</td><td>18.2</td><td>29.8</td></tr>
<tr><td></td><td>Other Noble Gases</td><td>1,640</td><td>Not detected</td><td>Not detected</td></tr>
<tr><td></td><td>Uranium</td><td>0.152</td><td>0.00942</td><td>0.02</td></tr>
<tr><td>Noise</td><td colspan="2">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.</td><td colspan="2">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.</td><td>Noise impacts from construction and operation were similar to those discussed in the 1999 SWEIS.</td></tr>
<tr><td>Ecological Resources</td><td colspan="2">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</td><td colspan="2">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</td><td>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.</td></tr>
</table>

Resource or Impact Area	*1999 SWEIS Projected Impacts*	*Actual Impacts and Performance Changes (1999 to 2004)*	*Assessment*
	endangered species, 2 federally 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. 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 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).	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 Areas of Environmental Interests. 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 wildfire potential. Thinning has both positive and negative effects on wildlife. An infestation of bark beetles has resulted in a 12 to 100 percent mortality of pine and fir trees across LANL.	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. Forest thinning creates a forest that appears more park-like with an increase in 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	1.6 person-rem in peak year (2001)	
Risk (per year)	0.0165 latent cancer fatalities	0.00096 latent cancer fatalities in peak year (2001)	
- MEI	LANL site MEI located north-northeast of LANSCE.	No change in location for the LANL site MEI.	Dose to MEI continues to be bounded by projections in the *1999 SWEIS*.
Dose (per year)	5.44 millirem	1.84 millirem in peak year (2001)	
Risk (per year)	2.72×10^{-6} latent cancer fatalities	1.1×10^{-6} latent cancer fatalities in peak year	
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	240 person-rem in peak year (2003)	
Risk (per year)	0.281 latent cancer fatalities	0.144 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 2004)*	*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 has increased to 90 percent in 2005, and the number of known cultural resource sites increased as well. Conveyance and transfer of land resulted in cultural resources being removed from the responsibility and protection of DOE, including resources eligible for listing on the National Register of Historic Places, Native American 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 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.	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 2004, there were 13,261 LANL-affiliated employees.	Socioeconomic impacts from continued operations at LANL between 1998 and 2004 have exceeded the socioeconomic impacts projected in the *1999 SWEIS* due to the larger number of employees.
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: 371,695 megawatt-hours per year, with peak usage of 394,398 megawatt-hours in 2002. Average peak load demand: 68 megawatts, with a peak of 71 megawatts in 2003.	Annual electricity usage at LANL remained below the levels projected in the *1999 SWEIS*. Electrical usage would not exceed the annual 963,600 megawatt-hour system capacity, but could exceed the physical transmission capability (thermal rating) of the transmission lines of 110 megawatts.

Resource or Impact Area	***1999 SWEIS Projected Impacts***	***Actual Impacts and Performance Changes (1999 to 2004)***	***Assessment***
- Fuel	LANL was projected to require 1.84 billion cubic feet (52.1 million cubic meters) of natural gas per year.	Average annual usage: 1.4 billion cubic feet (39 million cubic meters) per year. Peak year usage: 1.5 billion cubic feet (42 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 8.1 billion cubic feet (229 million cubic meters) per year.
- Water	LANL was projected to require 759 million gallons (2.9 million liters) of water per year.	Average annual usage: 408 million gallons (1.5 billion liters) per year. Peak year usage: 453 million gallons (1.7 billion liters) (1999).	Annual water usage at LANL remained below the level projected in the *1999 SWEIS*. Demand for water could exceed the conservation limit of approximately 542 million gallons (2 billion liters) per year under the agreement with Los Alamos County.
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. The environmental restoration project has completed cleanup activities 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 activities by the environmental restoration project were undertaken in response to the Cerro Grande Fire. Environmental restoration project resulted in beneficial impacts by reducing 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*.
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, mixed transuranic, and chemical wastes). 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.	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 5 of the 6 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, all 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,	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.

Resource or Impact Area	*1999 SWEIS Projected Impacts*	*Actual Impacts and Performance Changes (1999 to 2004)*	*Assessment*
		but was within the low-level radioactive waste management capacity. Low-level radioactive waste operations at TA-54 were conducted within the existing footprint.	
Emergency Preparedness and Security	LANL's Comprehensive Emergency Management and Response Program that 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 would include replacing a number of aging structures either 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, CMR = Chemistry and Metallurgy Research, 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, 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).

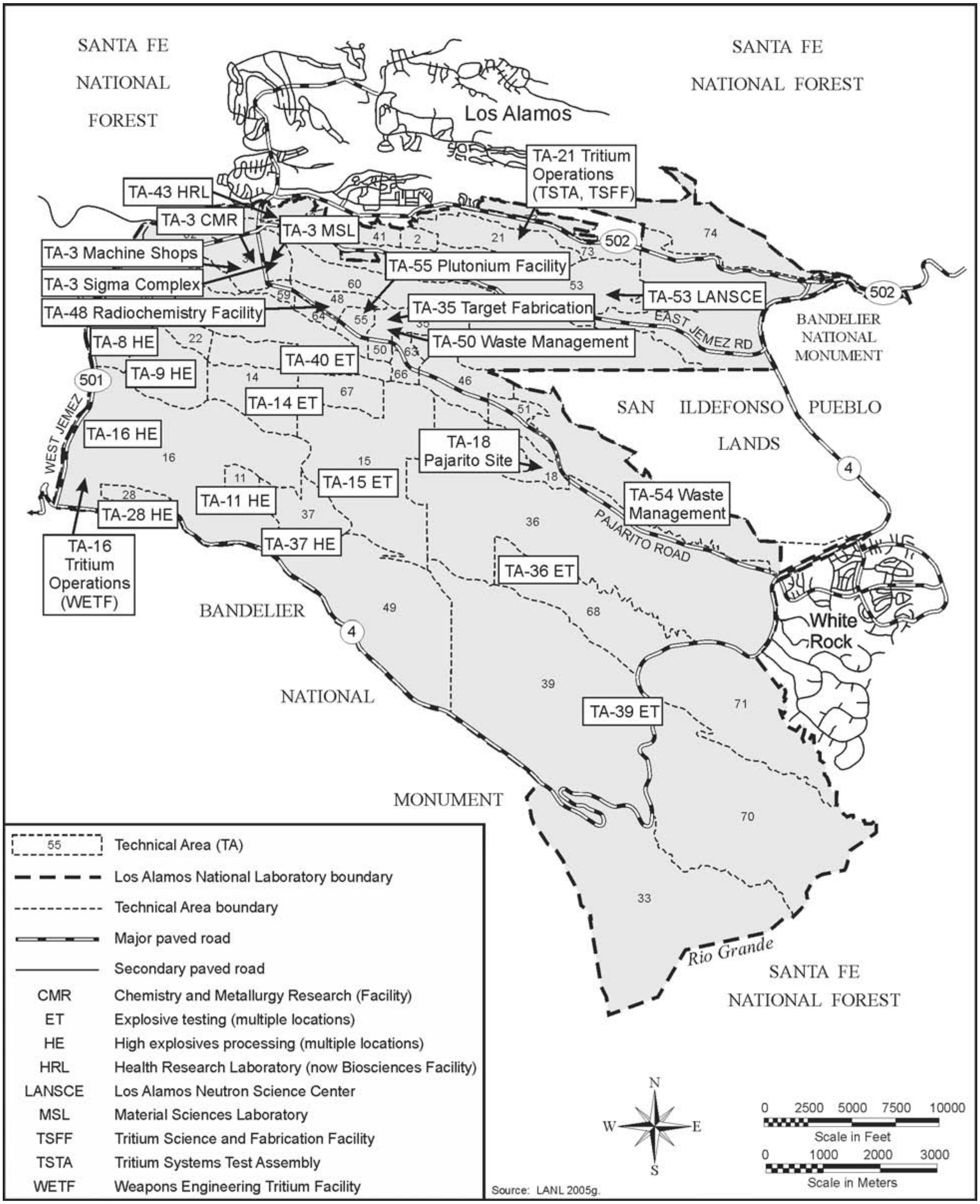


Figure 2–3 Los Alamos National Laboratory Key Facilities

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 *Draft 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) with implementation of 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 projects that have been approved based on completed NEPA analyses would go forward. The Expanded Operations Alternative proposes an increase in activity levels for some capabilities and 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—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—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)* 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). However, as a result of constraints at the time the Record of Decision (ROD) was issued, including project delays and operational limitations for the Chemistry and Metallurgy Research Building (instituted to ensure that the risks were maintained at an acceptable level), DOE determined that additional study of methods for implementing the 50 pits per year (80 pits per year using multiple shifts) production capacity was warranted. In effect, DOE postponed a decision to expand pit manufacturing beyond a level of 20 pits per year. However, the impacts analysis in the *1999 SWEIS* Expanded Operations Alternative is based on full implementation of pit production of 80 pits per year using multiple shifts. That impacts analysis is also the basis for all the alternatives analyzed in this SWEIS, although impacts in certain resource areas are distinguishable.

This chapter is organized by alternative and, within each alternative, describes projects at the site-wide, technical area (TA), or Key Facility level, 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. However, a number of proposed projects in the No Action and Expanded Operations Alternatives are not tied to a Key Facility. Instead they are either site-wide or TA-related. Projects that are site-wide in nature 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 for each Key Facility, and tables presenting the parameters describing 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 include parameters that are different 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. By the very nature of R&D, specific activities are expected to vary and evolve over time. However, these changes can be sufficiently characterized to ensure the analysis of their consequences within the context of the alternatives. In addition, activity levels identified for each capability should be considered 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 within 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 (10 *Code of Federal Regulations* [CFR] 1021, Subpart D) list classes of actions called categorical exclusions that DOE has determined do not individually or collectively have 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. Also, certain operations found to be associated with insignificant environmental impacts based on long-term DOE experience may be categorically excluded. After documenting that a proposed activity or project meets 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.

3.1 No Action Alternative

The No Action Alternative reflects implementation of decisions made by DOE and National Nuclear Security Administration (NNSA) based on the *1999 SWEIS* (DOE 1999a) and other analyses performed in accordance with DOE's NEPA compliance process. In the *1999 SWEIS* ROD, DOE announced its decision to implement the Expanded Operations Alternative described in the *1999 SWEIS*, but with a reduced level of plutonium pit manufacturing. Therefore, the current No Action Alternative continues implementation of the *1999 SWEIS* Expanded Operations Alternative. 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. In addition, many other actions have been implemented 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.

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 events 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.

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. 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 commuter bus parking lots at TA-48 and TA-63. - Auxiliary Actions include: – Construct a pedestrian bridge and roadway from TA-63 to TA-35. – 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 115-kilovolt power line between Norton and Southern TA Electrical Substations. Construct new 115-kilovolt electrical substation along the Pajarito Corridor West. Upgrade Norton Substation. Uncross Reeves and Norton-Los Alamos power lines.	Same as No Action Alternative	Same as No Action 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

Project	*No Action Alternative*	*Reduced Operations Alternative*	*Expanded Operations 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).

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 not legally obligated to include the Consent Order impact analysis, but for purposes of this SWEIS only, is including this information in support of collateral decisions that NNSA must make to facilitate Consent Order implementation.

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 2002j). Proposed changes to project implementation have been reviewed in subsequent NEPA documents: the *Supplement Analysis Security Perimeter Project* (February 2003), the *NEPA Compliance Review for Proposed Modifications to the Security Perimeter Project at Los Alamos National Laboratory* (March 2004), and most recently, the *NEPA Compliance Review Addendum for Proposed Modifications to the Security Perimeter Project at Los Alamos National Laboratory* (March 2005). 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, two staffed access control stations have been completed along Pajarito Road. Two additional stations would be built under the No Action Alternative—one at the intersection of Jemez Road and Diamond Drive (that intersection would be 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 would be redesigned at that point to facilitate vehicle screening and related activities. Together, these four access control stations would 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.

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, 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 would 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 would be integrated with the security control system installed in Phase I.

3.1.1.2 Land Conveyance and Transfer

As discussed in Chapter 2 of this SWEIS, LANL began conveying and transferring land to Los Alamos County and the Department of the Interior 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 2007, which is the deadline prescribed in Public Law 105-119 for conveyance and transfer of lands. Tracts identified for future conveyance and transfer are (LANL 2006):

- A-4, to be conveyed to Los Alamos County, is part of the airport along State Road 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 State Routes 4 and 502 and the easternmost part of Jemez Road.

3.1.1.3 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 line that would originate at the Norton Substation and terminate at a new DOE-administered West TA Substation. The transmission line from the Norton Substation to the point where it would reach New Mexico State Route 4 would be operated at 115 kilovolts but built to 345-kilovolt specifications to provide redundant service to both LANL and the Los Alamos townsite, which would allow for both to be supplied by one line when necessary. New power line and West TA Substation construction, Norton Substation modifications, and Reeves and Norton-Los Alamos power line uncrossing are expected to be completed by fiscal year 2009. A new substation would also be installed along Pajarito Corridor West at TA-50. See Chapter 4, Section 4.8.2.1 for more detail on these upgrades.

3.1.1.4 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 *Draft LANL Wildland Fire Management Plan* (LANL 2005i).

3.1.1.5 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 2002i) 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 would remove part of the aboveground portion of the Pajarito

Canyon flood retention structure, including gabions installed along the downstream channel. The streambed would be graded, the remaining sides of the flood retention structure would be stabilized, and the banks would be reseeded. The area would be monitored and maintained to prevent slope erosion and damage to the floodplain and downstream wetlands. This project would also include removal of the aboveground portions of the steel diversion wall at TA-18. Best management practices involving storm water controls would be implemented during removal activities as required by LANL's Construction Storm Water Permit Program.

3.1.1.6 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 2003d). 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, environmental protection, safety, and security measures to be implemented 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.

3.1.1.7 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 and, in one case, strontium-90-bearing items that have been 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 receive and store the same types and quantities of sealed sources at LANL facilities as it has in the past and would use commercial facilities as appropriate. 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 Facility, and Plutonium Facility Complex Key Facility. Activities related to this project are described under specific capabilities of those Key Facilities.

3.1.2 Technical Area Projects

Under the No Action Alternative, changes would 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 discussed in this section and presented in **Table 3–2**.

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
Center for Weapons Physics Research Project	No activity	No activity	Construct the Weapons Physics Research (see Appendix G).
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 an historic cabin that would be preserved (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 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.

3.1.2.1 Technical Area 3

TA-3 is the most populated area at LANL, with numerous buildings supporting 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 and expected to be completed and occupied during 2006 and 2007. Under the No Action Alternative, the Information Management

Office Building would be located at the northeast corner of the intersection of Diamond Drive and Pajarito Road and would add approximately 15,000 to 18,000 square feet (1,400 to 1,700 square meters) of office space on two stories. 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 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 is scheduled to be operational in June 2006. There is presently no timetable for installing the second unit.

3.1.2.2 Technical Area 18

Activities occurring in TA-18 are being discontinued in accordance with the ROD (67 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 2002h). 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 2005a]). The facilities would be deactivated as funding becomes available. Some buildings in DP East still contain equipment from current and recent operations that may contain

> **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.

accountable quantities of radioactive material. Most of this material would be removed during deactivation. Following deactivation, the tritium buildings would be placed in surveillance and maintenance mode along with the DP West buildings.

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 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; and the Atomic Energy Act of 1954. 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* is replacement of the existing surface with an engineered cover. Final selection of a corrective measure option will be made by the New Mexico Environment Department, which could choose NNSA's preferred option, a combination of options evaluated in the *Corrective Measures Study Report*, or a totally different option.

3.1.3 Key Facilities

3.1.3.1 Chemistry and Metallurgy Research Building

The Chemistry and Metallurgy Research Building Key Facility, 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 for the Chemistry and Metallurgy Research Building Key Facility 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 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, and **Table 3–3** indicates activity types and levels proposed and evaluated under all three alternatives for each capability.

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 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 radioactive material handling and storage. The Chemistry and Metallurgy Research Building also provides limited backup to support nuclear materials management needs for TA-55 activities and provides 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 uses 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.

Table 3–3 Chemistry and Metallurgy Research Facility Capabilities and Activity Levels

Capability	*No Action Alternative* [a]	*Reduced Operations Alternative*	*Expanded Operations Alternative* [b]
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 metallurgical microstructural and chemical 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 Chemistry and Metallurgy Research 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 sealed sources types and quantities stored for the Off-Site Source Recovery Project (see Appendix J).

Capability	***No Action Alternative*** [a]	***Reduced Operations Alternative***	***Expanded Operations Alternative*** [b]
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 Chemistry and Metallurgy Research Building	Construct and operate Chemistry and Metallurgy Research Replacement Facility in TA-55 and DD&D at the Chemistry and Metallurgy Building. Wing 9 hot cell operations and certain other capabilities would be eliminated. The Chemistry and Metallurgy Research Replacement Facility would replace the Chemistry and Metallurgy Building as the Key Facility.	Same as No Action Alternative	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.
[a] DOE 1999a.
[b] LANL 2004e, 2006.

Actinide Research and Development. Actinide research and processing at the Chemistry and Metallurgy Research Building typically involves solids or small quantities of solution. However, any research involving highly radioactive materials or remote handling 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 metallurgical microstructural and chemical 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 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 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 needed to address seismic concerns. 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 2003f). 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 facility and 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 would include a single aboveground, consolidated, Nuclear Hazard Category 2 laboratory building with a separate office and support building.

Phased construction is anticipated to begin in 2006. The office and support building would be constructed first and would house office space, training facilities, utility equipment, and laboratory space designed to handle small amounts of special nuclear material. Construction of a Hazard Category 2 nuclear facility capable of handling larger quantities of special nuclear material is expected to begin in fiscal year 2008, with estimated completion in 2014. Transition of Chemistry and Metallurgy Research Building capabilities and operations to the Chemistry and Metallurgy Research Replacement Facility would begin at construction completion. Not all Chemistry and Metallurgy Research 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 they would increase at the new replacement facility. Routine onsite shipments of analytical chemistry and materials characterization samples would continue during the transition period.

The Chemistry and Metallurgy Research Building Key Facility would include both the Chemistry and Metallurgy Research Building and the Chemistry and Metallurgy Research Replacement Facility 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, and **Table 3–4** indicates activity types and levels proposed under all three alternatives for each capability.

Research and Development on Materials Fabrication, Coating, Joining, and Processing. Materials synthesis and processing work addresses R&D on making items out of materials that are difficult to work with. The 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; that is, separated into pure forms for reuse or storage.

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

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.

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 2004e, 2006.

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, and **Table 3–5** indicates activity types and levels proposed under all three alternatives for each capability.

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 2004e, 2006.

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.

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, 3-1819, 3-1698, 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.

However, these changes can be sufficiently characterized to ensure the analysis of their consequences within the context of this SWEIS. The following paragraphs describe the capabilities of this Key Facility, and **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, 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 2004e, 2006.

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 these 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 (2,700 degrees Celsius) 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 study and corrosion characterization of materials are carried out in an additional support laboratory.

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.

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.

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

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			
Install New Processors	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.

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

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 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

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

paragraphs describe the capabilities of this Key Facility, and **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

Capability	***No Action Alternative*** [a]	***Reduced Operations Alternative***	***Expanded Operations 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]
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 2004e.
[c] LANL 2006.

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 any explosives application in nuclear weapons technology. Information on 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. It is also necessary to have a thorough understanding of the chemical and physical properties of these materials 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 (that is, 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 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. Firing site buildings, occupying 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 (3,100 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, and **Table 3–9** indicates activity types and levels proposed under all three alternatives for each capability.

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 explosives.	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 Twomile 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 2004e, 2006.
[c] DOE 2003g.
[d] DOE 1995a.

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 replace actual weapons materials in the mockup nuclear weapons package to ensure no potential for a nuclear explosion. Most hydrodynamic tests are conducted at TA-15; others are conducted at TA-36.

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. In the past, DOE has conducted dynamic experiments using plutonium metal. DOE could perform such studies again in the future at DARHT and other facilities. As a matter of policy, 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 the 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, 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. Calibration, development, and maintenance testing are those experiments conducted primarily to prepare for more elaborate tests, and include 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 2003g). This project would consolidate operations of the LANL organization responsible for dynamic experimentation within the Twomile 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 Twomile Mesa Complex, including construction of a new road and security gate to provide access to the Dynamic Experimentation Facility. The project provides for removal or demolition of some of the vacated structures.

Another project for this Key Facility would be the 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. The structure is needed for the first dynamic experimentation shot, currently scheduled for 2009. However, if available, the structure could be used to support other DARHT tests prior to that time.

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 are being phased out of this building and 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, and **Table 3–10** indicates activity types and levels proposed under all three alternatives for each capability.

Table 3–10 Tritium Facilities Capabilities and Activity Levels

Capability	*No Action Alternative* [a]	*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 existing inventory of 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] DOE 1999a, LANL 2006.

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, 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 with which to conduct 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. R&D activities related to tritium gas purification 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 (RLWTF) 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 2002h) for 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. However, no decisions were made 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, and it 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 returned to storage elsewhere at LANL. Radiation sealed sources retrieved from other locations under the Off-Site Source Recovery Project would continue to be received at TA-18 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, and **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).

Capability	*No Action Alternative* [a]	*Reduced Operations Alternative*	*Expanded Operations Alternative* [b]
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, 2002h; LANL 2004e.
[b] DOE 2002h.

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 to be used as 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 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, and **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 2006.
[b] LANL 2006.

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 degrees Fahrenheit to 302 degrees Fahrenheit (20 degrees Celsius to 150 degrees Celsius) or by meltprocessing at temperatures from room temperature up to 572 degrees Fahrenheit (300 degrees Celsius). 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 both internal and external to LANL.

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* 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 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 its intended purpose. DOE 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. A ROD is expected in late 2006.

The following paragraphs describe the capabilities of this Key Facility, and **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

Capability	***No Action Alternative*** [a]	***Reduced Operations Alternative***	***Expanded Operations Alternative***
Genomic and Proteomic Science	Develop and implement high-throughput tools. Perform genomic and proteomic analysis. Study of 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
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 2004e, 2006.

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 understanding 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 computationally 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. This capability includes 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 their 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: 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.

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 are the Radiochemistry Laboratory, Machine and Fabrication Shop, Diagnostic Instrumentation and Development Building, Advanced Radiochemical Diagnostics Building, and Analytical 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, and **Table 3–14** indicates activity types and levels proposed under all three alternatives for each capability.

Table 3–14 Radiochemistry Facility Capabilities and Activity Levels

Capability	*No Action Alternative* [a]	*Reduced Operations Alternative*	*Expanded Operations Alternative* [b]
Radionuclide Transport	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

Capability	***No Action Alternative*** [a]	***Reduced Operations Alternative***	***Expanded Operations Alternative*** [b]
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
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.	No activity	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 2006.

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.

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. The 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 staff 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 also develop new separations techniques based on experimental chemical systems, using radioactive tracers to synthesize the chemicals and to characterize their performance. Nuclear chemistry efforts also use exotic laser-based atom traps for probing the interactions of energy and atoms in energy regimes not easily accessed by other techniques. This work requires conducting extensive laser spectroscopy, handling of radioactive materials, and interpreting the resulting data. In other nuclear chemistry efforts, targets are irradiated 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 (elements with an atomic weight greater than that of uranium [92]) 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.

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, 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 treats radioactive liquid wastes generated by other LANL facilities and houses analytical laboratories to support waste treatment operations. The Radioactive Liquid Waste Treatment is the largest structure in TA-50, with 40,000 square feet (3,720 square meters) under roof. Operation of a new 300,000-gallon (1,100,000-liter) influent storage facility currently under construction is expected to begin by 2007. The following paragraphs describe the capabilities of this Key Facility, and **Table 3–15** indicates activity levels proposed under all three alternatives for each capability.

Waste Transport, Receipt, and Acceptance. Most radioactive liquid wastes are conveyed directly to the Radioactive Liquid Waste Treatment through an underground pipeline system. Pipelines for liquid radioactive waste exist in TA-3, TA-21, TA-35, TA-48, TA-55, and TA-59.[2] Some other generators, not connected by the underground pipeline system, transfer their wastes into a tanker truck for delivery to the Radioactive Liquid Waste Treatment. Generators of small quantities of radioactive liquid wastes collect their wastes in drums which are then trucked to TA-50.

In addition to receiving and accepting radioactive liquid waste trucked to the TA-50 facility from other LANL locations, radioactive liquid wastes are trucked to the TA-53 facility for evaporation, and other radioactive liquid waste is shipped to an offsite commercial facility for solidification. The Radioactive Liquid Waste Treatment sends the returned solidified waste and other solid waste to TA-54 waste management facilities 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.

[2] *Not all pipelines connect to or pump radioactive liquid waste to the Radioactive Liquid Waste Treatment. The pipeline in TA-53 moves waste only within that TA (as part of LANSCE). The pipeline from TA-21 is no longer used.*

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 the RLWTF in TA-50. Support, certify, and audit generator characterization programs. Maintain the waste acceptance criteria for the 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: - 880 cubic feet (250 cubic meters) of low-level radioactive waste; - 7 cubic feet (2 cubic meters) of mixed low-level radioactive waste; - 35 cubic feet (10 cubic meters) of transuranic waste; and - 900 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: - 1,100 cubic feet (300 cubic meters) of low-level radioactive waste; - 7 cubic feet (2 cubic meters) of mixed low-level radioactive waste; - 50 cubic feet (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	Construct and operate 300,000-gallon (1.1 million-liter) influent storage facility by 2007.	Same as No Action Alternative	Same as No Action Alternative, plus: - Implement *RLWTF Upgrade Project*: – Construct and operate a replacement for the existing RLWTF at TA-50. Start-up estimated in 2010 (see Appendix G). – 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 2006.
[b] LANL 2006.

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 buildings. 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, and **Table 3–16** indicates activity types and levels proposed under all three alternatives for each capability.

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 it ultimately removed as excess heat.

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/or 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
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

Capability	***No Action Alternative*** [a]	***Reduced Operations Alternative***	***Expanded Operations Alternative*** [b]
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 next 20 to 30 years (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 2004e, 2004h.
[b] LANL 2006.

This capability is responsible for development, configuration, and maintenance activities for 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 (from LANL organizations and external users such as scientists from universities, other laboratories, and the international scientific community) require support from TA-53 personnel, whether 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 and 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 with the generation of fewer byproduct isotopes than 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 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, and 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 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 nonpermeable liners and instrumentation to detect leaks.

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 waste, transuranic waste, 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 MDA 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 wastes are processed in the Waste Characterization, Reduction and Repackaging Facility in TA-50 and are transported to TA-54 for assay and storage. Transuranic wastes are stored onsite until they are 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, and **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, or packaged together, to facilitate their management.

Capabilities include coring and visual inspection of a percentage of transuranic waste packages, ventilation of drums of transuranic waste retrieved from below grade, maintenance compliance with the current version of the WIPP waste acceptance criteria, and coordination with WIPP operations for disposal of LANL transuranic waste.

Compaction. Low-level radioactive waste generated throughout the site is compacted to reduce the volume prior to disposal.

Size Reduction. 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.

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	Support, certify, and audit generator characterization programs. Maintain waste acceptance criteria for LANL waste management facilities. Characterize 130 cubic yards (100 cubic meters) of legacy mixed low-level radioactive waste. Characterize 11,000 cubic yards (8,400 cubic meters) of legacy transuranic waste. Characterize 260 cubic yards (200 cubic meters) of newly generated transuranic waste annually. Maintain waste acceptance criteria for offsite treatment, storage, and disposal facilities. Overpack suspect containers and bulk small waste items as required. Perform coring and visual inspection of a percentage of transuranic waste packages. Ventilate 1,600 cubic yards (1,200 cubic meters) of transuranic waste retrieved from below grade. 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 250 cubic yards (190 cubic meters) of newly generated transuranic waste from TA-55. - Characterize about 130 cubic yards (100 cubic meters) of remote-handled legacy transuranic waste.
Waste Transport, Receipt, and Acceptance	Collect chemical and mixed wastes from LANL generators and transport them to Consolidated Remote Storage Sites and TA-54. Ship 35,260 tons (32,000 metric tons) of chemical wastes for offsite treatment and disposal in accordance with EPA land disposal restrictions. Ship 200 cubic yards (150 cubic meters) of mixed low-level radioactive waste for offsite treatment and disposal in accordance with EPA land disposal restrictions annually. Ship 11,000 cubic yards (8,400 cubic meters) of legacy transuranic waste to WIPP. Ship 260 cubic yards (200 cubic meters) of newly generated transuranic waste (including environmental restoration wastes) to WIPP annually. Ship low-level radioactive wastes to offsite disposal facilities. 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 250 cubic yards (190 cubic meters) of additional transuranic waste to WIPP. - Ship 130 cubic yards (100 cubic meters) of remote-handled legacy transuranic waste to WIPP. - Ship additional transuranic waste from DD&D and remediation activities to WIPP.

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 3,000 cubic yards [2,340 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, 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. Provide special case treatment for 1,400 cubic yards (1,030 cubic meters) of transuranic waste.	Same as No Action Alternative	Same as No Action Alternative, plus: - Process newly generated transuranic waste through new 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: - Expand activities supporting the Off-Site Source Recovery Project to include nonactinide sources (see Appendix J). - Store transuranic waste generated by DD&D and remediation activities.
Waste Disposal	Dispose 55 cubic yards (42 cubic meters) of low-level radioactive waste in shafts, 15,000 cubic yards (11,500 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 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 Transuranic Waste Consolidation 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; DD&D = decontamination, decommissioning, and demolition.

[a] DOE 1999a.

[b] LANL 2006.

[c] LANL 2005f.

Waste Transport, Receipt, and Acceptance. Hazardous and mixed wastes are collected from LANL generators and transported to the consolidated remote storage sites and TA-54 and are 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 and 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 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 Retrieval. This capability is the retrieval and management of waste stored in pits, shafts, and trenches in TA-54 Area G so the waste can be processed for eventual disposition.

Other Waste Processing. On an as-needed basis, waste management of special waste types is performed. LANL demonstrates treatment of liquid mixed low-level radioactive waste, stabilizes uranium chips, provides special case treatment for certain transuranic wastes, and accepts environmental restoration soils for disposal at Area G as low-level radioactive waste.

Decontamination Operations. This capability was relocated from the Radioactive Liquid Waste Treatment Facility in 2000. Decontamination is performed to either enable reuse or reduce the contamination of materials to be disposed of. Items generally decontaminated include respirators, vehicles, portable equipment, scrap and precious metals, and lead shielding.

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 Area G is reaching the limit of its disposal capacity, the entire disposal site 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.

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, and **Table 3–18** indicates activity types and levels proposed under all three alternatives for each capability.

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 certified 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	Same as No Action Alternative except: - Produce up to 50 certified pits per year. [c]
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 Chemistry and Metallurgy Research Building. Process 1 to 2 pits per month (up to 12 pits per year) 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 [d]	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. - Increase type and quantity of sealed sources stored for Off-Site Source Recovery Project.
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 20 to 30 years (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; DD&D = decontamination, decommissioning, and demolition.

[a] DOE 1999a.

[b] LANL 2006.

[c] Pit production is proposed at a rate of 50 certified pits per year. However, NNSA may need to produce more than 50 pits in order to obtain 50 certified pits. The environmental impact analyses in this SWEIS are based on an annual production rate of 80 pits per year using multiple shifts.

[d] The *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems* (DOE 2005b) evaluates consolidation of radioisotope power system nuclear operations at a single site. The Proposed Action would consolidate these activities at Idaho National Laboratory and eliminate the activities currently performed at the Plutonium Facility at LANL.

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. LANL staff would produce plutonium pits and fabricate parts and samples for R&D activities. This capability 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 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.

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 continue 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 the R&D and testing, plutonium-238 is processed, recovered, recycled, and blended. Materials and parts are fabricated and units tested in support of space and terrestrial uses.

Storage, Shipping, and Receiving. The Plutonium Facility provides for 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. All materials from TA-18 are scheduled to be moved to final disposition locations by March 2008. 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):

- Chemistry and Metallurgy Research Facility
- 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: RLWTF
- Waste Management Operations: Solid Radioactive and Chemical Waste Facilities
- Plutonium Facility Complex

The four Key Facilities discussed in the following paragraphs would operate at levels reduced from those described for the No Action Alternative.

3.2.1 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 under this alternative as under the No Action Alternative, including removing or demolishing unneeded vacated structures.

3.2.2 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). Furthermore, 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.

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 Twomile 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.

3.2.3 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.

3.2.4 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 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.

3.3 Expanded Operations Alternative

This alternative considers LANL operations at a higher level than the No Action Alternative and 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 or major modification to existing facilities is described and the potential impacts 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 increase in the type and quantity 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 toward TA-3. Auxiliary Action B, which would not be implemented independent 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 staff 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 Hazardous and Solid Waste Amendments 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 staff have been conducting investigations and corrective actions in accordance with the LANL Hazardous Waste Facility Permit. However, the Consent Order signed on March 1, 2005, 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 a preferred corrective measure to the New Mexico Environment Department. However, the New Mexico Environment Department would decide 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 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 envirotranspiration 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 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, the New Mexico Environment Department has allowed Los Alamos County, which operates the landfill under a Special Use Permit, until December 2006 to close the landfill. However, Los Alamos County is pursuing an extension from the New Mexico Environment Department to operate the landfill until 2007 to achieve final waste grade (LAC 2005d). Should groundwater monitoring wells be required on DOE property outside the confines of the landfill, NNSA would install and maintain those wells in support of the Landfill Closure Plan.

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 Off-Site Source Recovery Project would increase the type and quantity of sealed sources accepted. In 2004, following transfer of project management to NNSA as the U.S. Radiological Threat Reduction Program (DOE 2004c), the mission of the Off-Site Source Recovery Project was expanded to include:

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[3] NNSA is not legally obligated to include the Consent Order impacts analysis, but for purposes of this SWEIS only, NNSA is including this information in support of collateral decisions that NNSA must make to facilitate implementation of Consent Order activities.

- all concentrations of the sources in the original scope commonly found in sealed sources; and
- the additional isotopes of cobalt-60, cesium-137, iridium-192, radium-226, and californium-252, all of which are commonly found in sealed sources, as well as strontium-90 used in radioisotope thermoelectric generators.

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 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

Center for Weapons Physics Research Project

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 Center, which would allow for 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 Center for Weapons Physics Research 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 40,000 square feet (3,720 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 Center for Weapons Physics Research 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 three-story, 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 nine new replacement office buildings would be phased beginning in 2008.

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 interfering 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, in which potential impacts of DD&D of structures in TA-21 are evaluated.

Field activities include preparation work and establishing waste staging areas, utility management, removal of internal equipment, abatement or decontamination, removal of roofing and exterior equipment, above- and belowgrade 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 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, replacing 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 remote from core areas at LANL. The remote location would provide an enhanced level of security by receiving and inspecting commercial vehicle shipments 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 State Route 4. Shipments would be offloaded and searched at the warehouse, then shipped to the ultimate onsite user.

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 that area 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 (see Appendix G), and operations would be overseen by Radiochemistry Laboratory personnel. (See Appendix G for a description of this project.)

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 teraops and could approach 200 teraops. 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 that would require 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 additional 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 in 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 in the No Action Alternative (see Section 3.1.3.8). However, once all tritium operations are finished at the Tritium Systems Test Assembly and the Tritium Science and Fabrication Facility, the buildings would undergo DD&D.

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 at TA-18 that would be preserved as an historic structure, buildings 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 the 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, described in Table 3–14. Under the Expanded Operations Alternative, 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, and Atom Trapping would be a 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 that would remain 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

RLWTF 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 RLWTF building would be constructed in TA-50, with an estimated date of beneficial occupancy in 2011. 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. 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. However, the LANSCE Refurbishment Project would be implemented. This project, which would include renovations and improvements to the existing facility to increase its reliability and extend its operation for the next 20 to 30 years, 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 would increase for the Waste Characterization, Packaging, and Labeling; and Waste Transport, Receipt, and Acceptance capabilities to accommodate additional transuranic waste that would result from increased pit production at the Plutonium Facility Complex. Additional storage and shipping of transuranic waste and disposal of low-level radioactive waste from DD&D and remediation activities would be performed. Also, the Waste Retrieval capability would be restarted to retrieve the transuranic waste stored in pits, shafts, and trenches in TA-54, Area G, 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, under which radioactive sources and devices (primarily sealed sources) regulated by NRC or Agreement States are recovered, 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 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 Transuranic Waste Consolidation Facility in TA-50 or TA-63; 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 50 certified pits per year to meet the near-term needs of the Stockpile Stewardship Program. Pit production is proposed at a rate of 50 certified pits per year, but NNSA may need to produce more than 50 pits to obtain 50 certified pits. Therefore, the environmental impact analyses in this SWEIS are based on the production rate of 80 pits per year both to provide NNSA sufficient flexibility to obtain 50 certified pits each year, and to bound the environmental impacts of producing 50 certified pits per year. Increased pit production would cause changes in activity levels at other Key Facilities as well. 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. This increase would impact all capabilities at the Plutonium Facility Complex, as shown in Table 3–18.

Also under this alternative, up to 460 pounds (210 kilograms) of plutonium oxide would be polished annually and stored pending shipment for use at the Mixed Oxide Fuel Fabrication Facility at the Savannah River Site, and 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 the Expanded Operations Alternative, the pellets would be removed from the fuel rods and repackaged into smaller containers for storage in positions 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 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. Building 55-41, a 35,000-square-foot (3,150-square-meter) building, would be demolished or modified to accommodate construction of the radiography facility. 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.

3.4 Preferred Alternative

NNSA's Preferred Alternative for the continued operation of LANL is the Expanded Operations Alternative. This alternative includes fabrication of up to 50 certified pits per year (80 pits per year using multiple shifts) at the Plutonium Facility Complex in TA-55 and increased activity levels at certain other Key Facilities to support this level of pit production. Activities that would facilitate compliance with the Consent Order and remediation of MDAs would be undertaken. Capabilities, activity levels, and projects identified in the No Action Alternative that are unchanged in the Expanded Operations Alternative would continue as described. Proposed increases in activity levels and new capabilities for existing Key Facilities would be implemented, and proposed projects for which analyses are included in the appendices to this SWEIS would proceed commensurate with funding.

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. Two alternatives, a "Greener Alternative" and a "true No Action Alternative" (or shutdown alternative) were suggested during the scoping process.

A Greener Alternative was evaluated in the *1999 SWEIS*, the name and general description of which were provided by interested citizens as a result of the scoping process for that SWEIS. This alternative evaluated LANL capabilities existing at that time with an emphasis on work performed in support of basic science, waste minimization and treatment, dismantlement of nuclear weapons, 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. Additionally, important aspects of the Greener Alternative evaluated in the *1999 SWEIS*, specifically optimization of work in the field of nonproliferation regarding weapons of mass destruction, as well as enhanced weapons dismantlement work, were incorporated into the No Action Alternative analyzed in this new SWEIS. Other aspects of the Greener Alternative in the *1999 SWEIS* have also been incorporated into the No Action Alternative of this SWEIS. These include enhanced work on national health research, waste minimization and environmental restoration technologies, and international nuclear safety. Therefore, NNSA is not evaluating a Greener Alternative in this new SWEIS.

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 No Action 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. These activities are vital to U.S. security and are among the major components of the mission assigned to LANL by NNSA. Because of the impacts on national security and safety that would be involved with ceasing operations and closing LANL, and because doing so would not allow LANL to continue supporting the missions assigned to it 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 provides an overview of the impacts analyses performed for this SWEIS. It is a summary that provides 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, and includes **Table 3–19** which summarizes the potential consequences of each alternative by resource area. Section 3.6.2 is a summary of the cumulative impacts analysis 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. However, as discussed in Chapter 1, the NNSA Administrator may make decisions on individual projects or proposed activities rather than making a single decision to implement an entire alternative. Although the summary in Section 3.6.1 includes impacts from these projects, Section 3.6.3 presents summaries of the environmental consequences for each of the 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.

3.6.1 Comparison of Potential Consequences of Alternatives for Continued Operation at Los Alamos National Laboratory

The potential environmental consequences associated with the three alternatives are summarized in this section. This summary focuses on the site and provides an overview of impacts for each resource area in order to better understand the total potential impacts of each alternative. Table 3–19, located at the end of this section, presents a comparison of the environmental consequences of the three alternatives analyzed in this SWEIS.

Land Use

Under the No Action Alternative, the conveyance and transfer of land from LANL to Los Alamos County and the Department of the Interior in trust for the Pueblo of San Ildefonso and the Power Grid Upgrades Project have the potential to 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 impacts of the No Action Alternative, changes to land use could occur as the result of a number of projects including the Replacement Office Buildings Project, Radiological Sciences Institute Project, TA-18 Closure Project, MDA Remediation

Project, RLWTF Upgrade Project, Science Complex Project, Remote Warehouse and Truck Inspection Station Project, and the 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 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, the MDA remediation activities could lead to fewer restrictions on land use under the Removal Option upon completion of remedial actions.

Visual Environment

Under the No Action Alternative, possible development following the conveyance and transfer of land could degrade 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 but more noticeable from closer vantage points; however, near views are often restricted to LANL employees. Power grid upgrades could adversely impact the view in previously undisturbed areas. Impacts under the Reduced Operations Alternative would be similar to those identified for the No Action Alternative. While in many cases impacts to the visual environment from implementation of the Expanded Operations Alternative would be similar to the No Action Alternative, a number of proposed projects would cause noticeable changes to the visual environment. The MDA remediation activities would result in the borrow pit in TA-61 being more visible, and the Security-Driven Transportation Modifications Project could, depending on the auxiliary action selected, result in new bridges being built over site canyons. Also, 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. The visual environment at both TA-18 and TA-21 would be enhanced by the removal of old buildings, and at TA-21 could change in the longer-term if development takes place. Finally, removal of the white-colored 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.

Geology and Soils

There is little difference in the impacts on geologic resources for the No Action and Reduced Operations Alternatives; however, there is a large distinction between those two alternatives and the Expanded Operations Alternative. Under the Expanded Operations Alternative, facility construction and DD&D for the following projects would impact geologic materials: Center for Weapons Physics Research, Replacement Office Buildings, Radiological Sciences Institute, RLWTF 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 are 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 1.4 million cubic yards (1.1 million cubic meters) of backfill and surface grade materials under the Removal Option. These geologic resources would be available either at LANL or from nearby offsite sources.

Under all the alternatives, remediation of waste 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 impacts on surface water quality and quantity from the No Action Alternative. Under the Reduced Operations Alternative, the elimination of cooling tower effluent from LANSCE would result in a major reduction of effluent discharges to Los Alamos Canyon. The Expanded Operations Alternative could have beneficial impacts on surface water quality due to the potential removal or stabilization of contaminants at the MDAs, the installation of new treatment technologies associated with the RLWTF Upgrade Project, and the possible elimination of the RLWTF outfall 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 to Los Alamos Canyon. 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. 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 outfalls in the canyons. 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. 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 and from shutdown of LANSCE and the Pajarito Site (TA-18). A minor increase in operations emissions could occur under the Expanded Operations Alternative, but emissions would remain within the limits of the operating permit. 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 emissions would be higher. 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. 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 activity levels of some Key Facilities 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 potential small increases in radiological air emissions over the No Action Alternative would result from increased activity levels and the operation of new facilities. These emissions would be dominated by operations at LANSCE. There could be temporary short-term 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. Under the Reduced Operations Alternative, a minor reduction in explosives testing noise would occur. 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. Construction, DD&D, and remediation activities would result in a minor increase in offsite noise from equipment use and traffic noise impacts to the public under the No Action and Reduced Operations Alternatives. Under the Expanded Operations Alternative, increased equipment-related noise impacts would occur from additional construction, DD&D, and 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, while resulting in short-term adverse impacts on wildlife, would have long-term benefits by 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 would generally be similar to the No Action Alternative. Under the Expanded Operations Alternative, impacts on ecological resources would be greater than those of the No Action Alternative. A number of projects could impact habitat and wildlife. Those impacts would mostly be temporary disturbances during construction and demolition; however, if all of the proposed projects were implemented, up to about 90 acres (36 hectares) of habitat would be lost. Permanent disturbances could include construction of bridges associated with the Security-Driven Transportation Modifications Project. These bridges could be built within Areas of Environmental Interest for the Mexican spotted owl and, if so, would result in the need to consult with the U.S. Fish and Wildlife Service on mitigation of potential impacts. The Mexican spotted owl would also be affected if the RLWTF were to cease discharging effluent. This would likely reduce the extent of perennial and intermittent stream reaches and associated wetland and riparian habitat thereby reducing the abundance and diversity of prey species.

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, with emissions from the firing sites (TA-15 and TA-36) contributing 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. 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, with minor reductions from the termination of operations at the Pajarito Site and lower levels of high explosives processing and testing. 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, resulting in slight increases in the estimated doses to 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 biological agents. 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 281 person-rem per year under the No Action Alternative. Under the Reduced Operations Alternative, the dose would drop to 258 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 408 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 520 person-rem annually.

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 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 explosive processing and testing. Impacts from the Reduced Operations Alternative would generally 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. Individual projects would have minimal potential to impact archaeological resources since most projects would not be located in the immediate area of archaeological sites, and those that are so situated 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 2005h). 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. However, removal of the domes from Area G of TA-54 as part of the Waste Management Facilities Transition Project would have a positive effect on views from Pueblo of San Ildefonso lands.

Socioeconomics

Under the No Action Alternative, no change in the socioeconomic impacts on the region from those currently being observed would be expected. LANL is a major employer in the region and provides large socioeconomic contributions to the region. Impacts from the Reduced Operations Alternative would be similar to those associated with the No Action Alternative. However, under the Reduced Operations Alternative, direct employment at LANL would be expected to decrease by about 3.8 percent (510 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 on the order of 1,375 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 up to 920 jobs by 2007 and 2,240 jobs by 2011 would be added at LANL, which would be expected to result in an indirect increase in additional jobs in the region numbering in the thousands. While 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. While the impact on Los Alamos County would currently be muted by the lack of available housing, the County is planning for additional housing that could allow more employees to live in the County. Rio Arriba and Santa Fe counties would also be expected to grow as a result of these increases in employment at LANL. Considering 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 perceived 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 system 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 require about 48 and 75 percent, respectively, of the capacity of the power pool serving the Los Alamos area. Natural gas requirements and water requirements would be approximately 27 and 93 percent, respectively, of system capacity. For the Reduced and Expanded Operations Alternatives, respectively, projected electricity requirements would be 38 and 62 percent of capacity, peak load demand would be 56 and 97 percent of capacity, natural gas requirements would be 27 and 29 percent of capacity, and water requirements would be 89 and 101 percent of capacity. Projections for natural gas demand show less variation across the alternatives since 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 Los Alamos Water Supply System's water rights could be exceeded under the Expanded Operations Alternative. This potential exists, based on the projected infrastructure requirements, for increased operations at LANL and the forecasted demands of other non-LANL users in Los Alamos County. However, completion of a new transmission line and other upgrades would help offset the deficit in 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 generator would add an additional 20 megawatts (175,200 megawatt-hours) of generating capacity beyond 2006. 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, Zone 4, would provide onsite disposal capacity for low-level radioactive waste from operations through 2016 and beyond. Due to the uncertainties of predicting 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, and reduced operational levels at the high explosives facilities. Wastes generated by environmental restoration and DD&D activities would be expected to be the same as 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, and increases in levels of operation at a number of the Key Facilities, so larger volumes of all waste types would be generated than under the other alternatives. Retrieval and processing of transuranic waste stored in shafts in Area G of TA-54 would also generate additional volumes of transuranic and low-level radioactive waste.

Full implementation of the MDA Removal Option is conservatively estimated to generate 22,000 cubic yards (17,000 cubic meters) of transuranic waste. Final waste volumes may be less than the maximum volume analyzed in this SWEIS since the estimates are based on the volume of waste as excavated (including soil) and all major MDAs being removed; no credit has been taken for waste volume reduction techniques such as sorting. In this SWEIS, it is assumed that the transuranic waste would be disposed of at WIPP.

Volumes of low-level radioactive waste generated under the MDA Removal Option would exceed LANL's planned onsite disposal capacity. This SWEIS includes analysis of transporting low-level radioactive waste to offsite disposal facilities.

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 offsite locations to or from which repeated shipments would be made. The specific locations analyzed were the Pantex Plant in Texas and the Savannah River Site in South Carolina for transport of special nuclear material, 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 be under the Expanded Operations Alternative if all of the large MDAs were exhumed and the Nevada Test Site was the main option for disposal of low-level radioactive waste. This alternative could result in about 120,240 shipments of radioactive materials and waste. It is estimated there could be about 3 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 risks than radiological risks; but, 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 result in an acceleration of wear on local roads and could 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 few high and adverse impacts from the continued operation of LANL under any of the alternatives, and, to the extent impacts may be high and adverse, NNSA expects the impact to affect all populations in the area equally. NNSA also analyzed human health impacts from exposure through special pathways, including subsistence consumption of game animals, fish, native vegetation, surface waters, sediments, and local produce. The special pathways have the potential to 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 minority populations in the area. However, analyses show the human health impacts associated with these special pathways would not present disproportionately high and adverse impacts to 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. This is because actions under each alternative do not, for the most part, affect the location, frequency, scenario, or material at risk of the postulated accidents.

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 would impact LANL, and if the fire were to burn the waste storage domes at TA-54 and cause 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 frequency 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 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. 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, formaldehyde being released at 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 and workers would be a postulated Performance Category-3 earthquake with a frequency of once every 2,000 years. 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. In the event of such a seismic accident, the MEI would have an increased lifetime risk of an LCF of 0.55 (1 chance in 1.8) and an additional 3 LCFs could be expected in the population; a noninvolved worker 110 feet (100 meters) from certain failed buildings would likely develop an LCF. Taking into account the likelihood of occurrence, the annual risks from a seismic event are estimated to be 1 chance in 3,600 for an MEI, 1 chance in 2,000 for the noninvolved worker, and no (0.005) additional LCFs in the offsite population. The largest chemical risk from such an event would result from a formaldehyde release from the Bioscience Facilities in TA-43, leading to life-threatening concentrations at the locations for the noninvolved worker and the nearest MEI.

The facility accident with the highest estimated radiological consequences to the offsite population would be a building fire and spill at the Decontamination and Volume Reduction System Facility. If this accident were to occur, there could be four additional LCFs in the offsite population. The 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, an LCF in a noninvolved worker located about 110 yards (100 meters) from the site of the accident would be likely, and there would also be a 0.50 likelihood (1 chance in 2) of an LCF in the MEI, assumed to be present at the nearest site boundary for the duration of the accident release. Taking into account the frequency of the postulated accidents, the estimated highest risk accident would be a fire at the Radioactive Assay and Nondestructive Test outdoor container storage area. The increased risk of an LCF for this accident would be 0.0009 (about 1 chance in 1,150) for the MEI, 0.006 (about 1 chance in 160) for the noninvolved worker, and 0.02 for the offsite population (a risk of 1 LCF occurring in the population over approximately 40 years of operations).

For chemical accident risks, the 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 be close enough to the facility to receive a life-threatening exposure to this chemical in the event of an 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 in the event of an accident. There is a great deal of uncertainty as to how much and which chemicals were disposed of in the MDAs; the MDA closest to the public (and thus with the potential for the 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.

Table 3–19 Summary of Resource Areas Environmental Consequences

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative (Preferred Alternative)*
Land Use			
	Land Conveyance and Transfer - 1,929 acres (781 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. *Power Grid 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* - No major changes in land use designations in most cases since 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. However, plans have 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 land use plans. *TA-18 Closure Project* - Possible change in land use designation of TA-18 after DD&D of the Pajarito Site. *TA-21 Structure DD&D Project* - Possible change in land use designation following DD&D. *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* - 4 acres (1.6 hectares) of undeveloped land near the border of TA-5 and TA-52 could be developed for evaporation basins. *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. *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.

	No Action Alternative	***Reduced Operations Alternative***	***Expanded Operations Alternative (Preferred Alternative)***
Visual Environment			
	Land Conveyance and Transfer - Development could degrade views of presently undeveloped tracts. *Power Grid Upgrades* - Short-term visual impacts during construction. - Adverse visual impact in undisturbed areas. - No overall change in view from Bandelier National Monument. *Disposition of Flood Retention Structures* - Temporary impacts during removal if staging areas are located near Pajarito Road. Temporary impacts during construction of the Chemistry and Metallurgy Research Replacement 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 Facility, and - High Explosives Testing Facility.	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. *Center for Weapons Physics Research* - 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. *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 basins are built near the border of TA-5 and TA-52. *Waste Management Transition Project* - Beneficial impact on near and distant views from removal of white-colored domes in TA-54.

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative (Preferred Alternative)*
			- Temporary impacts during construction of structures at TA-50 and TA-54. *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* - Site would be readily visible from East Jemez Road; lighting could be visible from 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). - 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: - *Center for Weapons Physics Research*, - *Replacement Office Buildings*, - *TA-18 Closure*, - *TA-21 Structure DD&D*, - *Radiological Sciences Institute (including the Institute for Nuclear Nonproliferation Science and Technology)*, - *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 impact on Pajarito	Same as No Action Alternative, except shutdown of LANSCE operations would result in major reductions of NPDES-permitted cooling tower discharges, particularly to Los Alamos Canyon.	Same as No Action Alternative, and: Potential long-term positive impact from MDA remediation because water quality would be protected by removal or stabilization of waste or contaminants in soil. Complete Removal Option for DD&D of TA-21 would eliminate

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative (Preferred Alternative)*
	floodplains. Restoration of normal flow would cause sediments to alter channel and readjust floodplains.		two NPDES-permitted outfalls reducing discharges to Los Alamos Canyon. Volume of water in Mortandad Canyon would be greatly reduced if the RLWTF became a zero discharge facility. Surface water quality in Mortandad Canyon would be improved in both short term and long term.
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.	Long-term impacts as a result of operations might be reduced by elimination of additional outfalls.	Same as No Action Alternative, except potential positive long-term impact from MDA remediation on long-term contaminant migration.
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 and shutdown of LANSCE and the Pajarito Site (TA-18).	Higher level of emissions from increased operations and proposed construction, demolition, and remediation. Hazardous air pollutants could increase by up to 2.5 percent from the higher level of High Explosives Processing. Temporary construction-type releases of criteria pollutants would occur from MDA remediation, DD&D, and construction of new facilities.
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	0.00082	0.00084 [c]
Uranium [e]	0.15	0.12	0.15
Particulate and vapor activation products	30	0.014	30
Gaseous mixed activation products	30,500	100 [f]	30,500 [f]
Mixed Fission Products [g]	1,650	1,650	1,650

[a] Includes both gaseous and oxide forms of tritium.
[b] Tritium emissions would decrease to 1,850 curies per year starting in 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 Transuranic Waste Consolidation 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 starting in 2009 due to the shutdown of TA-18, resulting in zero GMAP emissions in the Reduced Operations Alternative and 30,400 curies per year in the Expanded Operations Alternative.
[g] Mixed fission products include krypton-85, xenon-131m, xenon-133, and strontium-90.

	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 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. *Power Grid Upgrades* - Temporary displacement of wildlife due to construction-related activities. - Potential 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. - Potential 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 would cause loss or displacement of associated wildlife. Short-term impacts in TA-6, TA-22, and TA-40 from construction of new High Explosives Test Facility buildings and	Same as No Action Alternative, plus: - Reduction in high explosives testing 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. *Security-Driven Transportation Modifications Project* - Parking lot construction and placement of pedestrian and vehicle bridges for all proposed activities would destroy up to 30 acres (12 hectares) of natural habitat. - A section of new roadway under Auxiliary Action B would destroy some natural habitat. - Under both auxiliary actions, bridge traffic over the core zone of the Sandia-Mortandad Canyon Mexican spotted owl Area of Environmental Interest has the potential to 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. - Clearing 13 acres (5.3 hectares) of mixed conifer forest in TA-3 would result in loss or permanent displacement of wildlife. *TA-18 Closure Project* - Minor impact on wildlife during demolition of Pajarito Site structures in TA-18. - 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. *Radiological Sciences Institute Project (including the Institute for*

	No Action Alternative	***Reduced Operations Alternative***	***Expanded Operations Alternative (Preferred Alternative)***
	demolition of old structures would cause loss or displacement of wildlife.		*Nuclear Nonproliferation Science and Technology)* - Temporary disturbance of wildlife during demolition of structures and construction in TA-48. - Clearing of 12.6 acres (5.1 hectares) of ponderosa pine forest would cause loss or displacement of associated wildlife. *RLWTF Upgrade Project* - Potential reduction in availability of prey for the Mexican spotted owl if the facility becomes a zero liquid discharge facility, necessitating Section 7 consultations with the U.S. Fish and Wildlife Service. - Loss of 4 acres (1.6 hectares) of habitat if evaporation basins are constructed. *Waste Management Facilities Transition Project* - Short-term impacts on wildlife in the vicinity of TA-50 and TA-54 from new construction and demolition for new and upgraded Solid Radioactive and Chemical Waste Facilities. - Activities could occur in portions of the Mexican spotted owl or willow flycatcher areas of environmental interest. *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. *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 pinion-juniper woodland would be cleared.

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative (Preferred Alternative)*
Human Health			
Offsite Population Dose (person-rem per year) Risk (LCFs per year)	 30 0.018	 6.4 [h] 0.0038	 36 [i, j] 0.022
MEI [k] Dose (millirem per year) Risk (LCFs per year)	 7.8 4.7×10^{-6}	 0.79 [h] 4.7×10^{-7}	 8.2 [i, j] 4.9×10^{-6}
Workers Dose (person-rem per year) Risk (LCFs per year)	 281 0.17	 258 0.15	 408 to 520 [l] 0.24 to 0.31 [l]
[h] Starting in 2009, TA-18 (Pajarito Site) would not be contributing to radiological air emissions, thereby reducing the MEI and population doses. [i] Population dose and MEI dose include 6.2 person-rem and 0.42 millirem respectively, attributable to MDA remediation. This dose could be less depending on the MDAs being remediated, whether an MDA is being capped or contamination removed, the number of MDAs being remediated at one time, and other factors. [j] Starting in 2009, TA-18 (Pajarito Site) and TA-21 would not be contributing to radiological air emissions, thereby reducing the MEI and population doses. [k] 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. [l] The range for the Expanded Operations Alternative reflects the contribution from the two MDA remediation options. The lower value is for the Capping Option, the higher value is for the Removal Option.			
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. Potential 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: Removal of white domes under the *Waste Management Facilities Transition Project* would have a positive impact on views from traditional cultural properties. 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. Construction, modification, or renovation projects and associated DD&D for the following new or existing facilities: - *Security-Driven Transportation Modifications,* - *Center for Weapons Physics Research,* - *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, and*

	No Action Alternative	***Reduced Operations Alternative***	***Expanded Operations Alternative (Preferred Alternative)***
			- Remote Warehouse and Truck Inspection Station. DD&D for the following: - TA-18 Closure Project - TA-21 Structure DD&D
Socioeconomics			
	LANL Employment		
	Projected to stay at 2004 levels.	Projected to decrease by 510 employees from 2004 levels. These cuts would be expected to result in the loss of about 865 indirect jobs in the region.	Projected to increase by 2.3 percent per year so that from 2007 to 2011 an additional 920 to 2,240 employees would work at LANL and another 1,560 to 3,800 jobs would be created indirectly. 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 would become available in the tri-county area as a result of the projected decrease in LANL's employment level. These would be expected to offset the need for additional housing units in the region since the population would still be expected to grow, although at a slower rate (about 1.3 percent versus 2.3 percent).	Additional housing units would be required in the Tri-County area as a result of the projected increase in LANL's employment level along with the projected increase in the region's population; further growth would be expected.
	Workforce		
	Completion of previously approved construction projects is expected to draw workers already in the region who historically work from job-to-job.	Same as No Action Alternative.	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 1.4 percent.	Annual gross receipts tax yields directly and indirectly associated with LANL employment are projected to increase by between 2.6 and 5.8 percent from 2007 through 2011 over 2004 levels in real terms.

	No Action Alternative	***Reduced Operations Alternative***	***Expanded Operations Alternative (Preferred Alternative)***
	Services		
	The demand for services such as police, fire, and hospital beds would be expected to remain at current levels on a proportional basis compared 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 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 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 1,000 and 2,600 in the tri-county area, resulting in an estimated increase in needed public school funding from the State of $8 million in 2007 to $21 million in 2011.
Site Infrastructure			
LANL Site and Other Los Alamos County Users Total Per Alternative (annual)	Electricity requirements: 632,000 megawatt-hours total (486,000 megawatt-hours for LANL); 48 percent of system capacity. Electric Peak Load: 112 megawatts total (92.3 megawatts for LANL); 75 percent of system capacity. Natural Gas Demand: 2,213,000 decatherms total (1,195,000 decatherms for LANL); 27 percent of system capacity. Water Demand: 1,682 million gallons total (388 million gallons for LANL); 93 percent of system capacity. *Project Effects:* - Ongoing electrical power system upgrades would have a positive incremental impact on site 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.	Electricity Requirements: 497,000 megawatt-hours total (350,000 megawatt-hours for LANL); 38 percent of system capacity. Electric Peak Load: 84.5 megawatts total (64.9 megawatts for LANL); 56 percent of system capacity. Natural Gas Demand: 2,190,000 decatherms total (1,171,000 decatherms for LANL); 27 percent of system capacity. Water Demand: 1,605 million gallons total (310 million gallons for LANL); 89 percent of system capacity. *Project Effects:* Same as the No Action Alternative.	Electricity Requirements: 814,000 megawatt-hours total (668,000 megawatt-hours for LANL); 62 percent of system capacity. Electric Peak Load: 145 megawatts total (125 megawatts for LANL); 97 percent of system capacity. Natural Gas Demand: 2,320,000 decatherms total (1,301,000 decatherms for LANL); 29 percent of system capacity. Water Demand: 1,816 million gallons total (522 million gallons for LANL); 101 percent of system capacity. *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).

Waste Type	*No Action Alternative*	*Reduced Operations Alternative*	*Expanded Operations Alternative (Preferred Alternative)*
Waste Management			
Transuranic Waste			
Contact-handled (cubic yards) [m]	3,500 to 5,900	3,500 to 5,900	5,400 to 33,000
Remote-handled [n] (cubic yards)	–	–	12 to 62
Low-Level Radioactive Waste [n, o]			
Bulk low-level radioactive waste (cubic yards)	38,000	38,000	194,000 to 881,000
Packaged low-level radioactive waste (cubic yards)	33,000 to 118,000	33,000 to 99,000	81,000 to 173,000
High activity low-level [n] radioactive waste (cubic yards)	–	–	0 to 347,000
Remote-handled low-level [n] radioactive waste (cubic yards)	–	–	470 to 1,700
Mixed low-level radioactive waste (cubic yards)	1,800 to 2,700	1,800 to 2,700	4,000 to 183,000
Construction/Demolition Debris [p] (cubic yards)	197,000	197,000	656,000 to 736,000
Chemical waste [q] (pounds)	19,000,000 to 37,000,000	19,000,000 to 37,000,000	65,000,000 to 129,000,000
Liquid transuranic waste (gallons per year)	30,000	30,000	50,000
Liquid low-level radioactive waste (at TA-50) (gallons per year)	4,000,000	4,000,000	5,000,000
Liquid low-level radioactive waste (at TA-53) (gallons per year)	140,000	5,000 [r]	140,000

[m] Operations waste volumes are assumed to be contact-handled transuranic waste and packaged low-level radioactive waste, although small volumes of remote-handled or high-activity waste could be generated.

[n] 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.

[o] 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.

[p] Demolition waste includes uncontaminated wastes such as steel, brick, concrete, pipes and vegetative matter from land clearing.

[q] 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.

[r] 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: Due to rounding, values may not equal 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)*	
Transportation (for 10-Year Period 2007-2016)				
Incident Free				
Public Radiation Exposure *Dose (person-rem) /* *Risk (LCFs):*			**MDA Capping Option**	**MDA Removal Option**
Total	49 / 0.030	44 / 0.027	74 / 0.044	271 / 0.16
LANL to Pojoaque	1.55 / 0.00093	1.44 / 0.00086	2.32 / 0.0014	7.62 / 0.0046
Pojoaque to Santa Fe	2.54 / 0.0015	2.35 / 0.0014	3.80 / 0.0023	12.5 / 0.0075
Worker Radiation Exposure: (transport drivers) *Dose (person-rem) /* *Risk (LCFs):*	147 / 0.088	131 / 0.079	230 / 0.138	884 / 0.53
Transportation Accidents				
Population: - Radiological *Risk (LCFs)*	0.00016	0.00014	0.00023	0.0016
- Nonradiological *Traffic Fatalities* [s]	0	0	1	3
[s] Nonradiological traffic accidents include all traffic accidents involving both radioactive and nonradioactive materials and waste shipments. Values presented are the nearest whole number.				
Local Traffic				
Average Daily Traffic at Entry Points	42,300	40,700	up to 49,200	
Environmental Justice				
	No disproportionately high and adverse impacts on minority or low-income populations. 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.	Same as No Action Alternative.	
Facility Accidents (highest risk accidents presented)				
Wildfire – Radiological (Waste Storage Domes at TA-54 – assumed frequency 1 in 20 years)				
Offsite Population Dose (person-rem) Risk (LCFs per year) **MEI** Dose (rem) Risk (LCFs per year) **Noninvolved Worker** Dose (rem) Risk (LCF per year)	 91,300 2.7 1,930 0.05 8,730 0.05	Same as No Action Alternative.	Same as No Action Alternative.	

	No Action Alternative	Reduced Operation Alternative	Expanded Operations Alternative (Preferred Alternative)	
Wildfire – Chemical (Releases formaldehyde at TA-43 – assumed frequency 1 in 20 years)				
- 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 93 yards 13 yards	Same as No Action Alternative		3 (3.26)
Site-Wide Seismic Event – Radiological (PC-3 seismic event – assumed frequency 1 in 2,000 years)				
Offsite Population Total Dose (person-rem) Risk (LCF per year) **MEI** Maximum Dose (rem) Risk (LCF per year) **Noninvolved Worker** Maximum Dose (rem) Risk (LCF per year)	 17,429 0.005 462 0.0003 2,150 0.001[u]	Same as No Action Alternative	Same as No Action Alternative	
Site-Wide Seismic Event – Chemical (PC-3 seismic event releases formaldehyde at TA-43 – assumed frequency 1 in 2,000 years)				
- 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 120 yards 13 yards	Same as No Action Alternative		3 (3.26)
Facility Accident (RANT outdoor container storage area fire – assumed frequency 1 in 100 years)				
Offsite Population Dose (person-rem) Risk (LCF per year) **MEI** Dose (rem) Risk (LCF per year) **Noninvolved Worker** Dose (rem) Risk (LCF per year)	 3,970 0.02 71.5 0.0009 532 0.006	Same as No Action Alternative	Same as No Action 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 [t] limit) - ERPG-3 distance - Distance to the site boundary	5 parts per million 962 yards 537 yards	Same as No Action Alternative		3 (3.26)

[t] 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 2005a).
[u] 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 1,000.

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; rem = roentgen equivalent man; LCF = latent cancer fatality; MEI = maximally exposed individual; ERPG = Emergency Response Planning Guideline; PC = performance category; RANT = Radioactive Assay and Nondestructive Test.
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 Part 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 impact 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 potentially impacting LANL include the possible siting of a modern pit facility at LANL (DOE/EIS-0236-S2) (DOE 2003b), consolidation of nuclear operations related to production of radioisotope power systems (DOE/EIS-0373D) (DOE 2005b), and the conveyance and transfer of land at LANL to Los Alamos County and the Department of the Interior in trust for the Pueblo of San Ildefonso (DOE/EIS-0293) (DOE 1999d).

The impacts associated with the production of a maximum of 450 pits per year are estimated in the draft EIS for a modern pit facility. The impacts evaluated in this SWEIS are based on pit production for as many as 80 pits per year. Because pits would be produced at either a modern pit facility or in existing, albeit updated, facilities at LANL, the impacts associated with pit production are overestimated in this cumulative impacts section.

Consolidation of DOE Office of Nuclear Energy, Science and Technology plutonium-238 activities at the Idaho National Laboratory 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 2005b) 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 to continue at the LANL Plutonium Facility Complex, as described under the *Consolidation EIS* No Action Alternative, manufacturing of up to approximately 50 pits per year (80 pits per year using multiple shift operations) 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 impact of the 80-pit-per-year production and plutonium-238 processing (at levels far above the level of plutonium-238 processing identified in the *Consolidation EIS*) has already been evaluated in both the LANL *1999 SWEIS* and this new SWEIS. Therefore, there would be no additional cumulative effect from these activities.

An EIS analyzing the potential environmental impacts of operation of a BSL-3 Facility is in preparation. At its current stage of development definitive data for inclusion in the cumulative impacts analysis are not available for this draft SWEIS. However, information about the facility and its potential operations can be evaluated at a general level that is adequate to assess potential contributions to cumulative impacts.

The BSL-3 Facility in TA-3 is a single-story 3,200-square foot (300-square meter) stucco building. It houses two BSL-3 laboratories, a BSL-2 laboratory, and support facilities including offices, a locker room, and showers. Construction is complete, but no operations have been conducted in the facility. Operation of this facility is anticipated to result in, at most, minimal incremental impacts on all resource areas. Utility use would be much less than most other LANL facilities and it would not affect overall utility demand at LANL or in the region. Air emissions would be passed through high-efficiency particulate air filters and would not affect the air quality of the region. Liquid and solid wastes from operational areas would be thermally or chemically destroyed prior to discharge or disposal. Liquid waste would be discharged to the LANL sanitary sewage system where it would be commingled and treated prior to discharge and would have minimal impact on local and regional water quality. Small amounts of radiological materials would be used as tracers resulting in the generation of small quantities of radioactive waste. Relatively small amounts of other regulated wastes would also be generated. These quantities of waste would be easily managed within the LANL waste management infrastructure and would have a negligible impact on transportation.

Reasonably foreseeable actions for the region surrounding LANL were also reviewed and included in the analysis. Interviews were conducted with personnel in planning departments in the surrounding counties, and 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 also reviewed for activities that could contribute to cumulative impacts.

Each resource area in this SWEIS was reviewed for potential cumulative impacts and 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 the decisions to implement the Expanded Operations Alternative in this SWEIS and locate the 450 pit per year modern pit facility at LANL were made.

Land Use, Visual Environment, Ecological Resources, and Cultural Resources

Cumulative impacts on land use, visual environment, ecological resources, and cultural resources are largely due to the conveyance and transfer of land to Los Alamos County and the Department of the Interior in trust for the Pueblo of San Ildefonso as required under Public Law 105-119. Up to 826 acres (334 hectares) of land could be developed after the transfer. For example, Los Alamos County has indicated there are proposals to develop approximately 1,000 new residences on land adjacent to LANL and develop land for light industry 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.

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 confined in-place (MDA Capping Option), the final covers would require up to 2.5 million cubic yards (1.9 million cubic meters) of crushed tuff for fill and additional rock, gravel, topsoil, and other bulk materials for surface grading and erosion control. These materials would be obtained from both LANL resources and the quarries and mines in the surrounding counties. While the quantity of materials would be large, there are sufficient resources in the region to meet the demand.

Water Resources

Reasonably foreseeable activities in the region have the potential to 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. 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, as well as to track the amount of water available for use.

Air Quality

The cumulative concentrations of all criteria pollutants from operations are expected to remain well below Federal and state ambient air quality standards.

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 the 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 occur near the site boundary. The impact on the public would be expected to be minor.

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) were found to be generally 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 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 with the addition of a modern pit facility) could be as much as 36 person-rem per year. The dose to the offsite MEI from all anticipated airborne emissions at LANL (Expanded Operations Alternative with the addition of a modern pit facility) could be as much as 8.2 millirem per year. The Clean Air Act limits airborne doses to 10 millirem per year to any individual member of the public. No additional LCFs would be expected at these dose levels.

Collective worker doses would increase substantially if a facility producing 450 pits annually were located at LANL at the same time that the MDA Removal Option was being implemented. Collective worker dose would increase from about 280 person-rem per year under the No Action Alternative to an average of 1,080 person-rem per year due to the number of workers involved. Worker dose would decrease by about 110 person-rem annually after the MDA remediation work was complete. At a collective dose of 1,080 person-rem per year, less than 1 (0.71) LCF would be expected. Individual worker dose would be maintained as low as reasonably achievable (ALARA) and within applicable regulatory limits.

Infrastructure

The cumulative peak load electrical capacity and the water use capacity would be exceeded for the combined LANL Expanded Operations Alternative and a modern pit facility. Planned upgrades to the electrical system should be sufficient to offset the deficit in peak load capacity and ensure that electric energy is available when needed 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 anticipated, and LANL demands on infrastructure resources are below projected levels and within site capacities. Potential shortfalls in available capacity will need to be addressed if increased site requirements are realized.

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, and the potential operation of a modern pit facility. Although this would be the case under all alternatives, the quantities of wastes projected under the Expanded Operations Alternative would be significantly greater than those projected under the other alternatives. Sufficient disposal capacity, both on- and offsite, for all waste types would be available except under the Expanded Operations Alternative with the MDA Removal Option and the operation of a modern pit facility. In this scenario the projected low-level radioactive waste volume (1.5 million cubic yards [1.1 million cubic meters]) would exceed the onsite disposal capacity, and the projected transuranic waste volume (48,000 cubic yards [37,000 cubic meters]) would significantly exceed the volume (27,500 cubic yards [21,000 cubic meters]) attributed to LANL in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997b). Therefore, additional resources, including new facilities, could be required to augment existing waste management capabilities.

Transportation

The total cumulative worker dose from 100 years of radioactive materials shipments (general transportation, historical DOE shipments, and reasonably foreseeable actions as estimated in the *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* and [DOE 2002b]) and shipments associated with the LANL SWEIS alternatives is estimated to be a maximum of 361,030 person-rem, which would be expected to result in 217 LCFs. The total cumulative dose to the general public was estimated to be a maximum of 340,130 person-rem, which would be expected to result in 204 excess LCFs. The total estimated traffic fatalities associated with accidents involving radioactive material and waste transports would be a maximum of 103.

LANL alternatives are expected to result in no more than 3 traffic fatalities and no worker or public cancer deaths (LCFs), and therefore 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 Table 4–46).

Traffic could increase on county roads from increased development of both housing and light industry as a result of the conveyance and transfer of lands to Los Alamos County and the Department of the Interior in trust for the San Ildefonso Pueblo, increased truck shipments under the Expanded Operations Alternative, and projected increases in the LANL workforce under the Expanded Operations Alternative combined with the possibility that a modern pit facility might be located at LANL. Under this scenario, daily traffic could increase by up to 30 percent. Approximately 17 percent of the increase would be associated with increased vehicle trips under the Expanded Operations Alternative, and 13 percent would be due to operation of a modern pit facility.

Development of land transferred under the *Land Conveyance and Transfer EIS* could result in an increase in traffic in the vicinity of the airport and TA-21 based on current Los Alamos County plans to develop light industry 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.

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 impacts of implementing each of the proposed projects.

The sliding-scale approach is used in this SWEIS for evaluating environmental consequences. This approach implements the Council on Environmental Quality instruction to "focus on significant environmental issues" (40 CFR 1502.1) and 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 described once in the following bullets and noted as "typical construction-related impacts," but 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 from construction and DD&D sites. Best management practices would be required and would mitigate most of these impacts.

- Air quality impacts would be increased by emissions of criteria air pollutants, primarily carbon monoxide and oxides of nitrogen from vehicles and heavy equipment and 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 potential adverse ecological impacts from construction and DD&D activities. Impacts could be minimized by not 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, such as use of personal protection equipment such as coveralls, respirators, gloves, hard hats, steel-toed boots, eye shields, and ear plugs or covers. Workers would also be protected by other engineered and administrative controls.

- Increased consumption of fuels, water, and electricity would occur during construction and DD&D.

Summary of Impacts for the Center for Weapons Physics Research Project

The Center for Weapons Physics Research 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 facility 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 need to be demolished to make room for the Center for Weapons Physics Research, 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.

Summary of Impacts for the Replacement Office Buildings Project

The TA-3 Replacement Office Buildings would consolidate staff and activities currently located in temporary or aging permanent buildings into more efficient and safer structures. The complex would include the construction of 11 two-story buildings, 1 three-story building, and related parking structures. The Wellness Center and a warehouse would be demolished to accommodate this project.

Table 3–20 Summary of Impacts for the Center for Weapons Physics Research 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 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 low-level radioactive waste; 187,000 cubic yards solid waste including demolition debris; and 313,000 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.

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.

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; loss of 12 acres of habitat.
Ecological Resources	Temporary construction-related impacts. Loss of 13 acres of habitat.
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 an 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, requirement would be similar to or less than the facilities being replaced.
Waste Management	*Construction* – 1,800 cubic yards of construction waste. *DD&D* – 31 cubic yards low-level radioactive waste and 6,900 cubic yards 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.

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 the temporary disruption of traffic on Pajarito Road during construction; increased local traffic during operations; and the movement of large amounts of DD&D waste. **Table 3–22** summarizes the potential impacts of implementing this project.

Summary of Impacts for Radioactive Liquid Waste Treatment Facility Upgrade Project

This project has been proposed to improve the operation and reliability of the RLWTF 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 treatment building for liquid low-level radioactive and transuranic waste would be constructed west of the existing facility in a parking area, and the East Annex would be demolished. Under Option 2, two new treatment buildings (one for low-level radioactive liquid waste and one for transuranic liquid waste) would be constructed, one to the west and one to the north of the existing facility. 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 also be renovated for reuse; the most DD&D would be required under this option. An auxiliary action of installing a pipeline and constructing evaporation basins to treat effluent could occur with any of the options.

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 to 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 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 vicinity of 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.
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 transuranic waste; 93,000 cubic yards low-level radioactive waste; 1,000 cubic yards mixed low-level radioactive waste; and 74,000 cubic yards demolition debris and 1,304,000 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	Considered and dismissed.
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.

Potential impacts from each of the 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 to release 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 basins would result in a change in the land use category and the permanent loss of habitat of about 4 acres (1.6 hectares) of currently undeveloped land. Use of the evaporation basins would improve surface water quality by eliminating a discharge that has the potential to contribute to the 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 basins were implemented, the land use designation of about 4 acres of land for the area of the basins 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 basins is currently undeveloped and wooded and the change would be noticeable from areas west of LANL.
Geology and Soils	Temporary construction- and DD&D-related impacts. Permanent removal of contaminated soil to accommodate new facilities. Up to 174,000 cubic yards of rock and soil could be disturbed, assuming construction of the evaporation basins.
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 impacts. Loss of about 4 acres of habitat if evaporation basins are built, and potential reduction in availability of prey for the Mexican spotted owl, requiring Section 7 consultations with the U.S. Fish and Wildlife Service.
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. Emissions do not have a distinguishable effect on the projected dose to the public.
Cultural Resources	Possible impact on several historic buildings, 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* – 620 cubic yards of construction debris. *DD&D* – 300 cubic yards of transuranic waste; 11,400 cubic yards of low-level radioactive waste; 220 cubic yards 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 would potentially 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. However, the maximum dose to the MEI as a result of emissions 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 in LANL during the examination process. The three options for the new facility are to construct a new building within TA-55, build an addition to Building 55-41, or renovate Building 55-41 to fit the needs of the new facility. All three options would include some DD&D of existing structures. Minor impacts from construction and DD&D would be expected from each option. One of the buildings that could be affected by this project is potentially eligible for listing on the National Register of Historic Places, and would be protected as appropriate. Demolition or building modification could require documentation to resolve adverse effects. 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 for the proposed option.

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 9,500 cubic yards of soil and rock would be disturbed.
Water Resources	No or negligible impact.
Air Quality and Noise	*Air Quality* – Temporary construction- and DD&D-related impacts. *Noise* – Temporary construction- and DD&D-related impacts.
Ecological Resources	No or negligible impact.
Human Health	*Construction and DD&D* – 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. *Operations* – Operations would involve high radiation fields. Worker health would be protected by facility design, radiation control procedures, and personal protective equipment.
Cultural Resources	Possible impact on Nuclear Materials Storage Building, which is potentially eligible for listing on National Register of Historic Places. Demolition or building modification 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.
Waste Management	*Construction and DD&D* – About 8,000 cubic yards of solid waste would be generated during demolition of Building 55-41 and 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; DD&D = decontamination, decommissioning, and demolition.
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. These include 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 the 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 from these activities.

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 potential very small 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 transuranic waste; 1,300 cubic yards low-level radioactive waste; 220 cubic yards mixed low-level radioactive waste; 2,700 cubic yards demolition debris; and 2,000 pounds 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 865,000 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.		
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 for the Northwest TA-62 site due to location of site 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.		

Resource Area	Impact Summary		
	Northwest TA-62 Option	***Research Park Option***	***South TA-3 Option***
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 State Route 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 installation of 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 form 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.
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.

Resource Area	***Impact Summary***
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 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* – Potential 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.
Air Quality and Noise	*Air Quality* – Temporary DD&D-related impacts. *Noise* – Temporary DD&D-related impacts.
Ecological Resources	Temporary DD&D-related impacts; 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. The DD&D of other structures could have a positive impact on the appearance of the TA.
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 4,600 cubic yards of low-level radioactive waste; 5 cubic yards of mixed low-level radioactive waste; 17,000 cubic yards of demolition debris; and 90,000 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 result in the removal of essentially all structures within TA-21; the Compliance Support Option would result in removal of only those structures necessary to support remediation activities.

Onsite and offsite visual impacts would be improved with the 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 control of DOE. 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 State Route 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 would occur in a portion of the Mexican spotted owl Area of Environmental Interest buffer zone.	
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; 35,000 cubic yards of low-level radioactive waste, 65 cubic yards mixed low-level waste; 48,000 cubic yards solid waste; and 440,000 pounds of chemical waste.	Approximately 60 percent less solid debris would be generated under this Option than 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.	

Resource Area	Impact Summary	
	Complete DD&D Option	Compliance Support Option
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 would DD&D certain aboveground facilities in TA-54, Areas G and L, to facilitate closure of those areas; construct additional waste management facilities; and remove waste stored underground in pits and shafts in Area G, and prepare and ship this waste for disposal. New waste management facilities would include a retrieval facility to assist with removing high-activity remote-handled transuranic waste from certain shafts, new low-level radioactive waste facilities in TA-54, and a new Transuranic Waste Consolidation Facility in TA-50 or TA-63 to store and process transuranic waste.

The waste storage domes in MDA G would be removed as part of this project. Their removal would have a beneficial impact on both near and distant views. Since these domes are visible from the lands of the Pueblo of San Ildefonso, their removal would improve the views from traditional cultural properties. Accommodations for the Mexican spotted owl and willow flycatcher during removal, construction, and DD&D activities could be required. Eventual removal of stored wastes in Area G would reduce the dose to the facility-specific MEI by eliminating the point source at the Decontamination and Volume Reduction System Facility; the location of the new Transuranic Waste Consolidation Facility would make the emission point further from the LANL site boundary. Worker doses could also eventually decrease after 2015, once these 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[4]

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 other potential release sites are remediated, and (2) a Removal Option, in which the waste and contamination within the MDAs are removed and other potential release sites are remediated. These options are for analytical purposes only and do not necessarily represent what NNSA would propose to the New Mexico Environment Department as corrective measures. Other smaller cleanup and remediation activities would also occur at LANL. The impacts of remediating other potential release sites would be small relative to those for MDA remediation and are assumed to be encompassed by the identified impacts.

[4] NNSA is not legally obligated to include the Consent Order impact analysis, but for purposes of this SWEIS, NNSA is including this information in support of collateral decisions that NNSA may make to facilitate Consent Order implementation.

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. *Visual Environment* – Positive impact due to removal of the white-colored domes in TA-54.
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. Long-term 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; activities could occur in portions of either the willow flycatcher or the Mexican spotted owl Area of Environmental Interest. Actions to avoid or mitigate impacts may be needed if species are found to be present near the work areas.
Human Health	Minimal radiological impacts to offsite population. Reduced impacts to MEI. Removal of transuranic waste would reduce area sources of radiological exposure in Area G, potentially decreasing worker exposures after 2015.
Cultural Resources	Removal of the white-colored domes would reduce visual impacts on nearby traditional cultural properties.
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 591,000 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	Impacts of a release at the proposed Transuranic Waste Consolidation Facility or new transuranic waste storage buildings at TA-50 or TA-63 would be less than those that could occur at TA-54 from current operations.

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.

The Removal Option would result in far greater 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 continue over a number of years, MDA remediation activities would have a larger impact than other proposed projects. Under the Removal Option, extremely large quantities of wastes would be generated, including low-level radioactive waste and transuranic waste. The estimated quantities of low-level radioactive waste and transuranic waste would exceed the disposal capacity currently planned for LANL and the current LANL WIPP allocation. Therefore, additional waste disposal capacity for both types of waste would have to be identified.

The Removal Option would result in over 100,000 shipments of radioactive and nonradioactive wastes potentially requiring 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. 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 is 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). 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 these options.

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 since 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 utilization 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 1.4 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 susceptibility of the 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 also 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.
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. Possible loss of habitat at the TA-61 borrow pit.	
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 transuranic waste; 20,000 cubic yards low-level radioactive waste; 1,800 cubic yards mixed low-level radioactive waste; 47,000 cubic yards solid waste; and 50 million pounds chemical waste. Sufficient capacity would exist at LANL to dispose of the low-level radioactive waste.	22,000 cubic yards transuranic waste; 1,000,000 cubic yards 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 would likely 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.	Very 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 would have the potential to result in traffic fatalities.

Resource Area	*Capping Option*	*Removal Option*
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, according to the security level, privately-owned vehicles along portions of the Pajarito Corridor West between TA-48 and TA-63. The project would involve constructing new roadways, parking lots, pedestrian and vehicle bridges, and security check points. Auxiliary actions are also considered that would construct bridges across Mortandad and Sandia Canyons. **Table 3–33** summarizes the potential impacts of these activities.

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 potential exists for the proposed bridges to 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, and the light and noise from traffic could create adverse effects. Thus, this project has the potential to adversely impact the Mexican spotted owl and consultation with the U.S. Fish and Wildlife Service may be required.

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. Proposed construction falls within Areas of Environmental Interest buffer zone for 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. Proposed Auxiliary Action B construction falls within Areas of Environmental Interest buffer zone for the Mexican spotted owl, and would remove 1.3 acres of habitat. Potential adverse impact on owls from traffic noise and light.
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.

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, at a minimum, a 100-teraops capability, and could approach 200 teraops. This action would consist of the addition of mechanical and electrical equipment, including chillers, cooling towers, and air-conditioning units. **Table 3–34** summarizes the potential impacts of these activities.

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.

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. Should the Sanitary Effluent Recycling Facility become operational and effective in supplying the Metropolis Center with cooling water, the Metropolis Center would require less water from LANL's water supply system.

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 allow for expansion of the types and quantities of sealed sources that could be managed at LANL by the Off-Site Source Recovery Project. 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 direct 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 and a seismic event with fire at Wing 9 of the Chemistry and Metallurgy Research Building. Consequences of the Wing 9 event were also 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 the Wing 9 of the Chemistry and Metallurgy Research Building accident 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 (DOE) operations at the site; it forms a baseline description 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 by reference. The present chapter provides a summary of each resource area for context, based on the *1999 SWEIS*, but emphasizes 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 2004. For other resource areas (such as land use, noise, ecology, and cultural resources) the data are current as of the end of 2004 unless otherwise noted.

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 2006). 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 the Federal and state Governments for its economic base. Area communities are generally small and primarily support urban uses including residential, commercial, light industrial, and recreational facilities. The region also includes American Indian 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, American Indian pueblos, the U.S. National Park Service, the County of Los Alamos, private land owners, the State of New Mexico, and the U.S. Bureau of Land Management.

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 location 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 (there is 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 2006).

Only about 2,400,000 gross square feet (223,000 gross square meters) of space in 409 buildings is 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 is leased within the Los Alamos townsite and White Rock community to provide workspace for an additional 1,683 people (LANL 2006).

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 condition of the facilities as 23 percent being in excellent condition; 17 percent in good; 11 percent in adequate; 17 percent being 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 2006). 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 at LANL, nor are there any prime farmlands in the vicinity. In 1977, DOE designated LANL as a National Environmental Research Park; and, 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 2003f).

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 2003g). 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).

The 10 land use categories noted above describe the activities at LANL 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 is generally 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 Federal 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 30,241 acres (12,238 hectares) of land, including approximately 2,105 acres (852 hectares) recently transferred from DOE (as described later in this subsection). Pueblo land use is a mixture of residential use, 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 State Road 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, Pueblo environmental staff obtain environmental samples and perform monitoring on 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, Pueblo environmental staff track sampling sites on Pueblo of San Ildefonso lands that are used by Federal and state agencies, assist with maintaining these sites and collecting samples, and incorporate 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. The Monument 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 has since declined to about 292,000 in 2002 (LANL 2006).

Also located in the Los Alamos area is the Valles Caldera National Preserve. The Preserve was created in 2001 when the Federal Government purchased the 89,000-acre (36,017-hectare) Baca Ranch 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*. This action was part of the process to update its 1987 Plan (previously addressed in the *1999 SWEIS*) (DOE 1999a, LAC 2004c). The county consists of approximately 69,860 acres (28,272 hectares), most of which is owned by the Federal Government. Only about 8,751 acres (3,541 hectares), including land that has been conveyed from DOE (as described later in the subsection), are under county jurisdiction with much of this land 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 *Comprehensive*

Plan. When Federal land changes ownership, the new owner is required to submit an amendment to the general plan, as well as a zoning change before the land can be developed (LAC 2004c). 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 2003g, 2006).

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) on LANL (Balice, Bennett, and Wright 2004) (see **Figure 4–5**). Direct effects of the fire on land use at LANL included impacts on numerous site structures. Of the 332 structures affected by the fire, 236 were impacted, 68 damaged, and 28 destroyed (ruined beyond economic repair). Fire mitigation work such as flood retention facilities affected about 50 acres (20.2 hectares) of undeveloped land (LANL 2003g). 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 the treatment, including thinning of existing stands, of up to 10,000 acres (4,047 hectares) to reduce wildfire hazard. Between 2001 and 2004, 7,433 acres (3,008 hectares) have been treated. In addition, 800 acres (324 hectares) were thinned between 1997 and 1999 (LANL 2006).

As a result of the passage of Public Law 105-119, Section 632, 10 tracts (consisting of 32 subtracts) comprising 4,819.51 acres (1,950.41 hectares) were designated for conveyance and transfer from DOE to the Incorporated County of Los Alamos and the Department of the Interior to be held in trust for the Pueblo of San Ildefonso. However, the conveyance and transfer of 635.4 acres (257.1 hectares) have been deferred. Thus, the total land to be turned over is 4,184.11 acres (1,693.27 hectares). To date, 2,254.97 acres (912.56 hectares) have been turned over, including all but 3.4 acres (1.4 hectares) to the Pueblo of San Ildefonso (LANL 2004e, 2006). This has resulted in a reduction in the size of LANL from 27,520 acres (11,137 hectares) at the time of publication of the *1999 SWEIS* to its present size of 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 2004c), conveyed land falling under county jurisdiction would require a general plan amendment and zoning 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.

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		*Size (acres)*	*Status*	*Recipient*
Description	*Designator*			
Manhattan Monument	A-1	0.07	Conveyed	Los Alamos County
Site 22	A-2	0.17	Conveyed	Los Alamos County
Airport				
Airport-1 (East)	A-3	9.44	Conveyed	Los Alamos County
Airport-2 (North)	A-4	92.6	To be conveyed	Los Alamos County
Airport-3 (South)	A-5			
Unit 1	A-5-1	32.30	Conveyed	Los Alamos County
Unit 2	A-5-2	43.78	Deferred [a]	
Unit 3	A-5-3	14.94	Deferred	
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			
Unit 1	A-8-A	22.05	To be conveyed	Los Alamos County
Unit 2	A-8-B	2.87	To be conveyed	Los Alamos County
DP Road-2 (North)	A-9	4.25	Conveyed	Los Alamos County
DP Road-3 (East)	A-10	13.8	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	8.82	To be conveyed	Los Alamos County
Rendija (A-14)	A-14	918.3	To be conveyed	Los Alamos County
Technical Area 21				
TA-21-1 (West)	A-15			
Unit 1	A-15-1	7.55	Conveyed	Los Alamos County
Unit 2	A-15-2	1.18	Deferred	
TA-21-2 (East)	A-16	252.1	Deferred	
Technical Area 74				
TA-74-1 (West)	A-17	5.52	Conveyed	Los Alamos County
TA-74-2 (South)	A-18			
Unit 1	A-18-A	623.0	To be conveyed	Los Alamos County
Unit 2	A-18-B	48.0	To be conveyed	Los Alamos County
TA-74-3 (North)	B-2	2089.88	Transferred	Pueblo of San Ildefonso
TA-74-4 (Middle; Little Otowi)	B-3	3.4	To be transferred	Pueblo of San Ildefonso
White Rock				
White Rock	C-1	15.41	To be conveyed	NM State Highway and Transportation Department
White Rock-1	A-19	76.33	Conveyed	Los Alamos County
White Rock-2	B-1	14.94	Transferred	Pueblo of San Ildefonso
White Rock "Y"				
White Rock "Y"-1	C-2	104.1	To be conveyed	NM State Highway and Transportation Department
White Rock "Y"-2	A-20	323.4	Deferred	
White Rock "Y"-3	C-3	53.6	To be conveyed	NM State Highway and Transportation Department
White Rock "Y"-4	C-4	20.1	To be conveyed	NM State Highway and Transportation Department

[a] Deferred - not scheduled for conveyance or transfer.
Note: To convert acres to hectares, multiply by 0.40469.
Source: LANL 2006.

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 fairly 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 and utilitarian appearance. As 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. However, the new National Security Sciences Building is eight stories in height and is highly visible. The Los Alamos townsite appears mostly residential in character, with the water storage towers being 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 2004e).

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).

In order to decrease the impact of development, new structures generally have been designed and built to have 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 2003g, DOE 2001).

An important viewpoint of LANL is Bandelier National Monument. 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 Route 4 generally are of a 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 Route 501 near where it meets NM Route 4. Visible in the vicinity of 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 are still generally screened from view, some developed areas that were previously screened by vegetation are now more visible to passing traffic (DOE 2000f, LANL 2004e).

Since 1997, wildfire prevention activities, such as forest thinning, have been implemented at LANL on an accelerated schedule. Between 1997 and 2004, 8,233 acres (3,332 hectares) of forests and woodlands had been 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 has killed thousands of trees; thus, further opening the forest and making LANL facilities more visible (LANL 2004e, 2006).

To date, 2,255 acres (913 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 2004e). However, this has not resulted in a change in the visual setting of either the site or the surrounding area, since development has not yet occurred on any of this land.

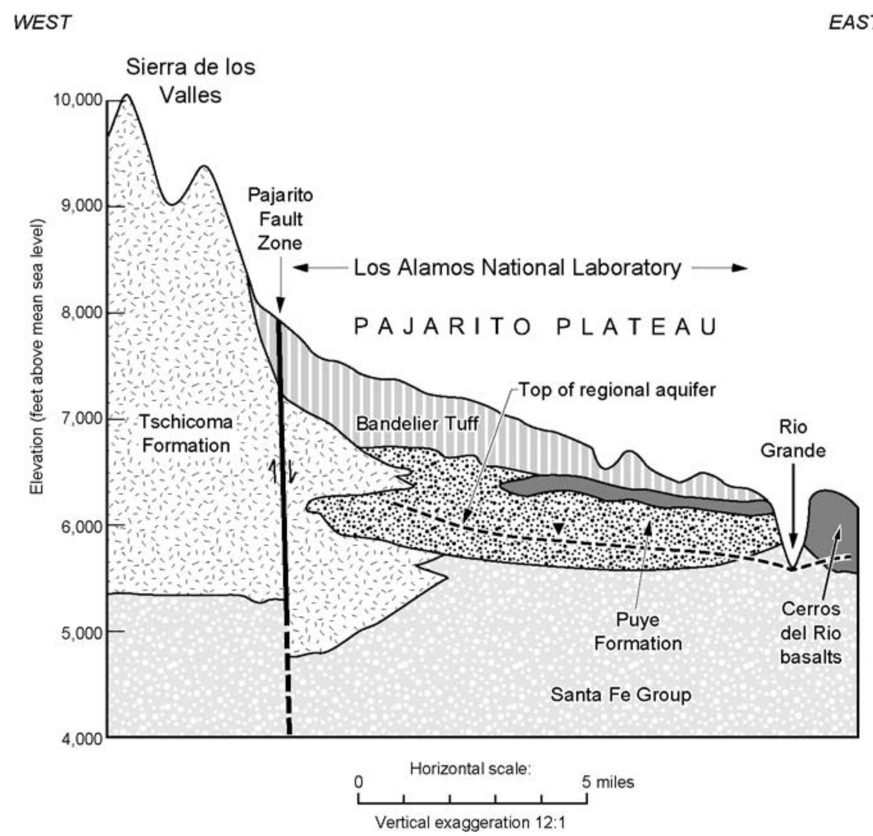
Following the events of September 11, 2001, a number of changes that limited or redirected public access to facilities at LANL were initiated. This has resulted in fewer opportunities for the public to view LANL facilities (LANL 2004e).

4.2 Geology and Soils

This section describes the geology, geologic conditions, soils, and mineral and geothermal resources present at LANL and the surrounding area. In general, the information provided in Section 4.2 of the *1999 SWEIS* is current; the most significant changes are updates to seismic conditions and 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 period of volcanism, 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 (DOE 1999a). During emplacement, intense heat and hot volcanic gases welded portions of these tuffs into 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 2004e). 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.



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 2005j.

Figure 4–7 Generalized Cross-Section of the Los Alamos National Laboratory Area

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 2004e), an increase from the previously reported maximum thickness of 130 feet (40 meters) (DOE 1999a).

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 feet (183 to 305 meters) 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, and 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, and as a result the formation overlaps and postdates the Tshicoma Formation. The sediments are late Miocene to late Pliocene in age. They 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). The Cerros del Rio Basalts are 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 and forms 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 at 1.6 and 1.22 million years ago (DOE 1999a). The eruptions produced widespread and voluminous ash flow sheets made up 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 as well as both vertically and laterally within individual layers. The induration and fracturing of the volcanic deposits at LANL are an important control on canyon wall formation, slope stability, subsurface fluid flow, seismic stability, and 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 as follows (LANL 1999a):

- The Tsankawi Pumice Bed (Qbtt) is the basal pumice fallout deposit of the Member. This pumice bed is typically 20 to 30 inches (50 to 70 centimeters) thick at LANL. 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) forming 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 forming 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 forming 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 intercalcated 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.

In general, subunits of the Tshirege Member dip gently southeastward on the Pajarito Plateau. This dip is likely the primary initial dip, resulting mainly 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 at LANL, with greater frequency of occurrence to the west.

Unconsolidated sediments form surficial, localized deposits across LANL. These deposits include colluvium and Quaternary alluvium. Colluvium occurs at the base of slopes; it is an accumulation of materials from rock falls and other gravity-driven processes. 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 4.3.1.3.

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 engineering properties of the rocks. In general, poorly indurated and densely fractured layers tend to form canyon slopes 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 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 non-fractured 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 River, 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 may also 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. The low seismic activity is now interpreted to indicate that seismic signals of magma movement are partially absorbed deep in the subsurface due to elevated temperatures and high heat flow (LANL 2004e). 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 seismic hazards study completed in 1995 at LANL was used as the basis for the *1999 SWEIS*. The study estimated ground-shaking hazards from a variety of seismic sources and the resulting ground motions that may be caused by these earthquake sources. The study included all earthquake faults within 10 miles (16 kilometers) that met the definition of the term "capable fault" used by the U.S. Nuclear Regulatory Commission to assess the seismic safety of nuclear power reactors (10 *Code of Federal Regulations* [CFR] 100, Appendix A).

While the guidance for probabilistic ground motion and surface rupture hazards is still current, the probabilistic hazard is scheduled to be recalculated in 2006 (LANL 2004e, 2006). The reanalysis is being conducted as a periodic update to the 1985 analysis. It will incorporate data collected and studies completed since the last analysis and will incorporate the most current DOE methodology. In general, the more recent studies have identified new seismic features beneath LANL and led to a better understanding of the relationship of the faults in the LANL area. Using these data, the basic seismic setting and level of seismic risk is likely to remain similar to that calculated in 1985.

Considerable advances have been made since publication of the *1999 SWEIS* in the understanding of the geometry of the Pajarito Fault system and the seismic hazards posed by the three principal faults of the system in the vicinity of LANL: the Pajarito Fault, the Rendija Canyon Fault, and the Guaje Mountain Fault. The updated geometry information is reflected in **Figure 4–9** (LANL 2004e).

Presented below is a summary of data 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 2004e). It represents data derived from trench and borehole studies, as well as other studies conducted on seismic hazards in the vicinity of LANL. These studies have focused on the western third of LANL (shaded area in Figure 4–9) because the principal faults, and the principal seismic risks at LANL, are located in that portion of the area.

Pajarito Fault

The geometry of the Pajarito Fault varies appreciably along its north-south extent. Its surface 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 2004e). Landslides along the main escarpment of the Pajarito Fault are cut by pronounced lineaments visible on aerial photographs that may express underlying faults, but this has not been confirmed.

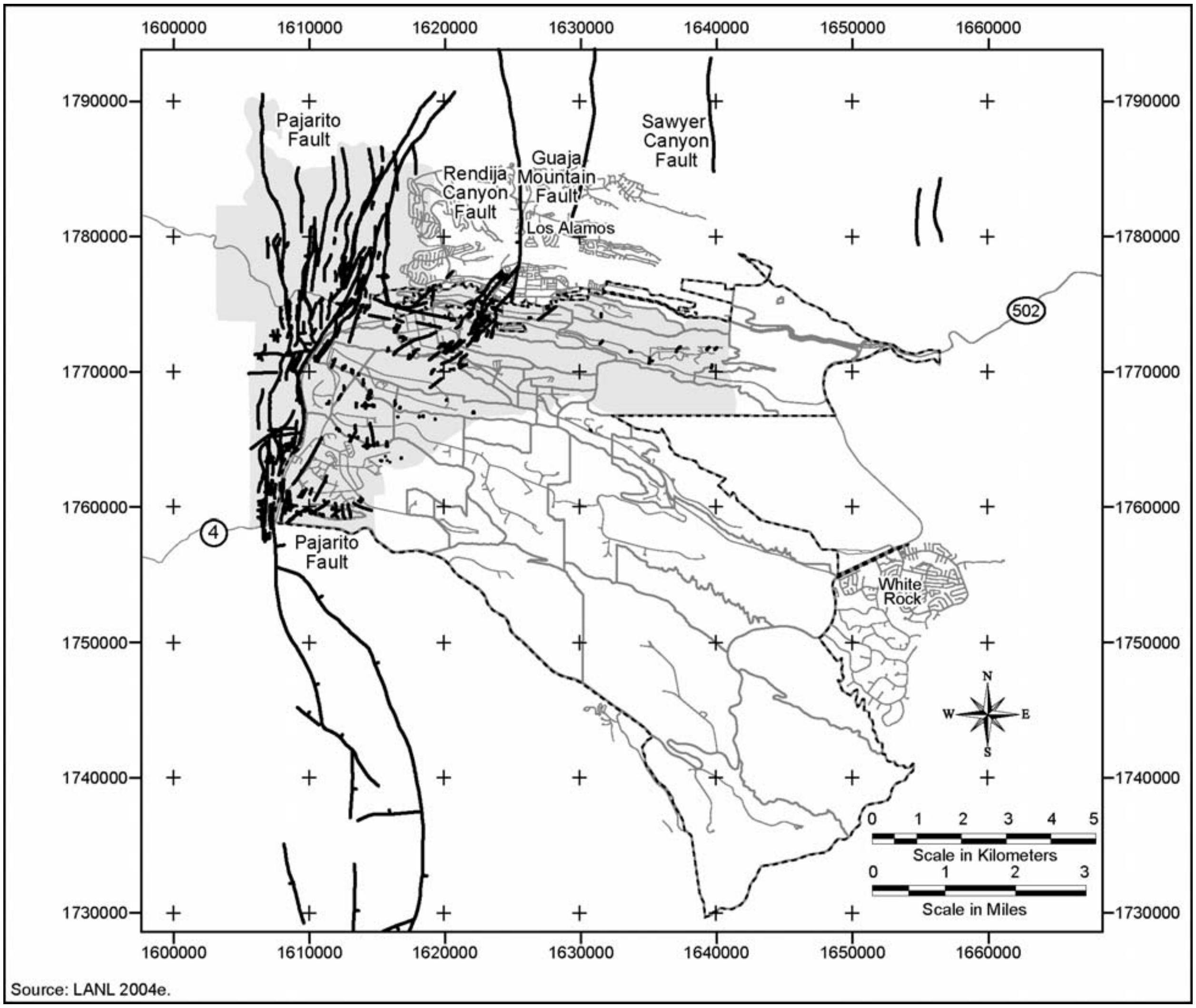


Figure 4–9 Mapped Faults in the Los Alamos National Laboratory Area

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 (1,005 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 2004e).

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, have indicated more recent movement (**Table 4–3**) (LANL 2004e). It has been concluded that this age range could indicate faulting contemporaneous with the most recent faulting event on the Guaje Mountain Fault or the Rendija Canyon Fault. Additional study will be needed to determine how movement on the three faults is related.

Table 4–3 Summary of Movement on Major Faults

Name	*Approximate Length*	*Type*	*Most Recent Faulting Event*	*Maximum Earthquake Potential* [a]
Pajarito	26 miles	Normal, down-to-the-east [b]	1,500 to 2,000 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	4,200 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 2004e.

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 2004e).

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 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 be independent structures. These are areas of generally higher potential for seismic surface rupture, relative to locations farther removed from the Pajarito Fault zone. Probabilistic analyses of surface rupture potential at TA-16 indicate that, even in consideration of 1-in-10,000-year events, seismic surface rupture only becomes a significant hazard on the principal or main trace of the Pajarito Fault (LANL 2004e).

Rendija Canyon Fault

Studies of the Rendija Canyon Fault (LANL 2004e) 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 kilometer) 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. 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). These may be related to the end of the Rendija Fault structures related to differential movement on the two fault zones, or independent structures. 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 9,000 or 23,000 years ago. Geologic mapping shows that there is no faulting in the near-surface directly beneath TA-55 (LANL 2004e). The closest fault is about 1,500 feet (460 meters) west of the 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, currently under construction, 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 2004e).

A probabilistic seismic hazards analysis of TA-3 was completed in 1998 (LANL 2004e). This study provided estimates of the probability of surface fault displacement considering three different possible scenarios for the southern end of the Rendija Canyon Fault. The three scenarios were required because geological data were insufficient to confirm geologic conditions at the two sites of primary concern (Chemistry and Metallurgy Research Building and Nonproliferation International Security Center). The probabilistic displacement hazard for the worst-case scenario was determined to be less than 0.67 inches (1.7 centimeters) of displacement in 10,000 years. The low hazard resulted from the long recurrence interval (33,000 to 68,000 years), and related low slip rates on the Rendija Canyon Fault (LANL 2004e).

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 2004e). 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 southside 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 2004e).

Based on available data, a series of seismic events have been identified on the Guaje Mountain Fault. These range in age from 4,200 to 300,000 years ago and have up to approximately 7 feet (2 meters) of displacement (LANL 2004e).

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 2004e).

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 2004e).

Pajarito Fault System Event Chronology

Recent work has shown that the Pajarito Fault system is a broad zone of distributed deformation, and that the master Pajarito Fault itself probably breaks the surface along only part of its length in the vicinity of LANL (LANL 2004e). Most of the geologic structures that have been the targets of seismic studies are, in fact, faults subsidiary to the three main faults (that is, the Pajarito, Rendija Canyon, and Guaje Mountain Faults). As such, the individual faults do not provide a complete record of paleoseismic events for the entire system.

The potential seismic hazard at LANL is dominated by seismic ground motion associated with earthquakes on nearby faults. It also includes surface rupture along faults within the boundaries of LANL. New data obtained by the LANL Seismic Hazards Program over the last 5 years, combined with previous work, suggest that there may have been three Holocene surface-rupturing events within the Pajarito Fault system. Although this scenario was considered in the probabilistic analyses presented in the *1999 SWEIS*, it was given a low weight (LANL 2004e).

A report in preparation by the LANL Seismic Hazards Geology Team will document a comprehensive review and re-evaluation of geochronological constraints on paleoseismic activity in the Pajarito Fault system. This study is being prepared to recalculate the probabilistic seismic hazard at LANL. The reanalysis of the seismic hazard will incorporate data from studies completed since the *1999 SWEIS* (LANL 2004e). Both the comprehensive review and reanalysis of seismic hazard are planned for completion in the fourth quarter of 2006.

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 2004e).

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 2002i).

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. 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 (Gallaher and Koch 2004). 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 causes 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. 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 2004e), except where otherwise noted. The soil monitoring program at LANL is comprised of: (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, offsite (regional), and background 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).

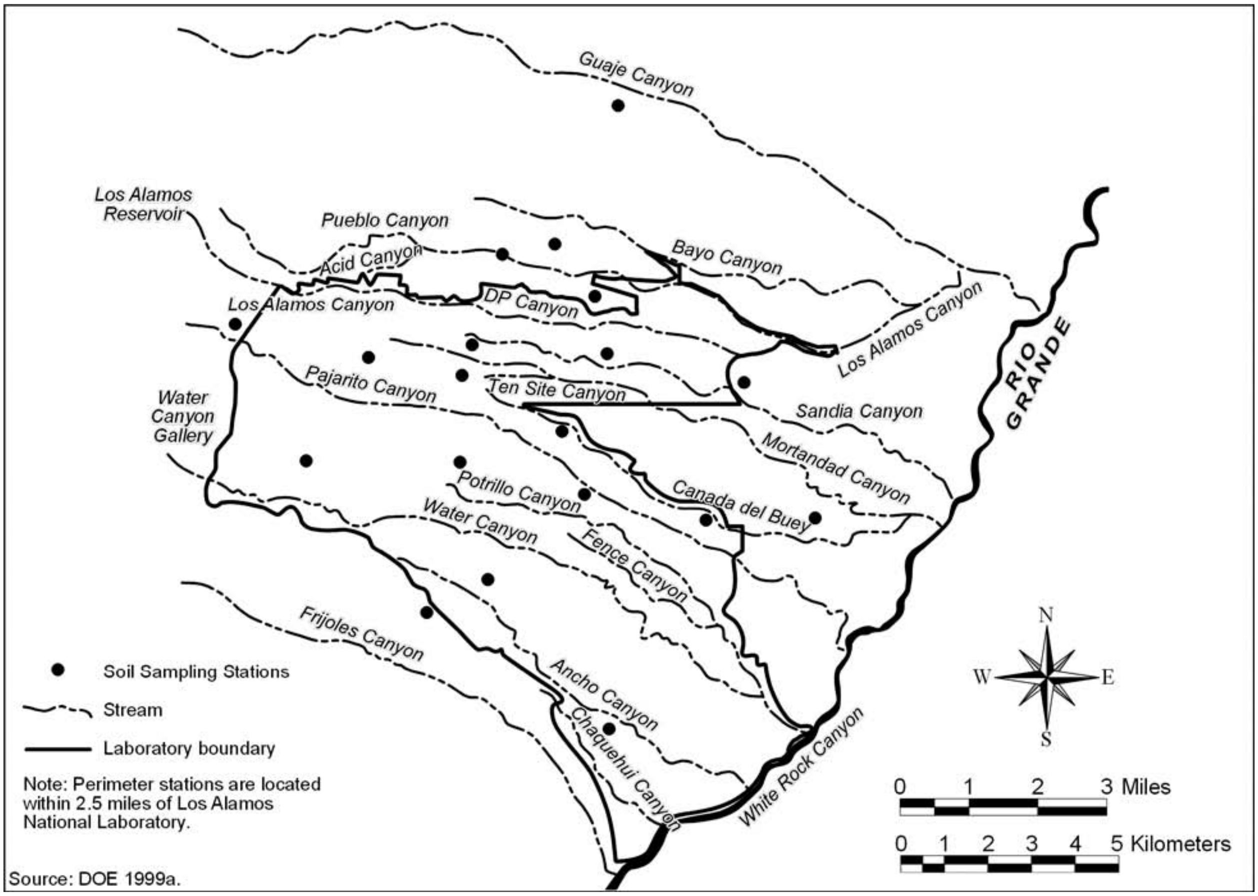


Figure 4–10 Onsite and Offsite Perimeter Soil Sampling Locations

The soil radionuclide and radioactivity samples collected from 1974 through 2003 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. 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 2004e).

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 2004e). 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*.

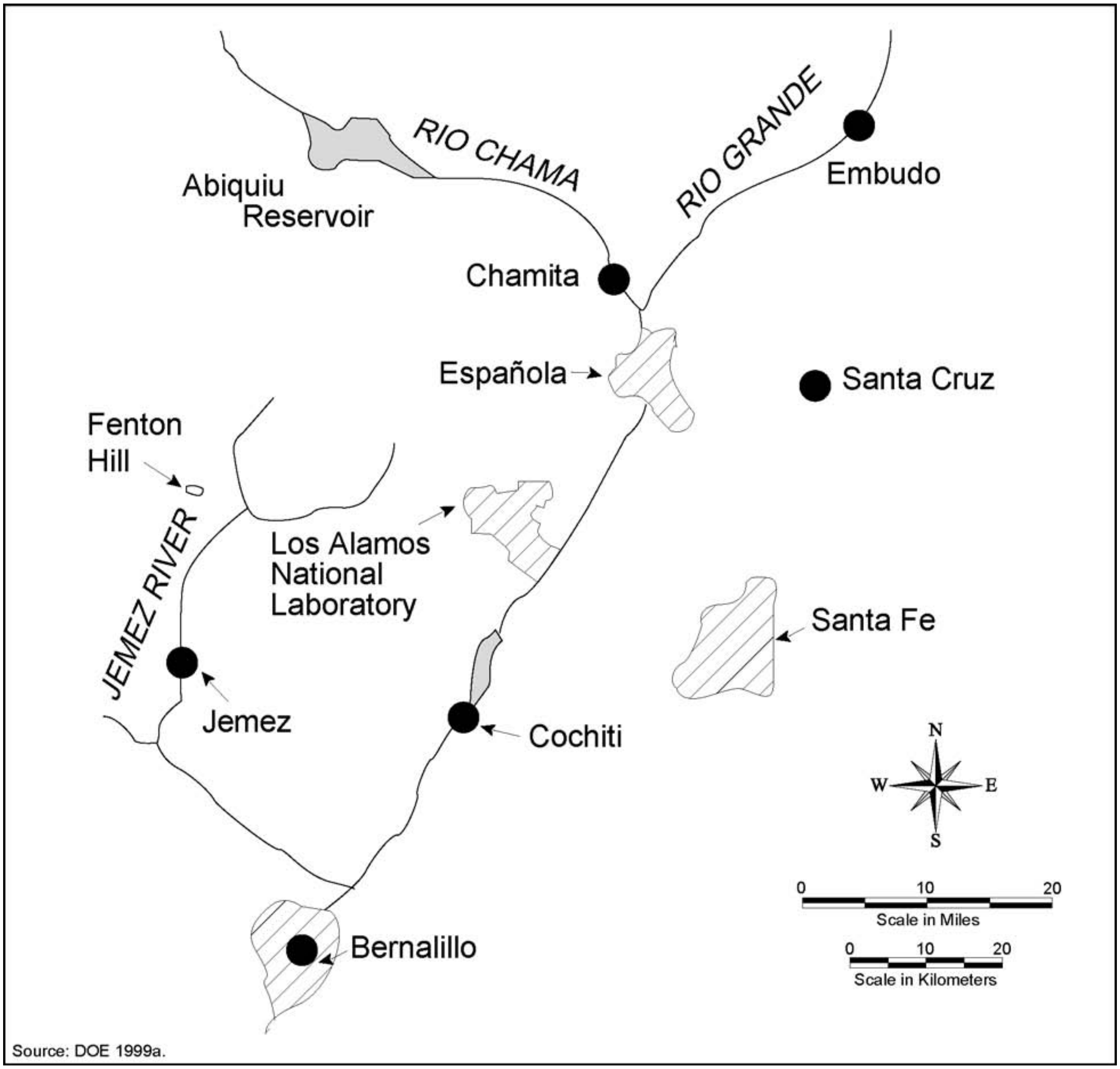


Figure 4–11 Regional Soil Sampling Locations

Of the radionuclides in soils from perimeter and onsite stations that exceeded regional statistical reference levels, most detections 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 2004e).

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 2004e), 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 improved air emissions from regional coal-fired manufacturing facilities (LANL 2006).

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 2004e). 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 2004e).

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 2004e).

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 2004e).

As described in *Cerro Grande Fire Impacts to Water Quality and Steam Flow near Los Alamos National Laboratory: Results of Four Years of Monitoring* (Gallaher and Koch 2004), 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 (Gallaher and Koch 2004).

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 2000f); 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 2002i).

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 4.3.1.4. 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 2005c).

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 2003f). 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. 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.

Detailed information on the geology, hydrology, and hydrogeology of the area was presented in Sections 4.2 and 4.3 of the *1999 SWEIS*, with updated information provided annually in the *SWEIS Yearbooks* (LANL 2001e, 2002d, 2003g, 2004h, 2005g and 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 2004e).

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.

4.3.1 Surface Water

Surface water may be affected by LANL operations when streams and springs receive industrial effluents discharged from LANL, stormwater that flows over the site, and sediments that can be mobilized by stormwater runoff.

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 2005j).

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. *Ephemeral* applies to streams that flow only in response to local precipitation or snowmelt.
- *Intermittent* applies to streams that surface because the water table is higher than the streambed.

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 and aquatic life standards are used for comparison, although surface water on the Pajarito Plateau is not used for these purposes. 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 4–4** summarizes the standards and references used to evaluate surface water and sediment quality.

Table 4–5 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 and livestock watering. **Table 4–6** 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) permitted 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 4–4 Standards and References Used for Evaluating Water Quality

			Potentially Applicable To				
			Pajarito Plateau			***Rio Grande***	
Type	***Source***	***Standard or Reference Value***	***Perennial Surface Water (spring supported, effluent supported)***	***Intermittent and Ephemeral Surface Waters***	***Sediments***	***Surface Water***	***Sediments***
Standard	NMWQCC	Irrigation	N/A	N/A	N/A	X	N/A
Standard	NMWQCC	Livestock Watering	X	X	N/A	X	N/A
Standard	NMWQCC	Wildlife Habitat	X	X	N/A	X	N/A
Standard	NMWQCC	Aquatic Life-acute	X	N/A	N/A	X	N/A
Standard	NMWQCC	Aquatic Life-chronic	X	N/A	N/A	X	N/A
Standard	NMWQCC	Human Health (persistent contaminants)	X	X	N/A	X	N/A
Standard	NMWQCC	Human Health (cancer causing, or toxic)	X	N/A	N/A	X	N/A
Reference	NMWQCC	Groundwater for Human Health	X (filtered samples)	X (filtered)	N/A	N/A	N/A
Reference	NMWQCC	Groundwater other Standards for Domestic Water	X (filtered)	X (filtered)	N/A	N/A	N/A
Reference	EPA	Drinking Water Systems MCL (filtered)	N/A	N/A	N/A	X	N/A
Reference	EPA	Fish Consumption and Water	N/A	N/A	N/A	X	N/A
Reference	EPA	EPA Region 6 Tap Water Screening Level	X	X (filtered)	N/A	N/A	N/A
Risk-human	DOE	DOE DCGs for Public Dose (radionuclides, 100 millirem dose per year	X	X	N/A	N/A	N/A
Risk-human	DOE	DOE DCGs for Drinking Water Systems (radionuclides, 4 millirem dose per year)	X (filtered)	X (filtered)	N/A	X (filtered)	N/A
Risk-human	EPA	EPA Region 6 Residential and Industrial Outdoor Worker Soil Screening Levels (metals, organics, chemicals)	N/A	N/A	X	N/A	X
Risk-human	LANL/USGS	Residential Soil Screening Action Levels (radionuclides)	N/A	N/A	X	N/A	X
Reference	Environment Canada	Guideline for Protection of Aquatic Life	N/A	N/A	N/A	N/A	X
Reference	LANL	Background radionuclides and metals	N/A	N/A	X	N/A	N/A
Reference	LANL	Background radionuclides	N/A	N/A	N/A	N/A	X
Reference	USGS	Prefire metals and organic chemicals	N/A	N/A	N/A	N/A	X
Reference	LANL/ NMED	Prefire metals and radionuclides	X	X	X	X	X

NMWQCC = New Mexico Water Quality Control Commission, N/A = not applicable, EPA = U.S. Environmental Protection Agency, MCL = maximum contaminant level, DCG = Derived Concentration Guideline, USGS = U.S. Geologic Survey, NMED = New Mexico Environment Department.
Sources: DOE 1990, Environment Canada 2002, EPA 2002, 2004, Gilliom, Mueller, and Nowell 1997, NMED 2004b, NMWQCC 2002a, 2002b.

Table 4–5 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.	Increased transport of contaminated sediments in Pueblo Canyon in response to post-fire flooding and increased urbanization.
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 60 percent of Derived 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 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.	None
Dissolved Copper in Surface Water	Detected in many canyons above New Mexico acute aquatics 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

Source: LANL 2005j.

Other possible sources of surface water impacts are isolated spills, former photographic processing facilities, highway runoff, and residual Cerro Grande Fire ash (LANL 2005j). 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 2004e). 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 4–6 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	- 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	- Selenium	- Natural Sources - Post-development Erosion and Sedimentation - Surface Mining - Watershed Runoff following Forest Fire
Los Alamos Reservoir	- Livestock Watering - Marginal Coldwater Fishery - Wildlife Habitat	- Other	- Watershed Runoff following Forest Fire
Los Alamos Canyon (San Ildefonso Pueblo boundary to Los Alamos Reservoir)	- Livestock Watering - Wildlife Habitat	- 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	- 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 (San Ildefonso Pueblo boundary to headwaters)	- Wildlife Habitat	- Polychlorinated biphenyl-1254 - Polychlorinated biphenyl-1260	- Atmospheric Deposition of Toxics - Inappropriate Legacy Waste Disposal - Landfills - Post-development Erosion and Sedimentation
Mortandad Canyon (San Ildefonso Pueblo boundary to headwaters)	- Livestock Watering - Wildlife Habitat	- 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 (Rio Grande to headwaters)	- Livestock Watering - Wildlife Habitat	- Gross Alpha - Selenium	- Inappropriate Legacy Waste Disposal - Natural Sources - Post-development Erosion and Sedimentation - Watershed Runoff following Forest Fire
Water Canyon (Rio Grande to headwaters)	- Livestock Watering - Wildlife Habitat	- 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.
Source: NMED 2004a.

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 2004 (LANL 2005j). An overview of the 2004 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 very good. Most samples are within normal ranges or at concentrations far below regulatory standards or risk-based advisory levels (LANL 2005j).

- 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 2005j).

- 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 Derived Concentration Guides, is shown in **Table 4–7**. This is similar to the conditions described in the *1999 SWEIS* (DOE 1999a, LANL 2004f).

Table 4–7 Estimated Average Annual Concentrations of Radionuclides for Persistent Waters in Pueblo and Mortandad Canyons Compared with the Derived Concentration Guides

Radionuclide	*DOE 100-Millirem DCG for Public Exposure (picocuries per liter)*	*Lower Pueblo Canyon (at State Route 502)*		*Mortandad Canyon below TA-50 Radioactive Liquid Waste Treatment Facility Outfall*	
		Estimated 2004 Time-Weighted Annual Average (picocuries per liter)	*Ratio to DCG*	*Estimated 2004 Time-Weighted Annual Average (picocuries per liter)*	*Ratio to DCG*
Americium-241	30	0.01	0.00033	8	0.267
Cesium-137	3,000	0.02	0.00001	42	0.014
Plutonium-238	40	0.001	0.00002	5	0.125
Plutonium-239 and Plutonium-240	30	0.3	0.01	5	0.167
Strontium-90	1,000	0.6	0.0006	4	0.004
Sum of Ratios			0.011	–	0.577

DCG = Derived Concentration Guide, TA = technical area.
Source: LANL 2005j.

In addition to environmental monitoring, LANL personnel maintain other compliance programs. Liquid effluents from NPDES-permitted outfalls are required to meet limitations established by the NPDES permit program (see Section 4.3.1.2) and the groundwater discharge permit program. 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. 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.

4.3.1.2 Industrial Effluents

Liquid effluent 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 (LANL 2004b).

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 4–8** shows the number of outfalls and the type of effluent that is discharged through the outfalls.

Table 4–8 National Pollutant Discharge Elimination System Industrial Point Source Outfalls, Permit #NM 0028355

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 2001.

The 21 permitted outfalls at LANL discharge into six local canyons in the LANL region, with the amount of discharge varying from year to year. In 2004, approximately 163 million gallons (617 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 identified in the *1999 SWEIS* 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 2005g). The annual flow from permitted outfalls and discharges by watershed is shown in **Table 4–9**.

Table 4–9 National Pollutant Discharge Elimination Systems Permitted Outfalls and Discharges by Watershed

Canyon	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*
Cañada del Buey [a]						
Number of permitted outfalls	3	1	1	1	1	1
Discharge (million gallons per year)	2.6	0	0	0	0	0
Guaje [b]						
Number of permitted outfalls	6	0	0	0	0	0
Discharge (million gallons per year)	1.7	0	0	0	0	0
Los Alamos						
Number of permitted outfalls	7	5	5	5	5	5
Discharge (million gallons per year)	45.2	37.4	19.34	36.79	34.52	29.57
Mortandad						
Number of permitted outfalls	6	5	5	5	5	5
Discharge (million gallons per year)	39.3	31.6	4.21	31.4	33.12	15.9
Pajarito [c]						
Number of permitted outfalls	2	0	0	0	0	0
Discharge (million gallons per year)	0	0	0	0	0	0
Pueblo						
Number of permitted outfalls	1	0	0	0	0	0
Discharge (million gallons per year)	0.9	0	0	0	0	0
Sandia						
Number of permitted outfalls	6	4	4	5	5	5
Discharge (million gallons per year)	213.2	180.2	100.38	108.58	140.41	116.43
Water [d]						
Number of permitted outfalls	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
Totals						
Number of permitted outfalls	36	20	20	21	21	21
Discharge (million gallons per year)	317.2	265.4	124.04	178.18	209.82	162.52

[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.
Source: LANL 2003g, 2004h, 2005g.

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 2005g). Total effluent discharges to the canyons from LANL decreased by about 50 percent over the past five 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, seven-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 4–10**. Total effluent discharges from all facilities in 2004 are about half of the total discharges in 1999. In 2004, Key Facilities discharged about 38.85 million gallons (147 million liters) of effluent, representing 24 percent of the total annual flow; and Non-Key Facilities discharged about 123.67 million gallons (468 million liters) of effluent, or 76 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.

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 4–11**. Permit exceedance trends are shown in **Figure 4–14**. The number of samples exceeding permit limits in Table 4–11 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 2006). 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, 2002c, 2004a, 2004f, 2005j). Generally, exceedances of permit standards in the 5 years since 2000 were of excess total residual chlorine.

Table 4–10 National Pollutant Discharge Elimination Systems Permitted Outfalls and Discharges by Facility

Facility	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*
Plutonium Complex						
Number of permitted outfalls	1	1	1	1	1	1
Discharge (million gallons per year)	8.6	6.5	0.41	2.82	3.02	2.72
Tritium Facility [a]						
Number of permitted outfalls	2	2	2	2	2	2
Discharge (million gallons per year)	9.0	8.6	0.39	13.4	19.03	22.09
CMR Building						
Number of permitted outfalls	1	1	1	1	1	1
Discharge (million gallons per year)	4.5	2.3	0.02	0.76	2.16	1.19
Sigma Complex						
Number of permitted outfalls	2	2	2	2	2	2
Discharge (million gallons per year)	5.77	3.9	0.06	2.00	7.62	1.97
High Explosives Processing Facility						
Number of permitted outfalls	3	3	3	3	3	3
Discharge (million gallons per year)	0.2	0.1	0.04	0.03	0.02	0.037
High Explosives Testing Facility						
Number of permitted outfalls	3	2	2	2	2	2
Discharge (million gallons per year)	14.3	16.1	9.00 [b]	1.38	1.75	0.58
LANSCE						
Number of permitted outfalls	4	4	4	4	4	4
Discharge (million gallons per year)	37.2	30.5	20.45	24.04	16.46	8.12
Biosciences Facilities (previously called Health Research Laboratory)						
Number of permitted outfalls	1	0	0	0	0	0
Discharge (million gallons per year)	0	0	0	0	0	0
Radiochemistry Facility						
Number of permitted outfalls	1	0	0	0	0	0
Discharge (million gallons per year)	0	0	0	0	0	0
Radioactive Liquid Waste Treatment Facility						
Number of permitted outfalls	1	1	1	1	1	1
Discharge (million gallons per year)	5.3	4.9	3.6	2.92	2.97	2.14
Number of permitted outfalls	0	0	0	0	0	0
Discharge (million gallons per year)	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
Discharge (million gallons per year)	85.0	72.5	24.99	47.17	53.03	38.85
Non-Key Facilities						
Number of permitted outfalls	17	4	4	5	5	5
Discharge (million gallons per year)	232	192.5	99.01	130.83	156.79	123.67
Totals						
Number of permitted outfalls	36	20	20	21	21	21
Discharge (million gallons per year)	317	265	124	178	209.8	162.52

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 2003g Table 3.2-4 as .006638. The correct value is 9.0, per LANL 2004e.

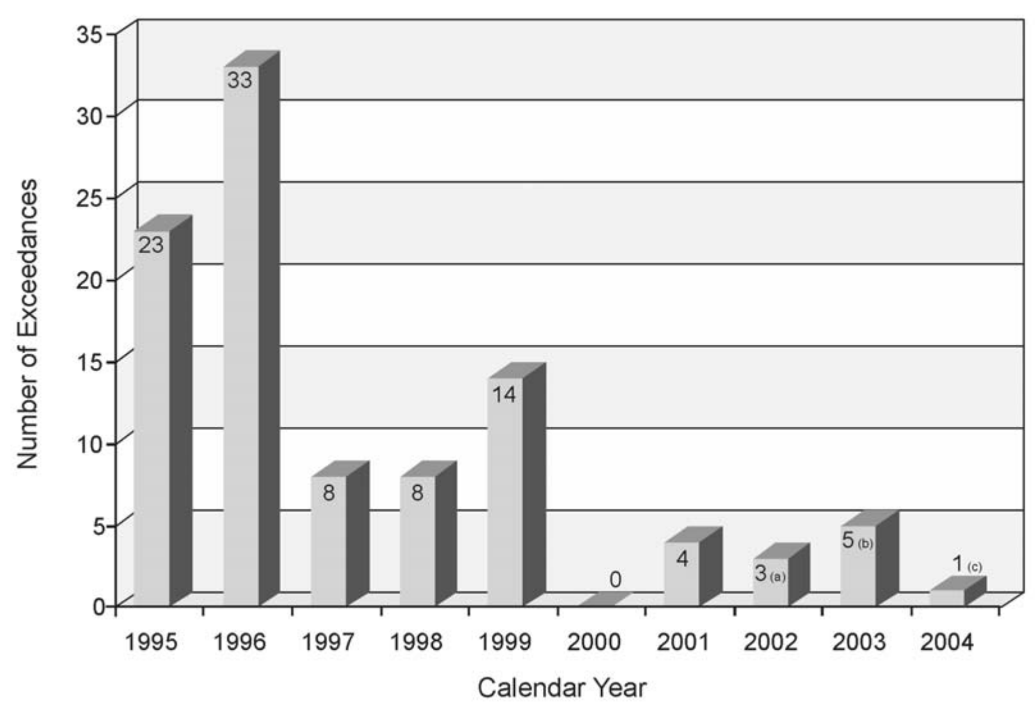
Note: To convert gallons to liters, multiply by 3.785.

Source: LANL 2003g, 2004e, 2004h, 2005g.

Table 4–11 Effluent Quality Monitoring and Compliance with Permit Limits for National Pollutant Discharge Elimination Systems-Permitted Outfalls

	1999	*2000*	*2001*	*2002*	*2003*	*2004*
Industrial Outfalls						
Number of permitted outfalls (as of end of calendar year)	19	20	20	20	20	21
Number of samples collected	1,248	1,121	1,085	1,084	958	1,283
Number of samples exceeding permit limits	14 [a]	0	4	2 [b]	3 [c]	1 [d]
Yearly compliance rate (percent)	98.88	100	99.63	99.82	99.69	99.92
Sanitary Outfalls						
Number of permitted outfalls (as of end of calendar year)	1	1	1	1	1	1
Number of samples collected	175	200	134	129	132	145
Number of samples exceeding permit limits	0	0	0	0	0	0
Compliance rate (percent)	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 2006).
[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, 2002c, 2004a, 2004f, and 2005j, 2006.



a) One sample exceeded both monthly average and daily maximum permit limits, so it counted as two exceedances.
b) Two samples exceeded both monthly average and daily maximum permit limits, so they each counted as two exceedances.
c) One sample exceeded both monthly average and daily maximum permit limits, but is counted as one exceedance under the new reporting method.

Sources: LANL 1996b, 1997c, 1999b, 2000d, 2001f, 2002c, 2004a, 2004c, 2006.

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 4-10 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 2002d, 2003g, 2004h, 2005g).

The volume of treated effluent discharged from the TA-50 Radioactive Liquid Waste Treatment Facility has steadily decreased since the *1999 SWEIS*. In 2004, the Radioactive Liquid Waste Treatment Facility discharged 2.14 million gallons (8.1 million liters) per year compared to the 5.51 million gallons (21 million liters) per year, discharged in 1999. Annual effluent discharges are shown in Table 4–10.

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 2004e). New treatment processes have been installed since then to improve effluent quality. With these improvements, calendar year 2004 marked the fifth 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). Annual average alpha activity in the Radioactive Liquid Waste Treatment Facility effluent was reduced to 2.3 picocuries per liter in 2004, compared to the DOE Derived Concentration Guide of 30 picocuries per liter.

During this same 5-year period, the Radioactive Liquid Waste Treatment Facility has also met 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 2004f). **Table 4–12** summarizes the water quality in the Radioactive Liquid Waste Treatment Facility effluent for 2004 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 0.037 million gallons (0.14 million liters) per year in 2004. Yearly effluent discharged is shown in Table 4–10, High-Explosives Processing Facility. The High-Explosives Wastewater Treatment Facility is discussed further in Section 4.9 (LANL 2004f, LANL 2005g).

Table 4–12 Selected Water Quality Data for Radioactive Liquid Waste Treatment Facility Effluent in 2004

Contaminant	*Effluent Concentration in 2004*	*Standard Concentration Limit*	*Water Quality Standard*
Gross alpha	2.3 picocuries per liter	30 picocuries per liter	DOE Derived Concentration Guideline for Public Dose
Nitrogen as nitrate	3 milligrams per liter	10 milligrams per liter	NMED Groundwater Standard for Human Health
Fluoride	0.2 milligrams per liter	1.6 milligrams per liter	NMED Groundwater Standard for Human Health
Total dissolved solids	75 milligrams per liter	1,000 milligrams per liter	NMED Groundwater Standard for Domestic Water Supply
Perchlorate	Less than 1 microgram per liter	(a)	No current standard
Tritium	10,600 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 2005j, 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 2005j).

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 2005j). 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's staff have improved the monitoring of stormwater runoff. The program improvements are the result of changes in EPA NPDES stormwater program requirements, 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 storm water 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 4–13 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 4–13 Summary of Stormwater Program Activity

	1999	*2000*	*2001*	*2002*	*2003*	*2004*
National Pollutant Discharge Elimination System Industrial Stormwater Program						
Number of industrial activities permitted for discharge of stormwater	22	19	20	18	17	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
Number of stormwater pollution prevention plans implemented at construction sites	Not applicable	Not applicable	23 [a]	44 [a]	51 [b]	67 [b]
Number of stormwater pollution prevention plan inspections conducted at construction sites	Not applicable	Not applicable	Not applicable	435	675	616

[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, 2002c, 2004a, 2004f, 2005j.

Recent data from stormwater runoff monitoring detected some contaminants onsite and offsite, but the exposure potential for these contaminants is limited (see Table 4–5). Radionuclides have been detected in runoff at higher than background levels in Pueblo, DP, Los Alamos, and Mortandad Canyons, with sporadic detections extending offsite in Pueblo and Los Alamos Canyons. Stormwater runoff exceeded the wildlife habitat standard for gross alpha activity of 15 picocuries per liter since the Cerro Grande Fire in nearly all canyons. Los Alamos Canyon and Sandia Canyon runoff and base flows contain polychlorinated biphenyls at levels above New Mexico human health stream standards. 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 2005j).

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 March 2004, LANL protected 23 industrial activity locations with 18 stormwater pollution prevention plans, operated and sampled stormwater flow at 20 monitoring stations, inspected and maintained best management practices, and published and reported monitoring results to EPA and NMED in discharge monitoring reports (NNSA 2004b).

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 2004f).

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, use appropriate best management practices to control the transport of pollutants, including sediment, from disturbed areas. They also 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 2004l, 2004d, 2004n). 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, the condition 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 2004f).

Information in Table 4–13 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 expected to be in effect through 2007, when all the goals of the agreement should be 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 2005g, 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 2004l). 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 2004l, 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 404 and 401 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 4–14 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.

Table 4–14 Summary of Dredge and Fill Permits Issued Each Year

	1999	*2000*	*2001*	*2002*	*2003*	*2004*
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

Source: LANL 2006.

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 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 2004e).

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, 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 2004f).

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 2004 operating data to 1999 data, discharges to Sandia Canyon decreased about 45 percent (96.8 million gallons [366 million liters] per year); Los Alamos Canyon discharges declined about 35 percent (about 15.6 million gallons [59 million liters] per year); discharges into Mortandad Canyon decreased about 60 percent (23.4 million gallons [89 million liters] per year); and discharges into Water Canyon decreased about 96 percent (about 13.7 million gallons [52 million liters] per year) (LANL 2005g).

- *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 2005j, Gallaher and Koch 2004). Monitoring results are compared against a variety of reference standards, screening action levels, and background values as described in Table 4–4. With these improvements, DOE has a better understanding of sediment contamination in the area than in 1999.

During the 2004 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 2002i). 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 State Road 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 2002i). 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).

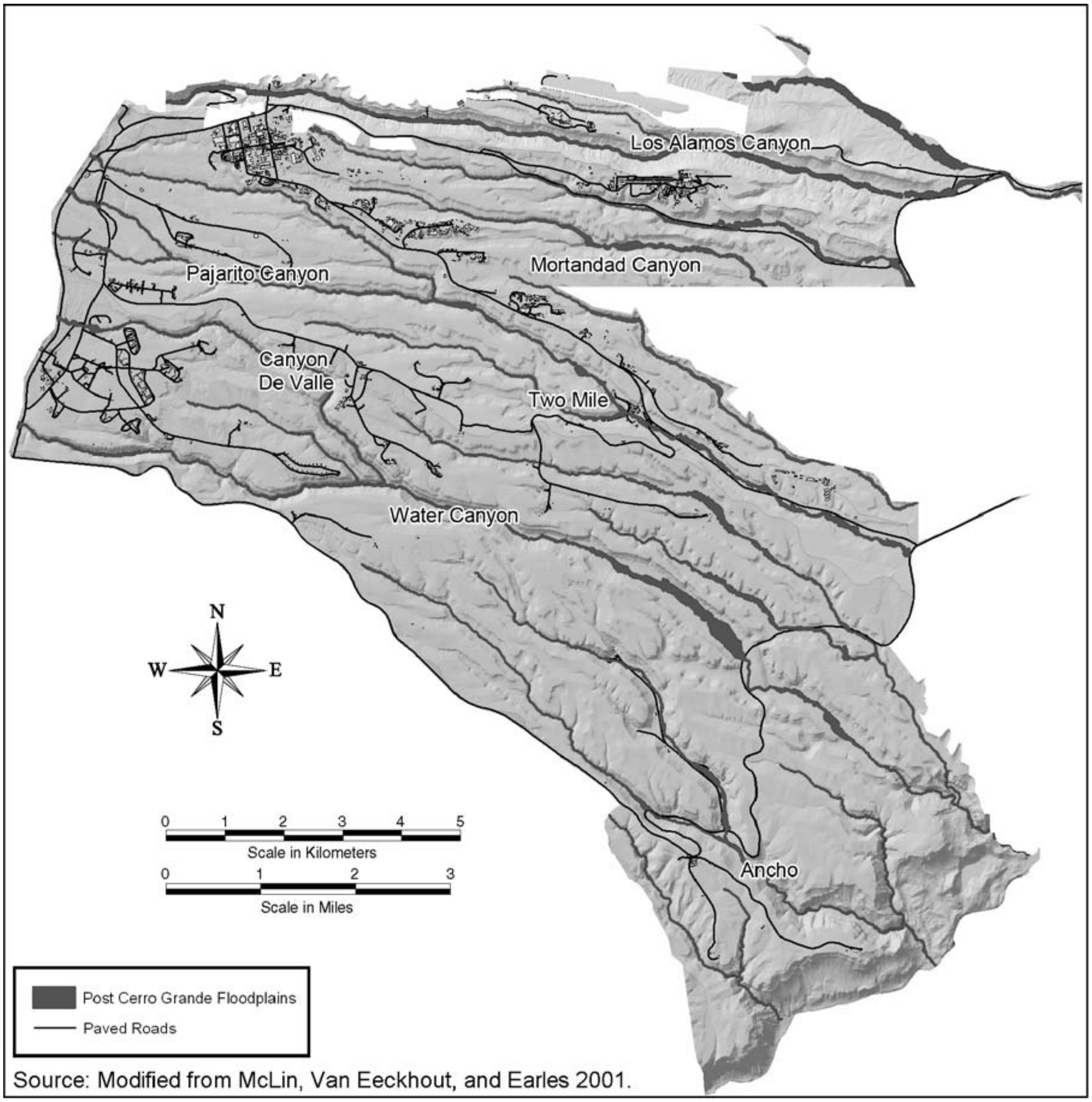


Figure 4–15 Post-Cerro Grande Fire Floodplains

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 2004e, 1998a).

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 4–6, 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 a summary report on the four years of post-fire monitoring and the resulting impacts to water quality and sediments (Gallaher and Koch 2004). This report included results of sampling performed by DOE, as well as sampling performed by the NMED and the U.S. Geological Survey. 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 2004o). 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).

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 increased by as much as 50 to 80 times from 1999 levels (LANL 2004o, 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 2005j). 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).

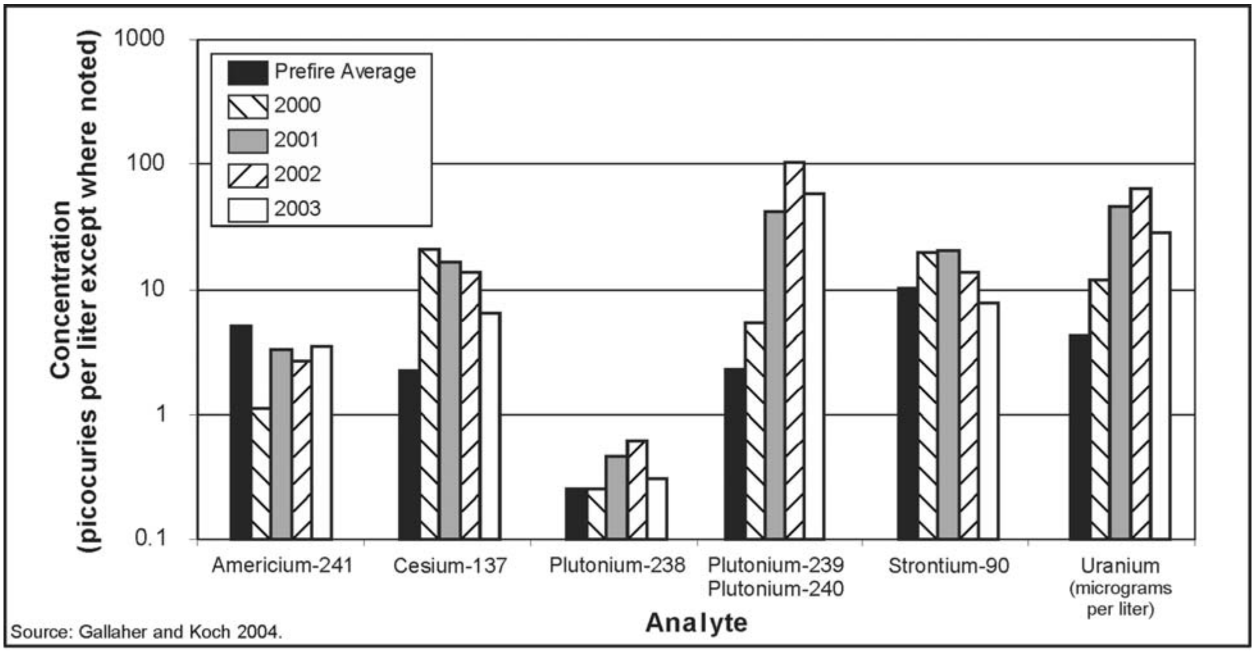


Figure 4–16 Flow-Weighted Average Concentrations of Radionuclides, Pre-Cerro Grande Fire to 2003

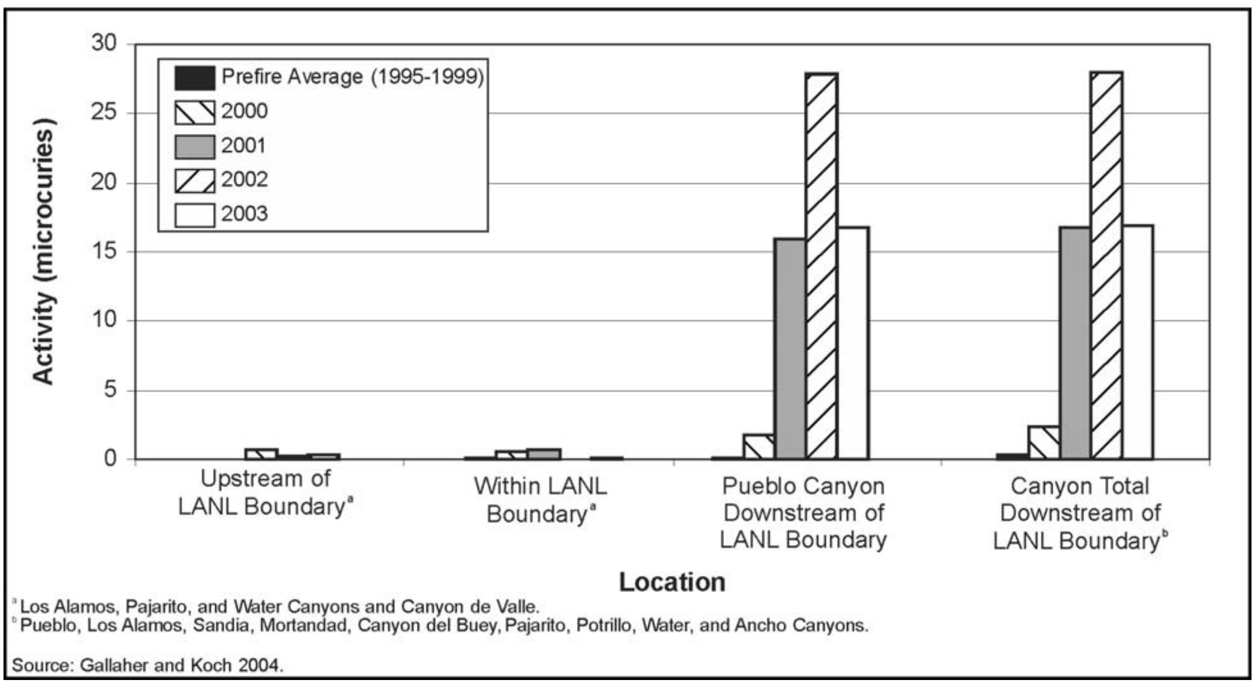


Figure 4–17 Estimated Plutonium-239 and Plutonium-240 Transported by Suspended Sediment in Runoff, Pre-Cerro Grande Fire to 2003

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. Concentrations of americium and uranium in sediments also increased and are attributed to historic LANL activities (Gallaher and Koch 2004).

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 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 10 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). 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 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 long-term disposition of the flood control structures has not yet been determined and 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 2002i). LANL personnel will continue monitoring and maintaining these structures until they are removed or until the affected watersheds are recovered or hydrologically stable (LANL 2004e).

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

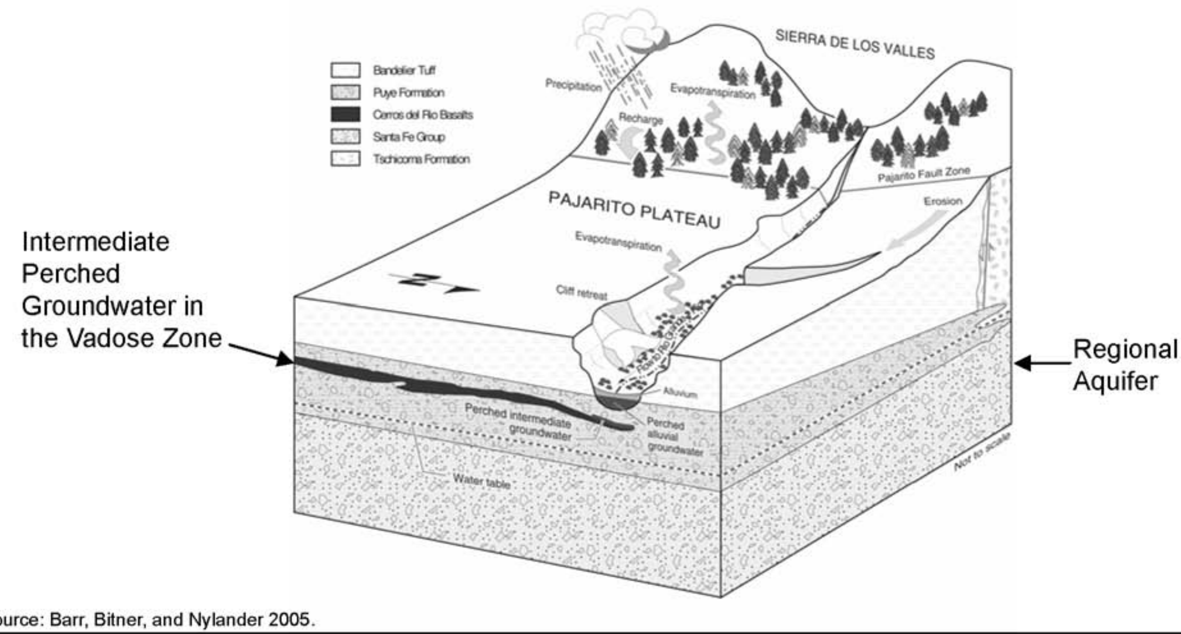
Pueblo Canyon into lower canyons. There are indications that stormwater runoff and sediment transport from most of the burned watersheds have improved and watershed conditions are expected to return to pre-fire conditions sometime between 2006 and 2010 (DOE 2002i, LANL 2004f).

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).

The amount of rainfall in the LANL region is 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.



Source: Barr, Bitner, and Nylander 2005.

Figure 4–18 Illustration of the Hydrologic Cycle at Los Alamos National Laboratory

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 (36.6 meters) in Pueblo Canyon and as deep as 750 feet (227 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 (213 meters). The source of this perched water may be infiltration from streams that discharge from canyons along the mountain front and also underflow of recharge from the Sierra de los Valles.

The regional aquifer of the Los Alamos area occurs at a depth of approximately 1,200 feet (366 meters) along the western edge of the plateau and about 600 feet (183 meters) along the eastern edge. The regional aquifer lies about 1,000 feet (305 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).

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 (107 to 189 meters) of unsaturated tuff, basalt, and low moisture content sediments separate the alluvial and perched groundwater zones and the regional aquifer (LANL 2005j). Groundwater flow from the Sierra de los Valles to the Pajarito Plateau may be affected by the Pajarito Fault.

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 impeded downward water movement (LANL 2005k). 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 suitable as a drinking water source.

Runoff or effluent discharges that do not infiltrate into the mesa tops is directed down the canyons, and can enter the alluvium to form an unconfined groundwater body, particularly during spring snowmelt and mid- to late-summer thunderstorms. Springs derived from some intermediate perched groundwater zones are located along canyons in the southwestern portion of LANL (LANL 2003c). 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 2005j). 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 and LANL. 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 recent drop in the water table remains 1 to 2 feet (0.3 to 0.6 meters) per year as projected in the *1999 SWEIS*.

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 modeled as part of the Hydrogeologic Work Plan in order to further understand the hydrogeology and detect contamination in the regional aquifer (LANL 2003c). Additional information on the geology and hydrology around LANL is presented in Appendix E.

Since 1998, a total of 34 new wells reaching to the regional aquifer have been constructed. Additionally, five new intermediate-depth wells have been drilled. As the result of a Consent Order reached with the NMED, DOE is changing the focus to watershed-specific investigations to find groundwater contamination and contaminant transport mechanisms (LANL 2004k).

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.

The chemical interaction between tuff and water is also important. Volcanic glass in the tuff captures contaminants by chemically attaching them to mineral surfaces (adsorbed) or by taking them into the structure of the minerals themselves (absorbed). As a result, large volumes of contaminants are trapped, some permanently and some temporarily. The combination of these physical and chemical processes in the unsaturated tuff slows the movement of 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. Both lateral movement of contaminants in the canyon channels and movement of contaminants downward into local perched water bodies underlying the canyon channels are currently being monitored (LANL 2005k).

Groundwater Quality Standards

For evaluation of groundwater samples from supply wells that draw water from the regional aquifer, DOE applied regulatory standards and risk levels. This was accomplished by comparing concentrations of radionuclides in the samples to the derived concentration guides for ingested water calculated from DOE's 4-millirem drinking water dose limit and by comparing concentrations to EPA maximum contaminant levels.

For risk-based screening, groundwater samples from sources other than water supply wells, may be compared with DOE's 4-millirem per year drinking water derived concentration guides and with EPA maximum contaminant levels. The New Mexico drinking water regulations and EPA maximum contaminant levels apply as regulatory standards to nonradioactive constituents 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 non radioactive chemical quality parameters in all groundwater samples (NMWQCC 2002b). 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 noncancer causing substances. A hazard index of 1 or less indicates that no (noncancer) adverse human health effects are expected to occur. DOE uses the EPA Region 6 tap water screening levels to screen the New Mexico Water Quality Control Commission toxic pollutant compounds (EPA 2004). For cancer-causing substances, the Region 6 tap water screening levels are at a risk level of 10^{-6} (1 chance in a million), so DOE uses 10 times these values to screen for a risk level of 10^{-5} (1 chance in 100,000).

Groundwater is a source of flow to springs and other surface waters that are used by neighboring American Indian 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 2004f, NMWQCC 2002b).

Groundwater Quality in the LANL 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, 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 greater 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 dry rock. As a result, little contamination reaches the regional aquifer from the shallow perched groundwater bodies and water quality impacts on the regional aquifer, though present, are low. The drinking water in the Los Alamos area has not been adversely impacted by DOE actions. Low levels of tritium and perchlorate (below drinking water standards or proposed standards) have been detected since 2000 in one water supply well (Otowi-1) that is not currently used in the County drinking water system. All drinking water produced by the Los Alamos County water supply system meets Federal and state drinking water requirements.

Perched Alluvial and Intermediate-Depth Groundwater

The discharge of radioactive effluents has caused alluvial groundwater contamination in DP Canyon, Los Alamos Canyon, and Mortandad Canyon. Strontium-90 is consistently measured at levels above the 8-picocuries-per-liter EPA drinking water maximum containment level in these canyons. Mortandad Canyon also has a localized groundwater concentration of plutonium-238, plutonium-239, plutonium-240, and americium-241 above the 4-millirem DOE standard for drinking water. 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; levels dropped below the 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 (LANL 2004f, LANL 2005j).

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 until new treatment methods were installed to remove nitrate in 1999 and perchlorate in 2002. Nitrate levels were below the 10-milligram-per-liter EPA maximum contaminant level in Mortandad Canyon in 2003 and 2004 (for alluvial groundwater), but were close to or exceeded that level in previous years. Nitrate concentrations in Pueblo Canyon have been around the maximum containment level in recent years. Maximum perchlorate levels have been below 200 parts per billion in alluvial and intermediate perched groundwater in Mortandad Canyon (LANL 2004f, 2005j). EPA has not established a drinking water standard for perchlorate.

Molybdenum is found in Los Alamos Canyon alluvial groundwater as a result of treatment chemicals no longer used in the TA-53 cooling towers. Levels in the alluvial groundwater have been quite variable in recent years and are often above the 1 milligram per liter New Mexico groundwater standard for irrigation use. Barium and RDX (an explosive) are present in alluvial groundwater of Cañon de Valle, at levels exceeding the New Mexico groundwater standard of 1 milligram per liter and EPA Region 6 screening level of 6.1 parts per billion, respectively (LANL 2004f).

Regional Groundwater Quality

Water produced by regional aquifer wells at LANL continues to meet drinking water standards, but contaminants reaching the regional aquifer have been documented. Contaminants already in the rock layers can be expected to continue to enter the groundwater system over long periods of time (LANL 2005k).

Naturally-occurring uranium is the primary radionuclide detected in the regional aquifer, found at levels near the EPA maximum contaminant level of 30 micrograms per liter. Tritium is present at trace levels in Pueblo, Los Alamos, and Sandia Canyons. Perchlorate has been detected in the regional aquifer in Pueblo and Mortandad Canyons, with a few values reaching as high as 6 parts per billion, and is present at concentrations less than 1 part per billion in groundwater throughout northern New Mexico. Naturally-occurring arsenic is present in Guaje Canyon wells at levels below the EPA maximum contaminant level. Well R-25 in Water Canyon has elevated levels of the explosives compounds RDX and trinitrotoluene (TNT), as well as the organic solvents perchloroethylene and trichloroethylene at levels near EPA Region 6 tapwater screening levels, but slightly below EPA maximum contaminant levels (LANL 2004e).

On December 23, 2005, the NMED was verbally notified by DOE that groundwater samples collected in May, September, and November of 2005 from the regional aquifer in Well R-28 located in Mortandad Canyon contain 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 Safe Drinking Water Act Maximum Contaminant Level, of 100 parts per billion (Bearzi 2005). The letter requires DOE to provide an Interim Measures Work Plan. The NMED outlined requirements for a plan that will give a detailed assessment of hydraulic properties of the regional aquifer from data obtained from Wells R-28 and R-11 in Mortandad and Sandia Canyons and from monitoring wells in Los Alamos and Pajarito Canyons. There will be assessments of historical pumping, groundwater gradients, and effluent discharges. DOE will make available 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.

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 2004e).

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 2004e). 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 2004e).

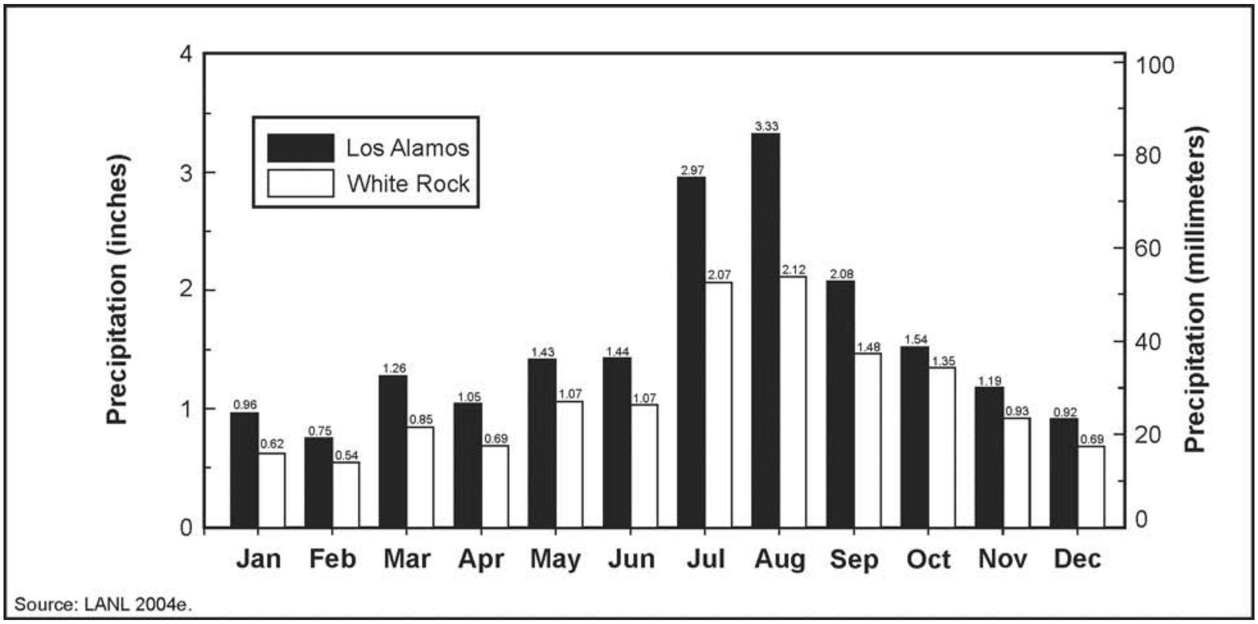


Figure 4–20 Los Alamos Area Mean Precipitation (1971 to 2000)

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 2004e). Precipitation in 2004 was close to average (LANL 2005g).

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 is 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 2004e).

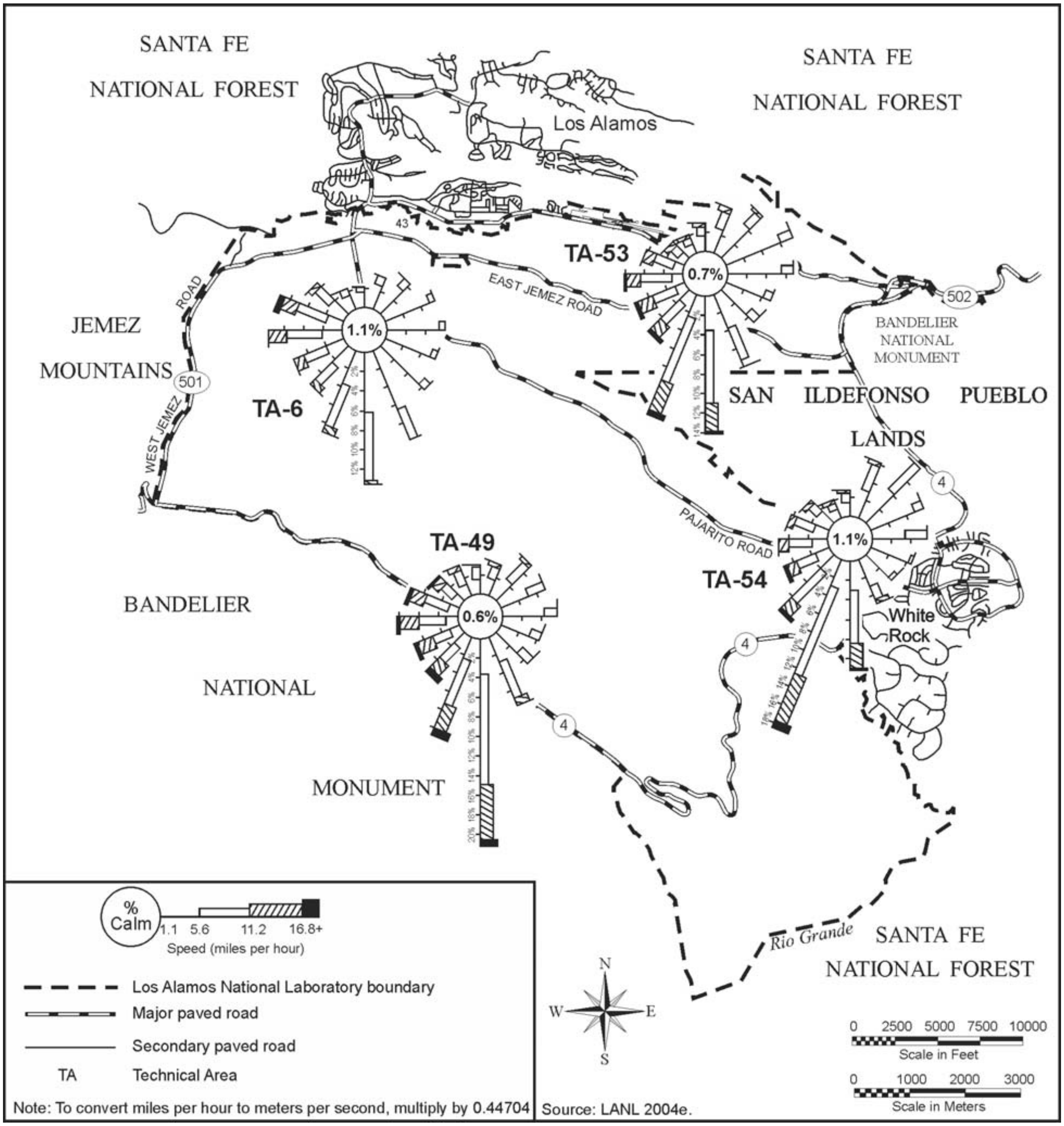


Figure 4–21 Los Alamos National Laboratory Meteorological Stations with Daytime Wind Rose Data

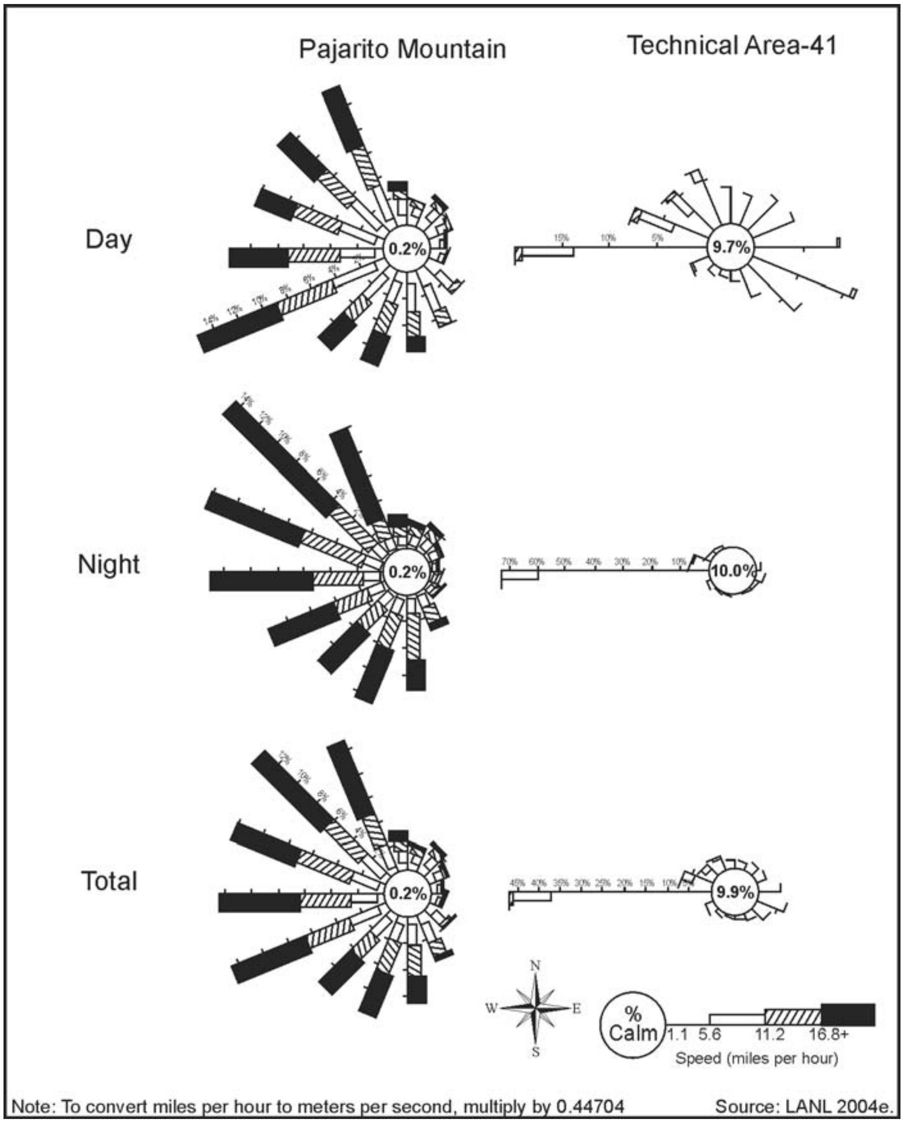


Figure 4–24 Pajarito Mountain and Technical Area 41 Associated Wind Rose Data

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 2004e).

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 2004e).

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 2004e).

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 2004e).

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 occur 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 2004e).

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 (LANL 2004e).

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 (LANL 2004e).

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 New Mexico Administrative Code (NMAC) (LANL 2004e).

Almost all operations at LANL were in existence before August 31, 1972, when NMED air permit regulations were first applicable. Therefore, air quality permits were not required. Air quality construction permits are obtained from the New Mexico Air Quality Bureau for operations that have been modified or constructed after August 31, 1972 (LANL 2004e). Air quality permits are discussed further in Chapter 6.

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 2004e, NMED 2004c).

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 2004e).

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 2004e).

Estimated emissions from operations at LANL for the years 1999 through 2004 are shown in **Table 4–15**. This data includes 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 2004, Comparison of 2004 Data*

Projections of the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory (SWEIS Yearbook – 2004) (LANL 2005g). 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 – 2004* 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 4–15 Emissions of Criteria Pollutants

Pollutant [a]	***Emissions (tons per year)***					
	1999	***2000***	***2001***	***2002***	***2003***	***2004*** [b]
Carbon monoxide	32	26	29.08	28.1	31.9	35.4
Nitrogen oxides	88	80	93.8	64.7	49.6	50.5
Particulate matter	4.5	3.8	5.5	15.5 [c]	22.1 [c]	4.8
Sulfur oxides	0.55	4.0 [d]	0.82	1.3 [e]	1.6 [e]	1.5

[a] Tons per year.
[b] Values include emissions from small boilers and heaters not included in previous years' emissions inventories.
[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.
Source: LANL 2003g, 2005g.

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 2003g, 2004h).

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 2003g).

Approximately two-thirds of the most significant criteria pollutant, nitrogen oxides result 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 2003g, 2004h).

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, PM_{10}, 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 Actions considered in this *SWEIS* do not require a conformity determination.

Toxic air pollutant emissions for Key Facilities at LANL are presented in Appendix A of the *SWEIS Yearbook – 2004* and are based on chemical usage in these areas (LANL 2005g). Total emissions of hazardous air pollutants and volatile organic compounds for 1999 through 2004 are presented in **Table 4–16**.

Table 4–16 Emissions of Hazardous Air Pollutants and Volatile Organic Compounds from Chemical Use

Pollutant	*Emissions (tons per year)*					
	1999	*2000*	*2001*	*2002*	*2003*	*2004*
Hazardous Air Pollutants	13.6	6.5	7.4	7.74	7.32	5.71
Volatile Organic Compounds	20	10.7	18.6	14.9	11.2	7.95

Note: To convert tons per year to metric tons per year, multiply by 0.9072.
Source: LANL 2005g.

The total emissions of hazardous air pollutants and volatile organic compounds showed considerable variation over the period 1999 through 2004. 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 2004h). 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 were lower in 2004 due to the shutdown of activities in July 2004 (LANL 2005g).

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. DOE has not been required to obtain any permits specifically for toxic air pollutant emissions, and therefore there is no requirement to monitor for toxic air pollutants. Additionally, in the Title V operating permit application, DOE requested voluntary facility-wide limits on hazardous air pollutants to keep LANL below the major source threshold for hazardous air pollutants. Past actual emissions of hazardous air pollutants have been well below the threshold (LANL 2004e).

In the *1999 SWEIS*, a list of 382 chemicals of interest were 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 2004e).

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 2003g, LANL 2004h, LANL 2005g). The amount of individual chemicals purchased varies from year to year. However, in some areas the total amount 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 2004e). 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 (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.

New Mexico State had ambient air quality control standards for beryllium, which were repealed in 1995. To ensure that LANL beryllium emissions did not exceed those standards, ambient air monitoring of beryllium was performed at LANL from 1988 to December 1995, as discussed in the *1999 SWEIS*. The recorded beryllium levels were low, and as a result, beryllium monitoring was discontinued after December 1995. Beryllium monitoring resumed in 1998 through the present at over 20 sites located near potential beryllium sources at LANL or in nearby communities. Air concentrations remain very similar to those measured previously. For comparison purposes, the results were 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 2005j).

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. Funding for the NonRadNET program ended in late December 2002, with five full quarters of data collected. The NonRadNET program included real-time ambient sampling for total suspended particulates, PM_{10} and $PM_{2.5}$. Additionally, air samples were collected 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 in **Table 4–17**. 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 2004g).

Table 4–17 2002 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)*
Diamond Drive	PM_{10}	Not Sampled	Not Sampled
	$PM_{2.5}$	8.5	15
Los Alamos Medical Center	PM_{10}	19.0	50
	$PM_{2.5}$	8.7	15
White Rock Fire Station	PM_{10}	19.0	50
	$PM_{2.5}$	8.2	15

NAAQS = National Ambient Air Quality Standards, PM_n = Particulate matter less than n microns in aerodynamic diameter.
Source: LANL 2004a.

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 (or 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 2004. 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 4–18** summarizes regional levels of radioactivity in the atmosphere over the period 1999 to 2004.

Table 4–18 Annual Average Background Concentration of Radioactivity in the Regional Atmosphere

	Units [a]	*EPA Concentration Limit* [b]	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*
Gross Alpha	fCi/m^3	NA	1	1	0.8	0.8	0.8	1.1
Gross Beta	fCi/m^3	NA	13.4	13	13.9	13.3	13.7	18.3
Tritium	pCi/m^3	1,500	0.5	0.8	NM	NM	NM	0.1
Strontium-90	aCi/m^3	19,000	NA	NA	NA	4	11	NA
Plutonium-238	aCi/m^3	2,100	NM	0	0	0	NM	0.09
Plutonium-239 and Plutonium-240	aCi/m^3	2,000	0.1	0	0.1	0.3	NM	NM
Americium-241	aCi/m^3	1,900	NM	0.3	NM	0.3	NM	NM
Uranium-234	aCi/m^3	7,700	16.1	17.1	17.9	21.7	20.9	17.4
Uranium-235	aCi/m^3	7,100	1.2	0.9	1.3	2.4	1.8	1.17
Uranium-238	aCi/m^3	8,300	15.2	15.9	17.7	21.8	20.1	17.0

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 2004f, 2005j.

In 2004, 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 2004 totaled approximately 5,230 curies. Of this total, tritium emissions composed approximately 790 curies, and air activation products from Los Alamos Neutron Science Center (LANSCE) stacks contributed nearly 4,440 curies. Combined airborne materials such as plutonium, uranium, americium, and thorium were less than 0.00001 curie. Emissions of particulate/vapor activation products totaled less than 0.01 curie, dominated by the LANSCE stacks (LANL 2005j). **Table 4–19** provides further detailed emissions data for buildings with sampled stacks in the years 1999 through 2004. Overall, radiological air emissions at LANL tend to be dominated by emissions from LANSCE stacks and tritium.

Table 4–19 Range of Annual Airborne Radioactive Emissions from Los Alamos National Laboratory Buildings with Sampled Stacks from 1999 through 2004 (curies)

TA Building	*Tritium* [a]	*Americium-241*	*Plutonium* [b]	*Uranium* [c]	*Thorium* [d]	*P/VAP* [e]	*G-MAP* [f]	*Strontium-90* [g]
TA-3-029		1.8×10^{-7} - 2.6×10^{-6}	2.1×10^{-6} - 2.1×10^{-5}	2.8×10^{-6} - 7.1×10^{-6}	1.3×10^{-7} - 1.3×10^{-6}			2.1×10^{-7}
TA-3-102		1.0×10^{-10} [g]	3.9×10^{-10} [h]	2.0×10^{-8} - 3.3×10^{-7}	8.0×10^{-10} - 7.2×10^{-9}			
TA-16-205	140-7900							
TA-16-155	66-520							
TA-21-209	300-760							
TA-48-001			1.7×10^{-9} [h]	6.1×10^{-10} [i]	1.1×10^{-9} [g]	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} [h]	3.7×10^{-8} - 7.0×10^{-8}			
TA-50-037		5.8×10^{-10} [h]	8.9×10^{-10} [h]	1.9×10^{-8} [i]	3.4×10^{-9} [g]			3.4×10^{-9}
TA-50-069		5.8×10^{-11} - 1.7×10^{-10}	9.9×10^{-11} - 2.7×10^{-9}		1.2×10^{-10} [g]			
TA-53-003	0.57-1.8					3.5×10^{-10} [g]	1.7- 8.4	
TA-53-007	0.45-5.7					0.0025-60	300-5900	
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}	3.9×10^{-8} - 1.5×10^{-7}			5.6×10^{-8}

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 2003.
[h] Only emitted during 2002.
[i] Only emitted during 1999.
Source: LANL 2004f, 2005j.

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 4–20** reflects average visibility from 1993 through 2002 from approximately 79 to 113 miles (127 to

182 kilometers) (LANL 2004e). 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).

Table 4–20 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 2004e.

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.

"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 2004e).

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 2003f). 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 2004e).

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 13,261 at the end of 2004, or about 17 percent above the projected level (LANL 2005g), 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 2004e).

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 and in field trailers, 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 2004e).

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; Piñon (*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 2004e).

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 2005j). Additionally, about 8,233 acres (3,332 hectares) of forest have been thinned between 1997 and 2004 to reduce future wildfire potential (LANL 2006). 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 piñon 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. The drought has continued through 2004 (LANL 2005j).

As noted in Section 4.1.1, 2,255 acres (913 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 2004e). This resulted in a reduction in the size of LANL from 27,520 acres (11,137 hectares) at the time of publication of the *1999 SWEIS* to its present size of 25,600 acres (10,360 hectares). Much of the transferred land is in a natural state and falls within the Piñon-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.) (U.S. Army Corps of Engineers 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 2004e, 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 U.S (U.S. Army Corps of Engineers 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 2006).

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 since development has not taken place; however, future development could result in direct loss of wetland structure and function with 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 2004e).

While the Rio Grande and Rito de los Frijoles in Bandelier National Monument are the only truly perennial streams in the region, 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 2004e). 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 4–21**). 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.

> **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.

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 4–21. 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.

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).

Table 4–21 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		
Golden eagle	*Aquila chrysaetos*	Conservation Concern		Has been known to nest in the Los Alamos area, but not found every year

Common Name	Scientific Name	Status [a]		Notes
		Federal	State	
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
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

Common Name	Scientific Name	Status [a]		Notes
		Federal	State	
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 2004e, 2006, NMAC 19.21.2, NMDGF 2004a, 2004b, NMNHP 2004, NMSF 2004, USFWS 2002, 2004a, 2004b.

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 2006).

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 2006). The peregrine falcon, which requires cliffs for nesting, has been found within juniper savannah and piñon-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 piñon-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 piñon-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[1] 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

[1] 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.

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. 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 2003f).

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 2003c, 2006).

As noted above (see Section 4.1.1), 2,255 acres (913 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 2005b). 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 and 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 2004e). Monitoring data for a variety of environmental media are published annually in the site Environmental Surveillance Reports (LANL 2002c, 2004a, 2004c, 2005j).

In 1999, an ecology-based biodiversity evaluation of the site was initiated (Muldavin and Yanoff 1999). The initial study involved developing a protocol to support the *Los Alamos National Laboratory Threatened and Endangered Species Habitat Management Plan* (LANL 1998c) and general long-term biological resources management. Both field assessment and Geographic Information System data were used to evaluate two of the canyons on the site (Cañon de Valle and Mortandad Canyon). Upon completion of the evaluation of the entire site, it is hoped that Biodiversity Conservation Areas in combination with Areas of Environmental Interest can be used to develop sound biological resource management strategies that can serve to protect LANL's biological heritage, while at the same time avoiding conflict with its other mission objectives.

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 risk to the public and workers from all hazards are described in the *1999 SWEIS* (see 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 2002).

Table 4–22 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 1998 through 2002. During that period, the overall cancer incidence (407.4) and death rates (171.2) for the State of New Mexico were somewhat below the national average (461.6 and 197.8, respectively). Total cancer incidence in Los Alamos County (441.3) 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. 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, stomach cancer and thyroid cancer in Los Alamos County were not reported by the National Cancer Institute (NCI 2005).

In a study entitled *Public Health Assessment for 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 2005). 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 was no data to link environmental factors 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 periods, some cancers will occur more frequently and others less frequently than seen in reference populations. Often, the elevated rates are not statistically significant and may be the result of random chance."

Table 4–22 Five Year Profile of Cancer Mortality and Incidence in the U.S., New Mexico and Los Alamos Region, 1998 through 2002

Statistic	*U.S.* [a]	*New Mexico*	*Los Alamos County*	*Santa Fe County*	*Sandoval County*	*Rio Arriba County*
Average Deaths Per Year	551,100	2,894	25	169	134	59
Annual Death Rate (per 100,000)	197.8 (197.6, 198.1)	171.2 (168.4, 174.0)	137.8 (113.9, 167.0)	144.6 (134.9, 154.9)	170.0 (157.3, 183.5)	162.6 144.3, 182.7)
Annual Incidence Rate (per 100,000) [b]						
All sites [c]	461.6 (460.8, 462.5)	407.4 (403.2, 411.7)	441.3 (399.5, 488.1)	461.2 (444.2, 478.6)	445.0 (424.7, 466.0)	381.0 (353.4, 410.3)
Brain and Other Nervous System	6.4 (6.3, 6.5)	5.6 (5.1, 6.1)	NA [d]	7.2 (5.2, 9.7)	4.8 (3.0, 7.5)	NA [d]
Breast (female)	127.2 (126.6, 127.8)	116.6 (113.6, 119.8)	135.4 (105.8, 175.7)	151.8 (139.3, 165.3)	129.1 (114.7, 144.9)	89.0 (71.8, 109.3)
Colon and Rectum	53.1 (52.8, 53.4)	42.3 (40.9, 43.7)	38.4 (27.0, 55.7)	41.0 (36.0, 46.5)	51.9 (45.1, 59.5)	47.7 (38.2, 59.0)
Leukemia	11.5 (11.4, 11.6)	11.8 (11.1, 12.6)	NA	17.4 (14.2, 21.2)	13.6 (10.3, 17.8)	8.7 (5.2, 14.1)
Lung and Bronchus	67.7 (67.4, 68.0)	46.9 (45.4, 48.4)	32.9 (22.1, 49.7)	42.3 (37.2, 48.0)	49.3 (42.6, 56.8)	39.3 (30.6, 49.8)
Melanoma of Skin	15.8 (15.6, 15.9)	16.4 (15.6, 17.3)	24.8 (16.3, 39.3)	21.1 (17.7, 25.0)	18.2 (14.4, 22.7)	8.8 (5.1, 14.4)
Non-Hodgkin's Lymphoma	18.2 (18.0, 18.3)	15.5 (14.7, 16.3)	NA [d]	20.2 (16.8, 24.2)	16.8 (13.0, 21.4)	15.5 (10.2, 22.6)
Ovary	13.4 (13.2, 13.6)	12.6 (11.6, 13.7)	NA [d]	14.6 (10.8, 19.3)	10.5 (6.7, 15.8)	NA [d]
Prostate	161.2 (160.4, 161.9)	146.9 (143.1, 150.8)	225.9 (184.7, 277.7)	188.9 (172.5, 206.7)	143.5 (126.3, 162.7)	160.3 (134.3, 190.6)
Stomach	7.1 (7.0, 7.2)	7.4 (6.9, 8.0)	NA [d]	7.3 (5.3, 10.0)	9.1 (6.4, 12.6)	11.8 (7.3, 18.3)
Thyroid	7.5 (7.4, 7.6)	9.6 (9.0, 10.3)	NA [d]	10.4 (8.1, 13.2)	12.9 (9.7, 16.9)	12.9 (8.3, 19.3)

[a] U.S. incidence rates reported by National Cancer Institute are for 2001, not for the entire 1998 through 2002 rate period.
[b] Age adjusted incidence rates. 95 percent confidence interval in parentheses.
[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 2005.

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. Therefore, the total annual dose from sources other than LANL is approximately 400 to 500 millirem.

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 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 61). These doses are in addition to exposures from natural background, consumer products, and natural resources.

Radiological Dose Assessment (2004)

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 and Compliance Report*.

The *1999 LANL 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 2004* (LANL 2005j).

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),
- The onsite MEI, defined as the member of the public who is on LANL or DOE property, such as Pajarito Road, and
- Residents in the Los Alamos Townsite and White Rock.

The doses from the first two cases above, for the past 11 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.

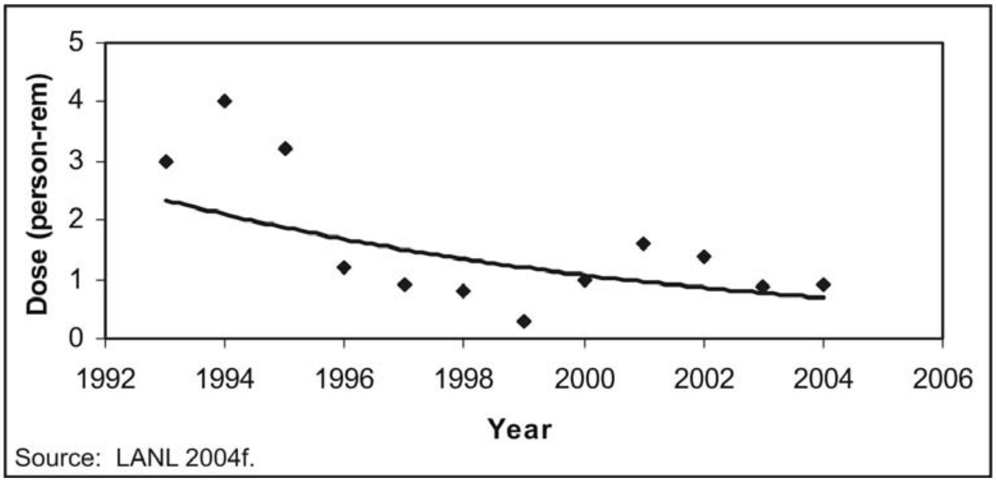


Figure 4–26 Trend of Collective Dose (person-rem) to the Population within 50 Miles (80 kilometers) of Los Alamos National Laboratory

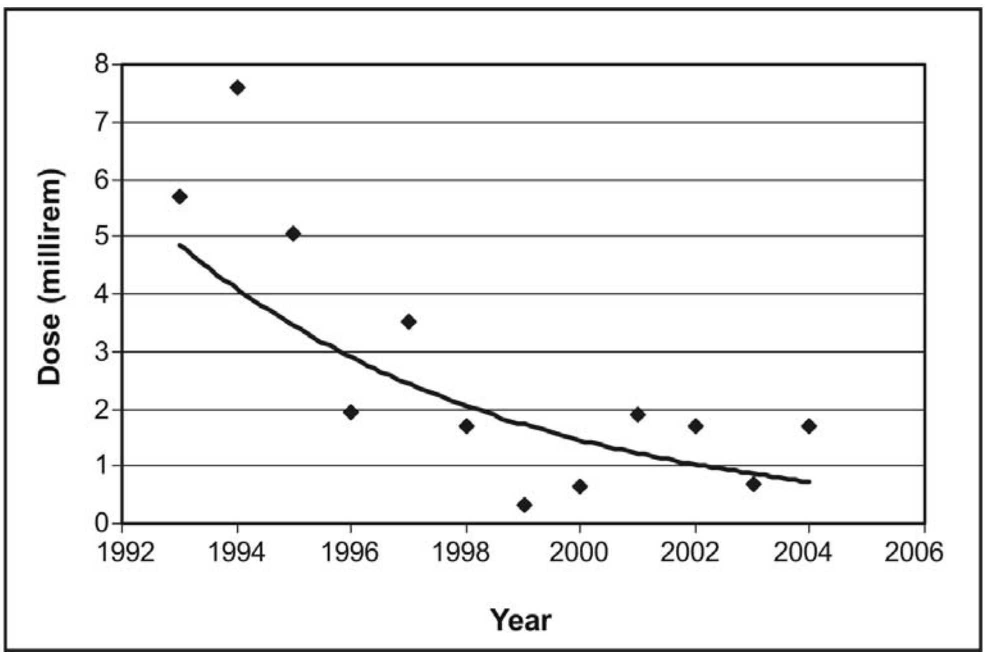


Figure 4–27 Trend of Dose (millirem) to the Maximally Exposed Individual Offsite

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 4–23**. 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.

Table 4–23 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 2004 collective population dose attributable to LANL operations to persons living within 50 miles (80 kilometers) of the site was 0.90 person-rem. Tritium contributed about 45 percent of the dose, and short-lived air activation products such as carbon-11, nitrogen-13, and oxygen-15 from LANSCE contributed about 53 percent.

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 2004, the location was at East Gate along State Road 502 entering 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 2004 was estimated at 1.68 millirem. This includes 1.52 millirem that would come from LANSCE stack emissions, 0.12 millirem from emissions at other LANL stacks, and 0.04 millirem from the radionuclides measured at the AIRNET station. The higher emissions and subsequent dose in 2004 are due to operations requiring higher beam power and increased radioactive gas production occurring in the water used to cool the beam target.

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 would be located on Pajarito Road while passing TA-18. The calculated dose at that location in 2004 adjusted for occupancy rates and natural background radioactivity was 1.79 millirem. Although this road is now restricted from normal public access, members of the public can still access this area as visitors or as contractors providing support services not directly related to site activities.

Doses in Los Alamos Townsite and White Rock

Los Alamos Townsite. During 2004, the measurable contributions to the dose at an average Los Alamos residence were as follows: 0.01 millirem from radionuclides produced at LANSCE and 0.02 millirem from tritium. Other nuclides contribute less than 0.01 millirem. These doses add up to 0.04 millirem.

White Rock. During 2004, the measurable contributions to the dose at an average White Rock residence were as follows: 0.01 millirem from emissions at LANSCE and 0.01 millirem from tritium. Other nuclides each contribute less than 0.01 millirem. These add up to 0.03 millirem.

Water (Ingestion Pathway)

For all radionuclides except uranium, the doses from drinking water are less than 0.1 millirem per year. Natural uranium in the drinking water contributes a dose of about 0.1 millirem per year in Los Alamos County and more in parts of the Rio Grande Valley. Thus the LANL contribution to the drinking water dose is too small to measure and is much less than 0.1 millirem per year (LANL 2005j).

Soil (Direct Exposure Pathway)

The doses from cesium-137 and strontium-90 concentrations in soil are on the order of 0.1 millirem per year, but all, or almost all, are from global fallout and not from LANL. The tritium is mainly from three sources: cosmic rays, nuclear weapons testing, and LANL; however, the total dose from tritium in soil is about 0.01 millirem per year. Similarly, the transuranics (such as plutonium) may include a small contribution from LANL, but the dose is less than 0.01 millirem per year. Finally, the isotopic mixture of uranium is consistent with natural uranium. Therefore, the LANL contribution to dose from soil is too small to measure and is less than 0.1 millirem per year (LANL 2005j).

Food (Ingestion Pathway)

Tritium concentrations near the LANL perimeter are measurably higher than regional concentrations, but the resulting doses from food stuffs grown there are far below 0.1 millirem per year. The concentrations of other radionuclides are either consistent with global fallout or below levels that would result in a dose of 0.1 millirem per year per pound consumed. The LANL contribution to the food dose is therefore too small to measure and is less than 0.1 millirem per year (LANL 2005j). In summary, the total annual dose to an average resident from all pathways is less than 0.1 millirem. This includes doses from inhalation, ingestion of food and water, and direct exposure. No observable health effect is expected from these doses.

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 non-radioactive 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 non-radioactive 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.

In Appendix C (of this *SWEIS*), the diet and other exposure parameters for a Los Alamos County resident, whose living habits and diet result in higher than average exposure to radionuclides and chemicals in the environment; or recreational user of wildlands; and an individual whose diet approximates a substance diet of locally acquired foodstuffs are reviewed and updated. The dose and risk to each of these receptors is assessed using the most recent available environmental surveillance data (through 2004, in most cases). Where appropriate, updated exposure pathway parameters and risk factors are used to estimate the dose and risk from radioactive and non-radioactive contaminants in the environment. The results of these analyses are not much different from those presented in the *1999 SWEIS*. The worst-case individual 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 non-radioactive 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 was identified as having a hazard index near 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 is endemically present in the geology, 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 2002e).

The LANL study considered the possibility that the fire enhanced flooding in watersheds that have residual contamination from early LANL operations (LANL 2002e). 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) were likely to have experienced health effects as a result of exposures to radioactive and non-radioactive 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 April 2005, the ATSDR released (for public comment) a report on their public health assessment of past and present LANL operations (ATSDR 2005). The ATSDR reviewed the 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, 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.

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 2003g).

4.6.2.1 Worker Exposures to Ionizing Radiation

Occupational radiation exposures for workers at LANL from 1999 to 2004 are summarized in **Table 4–24**. The collective Total Effective Dose Equivalent (TEDE) for the LANL workforce during 2004 was 125 person-rem, considerably lower than the workforce dose of 704 person-rem projected in the *1999 SWEIS* ROD (LANL 2005j).

Table 4–25 summarizes the highest individual dose data for 1999 through 2004. The highest individual doses in 2004 were 1.539, 1.510, 1.500, 1.148, and 1.061 rem. There were no doses that exceeded DOE's 5 rem per year Radiation Protection Standard. 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 2005g).

Table 4–24 Radiological Exposures of Los Alamos National Laboratory Workers

Parameter	Units	1999	2000	2001	2002	2003	2004
Collective TEDE (external plus internal)	person-rem	131	196	113	164	241	125
Number of workers with measurable dose	Number	1,427	1,316	1,332	1,696	1,989	1,710
Average measurable dose (external plus internal)	Millirem	92	149	85	96	121	73
Average measurable dose (external only)	Millirem	90	65	83	95	111	68

TEDE = total effective dose equivalent, rem = roentgen equivalent man.
Source: LANL 2003g, 2005g.

Table 4–25 Highest Individual Doses to Los Alamos National Laboratory Workers [a]

1999	2000	2001	2002	2003	2004
1.910	1.048	1.284	2.214	3.0 [b]	1.539
1.866	1.013	1.225	1.897	1.8 [b]	1.510
1.783	0.905	1.123	1.813	1.710	1.500
1.755	0.828	1.002	1.644	1.569	1.148
1.749	0.815	0.934	1.619	1.214	1.061

[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 2005g, NNSA 2003.

The collective TEDE for 2004 is 60 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 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 2005g).

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 non-ionizing radiation are regulated by the U.S. Food and Drug Administration while the Occupational Safety and Health Administration regulates worker exposures. 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 4.3.1.5 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 4–26 summarizes occupational injury and illness rates at LANL from 1996 through 2004. Occupational injury and illness rates for workers in 2004, although higher than 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 2005g).

Table 4–26 Occupational Injury and Illness Rates at Los Alamos National Laboratory [a]

Calendar Year	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*
TRC [b]	5.88	5.55	3.35	2.52	1.97	1.96	2.39	2.30	2.86
DART [c]	3.86	3.45	1.77	1.37	0.94	0.91	1.46	1.26	1.35

[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 2003g, 2005g.

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 followup 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 2006).

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 2003h).

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 2004j, 2004m).

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, 2003g, 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 staff 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 meters) 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 staff and Los Alamos County police, fire, emergency medical, and 911 dispatch are operated 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 staff 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 staff 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.

4.7 Cultural Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulations, and guidelines. In order to fully meet the requirements of these laws, regulations, and guidelines, DOE has recently completed *A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico* (LANL 2005h). This plan has undergone public review and will be fully implemented in 2006 through a programmatic agreement between DOE, the Advisory Council on Historic Preservation, the New Mexico State Historic Preservation Office, and Los Alamos County (DOE et al. 2002). The programmatic agreement establishes various stipulations, such as documentation of historic structures and buildings and the establishment of archaeological preservation districts, which must be met by DOE prior to the conveyance of parcels to Los Alamos County. It further stipulates that a separate Memorandum of Understanding be developed prior to the transfer of any parcel to the Bureau of Indian Affairs to be held in trust for the Pueblo of San Ildefonso.

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, Native American 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 2005h).

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 4–27**. 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 2005h).

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 2005h).

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.

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 2005h).

Table 4–27 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 2005h.

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 2005h).

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 (LANL 2002e). Damage included direct loss, soot staining, spalling, and cracking of stone masonry walls of Ancestral Pueblo fieldhouses and roomblocks, 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 2004e). 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 2005h).

The conveyance and transfer of land to Los Alamos County and the Department of the Interior to be held in trust for the Pueblo of San Ildefonso has resulted in archaeological sites being removed from DOE protection (LANL 2002a). 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 Sun Ildefonso and Santa Clara Pueblos. These easements are being set up with a private conservation trust to provide protection in perpetuity (LANL 2004e, 2004h).

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 2006).

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 2005h).

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 2005h). 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 et al. 2002, LANL 2004e).

As a result of the conveyance and transfer of 2,255 acres (913 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 2006).

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 2006). 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 2005h).

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 staff arrange site visits as may be desired by tribal representatives with San Ildefonso, Santa Clara, Jemez, and Cochiti Pueblos 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 2002a).

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 2002a); 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 2006).

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* – 2004 (LANL 2005g) and other site documents.

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**). Nearly 90 percent of LANL site employees and their families reside in these counties (see **Table 4–28**). Thus, the socioeconomic conditions of these counties have the most potential to be directly or indirectly affected by changes in operations at LANL. In 2004, 12,584 persons in New Mexico were employed at LANL.

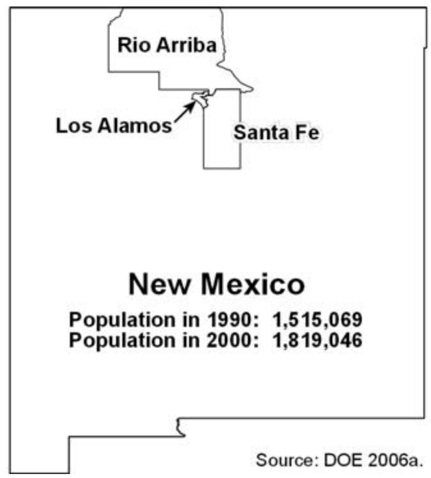


Figure 4–28 Counties in the Los Alamos National Laboratory Region of Influence

Between 2000 and 2004, the civilian labor force in the Tri-County area increased 8.9 percent to the 2004 level of 109,229. In 2004, the annual unemployment average in the region of influence was 4.6 percent, which was smaller than the annual unemployment average of 5.7 percent for New Mexico (NMDOL 2005a).

Table 4–28 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
Average 1996 to 2004	12,430	11,028	88.7	95,291	11.6

ROI = Region of Influence.
Sources: NMDOL 2005a; LANL 2003g, 2004h, 2005g.

In 2004, direct government employment represented the largest sector of employment in the Tri-County area (29.1 percent), followed by trade, utilities, and transportation activities (15.2 percent) and leisure and hospitality (12.7 percent). The totals for these employment categories in New Mexico were 25.1 percent, 17.4 percent, and 10.5 percent, respectively (NMDOL 2005b).

4.8.1.2 Demographic Characteristics

The 2000 demographic profile of the region of influence population and income information is included in **Table 4–29**. 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).

Table 4–29 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 2006a.

4.8.1.3 Regional Income

Income information for the LANL region of influence is included in **Table 4–30**. 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 2003 of $32,468 and a per capita income of $20,720 and Los Alamos County at the upper end with a medial household income of $93,089 and a per capita income of $48,451. 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 2003, only 3.0 percent of the population in Los Alamos County was below the official poverty level compared with 17.9 percent of the population of Rio Arriba County.

Table 4–30 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 2003 (dollars)	93,089	32,468	42,950	35,091
Per capita income 2003 (dollars)	48,451	20,720	32,378	24,995
Percent of persons below poverty line (2003)	3.0	17.9	12.3	17.7

Source: DOC 2006c, 2006d.

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 4–31**). From 1997 through 2004, the number of employees exceeded *1999 SWEIS* ROD projections. The 13,261 employees at the end of 2004 were 1,910 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 2003g).

Table 4–31 Los Alamos National Laboratory-Affiliated Work Force

SWEIS ROD [a]	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*
11,351	11,155	11,496	12,008	12,412	12,015	12,380	13,524	13,616	13,261

[a] 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.

Source: LANL 2003g, 2004h, 2005g.

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 2004h).

4.8.1.5 Housing

Table 4–32 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 have likely decreased.

Table 4–32 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.

The residential distribution of management and operating contractor employees reflects the overall housing market dynamics of the three counties. In 2004, over 88 percent of management and operating contractor employees continued to reside in the Tri-County area as shown in **Table 4–33**.

Table 4–33 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

Source: LANL 2003g, 2004h, 2005g.

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 4–34 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 4–34 General Funds Revenues in the Tri-County Region (Fiscal Year 2003)

Source	*Los Alamos County (FY 2003 $)*	*Rio Arriba County (FY 2003 $)*	*Santa Fe County (FY 2003 $)*
Property Taxes	4,298,335	3,825,225	25,331,255
Gross Receipt Taxes	16,541,971	2,094,991	9,271,503
Oil, Gas and Mineral Taxes	Not available	7,256,598	0
Other Taxes, Penalties and Interest	428,236	364,856	1,282,287
Licenses, Permits, Fees and Service Charges	63,719,827	614,051	598,601
Misc. Income	56,244,216	3,536,397	16,905,470
Restricted Funds	Not available	5,146,384	16,928,997
Total Receipts	141,232,585	22,838,502	70,318,113

FY = fiscal year.
Source: LANL 2004e.

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 2006).

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).

Three hospitals serve the Tri-County region: Los Alamos Medical Center, Española Hospital, and St. Vincent Regional Medical Center in Santa Fe. These hospitals have a bed capacity of 47, 80, and 268, respectively (LAMC 2006, Presbyterian 2006, St. Vincent 2006).

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 2003f, LANL 2005g). 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 2004e, 2005g). 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).

Within LANL, DOE also operates a natural gas-fired steam and electrical power generating plant at TA-3 (TA-3 Co-Generation Complex), 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 2004e; LANL 2005k). 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 2004e, 2005g).

The trends in peak electric load demand and total electrical energy consumption within the Los Alamos Power Pool are provided in **Table 4–35** and **Table 4–36**, respectively. Annual (fiscal year) observed peak load and total energy requirements for the period 1999 through 2004 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 EIS.

Table 4–35 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	43,976	68,486	14,399	82,885
2000	45,104	45,104	65,447	15,176	80,623
2001	50,146	50,146	70,878	14,583	85,461
2002	45,809	20.938	66,747	16,653	83,400
2003	50,008	20,859	70,687	16,910	87,597
2004	47,608	21,811	69,419	16,231	85,650

LANSCE = Los Alamos Neutron Science Center.
[a] Projections from the *1999 SWEIS* for the Expanded Operations Alternative.
Note: All values are in kilowatts. To convert kilowatts to megawatts, divide by 1,000.
Sources: DOE 1999a; LANL 2004e, 2005g.

Table 4–36 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

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 2004e, 2005g.

Electrical energy use at LANL remains below projections in the *1999 SWEIS*. Peak demand was projected to be 113,000 kilowatts with 63,000 kilowatts being used by LANSCE and about 50,000 kilowatts 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 2005g).

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 from 2003 to 2004 within the generally upward trend in total electricity demand (see Table 4–36).

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 may continue through fiscal year 2006. 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. 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 was operational in 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. The second axis became operational in late fiscal year 2004 adding about 2 megawatts of load (LANL 2005g).

Overall, in 2004 the total peak load was about 69.4 megawatts for LANL and about 16.2 megawatts for the rest of the Power Pool users (see Table 4–35). A total of 413,392 megawatt-hours of electricity were used at LANL in 2004. Other Los Alamos County users consumed an additional 127,429 megawatt-hours for a Power Pool total electric energy consumption of 540,821 megawatt hours (see Table 4–36). Over the period 1999 to 2004, total maximum peak load demand occurred in 2003 when LANL and other Los Alamos County users required 58 percent of the Power Pool's capacity. Total maximum electric energy demand occurred in 2004 when 41 percent of the 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 40 megawatts (350,400 megawatt-hours) is available via the upgraded TA-03 Co-Generation Complex for a power pool total electric energy availability of 1,314,000 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 2005g). 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 2004e).

To address such situations, the new transmission line 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 would be constructed at 345 kilovolts but operated in the short term at 115 kilovolts, as large pulse power loads at LANL would need the higher voltage in the future. The second segment would be constructed and operated at 115 kilovolts (LANL 2005g). Construction of the portion of the new transmission line from the Southern TA Substation to the Western TA Substation has begun and should be finished by March 2006, along with the uncrossing of the two existing transmission lines. Construction of the new Southern TA switchyard is expected to be finished around August 2006, and the entire project should become operational at that time. The construction of the portion of the line from the Norton Substation to the Southern TA Substation is still being negotiated (LANL 2005g, 2006).

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. Actual project start is scheduled for June 2006 with construction scheduled to be completed in late 2007 (LANL 2006).

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 greater than 15 megawatts (LANL 2005g). These improvements will increase the overall output of the facility to more than 20 megawatts in the short term. Modification of the steam path has been completed, and rewinding of the Number 3 steam turbine should be finished and the unit reinstalled in the May 2006 timeframe. In addition, construction has begun to install the first of two possible new gas-fired combustion turbine generator at the TA-3 Co-Generation Complex. This new 20-megawatt unit is scheduled to be operational in June 2006. At present, DOE has no timetable for installing a second new unit; the second unit was proposed for reliability purposes only (LANL 2006).

Also, as part of ongoing electric reliability upgrades at LANL, a conceptual design report for the Electrical Infrastructure and Safety Upgrades 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 Upgrade Project has been coordinated with the *Ten-Year*

Comprehensive Site Plan, 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 2005, 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), and four projects were scheduled for design (TA-46-1, TA-53-2, TA-48-1, TA-35-2) in the next fiscal year (LANL 2005g, 2006).

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 2003g). 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 2005g). 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 2005g). 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 2003e). 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-03 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 2003e). As mentioned above, relatively small quantities of fuel oil are also stored at LANL as a backup fuel source for emergency generators, and use is therefore negligible.

The trends in natural gas consumption for the Los Alamos service area and associated steam production at LANL are provided in **Table 4–37** and **Table 4–38**, respectively. Annual (fiscal year) recorded natural gas consumption for the period 1999 through 2004 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 million cubic meters]). As shown in Tables 4–37 and 4–38, 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 2004, total LANL natural gas consumption was 1,149,936 decatherms (equivalent to about 1.15 billion cubic feet [32.6 million cubic meters]) and total steam production was 371,020 thousand pounds. For fiscal year 2004, natural gas consumption for electricity generation was again the lowest since issuance of the *1999 SWEIS*.

Table 4–37 Trend in Natural Gas Consumption for Los Alamos National Laboratory and Los Alamos County

Fiscal Year	*Natural Gas*			*Los Alamos County Consumption*	*Total Los Alamos Area Consumption*
	Total LANL Consumption	*Total Used for Electric Production*	*Total Used for Heat Production*		
1999 SWEIS [a]	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

[a] Projection from the *1999 SWEIS* for the Expanded Operations Alternative (DOE 1999a).
Note: Natural gas 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; DOE 1999a; LANL 2004e, 2005g.

Table 4–38 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

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.
Source: LANL 2004e, 2005g.

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 4–37). In 2004, other Los Alamos County users consumed 931,940 decatherms (equivalent to about 932 million cubic feet [26.4 million cubic meters]) as compared to 870,402 decatherms (870 million cubic feet [24.6 million cubic meters]) in 2000. For 2004, total natural gas usage for the Los Alamos service area was 2,081,876 decatherms (equivalent to about 2.08 billion cubic feet [59 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 2003g).

As for the electrical transmission and distribution system (see Section 4.8.2.1), the *1999 SWEIS* noted 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 State Route 502 in TA-72 (DOE 2002g, NNSA 2005b). Construction of the pipeline was completed in late 2005 with tie-in to the existing transmission system expected in the spring of 2006 (LANL 2006).

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 2004e, DOE 2003g).

On September 8, 1998, DOE transferred operation of the system from DOE to Los Alamos County under a lease agreement. Under the 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 lease agreement (DOE 2003g, LANL 2005g).

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. Los Alamos County continues to pursue the use of San Juan-Chama water as a means of preserving those water rights (DOE 2003g, LANL 2005g). 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. Los Alamos County is in the process of converting its water contract with the Bureau of Reclamation from a purchase to a repayment form of contract which in part is preferable because it has no expiration date. This process must be completed before the County can move forward with additional investment in the project. Negotiations have been completed and the contract conversion is expected to be completed in 2006 (LAC 2004d, Glasco 2005).

LANL is now considered a Los Alamos County water customer, and the County bills LANL for water used. 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 2005g). 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 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 2005g).

The trend in water use for LANL and other Los Alamos County users is shown in **Table 4–39**. Annual (fiscal year) observed water demand for the period 1999 through 2004 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 2004, approximately 346.6 million gallons (1,312 million liters) of water were used at LANL. This was about 412 million gallons (1.56 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 2006). 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 2005j). Current water use at LANL compared to the calculated NPDES discharge of 162.5 million gallons (615 million liters) in 2004 indicates that the site's consumptive water use is about 47 percent (LANL 2005g). 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 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).

Table 4–39 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

[a] Water data are routinely collected and summarized by calendar year, rather than by fiscal year, as 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: DOE 1999a; Glasco 2005, LANL 2004e, 2005g.

While LANL total and consumptive water use has generally decreased from 1999 to 2004, 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. 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 (LANL 2005g). DOE has instituted a number of conservation and gray-water[2]-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.

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, decommissioning, demolition and decontamination 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 characteristics; regulatory status; applicable treatment and disposal standards; and final disposition of the waste (LANL 2004h).

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 2003d)

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 2004p). 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)

[2] Generally treated or untreated that is not suitable for drinking but can be used for secondary purposes such as industrial cooling.

- 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 2004p). 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 by DOE is reported annually in the site environmental surveillance reports (for example, LANL 2005j).

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 2001d, 2002c, 2004a, 2004c). 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 1999c).

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 2004, the High Explosives Wastewater Treatment Facility discharged about 35,000 gallons (130,000 liters) to an outfall, compared to the *1999 SWEIS* projection of 170,000 gallons (644,000 liters) (LANL 2005g).

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 2003g).

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 2004 from LANL outfalls have fallen within *1999 SWEIS* projections (LANL 2003g, 2004h, 2005g).

4.9.2 Solid Waste

Sanitary solid waste is excess material that is not radioactive or hazardous and can be disposed in a solid waste landfill. Solid waste generated at LANL is disposed 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 2004p). The per capita generation of routine solid waste (for example food, paper, plastic) at LANL has decreased by about 58 percent over the 10-year period from 1993 through 2003 (LANL 2004h). Nonroutine solid waste is generated by construction and demolition projects, and also includes waste generated by Cerro Grande Rehabilitation Project cleanup activities. Rates for the recycled portion of sanitary waste have steadily increased from about 10 percent in 1993 to about 67 percent in 2004 (LANL 2005g).

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 by the end of 2006; extended use through 2007 is possible if a Closure Plan modification is approved by the NMED (LAC 2005a). 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 in a municipal landfill or a construction and demolition debris landfill (NMED 1995). 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 2003, approximately 89 percent of the uncontaminated construction and demolition waste was recycled, and those rates are expected to continue (LANL 2004h). The total amount of construction waste generated in 2004 decreased by 33 percent from 2003 (LANL 2005g)

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 2004h).

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 2004i).

Table 4–40 presents a summary, by waste type, of radioactive and chemical waste quantities generated from 1999 through 2004. The quantities include contributions across LANL, including Key Facilities, Non-Key Facilities and the LANL environmental restoration project. Projections from the ROD for the *1999 SWEIS* are included for comparison.

Table 4–40 Los Alamos National Laboratory Waste Types and Generation

Waste Type	*Units*	*1999 SWEIS ROD Projection*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*
Low-Level Radioactive Waste	cubic yards per year	16,000	2,190	5,530	3,400	9,560	7,640	19,400
Mixed Low-Level Radioactive Waste	cubic yards per year	830	30	780	80	30	50	50
Transuranic Waste	cubic yards per year	440	190	160	150	160	530	50
Mixed Transuranic Waste	cubic yards per year	150	110	120	60	110	210	30
Chemical Waste	10^3 pounds per year	7,160	34,000	61,000	60,800	3,820	1,520	2,460

ROD = Record of Decision.
Note: To convert cubic yards to cubic meters, multiply by 0.76456; pounds to kilograms, multiply by 0.4536.
Source: LANL 2003g, 2004h, 2005g.

Site-wide waste quantities for the 6-year period from 1999 through 2004 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.

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 2004p). 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 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 6-year period are shown in **Table 4–41**. Contributions from Non-Key Facilities exceeded *1999 SWEIS* projections for several years, primarily due to heightened operational activities and new construction (LANL 2004h, LANL 2005g). 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 five years of the six-year period. In 2004, the *1999 SWEIS* projection was exceeded due to heightened activities and new construction at Non-Key Facilities (LANL 2005g).

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 2004p).

The facility-specific mixed low-level radioactive waste generation rates for the 6-year period are shown in **Table 4–42**. 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 2004h). Overall LANL mixed low-level radioactive waste generation was below the *1999 SWEIS* projections for each year of the six-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 2004p).

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 2004p).

Table 4–41 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]
Chemistry and Metallurgy Research Building	2,380	240	345	586	509	553	175
Sigma Complex	1,256	80	68	< 1	264	162	< 1
Machine Shops	793	53	535	29	58	20	20
Materials Science Laboratory	0	0	0	0	0	0	0
High-Explosives Processing	21	11	4	1	11	37	0
High-Explosives Testing	1,229	< 1	< 1	0	0	0	114
Tritium Facilities	628	62	64	0	118	143	33
Pajarito Site	190	41	18	17	0	13	0
Target Fabrication Facility	13	0	0	< 1	< 1	0	0
Biological Sciences	45	18	0	0	0	0	4
Radiochemistry Laboratory	353	52	75	72	45	102	23
Radioactive Liquid Waste Treatment Facility	209	229	173	676 [d]	252	510 [e]	464 [f]
Los Alamos Neutron Science Center	1,419	92	37	< 1	0	92	3
Solid Radioactive and Chemical Waste Facilities	228	28	17	18	46	267	54
Plutonium Facilities	986[g]	451	260	392	388	513	247
Total low-level radioactive waste for Key Facilities	9,750	1,358	1,597	1,794	1,692	2,412	1,138
Non-Key Facilities	680	458	3,637 [h]	744	698	4,948 [i]	18,262[j]
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
Percentage of Total from Key Facilities	**94**	**75**	**44**	**71**	**71**	**33**	**6**
Environmental Restoration	5,572	374	296	812	7,173	283	1
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
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
Percentage of Total from Key Facilities	**61**	**62**	**29**	**54**	**18**	**32**	**6**

ROD = Record of Decision.
[a] LANL 2003g.
[b] LANL 2004h.
[c] LANL 2005g.
[d] Amount includes approximately 497 cubic yards of water transferred to TA-53, due to high tritium content (LANL 2003g).
[e] *1999 SWEIS* ROD projection exceeded due in part to the removal of sludge from the concrete storage tank in WM-2 (LANL 2004h).
[f] *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 effluent tanks (LANL 2005g).
[g] Includes estimates of waste generated from the facility upgrades associated with pit fabrication. LANL 2003g.
[h] Amount includes waste generated from decontamination and demolition activities and from soil and sediment removal in Mortandad and Los Alamos Canyons (LANL 2003g).
[i] *1999 SWEIS* ROD projection exceeded due to heightened activities and new construction (LANL 2004h).
[j] *1999 SWEIS* ROD projection exceeded due to heightened activities and new construction (LANL 2005g).
Note: To convert cubic yards to cubic meters, multiply by 0.76456.

Table 4–42 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]
Chemistry and Metallurgy Research Building	25	< 1	< 1	< 1	1	6	< 1
Sigma Complex	5	< 1	0	2	0	0	7
Machine Shops	0	0	< 1	< 1	0	0	0
Materials Science Laboratory	0	< 1	0	0	0	0	0
High-Explosives Processing	0.3	0	0	0	0	0	0
High-Explosives Testing	1	0	0	0	0	0	25 [d]
Tritium Facilities	4	0	0	< 1	1	2	< 1
Pajarito Site	2	10 [e]	0	0	0	0	0
Target Fabrication Facility	0.5	0	0	0	0	0	< 1
Biological Sciences	4	< 1	0	0	0	0	0
Radiochemistry Laboratory	5	< 1	2	4	3	8	2
Radioactive Liquid Waste Treatment Facility	0	4[f]	3[f]	3[f]	5 [f]	0	< 1
Los Alamos Neutron Science Center	1	< 1	6	< 1	1	< 1	0
Solid Radioactive and Chemical Waste Facilities	5	0	0	0	0	0	0
Plutonium Facilities	17 [g]	5	2	17	4	5	2
Total mixed low-level radioactive waste for Key Facilities	70	25	15	30	15	22	40
Non-Key Facilities	39	3	13	12	11	26	13
Total mixed low-level radioactive waste for Key and Non-Key Facilities	109	28	28	42	26	48	53
Percentage of Total from Key Facilities	**65**	**89**	**52**	**71**	**58**	**45**	**75**
Environmental Restoration	717	2	755[h]	38	0	0	0
Total mixed low-level radioactive waste for Non-Key Facilities and Environmental Restoration	756	5	768	50	11	26	13
Total mixed low-level radioactive waste = Key + Non-Key Facilities and Environmental Restoration	826	30	783	80	26	48	53
Percentage of Total from Key Facilities	**9**	**83**	**2**	**38**	**58**	**45**	**75**

ROD = Record of Decision.
[a] LANL 2003g.
[b] LANL 2004h.
[c] LANL 2005g.
[d] Amount consisted mostly of lead bricks and shielding, contaminated with beryllium and depleted uranium (LANL 2005g).
[e] *1999 SWEIS* ROD projection exceeded due to maintenance activities (LANL 2003g).
[f] *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 2003g).
[g] Includes estimates of waste generated from the facility upgrades associated with pit fabrication (LANL 2003g).
[h] Amount includes 751 cubic yards of waste generated as the result of emergency cleanups following the Cerro Grande Fire (LANL 2003g).
Note: To convert cubic yards to cubic meters, multiply by 0.76456.

The facility-specific transuranic waste generation rates for the 6-year period are shown in **Table 4–43.** Non-Key Facilities exceeded *1999 SWEIS* projections for the years 2000 through 2004; these exceedances are all attributable to the Offsite Source Recovery Program (LANL 2003g, LANL 2004h, LANL 2005g). Overall transuranic waste generation at LANL was well below the *1999 SWEIS* projections for 5 years of the 6-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 Offsite Source Recovery Program (LANL 2004h).

Table 4–43 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]
Chemistry and Metallurgy Research Building	37 [d]	12	32	61 [e]	13	10	6
Sigma Complex	0	0	0	0	0	0	0
Machine Shops	0	0	0	0	0	0	0
Materials Science Laboratory	0	0	0	0	0	0	0
High-Explosives Processing	0	0	0	0	0	0	0
High-Explosives Testing (listed as transuranic/Mixed transuranic)	0.3	0	0	0	0	0	0
Tritium Facilities	0	0	0	0	0	0	0
Pajarito Site	0	0	0	0	0	0	0
Target Fabrication Facility	0	0	0	0	0	0	0
Biological Sciences	0	0	0	0	0	0	0
Radiochemistry Laboratory	0	0	0	0	0	2	< 1
Radioactive Liquid Waste Treatment Facility	39	0	21	< 1	3	0	0
Los Alamos Neutron Science Center	0	0	0	0	0	0	0
Solid Radioactive and Chemical Waste Facilities	35	52	35	13	39	115 [f]	0
Plutonium Facilities	310 [d]	123	71	47	53	283	18
Total transuranic Waste for Key Facilities	421	187	159	122	108	410	25
Non-Key Facilities	0	0	4	32	48 [g]	118 [g]	28[h]
Total transuranic Waste for Key and Non-Key Facilities	421	187	163	154	156	528	53
Percentage of Total from Key Facilities	**100**	**100**	**98**	**79**	**69**	**78**	**47**
Environmental Restoration	14	0	0	0	0	0	0
Total transuranic Waste for Non-Key Facilities and Environmental Restoration	14	0	4	32	48	118	28
Total transuranic = Key + Non-Key Facilities and Environmental Restoration	436	187	163	154	156	528	53
Percentage of Total from Key Facilities	**97**	**100**	**98**	**79**	**69**	**78**	**47**

ROD = Record of Decision.
[a] LANL 2003g.
[b] LANL 2004h.
[c] LANL 2005g.
[d] *1999 SWEIS* projections modified to reflect the ROD determination to produce nominally 20 pits per year (LANL 2003g).
[e] *1999 SWEIS* ROD projection exceeded due to remodeling activities (LANL 2003g).
[f] *1999 SWEIS* ROD projection exceeded due to Decontamination and Volume Reduction System repackaging of legacy transuranic waste (LANL 2004h).
[g] Waste generated by the Offsite Source Recovery Program. Because this waste comes from shipping and receiving, it is attributed to Non-Key Facilities (LANL 2004h).
[h] *1999 SWEIS* ROD projection exceeded due to wastes received by the Offsite Source Recovery Program (LANL 2005g).
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 2004p).

The facility-specific mixed transuranic waste generation rates for the 6-year period are shown in **Table 4–44**. 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 2003g, LANL 2004h, LANL 2005g). 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 2004h). 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 2005g). Overall mixed transuranic waste generation at LANL was well below the *1999 SWEIS* projections for five years of the six-year period. In 2003, mixed transuranic waste quantities exceeded the *1999 SWEIS* projection due to repackaging of legacy waste for shipment to WIPP (LANL 2004h).

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 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 2005g). 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 2004p).

Table 4–44 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]
Chemistry and Metallurgy Research Building	17 [d]	3	1	1	22 [e]	15	< 1
Sigma Complex	0	0	0	0	0	0	0
Machine Shops	0	0	0	0	0	0	0
Materials Science Laboratory	0	0	0	0	0	0	0
High-Explosives Processing	0	0	0	0	0	0	0
High-Explosives Testing (Listed as transuranic/Mixed transuranic)	0.3	0	0	0	0	0	0
Tritium Facilities	0	0	0	0	0	0	0
Pajarito Site	0	0	0	0	0	0	0
Target Fabrication Facility	0	0	0	0	0	0	0
Biological Sciences	0	0	0	0	0	0	0
Radiochemistry Laboratory	0	0	0	0	0	0	0
Radioactive Liquid Waste Treatment Facility	0	6	0	6	< 1	4	0
Los Alamos Neutron Science Center	0	0	0	0	0	0	0
Solid Radioactive and Chemical Waste Facilities	0	0	10	17	20	77 [f]	< 1
Plutonium Facilities	133 [d]	86	22	39	72	102	31
Total of Mixed transuranic for Key Facilities	150	95	33	63	115	198	33
Non-Key Facilities	0	20	82	0	< 1	8 [g]	0
Total Mixed transuranic Waste for Key and Non-Key Facilities	150	114	116	63	114	206	31
Percentage Total from Key Facilities	**100**	**83**	**29**	**100**	**99**	**96**	**100**
Environmental Restoration	0	0	0	< 1	0	0	0
Total of Mixed transuranic Waste for Non-Key Facilities and Environmental Restoration	0	20	82	< 1	< 1	8	0
Total Mixed transuranic = Key + Non-Key Facilities and Environmental Restoration	150	115	115	63	116	206	33
Percentage of Total from Key Facilities	**100**	**83**	**29**	**99**	**99**	**96**	**100**

ROD = Record of Decision.
[a] LANL 2003g.
[b] LANL 2004h.
[c] LANL 2005g.
[d] *1999 SWEIS* projections modified to reflect the ROD determination to produce nominally 20 pits per year (LANL 2003g).
[e] *1999 SWEIS* ROD projection exceeded due to remodeling activities (LANL 2003g).
[f] *1999 SWEIS* ROD projection exceeded due to Decontamination and Volume Reduction System repackaging of legacy transuranic waste (LANL 2004h).
[g] Waste generated by the Offsite Source Recovery Program. Because this waste comes from shipping and receiving, it is attributed to Non-Key Facilities (LANL 2004h).
Note: To convert cubic yards to cubic meters, multiply by 0.76456.

The facility-specific chemical waste generation rates for the 6-year period are shown in **Table 4–45**. 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-03, and MDA R (LANL 2003g). Wastes generated by the environmental restoration project 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 4–45.

Table 4–45 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]
CMR Building	23,800	10,640	4,050	1,490	1,560	3,640	3,890
Sigma Complex	22,050	7,070	8,100	2,790	71,420 [d]	1,940	86,620[e]
Machine Shops	1,045,000	8,720	1,960	58,370	4,460	340	910
MSL	1,320	340	1,940 [f]	560	330	430	450
High-Explosives Processing	28,700	29,400	2,277,300 [g]	827,300 [h]	33,300 [i]	53,400 [j]	16,100
High-Explosives Testing	77,800	2,240	133,240 [k]	2,950	2,830	2,330	30
Tritium Facilities	3,750	70	20	5,770 [l]	11,390 [m]	90	20
Pajarito Site	8,820	3,760	280	200	180	60	60
Target Fabrication Facility	8,380	1,310	2,340	1,470	1,990	2,890	1,840
Biological Sciences	28,660	3,730	5,230	3,000	9,930	6,330	1,540
Radiochemistry Laboratory	7,280	3,340	27,470 [n]	39,080 [o]	410,350 [p]	10,710 [q]	68,100 [r]
Radioactive Liquid Waste Treatment Facility	4,850	440	850	151,700 [s]	2,520	150	210
Los Alamos Neutron Science Center	36,600	24,400	2,660	8,940	4,410	15,240	214,520 [t]
Solid Radioactive and Chemical Waste Facilities	2,030	70	1,780	990	1,900	1,800	2,640 [u]
Plutonium Facilities	18,500	5,600	3,450	25,800 [v]	31,400 [w]	42,670 [x]	17,200
Total Chemical Waste for Key Facilities	1,317,540	101,130	2,470,670	1,130,410	587,970	142,020	414,130
Non-Key Facilities	1,435,000	1,687,400 [y]	810,800	2,766,100 [z]	737,100	1,377,500	2,047,100 [aa]
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
Percentage of Total from Key Facilities	**48**	**6**	**75**	**29**	**44**	**9**	**17**
Environmental Restoration	4,409,200	32,252,800 [bb]	57,728,200 [cc]	63,526,800 [cc]	2,497,300	70	160
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	1,377,570	2,047,260

Facility	***SWEIS ROD***	***1999*** [a]	***2000*** [a]	***2001*** [a]	***2002*** [a]	***2003*** [b]	***2004*** [c]
Total Waste = Key + Non-Key Facilities and Environmental Restoration	7,161,740	34,041,330	61,009,670	67,423,310	3,822,370	1,519,590	2,461,390
Percentage of Total from Key Facilities	**18**	**< 1**	**4**	**2**	**15**	**9**	**17**

CMR = Chemistry and Metallurgy Research, MSL = Materials Science Laboratory, ROD = Record of Decision.
[a] LANL 2003g.
[b] LANL 2004h.
[c] LANL 2005g.
[d] Amount includes a significant quantity of waste generated by structure rehabilitation and equipment disposal associated with bringing the Press Building back on-line (LANL 2003g).
[e] *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 2005g).
[f] *1999 SWEIS* ROD projection exceeded due to remodeling of a C-Wing laboratory (LANL 2003g).
[g] Cleanup of MDA R generated 2,225,932 pounds of waste (LANL 2003g).
[h] Cleanup of MDA R generated 815,975 pounds of waste (LANL 2003g).
[i] *1999 SWEIS* ROD projection exceeded due to wastes disposed through chemical cleanout initiative (LANL 2003g).
[j] *1999 SWEIS* ROD projection exceeded due to the demolition of Buildings TA-16-220, -222, -223, -224, -225, and -226 (LANL 2003g).
[k] *1999 SWEIS* ROD projection exceeded due to cleanup following the Cerro Grande Fire (LANL 2003g).
[l] Amount includes 5,181 pounds generated by refrigerant replacement at TA-16-450 (LANL 2003g).
[m] Amount includes 8,818 pounds generated by refrigerant replacement at TA-16-450 (LANL 2003g).
[n] Amount includes 24,160 pounds of construction and demolition debris generated during cleanup following the Cerro Grande Fire (LANL 2003g).
[o] Amount includes 19,535 pounds of waste generated through chemical cleanout initiative (LANL 2003g).
[p] Amount includes 403,204 pounds of contaminated soil excavated during a construction project outside TA-48-1 (LANL 2003g).
[q] Amount includes waste generated through chemical cleanout initiative and the recycling of two mercury-containing shields weighing a total of 8,000 pounds (LANL 2004h).
[r] Amount includes waste generated through chemical cleanout initiative and disposal of mercury shielding as part of the facility radiological status downgrade effort (LANL 2005g).
[s] Amount includes 151,200 pounds of waste (soil and asphalt) generated as a result of replacement of storage tanks and plumbing (LANL 2003g).
[t] 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.
[u] *1999 SWEIS* ROD projection exceeded due to the Decontamination and Volume Reduction System repackaging of legacy transuranic waste (LANL 2005g).
[v] Amount includes 23,001 pounds of contaminated soil and debris from the replacement of hydraulic cylinders at the front gate (LANL 2003g).
[w] Amount includes oil-contaminated soil generated when a transformer was dropped during relocation (LANL 2003g).
[x] 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 2004h).
[y] *1999 SWEIS* ROD projection exceeded due to environmental restoration cleanups (LANL 2000f).
[z] Amount includes 161,926 pounds of construction and demolition debris resulting from cleanup following the Cerro Grande Fire (LANL 2003g).
[aa] *1999 SWEIS* ROD projection exceeded due to heightened activities and new construction (LANL 2005g).
[bb] *1999 SWEIS* ROD projection exceeded due to soils excavated during remediation of MDA P (LANL 2003g).
[cc] Amount includes industrial and other chemical waste resulting from the cleanup following the Cerro Grande Fire (LANL 2003g).
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 6-year period are shown in **Table 4–46**. 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 6-year period of 1999 through 2004, all annual effluent quantities from the Radioactive Liquid Waste Treatment Facility were well within the *1999 SWEIS* projection. Source reduction efforts and internal recycling were the primary contributors to reduced waste quantities (LANL 2004h, 2005g).

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 6-year period.

Table 4–46 Radioactive Liquid Waste Treated at Los Alamos National Laboratory

Facility	*SWEIS ROD*	*1999* [a]	*2000* [a]	*2001* [a]	*2002* [a]	*2003* [b]	*2004*
Pretreatment of radioactive liquid waste at TA-21	237,800 gallons/year	11,900 gallons	11,900 gallons	120,700 gallons	8,000 gallons	6,510 gallons	0
Percentage of SWEIS projection of pretreatment at TA-21	–	5	5	51	3	3	0
Pretreatment of radioactive liquid waste from TA-55	21,100 gallons/year	Less than 21,100 gallons	2,380 gallons	5,810 gallons	9,350 gallons	13,700 gallons	13,700 gallons
Percentage of SWEIS projection of pretreatment from TA-55	–	Less than 100	10	30	40	70	70
Solidification of transuranic (transuranic) sludge at TA-50	4 cubic yards/ year	7 cubic yards	7 cubic yards	None	None	4 cubic yards	0
Percentage of SWEIS projection of solidification of transuranic sludge	–	170	170	0	0	100	0
Radioactive liquid waste treated at TA-50	9,246,000 gallons/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
Percentage of SWEIS projection of radioactive liquid waste treated at TA-50	–	57	54	40	33	39	23
De-water low-level radioactive waste sludge at TA-50	13 cubic yards/ year	48 cubic yards	63 cubic yards	79 cubic yards	13 cubic yards	38 cubic yards	18 cubic yards

Facility	*SWEIS ROD*	*1999* [a]	*2000* [a]	*2001* [a]	*2002* [a]	*2003* [b]	*2004*
Percentage of SWEIS projection of low-level radioactive waste sludge de-watered at TA-50	–	370	480	600	100	290	137
Radioactive liquid waste treated at TA-53	Not projected	(c)	(c)	(c)	64,200 gallons	103,900 [d] gallons	88,800 [e] gallons
Percentage of SWEIS projection of radioactive liquid waste treated at TA-53	NA	NA	NA	NA	NA	NA	NA

ROD = Record of Decision, TA = technical area, NA = not available.
[a] LANL 2003g.
[b] LANL 2004h.
[c] Flows into the TA-53 surface impoundments started in 2000, but were first reported in the 2002 *Yearbook* (LANL 2003g).
[d] LANL 2004e.
[e] LANL 2006.
Note: To convert gallons to liters, multiply by 3.7853; cubic yards to cubic meters, multiply by 0.76456.

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 State Highway and Transportation Department. 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 4–47** shows the pick up and drop off locations that are included among those currently serviced by this public transportation service. Typical weekday ridership for the two park and ride routes serving Los Alamos are shown in **Table 4–48**.

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 4–47 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 State Highway and Transportation Department property.
Española
ESPANOLA – 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 4–48 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 4–49**.

Table 4–49 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 State Route 4	4,984
East Jemez Road at State Route 4	9,502
West Jemez Road at State Route 4	2,010
DP Road at Trinity Drive	1,255
Total	42,296

Source: KSL 2004, LAC 2005a.

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 State Road 4 measured in September 2004 are presented in **Table 4–50**.

Table 4–50 Average Weekday Traffic Volume in the Vicinity of New Mexico 502 and State Route 4

Location	*Average Daily Vehicle Trips*
Eastbound on New Mexico 502 east of the intersection with New Mexico 4	10,100
Westbound on New Mexico 502 east of the intersection with New Mexico 4	7,765
Eastbound on New Mexico 502 west of the intersection of New Mexico 502 and New Mexico 4	6,540
Westbound on New Mexico 502 west of the intersection of New Mexico 502 and New Mexico 4	4,045
Westbound on State Route 4 between East Jemez Road and the New Mexico 502/4 intersection	6,505
Eastbound on State Route 4 between East Jemez Road and the New Mexico 502/4 intersection	6,665
Transition road from northbound State Route 4 to eastbound New Mexico 502	5,170
Transition road from eastbound New Mexico 502 to southbound State Route 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 4–51**. In 2004, there were over 5,700 motor vehicle accidents in Los Alamos, Rio Arriba, and Santa Fe Counties resulting in 58 fatalities.

Table 4–51 New Mexico Traffic Accidents in Los Alamos and Nearby Counties, 2004

County	Total Accidents	Fatalities	Injuries
Los Alamos	274	0	117
Rio Arriba	698	32	426
Santa Fe	4,744	26	2,636
New Mexico	52,288	522	26,481

Source: NMDOT 2006a.

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 included 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 2004, there was an average of 237 offsite waste shipments per year. These consisted, on average, of 191 shipments of hazardous materials and 46 shipments of radioactive materials as shown in **Table 4–52**. 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 4–52.

Table 4–52 Offsite Waste Shipments 2002 - 2004

Waste Type	*2002*	*2003*	*2004*	*Total*
Hazardous	154	157	262	573
Low-Level Radioactive	3	68	12	83
Mixed Low-Level Radioactive	17	19	19	55
Transuranic	1	46	0	47
Total	175	290	293	758

Source: LANL 2006.

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 designated hazardous materials route for Los Alamos County is East Jemez Road to NM 4 to NM 502.

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 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 one of the two largest contributors to radioactive air emissions, the other being the Tritium Facilities (both Key and Non-Key) (LANL 2005j). 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.

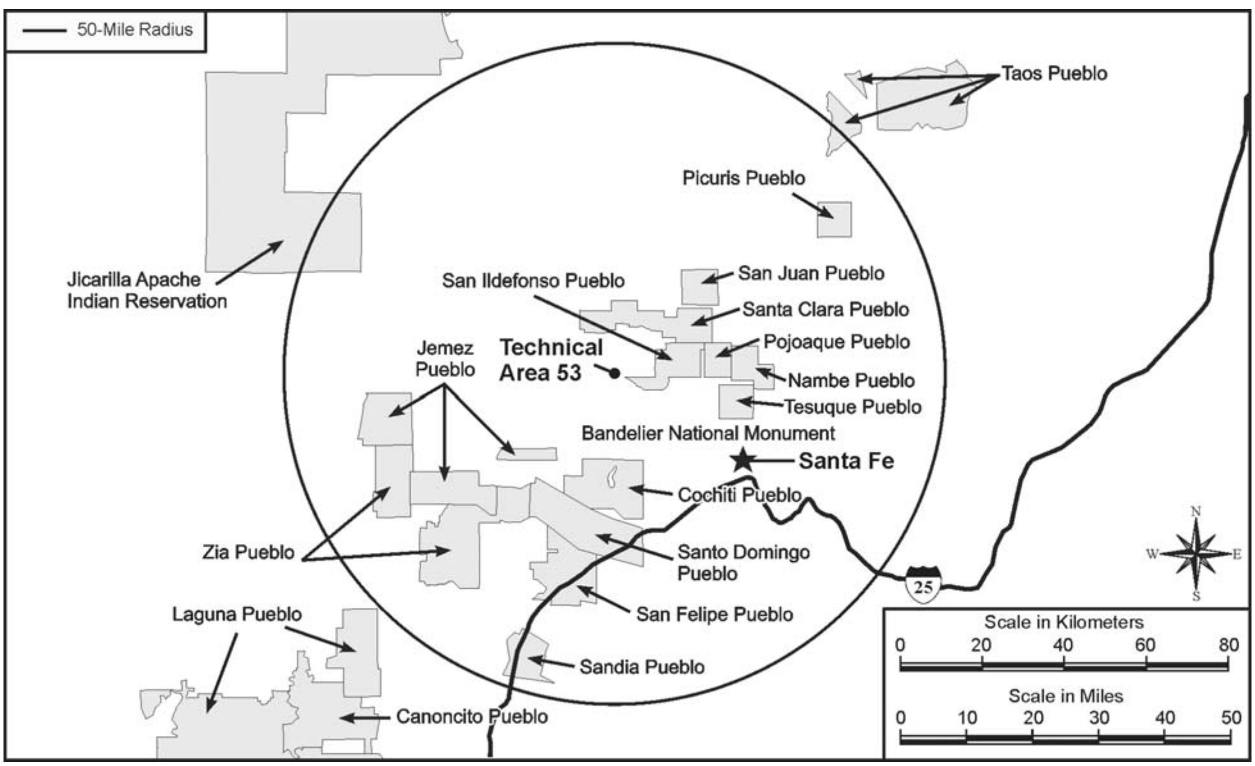


Figure 4–31 Location of Technical Area 53 and Indian Reservations Surrounding Los Alamos National Laboratory

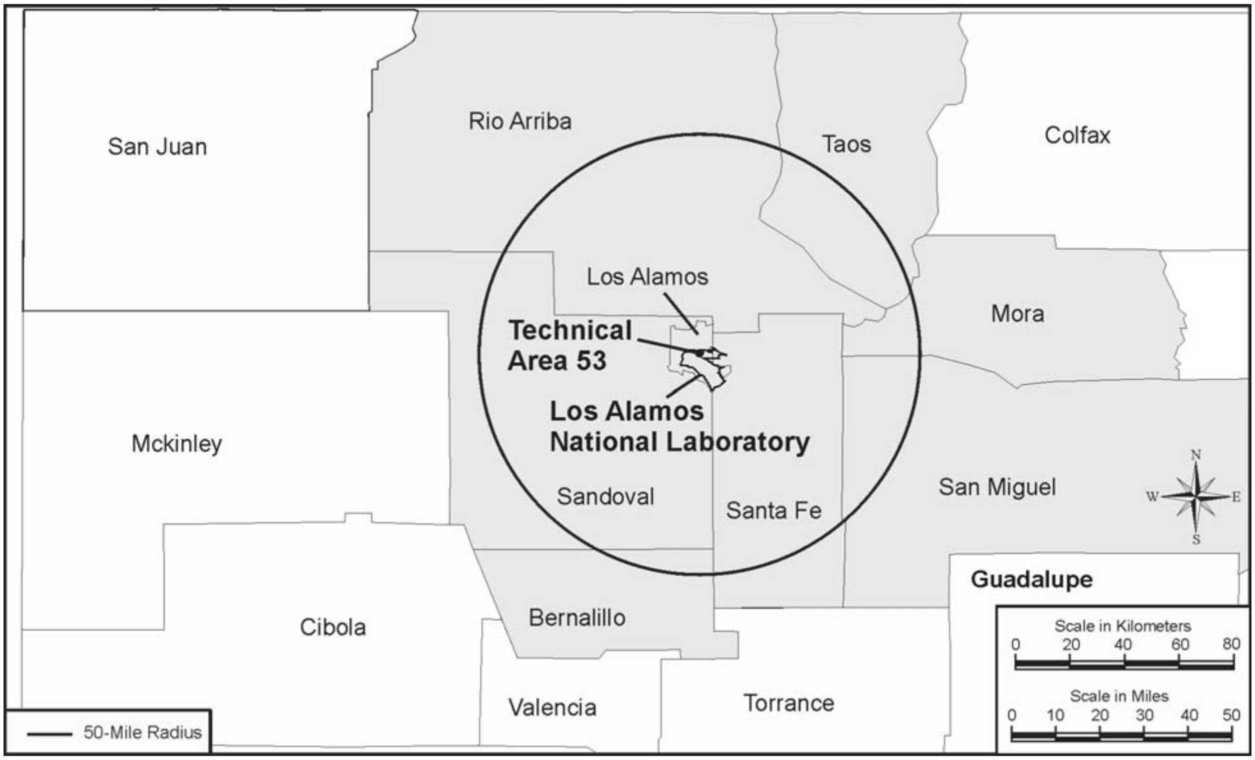


Figure 4–32 Potentially Affected Counties Surrounding Los Alamos National Laboratory

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 4–53 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 4–53 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 2006a.

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 4–54**). 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 4–54 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 2006a.

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 15 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.

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 environmental restoration project complete 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 environmental restoration project 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. As a result of the investigations, remediations, and the 1999 and 2000 Annual Unit Audits, DOE has reduced the number of potential release sites at LANL requiring further action by over 60 percent. A small percentage of sites, currently estimated at less than 10 percent, will go through the entire corrective action process, a task that is expected to take until 2015 to complete (LANL 2005l).

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 2003g). The project has also completed a number of source removals through voluntary corrective actions and has continued site investigations (LANL 2003g, 2004h). In 2004, the environmental restoration project completed eleven 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 2005g).

Major unplanned activities by the LANL environmental restoration project were undertaken in response to the Cerro Grande Fire. Due to the threat of erosion and enhanced contaminant transport, the project performed the following activities: 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 2003g)

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, the environmental restoration project has operated within the envelope evaluated in the *1999 SWEIS*.

Requirement for correction actions performed at LANL is accordance either RCRA and its Hazardous and Solid Waste Amendments (HSWA) have 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. Nor does the Consent Order address releases of radionuclides, which are under the regulatory authority of the DOE. Notwithstanding the Order, activities and associated impacts of LANL's environmental restoration project have remained within the scope of the *1999 SWEIS* and the ROD projections.

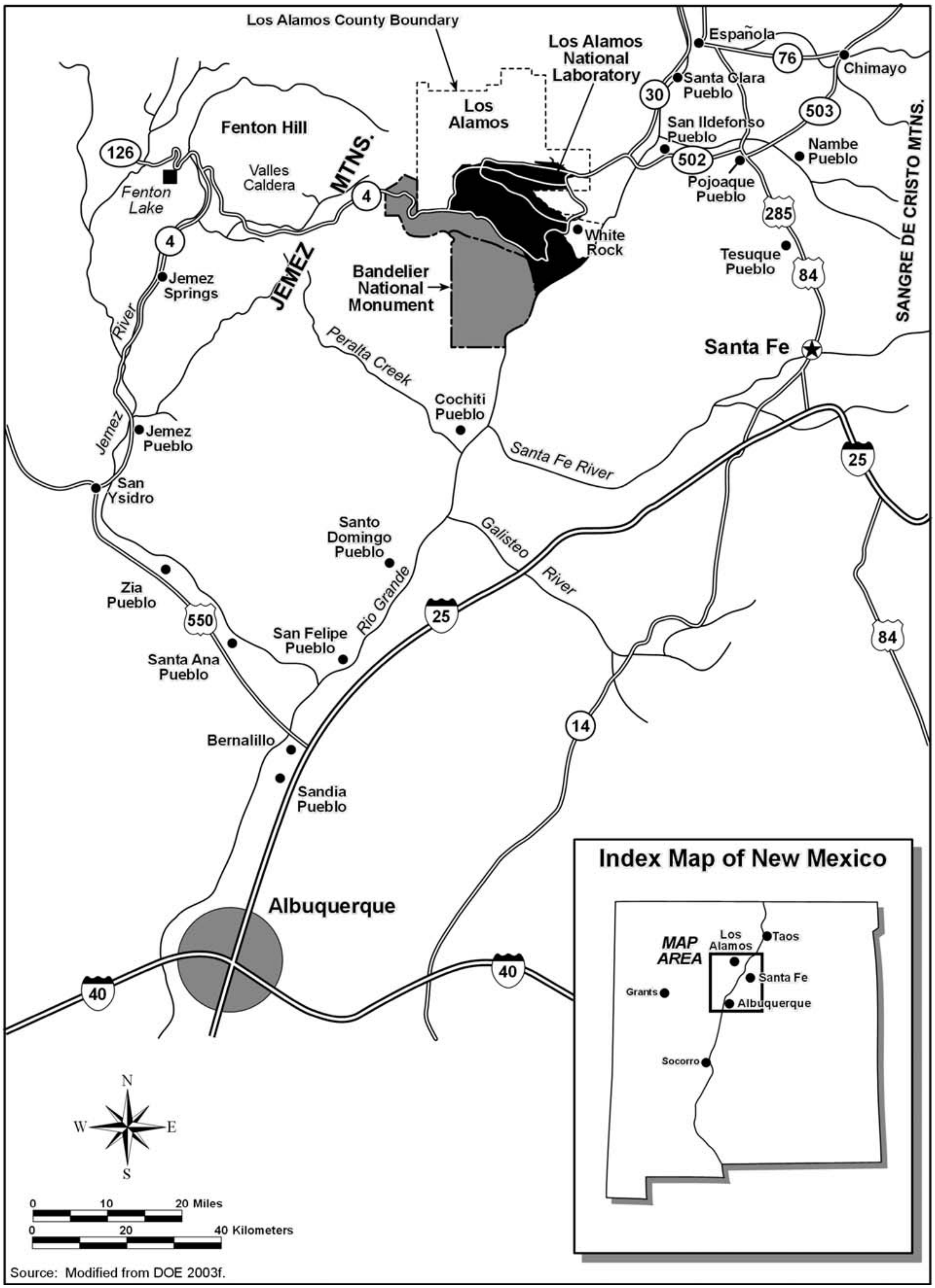


Figure 4–1 Location of Los Alamos National Laboratory

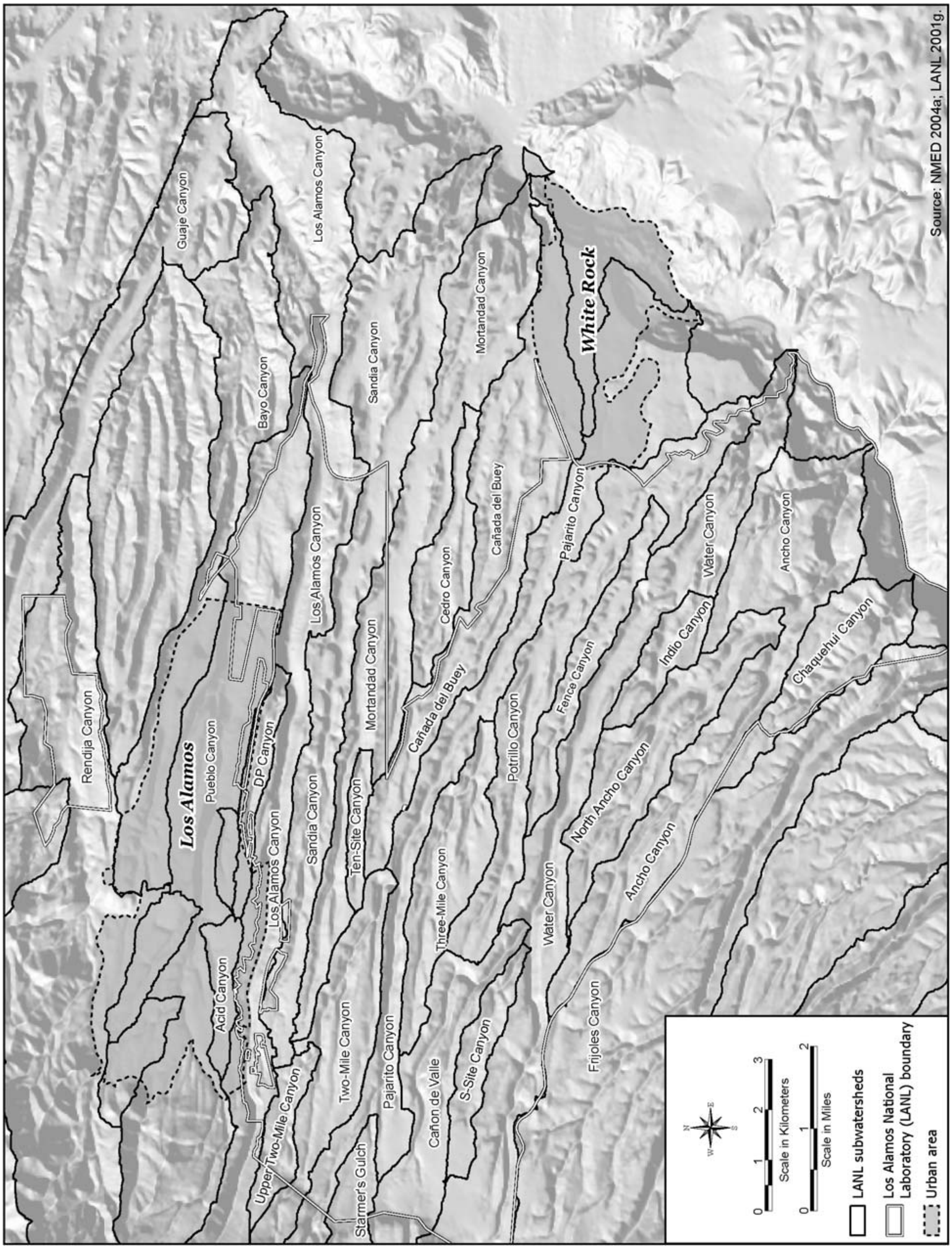
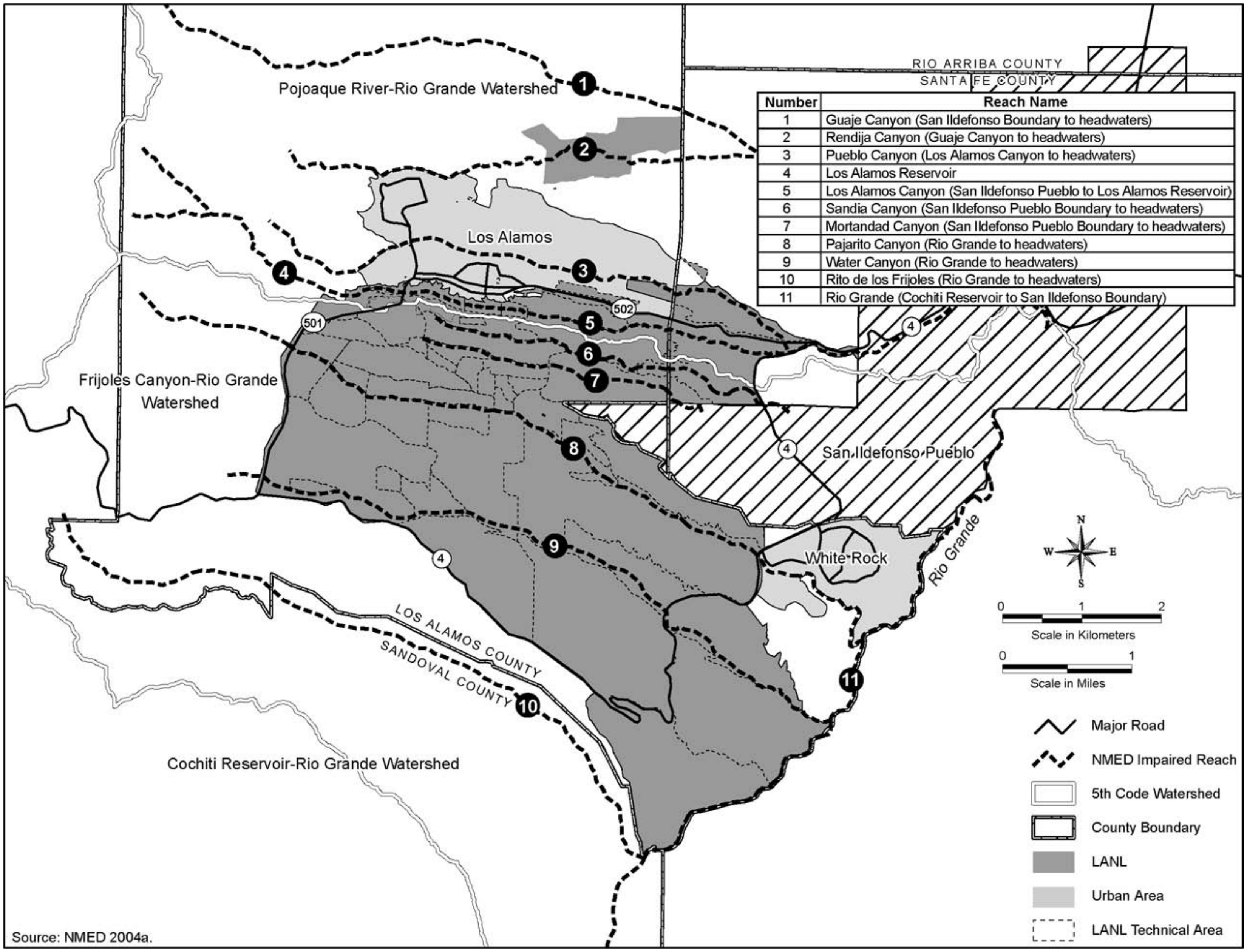


Figure 4–12 Watersheds in the Los Alamos National Laboratory Region



Number	Reach Name
1	Guaje Canyon (San Ildefonso Boundary to headwaters)
2	Rendija Canyon (Guaje Canyon to headwaters)
3	Pueblo Canyon (Los Alamos Canyon to headwaters)
4	Los Alamos Reservoir
5	Los Alamos Canyon (San Ildefonso Pueblo to Los Alamos Reservoir)
6	Sandia Canyon (San Ildefonso Pueblo Boundary to headwaters)
7	Mortandad Canyon (San Ildefonso Pueblo Boundary to headwaters)
8	Pajarito Canyon (Rio Grande to headwaters)
9	Water Canyon (Rio Grande to headwaters)
10	Rito de los Frijoles (Rio Grande to headwaters)
11	Rio Grande (Cochiti Reservoir to San Ildefonso Boundary)

Figure 4–13 Impaired Reaches in the Vicinity of Los Alamos National Laboratory

Figure 4–19 Los Alamos National Laboratory Meteorological Network

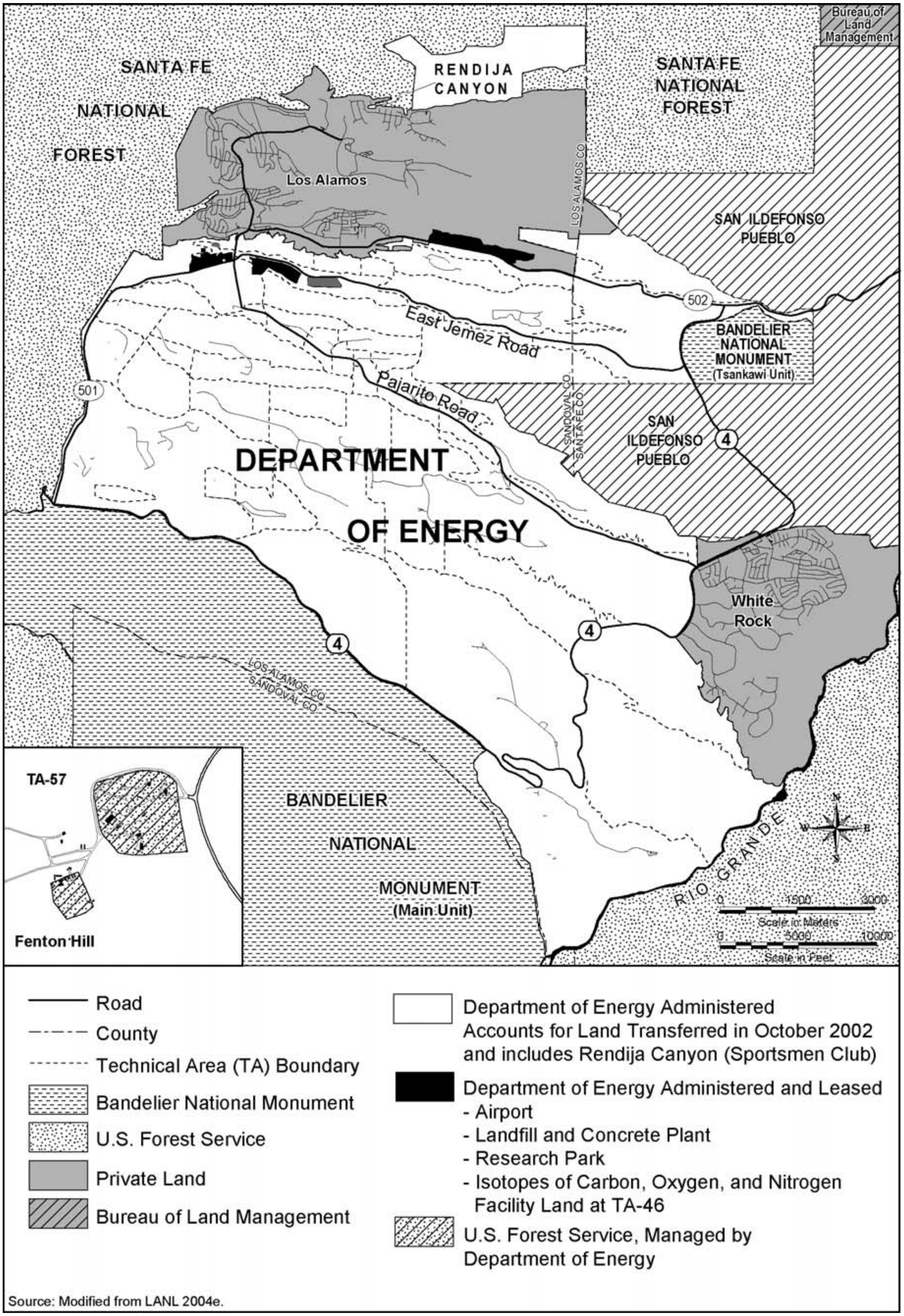


Figure 4–2 Land Management and Ownership

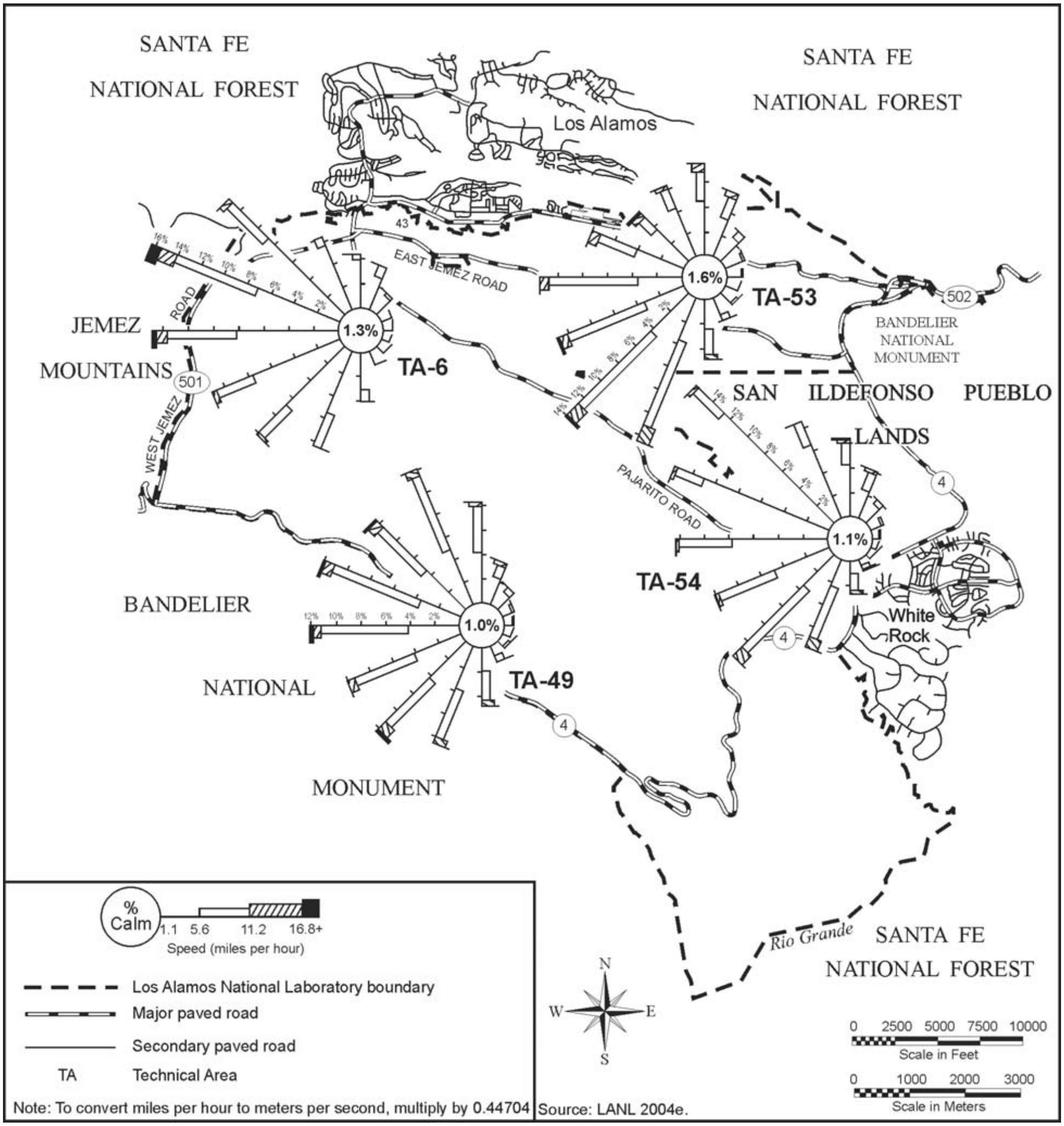


Figure 4–22 Los Alamos National Laboratory Meteorological Stations with Nighttime Wind Rose Data

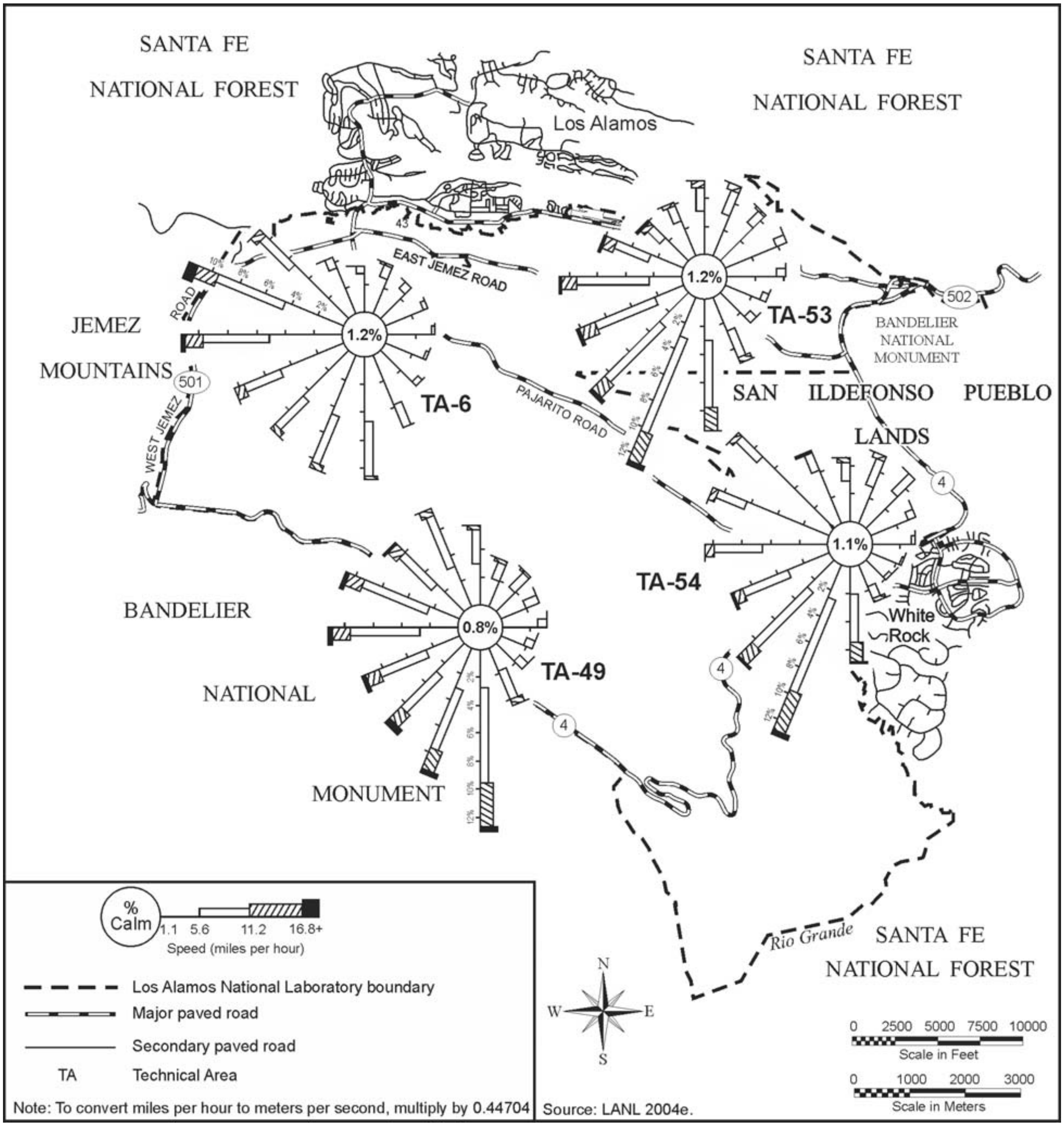


Figure 4–23 Los Alamos National Laboratory Meteorological Stations with Total Wind Rose Data

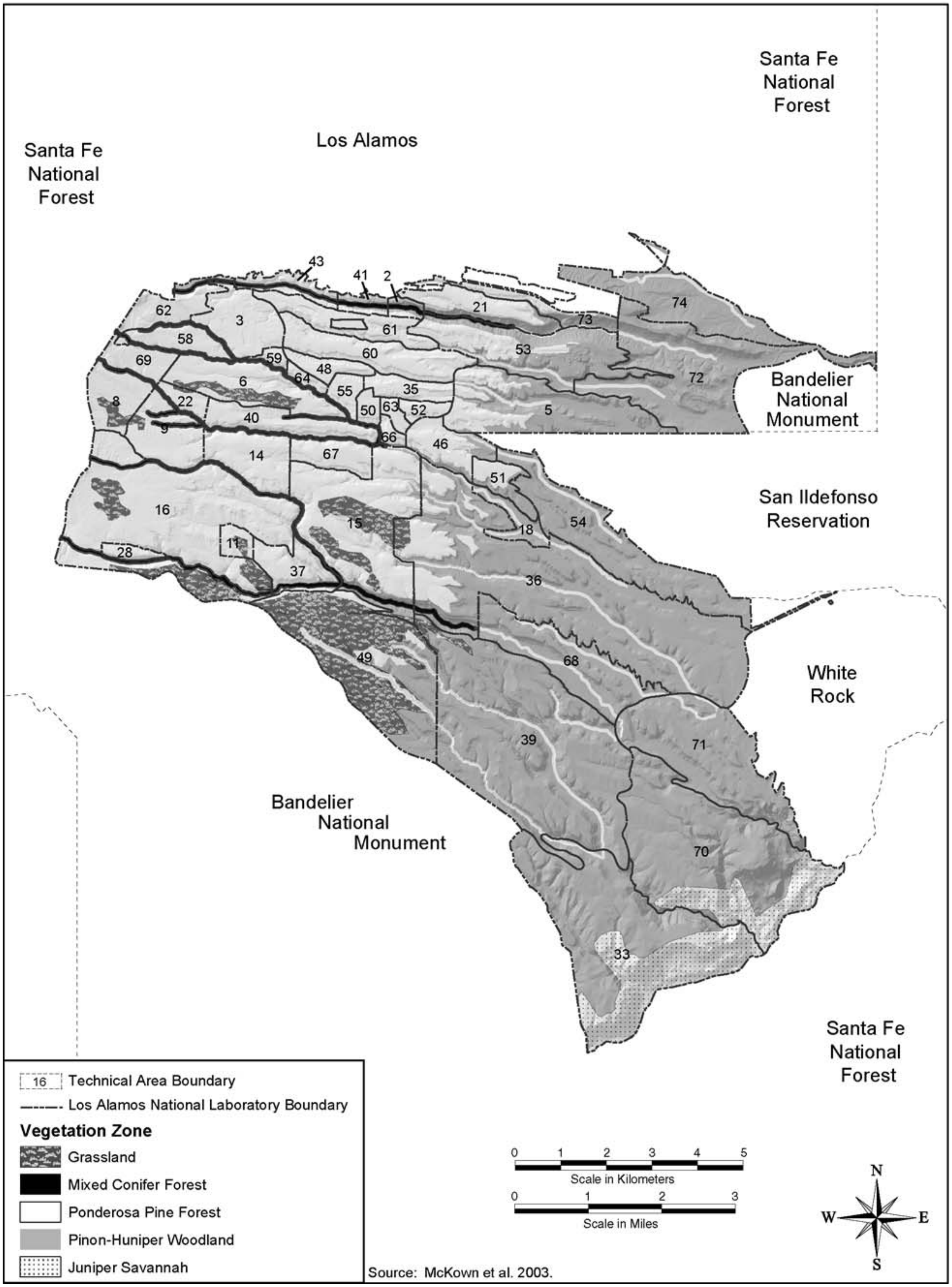


Figure 4–25 Los Alamos National Laboratory Vegetation Zones

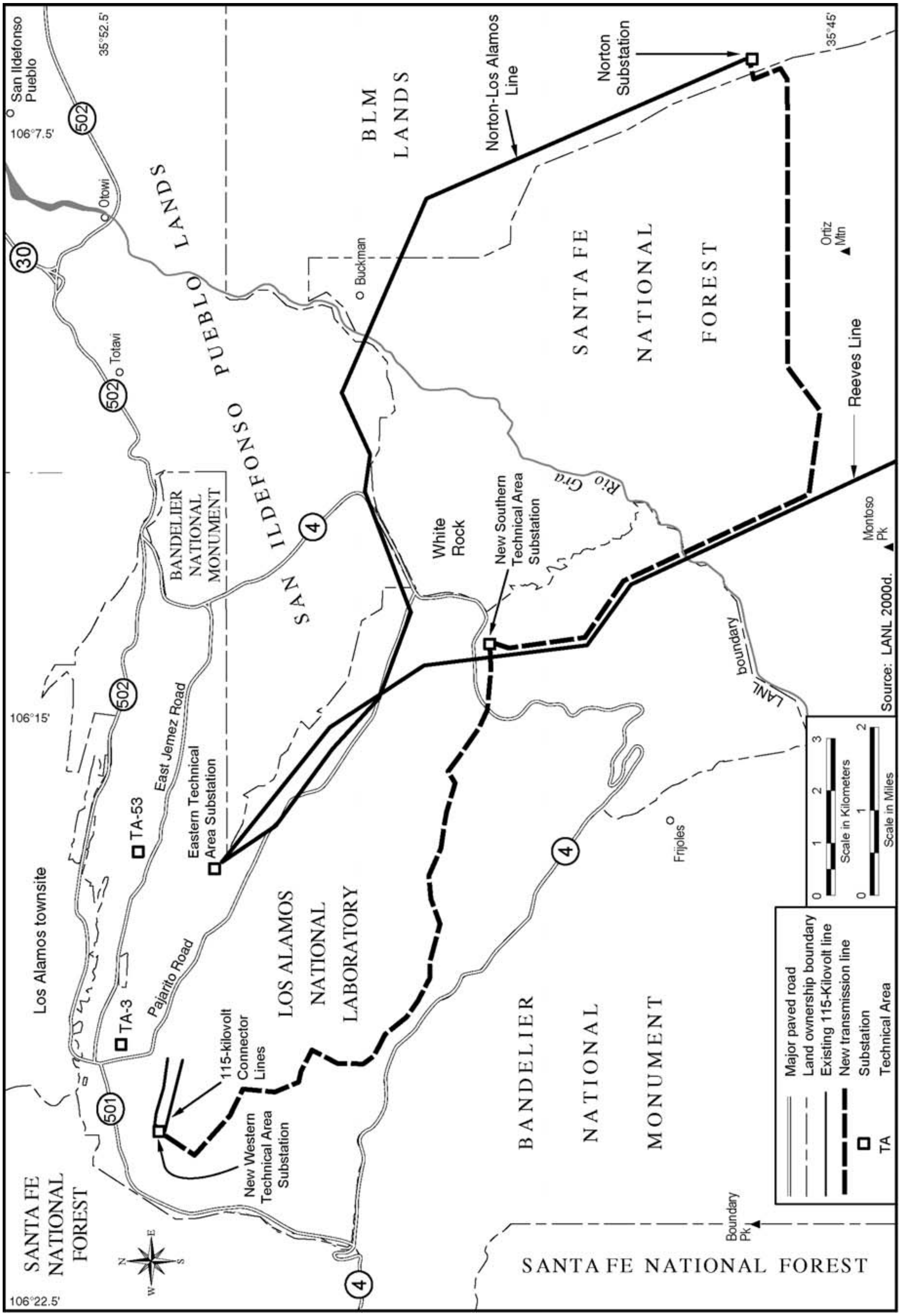


Figure 4–29 Los Alamos Area Electric Power Distribution System

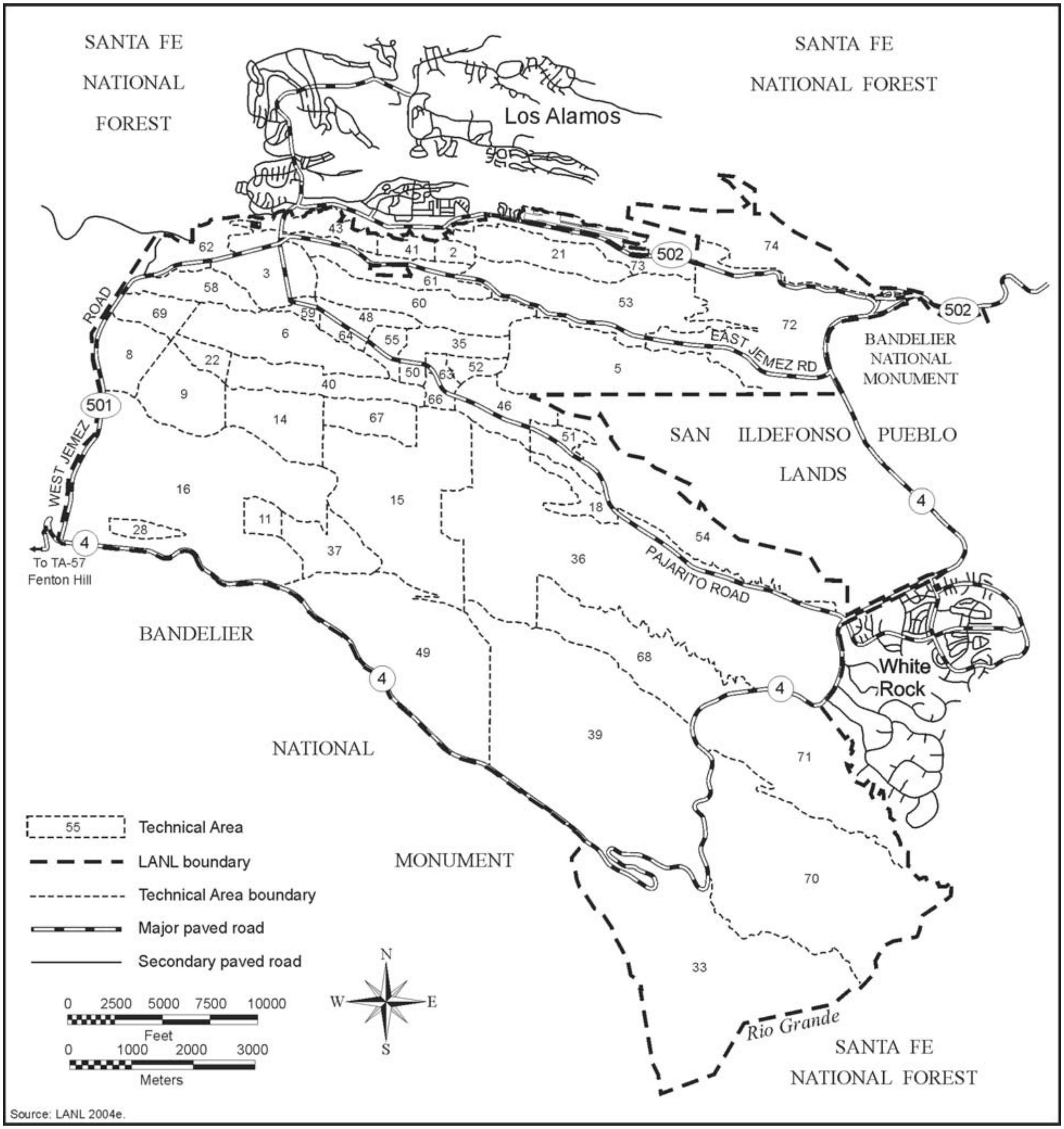


Figure 4–3 Technical Areas of Los Alamos National Laboratory

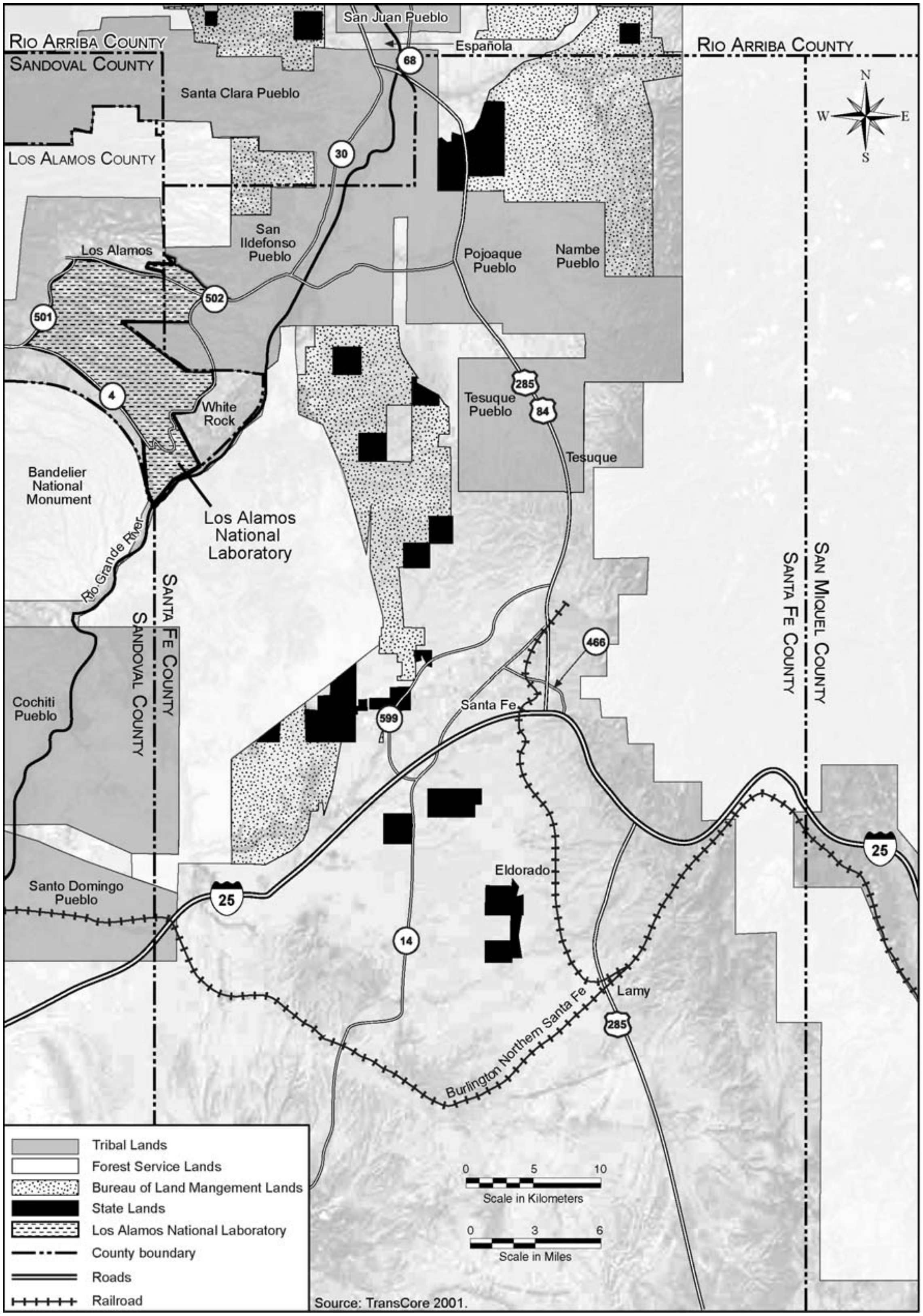


Figure 4–30 Los Alamos National Laboratory Vicinity Regional Highway System and Major Roads

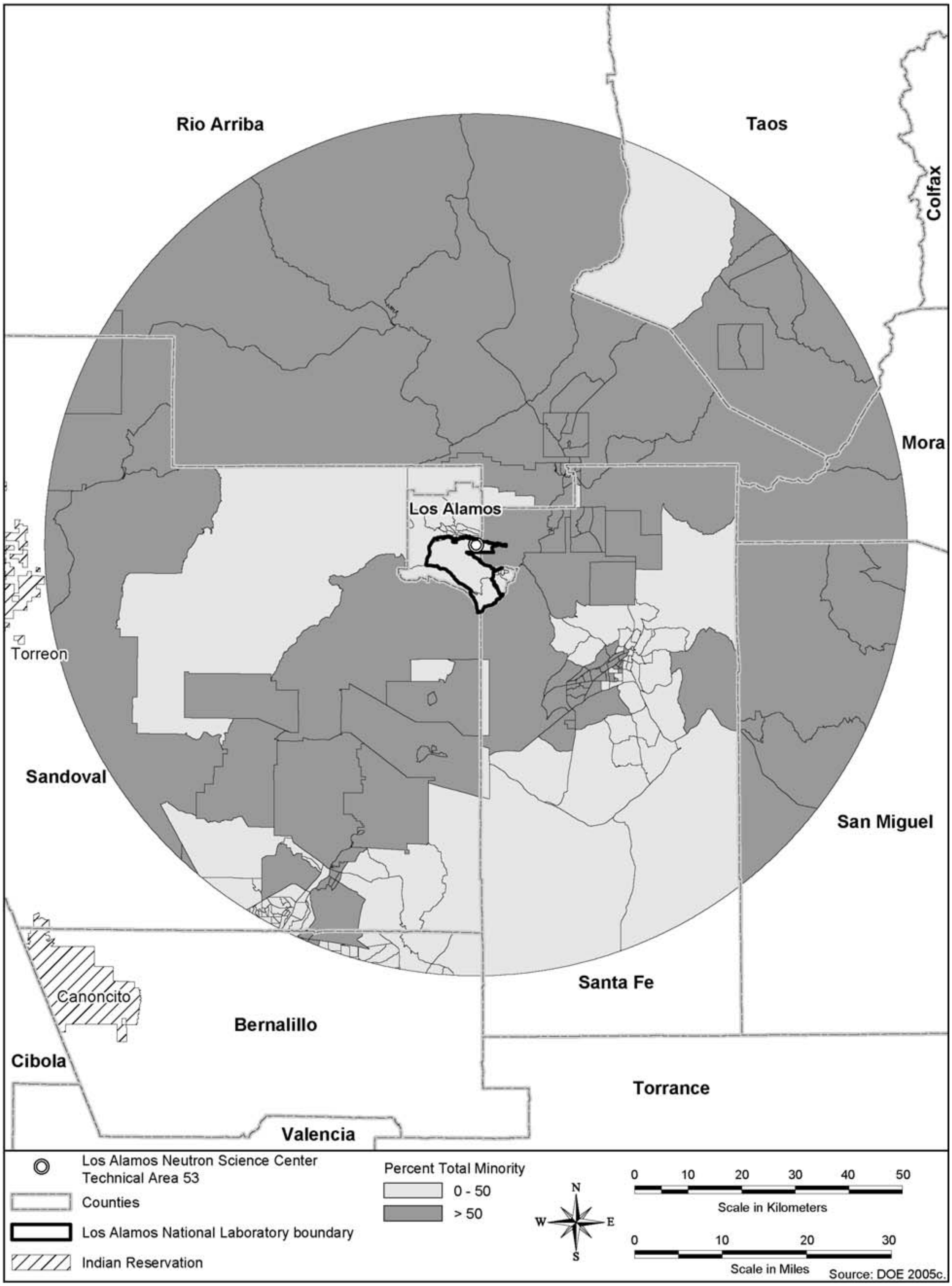


Figure 4–33 Minority Population – Block Groups with More Than 50 Percent Minority Population within a 50-mile (80-kilometer) Radius of Los Alamos National Laboratory

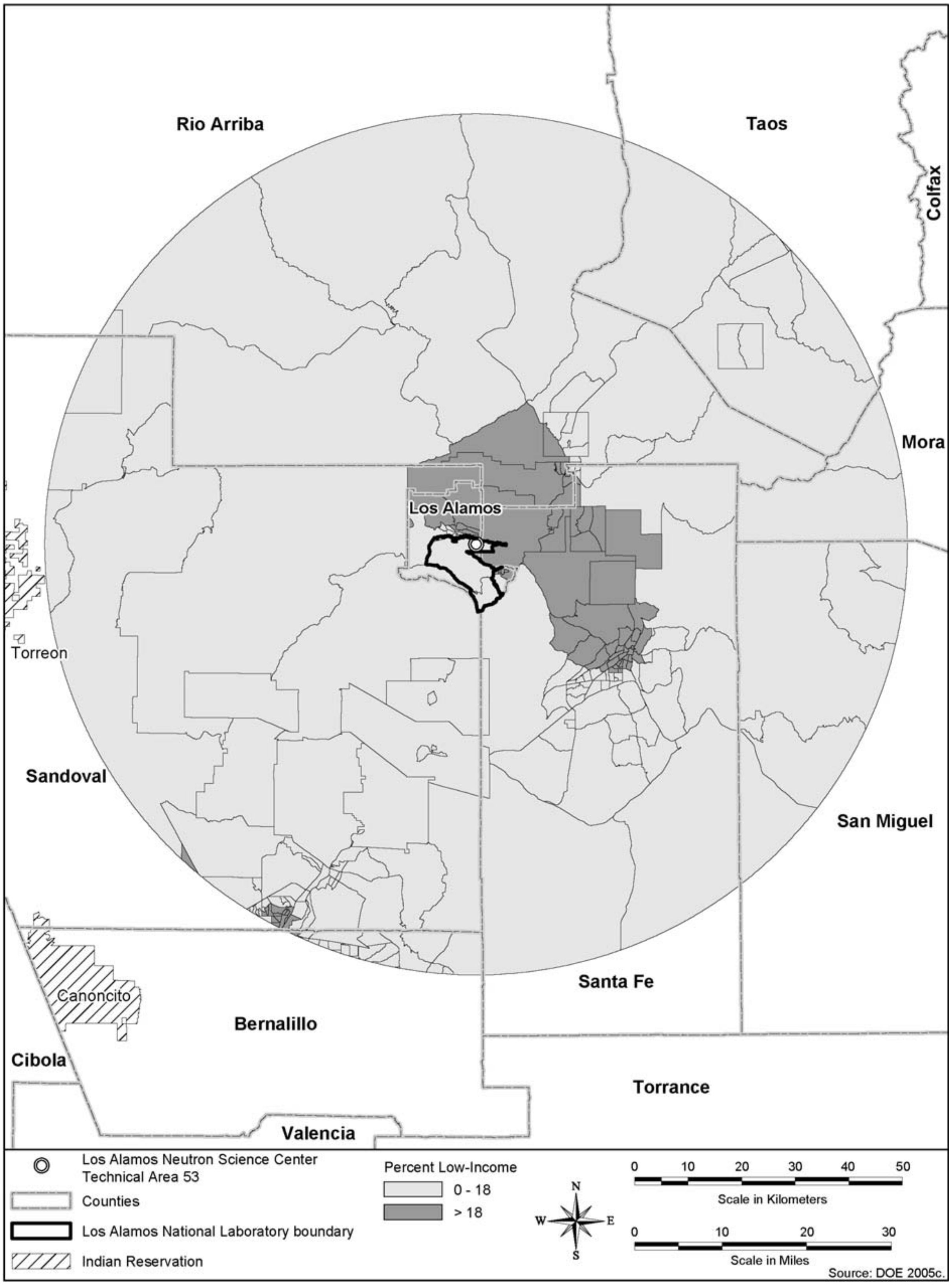


Figure 4–34 Low-Income Population – Block Groups with More Than 18 Percent of the Population Living Below the Federal Poverty Threshold within a 50-mile (80-kilometer) Radius of Los Alamos National Laboratory

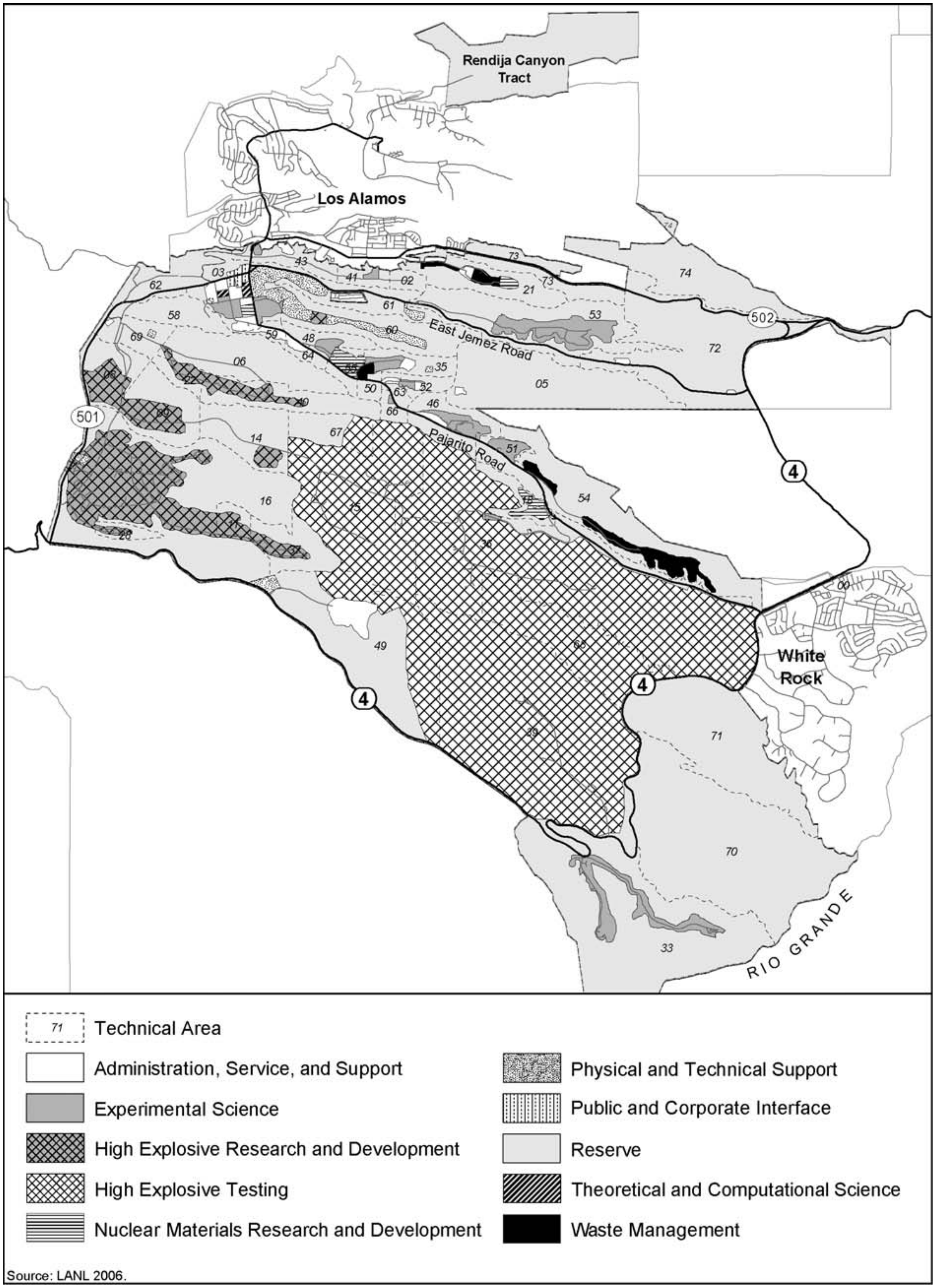


Figure 4–4 Los Alamos National Laboratory Site-Wide Land Use

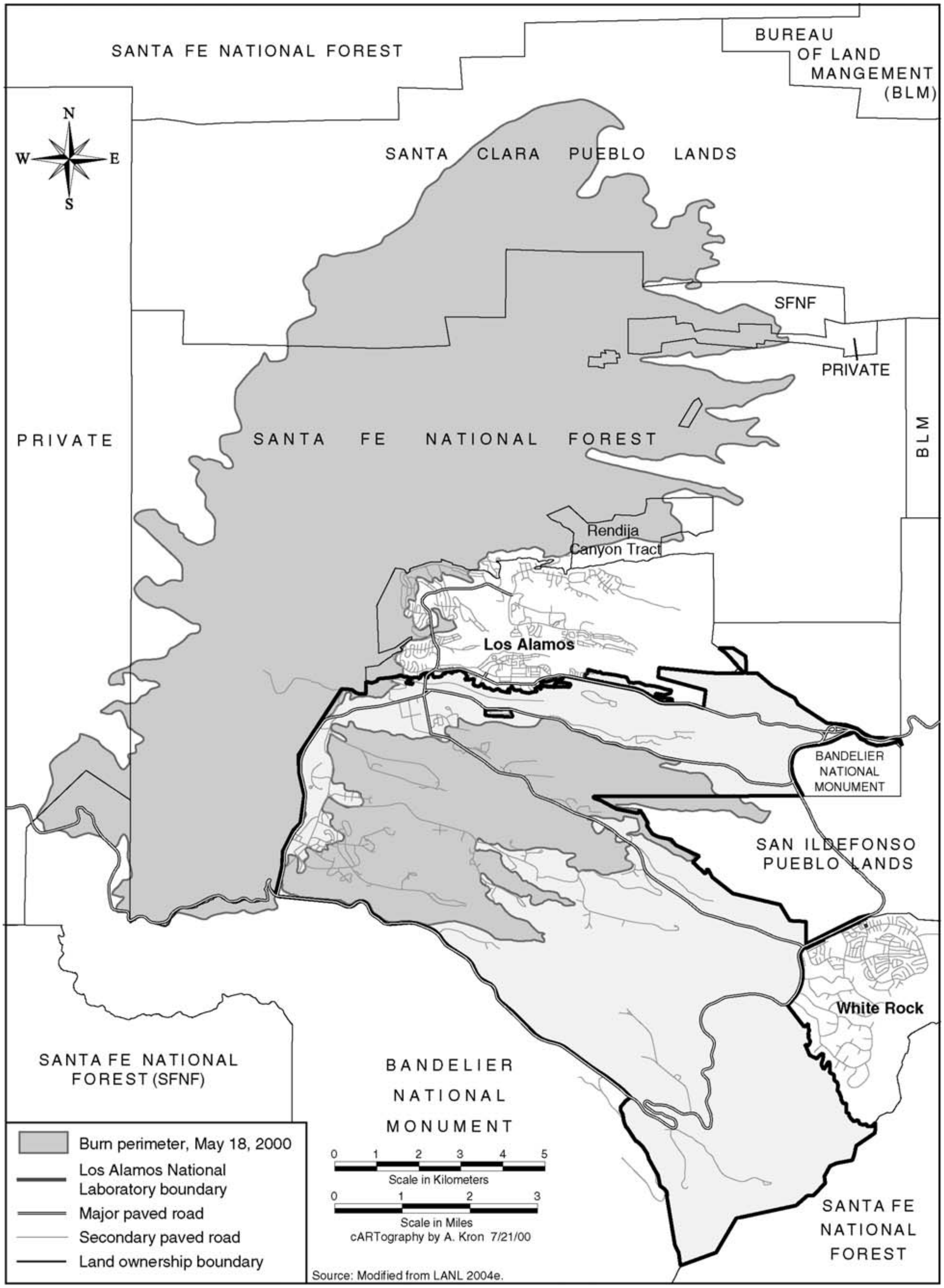


Figure 4–5 Cerro Grande Fire, Total Area Burned

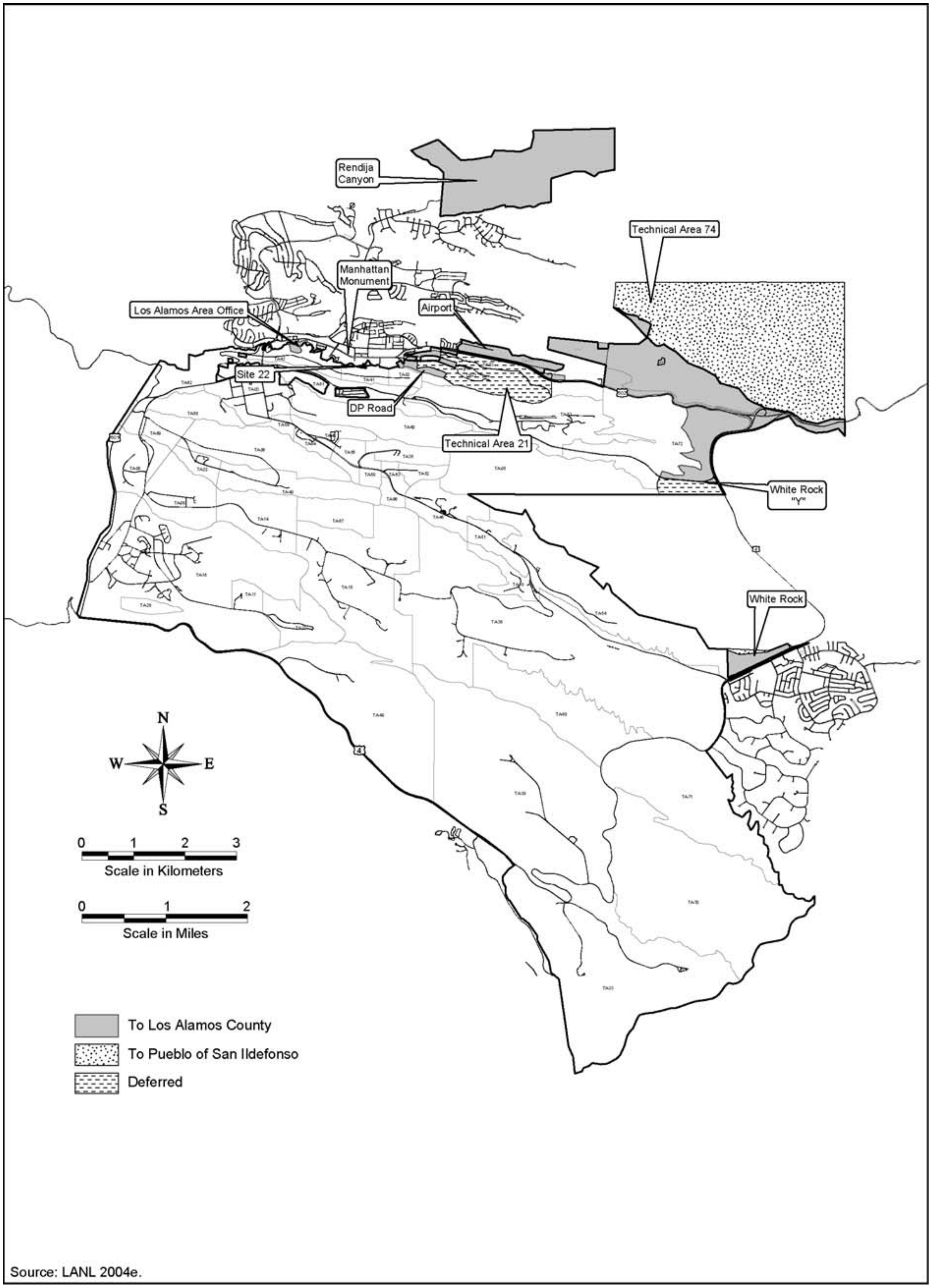


Figure 4–6 Overview of Land Conveyance and Transfer

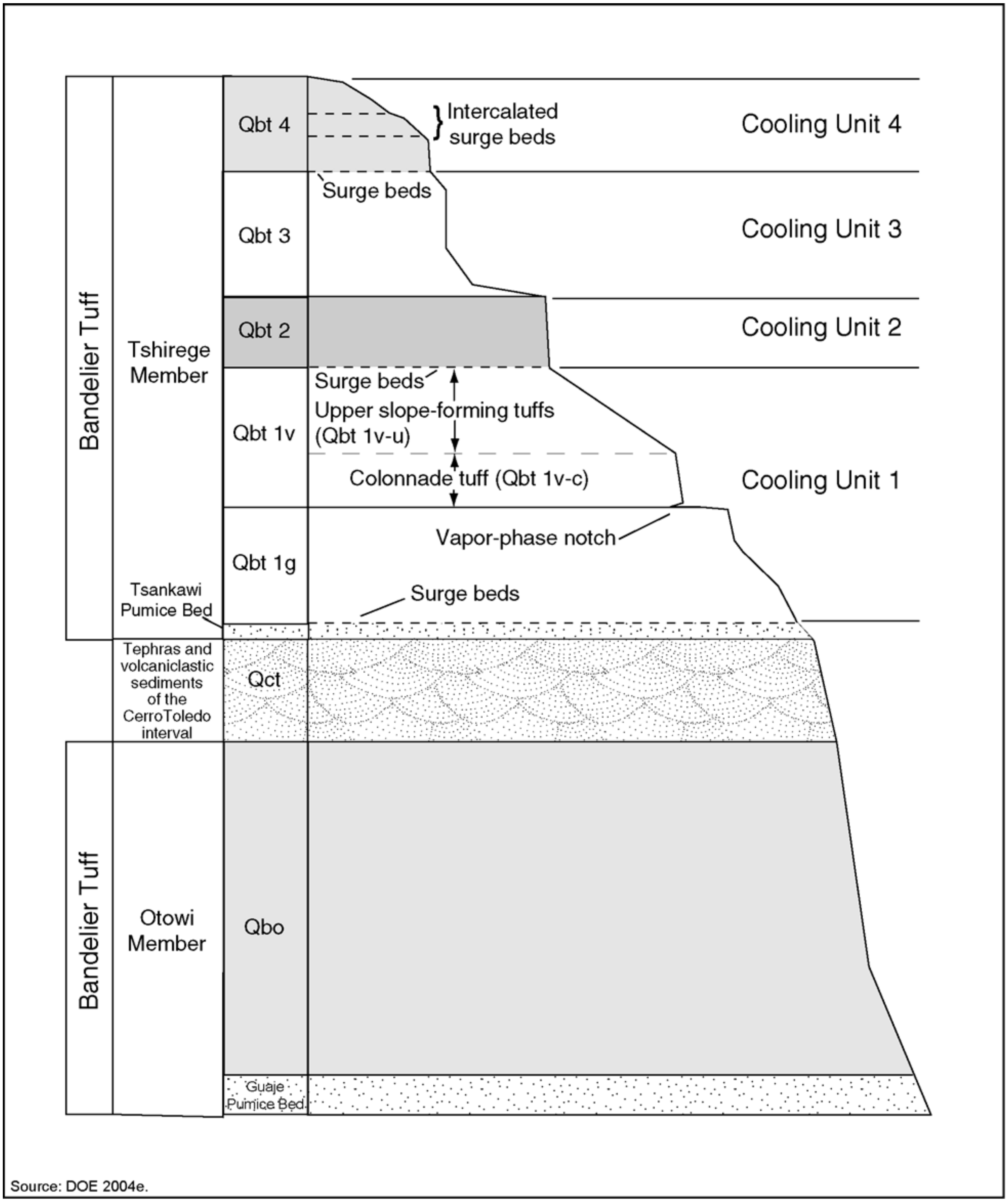


Figure 4–8 Stratigraphy of the Bandelier Tuff

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). 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 and transfer of certain lands to Los Alamos County and the U.S. Department of the Interior to be held in trust for the San Ildefonso Pueblo that, in effect, changes 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 50 pits per year under single-shift operations (80 pits per year using multiple shifts) in TA-55. The manufacturing of pits in TA-55 at any of the levels discussed above is not expected to have a distinguishable effect on a number of the 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. Larger impacts would be expected depending on the alternative chosen in terms of worker health, socioeconomics, waste management and transportation.

The changes in the operations and capabilities active at LANL have the effect of potentially changing releases to the environment and the impacts of potential accidents and are factored into the analyses presented below. In addition to changes in LANL operations and the environment, new projects or projects to maintain existing LANL capabilities have also been evaluated for environmental impacts. The impacts of these individual projects are detailed in Appendices G through J and are brought forward and included 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 (e.g., 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.

5.1.1.1 No Action Alternative

The No Action Alternative is represented by the existing environment as it relates to land use, together with actions that the U.S. Department of Energy (DOE) NNSA decided upon, but that have not been fully implemented, with other National Environmental Policy Act (NEPA) compliance reviews issued since the *1999 SWEIS*. Impacts with regard to land use 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. Only those projects that have been evaluated in their respective environmental analyses as having an impact on land use are addressed below.

Los Alamos National Laboratory Site-Wide Impacts

Two projects that are being implemented, and for which NEPA documentation has been prepared since issuance of the *1999 SWEIS* ROD, have potential impacts on land use across a number of technical areas: conveyance and transfer of land under Public Law 105-119, and proposed power grid upgrades (DOE 1999a, 1999d, 2000a).

The conveyance and transfer of land from the DOE to Los Alamos County and the Department of the Interior to be held in trust for the Pueblo of San Ildefonso began in 2002. By the end of 2005, 2,255 acres (913 hectares) had been turned over (see Section 4.1.1). In order to meet the requirements of Public Law 105-119, Section 632, the remaining acreage (1,929 acres [781 hectares]) must be turned over by 2007. Direct impacts of the conveyance and transfer process on land use include a reduction in the size of LANL from 27,520 acres (11,137 hectares) to 25,600 acres (10,360 hectares). Indirect impacts (that is, impacts resulting from actions undertaken by the recipients after the proposed conveyance and transfer of the tracts) include possible development or redevelopment of up to 826 acres (334 hectares), the potential for the introduction of land uses that would be incompatible with adjacent land owners' resource protection efforts, and the loss of recreational opportunities on some tracts (DOE 1999d).

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 – 1,929 acres (781 hectares) would be conveyed or transferred. – Development could occur on up to 826 acres (334 hectares). – Potential introduction of incompatible land uses. – Loss of recreational opportunities. Power Grid 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 the capping option. – No major changes in land use designations in most cases since 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 – 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 DD&D – Future LANL development could negate the proposed change in land use from the current designation to Reserve.
Remote Warehouse and Truck Inspection Station (TA-72)	No change in land use	Same as No Action Alternative	– Construction would affect 4 acres (1.6 hectares) of undisturbed land. – Land use designation would change from Reserve to Physical/Technical Support.
Key Facilities			
Pajarito Site DD&D (TA-18)	No change in land use	Same as No Action Alternative	Disposition acreage for future use. 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	– 12.6 acres (5.1 hectares) of undeveloped land to be developed. – Land use change is consistent with future land use designations.

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
Radioactive Liquid Waste Treatment Facility (TA-50)	No change in land use	Same as No Action Alternative	− Construction of the liquid waste management building would not result in a change in land use. − Construction would affect 4 acres (1.6 hectares) of undeveloped land. − New evaporation basins, if built, would likely result in a change in land use designation from Reserve to Waste Management.
Bioscience Facilities	No change in land use	Same as No Action Alternative	− Construction would affect 5 acres (2 hectares) of undeveloped land. − For Options 1 and 3 development would be consistent with a change in future land 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.

Although the Power Grid Infrastructure Upgrades Project is not expected to have a major effect on existing land uses, it would affect up to 473 acres (191 hectares) and be 19.5 miles (31 kilometers) in length. In general, it 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 operation 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. However, several minor impacts are possible including short-term impacts on cattle grazing and recreational use during construction on one segment that is outside of LANL and potential adverse effects on existing or future high explosives testing within LANL. Additionally, the project could provide a minimal constraint within the Dynamic Testing area and Twomile Mesa South within areas designated for future experimental use, as development could not occur within the right of way (DOE 2000a).

5.1.1.2 Reduced Operations Alternative

Los Alamos National Laboratory Site-Wide and Technical Area Impacts

Under the Reduced Operations Alternative, impacts on land use from those actions addressed for the No Action Alternative (see Section 5.1.1.1) would still take place. 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 level at LANL above those established for the No Action Alternative, which would still take place. Additionally, the Expanded Operations Alternative includes a number of new projects that have the potential to impact land use at LANL. Not all new projects would affect land use, because 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, there are two proposed actions that have the potential to impact land use across a number of technical areas at LANL. These are material disposal area (MDA) Remediation and 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 would be recommended by LANL, but decisions would be made by the New Mexico Environment Department (NMED). 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 are open areas that are fenced and excluded from any use other than safely maintaining inventories of waste. In the future, the 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 could free up to roughly 110 acres (45 hectares) for purposes other than as an exclusion area for radioactive waste. However, this would not mean that there would be major changes in the designated land use of the technical areas containing the MDAs. The extent of removal would depend on information obtained from the program and on regulatory decisions.

The investigation, remediation, and restoration program for MDA B would remove at least some waste and contamination. Alternative uses for this portion of TA-21 may be possible. Opportunities for different uses of some lands may arise following potential release site (PRS) remediation. This would depend on the corrective measure required by NMED and implemented by LANL, and 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 land use plans for the Pajarito Corridor West as set forth 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 as set forth in the *Comprehensive Site Plan 2001*. A second action involves construction of a second new two-lane bridge which 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. 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 is the case for the bridge over Mortandad Canyon. Thus, construction of the Sandia Canyon bridge would represent a departure from the current site development plan; however, the 2000 Plan did address the concept of a future road over the canyon (LANL 2000a, 2001c).

Technical Area Impacts

Two projects are proposed that have potential impacts on land use within TA-3 and TA-21. These are addressed below.

Technical Area 3

Construction of the Replacement Office Buildings would require 13 acres (5.3 hectares) of undeveloped land within TA-3 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-hectares) 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. However, portions of the eastern parcel 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).

Key Facilities Impacts

Five projects with land use impacts are being proposed that are related to Key Facilities at LANL as discussed below.

Pajarito Site

The decontamination, decommissioning, and demolition (DD&D) of TA-18 buildings and structures would result in an overall change in the land use designation of the TA, since 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 and a small part of TA-55, of which about 12.6 acres (5.1 hectares) are currently undeveloped. Development would require that some areas currently designated Reserve and Experimental Science be redesignated as Nuclear Materials Research and Development; however, this is consistent with future land use concepts since 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 building would occur in a developed area of TA-50 and would not result in changes to the current or future land use designation of Waste Management. If the evaporation basins, 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 basin areas, as well as a portion of the pipeline route, would likely change from Reserve to Waste Management.

Science Complex

Under the Northwest TA-62 Site option a site located immediately to the west of TA-3 would be used for construction of the Science Complex. Current land use within the site area is classified as Reserve and has not been predicted to change in the future (LANL 2003g). Thus, construction of the Science Complex, which would disturb 5 acres (2 hectares) of undeveloped land, would result in a change in future land use from Reserve to Experimental Science.

Remote Warehouse and Truck Inspection Station

Construction of the Remote Warehouse and Truck Inspection Station along the south side of East Jemez Road would require the clearing of about 4 acres (1.6 hectares) of land. Since current and future land use within the site area is designated as Reserve, development of the site would represent a change in land use from Reserve to Physical/Technical Support.

5.1.2 Visual Environment Impacts

Visual resources are natural and manmade features that give a particular landscape its character and aesthetic quality. The analysis of impacts to visual resources was comparative and consisted 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 No Action Alternative is represented by the existing visual environment at LANL, including actions that DOE or NNSA has decided upon, but that have not been fully implemented, with other NEPA compliance reviews issued since the *1999 SWEIS* ROD. Impacts to the visual environment are described in terms of those projects that impact the site as a whole and those that affect specific technical areas. Key Facilities are addressed separately. Only those projects that have been evaluated in their respective environmental analyses as having an impact on the visual environment at LANL are addressed below.

Los Alamos National Laboratory Site-Wide Impacts

The conveyance and transfer of land to Los Alamos County and Department of the Interior to be held in trust for the Pueblo of San Ildefonso has 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. However, the evaluation also determined that the potential 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).

Table 5–2 Summary of Environmental Consequences on the Visual Environment

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
LANL Site			
	Land Conveyance and Transfer: − Development could degrade views of presently undeveloped tracts. Power Grid 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, since 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 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 parking lots, as well as vehicle and pedestrian bridges under all auxiliary actions.
Affected Technical Areas			
TA-3	No change in impacts to visual resources	Same as No Action Alternative	Center for Weapons Physics Research: − 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 Building 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 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.

	No Action Alternative	***Reduced Operations Alternative***	***Expanded Operations Alternative***
		Key Facilities	
Chemistry and Metallurgy Research (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 Facility (TA-16)	− Temporary impacts during construction of replacement building. − 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 Facility (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	− 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	− 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	− Short-term impact from construction of new treatment building in TA-50. − Permanent change to the visual environment if evaporation basins are built near the border of TA-52 and TA-5.
Solid Radioactive and Chemical Waste Facilities (TA-50 and TA-54)	No change in impacts to visual resources	Same as No Action Alternative	− Short-term impacts during construction. − Beneficial impact on near and distant views from removal of white-colored domes in TA-54. − Minimal visual impact of new Transuranic Waste Processing Facility to public from Pajarito Plateau rim and employees from Pajarito Road.

	No Action Alternative	***Reduced Operations Alternative***	***Expanded Operations Alternative***
Bioscience Facilities	No change in impacts to visual resources	Same as No Action Alternative	The Science Complex Project includes: – 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 since the new facility would be generally located within a developed part of TA-3.
Remote Warehouse and Truck Inspection Station (TA-72)	No change in impacts to visual resources	Same as No Action Alternative	– 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 Bandelier National Monument.

MDA = material disposal area, PRS = potential release site, TA = technical area, DD&D = decontamination, decommissioning, and demolition.

The power grid infrastructure upgrades project was determined to affect the visual environment in the vicinity of the 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. However, revegetation after construction 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 area is undeveloped, or where the contrast with the natural landscape is marked. The evaluation determined that there would not be a dramatic change to 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 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 that would occur as a result of selected thinning activities. The forest at LANL would become more natural with an increase in the diversity of shrubs, herbs, and grasses in the understory. 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 make the contrast between the background setting and LANL's industrial character more obvious (DOE 2000e).

The disposition of flood and sediment retention structures was determined to have a temporary effect on visual resources if staging areas for the concrete removal were located near Pajarito Road. The actual demolition of the flood retention structure in Pajarito Canyon and the steel diversion wall upstream from TA-18 would take place in restricted areas and not be 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 in visual resources (DOE 2002i).

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 the publication of the *1999 SWEIS*, NEPA compliance has been completed for three currently active projects related to Key Facilities. These include the Chemistry and Metallurgy Research Building Replacement TA-55, the Weapons Manufacturing Support Facility at TA-16, and the Dynamic Experimentation Complex at TA-6, TA-22, and TA-40. Impacts to visual resources of these projects are discussed below.

Chemistry and Metallurgy Research Building

Impacts to visual resources resulting from construction of the Chemistry and Metallurgy Research Building Replacement 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 Building Replacement would be readily visible to LANL employees from Pajarito Road. It would also be visible to the public from the upper reaches of the Pajarito Plateau rim (which would consist of six new one- to two-story buildings as well as modifications to roads, parking lots, and fencing) (DOE 2003f). Future DD&D of the Chemistry and Metallurgy Research Building would likely result in a temporary park-like area once the site was revegetated. However, as it is likely that infill building would occur later; no long-term visual change is likely, therefore, although new construction would blend in with modern construction.

High Explosives Processing

Construction and demolition 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. Since 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 in that 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 since the area is generally not visible from public roads. Demolition activities would generally 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 2002k).

High Explosives Testing

Construction activities related to the Dynamic Experimentation Complex at TA-6, TA-22, and TA-40 were determined to 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, is generally 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 since it would still resemble an industrial park, but on an expanded scale, with similar architecture. Demolition activities would generally result in the same local short-term adverse effects identified for the construction phase. Overall, the removal of buildings would enhance visual characteristics, with some areas being returned to more natural conditions (DOE 2003g).

5.1.2.2 Reduced Operations Alternative

Under the Reduced Operations Alternative, impacts on the visual environment from actions addressed for the No Action Alternative (see Section 5.1.2.1) would still take place.

5.1.2.3 Expanded Operations Alternative

The Expanded Operations Alternative reflects proposals that would expand the overall operations level at LANL in addition to those established for the No Action Alternative. Additionally, the Expanded Operations Alternative includes a number of new projects that have the potential to impact the visual environment at LANL. Not all new projects would affect the visual environment since 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 actions have the potential to impact visual resources across a number of technical areas 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 or removal. A combination of capping and removal could also be selected. Remedies would be recommended by LANL on an MDA-by-MDA basis with the decision being made by NMED. 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 for revegetation. Not all land would be affected at the same time. Many of the affected sites would not be in areas routinely visible by the public; however, a number of the MDAs are located on DP Mesa in TA-21 and are visible from the Los Alamos townsite. Remediating the MDAs would present 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 would generally be similar to those in existence prior to the implementation of corrective measures. One difference between the capping and removal options is that under the latter, as needed, the MDAs would be covered by containment structures while waste was removed. (The investigation, remediation, and restoration program at MDA B would also be conducted under containment structures.) These domed structures would be visible from greater distances than would the MDAs under the capping option; however, their presence would be temporary. After waste removal was completed, the structures would be removed and the site revegetated. Under both 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 ultimately reclaimed and revegetated. Remediating the additional PRSs 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 little or no visual impact, the 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, highway, and pedestrian bridges would be especially pronounced since 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. While the roadway would have minimal impact on visual resources since 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 be in contrast to the forested setting of the canyon, altering its natural appearance as viewed from both nearby locations and higher elevations to the west.

Auxiliary Action B involves construction of a second, new two-lane bridge that would be built 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. Impacts on visual resources would be similar to those addressed above for the first action.

Technical Area Impacts

Three projects are being planned that have potential impacts on visual resources at TA-3 and TA-21. These are addressed below.

Technical Area 3

Construction of 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 appreciably change 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 that 13 acres (5.3 hectares) be cleared and graded. This would result in short-term impacts to the visual environment, including construction activities and increased dust generation. The forested area along West Jemez Road within which the project would be built would be replaced with buildings and a parking lot that would be readily visible from West Jemez Road, Pajarito Road, and nearby areas. However, views from Pajarito Road would only be apparent to employees since 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. However, since both the western part of the site, which has been be transferred to Los Alamos County, and the eastern section could be developed in the future, these efforts would be aimed primarily at soil stabilization and not at recreating a more natural environment. With redevelopment likely, future views of the TA from State Route 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

Three projects are being proposed that are related to Key Facilities at LANL under the Expanded Operations Alternative as discussed below.

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 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 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 only be visible to LANL workers. Construction of the Radiological Sciences Institute would also change distant views of TA-48, since the size of the developed area would increase as well as the number of buildings and parking lots. The overall broad viewshed effect would be minimal due to the extensive nature of existing development on the mesa.

The 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 primarily be observed by LANL employees. Also, distant views from higher elevation to the west would not appreciably change (see Appendix G).

Construction of the new treatment building in TA-50 would result in temporary local visual impacts. Once built the new treatment building would not result in a change to the overall visual character of TA-50. However, the current natural setting in the area of the evaporation basins and a portion of the pipeline would be disrupted by the removal vegetation and construction activities.

Radioactive Liquid Waste Storage Facility

Construction would consist of either a single treatment building or two treatment buildings, with the possibility of renovation of existing buildings. Regardless of the construction option, visual impacts would be temporary and localized. Any new buildings that would be constructed would be no more than two stories high with established color schemes for building exteriors. If evaporation basins are constructed, there would be a permanent change to the visual environment because the area near TA-52 and TA-5 where the basins would be constructed is currently undeveloped and wooded. This natural setting would be disrupted by a noticeable break in the forest cover from higher areas to the east of LANL.

Solid Radioactive and Chemical Waste Facilities

Waste Management Facilities Transition activities primarily would involve work within TA-54, TA-50, and TA-63. Actions taking place within TA-54, including some new construction and removal of the white-colored domes and other facilities, would occur within previously disturbed areas. While most activities taking place within TA-54 would have minimal impact on visual resources due to the developed nature of the area, removal of the white-colored domes at MDA G would have a beneficial impact on both near and distant views, since these structures can be seen many miles away from areas in the Nambe and Espanola area and from areas in western and southern Santa Fe. They are also visible from the lands of the Pueblo of San Ildefonso. A Transuranic Waste Processing Facility would be required and could be located within either TA-50 or TA-63. However, since Pajarito Road is closed to the public, the view of this facility would only be available to LANL employees. Regardless of where a Transuranic Waste Processing Facility would be constructed, the presence of equipment and dust would cause temporary impacts on visual resources. There would be little impact to the viewshed from higher elevations to the west due to the existing highly 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 co-located with the Transuranic Waste Processing Facility or be separate from it. This option also involves upgrading satellite storage areas around LANL for mixed low-level radioactive waste and hazardous or chemical waste. In general, impacts on visual resources of this option would be similar to those described above since similar actions would take place within the same technical areas (see Appendix H).

Science Complex

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 result in an impact to visual resources in this area because views from TA-3 or from West Jemez Road to the west, north, and east would be obstructed. Also, with the 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 since the Science Complex would be 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 canyon 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 was previously 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. However, the trails at Tsankawi are closed to the public after dusk. Lighting to 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, LANL operations have limited impact on geology and soils, except in specific circumstances. This is because the majority 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. 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 presents a summary of the impacts for each of the proposed alternatives with respect to 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.	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: − Activities could impact approximately 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 1.4 million cubic yards (1.1 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: − Would disturb up to 238,000 cubic yards (182,000 cubic meters) of soil and rock for construction. − Construction of bridges could disturb up to 26,000 cubic yards (20,000 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 Center for Weapons Physics Research 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.
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.

	No Action Alternative	Reduced Operations Alternative	Expanded Operations Alternative
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, 25 acres (10 hectares) would have to be excavated an average of 33 feet (10 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 impact undisturbed native 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 impact undisturbed native 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 about 95,000 cubic yards (72,000 cubic meters) of soil and rock for building excavation. – Construction of evaporation basins would impact approximately 80,000 cubic yards (61,000 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. – Negative impact in the areas where construction would impact undisturbed native 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 865,000 cubic yards (661,000 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 impact undisturbed native soils.

	No Action Alternative	Reduced Operations Alternative	Expanded Operations Alternative
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 (130,000 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 9,500 cubic yards (7,300 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 (such as underground nuclear tests or operation of injection wells) that could modify the movement of magma, trigger volcanic activity, or increase the probability of seismic events. This is unchanged from the *1999 SWEIS* impact analysis (DOE 1999a). The estimated level of seismic hazard in use at present is based on the 1985 probabilistic seismic hazard assessment referenced in the *1999 SWEIS*. This assessment is being updated to reflect continuing studies of the seismic and structural setting at LANL as well as a comprehensive review of existing data and those collected since the 1985 assessment (LANL 2004e). The update is expected to be completed in the fourth quarter of 2006. This is a periodic update of the seismic assessment for LANL; it is not related to any changes in LANL activities or the alternatives discussed herein.

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 be the result of 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 increase the level of legacy contaminants (both chemical and radiological) in soils at the site. As discussed in Section 4.2.3.1, the levels of legacy contaminants are generally decreasing over time, a reflection of contaminant decay, soil losses, and improvements in LANL work practices and environmental management.

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 to use 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 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. However, at present the pit is being used to stockpile and manage materials from other areas and no quarrying is being conducted.

Technical Area Impacts

No activities planned to be undertaken under the No Action Alternative are expected to additionally impact geology and soils at any of the technical areas.

Key Facilities

No activities planned to be undertaken under the No Action Alternative with respect to the construction or operations of 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 expected under the No Action Alternative.

Technical Area Impacts

Geology and soils impacts under the Reduced Operations Alternative with respect to the technical areas would be similar to those expected under the No Action Alternative.

Key Facilities

High Explosives Testing

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 as compared to the No Action Alternative.

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 that have been established to protect public and worker health and the environment. DOE Order 420.1B (DOE 2005d) 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 the reevaluation 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 and for evaluation, modification, or upgrade of existing structures, systems, and components so that DOE facilities 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.

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 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 to be built under this alternative would be located at sufficient distance from steep slopes (such as canyon walls) and would use standard construction practices 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 remediation sites. At these sites, 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, the potential does exist for PRSs and PRS affected areas to be impacted. 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 3.4 million cubic yards (2.6 million cubic meters) of soil and rock would be impacted; however, over 90 percent of the material would be from areas disturbed by present or past activities, minimizing the loss of native soils. The impact would include both the facility footprint 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 an extended period of time. In all instances, adherence to standard best management practices for soil erosion and sediment control, including watering during construction, would serve to minimize soil erosion and loss. 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

Proposed actions under the Expanded Operations Alternative would significantly impact mineral resources at LANL. The impacts are due to proposed closures of the MDAs under the Consent Order[1] (NMED 2005) through either waste containment via construction of evapotranspiration covers or waste removal by excavation and offsite disposal. If final covers were constructed at the MDAs 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. Impact 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 for erosion control and site restoration.

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 the MDA remediation. Borrow materials could also 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

[1] NNSA is not legally obligated to include the Consent Order impacts analysis, but for purposes of this SWEIS, NNSA is including this information in support of collateral decisions that NNSA may make to facilitate implementation of Consent Order activities.

and the impact to LANL soils, surface water, and potential impact to groundwater from enhanced infiltration.

Security Driven Transportation Modifications

The proposed Security-Driven Transportation Modifications would disturb up to 238,000 cubic yards (182,000 cubic meters) of soil and rock during construction. In addition, construction of optional bridges under this proposal could disturb up to 26,000 cubic yards (20,000 cubic meters) of soil and rock.

Technical Area Impacts

Technical Area 3

Construction of Replacement Office Buildings and the Center for Weapons Physics Research would impact about 874,000 cubic yards (668,000 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 impact undisturbed native soils.

Technical Area 21

Remediation of MDAs A, B, T, and U, and DD&D of structures would take place in areas already disturbed by site activities so there would be no impact on native soils. Additional fill materials would be obtained onsite or from nearby offsite sources. Completion of DD&D and MDA remediation would result in 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, about 65 percent of the Capping Option maximum tuff requirement would be needed; thus, the TA-61 borrow pit would only need to be excavated an average of 33 feet (10 meters) over 25 acres (10 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 impact approximately 223,000 cubic yards (170,000 cubic meters) of soil and rock. There would be 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 865,000 cubic yards (661,000 cubic meters) of soil and rock for 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 a lesser 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.

The accompanying DD&D of a similar square footage of existing facilities would reduce legacy contamination and potential soil erosion. Materials excavated for facility construction and DD&D would be managed to minimize erosion and losses. Backfill for facility construction or DD&D 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 impact undisturbed native soils.

Radioactive Liquid Waste Treatment Facility

Construction of a Radioactive Liquid Waste Treatment Facility (RLWTF) would impact about 80,000 cubic yards (61,000 cubic meters) of soil and rock for building excavation. In addition, another approximately 84,000 cubic yards (64,000 cubic meters) of soil and rock would be impacted as a result of construction of evaporation basins. 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 that may be required would be obtained at LANL or from nearby offsite sources. There would be a negative impact on areas where construction would impact 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. From 80,000 to 169,000 cubic yards (61,000 to 130,000 cubic meters) of soil and rock would be impacted due to earthmoving operations; 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, re-location, and replacement of applicable facilities) would impact approximately 80,000 cubic yards (61,000 cubic meters) of rock and soil. Option 2 (Interim Actions Necessary for Meeting Consent Order and Other Options) impacts would be in addition 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 no additional facility would 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 would be a positive impact through 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 for building reconfiguration and upgrades. The actual amount of material disturbed would depend on the option selected. Option 1 (construction of the New Radiography Facility) would result in disturbance of the largest volume of soil and rock, cited above. Option 2 (Hybrid Option) would disturb approximately 9,500 cubic yards (7,300 cubic meters) of soil and rock, and Option 3 (Renovation Option) would disturb approximately 2,100 cubic yards (1,600 cubic meters) of soil and rock. In each case, the construction would be within and adjacent to the existing building, 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 storm water or 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 that are 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, storm water 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 upon patterns observed from previous actions. For example, the effect of installing a new treatment system at the RLWTF would be an expected reduction in the number of samples with constituents that exceed NPDES permit requirements. Thereafter, samples from short-lived and intermittent streams downgradient of that facility's outfall could be expected to have reduced concentrations of the removed contaminant after a few years. The effect may not be immediate if effluents are diluted by perennial or storm water flows, but the long-term effect would be improved surface water quality in that canyon. This type of beneficial impact would be significant.

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 storm water could mobilize contaminants in sediment and transport them for long distances downstream. Actions that could increase surface water volumes would be likely to mobilize contaminated sediment, potentially adversely affecting surface water quality.

Surface disturbance from construction activities have the potential to remove protective vegetative or other earth cover, loosen soil particles, and generate accelerated erosion that could result in sedimentation entering the waterways. For this analysis, it was assumed that accelerated erosion from surface disturbance during construction would be minimized by the installation and maintenance of erosion and sediment controls, 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.

Storm water 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.

While the acreage of impervious area of LANL facilities to be constructed in each watershed is needed to calculate changes in runoff volume under each alternative, the proposed facility designs are not developed to the point where the footprint size of the facilities is usable for that purpose. Storm water management is required to be implemented as part of LANL's construction specifications (LANL 2004d). For this analysis, it was assumed that new construction would include installing construction site storm water controls, so there would not be an increase in peak surface water runoff reaching the canyons. Therefore, increased runoff from additional impervious surfaces was not considered in the impact analysis.

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 they 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 − Not applicable		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	Minor 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 Facility – Dynamic Operations Complex	No impact on surface water quality.	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	Volume of water in Mortandad Canyon greatly reduced and surface water quality would be improved.
LANSCE (TA-53)	No impact on surface water quality.	Effects may be temporary or permanent, if shut down. 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 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, calculated from the totalized or estimated average flows from 2001 through 2004. **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 more than 40 percent are considered significant. The threshold for significance using a percent change in outfall contributions of greater than 40 percent was selected to provide a measure of change specifically for this SWEIS, based on past changes that made a difference to water quality and quantity. In those canyons where flows are typically relatively low, it is predicted that outfall changes would affect both water quality and quantity downstream.

5.3.1.1 No Action Alternative

Los Alamos National Laboratory Site-Wide Impacts

In order 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 would be modified to reduce the total number of outfalls from 21 to 17. The four outfalls that would be removed from the permit in 2006 have not discharged effluent in recent years, so no direct impacts to water quality or flow volumes in the canyons would result.

When the 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 in the Flood Structures Removal Project (DOE 2002i). 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 water course 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 2002i). After removal of the flood control structures in Pajarito Canyon is completed, there would be increased potential for sediment transport in the short term, as the channel adjusts to the change (LANL 2002b).

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 is 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 2002i).

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 Facility – 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	2.1	2.1	2.1
Sigma Complex – 1 outfall	5.8	5.8	5.8
Plutonium Complex– 1 outfall	4.0	4.0	4.0
Radioactive Liquid Waste Treatment Facility– 1 outfall	4.4	4.4	5.5 [e]
Non-Key Facilities – 1 outfall	28.5	28.5	28.5
Canyon Total	44.8	44.8	45.9
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)	79.1	49.1	66.8
Non-Key Facilities	200.9	200.9	200.9
Totals	280.0	250.0	267.7

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 2001, LANL 2006.

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 have a beneficial impact on surface water quality, as wildfires destroy the vegetation that stabilizes the soil and promotes storm water infiltration. With fewer wildfires, there would be less potential for increased storm water runoff to erode soil and mobilize contaminants (DOE 2000e), reducing the potential for surface water contamination from high sediment loads in storm water. Reducing wildfire potential would also 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. Adverse impacts on surface water quality due to construction on the canyon walls and access control and traffic improvements near the watercourse would be minimized through the implementation of a storm water pollution 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, due to the removal of contaminants found in the drainage pathway from a chemical (polychlorinated biphenyls) storage area and the outfalls. There would be a negligible adverse effect from increased storm water runoff over the new impervious road surfaces that would allow additional flows containing potential contaminants.

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. The TA-46 Sanitary Wastewater System Plant would have a minor beneficial impact on surface water quality and quantity in Sandia Canyon due to reduced NPDES outfall volumes and associated contaminants from the implementation of the effluent recycling project for cooling towers at the Metropolis Center (LANL 2006).

Key Facilities Impacts

Sigma Complex

At the Sigma Complex, one cooling tower NPDES outfall (03A024) would be removed (LANL 2006). 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 2006).

High Explosives Processing

At the High Explosives Processing Facility, one NPDES outfall (05A097) would be removed (LANL 2006). 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 Facility (05A055) at TA-16 and the cooling water outfall (03A130) at TA-11 would continue discharging treated effluent into Water Canyon (LANL 2006).

High Explosives Testing

At the High Explosives Testing Facility, implementation of the Dynamic Operations Complex Enhanced Containment would reduce potential 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 by reducing the potential contaminants that could be mobilized by storm water.

Los Alamos Neutron Science Center

At the Los Alamos Neutron Science Center (LANSCE), a project to upgrade the cooling towers would result in a reduction in the number of cooling tower outfalls at the facility from four to two. 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 impacts on surface water quality and quantity from those actions discussed under the No Action Alternative would still take place under the Reduced Operations Alternative, except those explicitly associated with the reduced ordinance operations.

Key Facility Impacts

Under the Reduced Operations Alternative, impacts to surface water quality would be the same as described under the No Action Alternative with the exception of those impacts described below. There would be little or no effect on floodplains from changes to Key Facilities.

High Explosives Processing

Reduced operations at the High Explosives Processing Facilities 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 of 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 result in significant beneficial impacts to surface water.

High Explosives Testing

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 the LANSCE Facility may be short-term or permanent. Shutdown of the LANSCE facility would result in a significant change to 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. The shut down of the LANSCE facility would also slightly affect Sandia Canyon; the change would be approximately 1 percent less effluent flow than under the No Action Alternative. In both canyons, this would have a beneficial impact on surface water quality in Los Alamos Canyon, because reduced flows would potentially mobilize fewer contaminated sediments.

5.3.1.3 Expanded Operations Alternative

Surface water quality and quantity impacts from those actions discussed under the No Action Alternative would still take place under the Expanded Operations Alternative.

Los Alamos National Laboratory Site-Wide Impacts

There would be beneficial impacts to surface water quality following remediation of the MDAs. 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 a storm water pollution prevention plan 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 even more than the No Action Alternative, because more potential contamination sources at the MDAs would be stabilized or removed (see Appendix I).

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 contaminant 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 have 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 RLWTF, two bridges, other building construction, and demolition of the existing annexes would have little or no adverse impact on surface water quality, due to the installation of storm water management and erosion and sediment controls based on compliance with a site-specific storm water pollution prevention plan and LANL's construction specifications.

Radioactive Liquid Waste Treatment Facility

Proposed increased discharges from the RLWTF outfall as a result of increased activity at facilities that generate radioactive liquid waste (see Table 5–5) would result in about 2.5 percent higher effluent discharge rate into Mortandad Canyon, compared to the No Action Alternative. RLWTF effluent currently accounts for about 12 percent of the discharges into Mortandad Canyon and this percentage of overall flow contribution to the canyon would increase in the future. Contaminant transport through sediment mobilization could be enhanced due to the outfall discharge rate increases. Cooling water discharges are the only other LANL effluents introduced into Mortandad Canyon.

Operation of a new RLWTF would have a beneficial impact on surface water quality, as the improved low-level radioactive waste and transuranic waste processes would reduce the contaminant concentrations in the effluent discharged into Mortandad Canyon, and could meet potentially more stringent future water quality standards. Improved surface water quality in RLWTF discharges would reduce the introduction of low levels of radioactive and chemical constituents in an already contaminated canyon reach. One option for the new RLWTF is to eliminate discharges into Mortandad Canyon. If the facility becomes a zero discharge facility, then surface water quality would be positively affected. Elimination of effluent flows into the canyon at the RLWTF 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 RLWTF outfall is 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 possibly 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

This section addresses potential impacts to groundwater quality in terms of releases that could enter the groundwater over time and potentially contaminate it. The impacts from liquid effluent releases to the canyons and from solid radioactive waste disposal on the mesa tops are evaluated. Use of groundwater to support LANL operations is addressed in Section 5.8.2, Utility Infrastructure.

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 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 either beneficially or adversely affected 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 in storage in the ground; conversely, uncontaminated surface water infiltrating into already contaminated groundwater would facilitate 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 nondrinking 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 water borne contaminants interact with and move through rock fractures and the rock matrix into the regional aquifer below LANL. There 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. As discussed in Section 4.3.2, chromium contamination was recently discovered in groundwater wells in Mortandad Canyon. LANL is developing an Interim Measures Work Plan that will include assessments of historical pumping, groundwater gradients, and effluents discharges. Analyses, and field and experimental data will continue to be refined to support the development of corrective measures studies required by the Consent Order and the maintenance of MDA performance assessments and composite analyses, with an emphasis on reducing important uncertainties in the analyses. 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.

Recent drilling and new characterization efforts in the vicinity of LANL has resulted in modification of conceptual models that were developed in the past. In 2005, a series of reports of investigations in the Vadose Zone Journal developed conceptual models and discussed flow and transport through the vadose zone to perched ground water bodies and the regional aquifer below LANL. Many of the reports from this series are discussed in Appendix E. The reports describe the need for additional investigations (Newman and Robinson, 2005), the geologic framework of the groundwater system at LANL (Broxton and Vaniman 2004), and components of the conceptual models (Birdsell et al. 2005, Levitt et al. 2005, McLin et al. 2005, and Kwicklis et al. 2005). A LANL report by Rogers and Gallaher (2005) is also used for developing conceptual models. Numerical simulations were run, integrating the older data with new data to verify and modify previous conceptual models (Robinson et al. 2005a, 2005b, and 2005c, and Keating et al. 2005). These preliminary studies are helping to develop insight into the hydrologic properties of the regional aquifer.

LANL will be conducting future data collection activities, along with analysis of existing data. This will help to better define the interaction between groundwater and the rock matrix. It is anticipated that the new data, coupled with improvement 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. This new information is being used to update the performance assessment and composite analysis for MDA G.

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 the groundwater resource 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 in nature.	Similar to the No Action Alternative in terms of construction and DD&D activities. Long-term impacts as a result of operations might be reduced by elimination of additional outfalls in the canyons.	Similar to the No Action Alternative plus: MDA Remediation: − The effects of capping or removal of waste from the 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

There would be no changes 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, compared to the large volume of water already in storage in the alluvial aquifer, which would dilute any potential contamination to below significant levels.

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 produce any effect in the regional aquifer. As discussed in Section 5.3.1, discharges as a result of LANL operations are monitored to ensure that effluents to surface waters are kept below regulatory limits.

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 infiltration rates for dry mesas are considered to be less than 0.4 inches per year (10 millimeters per year) and are more often estimated to be on the order of 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. However, site disturbance can alter how quickly water moves through the vadose zone (Birdsell et al. 2005).

Groundwater modeling was performed for a performance assessment and composite analysis prepared for radioactive waste disposal at MDA G (LANL 1997a). The analysis assessed impacts assuming 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. There were 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. Projected groundwater ingestion doses 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 MDA 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. This is 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 is to close MDA H in place and cover with an engineered barrier. The engineered cover would be designed, constructed and maintained in order to limit infiltration and to 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 from implementing this closure option over the next 1,000 years (DOE 2004e).

5.3.2.2 Reduced Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Most impacts identified as occurring under the No Action Alternative to groundwater resources would also occur under the Reduced Operations Alternative. Long-term impacts might be reduced by elimination of some outfalls in the canyons, but no quantitative estimate of the reduction or its rate can be predicted at this time.

5.3.2.3 Expanded Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Impacts identified as occurring under the No Action Alternative to groundwater resources would also occur under the Expanded Operations Alternative. 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.

Possible impacts to groundwater resources will be addressed as part of any required corrective measure evaluation to be performed for MDAs and other PRSs in accordance with the Consent Order. A corrective measure evaluation for an MDA would consider alternatives including 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 PRS subject to the Consent Order), and a decision on the remedy to be applied would be made by NMED. A corrective measure evaluation performed for MDA G in TA-54 would be coordinated with the update to the performance assessment and composite analysis that is currently under preparation. This update would consider the application of a final cover over the disposal units, and would also update information about the site and the contents of the disposal units.

The effects of either a capping or 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 very long-term migration of contaminants and corresponding impacts on the environment, from wastes present in the MDAs. Where engineered barriers are used to cap MDAs, under the MDA Capping Option, they would be designed, constructed and maintained in order to limit infiltration. Over the long-term, the covers, by limiting infiltration, would slow contaminant migration from the MDAs. Excavation and removal of the waste and contaminated soil and rock, under the MDA Removal Option, would eliminate nearly all of the source term. However, the filled, compacted excavation may still experience larger infiltration rates (for a time) 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 introduction, directly or indirectly, 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. They may be in the form of solid particles, liquid droplets, gases, or a combination of these 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, allowing 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 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 Title 40 of the *Code of Federal Regulations,* Part 50 (40 CFR 50), “National Primary and Secondary Ambient Air Quality Standards.” Hazardous air pollutants and other toxic 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.*]), those regulated by the National Emissions Standards for Hazardous Air Pollutants (40 CFR 61), and those that have been proposed or adopted for regulation by the applicable state or are listed in state guidelines or permit regulations. 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 includes 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. The results of this analysis bound the potential impacts associated with the alternatives addressed in this SWEIS. Potential differences from 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, a 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, when 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 impact of criteria pollutant emissions from construction activities for various projects was 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.

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. Because LANL's toxic air pollutant emission rates are relatively low (compared to releases from production facilities), vary greatly, are released from hundreds of sources spread out over a large geographic area, and are well below the state's permitting threshold limits, toxic air pollutant emissions are not monitored.

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 potentially be emitted from each of LANL's technical areas and that would not result in air quality levels 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 potential air quality impacts of toxic air pollutants from LANL operations. Any pollutant with the potential to 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.

5.4.1.1 No Action Alternative

This section describes the estimated non-radiological air quality impacts from LANL operations under the No Action Alternative. The discussion includes estimated impacts from nonradiological air emissions. Radiological air emissions and their impacts on human health are discussed in Sections 5.4.2 and 5.6.1, respectively.

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: − Minor increases in air pollutant emissions could result from increases in commute distances. Power Grid Infrastructure Upgrade 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 Project: − 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 these would occur in new locations. − Minor to moderate air quality impacts would result from remediating MDAs and other PRSs.
Affected Technical Areas			
TA-3	− Minor change in air quality impacts from operation of new turbine generators. − Minor air quality impacts from constructing 3 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 Center for Weapons Programs Research.
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 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 (TA-3, TA-48, and TA-55)	– Minor air quality impacts from construction of new facility at TA-55.	Same as No Action Alternative	Same as No Action Alternative
High Explosives Processing Facility	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.
High Explosives Testing Facility	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 Facility (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 shut down of activities.	– Minor reduction in operation air quality impacts from shut down 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 shut down 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 Transuranic Waste Processing Facility and new access control station, low-level radioactive waste compactor building, and 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 TA-55 Reinvestment Project, and constructing radiography capabilities (see Appendix G).

MDA = material disposal area, PRS = potential release site, TA = technical area, DD&D = decontamination, decommissioning, and demolition, LANSCE = Los Alamos Neutron Science Center,

Los Alamos National Laboratory Site-Wide Impacts

Minor impacts on non-radiological air quality would occur from construction-type activities related to previously approved projects including construction of the power grid infrastructure upgrade, Wildfire Hazard Reduction Program activities, disposition of flood and sediment retention structures, activities related to the Trail Management Project, mechanical and manual Wildfire Hazard Reduction Program activities, and construction related to the Security Perimeter Project. These projects would result in temporary 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 results of the modeling 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, 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 emission limits specified in the air quality permit, 100 tons (91 metric tons) per year and 81 tons (74 metric tons) per year, respectively (NMED 2004c, Jacobsen, Johnson, and Rishel 2003, DOE 2002l). These emission limits were used in this site-wide analysis.

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).
Source: Jacobson, Johnson, and Rishel 2003.

For criteria pollutants, the concentrations from No Action Alternative operations would be less than 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.

Similarly, for toxic air pollutants, the bounding analyses (based on the emission rates evaluated in the *1999 SWEIS*) indicate that the pollutant emissions with the potential to 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.
- The additive emissions from all of the pollutants from all technical areas on receptor sites located near the Los Alamos Medical Center (DOE 1999a).

In the *1999 SWEIS*, emissions from high explosives testing site operations under the No Action Alternative were projected to be the same as the emissions projected under the Expanded Operations Alternative and this projection is similar to anticipated emissions from high explosives testing site operations under the No Action Alternative in this SWEIS. The emissions from high explosives testing site operations are shown in **Table 5–9**.

These emissions are estimated to result in toxic air pollutant concentrations that are above guidance values, indicating that a human health analysis should be performed. This human health analysis (Section 5.6.2) indicated that the nonradiological pollutants released from LANL high explosives testing site 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 some high explosives tests has reduced emission from these shots by 50 to more than 80 percent. Increased use of foam and vessels for explosives testing is expected to further reduce these emissions (LANL 2006)

A minor increase in vehicle emissions could result from development that occurs under Land Conveyance and Transfer. This increase is not expected to result in concentrations of pollutants that would threaten 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 estimated based on the existing permit applications as shown in **Table 5–10**. The results of the analysis with regard to public health are discussed in Section 5.6.2.

Table 5–9 Estimated Emission Rates of the Pollutants that Have the Potential to be Released from High Explosives Testing Sites

TAs with High Explosives Testing Operations [a]	*Pollutants that Have the Potential to be Released During Testing Operations*	*Estimated Maximum Amount of Material that Will 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 Have the Potential to be Released During Testing Operations*	*Estimated Maximum Amount of Material that Will 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.

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	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 non-radiological air quality impacts would occur from the 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 non-radiological air quality impacts would occur from the construction of the Chemistry and Metallurgy Research Building Replacement at TA-55, completion of 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 Building Replacement, 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 result in an increase in 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 are primarily associated with heating of facilities and providing electric power.

Chemistry and Metallurgy Research Building

Operation of the Chemistry and Metallurgy Research Building Replacement 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 Building 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 23.9
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 concentrations were analyzed at the site boundary and at the fence line of the technical area to which the public has short-term access. Since 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 2003f.

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 analyzed in the *1999 SWEIS* for the Expanded Operations Alternative. Emission estimates for the Plutonium Facility Complex for 2004 included about 0.85 tons (0.77 metric tons) per year of hazardous air pollutants, which is well below the 14.6 tons (13.2 metric tons) per year evaluated in the *1999 SWEIS* (DOE 1999a, LANL 2005g). 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. However, the impacts of hazardous air pollutant emissions under the No Action Alternative would be less than analyzed.

5.4.1.2 Reduced Operations Alternative

Non-radiological air quality impacts anticipated to occur from the activities associated with the No Action Alternative would still occur under the Reduced Operations Alternative with exception of those actions explicit 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, the Reduced Operations Alternative operation overall emission rates would likely be lower than those under the No Action Alternative as a result of 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 shutdown if LANSCE were shutdown, the 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.

Similarly, for toxic air pollutants, the number of high explosives experiments each year under the Reduced Operations Alternative would be less than for the No Action Alternative. As discussed in the No Action Alternative (Sections 5.4.1.1 and 5.6.2.1), these emissions would result in 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 usage projected under the No Action Alternative. As discussed for the No Action Alternative, this use level is expected to 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, the release of toxic air pollutants released under the Reduced Operations Alternative are not expected to cause air quality impacts that would affect human health and the environment.

Technical Area Impacts

Construction- and operations-related air quality impacts would be the same as under the No Action Alternative, except as described below in relations to Key Facilities.

Key Facilities Impacts

Construction-related non-radiological air quality impacts from Key Facilities would be the same as under the No Action Alternative.

High Explosives Processing and High Explosives Testing

A minor reduction in operational impacts would be expected from the 20 percent reduction in High Explosives Processing and High Explosives Testing activities. This could result in a reduction of about 0.05 tons (0.045 metric tons) per year of hazardous air pollutant emissions from High Explosives Testing and 0.2 tons (0.18 metric tons) per year from high explosives processing.

Los Alamos Neutron Science Center

Implementing the Reduced Operations Alternative for LANSCE at TA-53 would result in the shut down of that facility, and a reduction in emissions from the TA-53 boilers.

Pajarito Site

Shut down of operations at the Pajarito Site (TA-18) would also reduce emissions. This would result in a minor positive affect on overall air quality.

5.4.1.3 Expanded Operations Alternative

Non-radiological air quality impact that would occur from activities associated with the No Action Alternative would still occur under the Expanded Operations Alternative.

Los Alamos National Laboratory Site-Wide Impacts

Under the Expanded Operations Alternative, there would be emissions of criteria and toxic 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 total period of time as various facilities are constructed, demolished, and closed. In addition to the construction activities described for the No Action Alternative, there would be construction of various new buildings in various technical areas; DD&D of buildings; road, bridge, and walkway construction under the Security-Driven Transportation Modifications; and MDA remediation (as described in Appendix I) that would result in temporary increases in air pollutant concentrations at the site boundary and along roads to which the public has access. These impacts, except from MDA activities, would be similar to the impacts of other recent construction-type 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 occur near the site boundary. 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 and TA-61 borrow pit which in some cases 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 (MDA-A, -B, -T, and –U), concentrations at the site boundary near the Los Alamos town site were estimated to be above the 1-hour ambient standard for carbon monoxide and the 24-hour standard for nitrogen dioxide. Also, for the Removal Option at TA-54 (MDA G) concentrations at the site boundary near White Rock were estimated to 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 particulate matter less than or equal to 10 microns in diameter (PM_{10}) concentrations from Removal at MDA G would be more than 80 percent of the ambient standard. Concentrations under the Capping option at MDA G would be about 6 percent of those under the Removal Option. The overall emissions from heavy equipment for the Removal Option were estimated to be more than 20 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 a containment structure. Other emissions would be reduced by management controls and scheduling such that impacts on the public are minimized.

Changes in LANL operations proposed under the Expanded Operations Alternative, including relocation of existing operations, reinvestment 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 air pollutants for this new SWEIS were assessed based on the analysis on the *1999 SWEIS* Expanded Operation Alternative. In all but two cases, the estimated toxic 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 (these were referred to the human health and ecological risk assessment processes for further analysis) were High Explosive Firing Site operations and the additive emissions from all pollutants from all technical areas 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 due to LANL operations on receptor sites located near the Los Alamos Medical Center would likely be reduced.

Minor changes in vehicle emissions could result from the Security-Driven Transportation Modifications. A small increase from shuttle bus emissions could be partially offset by a decrease from less use of personally owned vehicles.

Technical Area Impacts

Construction nonradiological air quality impacts would be the same as under the No Action Alternative for specific technical areas (TA-3, TA-21, and TA-54), except there would be additional temporary construction impacts from additional office buildings and the Center for Weapons Programs Research at TA-3, minor construction impacts from DD&D of TA-18 buildings, and temporary construction impacts from the Science Complex and the Remote Warehouse and Truck Inspection Station. Construction impacts would occur during daytime hours from construction equipment operations and fugitive dust generation.

Operational nonradiological air quality impacts from specific technical areas (TA-3, TA-21, and TA-54) would be similar to those under the No Action Alternative. There would be a potential decrease in emissions from reduced intra-facility vehicle trips related to the Science Complex and a potential decrease in emissions from reduced delivery trips as a result of the new Remote Warehouse and Truck Inspection Station.

Key Facilities Impacts

Construction 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 with construction of the Institute for Nuclear Nonproliferation Science and Technology, construction of a replacement for RLWTF at TA-50, DD&D of the existing RLWTF, retrieval of transuranic waste from below ground storage at Solid Radioactive and Chemical Waste Facilities, construction of a new Transuranic Waste Processing Facility and other buildings, and minor facility modifications 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 RLWTF, the new Transuranic Waste Processing Facility, and new office buildings at TA-55 would not be expected to result in an increase in emissions of criteria pollutants because a comparable amount of space would be removed through DD&D. These emissions are primarily associated with heating of facilities and providing electric power. Operational nonradiological air quality impacts from other Key Facilities would be the same as under the No Action Alternative.

High Explosives Processing

There would be a minor increases in operation impacts from the 2.5 percent increase in High Explosives Processing activity. This could result in an increase of about 0.03 tons (0.027 metric tons) per year of hazardous air pollutant emissions from High Explosives Processing.

Tritium Facility

Operations related emissions from three boilers at TA-21 would be eliminated resulting in a reduction of as much as 1.6 tons (1.5 metric tons) per year of nitrogen oxides (about 3.2 percent of nitrogen oxides emissions at LANL), 0.12 tons (0.11 metric tons) of particulates, (about 2.5 percent of LANL total), and 1.3 tons (1.2 metric tons) of carbon monoxide emissions (about 3.7 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 the continued operation of LANL are 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). That impacts assessment is presented in Section 5.6. The following assessment of radiological air quality impacts is an intermediate step in developing the estimates of dose. The impacts are presented here as the projected quantities of radionuclides emitted under each alternative.

Radioactive air emissions from LANL come from both point sources, such as stacks and vents, and diffuse or nonpoint 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 facilities and certain radionuclides dominate the human health effects and are therefore those on which this analysis is focused. These include gaseous mixed activation products associated with LANSCE operations and tritium, plutonium, americium, and uranium associated with a number of the 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.

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	0.00082	0.00084 [d]
Uranium [f]	0.15	0.12	0.15
Particulate and Vapor Activation Products	30	0.014	30
Gaseous Mixed Activation Products	30,500	100 [g]	30,500 [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 would decrease to 1,850 curies per year starting in 2009 following decontamination, decommissioning, and demolition of TA-21.

[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 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 starting in 2009 due to the shutdown of TA-18, resulting in zero gaseous mixed activation product emissions for the Reduced Operations Alternative and 30,400 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 a containment structure (see Appendix I).

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 technical area 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 are generally projected to remain at levels similar to those projected in the *1999 SWEIS* Expanded Operations Alternative.

Chemistry and Metallurgy Research Building

As a result of a decision not to move certain capabilities to the Chemistry and Metallurgy Research Building, tritium is no longer projected to be a significant emission from this building.

Radiochemistry Facility

Based on actual emissions from 1999 to 2004, 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 that has been developed based on 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 technical area 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 as compared to the No Action Alternative (see Section 5.6).

High Explosives Processing and High Explosives Testing

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 impact on emissions would be the cessation of LANSCE operations. The emission of particulate and vapor activation products would be reduced by about 30 curies per year; the remaining 0.014 curies per year shown on Table 5–12 would be from the Radiochemistry Facility. The shutdown of LANSCE would also eliminate the emission of about 30,400 curies per year of gaseous mixed activation products.

Pajarito Site

The cessation of operations at TA-18, in particular, shutdown of SHEBA, would result in a reduction of the remaining gaseous mixed activation product emissions (100 curies per year). Cessation of TA-18 operations is assumed to occur in 2009.

5.4.2.3 Expanded Operations Alternative

Implementation of the Expanded Operations Alternative would result in some decreases in emissions of radiological constituents associated with the closure and DD&D of certain facilities. There would also be both long-term and short-term increases in emissions. The long-term increases would be associated with higher levels of activities at certain facilities. The short-term increases could occur during construction or DD&D activities and also 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 largest emissions would be from the remediation of the large MDAs; those are the focus of the analysis in Appendix I. Remediation of other PRSs is expected to produce less than the potential emissions from remediating the large MDAs. 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 with removal resulting in higher emissions than capping.) Under the removal option, varying radiological air emissions would be expected depending on the inventory of the MDA being remediated and whether or not exhumation would occur inside a containment structure equipped with a filtered exhaust system. Under the capping option, improved 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 being implemented. All of these factors would affect quantity and timing of releases of radiological constituents, resulting in variable releases over time. Although the releases would vary over time and be dependent on the remediation option selected, Section 5.6 presents an estimated dose for the option of removing all of the MDAs and the assumption that some of the removal actions would occur in a containment structure with a filtered exhaust.

Technical Area Impacts

A number of the projects analyzed in Appendices G, H, and J involve construction activities that would result in excavation activities, the DD&D of buildings, or both. These actions have the potential for minor increases in emission of radiological contaminants for short durations. The potential for these emissions would be minimized through the conduct of radiation surveys before actions begin and the use of a range of contamination control techniques which may include decontamination, application of dust suppressants, and use of containment structures. Consequently, these actions generally would not be expected to result in appreciable increases in emissions. Effects on radiological emissions associated with the TA-21 Structure DD&D are discussed as part of the Tritium Facility under the Key Facilities Impacts.

Key Facility Impacts

Under the Expanded Operations Alternative there would be both increases and decreases to projected emissions from Key Facilities. In addition, the location of some emission sources would change. As discussed above under Technical Area Impacts, construction and DD&D activities may result in minor, short-term increases in radioactive emissions. Similar minor, temporary increases in emissions may occur in connection with projects at Key Facilities.

Chemistry and Metallurgy Research Building

The Chemistry and Metallurgy Research Building Replacement TA-55 is expected to be completed and operational in 2014. With the exception of the Wing 9 hotcell, 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 hotcell capabilities would be moved to the Radiological Sciences Institute when it is available. Therefore, there would be no net change in projected radioactive emissions; however, the location of the emissions would change.

Pajarito Site

The TA-18 Pajarito Site closure would eliminate the primary source of emissions from that site, SHEBA. Therefore, starting in 2009, when SHEBA is not expected to be active at LANL, the emissions would be reduced by 100 curies per year (of argon-41) resulting in site-wide emissions of 30,400 curies per year of gaseous mixed activation products. The TA-21 Structure DD&D would include buildings that constitute part of the Tritium Facility. DD&D of structures at TA-21 would eliminate them as a source of emissions. This would reduce projected tritium emissions starting in about 2009 by 550 curies per year to 1,850 curies per year.

Plutonium Facility Complex

Addition of capabilities and increases in levels of operations under the Expanded Operations Alternative would not appreciably affect emissions from most of the Key Facilities. However, increases in the level of activities at the Plutonium Facility Complex, including producing up to 50 pits per year under single-shift operation (80 pits per year using multiple shifts), would result in a small increase in plutonium emissions. The higher level of activity would result in the annual emission of 0.00084 curies per year of plutonium as shown on Table 5–12.

Solid Radioactive and Chemical Waste Facilities

Implementing the Waste Management Facilities Transition Project (see Appendix H) could result in a temporary increase in emissions. Implementation of the project may result in the simultaneous operation of the temporary remote-handle transuranic waste retrieval facility, the new Transuranic Waste Consolidation Facility, and the existing Decontamination and Volume Reduction System (DVRS). 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 time frame until remote-handle transuranic waste retrieval is completed and the DVRS is shut down in support of the remediation of MDA G.

5.4.3 Noise Impacts

Noise, or 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 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 preventing 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 2004e).

Noise standards related to protecting worker hearing are contained in LANL's *Noise and Temperature Stresses – Laboratory Implementation Requirements* (LANL 2003a). 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 2003a). 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 2004e).

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, including 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. 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. Potential noise impacts of traffic were assessed based on the likely increase in traffic volume. Possible impacts on wildlife were evaluated 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 the 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 that is implemented. There is no single representative measurement of ambient noise available for the LANL site. For a description of existing noise levels, see Section 4.4.5.

Background levels of noise associated with LANL activities under any of the three alternatives would not likely approach the upper limit for sound levels in the community based upon 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, such as the operation of bulldozers, loaders, backhoes, and portable generators, typically produces noise with mean levels ranging from 81 to 85 dBA at 50 feet (15 meters). For a comparison with these noise levels, normal conversation is usually conducted at a sound level of about 60 dBA (FICN 1992). If heavy machinery were to be operated over an 8-hour period producing noise at levels above 85 dBA constantly, it would be considered unsafe for workers. However, these noises are generally produced for short time periods or even sporadically. 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 mostly noticed by LANL workers at the site performing those activities; these workers would also 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: − Could cause minor increases in traffic noise due to development. − Minor noise impacts could result from development. Power Grid Infrastructure Upgrade: − 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: − 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 options. 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 change in noise impacts from operation of new turbine generator. − Minor construction noise impacts from constructing 3 new office buildings. − Negligible operation noise impacts from new office buildings.	Same as No Action Alternative	Same as No Action Alternative, plus: − Minor construction equipment and traffic noise impacts from constructing Center for Weapons Physics Research and Replacement Office Buildings. − Negligible operational noise impacts from equipment at Center for Weapons Physics Research and Replacement Office Buildings.
TA-21	No change in noise impacts	Same as No Action Alternative	Minor construction equipment noise impacts from DD&D of structures. Some increase in traffic noise 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
TA-72	No change in noise impacts	Same as No Action Alternative	Minor construction equipment and traffic noise from constructing Remote Warehouse and Truck Inspection Station. Possible noticeable noise to public along East Jemez Road from

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
			operation of Remote Warehouse and Truck Inspection Station.
		Key Facilities	
Chemistry and Metallurgy Research Building Replacement (TA-3, TA-48, and TA-55)	– Little or no change in impacts from Chemistry and Metallurgy Research Building Replacement operation when moved to TA-55. – Minor construction equipment and traffic noise impacts from DD&D of old facility at TA-3 and construction of new facility at TA-55.	Same as No Action Alternative	Same as No Action Alternative
High Explosives Processing Facility	– No change in operation noise impacts. – Minor construction equipment and traffic noise impacts from TA-16 Engineering Complex and demolition of structures.	Same as No Action Alternative	Same as No Action Alternative
High Explosives Testing Facility	– No change in operation noise impacts. – Minor construction equipment and traffic noise impacts from construction of 15 to 25 new structures (new offices, laboratories, and shops) within the new Science Complex to replace about 59 structures currently used for dynamic experimentation operations, and removal or demolition of vacated structures.	Minor reduction in operation noise impacts from 20 percent reduction in activities. Same as No Action Alternative for construction.	Same as No Action Alternative
Tritium Facility (TA-21)	No change in noise impacts	Same as No Action Alternative	– Minor construction equipment and traffic noise impacts 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 from shut down of activities.	– Minor reduction in operation noise impacts from shut down of activities. – Minor construction equipment and traffic noise impacts from DD&D of TA-18 buildings.
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 with transfer of the Bioscience Facilities operations to the new Science Complex. – Minor construction noise impacts from construction of the new Science Complex.

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
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 (see Appendix G).
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 (see Appendix G) and DD&D of 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 Transuranic Waste Processing Facility (as described in Appendix H) 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	Same as No Action Alternative	– Minor construction equipment and traffic noise impact from minor facility modifications in support of increased pit production and Plutonium Complex Refurbishment Project, and constructing radiography capabilities (see Appendix G).

MDA = material disposal area, TA = technical area, DD&D = decontamination, decommissioning, and demolition, LANSCE = Los Alamos Neutron Science Center.

Noise from LANL construction-type activities may be somewhat noticeable to nearby members of the public. Environmental restoration activities that occur at 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 would not likely result in an adverse impact to the public. Nor are the noise levels likely to adversely affect sensitive wildlife receptors or their habitat. 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, these activities would need to be scheduled outside of the species' breeding season, or else, 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-type activities, including the construction of previously approved projects such as the Power Grid Infrastructure Upgrade, Wildfire Hazard Reduction Program activities, disposition of flood and sediment retention structures, activities related to the Trail Management Project, and construction for the Security Perimeter Project. These construction projects would result in temporary increases in noise from equipment and traffic.

Similarly, workers, the public or sensitive wildlife receptors would not likely be adversely impacted by explosives testing that is common to some degree over 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 technical areas 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 intensity, and air blast and ground vibrations are not expected to be present offsite of LANL at intensities great enough to adversely affect real properties. Sensitive wildlife species would not likely be adversely affected by "thunder-like" explosives testing events given their continued presence in areas over parts of the country that are known to be within higher-than-average lightning event areas, and their continued presence at LANL over the past 10 years. In fact, the continued well being of LANL's resident and long-term migratory populations of these sensitive species indicates that the level of noise generated by explosives testing under the No Action Alternative is at least tolerable by these particular species.

Implementing the No Action Alternative would likely result in the previously discussed operation effects common to all alternatives. Specifically for the No Action Alternative, a minor increase in vehicle noise could result from development that occurs under land conveyance and transfer.

Technical Area Impacts

Minor construction-related noise impacts would occur from the construction of 3 new office buildings at TA-3 and MDA H closure activities at TA-54. Minor operations-related noise impacts would occur as a result of 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 the operation of construction equipment for the construction of the Chemistry and Metallurgy Research Building Replacement 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 Science 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, and from the operation of heating, ventilation, and cooling systems, and other equipment at other new facilities including new structures for dynamic explosion operations and a new dynamic explosion structure at TA-15 associated with 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 as 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 under the Reduced Operations Alternative would be similar to the No Action Alternative. The primary noise, air blast waves, and ground vibration impacts from the 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 be occasional (rather than continuous) events. Effects would be similar to those currently generated whenever there is a high explosives test. Noises associated with LANSCE and TA-18 operations would be eliminated with the shut down of those facilities.

Technical Area Impacts

Construction- and operations-related noise impacts would be the same as under the No Action Alternative.

Key Facilities Impacts

Noise impacts from construction equipment and traffic from Key Facilities would be the same as under the No Action Alternative. A minor reduction in operational noise impacts would occur from the reduction in high explosives testing, and the shut down of activities at TA-18 (Pajarito Site), and LANSCE at TA-53.

5.4.3.3 Expanded Operations Alternative

Noise impacts associated with activities considered under the No Action Alternative would still occur under the Expanded Operations Alternative.

Los Alamos National Laboratory Site-Wide Impacts

Under the Expanded Operations Alternative, there would be an increase in the amount of interior and outdoor construction activities at LANL. These would individually be within the level of effects described for the No Action Alternative, but could be ongoing for a longer total period of time. In addition to the construction activities discussed for the No Action Alternative, construction of various new buildings in various technical areas; DD&D of buildings; road, bridge, and walkway construction under the Security-Driven Transportation Modifications; and MDA remediation as 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 (Appendix J) would be short term and similar to other roadway construction at LANL. Activities at MDAs which are close to the site boundary, such as at TA-21, could result in increases in noise levels sufficient to result in increased 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 shipment, and a minor to moderate increase in truck traffic noise from the MDA remediation options, especially along East Jemez Road near the Royal Crest Mobile Home Park. Other proposed construction activities under this alternative would include small-scale outdoor activities, work interior to existing buildings, construction of an addition to an existing building, construction of a new building within close proximity to others, and construction at specific technical areas and Key Facilities described below. Effects of these construction activities would be primarily limited to involved workers and would not likely result in any adverse effect on sensitive wildlife species or their habitat.

The largest increases in traffic noise from construction type activities would be associated with remediation of MDAs. Estimated increases in traffic along Pajarito Road could be substantial during years when remediation of MDA G is occurring. A similar increase in traffic along Route 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. Since 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. Since most of the increase in traffic would be from personnel vehicles, much of the increase in traffic and associated traffic noise would occur during the peak traffic hours. Increases in traffic along East Jemez Road, near the Royal Crest Mobile Home Park, could also be substantial during years when remediation of MDA G (capping and removal options) is occurring. The associated increase in traffic noise may be noticeable to residents at the Royal Crest Mobile Home Park due to the increase in truck and personnel vehicle trips.

As discussed in the No Action Alternative, the primary noise from the implementation of these alternatives would be generated by the air blast waves and ground vibration impacts associated with high explosives tests, although these explosions and the resulting noise would still 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. Effects of these operational activities would be primarily limited to involved workers and would not likely result in any adverse effect on sensitive wildlife species or their habitat, 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, especially at the Royal Crest Mobile Home Park under one of the options 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 technical areas (TA-3, TA-18, TA-21, and TA-54), except for a minor increase in traffic noise levels from construction employees' vehicles and materials shipment and a minor increase in noise levels at nearby businesses from DD&D at TA-21. Construction noise impacts would result from the same activities as under the No Action Alternative, with impacts from construction of additional office buildings and the Center for Weapons Programs Research at TA-3, minor impacts from DD&D of TA-18 buildings, DD&D at TA-21 and construction of the Remote Warehouse Truck Inspection Station. Effects of these construction activities would be primarily limited to involved workers and would not likely result in any adverse effect on sensitive wildlife species or their habitat.

Operational noise impacts would occur from the same type of activities as under the No Action Alternative, with minor changes to impacts from relocated and consolidated activities across the various technical areas. Possible noticeable noise to the public along East Jemez Road could occur from operations of the Remote Warehouse Truck Inspection Station.

Key Facilities Impacts

There would be no change 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-type employees' vehicles and materials shipment. Construction noise impacts from Key Facilities would be the same as under the No Action Alternative, with minor impacts 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 RLWTF at TA-50; DD&D of existing RLWTF; retrieval of transuranic waste from below ground storage at Solid Radioactive and Chemical Waste Facilities; construction of a new Transuranic Waste Processing Facility and associated buildings; and minor facility modifications at TA-55. 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 habitat. 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.

Operational noise impacts for Key Facilities would result from the same activities as 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 from the transfer of the Bioscience Facilities operations to the new Science Complex, and operations of the Radiological Sciences Institute, the replacement RLWTF, the new Transuranic Waste Processing Facility, and new office buildings at TA-55. Noise impacts, therefore, from Key Facilities operations would likely be about the same as for the No Action Alternative for activities associated with the Expanded Operations 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 in order 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 occur as a result of land disturbance, water use and discharge, human activity, and noise associated with project implementation. Each of these factors was considered when evaluating potential impacts from a Proposed Action. 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 construction due to erosion were evaluated qualitatively, recognizing that standard erosion and sediment control practices would be followed.

Of particular importance in evaluating potential impacts on protected and sensitive species is the effect that a proposed project could have on the species' habitat. Accordingly, LANL has established Areas of Environmental Interest for three species – the southwestern willow flycatcher (Federal and state endangered), bald eagle (Federal and state threatened), and Mexican spotted owl (Federal threatened and state sensitive) (LANL 2000e). Areas of Environmental Interest for these species include core and buffer zones, each of which has certain restrictions aimed at protecting both the species and its habitat. Accordingly, impacts to the bald eagle, southwestern willow flycatcher, and Mexican spotted owl were evaluated based on whether a proposed project, or a project element, would affect either of these zones.

This section addresses the impacts of the No Action, Reduced Operations, and Expanded Operations Alternatives on Ecological Resources. A summary of impacts is presented in **Table 5–14**.

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: – 2,255 acres (913 hectares) of land within the piñon-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. Power Grid Upgrades: – Minimal effects on vegetation. – Temporary impacts such as disturbance from construction activities, on wildlife. – Potential positive impact by 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. – Potential 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. Security-Driven Transportation Modifications Project: – Parking lot construction and placement of pedestrian and vehicle bridges under all alternatives would remove 30 acres (12 hectares) of natural vegetation. – A section of new roadway under one Auxiliary Action B would remove about 1.3 acres (0.5 hectare) of natural habitat plus additional limited acreage for the bridge footings, if built. – Bridges and traffic over the core zone of the Sandia-Mortandad Canyon Mexican spotted owl AEI have the potential to cause long-term impacts. Section 7 consultation with the U.S. Fish and Wildlife Service 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.
TA-21	No change in impacts to ecological resources.	Same as No Action Alternative.	TA-21 DD&D: – Short-term construction impacts on wildlife in adjacent areas.
		Key Facilities	
Chemistry and Metallurgy Research (TA-3, TA-48, and TA-55)	Limited acreage of ponderosa pine forest cleared with loss and displacement of associated wildlife.	Same as No Action Alternative.	Same as No Action Alternative.
High Explosives Testing Facility (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. – Restoration of site could create a more natural habitat and benefit wildlife, potentially including the Mexican spotted owl.
Radiochemistry Facility (TA-48)	No change in impacts to ecological resources.	Same as No Action Alternative.	– Minor impact to wildlife during construction and demolition. – 12.6 acres (5.1 hectares) of ponderosa pine forest cleared.
Radioactive Liquid Waste Treatment Facility (TA-50)	No change in impacts to ecological resources.	Same as No Action Alternative.	– New evaporation basins, if built, would disturb 4 acres (1.6 hectares) of primarily open field habitat within both the buffer and core zone of the Sandia and Mortandad Canyon Areas of Environmental Interest for the Mexican spotted owl. – Implementation of the evaporation basin option would reduce wetlands and riparian habitat in Mortandad Canyon and the abundance and diversity of Mexican spotted owl prey species.

	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 ecological resources.	Same as No Action Alternative.	− Short-term impacts on wildlife from new construction and demolition in TA-54 and TA-50 under both alternatives. − Activities could occur in Areas of Environmental Interest for the Mexican spotted owl or the willow flycatcher.
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.	The Science Complex Project includes: − 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.
Remote Warehouse and Truck Inspection Station (TA-72)	No change in impacts to ecological resources.	Same as No Action Alternative.	The Remote Warehouse Project includes: − 4 acres (1.6 hectares) of ponderosa pine forest and pinion-juniper woodland would be cleared. − Short-term construction impacts on wildlife.

MDA = material disposal area; AEI = Areas of Environmental Interest; TA = technical area; DD&D = decontamination, decomlmissioning, and demolition; LANSCE = Los Alamos Neutron Science Center.

5.5.1 No Action Alternative

The No Action Alternative is represented by the existing environment as it relates to ecological resources (see Sections 4.4.5 [for effects of explosives-related noise on wildlife] and 4.5) together with actions that will be implemented, based on other NEPA compliance reviews issued since the *1999 SWEIS*. Impacts to ecological resources are described in terms of those projects that impact the site as a whole and those that affect specific technical areas. Key Facilities are addressed separately. Only those projects that have been evaluated as having an impact on ecological resources are addressed below.

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*, that have potential impacts across a number of technical areas. These projects are addressed separately below.

The conveyance and transfer of land from DOE to Los Alamos County and the Department of the Interior to be held in trust for the Pueblo of San Ildefonso began in 2002, and, by the end of 2005, 2,255 acres (913 hectares) had been turned over (see Section 4.5). Additional acreage must be turned over by 2007. The land that has been, or is to be, turned over falls within the piñon-juniper woodland and ponderosa pine forest zones. Direct impacts of the conveyance and transfer include changes in responsibility for resource protection. The analysis determined indirect impacts included future development within the conveyed and transferred parcels. Approximately 770 acres (312 hectares) of relatively undisturbed habitat within the ponderosa pine forest and piñon-juniper woodland could be developed. Habitat modification resulting from development could affect potential habitats for several Federal-listed threatened and endangered species including the Mexican spotted owl; and, in some tracts, wetlands could be reduced or possibly lost, with potential increased downstream and offsite sedimentation. Additional indirect impacts of the land conveyance and transfer could result in a much less rigorous environmental and protection review process for future activities because neither the County of Los Alamos nor the Pueblo of San Ildefonso have regulations that would match the Federal review and protection process. Cumulatively, development could impact biodiversity as a result of fragmentation of habitat and disruption of wildlife migration corridors (DOE 1999d).

Electric power line upgrades were determined to have minimal effects on vegetation along the right-of-way. Impacts on wildlife during construction 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. Possible adverse effects on potential habitat for bald eagles, southwestern willow flycatchers, and Mexican spotted owls would not be expected due to the proposed placement of structures, roads, and laydown areas in existing roadways or disturbed areas. Timing of actions during construction and maintenance to avoid adverse effects on sensitive species or their habitats would ensure that these species were not impacted (LANL 2000e).

The Wildfire Hazard Reduction Program would, in the long term, create conditions at LANL that are consistent with a more natural historic ecological process with accompanying improved health and vigor and with increased biological diversity. 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 on a long-term basis. A general improvement in forest health would also be expected to benefit sensitive species. In fact, the goal of 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 potentially result in sedimentation of downstream wetlands. Also, noise and other activities associated with demolition 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 temporary, 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 Environment Interest if the area were to become occupied by that species. Activities taking place at the low-head weir, located in Los Alamos Canyon, and the road reinforcements in Twomile Canyon, Pajarito Canyon, and Water Canyon were found not to affect ecological resources (DOE 2002i).

No long-term or permanent changes to ecological resources would be expected from implementing the LANL Trails Management Program. However, short-term temporary effects on animals that live along trail reaches 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, would not likely be adversely affected, nor would their critical habitat be adversely affected, by activities associated with the Trails Management Program (DOE 2003d).

Technical Area Impacts

TA impacts on ecological resources would be essentially unchanged from current conditions under the No Action Alternative.

Key Facilities Impacts

Since the publication of the *1999 SWEIS,* NEPA compliance has been completed for two currently active projects related to Key Facilities that could potentially affect ecological resources. They are the Chemistry and Metallurgy Research Building Replacement at TA-55 and the Twomile Mesa Complex Consolidation at TA-22.

Chemistry and Metallurgy Research Building

The Chemistry and Metallurgy Research Building Replacement 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. However, some of this land has been previously disturbed. Where construction would occur on previously disturbed land, there would be little or no impact to terrestrial resources. Construction would remove some previously undisturbed ponderosa pine forest, resulting in the loss of less mobile wildlife such as reptiles and small mammals, and causing more mobile species, such as birds or large mammals, to be temporarily displaced. Indirect impacts from construction, such as noise or human disturbance, could also impact 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 Environment Interest, construction of the Chemistry and Metallurgy Research Building Replacement is not expected to adversely affect it. Operational impacts were determined to be minimal (DOE 2003f). DD&D of the existing CMR Building would allow that site to be revegetated. However, as the site is within TA-3, infill building at a later date would likely occur.

High Explosives Testing

Construction of the new facilities associated with the consolidation of activities at the Twomile Mesa Complex within TA-22 and the associated demolition of numerous structures within a number of technical areas across LANL were determined to have minimal impact on ecological resources. 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. Also, there would be no impacts to wetlands or sensitive species (DOE 2003g).

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 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, and operations would cease at the Pajarito Site (TA-18) and that facility would also be shut down. Since 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

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 intermittent high levels of noise. Startle or fright is the immediate behavioral reaction to transient, unexpected or unpleasant noise such as explosives testing (EPA 1980). Thus, although there would be a reduction in testing, 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 would, however, be lessoned.

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 ecological resource impacts for those actions addressed under that alternative (see Section 5.5.1). Additionally, the Expanded Operations Alternative includes a number of new projects that have the potential to impact ecological resources. Not all new projects would affect these resources since many would involve actions within, or modifications to, existing structures, or construction of new facilities within previously developed areas of LANL. 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 the 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. (Additionally, the need to provide 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, this would have minimal biota impact, since 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. Proper maintenance of equipment and restrictions preventing workers from entering adjacent undisturbed areas would lessen these impacts. Caps would be designed to prevent or reduce biointrusion; thus, ecological risks from contaminants being reintroduced into the environment would be reduced under this option. Once capped and revegetated, the MDAs would provide habitat similar to that which existed prior to remedial actions being implemented.

This option would not directly impact any wetlands or aquatic resources at LANL. Although some of the MDAs and the borrow pit fall within core and buffer zones of the Mexican spotted owl, only MDA D within TA-33 includes part of the core zone for the White Rock Canyon Bald Eagle Area of Environmental Interest. None of the MDAs or the borrow pit are within the southwestern willow flycatcher Area of Environmental Interest. Direct impacts to the spotted owl and bald eagle would not be expected as a result of remediation activities because the presence of these sensitive species is unlikely at any of the disturbed areas under consideration; species-specific surveys would be performed to determine their presence prior to initiation of field work. Indirect impacts would be prevented through implementation of the procedures set forth in the LANL *Threatened and Endangered Species Habitat Management Plan* (LANL 2000b). Remediating the other PRSs at LANL may also cause disruption of ecological resources, although such disruption would again be temporary and could be mitigated by implementation of existing LANL procedures.

Impacts to ecological resources under the MDA Removal Option would be similar to those described above. While short-term remedial actions would create a disruptive environment for local wildlife, long-term impacts would likely be beneficial in terms of ecological risk, since wastes would be removed. Also, there would be no restriction on the types of plants that could be introduced, permitting the 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 branch of Mortandad Canyon would affect undeveloped ponderosa pine forest, open land, and associated wildlife. Other project elements would largely take place in currently developed areas. Considering the lack of wetlands within the Pajarito Corridor West and the fact that aquatic resources are not present on the mesa, impacts to these resources would not occur. Although the parking lot in TA-63, the road across the eastern edge of TA-63, and the pedestrian and highway bridges fall within the Sandia-Mortandad, Pajarito Canyon, or Threemile Canyon Mexican spotted owl Area of Environmental Interest buffer zones, none of these areas are within core areas. Indirect impacts to the Mexican spotted owl would be prevented through implementation of the procedures set forth in the LANL *Threatened and Endangered Species Habitat Management Plan* (LANL 2000b).

One option 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. A second option 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 impact on habitat since they would generally follow existing rights-of-way which have already been disturbed. However, the road to be constructed for the second option would require the clearing and grading of 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 options, 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. If surveys conducted prior to construction identified owls within the core zones, restrictions would be implemented according to the LANL *Threatened and Endangered Species Habitat Management Plan* (LANL 2000b). Following construction of one or both bridges, their presence, as well as traffic generated noise and light, would have the potential to impact core zone habitat and prevent owls from using the area. Thus, prior to construction, Section 7 (of the Endangered Species Act) consultation with the U.S. Fish and Wildlife Service will be required. This process would necessitate the preparation of a biological assessment by DOE for the purpose of analyzing potential effects of the project on the owl or its habitat. This would be followed by the issuance of a biological opinion on the project by the U.S. Fish and Wildlife Service, which could propose reasonable and prudent alternatives to the proposed bridges.

Technical Area Impacts

Two projects are being planned that have potential impacts on ecological resources within TA-3 and TA-21. These are addressed below.

Technical Area 3

Construction of the Replacement Office Building Project would involve the clearing and grading of 13 acres (5.3 hectares) of mixed conifer forest within TA-3. This would result in the loss of less mobile wildlife such as reptiles and small mammals, and cause more mobile species, such as birds or large mammals, to be displaced. Construction of the new buildings and parking lot would not impact wetlands since none are located in or near the construction zone. Direct impacts to the Mexican spotted owl, southeastern willow flycatcher, and bald eagle would not be expected since the work area does not fall within the core zone of any Area of Environmental Interest. However, the Replacement Office Building complex is located partially in the buffer zone of the Los Alamos Canyon Mexican spotted owl Area of Environmental Interest. Indirect impacts to the owl from noise and light would be prevented through implementation of the procedures set forth in the *LANL Threatened and Endangered Species Habitat Management Plan* (LANL 2000b). Operation of the Replacement Office Building Project would likely have minimal impact on terrestrial resources within or adjacent to TA-3 (see Appendix G.2).

Technical Area 21

The DD&D of structures at TA-21 would take place 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. Upon DD&D of the buildings and structures, the site would be contoured and revegetated. However, revegetation would have only relatively short-term benefits to wildlife since both the parcel that has been conveyed to Los Alamos County and the parcel retained by DOE could be developed in the future. DD&D activities within TA-21 would have the potential to impact wetland areas by increasing runoff and siltation; however, best management practices should prevent any such impacts. The elimination of two NPDES-permitted outfalls associated with TA-21 operations would reduce the quantity of surface water discharge to the adjacent canyons. DD&D activities at TA-21 would not be expected to directly impact Mexican spotted owl potential habitat nearby since all activities would take place within developed portions of the TA. Indirect impacts would be prevented through implementation of the procedures set forth in the LANL *Threatened and Endangered Species Habitat Management Plan* (LANL 2000b).

Key Facilities Impacts

Four projects are being planned that are related to Key Facilities at LANL.

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. Direct impacts to the Mexican spotted owl are unlikely, as the construction zone does not include any part of the core area of either the Sandia-Mortandad Canyon or

Pajarito Canyon Area of Environmental Interest. Indirect impacts from excess noise and light would be prevented through implementation of the procedures set forth in the LANL *Threatened and Endangered Species Habitat Management Plan* (LANL 2000b). A summary of this plan is provided in Section 4.5.4.

The removal of existing buildings and structures at TA-48, as well as those that the Radiological Sciences Institute is to replace, would generate increased noise and levels of human disturbance. However, impacts would be temporary and would likely have minimal effect on wildlife since these structures exist within previously disturbed areas and wildlife in adjacent areas is accustomed to human activity. Since wetlands do not exist in the immediate area of any of the buildings to be removed in association with the new Radiological Sciences Institute, there would be no direct impacts on this resource. While demolition would not impact the Mexican spotted owl directly, indirect impacts from excess noise and light are possible. Such impacts would be avoided through implementation of the procedures set forth in the LANL *Threatened and Endangered Species Habitat Management Plan* (LANL 2000b) (see Appendix G.3).

Radioactive Liquid Waste Treatment Facility

There would be no anticipated impacts to terrestrial resources or wetlands from implementing any of the alternatives for the RLWTF, since it is located within a highly developed industrial area of TA-50. However, the industrial area where the RLWTF is located is within developed core and buffer zone habitat of the Sandia-Mortandad Canyon Mexican spotted owl Area of Environmental Interest. Under all alternatives, direct impacts to the spotted owl are unlikely; however, demolition and construction activities could result in indirect impacts from excess noise and light. Such impacts would be avoided through implementation of the procedures set forth in the LANL *Threatened and Endangered Species Habitat Management Plan* (LANL 2000b). If the option to construct the evaporation ponds is implemented 4 acres (1.6 hectares) of primarily open field habitat would be disturbed with the resultant loss and displacement of wildlife. This area is within the buffer and core zones of the Sandia and Mortandad Canyon Mexican spotted owl Area of Environmental Interest and a small portion of these zones would be lost. This would likely reduce the extent of perennial and intermittent stream reaches, and associated wetlands and riparian habitat, thereby reducing the abundance and diversity of prey species. Noise and light associated with the project should not adversely affect the owl. Consultation with the U.S. Fish and Wildlife Service would be undertaken, and reasonable and prudent alternatives would be determined for implementation.

Solid Radioactive and Chemical Waste Facilities

Under both options proposed for the Waste Management Facilities Transition activities (capping and removal) within TA-54, including new construction and removal of the white-colored domes, the activities would occur within developed areas. Thus, there would be little to no impact on ecological resources. While the TA does not fall within Areas of Environmental Interest for the Mexican spotted owl or bald eagle, it does include a portion of the southwestern willow flycatcher Area of Environmental Interest along its southern boundary. Use of best management practices would be expected to control storm water runoff associated with work in MDA G and MDA L that could result in indirect downstream impacts to the species.

The proposed Transuranic Waste Processing Facility could be located within either TA-50 or TA-63, and would disturb about 2 to 4 acres (0.8 to 1.6 hectares) of land. This would have minimal impact on ecological resources, although some trees would likely have to be removed if the TA-50 site were selected. Impacts to wetlands and aquatic resources from this project would not be expected. While direct impacts to the Mexican spotted owl from construction of the Transuranic Waste Processing Facility would not be expected, construction has the potential to disturb the species due to excess noise or light. Such impacts would be prevented through implementation of measures set forth in the LANL *Threatened and Endangered Species Habitat Management Plan* (LANL 2000b).

Pajarito Site

The DD&D of facilities at TA-18 would be of little impact on wildlife habitat during the processes since the facilities are located within areas that are developed and fenced. Animals could be intermittently disturbed by construction 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. This would have a beneficial effect on area wildlife.

The DD&D of buildings and structures at TA-18 would not directly impact the Mexican spotted owl, since all activities would take place within developed areas. Indirect impacts would be prevented through implementation of the procedures set forth in the LANL *Threatened and Endangered Species Habitat Management Plan* (LANL 2000b). As noted above, TA-18 would undergo restoration following DD&D. The restoration of canyon habitat could benefit the Mexican spotted owl by creating additional habitat within both the core and buffer zone of the Threemile Canyon Area of Environmental Interest in the long term (see Appendix H).

Science Complex

Construction of the Science Complex would involve the clearing and grading of approximately 5 acres (2 hectares) of ponderosa pine forest under the Northwest TA-62 and Research Park Site options. This would result in the loss and displacement of associated 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 since none are located in or near the construction zone under either option. Operation of the Science Complex would have minimal impact on terrestrial resources since 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 since the area is already partially developed and is within the more developed part of TA-3.

Although limited core and buffer habitat within the Los Alamos Canyon Mexican spotted owl Area of Environmental Interest would be affected under both the Northwest TA-62 or Research Park Site options, direct impacts on the Mexican spotted owl are unlikely. However, indirect impacts from excess noise and light are possible. If owls were determined to be present prior to construction restrictions would be implemented to ensure that noise and lighting limits were met.

Further, Section 7 consultation with the U.S. Fish and Wildlife Service would be conducted. Impacts to the Mexican spotted owl would not be expected under the South TA-3 option.

Warehouse and Truck Inspection Station

The proposed project would result in the clearing and grading of approximately 4 acres (1.6 hectares) of ponderosa pine forest and piñon-juniper woodland. This would result in the loss and displacement of associated 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 be likely to pose significant adverse effects to area wildlife. Impacts to the bald eagle, southwestern willow flycatcher, and Mexican spotted owl would not be expected since the site is more than a mile (1.6 kilometers) from the nearest Area of Environmental Interest.

5.6 Human Health

5.6.1 Radiological Impacts on the Public

People can be exposed to radiation through a variety of ways: inhalation, ingestion, injection, and from penetrating radiation. 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 contaminated with radioactive material that can be taken up by plants and animals. The body can also receive direct exposure to radiation from radionuclides in air emissions or from being in the vicinity of radioactive materials that have been deposited on the ground. Additionally, radiation can enter the body through skin breaks. Estimates were made of the amount of radioactive materials to which the public could be exposed as a result of LANL radioactive air emissions (see Section 5.4.2). Using these estimates, the 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 potential dose from LANL operations in addition to several other sources of radiation: 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 help 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 as Key Facilities. **Table 5–15** lists those Key Facilities used in the human health analysis 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 (Firing Sites)	TA-15/36
Tritium Facility [a]	TA-16
Pajarito Site	TA-18
Radiochemistry Facility	TA-48
Los Alamos Neutron Science Center	TA-53
Solid Radioactive and Chemical Waste Facilities [b]	TA-54
Plutonium Facility Complex	TA-55
Tritium Facility	Non-Key Facilities (TA-21)

TA = technical area.
[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 (RLWTF). This analysis confirmed that air emissions were “insignificant relative to other sources at LANL” (LANL 1997b) and the dose to the public from those emissions was not analyzed. For this new SWEIS, air emissions data from the RLWTF were again reviewed for the period 1999–2004. This review of actual radiological air emissions shows that since 2002 the trend is decreasing with a low of 7.9×10^{-8} curies per year (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 within this new SWEIS, and therefore, would result in insignificant health-related impacts to the public relative to other sources.

For the purpose of this new SWEIS, the Clean Air Act Assessment Package – 1988 (CAP-88) software was used to calculate these doses. CAP-88 is an 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.

In this SWEIS, an estimation of the 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 greatest. The location of the facility-specific MEI 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. The doses were then calculated at this facility-specific MEI location from all modeled facilities; thus, 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 dose would be less than the LANL site-wide MEI for that alternative.

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 (TA-11)	4,300 (1,311)	S
High Explosives Testing (TA-15/36)	7,415 (2,260)	NE
Tritium Facility (TA-16)	2,885 (879)	SSE
Pajarito Site (TA-18)	2,820 (860)	NE
Radiochemistry Facility (TA-48)	2,920 (890)	NNE
Los Alamos Neutron Science Center (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.

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 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 added number of latent cancer deaths (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 provide a conservative measure of the potential impacts to be used in the decisionmaking process, and do not necessarily portray an accurate representation of actual anticipated fatalities.

Tables 5–17 and **5–18** summarize the projected dose to the public from normal operations for each alternative for both a MEI near LANL property and the general population within 50 miles (80 kilometers) of LANL. The potential impact from the shut down of operations at LANSCE under the Reduced Operations Alternative would result in a major decrease in dose to the general public and to the MEI. Under all of the alternatives, the MEI would receive a dose that is smaller than the exposure limits set by the DOE and EPA.

Table 5–17 Summary of Projected Doses to the Maximally Exposed Individual from Normal Operations at LANL (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	0.016	0.011
Sigma Complex	0.0041	0.0060	0.0041
Machine Shops	0.00032	0.00045	0.00032
High Explosives Processing	1.3×10^{-6}	1.8×10^{-6}	1.3×10^{-6}
High Explosives Testing	0.25	0.72	0.25
Tritium Facility	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	0.79	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 a containment structure (see Appendix I).

[c] Dose would be zero following shutdown of Pajarito Site (TA-18) starting in 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 0.0017 millirem per year if the Decontamination and Volume Reduction System, the new Transuranic Waste Consolidation 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 starting in 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	0.43	0.43
Sigma Complex	0.16	0.16	0.16
Machine Shops	0.01	0.01	0.01
High Explosives Processing	0.00005	0.00004	0.00005
High Explosives Testing	6.4	5.15	6.4
Tritium Facility	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	6.4	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 a containment structure (see Appendix I).

[b] Dose would be zero following shutdown of Pajarito Site (TA-18) starting in 2009.

[c] This dose could increase to 0.06 person-rem per year if the Decontamination and Volume Reduction System, the new Transuranic Waste Consolidation 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 starting in 2009.

5.6.1.1 No Action Alternative

The annual doses to the general public and a 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 doses for the MEI and population are dominated by the projected emissions from operations at LANSCE. The projected doses also reflect the expected relocation of certain tritium capabilities from the Chemistry and Metallurgy Research Building back to the Plutonium Facility Complex as well as the change in operating levels as the Tritium Facility (TA-21) begins its 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) is from operations of the Key Facilities and the remaining contribution is 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 dose to the general public and a 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]	144,000 person-rem	425 millirem
Dose as a percent of background dose	0.02	1.8

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 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 350 to 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 developing a fatal cancer for the MEI from LANL operations under the No Action Alternative of about 1 chance in 213,000 (4.7×10^{-6}) per year.

Special Receptors

In addition to the potential for 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 include a Los Alamos County resident whose entire diet consists of locally-produced foodstuffs, an outdoor recreational enthusiast, and a Special Pathways receptor who relies heavily on fish and wildlife for subsistence. Using the worst-case consumption rates, **Table 5–20** presents the projected doses to these individuals and the associated risk of developing a fatal cancer.

Table 5–20 Annual Ingestion Pathway Dose for Worst-Case Consumption Rates by Special Receptors

	Dose (millirem)	***Cancer Fatality Risk*** [a]
Offsite Resident	7.2	4.3×10^{-6}
Recreational User	9.1	5.5×10^{-6}
Special Pathways Receptor	10.7	6.4×10^{-6}

[a] Based on a risk estimate of 0.0006 LCF per person-rem.

The associated LCF risks as a result of the doses shown in Table 5–20 would be about 1 in 230,000 for the Offsite Resident, 1 in 180,000 for the Recreational User, and 1 in 156,000 for the Special Pathways receptor per year. The doses from ingestion are 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, due largely 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 into the future and will 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 (discussed below).

Los Alamos Neutron Science Center

Nearly all of the calculated MEI dose (96 percent) is 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 greatest source of offsite dose from the airborne pathway. As a mitigating measure, operational controls at LANSCE limit the amount of radiological air emissions. These controls would limit the maximum dose to the LANL site-wide MEI from air emissions at LANSCE to 7.5 millirem. (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 when compared to that from operations at LANSCE.)

5.6.1.2 Reduced Operations Alternative

Under the Reduced Operations Alternative, the major decrease in doses to the public compared to the No Action Alternative would be due to the lack of radiological air emissions resulting from the potential cessation of LANSCE operations. Additional lower doses than those under the No Action Alternative would be expected from the reduction of operations in terms of both High Explosives Processing and Testing. In 2009 the cessation of operations at the Pajarito Site (TA-18) would result in a further reduction in 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 6.4 person-rem for the Reduced Operations Alternative. Nearly all of this dose (greater than 98 percent) is from operations of the Key Facilities and the remaining contribution is from non-key facility operations. Overall, the projected dose of 6.4 person-rem would result in 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]	6.4 person-rem	0.79 millirem (TA-36 MEI)
Latent cancer fatality risk [c]	0.0038	4.7×10^{-7}
Regulatory dose limit [d]	Not applicable	10 millirem
Dose as a percent of regulatory limit	Not applicable	7.9
Dose from background radiation [e]	144,000 person-rem	425 millirem
Dose as a percent of background dose	0.004	0.19

rem = roentgen equivalent man, 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] The shutdown of TA-18 in 2009 would result in a decrease in population dose of 0.23 person-rem and a negligible decrease in MEI dose.
[c] Based on a risk estimate of 0.0006 LCF per person-rem.
[d] 40 CFR 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 350 to 500 millirem (see Appendix C).

The LANL site-wide MEI under this alternative would be located approximately 7,415 feet (2,260 meters) northeast of the High Explosives Testing sites 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 0.79 millirem per year for the foreseeable future. This projected dose corresponds to an increased risk of developing a latent fatal cancer for the MEI from LANL operations under the Reduced Operations Alternative of about 1 chance in 2.1 million (4.7×10^{-7}) per year.

Special Receptors

The risk to the public from ingestion of foodstuffs and water under the Reduced Operations Alternative does not differ from that described in 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 Reduced Operations Alternative outside 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 as compared to the dose for the No Action Alternative.

High Explosives Testing

The long-lived uranium isotope emissions from the reduced level of activities at the High Explosives Testing at TA-15 and TA-36 would produce the majority of the population dose (80 percent). Because the location of the 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, the dose to the MEI from operations at the High Explosives Testing sites would be projected to be 0.72 millirem per year under this alternative, compared to a dose of 0.25 millirem from high explosives testing under the No Action Alternative even though there is a 20 percent reduction in high explosives testing under the Reduced Operations Alternative. In fact, more than 90 percent of the dose to the MEI under the Reduced Operations Alternative would be from emissions of uranium isotopes produced at the High Explosives Testing sites.

Pajarito Site

Starting in 2009, a decrease in dose of 0.23 person-rem per year would result from the cessation of operations at the Pajarito Site (TA-18).

5.6.1.3 Expanded Operations Alternative

Under the Expanded Operations Alternative, there would be new and expanded capabilities, construction projects, and some reduced activities. Operations as a result of LANSCE refurbishment could increase air emissions, including radiological emissions and consequential dose, due to enhanced operational availability of the accelerator facilities. There would also be an increase in pit production capability within the Plutonium Facility Complex (TA-55) of up to 50 pits per year under single-shift operations (80 pits per year using multiple shifts) resulting in additional radiological air emissions. Under this alternative there could be an additional temporary or one-time dose to the public from the cleanup of the MDAs, lasting until the MDA exhumation is completed. Implementation of this alternative would also result in smaller doses due to both the completion of the DD&D of buildings at TA-21 and the cessation 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 is from operations at the Key Facilities and the remaining 6 person-rem from remediation 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).

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. 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 chance in 203,000 (4.9×10^{-6}) per year.

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]	*Maximally Exposed Individual*
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]	144,000 person-rem	425 millirem
Dose as a percent of background dose	0.025	1.9

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 Transuranic Waste Consolidation Facility, and remote-handled transuranic waste retrieval and processing activities. The shut down of TA-18 and TA-21 in 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 dose include 6.2 person-rem and 0.42 millirem respectively, attributable to MDA remediation.

[d] Based on a risk estimate of 0.0006 LCF per person-rem.

[e] 40 CFR 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 350 to 500 millirem.

The varying effects of radiological air emissions from the major MDA remediation, 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, resulting in reduced doses. The MDA Removal Option would result in lower long term risks to members of the public as the bulk of the contamination would be removed from the site. But in the short term, the release of radionuclides into the air during removal could result in higher radiological doses to the public. If that removal were to take place under a containment structure, the releases of radiological air emissions would be filtered before exiting the structure, resulting in lower short-term doses to the public.

Under the MDA Removal Option, varying radiological air emissions would be released depending on the inventory of radionuclides at the MDA being remediated and whether the removal was performed under a containment structure. These removal activities would have a finite time period associated with their completion, lasting from a few months to several years depending upon the MDA. For that specified amount of time, there would be a 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 within 50 miles (80 kilometers) of operations at LANL under this Alternative includes a conservative dose estimate (6.2 person-rem per year) assuming all MDAs were being exhumed at one time.

The same factors, the inventory of radionuclides present in a given MDA and whether or not there is a containment structure being used, would have an affect on the dose to the MEI. In addition, the location of the MDA being remediated could have an affect on how much dose an MEI would receive. The impacts of the remediation of the MDAs on the LANL site-wide MEI were analyzed in Appendix I. Removal activities at each MDA could result in a contribution to the dose received by the LANL site-wide MEI under the Expanded Operations Alternative, located northeast of LANSCE near East Gate. Assuming *all* the large MDAs were being remediated at the same time, the portion of the estimated dose to the LANL site-wide MEI from MDA removal activities would be no more than 0.42 millirem in any given year.

Special Receptors

The risk to the public from ingestion of foodstuffs and water under the Expanded Operations Alternative does not differ from that described in 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 outside those associated with Key Facilities operations (discussed below) or MDA remediation activities (discussed above).

Key Facility Impacts

Under the Expanded Operations Alternative, the impacts to the public from activities at the Key Facilities, including both the increase in some activities and decreases in others, would remain similar to those in the No Action Alternative. The change in location of emissions from the Chemistry and Metallurgy Research Building in TA-3 to near TA-55 would have little effect on doses to the public when compared to the impacts from operations at LANSCE. Similarly, the increase in pit production at the Plutonium Facility Complex (TA-55) would result in a small increase in emissions and the resulting doses to the public would be relatively small when compared to the contribution from activities at LANSCE.

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 results from 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 from the airborne pathway.

High Explosives Testing

An additional 18 percent of the dose (6.4 person-rem per year) would be from operations at the High Explosives Testing Sites (TA-15 and TA-36).

Solid Radioactive and Chemical Waste Facilities

Implementation of the Waste Management Facilities Transition Project could result in relatively small additional impacts to the population near LANL. During the 2012 through 2015 time period, there is the potential for the simultaneous operation of the DVRS, the new Transuranic Waste Consolidation Facility, and remote-handled transuranic waste retrieval and processing activities. The resulting impacts to the population from the 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 population would be a reduction in dose due to the 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 would also result in a small increase in the dose to the population to 0.20 person-rem per year. The higher level of activity at the Plutonium Facility Complex associated with increased pit production would result in a negligible increase in the dose to the MEI (less than 0.001 millirem).

Pajarito Site and Tritium Facility

Starting in 2009, the estimated population dose would decrease slightly (by 0.32 person-rem per year) as a result of no emissions from activities at Pajarito Site (TA-18) and the Tritium Facility at TA-21. 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 when 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 technical areas, as analyzed in the *1999 SWEIS*, was dominated by the 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 as compared to those evaluated,) the estimated combined incremental cancer risk at the Los Alamos Medical Center would be slightly above the guideline value of one in one million (1.0×10^{-6}). However, it is known 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 in the *1999 SWEIS* for the Expanded Operations Alternative. 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 the Carcinogenic Pollutants that Have the Potential to 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 the 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 for the high explosives testing sites from emissions of beryllium, lead, and depleted uranium (DU) (see Table 5−9) were analyzed by calculating hazard indices for lead and DU and calculating the excess LCFs from beryllium. An 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 index for lead was less than 0.000015 and for DU was less than 0.000065. 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 sites would further reduce these emissions and health effects by about 20 percent (LANL 2006).

Emissions from beryllium sources, currently at the Chemistry and Metallurgy Research Buildings (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 chance in 415 million

(2.41×10^{-9}), which is below the guideline value of 1 chance in a million (1.0×10^{-6}). 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 chance in a million (1.0×10^{-6}) (DOE 1999a).

5.6.2.2 Reduced Operations Alternative

Key Facilities

Public risk as a result of chemical releases under the Reduced Operations Alternative would be approximately the same as those associated with the No Action Alternative. There could a reduction in risks associated high explosives processing and testing activities since these activities would be reduced by 20 percent under this alternative. There would also 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 as a result of chemical releases under the Expanded Operations Alternative would be approximately the same as those associated with the No Action Alternative with the exception of a small increase (2.5 percent) in high explosives processing that would not be expected to substantially change these risks.

5.6.3 Worker Health

Worker risks associated with continued operations of LANL include radiological (ionizing and nonionizing) 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 given 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. Non-compliance 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 851, goes into effect on February 7, 2007 to allow one year for contractor and site management compliance training (DOE 2006).

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 higher than the average annual worker dose shown in Section 4.6.2.1 because it includes the dose associated with achieving a production level of 20 pits per year at TA-55 and increased levels of activity associated with additional personnel working in the new Chemistry and Metallurgy Research Building Replacement. This collective worker dose would remain representative of the dose seen by the LANL workforce for the foreseeable future for the No Action Alternative.

Table 5–25 Projected Worker Exposure to Radiation under the No Action Alternative

Collective worker dose (person-rem per year)	281
Number of workers with measurable dose	1,933
Excess LCF risk per year among worker population	0.17 [a]
Average individual worker measurable dose (millirem)	145
Excess LCF risk per year for average individual worker	0.000087 [a]
DOE limit on annual worker radiation exposure (millirem)	5,000
LANL average individual worker dose as a percentage of DOE limit (percent)	2.9

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 under established procedures that require doses to be kept as low as reasonably achievable (ALARA). Any 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 with worker protection measures given for specific locations and activities.

DOE limits set the standard for worker exposure at 5,000 millirem per year whole body dose equivalent. DOE, in 10 CFR 835, requires that the ALARA process 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 145 millirem per year represents an increased risk of developing a latent fatal cancer of approximately 1 chance in 11,500 (8.7×10^{-5}) per year of operations. In addition to the 1,933 workers expected to receive a measurable dose, under the No Action Alternative, there would be over 11,000 LANL workers, or approximately 85 percent of the workforce, who would not likely receive any measurable dose during a year of normal operations.

Nonionizing Radiation Consequences

Under the No Action Alternative, negligible effects on LANL worker health from normal operations of nonionizing radiation sources, infrared radiation from instrumentation and welding, lasers, magnetic and electromagnetic fields, and microwaves would likely continue.

Biological Agent 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 biological agents.

Chemical Exposure Consequences

Occasional reportable, but minor, chemical exposures could occur at the rate of one to three incidents annually due to airborne asbestos, lead paint particles, crystalline silica, fuming perchloric acid, hydrofluoric acid, or skin contact with acids or alkalis.

Operation of the Beryllium Technology Center in the Sigma Complex presents the 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 applications of beryllium at LANL, evaluated as a carcinogen in the *1999 SWEIS*, was estimated to be less than 1 chance 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

The occupational injury and illness rates under the No Action Alternative are projected to follow the patterns observed from 1999 through 2004 reported in Section 4.6.2.1. Using LANL's average rates during this period, workers would have 2.33 recordable cases and 1.22 cases where days were missed, or activities were restricted or transferred as a result of 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 discussed in Section 5.8.1.1, the total recordable cases in terms of occupational injury and illness would be approximately 310 per year and cases that resulted in days away, restricted or transferred would be approximately 162. 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 doses on a cumulative basis from normal operations at LANL than under the No Action Alternative due to the potential shut down of LANSCE operations and the cessation of operations at TA-18.

Table 5–26 Projected Worker Exposure to Radiation under the Reduced Operations Alternative

Collective worker dose (person-rem per year)	258
Number of workers with measurable dose	1,574
Excess LCF risk per year among worker population	0.15 [a]
Average individual worker measurable dose (millirem)	164
Excess LCF risk per year for average individual worker	0.000098 [a]
DOE limit on annual worker radiation exposure (millirem)	5,000
LANL average individual worker dose as a percentage of DOE limit (percent)	3.3

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 145 millirem per year to 164 millirem per year under the Reduced Operations Alternative as compared to the No Action Alternative. This is due to a decrease in the number of workers who received less than the average dose under this Alternative. The average individual worker dose of 164 millirem per year represents an increased risk of developing a latent fatal cancer of approximately 1 chance in 10,500 (9.5×10^{-5}) per year of operations. Similar to the No Action Alternative, in addition to the 1,574 workers expected to receive a measurable dose there would continue to be over 11,000 LANL workers, or over 85 percent of the workforce, who would not receive any measurable dose during a year of normal operations, under the Reduced Operations Alternative.

Nonionizing Radiation Consequences

Under the Reduced Operations Alternative, negligible effects on LANL worker health from nonionizing radiation sources, infrared radiation from instrumentation and welding, lasers, magnetic and electromagnetic fields, and microwaves would likely continue.

Biological Agent Exposure Consequences

Under the Reduced Operations Alternative, effects on LANL worker health from normal operations would not be substantially different than 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 lower than those observed under the No Action Alternative as a result of a smaller projected workforce as discussed in Section 5.8.1.2. Using LANL's average rates, the total recordable cases in terms of occupational injury and illness would be approximately 297 per year and cases that resulted in days away, restricted or transferred would be approximately 156 compared to 310 and 162 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 the annual average worker exposure under the Expanded Operations Alternative. The operations expected to expand under this Alternative include the manufacturing of pits, the remediation of a number of large MDAs, and DD&D of a number of TAs. In the long run, the DD&D 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.

The largest factors affecting worker dose under this Alternative are the increase in pit production at TA-55 from 20 plutonium pits per year to 50 pits per year under single-shift operations (80 pits per year using multiple shifts) and the remediation of the MDAs. The contribution to the collective worker dose from production of 20 pits per year is 90 person-rem per year for the No Action Alternative compared to 220 person-rem from the production of up to 80 pits per year. Remediation of the MDAs under this Alternative is also expected to add to the site-wide collective worker dose. If the MDA Removal Option were pursued, it would add, on average, 113 person-rem per year to the site-wide collective worker dose. If the MDA Capping Option were pursued, it would add, on average, 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, the 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.

Table 5–27 Projected Worker Exposure to Radiation under the Expanded Operations Alternative

	MDA Removal Option	*MDA Capping Option*
Collective worker dose (person-rem per year)	520	408
Number of workers with measurable dose	3,646	2,211
Excess LCF risk per year among worker population	0.31 [a]	0.24 [a]
Average individual worker measurable dose (millirem)	143	184
Excess LCF risk per year for average individual worker	8.6×10^{-5} [a]	0.00011 [a]
DOE limit on annual worker radiation exposure (millirem)	5,000	5,000
LANL average individual worker dose as a percentage of DOE limit (percent)	2.9	3.7

MDA = material disposal area, LCF = latent cancer fatality.
[a] Based on a risk estimate of 0.0006 LCFs per person-rem (see Appendix C).

Under the Expanded Operations Alternative – MDA Removal Option, the average individual worker dose of 143 millirem per year represents an increased risk of developing a latent fatal cancer of approximately 1 chance in 11,600 (8.6×10^{-5}) per year of operations. Under the Expanded Operations Alternative – MDA Capping Option, the average individual worker dose of 184 millirem per year represents an increased risk of developing a latent fatal cancer of approximately 1 chance in 9,100 (1.1×10^{-5}) per year of operations.

Waste management workers, who currently receive, on average, a dose of approximately 163 millirem annually, would receive less annual dose under the Expanded Operations Alternative after 2015. By the end of 2015, all legacy transuranic waste would have been 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 Transuranic Waste Consolidation Facility to be built in either TA-50 or TA-63, but their exposures would be less than currently observed because the management of the newly-generated waste would not be as time-intensive as is 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 maintain their exposures ALARA and within administrative control levels.

Nonionizing Radiation Consequences

Under the Expanded Operations Alternative, negligible effects on LANL worker health from nonionizing radiation sources, infrared radiation from instrumentation and welding, lasers, magnetic and electromagnetic fields, and microwaves would likely continue.

Biological Agent Exposure Consequences

Under the Expanded Operations Alternative, effects on LANL worker health from normal operations would not be substantially different than 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 than 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, and, second, there is expected to be more construction, DD&D, and remediation work taking place under the Expanded Operations Alternative. The expansion of construction, DD&D, and remediation work is significant because these activities have higher incidence rates in terms of occupational injuries and illnesses than other types of work being performed onsite.

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]	292.4	153.1
Construction	21.3	10.4
Remediation (MDA Removal Option)	27.6	13.5
Decontamination, decommissioning, and demolition	2.6	1.3
Total	343.9	178.3

MDA = material disposal area.
[a] Based on LANL averages of 2.33 total recordable cases and 1.22 cases resulting in days away, restricted, or transferred per 200,000 hours worked.

While total recordable cases and cases resulting in days away, restricted or transferred would be 10 – 11 percent higher compared to the No Action Alternative, there would continue to be no fatalities expected under this alternative.

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 include those resulting from groundbreaking activities associated with new construction, building modifications, and demolition, as appropriate. Indirect impacts include those associated with reduced access to resource sites, as well as impacts associated with increased storm water runoff, increased 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 impacts from these activities to cultural resources was then assessed.

A summary of impacts is presented in **Table 5–29**.

5.7.1 No Action Alternative

The No Action Alternative is represented by the existing environment as it relates to cultural resources (see Section 4.7) together with actions that have been decided upon, but that have may not been fully implemented. These actions either were analyzed in other NEPA compliance reviews issued since the *1999 SWEIS* or in 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 technical areas. Key Facilities are addressed separately. Only those projects that have been evaluated in respective EAs as having an impact on cultural resources are addressed below.

Los Alamos National Laboratory Site-Wide Impacts

Two projects have been approved since publication of the *1999 SWEIS* that have the potential to impact cultural resources across a number of technical areas. These projects involve the conveyance and transfer of certain parcels of land at LANL to Los Alamos County and Department of the Interior to be held in trust for the Pueblo of San Ildefonso, and the management of the trails system at LANL. Other projects of a site-wide nature that have been determined not to have an 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, 2002i, 2003a, 2003d; NNSA 2004a, 2005a).

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	Same as No Action Alternative	Same as No Action Alternative plus: MDA Remediation Project: − No direct impacts expected for both options (that is, capping and removal). − 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	Center for Weapons Physics Research: − 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: − Potential adverse effects on nearby historic trail.
TA-21	No change in impacts to cultural resources.	Same as No Action Alternative	TA-21 DD&D: − Adverse effects on National Register of Historic Place-eligible historic buildings and structures.
Key Facilities			
Chemistry and Metallurgy Research (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 Facility (TA-16)	Adverse effect 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*
High Explosives Testing Facility (TA-6, TA-22, and TA-40)	Adverse effect from demolition and remodeling of historic buildings.	Same as No Action Alternative	Same as No Action Alternative
Pajarito Site (TA-18)	No change in impacts to cultural resources.	Same as No Action Alternative	Potential adverse effect from demolition of historic buildings.
Radiochemistry Facility (TA-48)	No change in impacts to cultural resources.	Same as No Action Alternative	The Radiological Sciences Institute Project includes: − Potential adverse effects on two archeological sites located near Radiochemistry Building. − Potential 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 white-colored domes would have a positive impact on views from traditional cultural properties located on adjacent lands of the Pueblo of San Ildefonso.
LANSCE (TA-53)	No change in impacts to cultural resources.	Same as No Action Alternative	− Potential 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	− Adverse effect to the potentially historic TA-55-41 building.
Bioscience Facilities	No change in impacts to cultural resources.	Same as No Action Alternative	The Science Complex Project includes: − Under all options, an eligibility assessment of the buildings to be replaced by the new Science Complex would be required. − Potential adverse effects on two 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	− Potential 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.

The conveyance and transfer of 10 tracts of land to Los Alamos County and the Department of the Interior to be held in trust for the Pueblo of San Ildefonso would have both direct and indirect impacts on cultural resources. To date, eight parcels have been conveyed or transferred in whole or in part (see 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 written to resolve the adverse effects of the conveyance of three tracts cited for development with 49 archaeological sites eligible for the National Register of Historic Places to the County of Los Alamos. The implementation of this data recovery plan is ongoing as of 2005. In addition, 34 archaeological sites are included within 3 protective easements at a single tract to be conveyed to the County for recreational purposes (LANL 2002a). The disposition of each of the tracts also affects the protection and accessibility to American Indian sacred sites or sites 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 tracts for recreational purposes. This action could result in physical destruction, damage, or alteration of cultural resources on the subject tracts and in adjacent areas and disturbance of traditional religious practices (DOE 1999d).

The Trails Management Program would provide enhanced protection of cultural resources at LANL. Management activities would be coordinated with LANL archaeologists in consultation with appropriate American Indian Tribes to minimize damages to any cultural resources present along trail reaches. Where activities associated with trail maintenance or use would adversely affect a trail it could be closed to all or certain users until the involved segment of trail could be rerouted around the cultural resources. Alternately, certain trail segments could be closed periodically for American Indian use. If work necessary to close a trail to all user groups would result in an adverse effect on a cultural resource, a data recovery plan would be prepared and the State Historic Preservation Officer and appropriate American Indian Tribes would be consulted before such work commenced. New trails would not be constructed in locations that would result in adverse effects on cultural resources, either from trail users or maintenance workers (DOE 2003d).

Technical Area Impacts

Technical Area 3

One project within TA-3, the installation of combustion turbine generators, has undergone NEPA compliance review since issuance of the *1999 SWEIS* and has not been 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 implementation of corrective measures at MDA H has undergone NEPA compliance review since issuance of the *1999 SWEIS* and has not been fully implemented. The analysis presented in the project-specific EA supported NNSA's determination that implementation of this action would not significantly impact cultural resources (DOE 2004e).

Key Facilities Impacts

Since the issuance of the *1999 SWEIS*, NEPA compliance documentation has been prepared for three currently active projects related to Key Facilities. These include the Chemistry and Metallurgy Research Building Replacement at TA-55, Weapons Manufacturing Support Facility at TA-16, and the Twomile Mesa Complex at TA-22. It has been determined that each of these projects has the potential to have some impact on cultural resources.

Chemistry and Metallurgy Research Building

Construction of the new Chemistry and Metallurgy Research Building Replacement was determined not to have an adverse impact on cultural resources at TA-55 (DOE 2003f). A parking lot associated with the complex to be located in TA-50 will impact an archaeological site. This site, the "Romero Cabin Site" was originally excavated in the 1980s. A data recovery plan was written to resolve the adverse effect of construction of the parking lot at the cabin site. The implementation of this data recovery plan is ongoing as of 2005 (LANL 2006).

High Explosives Processing

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. However, the demolition and remodeling of various buildings, which is a part of the project, will have an adverse effect on National Register of Historic Places-eligible historic structures, many of which were constructed in the 1950s. A Memorandum of Agreement between NNSA and the State Historic Preservation Officer for resolution of adverse effects will be prepared following State Historic Preservation Officer concurrence on 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 2002k).

The planned consolidation and construction that is part of the Twomile Mesa Complex at TA-22 will not impact any recorded prehistoric or historic sites. However, the demolition of various historic buildings as a part of that action will have an adverse effect on National Register of Historic Places-eligible and potentially eligible historic structures. As noted above for the TA-16 Weapons Manufacturing Support Facility, a Memorandum of Agreement between NNSA and the State Historic Preservation Officer for resolution of adverse effects will be prepared following State Historic Preservation Officer concurrence on 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 2003g).

5.7.2 Reduced Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Under the Reduced Operations Alternative, impacts to cultural resources from those actions discussed for the No Action Alternative (see Section 5.7.1) would still take place.

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 shut down as well. The Pajarito Site would then be dropped from the list of Key Facilities. Since 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 reflects proposals that would expand the overall operations level at LANL above those established for the No Action Alternative. Thus, this alternative includes those actions addressed under that alternative (see Section 5.7.1). Additionally, the Expanded Operations Alternative includes a number of new projects that have the potential to impact cultural resources. However, not all new projects would affect these resources, since many would involve actions within, or modifications to, existing structures or construction of new facilities within previously developed areas of LANL. 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 the remediation of MDAs at LANL; cultural resources impacts would be generally similar for both options. The surfaces of the MDAs would be disturbed whether they were capped or contamination removed. Because no archaeological resources are located within any of the MDAs, neither option would directly impact such sites. Risk of impact 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, and from workers or equipment leaving 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 fenced, as appropriate. As one example, a building eligible for inclusion in the National Register of Historic Places is within the solid waste management units comprising Firing Site R-44 in TA-15. However, if remediation of R-44 is required by NMED, remediation would take place in a manner protective of the building.

Most actions associated with implementing the Security-Driven Transportation Modifications Project would have little or no impact on cultural resources since 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 fenced, as appropriate. If previously unknown resources were identified during ground disturbing activities procedures as set forth in *A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico* would be followed (LANL 2005h). The proposed vehicle and pedestrian bridges over Ten Site Canyon would be highly visible from both nearby and distant locations. Thus, the potential exists that they may degrade views of the canyon from sites identified by American Indian 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. Since the corridors within which these would be constructed do not contain any known cultural resource sites, it is unlikely that construction of the bridges (or associated roadways) would have a direct impact on 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 in the vicinity of the Sandia Canyon bridge corridor. In the event that a previously unknown resource is identified during ground disturbing activities associated with the proposed options procedures set forth in LANL's cultural heritage management plan (LANL 2005h) would be followed. As noted above for the road and pedestrian bridges over Ten Site Canyon, the potential exists for the degradation of views of the canyon from sites identified by American Indian and Hispanic communities as traditional cultural properties (see Appendix J).

Technical Area Impacts

Three projects are being proposed that would have potential impacts on cultural resources within TA-3 and TA-21. These are related to the Center for Weapons Physics Research and the Replacement Office Buildings in TA-3 and TA-21 DD&D.

Technical Area 3

The proposed site of the Center for Weapons Physics Research is in an already-developed area of TA-3. However, TA-03-0028 is a potentially significant historic building that would be removed. Prior to its demolition it will be assessed for inclusion in the National Register of Historic Places in 2006. The current Administration Building (TA-03-0043) 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 are 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 tail located to the south of the parking lot must be managed as such until formally determined otherwise. Due to its proximity to the proposed project, there could be potential adverse effects to the trail from construction. Appropriate measures, such as fencing the trail, would be implemented to resolve any adverse effects.

Technical Area 21

Decontamination and demolition of buildings and structures at TA-21 would have direct effects on the National Register of Historic Places-eligible historic buildings and structures that are associated with the Manhattan Project and Cold War years at LANL. In total, there are 15 historic buildings and structures in TA-21; however, a number of these are located within the parcel that has been conveyed to Los Alamos County. With regard to 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 the 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 being 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 within the Pajarito Site (TA-18). These would continue to be protected during DD&D activities. Three LANL-associated buildings located within TA-18 have been identified as eligible for listing on the National Register of Historic Places. These include the Slotin Building (18-1) and two other buildings (18-2 and 18-5). 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 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 since none are located within areas to be disturbed by construction. However, one prehistoric site is located across the access road from the existing Radiochemistry Building, and the Radiochemistry Building itself is considered a historic structure. New construction in the area of the prehistoric site would require that the site boundaries be marked and the site 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 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 since 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).

Radioactive Liquid Waste Treatment Facility

Under the Proposed Action for replacing the RLWTF, effects to cultural resources would be minimal. Impacts to cultural resources in the vicinity of the pipeline and evaporation basins would be avoided during the siting process. However, if the pipeline alignment were to encroach on archaeological sites near the evaporation basins, the archaeological sites would require testing or excavation. This option would result in minimal effects on historic buildings since removal of later annexes to the RLWTF would not likely affect the original historic fabric of the building. However, changes in the process area of the RLWTF would require historic documentation before any equipment is removed from the building. The environmental consequences on cultural resources of the option to build and operate a single new low-level radioactive waste/transuranic facility would be the same as the Proposed Action option of building two separate buildings to house these facilities.

The New Construction and Renovation Option for the RLWTF could also result in minimal adverse effects on cultural resources. As discussed under the Proposed Action, impacts to archaeological sites near the pipeline route and evaporation basins would be avoided. In addition, changes to the structure of the existing RLWTF would alter the original historic appearance of the building. Removal of equipment, modification to 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 the 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 (capping and removal). All activities taking place in TA-54, including new construction and removal of the white-colored domes, would occur within developed areas. Thus, there would be no direct impact on cultural resources. However, a number of cultural resource sites are located nearby; thus, the 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. Placement of the proposed Transuranic Waste Processing Facility at TA-50 or TA-63 would not impact cultural resources since the potential facility locations are not situated near any cultural resources sites.

Adverse impacts on traditional cultural properties from activities associated with Waste Management Facilities Transition activities are unlikely since most activities would take place either within previously disturbed portions of TA-50 and TA-54 or in an existing structure. However, removal of the white-colored domes at TA-54 would have a positive impact on 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 listing on the National Register of Historic Places. Although project-related modifications would not affect the external appearance of the structure, it would be necessary to make a determination of potential adverse effects and document existing conditions, as appropriate. Additionally, any other significant historic buildings at TA-53 which 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.

Radiography Facility (TA-55)

Under all options Building 55-41 would be either demolished in whole or in part or renovated. TA-55-41 is a potentially significant historic building that has yet to be assessed for National Register of Historic Places eligibility status. If determined to be eligible prior to any demolition activities taking place, DOE in conjunction with the State Historic Preservation Office, would implement documentation measures such as preparing a detailed report containing the history and description of the affected properties. 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 be notified of the Memorandum of Agreement and would have an opportunity to comment.

Science Complex

Two archaeological sites are situated in the vicinity of the proposed Northwest TA-62 location and both sites have been determined to be eligible for the National Registry of Historic Places. These two sites are at risk of either direct or indirect adverse effects by construction of the Science Complex. Construction activity, traffic and ground disturbance could damage portions or both sites. Mitigation measures would be taken as appropriate to resolve 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 their 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 result in damage to 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 the secondary (indirect) impacts of LANL activities on employment, salaries, and procurement are analyzed in this SWEIS. The primary impacts are projected based on the changes in employment (in terms of full-time equivalents at LANL). Changes in employment were projected based on information regarding activities at Key Facilities, and 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). Changes in employment would likely result in additional, secondary changes in employment, salaries, and expenditures in the area, as well as changes in the demands on social services. These secondary impacts would occur within a regional economy because jobs added in a primary industry such as LANL create local opportunities for new employment in supporting industries. Analysis of these secondary economic and social impacts of LANL activities across the alternatives utilizes multipliers included in the *1999 SWEIS*. These multipliers were used to predict the total LANL socioeconomic impacts in the area. For example, if LANL were to expand employment by 100 full-time workers who would reside in the Tri-County area, the secondary effect of that action would be the addition of approximately 170 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 170 other jobs.

The projected changes in employment were then used to determine if there would be significant impacts in the Tri-County area in terms of the need for housing units, construction requirements at LANL, changes in local government finances, and the need for public services

Table 5–30 presents a summary of 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 continues to be a major economic force within the three-county region of influence consisting of Santa Fe, Los Alamos, and Rio Arriba Counties (the Tri-County area). Table 4–33 shows the percentage of the region of influence employment that is directly associated with LANL operations. As shown in this table, LANL contractors directly employ about 12 percent of the total number of persons employed in the region of influence, and this level has remained relatively steady over a number or years.

Table 5–30 Summary of Socioeconomic Consequences

No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
LANL Site		
LANL Employment		
2004 levels of employment used.	Decrease of 510 employees from 2004 levels. These cuts would be expected to result in the loss of about 865 indirect jobs in the region.	Increase by 2.3 percent per year so that from 2007 to 2011, an additional 920 to 2,240 employees would work at LANL and another 1,560 to 3,800 jobs would be created indirectly. This growth rate is consistent with the projected regional growth rate.
Housing		
No new housing units needed specific to changes in LANL's employment level.	Additional housing units would 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 since the population would still be expected to grow, albeit at a slower rate (about 1.3 percent versus 2.3 percent).	Additional housing units would be required in the Tri-County area as a result of 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 or Santa Fe County, or other surrounding counties, as opposed to Los Alamos County where a shortage of available housing would likely continue. The number of housing units needed would be dependent on the number of workers relocating from outside the area. Overall, the number of units would likely be small compared to the overall needs in the Tri-County area.
Construction		
Completion of previously approved construction projects would likely draw workers already 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 1.4 percent.	Annual gross receipts tax yields directly and indirectly associated with LANL employment are projected to increase by between 2.6 and 5.8 percent from 2007 through 2011 over 2004 levels in real terms as a result of the increasing size of LANL's workforce during that time frame.
Services		
The demand for services such as police, fire and hospital beds would likely remain at current levels on a proportional basis compared 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 growth.	The 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. However, regional population would still be projected to increase, even if LANL employment were to decrease by the small levels envisioned in this alternative, so the demand for services would likely increase albeit at a slower pace than under the No Action Alternative.	The 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 would be between 1,000 and 2,600 in the Tri-County area resulting in an estimated increase in needed public school funding from the state of $8 million to $21 million between 2007 and 2011. Most the additional services would be 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.

At the end of 2004, LANL employed 13,261 individuals; nearly 17 percent more than the employment projection of 11,351 presented in the *1999 SWEIS*. From 1996 through 2004, employment at LANL increased by approximately 2.3 percent per year. During the same period, employment in the region of influence increased by an average of 2.4 percent annually. For the No Action Alternative, it is assumed that employment levels would no longer increase but would stay steady at the 2004 level.

Work Force

The completion of construction projects previously approved under completed NEPA compliance reviews would likely draw workers already present in the region of influence who historically have worked 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 regional trends would likely be needed under the No Action Alternative.

Local Government Finance

Under this alternative, the Tri-County annual gross receipts tax yields would be expected to grow at the same level as the population. Any changes in tax rates are assumed to be driven by the need to improve service levels to meet public demand in the case of an increase or correspondingly, a determination that service levels can be cut back or reduced in some way in the case of a tax cut.

Services

Annual school enrollment trends in the Tri-County area would likely continue as a result of projected growth within the counties unrelated to LANL. The demands for police, fire, and other municipal services as a consequence of LANL employment needs would also be expected to remain at current levels.

5.8.1.2 Reduced Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Under the Reduced Operations Alternative, employment at LANL could decrease by approximately 3.8 percent, or 510 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 12,750 in 2007 under this alternative. In addition to the direct positions projected to be lost at LANL, indirect jobs would also be expected to be lost. Under this alternative, about 865 indirect positions are projected to be lost.

If these workers remained in the region of influence in 2007 and were unable to immediately find new employment, regional unemployment rates would be expected to increase by approximately 1.0 percent. Because 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 impact 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 time period. A similar decrease was seen from 2003 to 2004 when LANL's employment decreased by 2.6 percent, while the number of persons employed in the region of influence increased by 1.3 percent.

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. However, this would not be expected to have a significant adverse impact on the region because the population is expected to be growing at the same time, so the 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. However, given the lack of available units in Los Alamos County, any available units would likely be desired by others who may have wanted to move into the county but were unable to due to a 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, as compared to over 13 percent in the State of New Mexico and 9 percent across the United States [Census 2000]).

Work Force

The anticipated construction impacts would be the same as under the No Action Alternative.

Local Government Finance

Under the Reduced Operations Alternative, the Tri-County annual gross receipts tax yields associated with LANL employment would be expected to decrease by approximately 1.4 percent if all of the affected employees relocated outside of the region. However, any reduction in tax revenues associated with the potential loss of LANL employees would likely be more than offset by projected increases in the regional workforce outside of LANL.

Services

Annual school enrollment in the Tri-County area could decrease as a result of the 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 influx of non-LANL employees into the region, since the region is expected to continue to grow, albeit at a slightly slower rate if the employment levels at LANL were to drop to levels projected under this alternative.

The demands for police, fire, and other municipal services would not be expected to be impacted by the projected changes in employment under this alternative since they would represent less than one percent of the regional demand.

5.8.1.3 Expanded Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Under the Expanded Operations Alternative, employment at LANL would continue to increase. Increases would be expected as a result of increased pit production, and increased remediation and DD&D activities under this alternative. In addition, increased work would likely come to LANL 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 at LANL. From 1996 through 2004, employment at LANL increased by about 2.3 percent annually.

If LANL's employment rate were to continue to increase at the same level experienced from 1996 through 2004, approximately 15,500 individuals could be employed by LANL by the end of 2011, as shown in **Table 5–31**, an increase of about 2,240 over the 2004 level. Of those, approximately 13,756 employees would likely reside within the region of influence. In addition to the direct hires associated with LANL, approximately 3,800 positions would likely be added 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*	*ROI Employed*	*LANL as a Percent of ROI Employed*
2007	14,178	12,583	111,949	11.2
2008	14,497	12,866	114,664	11.2
2009	14,824	13,156	117,444	11.2
2010	15,158	13,452	120,292	11.2
2011	15,500	13,756	123,209	11.2

ROI = Region of Influence.

Housing

An increase in LANL employment of approximately 920 in 2007 to an increase of 2,240 in 2011, along with associated indirect hires, would likely increase the need for housing in the region of influence. Although there is limited housing available in Los Alamos County at the current time, new housing is planned to commence 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 or Rio Arriba, or other nearby counties, as has been 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 2004e).

Work Force

Under the Expanded Operations Alternative, construction and remediation efforts at LANL would increase; but, similar to the No Action Alternative, these projects would likely be staffed by workers already present in the region of influence who 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.

Local Government Finance

Under this alternative, the Tri-County annual gross receipts tax yields would be expected to increase by between 2.6 and 5.8 percent in real terms as a result of additional workers being added to LANL's workforce from 2007 through 2011. Any increases in tax revenues that would be needed to offset the cost of additional services to support the associated increase in population under the Expanded Operations Alternative would be covered by these new employees.

Services

Annual school enrollment in the Tri-County area due to the increase in LANL employment (direct and indirect) would be projected to increase by between 1,000 and 2,600 students from 2007 to 2011. Additional annual funding assistance of about $8 million to $21 million from the State of New Mexico would be required for public school operations because of these enrollment increases. This would be part of an expected increase of about 6,000 to 10,000 in school age children in the Tri-County area.

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 in the county, 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 projected to 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 the 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 encompassing affected technical areas and individual facilities and the utility systems for electric power, natural gas, and water that serve LANL. A description 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 Section 4.8.2.

In general, potential infrastructure impacts were assessed by comparing projections of utility resource requirements under each alternative against site capacities. While many LANL facilities do not meter utility use, annual site-wide demands are known and were used, in part, to make projections for each of the alternatives considered in this SWEIS. These projections included identifying base trends in site-wide infrastructure requirements, as well as within the larger region of influence, which were then adjusted for project-specific actions within specific technical areas and at Key Facilities considered under each alternative. Any projected demand for infrastructure resources exceeding site availability can be regarded as an indicator of impact. Where projected demand approaches or exceeds capacity, further analysis for that resource is warranted.

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**. Current (2004) values are presented because they provide the reference baseline against which projections for the three proposed alternatives can be compared in this SWEIS. For the Expanded Operations Alternative analyzed in the *1999 SWEIS* (DOE 1999a) and selected in the subsequent Record of Decision, LANL operations were projected to require 782,000 megawatt-hours of electricity 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. LANSCE operations have historically accounted for up to one-quarter to one-half of LANL's total water and electrical power demand, respectively. However, projections for LANSCE in the *1999 SWEIS* included operation of the Low-Energy Demonstration Accelerator. This facility only operated from late 1998 until it was shut down in December 2001. The Low-Energy Demonstration Accelerator was decommissioned in fiscal year 2003 (LANL 2005g). Thus, it will not be a factor in future LANSCE operations. Natural gas and water consumption was not projected for LANSCE, and the *1999 SWEIS* did not forecast utility infrastructure requirements for other Los Alamos County users.

While demand for key infrastructure resources (electricity, natural gas, and water) within the region of influence has generally exhibited an upward trend, there are notable exceptions. For electricity, total LANL demand increased by approximately 12 percent between 1999 and 2004 while other Los Alamos County user demands increased by 20 percent. In contrast, LANL natural gas consumption declined by nearly 20 percent between 1999 and 2004, but demand within the county increased by about 8 percent over roughly the same period. The decline at LANL is at least partly attributable to warmer than normal seasonal temperatures that have persisted since the early 1990s and possibly due to the switch from district heating plants to more efficient systems at individual LANL facilities. For water, total LANL demand also decreased by nearly 24 percent between 1999 and 2004, but this was offset by an increase of 18 percent among other Los Alamos County users, which accounts for the largest portion of total water use in the region of influence.

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: 632,000 megawatt-hours total (486,000 megawatt-hours for LANL); 48 percent of system capacity Electric Peak Load: 112 megawatts total (92.3 megawatts for LANL); 75 percent of system capacity Natural gas requirements: 2,213,000 decatherms total (1,195,000 decatherms for LANL); 27 percent of system capacity Water requirements: 1,682 million gallons total (388 million gallons for LANL); 93 percent of system capacity	Electricity requirements: 497,000 megawatt-hours total (350,000 megawatt-hours for LANL); 38 percent of system capacity Electric Peak Load: 84.5 megawatts total (64.9 megawatts for LANL); 56 percent of system capacity Natural gas requirements: 2,190,000 decatherms total (1,171,000 decatherms for LANL); 27 percent of system capacity Water requirements: 1,605 million gallons total (310 million gallons for LANL); 89 percent of system capacity	Electricity requirements: 814,000 megawatt-hours total (668,000 megawatt-hours for LANL); 62 percent of system capacity Electric Peak Load: 145 megawatts total (125 megawatts for LANL); 97 percent of system capacity Natural gas requirements: 2,320,000 decatherms total (1,301,000 decatherms for LANL); 29 percent of system capacity Water requirements: 1,816 million gallons total (522 million gallons for LANL); 101 percent of system capacity
MDA Remediation	No change in utility demands	Same as No Action Alternative	Up to 68 million gallons liquid fuels and 30 million gallons of water for remediation activities.
Security Driven Transportation Modifications	No change in utility demands	Same as No Action Alternative	Up to 4.0 million gallons liquid fuels and 18.6 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–2.1 million gallons liquid fuels and 9.6 million gallons of water for construction; no net increase in utility demands for operations. Center for Weapons Physics Research–2.7 million gallons liquid fuels and 14.4 million gallons of water for construction; no net increase in utility demands for operations.
TA-18	No change in utility demands	Same as No Action Alternative	Negligible, short-term increase in utility demands from DD&D of TA-18 buildings.
TA-21	No change in utility demands	Same as No Action Alternative	Negligible, short-term increase in utility demands from DD&D of structures.

	No Action Alternative	*Reduced Operations Alternative*	*Expanded Operations Alternative*
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 (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 Chemistry and Metallurgy Research Building Replacement operation when moved to TA-55.	Same as No Action Alternative	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 Facility (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 for negligible increase in operational utility demands.
High Explosives Testing Facility (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
Tritium Facility (TA-21)	No change in utility demands	Same as No Action Alternative	Negligible, short-term increase in utility demands 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 utility demands	Negligible decrease in site-wide operational utility demands from Pajarito Site shutdown.	Negligible, short-term increase in utility demands from DD&D of all TA-18 buildings.
Target Fabrication Facility	No change in utility demands	Same as No Action Alternative	Same as No Action Alternative

	No Action Alternative	***Reduced Operations Alternative***	***Expanded Operations Alternative***
Bioscience Facilities	No change in utility demands	Same as No Action Alternative	Science Complex–4.7 million gallons liquid fuels and 24 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–4.3 million gallons liquid fuels and 22.4 million gallons of water for construction; 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 –up to 504,000 gallons liquid fuels and 2.7 million gallons of water for construction; no net increase in utility demands for operations. Negligible short-term increase in utility demands from DD&D of existing Radioactive Liquid Waste Treatment Facility.
LANSCE (TA-53)	No change in utility demands	Moderate to major decrease in infrastructure resource requirements 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 construction. 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 895,000 gallons liquid fuels and 4.9 million gallons of water for construction; negligible incremental increase in utility demands for operations.
Plutonium Facility Complex (TA-55)	No change in utility demands	Same as No Action Alternative	Plutonium Facility Complex Refurbishment and Radiography Facility–Negligible, short-term increase in utility demands for construction; minor increase in utility demands for operations to support increased pit production.
Remote Warehouse and Truck Inspection Station (TA-72)	No change in utility demands	Same as No Action Alternative	Up to 536,000 gallons 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; LANSCE = Los Alamos Neutron Science Center.
Note: To convert gallons to liters, multiply by 3.78533.

Table 5–33 Current Infrastructure Requirements and System Capacities for the Los Alamos National Laboratory Region of Influence

Resource	*System Capacity*	*Current Requirement*		*Total Requirement*
		LANL	*Other Los Alamos County Users*	
Electricity				
Energy (megawatt-hours per year)	1,314,000 [a]	413,392	127,429	540,821
Peak load demand (megawatts)	150 [a]	69.4	16.2	85.6
Fuel				
Natural gas (decatherms per year)	8,070,000 [b]	1,149,936	931,940	2,081,876
Water (million gallons per year)	1,806 [c]	347	1,035	1,382

[a] 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. Values do not reflect completion of a new transmission line and other power grid upgrades that are ongoing.
[b] Reflects contractually-limited capacity of the natural gas system serving the Los Alamos area (see Section 4.8.2.2).
[c] Equivalent to the total water rights from the regional aquifer.
Note: A decatherm is equivalent to 1,000 cubic feet.
Source: Arrowsmith 2005, Glasco 2005, LANL 2005g.

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 are independent of subsequent project decisions at LANL. These ongoing activities add to the overall 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)	486,000	146,000	632,000	48
Peak load demand (megawatts)	92.3	19.6	112	75
Fuel				
Natural gas (decatherms)	1,195,000	1,018,000	2,213,000	27
Water (million gallons per year)	388	1,294	1,682	93

[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, Glasco 2005, DOE 2002h, LANL 2004e, 2005g, 2006.

Additionally, the infrastructure requirements projections are made for operations at LANL Key Facilities actually approaching operational levels forecast in the *1999 SWEIS* and associated Record of Decision. The level of operations forecast in the *1999 SWEIS* have not been realized to date, 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 reflects the rather conservative and 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 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 reduced utility demands, aging equipment physically limits the total operational availability of LANSCE to the extent that the levels of operations forecast in the *1999 SWEIS* would not be reasonable under the No Action Alternative.

No infrastructure capacity constraints are anticipated from implementation of the No Action Alternative in the short term, as 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 48 percent, 75 percent, 27 percent, and 93 percent, respectively, of the capacity of the utility systems that serve LANL.

The total peak load demand is projected to consume 75 percent of the Los Alamos Power Pool's peak load capacity by 2011. This includes consideration of the generating capacity of the TA-3 Co-Generation Complex at LANL which will have an electric generating capacity of at least 40 megawatts after a new turbine is installed by the end of 2006. 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 beyond 2006.

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 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 as compared to the past and, thus, could otherwise support an increase in natural gas consumption over time. Regardless, an adequate capacity margin is forecast to be maintained under the No Action Alternative.

Total water demand within the region of influence could exceed 90 percent of Los Alamos County's rights to withdraw water from the regional aquifer. This is despite the fact that projections indicate that LANL itself would remain within its annual water use ceiling quantity (542 million gallons [2,050 million liters]) under the No Action Alternative (see Section 4.8.2.3). As described in Section 4.8.2.3, Los Alamos County has completed feasibility studies to access 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

Construction and related DD&D requirements for electricity, fuels, and water in the affected technical areas under this alternative are expected to be negligible, including for replacement office building construction and continued upgrades to the Co-Generation Complex in TA-3 and

MDA H 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 this would have a negligible impact on the capacity 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, as the new facilities would generally replace older and less resource-efficient facilities. Further, upgrades at the TA-3 Co-Generation Complex would have a positive impact on 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 could, however, contribute to higher natural gas consumption should the facility be called upon 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 Building Replacement at TA-55, the Weapons Manufacturing Support Facility at TA-16, and construction of new dynamic experimentation support 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 the aforementioned new facilities would not be expected to result in a measurable overall increase in utility infrastructure demands, as the modern facilities would replace antiquated and less resource-efficient facilities, whereby an economy of scale would be achieved in operational efficiency. For example, completing construction of the 15 to 25 new buildings within the Twomile 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 from actions under the No Action Alternative would continue with certain operational reductions under this alternative. Reductions in the level of activity in high explosives processing and high explosives testing would have a negligible to minor impact on utility infrastructure requirements overall, as most other ongoing projects and activities would move forward as under the No Action Alternative. However, the entire LANSCE complex and TA-18 Pajarito Site would be placed into safe, shutdown mode under this alternative, although not all activities and associated utility demands would cease entirely. LANSCE accelerator and support operations currently demand a relatively large share (about 25 percent) of LANL's electricity and water. As such, shutdown of LANSCE would result in a measurable reduction in infrastructure resource demands site-wide as 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 38 percent, 56 percent, 27 percent, and 89 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)	350,000	146,000	497,000	38
Peak load demand (megawatts)	64.9	19.6	84.5	56
Fuel				
Natural gas (decatherms)	1,171,000	1,018,000	2,190,000	27
Water (million gallons per year)	310	1,294	1,605	89

[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.
Source: Projections based on Arrowsmith 2005, Glasco 2005, DOE 2002h, LANL 2004e, 2005g, 2006.

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), as base requirements would not be appreciably reduced due to high explosives processing and high explosives testing reductions.

Key Facilities Impacts

Los Alamos Neutron Science Center

Shut down 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 over the No Action Alternative. This action alone would result in a minor overall reduction in demands within the region of influence. Natural gas demand within the region would not be measurably affected, as LANSCE operational demands for natural gas are a small percentage of that used by LANL as a whole and as usage by LANL and other Los Alamos County users is affected more by weather and onsite electricity generation needs.

Pajarito Site

Shut down 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 would occur under this alternative that would affect numerous technical areas. Infrastructure requirements for these actions would be in addition to those needed for actions identified as part of the No Action Alternative. While 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 the projects would be implemented, such as the MDA Remediation Project. 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 to be limiting resources as they can be procured from offsite sources and supplied at the point of use as needed.

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)	668,000	146,000	814,000	62
Peak load demand (megawatts)	125	19.6	145	97
Fuel				
Natural gas (decatherms)	1,301,000	1,018,000	2,320,000	29
Water (million gallons per year)	522	1,294	1,816	101

[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.
Source: Projections based on Arrowsmith 2005, Glasco 2005, DOE 2002h, LANL 2004e, 2005g, 2006.

For a number of the new projects at LANL that involve DD&D of existing facilities whose capabilities would be replaced by newly constructed facilities, an economy of scale would be achieved in operational efficiency resulting in a net decrease in utility demands. This would tend to moderate the overall trend of 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 demands for electricity, particularly in electric peak load demand, and water over the No Action Alternative. Only minor increases in natural gas demand are forecast. Under this alternative, total annual electricity, electric peak load, natural gas, and water requirements would be about 62 percent, 97 percent, 29 percent, and 99 percent, respectively, of the capacity of the utility systems that serve LANL.

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 on the part of other Los Alamos County users that is forecast to persist. The predicted spike in electric peak load demand at LANL is primarily attributable to the Metropolis Center Increase in Level 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 compared to the Metropolis Center that would require about 131,400 megawatt-hours of electricity annually with a peak load demand of 18 megawatts. 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 beyond 2006.

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, due mainly to higher than normal seasonal temperatures. While implementation of the Expanded Operations Alternatives under this SWEIS could partly reverse this trend 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.

Under the Expanded Operations Alternative, increased operations at LANL, combined with projected growth in the rest of Los Alamos County, could exceed Los Alamos County's rights to withdraw water from the regional aquifer. In recent years, combined LANL and county water demands have consumed between 80 and 90 percent of the currently developed water rights. Nevertheless, LANL projections would still remain within its annual water use ceiling quantity (542 million gallons [2,050 million liters]) under this alternative. As discussed under the No Action Alternative (see Section 5.8.2.1) and detailed in Section 4.8.2.3, supplementing the Los Alamos 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 for the Center for Weapons Programs Research and Replacement Office Buildings in TA-3, and for the TA-21 structure DD&D project. Implementation of the TA-21 Structure DD&D project, which would include the natural-gas fired TA-21 steam plant, would also have a negligible to minor reduction in LANL natural gas consumption as the plant's natural gas demand was historically less than 10 percent of site-wide demand.

Key Facilities Impacts

A number of project actions would be undertaken as part of this alternative that would result in enhancement of operational capabilities of Key Facilities and a net increase in infrastructure resource demands to support the increased level of operations. Specifically, the Metropolis Center Increase in Level of Operations and LANSCE Refurbishment projects would result in a minor to moderate increase in LANL infrastructure resource requirements and within the region of influence to support higher levels of operations. Increased pit production at TA-55 under this alternative would entail a relatively minor increase in LANL infrastructure requirements because existing Plutonium Facility Complex operations currently constitute a relatively small percentage of LANL's total demands.

5.9 Waste Management

Waste management impacts are evaluated based on the quantities of waste generated by Key Facilities, non-Key Facilities and LANL's environmental restoration projects. Waste generation rates are 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 (see Section 5.4); Worker Health (see Section 5.6.3); Transportation (see Section 5.10); and Facility Accidents (see 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 are compiled by waste type and include process wastewaters (sanitary liquid waste, high explosives contaminated liquid waste, and industrial effluents); solid waste, and radioactive (including radioactive liquid waste) and chemical wastes. Due to the large number of construction and demolition projects now underway or planned at LANL, the additional categories of construction waste and DD&D waste have been included in the impacts analysis. LANL's environmental restoration project wastes are presented as a separate category.

The impacts associated with waste management were evaluated in the *1999 SWEIS*, based on the historical waste generation rates, projections of future waste generation, and the infrastructure in place to manage the wastes. With the exception of liquid wastes, solid (sanitary) wastes, and low-level radioactive waste, all LANL wastes are disposed offsite.

In this analysis, the *1999 SWEIS* projections were reviewed, and adjusted as needed, to present bounding values of waste quantities associated with each alternative. As discussed in 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 activities, and cleanup following the Cerro Grande Fire.

In addition to the waste generated onsite by LANL activities, LANL has historically 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 are generated 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 quantities of offsite waste expected are 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 are 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.

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)	38,000	38,000	194,000 to 881,000
Packaged low-level radioactive waste (cubic yards)	33,000 to 118,000	33,000 to 99,000	81,000 to 173,000
High activity low-level radioactive waste (cubic yards)	–	–	0 to 347,000
Remote-handled low-level radioactive waste (cubic yards)	–	–	470 to 1,700
Mixed low-level radioactive waste (cubic yards)	1,800 to 2,700	1,800 to 2,700	4,000 to 183,000
Transuranic Waste			
Contact-handled (cubic yards) [a]	3,500 to 5,900	3,500 to 5,900	5,400 to 33,000
Remote-handled (cubic yards)	–	–	12 to 62
Construction and demolition debris [c] (cubic yards)	197,000	197,000	656,000 to 736,000
Chemical waste [d] (pounds)	19,000,000 to 37,000,000	19,000,000 to 37,000,000	65,000,000 to 129,000,000
Liquid Radioactive Waste			
Liquid transuranic waste (gallons per year)	30,000	30,000	50,000
Liquid low-level radioactive waste (at TA-50) (gallons per year)	4,000,000	4,000,000	5,000,000
Liquid low-level radioactive waste (at TA-53) (gallons per year)	140,000	5,000 [e]	140,000

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 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 clearing.

[d] Chemical waste includes wastes regulated under 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; pounds to kilograms, multiply by 0.45359. Values have been rounded to the nearest hundred, thousand, or million.

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 in the *1999 SWEIS* for the Expanded Operations Alternative as modified for a lower level of pit production.

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 to be recycled in the Steam Plant cooling towers or 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 offsite as a New Mexico special waste. Offsite disposal capacity is expected to be adequate. (See 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 (644,000-liter) projection for annual discharges included in the *1999 SWEIS* (DOE 1999a). (See 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 2005j). 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 Section 4.9.1.4 for more details on industrial effluents.)

Sanitary waste generated at LANL will be managed at a transfer station, where solid waste is sorted and consolidated for transport to an offsite landfill (LANL 2005a, 2006). LANL conducts an aggressive waste minimization and recycling program, greatly reducing the amount of sanitary waste requiring disposal (LANL 2004p). Sanitary solid waste includes both routine and nonroutine wastes. Routine waste is waste produced from any type of periodic or recurring work that is considered ongoing in nature, including 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 2003d). Nonroutine waste quantities are projected for construction, DD&D and LANL's environmental restoration project wastes in the sections that follow. Under the No Action Alternative, three major construction projects would be undertaken that would generate significant quantities of construction wastes.

The projects are TA-16 Refurbishment, CMR Building Replacement, and Consolidation of Certain Dynamic Experimentation Activities. Construction wastes associated with these projects are expected to total about 12,000 cubic yards (9,200 cubic meters) (DOE 2002k, 2003f, 2003g). Generally, construction wastes may be disposed 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 through 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 offsite and offsite capacity is expected to be sufficient. The Chemistry and Metallurgy Research Building Replacement Project phase for DD&D would likely not occur until after 2015, after the new building was operational. Waste generated by the demolition process for that structure would likely involve both onsite and offsite disposal practices.

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	2	–	5,800	51,000
Los Alamos Site Office	–	–	–	10,000	486,000
General Excess Facilities	13,400	4,500	25	128,000	334,000
Dynamic Experimentation [b]	–	20	–	21,000	781,000
Chemistry and Metallurgy Research [c]	12,000	4,000	280	20,000	280,000
LANSCE Area A [d]	4,000	–	89	520	3,000
Total [e]	29,000	8,500	390	185,000	1,935,000

TA = technical area, LANSCE = Los Alamos Neutron Science Center.

[a] Chemical waste includes Resource Conservation and Recovery Act (RCRA) hazardous waste and Toxic Substances Control Act (TSCA) waste (asbestos).

[b] Values from Dynamic Experimentation EA (DOE 2003g).

[c] Values from the *Chemistry and Metallurgy Research Building Replacement EIS* (DOE 2003f) 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 2006).

[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 projects are presented separately from operational wastes. These nonroutine waste quantities could vary widely from year to year, and differ significantly from projections due to actual site-specific conditions encountered during field activities. Low-level radioactive waste generated by LANL's environmental restoration projects could be disposed onsite at TA-54 Area G or offsite at a commercial or DOE disposal facility. Chemical waste quantities generated by LANL's environmental restoration projects are expected to be substantial (LANL 2004i). Offsite capacity for all waste types is expected to be sufficient.

The expected impacts of waste generation are presented below for each category of chemical and radioactive waste. Projections of chemical and radioactive waste quantities are presented in **Table 5–39**. Information presented is based on the *1999 SWEIS* projections updated with information from the *Waste Volume Forecast*, prepared in June 2003 (LANL 2003d) and updated in September 2004 (LANL 2004i). The *Forecasts* integrate historical generation data with near- and long-term program plans (LANL 2003d). To aid the analysis, waste categories were further characterized as routine or non-routine.

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 [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 Facility	20	<1	0	28,000
High Explosives Testing Facility	1,200	1	<1	78,000
Tritium Facility	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 [d]	330	3	13	880
Los Alamos Neutron Science Center	1,400	1	0	37,000
Solid Radioactive and Chemical Waste Facilities [e]	300 [f]	10 [f]	35	2,000
Plutonium Facility Complex	990	20	440	19,000
Non-Key Facilities	1,000 [g]	40	30 [g]	1,435,000
TOTAL [h]	11,000	120	570	2,749,000

[a] Projected values from *1999 SWEIS* Record of Decision, as documented in the *2004 SWEIS Yearbook* (LANL 2005g), unless otherwise noted. Projections are based upon expected, routine facility operations and do not include wastes from non-routine events such as chemical cleanouts and construction projects.
[b] Values reflect a pit production level of 20 pits per year.
[c] Value not projected in *1999 SWEIS* Record of Decision. Metropolis Center was not a designated Key Facility at that time.
[d] Values adjusted from *1999 SWEIS* projections based on historical generation rates and new projections (LANL 2006).
[e] This Key Facility includes the Legacy Transuranic Waste Retrieval Program and the Offsite Source Recovery Program.
[f] Value adjusted upward from *1999 SWEIS* Record of Decision projection based on projections in the 2004 revision to the *Waste Volume Forecast*. (LANL 2004i).
[g] Value adjusted upward from *1999 SWEIS* projection based on historical generation rates and projections in the 2004 revision to the *Waste Volume Forecast* (LANL 2004i).
[h] Totals may not add due to rounding.
Note: To convert pounds to kilograms, multiply by 0.45359; 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 trending downward (LANL 2003d) 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 Facility, due to increased numbers of hydrotests and the use of a foam matrix for waste containment, is projected to double its average low-level radioactive waste generation (LANL 2004i). In addition, relocating the actinide processing and recovery capability to the Chemistry and Metallurgy Research Building may increase low-level radioactive waste quantities by up to 24 cubic yards (18 cubic meters) per year (DOE 2003f). 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 trending downward and LANL's environmental restoration project-generated quantities varying widely (LANL 2004i). 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 categories of waste are managed for ultimate 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 2004i). 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 additional 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 Building may increase transuranic waste quantities by 8 cubic yards (6.1 cubic meters) per year (DOE 2003f). After 2007, most transuranic wastes would be generated through routine activities (LANL 2003d). The capacity of WIPP allocated to LANL newly-generated transuranic waste 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 2003d) and is expected to continue in this direction under the No Action Alternative. Bulk chemical wastes generated by LANL's environmental restoration projects and operational waste generation comprise approximately 90 percent of the chemical and hazardous waste generated across LANL (LANL 2003d). Although LANL's environmental restoration project quantities are highly variable, operational bulk chemical waste is generated primarily at the Sanitary Wastewater Systems Plant and quantities are steady. Nonbulk chemical and hazardous wastes are generated by a wide range of operations at LANL (LANL 2004i). Approximately half of the nonbulk chemical waste is not regulated as hazardous by the State, but does not meet waste acceptance criteria for disposal at a solid waste landfill (LANL 2003d). Rates of generation for nonbulk chemical and hazardous wastes from operations are expected to remain steady under the No Action Alternative (LANL 2003d). Scheduled cleanouts of outdated or unused chemicals periodically could increase annual quantities for specific facilities

(LANL 2004i). 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 technical area are complete. The RLWTF at TA-50 continues to treat the majority of radioactive liquid wastes generated at LANL. Treated radioactive liquid waste quantities at the RLWTF, including acid and caustic radioactive liquid waste treated in Room 60, are projected in **Table 5–40**. Increased hydrotesting at the High Explosives Testing Facility is expected to generate additional radioactive liquid waste, up to 66,000 gallons (250,000 liters) annually to be treated at the RLWTF, but 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 $yards^3$ (12 $meters^3$) 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 $yards^3$ (50 $meters^3$) 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 $yards^3$ (20 $meters^3$) per year

TA = technical area.
[a] No new radioactive liquid waste is being generated at TA-21, and all inventory that exists in tanks and equipment is expected to be processed by 2007.
[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 2006.

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** includes a summary of waste quantities estimated for operations, DD&D, and LANL's environmental restoration project 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 2004i) 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.

Most wastes, with the exception of some low-level radioactive waste, are disposed 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 LANL's environmental restoration project-generated wastes, some variances from projections are possible in future years. The waste management infrastructure at LANL is adequate, in terms of staffing and facilities, to manage the quantities of waste expected to be generated under the No Action Alternative.

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	-	29,000	8,800	38,000
Packaged low-level radioactive waste	25,000 to 110,000	8,500	–	33,000 to 118,000
High Activity low-level radioactive waste	–	–	–	–
Remote-handled low-level radioactive waste	–	–	–	–
Mixed Low-Level Radioactive Waste	270 to 1,200	390	1,100	1,800 to 2,700
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]	185,000	–	197,000
Chemical Waste [g] **(pounds)**	9,997,000 to 27,000,000	1,935,000	7,513,000	19,000,000 to 37,000,000

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 2003d, 2004i), 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, Chemistry and Metallurgy Research Building Replacement, LANSCE Area A Renovation, and Consolidation of Certain Dynamic Experimentation Activities.

[c] Details of LANL's environmental restoration activities and resulting wastes are provided in Appendix I. A remediation decision is pending from NMED on remediation of MDA H. If it were to be removed, an additional 600 cubic yards of chemical waste and 4,800 cubic yards of bulk low-level radioactive waste would be generated.

[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) 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.

[e] Construction and demolition debris includes uncontaminated wastes such as steel, brick, concrete, pipe and vegetative matter from land clearing.

[f] Construction debris quantities were estimated for the following projects: TA-16 Refurbishment, Chemistry and Metallurgy Research Building Replacement, and Consolidation of Certain Dynamic Experimentation Activities.

[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; pounds to kilograms, multiply by 0.45359. Values have been rounded to the nearest hundred, thousand, or million.

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 be managed at a transfer station, where solid waste is sorted and consolidated for transport to an offsite landfill (LANL 2005a). As discussed under the No Action Alternative, waste minimization and recycling activities would reduce the quantities of solid waste disposed. Waste management impacts associated with DD&D activities would be the same as those of the No Action Alternative.

Under the Reduced Operations Alternative, smaller quantities of some radioactive and chemical wastes would be generated due to the shut down of the Pajarito Site and LANSCE, and 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**.

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** includes a summary of waste quantities estimated for operations, DD&D, and LANL's environmental restoration projects 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 2004i) and the upper end representing the *1999 SWEIS* projection, except as noted. The waste management infrastructure at LANL is adequate, in terms of staffing and facilities, to manage the quantities of waste expected to be generated under the Reduced Operations Alternative.

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 [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 Facility	15 [d]	<1 [d]	0	23,000 [d]
High Explosives Testing Facility	980 [d]	1 [d]	<1 [d]	62,000 [d]
Tritium Facility	630	4	0	3,800
Pajarito Site [e]	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 [f]	330	3	13	880
Los Alamos Neutron Science Center [g]	5	1	0	0
Solid Radioactive and Chemical Waste Facilities [h]	300 [i]	10 [i]	35	2,000
Plutonium Facility Complex	990	20	440	19,000
Non-Key Facilities	1,000 [j]	40	30 [j]	1,435,000
Total [k]	9,100	120	570	2,682,000

[a] Projected values from *1999 SWEIS* Record of Decision, as documented in the *2004 SWEIS Yearbook* (LANL 2005g), unless otherwise noted. Projections are based upon expected, routine facility operations and do not include wastes from non-routine events such as chemical cleanouts and construction projects.
[b] Values reflect a pit production level of 20 pits per year.
[c] Value not projected in *1999 SWEIS* Record of Decision. 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] No wastes would be generated at TA-18 as activities are ceased.
[f] Values adjusted from *1999 SWEIS* projections based on historical generation rates and new projections (LANL 2006).
[g] Only small quantities of waste would be generated as LANSCE operations are halted and the facility is maintained in standby mode.
[h] This Key Facility includes the Legacy Transuranic Waste Retrieval Program and the Offsite Source Recovery Program.
[i] Value adjusted upward from *1999 SWEIS* Record of Decision projection based on projections in the 2004 revisions to the *Waste Volume Forecast* (LANL 2004i).
[j] Value adjusted upward from *1999 SWEIS* projection based on historical generation rates and projections in the 2004 revisions to the *Waste Volume Forecast* (LANL 2004i).
[k] 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; 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)/year
Solidification of transuranic sludge at TA-50	16 yards^3 (12 meters^3)/year
Radioactive liquid waste treated at TA-50	4,000,000 gallons (15,000,000 liters)/year
Secondary treatment of radioactive liquid waste at TA-50	260,000 gallons (1,000,000 liters)/year
De-water low-level radioactive waste sludge at TA-50	70 yards^3 (50 meters^3)/year
Radioactive liquid waste treated at TA-53	5,000 gallons (20,000 liters)/year [b]
Transport evaporator bottoms to Tennessee	66,000 gallons (250,000 liters)/year
Receive solidified evaporator bottoms from Tennessee [c]	25 yards^3 (20 meters^3)/year

TA = technical area.
[a] No new radioactive liquid waste is being generated at TA-21, and all inventory that exists in tanks and equipment is expected to be processed by 2007.
[b] Under the Reduced Operations Alternative, operations at the LANSCE facility will cease. Approximately 5,000 gallons (20,000 liters) of radioactive liquid waste per year from TA-50 will continue to be treated at TA-53.
[c] This is solid low-level radioactive waste that is disposed of at TA-54.
Source: LANL 2006.

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 be managed at a transfer station, where solid waste is sorted and consolidated for transport to an offsite landfill (LANL 2005a). Waste minimization and recycling activities would reduce quantities of solid waste disposed.

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, mixed low-level radioactive waste, sanitary, asbestos, and hazardous wastes. Most of the waste would be disposed offsite. Demolition debris may be sent to any solid waste landfill permitted to accept such debris. Low-level radioactive waste may be disposed 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 5–44 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	–	29,000	8,800	38,000
Packaged low-level radioactive waste	25,000 to 91,000	8,500	–	33,000 to 99,000
High activity low-level radioactive waste	–	–	–	–
Remote-handled low-level radioactive waste	–	–	–	–
Mixed Low-Level Radioactive Waste	270 to 1,200	390	1,100	1,800 to 2,700
Construction and Demolition Debris [e]	12,000 [f]	185,000	–	197,000
Chemical Waste [g] **(pounds)**	9,997,000 to 27,000,000	1,935,000	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 2003d, 2004i), 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 under the No Action Alternative.

[c] LANL's environmental restoration project-related waste quantities are the same as 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) 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.

[e] Construction and demolition debris includes uncontaminated wastes such as steel, brick, concrete, pipe and vegetative matter from land clearing.

[f] Construction debris quantities are the same as under 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; pounds to kilograms, multiply by 0.45359. Values have been rounded to the nearest hundred, thousand, or million.

Table 5–45 Wastes from Decontamination, Decommissioning, and Demolition Activities – Expanded Operations Alternative (cubic yards)

DD&D Project	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]	–	29,000	8,500	390	185,000	1,935,000
Center for Weapons Physics Research	–	13,000	4,300	–	187,000	313,000
Replacement Office Buildings	–	23	8	–	6,900	–
Radiological Sciences Institute	1,100 [c]	70,000	23,000 [c]	1,000	74,000	1,304,000
Radioactive Liquid Waste Treatment Facility Upgrade[d]	300	8,500	2,800	220	1,800	212,000
TA-55 Radiography Facility	–	–	–	–	7,900	–
Plutonium Refurbishment	340	970	320	220	2,100	2,000
TA-18 Closure	–	3,500	1,200	5	17,000	90,000
TA-21 Structure	1	26,000	8,700	65	48,000	440,000
Waste Management Facilities Transition	–	23,000	7,500	8	53,000	591,000
Total [e]	1,800	174,000	56,000	1,900	584,000	4,883,000

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, DD&D associated with the Radiological Sciences Institute is expected to generate 467 cubic yards of remote-handled low-level radioactive waste and 12 cubic yards of remote-handled transuranic waste.

[d] Waste volumes reflect the option that generates the most waste.

[e] Totals may not add due to rounding.

Note: To convert cubic yards to cubic meters, multiply by 0.76456. Values have been rounded to the nearest hundred, thousand, or million.

The type and extent of environmental restoration activities that would be required by NMED are not yet well-defined. To assess impacts under this uncertain scope, 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 anticipated for these wastes due to the difficulty in predicting selected remedies and waste types and quantities.

Table 5–46 Construction Wastes [a] – Expanded Operations Alternative

Construction Project	*Waste Generated (cubic yards)*
No Action Total	12,000
Center for Weapons Physics Research	1,600
Replacement Office Buildings	1,800
Radiological Sciences Institute	2,800
Radioactive Liquid Waste Treatment Facility Upgrade	620
TA-55 Radiography Facility	50
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 clearing.

Note: Values have been rounded to the nearest hundred, thousand, or million.

Even greater quantities of MDA remediation wastes would be generated under the Removal Option, with substantial quantities of demolition debris and low-level radioactive waste expected, greatly exceeding the quantities projected under the No Action Alternative. Variations in actual versus projected waste quantities would be anticipated for LANL's environmental restoration project wastes due to the difficulty in predicting selected remedies and waste types and quantities. The closure of some TA-54 Area G facilities, and 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 would also 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 increased levels of operations at various facilities. Expanded actinide activities at the Chemistry and Metallurgy Research Building, increased pit production (up to 50 pits per year under single-shift operations [80 pits per year using multiple shifts]) at the Plutonium Facility Complex, and increased recovery of sealed sources under the Offsite Source Recovery Program would result in larger quantities of transuranic and low-level radioactive waste. In addition, the restart of the Mixed Oxide Program, converting weapons-grade plutonium to a form usable in commercial reactors, could generate additional quantities of transuranic waste (LANL 2004i). 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 levels of pit production and restart of the Mixed Oxide Program. The TA-21 demolition work is expected to generate about 8,400 gallons (32,000 liters) of low-level radioactive liquid waste; this waste would be treated at the RLWTF 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	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 Facility	20	<1	0	29,000
High Explosives Testing Facility	1,200	1	<1	78,000
Tritium Facility	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 [d]	390	3	18	1,100
Los Alamos Neutron Science Center	1,420	1	0	37,000
Solid Radioactive and Chemical Waste Facilities [e]	300 [f]	10 [f]	35	2,000
Plutonium Facility Complex	1,400 [g]	20	690 [h]	19,000
Non-Key Facilities	1,000 [i]	40	30 [i]	1,435,000
TOTAL [j]	12,000	130	860	2,750,000

[a] Projected values from *1999 SWEIS* Record of Decision, as documented in the *2004 SWEIS Yearbook* (LANL 2005g), unless otherwise noted. Projections are based upon expected, routine facility operations and do not include wastes from non-routine 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] Values adjusted from *1999 SWEIS* projections based on historical generation rates and new projections (LANL 2006).
[e] This Key Facility includes the Transuranic Waste Retrieval Project and the Offsite Source Recovery Program.
[f] Value adjusted upward from *1999 SWEIS* projection based on projections in *Waste Volume Forecast* (LANL 2004i).
[g] Projections for transuranic and low-level radioactive waste assume pit production up to a level of 80 pits per year, based on *1999 SWEIS* projections (DOE 1999a) and more recent waste estimates (LANL 2005d).
[h] Projections for transuranic and low-level radioactive waste assume pit production up to a level of 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 is projected due to restart of Mixed Oxide Program (LANL 2004i).
[i] Value adjusted upward from *1999 SWEIS* projection based on historical generation rates and projections in the *Waste Volume Forecast* (LANL 2004i).
[j] Totals may not add due to rounding.

Note: To convert cubic yards to cubic meters, multiply by 0.76456; pounds to kilograms, multiply by 0.45359. Values have been rounded to the nearest hundred, thousand, or million.

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)/year
Solidification of transuranic sludge at TA-50	22 yards^3 (17 meters^3)/year
Radioactive liquid waste treated at TA-50	5,000,000 gallons (20,000,000 liters)/year
Secondary treatment of radioactive liquid waste at TA-50	320,000 gallons (1,200,000 liters)/year
De-water low-level radioactive waste sludge at TA-50	80 yards^3 (60 meters^3)/year
Radioactive liquid waste treated at TA-53	140,000 gallons (520,000 liters)/year [b]
Transport evaporator bottoms to Tennessee	80,000 gallons (300,000 liters)/year
Receive solidified evaporator bottoms from Tennessee [c]	30 yards^3 (25 meters^3)/year

[a] No new radioactive liquid waste is being generated at TA-21, and all inventory that exists in tanks and equipment is expected to be processed by 2007.
[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 2006.

Summary— **Table 5–49** includes a summary of waste quantities estimated for operations, DD&D, and LANL's environmental restoration projects 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 categories of Operational Waste and Remediation Waste, 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 2004i) 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 due to heightened operations at the Plutonium Facility Complex and increased characterization and management activities in the legacy waste retrieval program compared to the No Action Alternative. Although operational transuranic waste quantities are higher under this Alternative, waste disposal capacity at WIPP is expected to be adequate, assuming best estimates are realized. Operational low-level waste quantities are also expected to increase under this Alternative; the use of both onsite and offsite disposal options may be necessary for management of this waste. As detailed in Appendix H, improvements to the LANL waste management infrastructure would be implemented to ensure safe and efficient management of wastes.

DD&D activities are also 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.

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	1,800	280 to 22,000	5,400 to 33,000
Remote-handled	–	12	0 to 50	12 to 62
Low-Level Radioactive Waste [d]				
Bulk low-level radioactive waste	–	175,000	20,000 to 710,000	194,000 to 881,000
Packaged low-level radioactive waste	25,000 to 117,000	57,000	–	81,000 to 173,000
High activity low-level radioactive waste	–	--	0 to 350,000	0 to 347,000
Remote-handled low-level radioactive waste	–	470	0 to 1,200	470 to 1,700
Mixed Low-Level Radioactive Waste	270 to 1,300	1,900	1,800 to 180,000	4,000 to 183,000
Construction and Demolition Debris [e]	26,000	584,000	47,000 to 130,000	656,000 to 736,000
Chemical Waste [g] **(pounds)**	9,997,000 to 28,000,000	4,883,000	50,000,000 to 97,000,000	65,000,000 to 129,000,000

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 2003d, 2004i), 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, plus all DD&D wastes estimated to arise from new projects under the Expanded Operations Alternative as detailed in Table 5–45.

[c] 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) 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.

[e] Construction and demolition debris includes uncontaminated wastes such as steel, brick, concrete, pipe and vegetative matter from land clearing.

[f] Construction debris quantities include those under the No Action Alternative, plus all construction wastes estimated to arise from new projects under the Expanded Operations Alternative as detailed in Table 5–46.

[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; pounds to kilograms, multiply by 0.45359. Values have been rounded to the nearest hundred, thousand, or million.

For remediation waste, the range is intended to reflect the uncertainty associated with site cleanups. Final decisions on site cleanup will be made after DOE and LANL investigate the site and propose a remedy to NMED. NMED would then accept public comment on the proposed remedy and make a final decision. For many of LANL's environmental restoration project sites, 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 produced relatively small amounts of waste, and a Removal Option, which involves significant intrusive cleanups and produces 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, some remedial actions would take place at high explosives testing sites and outfalls, and retrieval of buried transuranic waste would be undertaken. Actions at most MDAs would be limited to installing an engineered cover, with 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 at Area G, depending upon available capacity and disposal priorities.

Under the MDA Removal Option, the same remedial activities would take place as under the MDA Capping Option, with one important addition. All MDAs would be exhumed, generating very large quantities of waste, including transuranic, low-level radioactive, mixed low-level radioactive, uncontaminated debris, and chemical waste. For the categories of uncontaminated debris (managed as solid waste) and chemical wastes, offsite disposal capacity is expected to be adequate. The quantities of low-level radioactive waste would exceed the planned capacity at Area G; decisions on onsite or offsite disposal would depend upon available capacity and disposal priorities. Quantities of transuranic waste projected under the MDA Removal Option are conservative; they are based on the volume of waste as excavated (including soil) and all major MDAs being removed. There has been no credit taken for use of waste volume reduction techniques such as sorting. It is assumed that all of the transuranic waste would be disposed of at WIPP.

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 population 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 takes into account a spectrum of accidents ranging from high-probability accidents of low severity (a fender bender) to hypothetical high-severity accidents that have a correspondingly 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 there could be a release of radioactivity 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 having a probability greater than 1×10^{-7} (1 chance in 10 million) per year. The latter consequences were determined for atmospheric conditions that would prevail during accidents. The analysis used the RISKIND computer program to estimate doses to individuals and populations (Yuan et al. 1995).

Incident-free 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 using 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 offsite commercial truck transportation, separate accident rates and accident fatality risks were used for rural, suburban, and urban population zones. The 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 were 3.15, 3.52, and 3.66 per 10 million truck-kilometers, and the fatality rates were 0.88, 1.49, and 2.32 per 100 million truck kilometers for rural, suburban, and urban zones, respectively.

For 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 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, provided in *Determination of Influence Factor and Accident Rates for Armored Tractor/Safe Secure Trailer* (Phillips, Claus, and Blower 1994), was used to estimate accident frequencies for rural, urban and suburban transports. Accident fatalities for the SST transports were estimated using the commercial truck transport fatality per accident ratios within each zone.

For local and regional transport of industrial and hazardous waste, New Mexico State accident and fatality rates, also 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 is 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 are transported both onsite, between the technical areas, and offsite to multiple locations. Onsite transport constitutes the majority of activities that are part of routine operations in support of various programs. The radioactive materials transported onsite between technical areas 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* (DOE 1999a) 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*. Therefore, the *1999 SWEIS* projection of impacts would envelop the impacts for routine onsite transportation. The non-routine onsite transport activities, such as waste transport from facility DD&D or from MDA remediation, were evaluated and are presented in this SWEIS where applicable.

Offsite transports of radioactive materials would occur using both trucks and airfreight. Materials transported by air freight would be similar in number, type, and forms as those considered in the *1999 SWEIS*, and hence result in similar impacts. The air crew dose from airfreight radioactive transport was estimated at 2.4 person-rem per year (DOE 1999a).

Truck (both commercial and DOE SST) transport is analyzed further in this SWEIS. The *1999 SWEIS* provides a comprehensive listing of various radioactive material types, forms, origin and destination, quantities, and the projected number of shipments. The radioactive materials transported included, tritium, plutonium, uranium (both depleted and enriched), offsite source recovery, 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 for future transports. For analyses purposes in this SWEIS, the destinations were limited to those that would be greatly 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 sites supporting nuclear weapons production and mixed oxide fuel fabrication (such as the Pantex Plant in Texas and Savannah River Site in South Carolina). Transport of other radioactive materials would remain similar to those projected in the *1999 SWEIS*.

Table 5–50 provides the estimated number of offsite material shipments under each alternative over a 10-year period.

Table 5–50 Estimates of the Number of Offsite Shipments under Each Alternative

Alternative	*Number of Shipments*										
	Radioactive Materials									*Miscellaneous*	
	LSA Waste	*DD&D Bulk*	*LLW (B)* [a]	*High Activity* [b]	*LLW-RH* [c]	*Mixed LLW*	*TRU* [d]	*SNM*	*PuO_2*	*Hazardous*	*Others* [e]
No Action	624	784	8,517	300	0	190	1,317	600	0	950	10,764
Reduced Operations	624	784	7,283	300	0	190	1,317	600	0	938	11,764
Expanded Operations [f]	1,436 - 49,940	9,465	9,050	3,390 - 36,493	191 - 851	295 - 9,011	2,185 - 4,824	600	10	2,811 - 4,779	36,456 - 42,543

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 Type A containers (drums or B-25 boxes).

[b] High activity low-level radioactive waste containing more than 10 nanocuries per gram of transuranic waste transported in B-25 Type A boxes. This waste is comparable to Class B or C of 10 CFR 61 waste classification. This waste is generated during MDA waste retrieval, and from decontaminating and demolishing of some of the buildings.

[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 represents the estimated number of shipments for options of capping and remediation and removal and remediation of all MDAs.

Table 5–51 summarizes the total transportation impacts, as well as the transportation impacts on two nearby LANL transportation routes, namely LANL to Pojoaque, NM, the route segment that all trucks from LANL use; and Pojoaque to Santa Fe, NM, the route segment that all trucks using Interstate-25 (such as trucks traveling to WIPP) would use. For analyses purposes in this SWEIS, two sites, the DOE Nevada Test Site and a commercial facility in Utah were selected as possible disposal sites for 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 would always be disposed at WIPP.

The maximum total dose to the general public would be 271 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 (0.16 LCF). The total dose to general public under this option along the LANL to Pojoaque route would be 7.6 person-rem with less than one excess LCF (0.0046 LCF) among the exposed population. The total dose to general public along the Pojoaque to Santa Fe route would be up to 12.0 person-rem with less than one excess LCF (0.0075 LCF) among the exposed population.

Table 5–51 Risks of Transporting Radioactive Materials under Each Alternative

Alternative	Offsite Disposal Option [a]	Number of Shipments	Round Trip Kilometers Traveled (million)	Incident-Free				Accident	
				Crew		Population			
				Dose (person-rem)	LCFs	Dose (person-rem)	LCFs	Radiological Risk [b]	Nonradiological Risk [b]
No Action									
LANL to Pojoaque	NTS	12,332	0.77	4.53	0.0027	1.55	0.00093	3.6×10^{-6}	0.0087
Pojoaque to Santa Fe		12,332	0.97	7.59	0.0046	2.54	0.00153	5.8×10^{-6}	0.0110
Total		12,332	28.72	146.7	0.088	49.3	0.0296	0.000156	0.282
LANL to Pojoaque	Commercial	12,332	0.77	4.53	0.0027	1.55	0.00093	3.6×10^{-6}	0.0087
Pojoaque to Santa Fe		2,360 [c]	0.19	3.07	0.00184	1.21	0.00073	2.1×10^{-7}	0.0017
Total		12,332	25.25	129.4	0.0776	44.3	0.0266	0.000132	0.244
Reduced Operations									
LANL to Pojoaque	NTS	11,098	0.69	4.15	0.00249	1.44	0.00086	3.1×10^{-6}	0.0082
Pojoaque to Santa Fe		11,098	0.88	6.95	0.0042	2.35	0.0014	5.0×10^{-6}	0.010
Total		11,098	25.63	131.3	0.079	44.4	0.0267	0.000136	0.251
LANL to Pojoaque	Commercial	11,098	0.69	4.15	0.00249	1.44	0.00086	3.1×10^{-6}	0.0082
Pojoaque to Santa Fe		2,360 [c]	0.19	3.07	0.00184	1.21	0.00073	2.1×10^{-7}	0.0022
Total		11,098	22.60	116.2	0.070	40.2	0.024	0.000115	0.218
Expanded Operations (with MDA Removal Option)									
LANL to Pojoaque	NTS	120,244	7.48	25.07	0.0150	7.62	0.00457	0.000031	0.088
Pojoaque to Santa Fe		120,244	9.50	42.01	0.0252	12.48	0.0075	0.000046	0.112
Total		120,244	294.17	884.2	0.530	271.3	0.163	0.00156	2.93
LANL to Pojoaque	Commercial	120,244	7.48	25.07	0.0150	7.62	0.00457	0.000031	0.088
Pojoaque to Santa Fe		42,954 [c]	3.39	29.37	0.0176	9.09	0.0055	0.000023	0.040
Total		120,244	267.32	745.3	0.447	258.6	0.0155	0.00134	2.64
Expanded Operations (with MDA Capping Option)									
LANL to Pojoaque	NTS	26,622	1.66	7.18	0.0043	2.32	0.0014	5.3×10^{-6}	0.0196
Pojoaque to Santa Fe		26,622	2.1	12.02	0.0072	3.80	0.0023	8.3×10^{-6}	0.025
Total		26,622	63.5	229.80	0.138	73.6	0.044	0.00023	0.63
LANL to Pojoaque	Commercial	26,622	1.66	7.17	0.0043	2.32	0.0014	5.3×10^{-6}	0.0196
Pojoaque to Santa Fe		6,552 [c]	0.52	6.66	0.0040	2.28	0.00137	2.2×10^{-6}	0.0061
Total		26,622	56.6	208.6	0.125	67.90	0.041	0.00020	0.553

LCF = latent cancer fatality, NTS = Nevada Test Site, MDA = material disposal area.

[a] Under this option, the 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 and SRS would ship or receive special nuclear material.

[b] Risk is expressed in terms of LCF, except for the nonradiological, where it refers to the number of traffic accident fatalities.

[c] Shipment 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: To convert kilometers to miles, multiply by 0.62137.

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 with the remaining 10 percent related to truck trips in support of LANL activities. The alternatives were then analyzed assuming that traffic flows would 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 decline. Similarly, under the Expanded Operations Alternative, LANL employment is projected to increase and along with this increase, traffic would likely increase.

As shown in **Table 5–52**, local traffic flows would likely remain at their current levels under the No Action Alternative as employment levels would stay at their current levels. Under the Reduced Operations Alternative, a small decline in traffic through LANL would be expected mainly as a result of the projected decrease in employment under this alternative. Under the Expanded Operations Alternative, traffic would likely increase substantially due to the projected increase in employment and increased construction and remediation activities. This is particularly true for Pajarito Road as remediation activities start on MDA G. The Expanded Operations Alternative – MDA Removal Option would have a larger increase relative to the MDA – Capping Option due to the larger number of truck trips associated with MDA remediation along with a larger number of remediation workers needed to implement this option.

Table 5–52 Summary of Changes in Traffic Flow at the Entrances to Los Alamos National Laboratory

	Average Daily Vehicle Trips				
Alternative	***Diamond Drive Across Los Alamos Canyon***	***Pajarito Road at State Road 4***	***East Jemez Road at State Road 4***	***West Jemez Road at State Road 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 (%)	 23,700 -3	 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	8,700 +75	10,700 +13	2,200 +49	1,600 +27

MDA = material disposal area.

5.10.1 No Action Alternative

Los Alamos National Laboratory Site-Wide Impacts

Under this alternative, about 12,330 offsite shipments of radioactive materials would be made to the Nevada Test Site (or a commercial site in Utah), WIPP, and Pantex between 2007 and 2016. 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 onsite. Transuranic waste would be shipped to WIPP, and special nuclear material would be shipped between LANL and Pantex. The total projected (one-way) distance traveled on public roads transporting radioactive materials to various locations would range from 7.8 million to 8.9 million miles (12.6 million to 14.4 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 129 person-rem for the commercial Utah site low-level radioactive waste disposal option to 147 person-rem for Nevada Test Site disposal. The dose to the general population would range from 44 to 49 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 0.088 LCFs among the transportation workers and 0.030 excess LCFs in the affected population. The dose for the option that involves 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 the maximum annual dose to a transportation worker would be 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 latent fatal cancer from exposure during these activities.

The doses to the general population along the LANL to Pojoaque and the Pojoaque to Santa Fe routes were estimated to be a maximum of 1.6 and 2.5 person-rem, respectively. These doses would result in 0 (0.00093 and 0.0015) excess LCFs among the exposed population.

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 chance 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 5.9 million (1.7×10^{-7}) per year in an urban area. Given 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, should it occur, 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}).

Estimates of the total offsite transportation accident risks for all projected accidents involving radioactive shipments, regardless of type, under this alternative are as follows: a maximum radiological dose-risk to the general population of 0.26 person rem, resulting in 0.00016 LCFs and a maximum nonradiological accident risk of 0 (0.28) fatalities.

The maximum radiological transportation accident dose-risk to the general population along the LANL to Pojoaque and the Pojoaque to Santa Fe routes would be 0.0060 and 0.0096 person-rem, respectively. These doses would result in 0 (3.6×10^{-6} and 5.8×10^{-6}) excess LCFs among the exposed population. The maximum expected traffic fatalities along these routes would be 0 (0.0087) and 0 (0.011), respectively.

Impacts of Construction, Operations, and Hazardous Material Transportation

The impacts of transporting various nonradiological materials were also evaluated. These impacts are presented in terms of distance traveled and number of expected traffic accidents and fatalities. The transportation impacts under this alternative would be: 3.5 million miles (5.7 million kilometers) traveled, 1 (0.64) traffic accident, and 0 (0.07) fatalities.

Local Traffic

Under the No Action Alternative, the impact of LANL activities on local traffic flow and roadway infrastructure would be approximately the same as current conditions as described in Section 4.10.1. Efforts that are 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 a greater level of scrutiny.

5.10.2 Reduced Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Under this alternative, about 11,100 offsite shipments of radioactive materials would be made to the Nevada Test Site (or a commercial disposal site in Utah), WIPP, and Pantex between 2007 and 2016. Similar to the No Action Alternative, the maximum transportation impacts would result from the low-level radioactive waste being shipped to either the Nevada Test Site or a commercial disposal site in Utah, the transuranic waste being shipped to WIPP, and special nuclear material being shipped between LANL and Pantex. The total projected (one-way) distance traveled on public roads transporting radioactive materials to various locations would range from 7.0 million to 7.9 million miles (11.3 million to 12.7 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 116 person-rem for the Utah low-level radioactive waste disposal option to 131 person-rem for Nevada Test Site disposal. The dose to the general population would range from 40 to 44 person-rem for each option, respectively. Accordingly, incident-free transportation would result in a maximum of 0.079 LCFs among the transportation workers and 0.027 excess LCFs in the affected population for the option that involves disposal of low-level radioactive waste at the Nevada Test Site because of longer distance and larger affected population.

The impact of this alternative on individual transportation workers would be the same as discussed in 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 population along the LANL to Pojoaque and the Pojoaque to Santa Fe routes under this alternative were estimated to be a maximum of 1.4 and 2.4 person-rem, respectively. These doses would result in 0.00086 and 0.0014 excess LCFs among the exposed population.

Impacts of Accidents during Transportation

Similar to 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 1 in 5.9 million (1.7×10^{-7}) per year in an urban area. The consequences of such an accident should it occur would be similar to those provided under the No Action Alternative.

Estimates of the total offsite transportation accident risks for all projected accidents involving radioactive shipments, regardless of type, under this alternative are as follows: maximum radiological dose-risk to the general population of about 0.23 person-rem, resulting in 0.00014 LCFs and a maximum nonradiological accident risk of 0 (0.25) fatalities.

The maximum radiological transportation accident dose-risk to the general population along the LANL to Pojoaque and the Pojoaque to Santa Fe routes would be 0.0052 and 0.0083 person-rem, respectively. These doses would result in 0 (3.1×10^{-6} and 5.0×10^{-6}) excess LCFs among the exposed population. The maximum expected traffic fatalities along these routes would be 0 (0.0082) and 0 (0.010), 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 number of expected traffic accidents and fatalities. The transportation impacts under this alternative would be: 3.5 million miles (5.7 million kilometers) traveled, 1 (0.64) traffic accident, and 0 (0.07) fatalities.

Local Traffic

Under the Reduced Operations Alternative, the impact of LANL activities on local traffic flow and roadway infrastructure would be somewhat lower 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 the shut down of LANSCE (see Section 5.8.1.2), would likely result in small decreases in terms of local traffic flow and the impact 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 State Road 4	East Jemez Road at State Road 4	West Jemez Road at State Road 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	23,700	4,800	9,100	1,900	1,200
Percent Change from Baseline	-3	-4	-4	-5	-4

5.10.3 Expanded Operations Alternative

Los Alamos National Laboratory Site-Wide Impacts

Under this alternative, between 26,622 and 120,244 offsite shipments of radioactive materials would be made to the Nevada Test Site (or a commercial disposal site in Utah), WIPP, Pantex and the Savannah River Site between 2007 and 2016, under the MDA Capping Option and MDA Removal Option, respectively. Maximum transportation impacts would be realized in the event low-level radioactive waste was shipped to either the Nevada Test Site or a commercial site in Utah instead of being disposed onsite. Transuranic waste would be shipped to WIPP, and special nuclear material would be shipped between LANL and Pantex or Savannah River. The total projected (one-way) distance traveled on public roads transporting radioactive materials to various locations would range from 17.6 million to 19.8 million miles (28.3 million to 31.8 million kilometers) under the MDA Capping Option to 83.1 million to 91.4 million miles (133.7 million to 147.1 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 209 to 745 person-rem for the Utah low-level radioactive waste disposal option to 230 to 884 person-rem for Nevada Test Site disposal for the MDA Capping Option and MDA Removal Option. The dose to the general population would range from 68 to 74 person-rem for the MDA Capping Option to 259 to 271 person-rem for the MDA Removal Option. Accordingly, incident-free transportation would result in a maximum of 0.14 LCFs among transportation workers and 0.044 excess LCFs in the affected population for the MDA Capping Option, and a maximum of 0.53 LCFs among transportation workers and 0.16 excess LCFs in the affected population for the MDA Removal Option. The doses for options involving disposal of low-level radioactive waste at the Nevada Test Site are higher because of longer distances involved and larger affected population.

The impact of this alternative on individual transportation workers would be the same as discussed in 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 population along the LANL to Pojoaque and the Pojoaque to Santa Fe routes were estimated to be a maximum of 2.3 and 3.8 person-rem, respectively, under the MDA Capping Option. These doses would result in 0 (0.0014 and 0.0023) excess LCFs among the exposed population. Under the MDA Removal Option, the doses to the general population along the LANL to Pojoaque and the Pojoaque to Santa Fe routes were estimated to be a maximum of 7.6 and 12.5 person-rem, respectively. These doses would result in 0 (0.0046 and 0.0075) excess LCFs among the exposed population.

Impacts of Accidents during Transportation

Similar to 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 4 million (2.5×10^{-7}) per year in an urban area under the MDA Capping Option and 1 in 2 million (4.9×10^{-7}) per year in an urban area for the MDA Removal Option. The consequences of such an accident should it occur would be similar to those provided under the No Action Alternative.

Estimates of the total offsite transportation accident risks for all projected accidents involving radioactive shipments, regardless of type, under this alternative are as follows: maximum radiological dose risk to the general population of 0.38 person-rem, resulting in 0.00023 LCFs and a maximum nonradiological accident risk of 1 (0.63) fatality under the MDA Capping Option, and 2.6 person-rem, resulting in 0.0016 LCFs and a maximum nonradiological accident risk of 3 (2.9) fatalities under the MDA Removal Option.

The maximum radiological transportation accident dose-risk to the general population along the LANL to Pojoaque and the Pojoaque to Santa Fe routes would be about 0.0088 and 0.0139 person-rem under the MDA Capping Option, and about 0.052 and 0.076 person-rem under the MDA Removal Option. These doses would result in 0 (5.3×10^{-6} and 8.3×10^{-6} for the MDA Capping Option, and 3.1×10^{-5} and 4.6×10^{-5} for the MDA Removal Option) excess LCFs among the exposed population under either MDA remediation option. The maximum expected traffic fatalities along these routes would be 0 (0.0196) and 0 (0.025), respectively, under the MDA Capping Option. Under the MDA Removal Option, the maximum expected traffic fatalities along these routes would be 0 (0.088) and 0 (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 number of expected traffic accidents and fatalities. The transportation impacts under this alternative for the MDA Capping Option would be: 15.3 million miles (24.6 million kilometers) traveled, 3 (2.8) traffic accidents, and 0 (0.29) fatalities. For the MDA Removal Option, the nonradiological transportation impacts would be: 17.5 million miles (28.2 million kilometers) traveled, 3 (3.2) traffic accidents, and 0 (0.33) fatalities.

Local Traffic

Under the Expanded Operations Alternative, the impact 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 have a damaging effect on local transportation. As shown in **Table 5–54**, there are a number of intersections that 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 State Road 4*	*East Jemez Road at State Road 4*	*West Jemez Road at State Road 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	8,700	10,700	2,200	1,600
Percent Change from Baseline	+6	+75	+13	+9	+27

Areas of concern include the increased truck traffic East Jemez Road at State Road 4, if it continues to be the lone route for all trucks traveling to LANL or the Los Alamos town site. With a number of construction projects and MDA remediation efforts occurring along Pajarito Road related to efforts that are expected to be underway in TA-18, TA-54, TA-55 and TA-3 under this Alternative, it may become necessary to consider an alternative truck entry point for trucks working on these projects on Pajarito Road at State Road 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 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 and acceleration lanes for east and west bound traffic on East Jemez Road (see Appendix G.9). These concerns would likely be further exacerbated by the 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 needed 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 levels around this area.

The intersection of Trinity Drive and DP Road is already an area of concern. As discussed in Section 4.10.2, the New Mexico Department of Transportation is planning improvements to this intersection that will 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 increase the need for these improvements. The concerns with 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 the technical area during periods of heavy activity.

There are also expected to be large increases over the No Action Alternative on Pajarito Road, however, the level of usage on this road is much lower than on the other main access points into and out of LANL. Further traffic studies may need to be conducted to determine if any changes are needed in the event all of the planned projects progressed on their current schedules under the Expanded Operations Alternative. Pajarito Road would experience the largest increases in traffic once remediation efforts start at MDA G. It may become necessary to regulate the traffic flow at its intersection with State Road 4 during peak travel hours under this scenario.

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 implementation of 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, for example, 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 with 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 LANSCE Facilities at TA-53 at LANL. Based on the analysis of impacts for other resource areas, DOE expects few high and adverse impacts from the continued operation of LANL under any of the alternatives, and, to the extent impacts may be high and adverse, DOE expects the impacts to affect all populations in the area equally. DOE also analyzed the potential risk due to radiological exposure through the consumption patterns of special pathway receptors, including subsistence consumption of fish, native vegetation, surface waters, sediments, and local produce; absorption of contaminants in sediments through the skin; and inhalation of plant materials. The special pathway receptors analysis is important to the environmental justice analysis because this consumption pattern may reflect the traditional or cultural practices of minority populations in the area.

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. Special pathways were considered that took into account the levels of contaminants in native vegetation (piñon nuts and indian tea [Cota]), crops, soils and sediments, surface water, fish, and game animals on or near LANL.

Based on recent DOE monitoring results, concentrations of contaminants in native vegetation (piñon nuts), crops, soils and sediments, surface water, fish, and game animals in areas surrounding LANL have been quite low (at or near the threshold of detection), and were seldom above background levels (see Appendix C.1.4). Additional exposures to a person whose diet and activities reflect those of subsistence consumption of fish and wildlife would bring their total dose to just less than 4 millirem (0.004 rem) per year. Using a risk estimator value of 0.0006 lifetime probability of fatal cancer per person-rem, 0.004 rem per year would equate to an annual risk of developing a fatal cancer from this dose of about 1 in 415,000 (2.4×10^{-6}), from the ingestion pathway. Ingestion pathway calculations included concentrations of radionuclides in environmental media reported in LANL environmental surveillance reports for 2001 through 2004. This includes natural background, weapons testing fallout, and previous radiological releases from LANL. 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 between the alternatives considered in this new SWEIS, because most of the risk is 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. 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.

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 accidents at Key Facilities are estimated to be less than 0.22 LCFs (see Section 5.12.1). Thus, no excess LCFs would be expected in the entire offsite population resulting from an accident 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 risk 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, and, in some cases, would be lower than the risk associated with the No Action Alternative.

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 few high and adverse impacts from the continued operation of LANL under the Expanded Operations Alternative, and, to the extent impacts may be high and adverse, the impacts would affect all populations within the study area equally.

Construction Impacts—There would be no disproportionately high and adverse environmental impacts on minority and low-income populations due to construction activities at LANL that would occur under this alternative, or from the impacts of project-specific activities discussed in Appendices G, H, I, and J. As stated in other subsections of this chapter, environmental impacts from construction under this alternative would be small and would not be expected to significant and adverse beyond the LANL site boundary.

Operational Impacts—No disproportionately high and adverse environmental impacts on minority and low-income populations would occur under this alternative. This conclusion is a result of analyses presented 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.

As discussed in Section 5.6.1 and 5.6.2, radiological and hazardous chemical risks to the public resulting from normal operations would be small.

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 accidents at Key Facilities are estimated to be less than 0.22 LCFs (see Section 5.12.1). Thus, no excess LCFs would be expected in the entire offsite population resulting from an accident under the Expanded Operations Alternative.

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 5–55**. 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. Another natural event that can also impact multiple facilities, a wildfire, is addressed in Section 5.12.4. Additional details on the accident analysis are provided in Appendix D.

5.12.1 Facility Radiological Impacts

Radiological accident estimated consequences and risks associated with the No Action, Reduced, and Expanded Alternatives are shown in Tables 5–56 through 5–61.

5.12.1.1 No Action Alternative

The accident with the highest estimated consequences to the offsite population and MEI, as shown in **Tables 5–56** and **5–57**, is a building fire and spill at DVRS. If this accident were to occur, there could be 3.68 additional LCFs in the offsite population. The accident with the highest estimated consequences to the MEI is a fire at a waste storage dome. If this accident were to occur, an LCF to a noninvolved worker located 109 yards (100 meters) from the site of the accident would be likely, and there would also be a 0.50 likelihood (1 chance in 2) of an LCF to the MEI, assumed to be present at the nearest site boundary for the duration of the accident release. The MEI for all of the scenarios is located at the nearest site boundary.

The potential for exposures in excess of these at CMR exists because of public access to Diamond Drive, approximately 50 meters from the facility. The consequences to an individual at this Diamond Drive location during the HEPA Filter Fire would be 8.10 rem, resulting in an increased risk of a fatal latent cancer during the lifetime of the individual of 0.00486 or approximately 1 chance in 205. Appendix D (see Section D.3.2.1) contains further discussion of the CMR exposures.

Table 5–55 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)	0.02	0.02	0.02
• MEI (LCF per year)	0.0009	0.0009	0.0009
• Noninvolved Worker (LCF per year)	0.006	0.006	0.006
Facility Chemical Release [a]			
• Concentrations above which life-threatening health effects could result (ERPG-3 [t] limit)	5 parts per million	5 parts per million	5 parts per million
• ERPG-3 distance	881 meters	881 meters	881 meters
• Distance to the site boundary	491 meters	491 meters	491 meters
Site-Wide Seismic Event Radiological			
• Offsite Population (LCF per year)	0.005	0.005	0.005
• MEI (LCF per year)	0.0003	0.0003	0.0003
• Noninvolved Worker (LCF per year)	0.001	0.001	0.001
Site-Wide Seismic Event Chemical [a]			
• Concentrations above which life-threatening health effects could result (ERPG-3 [t] limit)	25 parts per million	25 parts per million	25 parts per million
• ERPG-3 distance	110 meters	110 meters	110 meters
• Distance to the site boundary	12 meters	12 meters	12 meters
Wildfire Radiological			
• Offsite Population (LCF per year)	2.7	2.7	2.7
• MEI (LCF per year)	0.05	0.05	0.05
• Noninvolved Worker (LCF per year)	0.05	0.05	0.05
Wildfire Chemical [a]			
• Concentrations above which life-threatening health effects could result (ERPG-3 [t] limit)	25 parts per million	25 parts per million	25 parts per million
• ERPG-3 distance	89 meters	89 meters	89 meters
• Distance to the site boundary	12 meters	12 meters	12 meters

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 2005c).

After taking into account the frequency of the postulated accidents (see Appendix D), the estimated highest risk accident would be a Radioactive Assay and Nondestructive Test (RANT) Outdoor Container Storage Area Fire (TA-54-38). **Table 5–58** shows the annual risk of an increased likelihood of an LCF for this accident to be 0.000858 (about one chance in 1,150 years) for the MEI. The offsite population annual risk of additional LCFs is estimated to be 0.0238 (about one chance in 40 years for an LCF in the total population) for any one member of the offsite population. Table 5–58 shows the annual risk of an increased likelihood of an LCF for this accident to be 0.00638 (about one chance in 157 years) for a noninvolved worker.

Table 5–56 Radiological Accident Offsite Population Consequences for the No Action Alternative

Accident Scenario	Maximally Exposed Individual		Population to 50 Miles (80 kilometers)	
	Dose (rem)	Latent Cancer Fatality Risk [a]	Dose (person-rem)	Latent Cancer Fatalities [b, c]
RANT Outdoor Container Storage Area Fire (TA-54-38)	71.5	0.0858	3,970	2.38
Fire at WETF (TA-16-205)	5.91	0.00355	187	0.112
WCRR Outdoor Storage Area Fire (TA-50-69)	1.10	0.000660	265	0.159
Waste Storage Dome Fire (TA-54)	419	0.503	4,230	2.54
Onsite Transuranic Waste Transportation Accident and Fire (TA-54)	186	0.223	5,720	3.43
Plutonium Facility Storage Container Release (TA-55-4)	2.50	0.00150	372	0.223
Plutonium Facility Ion Column Rupture (TA-55-4)	1.28	0.000768	131	0.0786
DVRS Operational Spill (TA-54-412)	19.6	0.0118	185	0.111
DVRS Building Fire and Spill Due to Forklift Collision (TA-54-412)	321	0.385	6,140	3.68
SHEBA Hydrogen Detonation (TA-18-168)	0.877	0.000526	69	0.0414
CMR HEPA Filter Fire (TA-3-29)	0.774	0.000464	200	0.12

RANT = Radioactive Assay and Nondestructive Test, TA = technical area, WETF = Weapons Engineering Tritium Facility, WCRR = Waste Characterization, Reduction, and Repackaging Facility, DVRS = Decontamination and Volume Reduction System, SHEBA = Solution High-Energy Burst Assembly CMR = Chemistry and Metallurgy Research Building, HEPA = high-efficiency particulate air (filter).

[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), 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, TA-54-412, Domes), 301,900 (TA-55-4).

Table 5–57 Radiological Accident Onsite Worker Consequences for the No Action Alternative

Accident Scenario	Noninvolved Worker at 110 Yards (100 meters)	
	Dose (rem)	Latent Cancer Fatality Risk [a]
RANT Outdoor Container Storage Area Fire (TA-54-38)	532	0.638
Fire at WETF (TA-16-205)	8.92	0.00535
WCRR Outdoor Storage Area Fire (TA-50-69)	44.7	0.0536
Waste Storage Dome Fire (TA-54)	1,950	1.00 [b]
Onsite Transuranic Waste Transportation Accident and Fire (TA-54)	761	0.913
Plutonium Facility Storage Container Release (TA-55-4)	35.8	0.0430
Plutonium Facility Ion Column Rupture (TA-55-4)	9.09	0.00545
DVRS Operational Spill (TA-54-412)	51.4	0.0617
DVRS Building Fire and Spill Due to Forklift Collision (TA-54-412)	888	1.00 [b]
SHEBA Hydrogen Detonation (TA-18-168)	15.4	0.00924
CMR HEPA Filter Fire (TA-3-29)	5.38	0.00323

RANT = Radioactive Assay and Nondestructive Test, TA = technical area, WETF = Weapons Engineering Tritium Facility, WCRR = Waste Characterization, Reduction, and Repackaging Facility, DVRS = Decontamination and Volume Reduction System, SHEBA = Solution High-Energy Burst Assembly, CMR = Chemistry and Metallurgy Research Building, HEPA = high-efficiency particulate air filter.

[a] Increased risk of an LCF to an individual, assuming the accident occurs.

[b] The indicated dose yields a risk value greater than 1.00. This means that it is likely that an individual exposed to the indicated dose would contract a fatal latent cancer in their lifetime. For this reason a value of 1.00 is shown.

Table 5–58 Radiological Accident Offsite Population and Worker Risks for the No Action Alternative

Accident Scenario	Frequency (per year)	Onsite Worker	Offsite Population	
		Risk to Noninvolved Worker at 110 Yards (100 meters) [a]	Risk to Maximally Exposed Individual [a]	Latent Cancer Fatalities [b, c]
RANT Outdoor Container Storage Area Fire (TA-54-38)	0.01	0.00638	0.000858	0.0238
Fire at WETF (TA-16-205)	1.1×10^{-5}	5.89×10^{-8}	3.95×10^{-8}	1.25×10^{-6}
WCRR Outdoor Storage Area Fire (TA-50-69)	0.0003	0.0000161	1.98×10^{-7}	0.0000477
Waste Storage Dome Fire (TA-54)	0.001	0.001	0.000503	0.00254
Onsite Transuranic Waste Transportation Accident and Fire (TA-54)	0.001	0.000913	0.000223	0.00343
Plutonium Facility Storage Container Release (TA-55-4)	1.0×10^{-6}	4.3×10^{-8}	1.50×10^{-9}	2.23×10^{-7}
Plutonium Facility Ion Column Rupture (TA-55-4)	1.0×10^{-6}	5.45×10^{-9}	7.68×10^{-10}	7.86×10^{-8}
DVRS Operational Spill (TA-54-412)	0.02	0.00123	0.000235	0.00222
DVRS Building Fire and Spill Due to Forklift Collision (TA-54-412)	0.001	0.001	0.000385	0.00368
SHEBA Hydrogen Detonation (TA-18-168)	0.0054	0.0000499	2.84×10^{-6}	0.000224
CMR HEPA Filter Fire (TA-3-29)	0.01	0.0000323	4.64×10^{-6}	0.00120

RANT = Radioactive Assay and Nondestructive Test, TA = technical area, WETF = Weapons Engineering Tritium Facility, WCRR = Waste Characterization, Reduction, and Repackaging Facility, DVRS = Decontamination and Volume Reduction System, SHEBA = Solution High-Energy Burst Assembly, CMR = Chemistry and Metallurgy Research Building, 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).

5.12.1.2 Reduced Operations Alternative

The accident impacts from the Reduced Operations Alternative are largely the same as those from the No Action Alternative. 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

The accident impacts from the Expanded Operations Alternative, shown in **Tables 5–59** through **5–61**, are generally greater than those from the No Action Alternative. SHEBA operations would cease for the Expanded Operations Alternative; its impacts, although relatively small, have been eliminated from the tables. 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 Transuranic Waste Consolidation Facility, located in TA-50 or TA-63. The impacts from this new facility would be less than those of the existing facilities because of the new location and because less material would be stored, the rest being moved offsite. The entries in Tables 5–59 through 5–61 reflect the present DVRS 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.

Table 5–59 Radiological Accident Offsite Population Consequences for the Expanded Operations Alternative

Accident Scenario	*Maximally Exposed Individual*		*Population to 50 Miles (80 kilometers)*	
	Dose (rem)	***Latent Cancer Fatality Risk*** [a]	***Dose (person-rem)***	***Latent Cancer Fatalities*** [b, c]
RANT Outdoor Container Storage Area Fire (TA-54-38)	71.5	0.0858	3,970	2.38
Fire at WETF (TA-16-205)	5.91	0.00355	187	0.112
WCRR Outdoor Storage Area Fire (TA-50-69)	1.10	0.000660	265	0.159
Waste Storage Dome Fire (TA-54)	419	0.503	4,230	2.54
Onsite Transuranic Waste Transportation Accident and Fire (TA-54)	186	0.223	5,720	3.43
Plutonium Facility Storage Container Release (TA-55-4)	2.50	0.00150	372	0.223
Plutonium Facility Ion Column Rupture (TA-55-4)	1.28	0.000768	131	0.0786
DVRS Operational Spill (TA-54-412)	19.6	0.0118	185	0.111
Explosion at MDA G	55.2	0.0662	766	0.460
DVRS Building Fire and Spill Due to Forklift Collision (TA-54-412)	321	0.385	6,140	3.68
Fire at CMR Involving Sealed Sources (TA-3-29)	0.0987	0.0000592	11,600	6.96
CMR HEPA Filter Fire (TA-3-29)	0.774	0.000464	200	0.12

RANT = Radioactive Assay and Nondestructive Test, TA = technical area, WETF = Weapons Engineering Tritium Facility, WCRR = Waste Characterization, Reduction, and Repackaging Facility, DVRS = Decontamination and Volume Reduction System, MDA = material disposal area, CMR = Chemistry and Metallurgy Research Building, HEPA = high-efficiency particulate air filter.

[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), 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).

MDA cleanup is a component of the Expanded Operations Alternative. A number of scenarios were considered for this activity and an explosion during cleanup 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 cleanup. The consequences and risks from this scenario are included in Tables 5–59 through 5–61. As with the No Action Alternative, TA-54 operations generally dominate the accident risks from Expanded Operations. Cleanup of MDA G in TA-54 adds a component to this risk. Appendix I includes more details about MDA cleanup accident impacts.

Table 5–60 Radiological Accident Onsite Worker Consequences for the Expanded Operations Alternative

Accident Scenario	*Noninvolved Worker at 109 Yards (100 meters)*	
	Dose (rem)	*Latent Cancer Fatality Risk* [a]
RANT Outdoor Container Storage Area Fire (TA-54-38)	532	0.638
Fire at WETF (TA-16-205)	8.92	0.00535
WCRR Outdoor Storage Area Fire (TA-50-69)	44.7	0.0536
Waste Storage Dome Fire (TA-54)	1,950	1.00 [b]
Onsite Transuranic Waste Transportation Accident and Fire (TA-54)	761	0.913
Plutonium Facility Storage Container Release (TA-55-4)	35.8	0.0430
Plutonium Facility Ion Column Rupture (TA-55-4)	9.09	0.00545
DVRS Operational Spill (TA-54-412)	51.4	0.0617
Explosion at MDA G	405	0.486
DVRS Building Fire and Spill Due to Forklift Collision (TA-54-412)	888	1.00 [b]
Fire at CMR Involving Sealed Sources (TA-3-29)	1.21	0.000727
CMR HEPA Filter Fire (TA-3-29)	5.38	0.00323

RANT = Radioactive Assay and Nondestructive Test, TA = technical area, WETF = Weapons Engineering Tritium Facility, WCRR = Waste Characterization, Reduction, and Repackaging Facility, DVRS = Decontamination and Volume Reduction System, MDA = material disposal area, CMR = Chemistry and Metallurgy Research Building, HEPA = high-efficiency particulate air filter.

[a] Increased risk of an LCF to an individual, assuming the accident occurs.

[b] The indicated dose yields a risk value greater than 1.00. This means that it is likely that an individual exposed to the indicated dose would contract a fatal latent cancer in their lifetime. For this reason a value of 1.00 is shown.

The accident with the highest consequences to the offsite population is a fire at CMR involving sealed sources as shown in Table 5–59. If this accident were to occur, there could be 6.96 additional LCFs in the offsite population. The accident with the highest consequences to the MEI is a building fire and spill at DVRS. If this accident were to occur, there would be a 0.385 likelihood (1 chance in 2.6) of an LCF to the MEI. The MEI for all of the scenarios is located at the nearest site boundary. The accident with the highest consequences to the noninvolved worker is a waste storage dome fire. If this accident were to occur, an LCF to a noninvolved worker located 110 yards (100 meters) from the site of the accident would be likely. If a building fire and spill at DVRS were to occur, an LCF to the noninvolved worker would also be likely.

The potential for exposures in excess of these at CMR exists because of public access to Diamond Drive, approximately 50 meters from the facility. The consequences to an individual at this Diamond Drive location during the Fire Impacting Sealed Sources (a component of only the Expanded Operations Alternative) or the HEPA Filter Fire would be 4.32 rem and 8.10 rem, respectively. These doses would result in an increased risk of a fatal latent cancer during the lifetime of the individual of 0.00259 (approximately 1 chance in 385) and 0.00486 (approximately 1 chance in 205), respectively. Appendix D (see Section D.3.2.1) contains further discussion of the CMR exposures.

After taking into account the frequency of the postulated accidents, the estimated highest risk accident would be a RANT Outdoor Container Storage Area Fire (TA-54-38). Table 5–61 shows the annual risk of an increased likelihood of an LCF for this accident to be 0.000858 (about one chance in 1,100 years for the MEI) for the MEI. The offsite population annual risk of additional

LCFs is shown to be 0.0238 (about one chance in 40 years for an LCF in the total population) for any one member of the offsite population. Table 5–61 shows the annual risk of an increased likelihood of an LCF for this accident to be 0.00638 (about one chance in 157 years) for a noninvolved worker.

Table 5–61 Radiological Accident Offsite Population and Worker Risks for the Expanded Operations Alternative

Accident Scenario	Frequency (per year)	Risk to Onsite Worker: Risk to Noninvolved Worker at 109 Yards (100 meters) [a]	Offsite Population: Risk to Maximally Exposed Individual [a]	Offsite Population: Population to 50 Miles (80 kilometers) [b, c]
RANT Outdoor Container Storage Area Fire (TA-54-38)	0.01	0.00638	0.000858	0.0238
Fire at WETF (TA-16-205)	1.1×10^{-5}	5.89×10^{-8}	3.95×10^{-8}	1.25×10^{-6}
WCRR Outdoor Storage Area Fire (TA-50-69)	0.0003	0.0000161	1.98×10^{-7}	0.0000477
Waste Storage Dome Fire (TA-54)	0.001	0.001	0.000503	0.00254
Onsite Transuranic Waste Transportation Accident and Fire (TA-54)	0.001	0.000913	0.000223	0.00343
Plutonium Facility Storage Container Release (TA-55-4)	1.0×10^{-6}	4.30×10^{-8}	1.50×10^{-9}	2.23×10^{-7}
Plutonium Facility Ion Column Rupture (TA-55-4)	1.0×10^{-6}	5.45×10^{-9}	7.68×10^{-10}	7.86×10^{-8}
DVRS Operational Spill (TA-54-412)	0.02	0.00123	0.000235	0.00222
Explosion at MDA G	0.01	0.00486	0.000662	0.00460
DVRS Building Fire and Spill Due to Forklift Collision (TA-54-412)	0.001	0.001	0.000385	0.00368
Fire at CMR Involving Sealed Sources (TA-3-29)	0.00024	1.74×10^{-7}	1.42×10^{-8}	0.00167
CMR HEPA Filter Fire (TA-3-29)	0.01	0.0000323	4.64×10^{-6}	0.00120

RANT = Radioactive Assay and Nondestructive Test, TA = technical area, WETF = Weapons Engineering Tritium Facility, WCRR = Waste Characterization, Reduction, and Repackaging Facility, DVRS = Decontamination and Volume Reduction System, MDA = material disposal area, CMR = Chemistry and Metallurgy Research Building, 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).

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 5–62**. These have been 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 which, if an accident were to occur, could result in serious health affects or life-threatening implications for exposed individuals.

Table 5–62 also shows the risk of worker and public exposure in the event of a chemical release. The cause of a release could be mechanical failure, corrosion, mechanical impact, or natural phenomena. (Chemical releases from site-wide events, that is, Seismic and Wildfire, are discussed in their respective sections.) The estimated frequency of each accident is shown in the table. The direction traveled by the chemical plume, which is dependent upon meteorological conditions at the time of the accident, would determine what segment of the worker and offsite populations would be at risk of exposure.

Table 5–62 Chemical Accident Risks under the No Action Alternative

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. Public access is at 537 yards (491 meters).	5.0 [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. 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. 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)	280,000 ppm [c]	1 chance in 15 years of workers within 215 yards (197 meters) of facility receiving exposures in excess of limit. 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. 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 2005c).

[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 2005c).

[c] The Temporary Emergency Exposure Limit value is used. ERPGs have not been issued for this substance.

For selenium hexafluoride located at TA-54-216, there is an annual risk of 0.0041 (once 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 (once 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.

For chlorine gas located outside of TA-55-4, there is an annual risk of 0.063 (once 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.

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 are eliminated in this alternative. The information in Table 5–62, then, is also applicable 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 is a component of the Expanded Operations Alternative for which the potential for accidental releases of toxic chemicals exists. Like the scenario for radionuclide release during this operation, an explosion during excavation which breaches any MDA enclosure and bypasses the HEPA filtration was chosen for analysis. There is a great deal of uncertainty as to how much and which chemicals were disposed of in the MDAs; the MDA closest to the public (and thus with the potential for the greatest impact on the public), MDA B, was chosen to conservatively represent 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 restrictive ERPG values to bound the impacts of an extensive list of possible chemicals disposed of in the MDAs. **Table 5–63** shows that both of these chemicals, if present in MDA B in the quantities assumed, would dissipate to below the ERPG-3 value very close to the release but would continue to represent 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

Two site-wide seismic events, referred to as Seismic 01 and Seismic 02, were postulated to estimate the effects of potential radiological and chemical releases. In the event of a site-wide seismic event, both radiological and chemical hazardous materials could be simultaneously released. Seismic 01 has an estimated annual frequency of occurrence of 0.001 (about once in 1,000 years); Seismic 02 has an estimated annual frequency of 0.0005 (about once in 2,000 years). 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 requires a more robust engineering design to survive. The number of LCFs calculated for these two postulated seismic events should be considered within the context of nonradiological human health impacts expected from these seismic events.

Table 5–63 Chemical Accident Impacts 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).
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 mg/m^3	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 mg/m^3	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, mg/m^3 = milligram per cubic meter.

[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 2005c).

[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 2005c).

[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.

These seismic events 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. Additional details on potential site-wide seismic impacts are provided in Appendix D.

5.12.3.1 No Action Alternative

Site-Wide Seismic 01 – Radiological

Site-Wide Seismic 01 is represented by a PC-2 seismic event. Referring to **Tables 5–64** through **5–66**, and noting that all the listed facilities could contribute to offsite population impacts, the facility with generally the highest contribution to worker and public risk is TA-3-29 (CMR). In the event of this seismic event, it is estimated that there would be 3.65 LCFs in the offsite population from the CMR release. It is likely that a noninvolved worker located 109 yards (100 meters) from the facility would, as a result of this release, contract a fatal latent cancer during his or her lifetime. Since the annual probability of this seismic event is 0.001, the risk of additional LCFs for this accident is estimated at 0.0037 per year in the offsite population. The increased risk of an LCF for the noninvolved worker is estimated at 0.0023 per year or approximately 1 chance in 435. There is potential for an individual at publicly accessible Diamond Drive, approximately 50 meters from CMR, to receive an exposure from that facility in excess of the MEI exposure. The calculated dose to such an individual is 6,400 rem, 100 times the CMR MEI dose. If an individual were at the Diamond Drive location, unprotected, for the duration of the CMR release, he or she would likely contract a fatal cancer during his lifetime.

Table 5–64 Site-Wide Seismic 01 Radiological Accident Offsite Population Consequences for the No Action Alternative

Facility Impacted by Seismic 01 Event	*Maximally Exposed Individual*		*Population to 50 Miles (80 kilometers)*	
	Dose (rem)	*Latent Cancer Fatality Risk* [a]	*Dose (person-rem)*	*Latent Cancer Fatalities* [b, c]
TA-3-29 (CMR)	62	0.074	6,080	3.65
TA-18-168 (SHEBA)	0.0301	0.0000181	0.770	0.000462
TA-21-155 (TSTA)	0.00146	8.76×10^{-7}	0.0492	0.0000295
TA-21-209 (TSFF)	0.0125	7.5×10^{-6}	0.433	0.00026
TA-50-1 (RLWTF)	3.02	0.00181	515	0.309
TA-54-38 (RANT)	64.2	0.077	1,120	0.672
TA-55-185 (Storage Shed)	5.98	0.00359	589	0.353
TA-54-412 (DVRS)	2.76	0.00166	49.1	0.0295
	Max 64.2	Max 0.077	Total 8,354	Total 5.01

TA = technical area, CMR = Chemistry and Metallurgy Research Building, SHEBA = Solution High-Energy Burst Assembly, TSTA = Tritium System Test Assembly, TSFF = Tritium Science and Fabrication Facility, RLWTF = Radioactive Liquid Waste Treatment Facility, RANT = Radioactive Assay and Nondestructive Test, DVRS = Decontamination and Volume Reduction System.

[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).

Table 5–65 Site-Wide Seismic 01 Radiological Accident Onsite Worker Consequences for the No Action Alternative

Facility Impacted by Seismic 01 Event	*Noninvolved Worker at 109 Yards (100 meters)*	
	Dose (rem)	*Latent Cancer Fatality Risk* [a]
TA-3-29 (CMR)	1,940	1.00 [b]
TA-18-168 (SHEBA)	1.06	0.000636
TA-21-155 (TSTA)	0.0111	6.66×10^{-6}
TA-21-209 (TSFF)	0.0974	0.0000584
TA-50-1 (RLWTF)	121	0.145
TA-54-38 (RANT)	576	0.691
TA-55-185 (Storage Shed)	239	0.287
TA-54-412 (DVRS)	10.1	0.00606

TA = technical area, CMR = Chemistry and Metallurgy Research Building, SHEBA = Solution High-Energy Burst Assembly, TSTA = Tritium System Test Assembly, TSFF = Tritium Science and Fabrication Facility, RLWTF = Radioactive Liquid Waste Treatment Facility, RANT = Radioactive Assay and Nondestructive Test, DVRS = Decontamination and Volume Reduction System.

[a] Increased risk of an LCF to an individual, assuming the accident occurs.

[b] The indicated dose yields a risk value greater than 1.00. This means that it is likely that an individual exposed to the indicated dose would contract a fatal latent cancer in their lifetime. For this reason a value of 1.00 is shown.

Table 5–66 Site-Wide Seismic 01 Radiological Accident Offsite Population and Worker Risks for the No Action Alternative

Facility Impacted by Seismic 01 Event	*Frequency (per year)*	*Onsite Worker*	*Offsite Population*	
		Risk to Noninvolved Worker at 109 Yards (100 meters) [a]	*Risk to Maximally Exposed Individual* [a]	*Latent Cancer Fatalities* [b, c]
TA-3-29 (CMR)	0.001	0.001	0.0000744	0.00365
TA-18-168 (SHEBA)	0.001	6.36×10^{-7}	1.81×10^{-8}	4.62×10^{-7}
TA-21-155 (TSTA)	0.001	6.66×10^{-9}	8.76×10^{-10}	2.95×10^{-8}
TA-21-209 (TSFF)	0.001	5.84×10^{-8}	7.50×10^{-9}	2.6×10^{-7}
TA-50-1 (RLWTF)	0.001	0.000145	1.81×10^{-6}	0.000309
TA-54-38 (RANT)	0.001	0.000691	0.0000770	0.000672
TA-55-185 (Storage Shed)	0.001	0.000287	3.59×10^{-6}	0.000353
TA-54-412 (DVRS)	0.001	6.06×10^{-6}	1.66×10^{-6}	0.0000295
		Maximum 0.00233	Maximum 0.000077	Total 0.00501

TA = technical area, CMR = Chemistry and Metallurgy Research Building, SHEBA = Solution High-Energy Burst Assembly, TSTA = Tritium System Test Assembly, TSFF = Tritium Science and Fabrication Facility, RLWTF = Radioactive Liquid Waste Treatment Facility, RANT = Radioactive Assay and Nondestructive Test, DVRS = Decontamination and Volume Reduction System.

[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), 334,100 (TA-18-168), 271,600 (TA-21-155, -209), 302,000 (TA-50-1), 343,100 (TA-54-38, DVRS).

All site facilities containing hazardous radiological materials which 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 worker and population risks given in Table 5–66 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 for multiple accidents at the same time. As a result, Table 5–66 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 5–66 only provides estimated impacts for facilities with the highest potential impacts. If all facilities were taken into account the summation of offsite population impacts from all LANL facilities with radiological materials would be somewhat higher.

Site-Wide Seismic 02 – Radiological

Site-Wide Seismic 02 is represented by a PC-3 seismic event. Referring to **Tables 5–67** through **5–69**, and noting that all the listed facilities could contribute to offsite population impacts, the facility with the highest contribution to public consequence are the waste storage domes in TA-54 holding transuranic waste. In the event of this seismic event, it is estimated that there would be 4.46 LCFs in the offsite population from this TA-54 release. This same facility would result in the highest contribution to MEI radiological consequence. The MEI located at the nearest site boundary and a noninvolved worker located 109 yards (100 meters) from the facility would, as a result of this release, have a strong likelihood of contracting a fatal cancer sometime during their lifetimes (greater than 1 chance in 2). Since the annual probability of this large seismic event is 1 in 2,000 years (0.0005), the risk of additional LCFs from this TA-54 release is estimated at 0.00223 per year in the offsite population. The increased risk of an LCF for the MEI and noninvolved worker are estimated at 1 chance in 260 (0.00384) per year and 1 chance in 775 (0.00129) per year, respectively. The next highest risk of an LCF to the general population and the noninvolved worker are from CMR releases.

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 worker and offsite population risks given in Table 5–69 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 for multiple accidents at the same time. As a result, Table 5–69 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 5–69 only provides estimated impacts for facilities with the highest potential impacts. If all facilities were taken into account, the summation of worker and offsite population risks from all LANL facilities with radiological materials could be somewhat higher.

Table 5–67 Site-Wide Seismic 02 Radiological Accident Offsite Population Consequences for the No Action Alternative

Facility Impacted by Seismic 02 Event	*Maximally Exposed Individual*		*Population to 50 Miles (80 kilometers)*	
	Dose (rem)	*Latent Cancer Fatality Risk* [a]	*Dose (person-rem)*	*Latent Cancer Fatalities* [b, c]
TA-3-29 (CMR)	62	0.0744	6,080	3.65
TA-16-205 (WETF)	6.43	0.00386	159	0.0952
TA-18-168 (SHEBA)	0.0301	0.0000181	0.770	0.000462
TA-21-155 (TSTA)	0.00146	8.76×10^{-7}	0.0492	0.0000295
TA-21-209 (TSFF)	0.0125	7.5×10^{-6}	0.433	0.000260
TA-50-1 (RLWTF)	3.02	0.00181	515	0.309
TA-50-69 (WCRR)	2.84	0.00170	237	0.142
TA-54-38 (RANT)	64.2	0.0770	1,120	0.672
TA-55-4 (Plutonium Facility)	4.21	0.00253	403	0.242
TA-55-185 (Storage Facility)	5.98	0.00359	589	0.353
TA-54-412 (DVRS)	33.7	0.0404	601	0.361
TA-54 (Waste Storage Domes)	462	0.554	7,430	4.46
TA-55-355 (SST Facility)	3.94	0.00236	294	0.176
	Max 462	Max 0.554	Total 17,429	Total 10.46

TA = technical area, CMR = Chemistry and Metallurgy Research Building, WETF = Weapons Engineering Tritium Facility, SHEBA = Solution High-Energy Burst Assembly, TSTA = Tritium System Test Assembly, TSFF = Tritium Science and Fabrication Facility, RLWTF = Radioactive Liquid Waste Treatment Facility, WCRR = Waste Characterization, Reduction, and Repackaging Facility, RANT = Radioactive Assay and Nondestructive Test, DVRS = Decontamination and Volume Reduction System, SST = Safe, Secure Transport.

[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-50-1, -69), 343,100 (TA-54-38, DVRS, Domes), 301,900 (TA-55-4, -185, -355).

Site-Wide Seismic 01 – Chemical

The facilities and chemicals of concern under site-wide Seismic 01 conditions are shown in Table 5–70. There are numerous chemicals in small quantities onsite that may be released under these conditions. The listed chemicals have been 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 5–70 also shows the estimated annual risks for workers and the public in the event of an accidental release for each chemical. The annual frequency of this accident is 0.001 per year. Since this accident is a site-wide seismic event, all 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 chance in 1,000 per year. 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 5–70, 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 5–68 Site-Wide Seismic 02 Radiological Accident Onsite Worker Consequences for the No Action Alternative

Facility Impacted by Seismic 02 Event	*Noninvolved Worker at 109 Yards (100 meters)*	
	Dose (rem)	*Latent Cancer Fatality Risk* [a]
TA-3-29 (CMR)	1,940	1.00 [b]
TA-16-205 (WETF)	5.86	0.00352
TA-18-168 (SHEBA)	1.06	0.000636
TA-21-155 (TSTA)	0.0111	6.66×10^{-6}
TA-21-209 (TSFF)	0.0974	0.0000584
TA-50-1 (RLWTF)	121	0.145
TA-50-69 (WCRR)	129	0.155
TA-54-38 (RANT)	576	0.691
TA-55-4 (Plutonium Facility)	47.9	0.0575
TA-55-185 (Storage Shed)	239	0.287
TA-54-412 (DVRS)	123	0.148
TA-54 (Waste Storage Domes)	2,150	1.00 [b]
TA-55-355 (SST Facility)	129	0.155

TA = technical area, CMR = Chemistry and Metallurgy Research Building, WETF = Weapons Engineering Tritium Facility, SHEBA = Solution High-Energy Burst Assembly, TSTA = Tritium System Test Assembly, TSFF = Tritium Science and Fabrication Facility, RLWTF = Radioactive Liquid Waste Treatment Facility, WCRR = Waste Characterization, Reduction, and Repackaging Facility, RANT = Radioactive Assay and Nondestructive Test, DVRS = Decontamination and Volume Reduction System, SST = Safe, Secure Transport.

[a] Increased risk of an LCF to an individual, assuming the accident occurs.

[b] The indicated dose yields a risk value greater than 1.00. This means that it is likely that an individual exposed to the indicated dose would contract a fatal latent cancer in their lifetime. For this reason a value of 1.00 is shown.

Site-Wide Seismic 02 - Chemical

The facilities and chemicals of concern under site-wide Seismic 02 conditions are shown in **Table 5–71**. There are numerous chemicals in small quantities onsite that could be released under these conditions. The listed chemicals have been selected from a complete set of chemicals used onsite based on their larger quantities, chemical properties, and human health effects.

Table 5–71 also shows the estimated annual risks for workers and the public in the event of an accidental release for each chemical. The annual frequency of this accident is 0.0005 per year. Since this accident is a site-wide seismic event, all 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 one chance in 2,000 per year. 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 at the Bioscience Facilities and chlorine gas at the Plutonium Facility Complex, as shown in Table 5–71, 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.

Table 5–69 Site-Wide Seismic 02 Radiological Accident Offsite Population and Worker Risks for the No Action Alternative

Facility Impacted by Seismic 02 Event	*Frequency (per year)*	*Onsite Worker*	*Offsite Population*	
		Risk to Noninvolved Worker at 109 Yards (100 meters) [a]	*Risk to Maximally Exposed Individual* [a]	*Latent Cancer Fatalities* [b, c]
TA-3-29 (CMR)	0.0005	0.0005	0.0000372	0.00182
TA-16-205 (WETF)	0.0005	1.76×10^{-6}	1.93×10^{-6}	0.0000476
TA-18-168 (SHEBA)	0.0005	3.18×10^{-7}	9.03×10^{-9}	2.31×10^{-7}
TA-21-155 (TSTA)	0.0005	3.33×10^{-9}	4.38×10^{-10}	1.48×10^{-8}
TA-21-209 (TSFF)	0.0005	2.92×10^{-8}	3.75×10^{-9}	1.30×10^{-7}
TA-50-1 (RLWTF)	0.0005	0.0000726	9.06×10^{-7}	0.000155
TA-50-69 (WCRR)	0.0005	0.0000774	8.52×10^{-7}	0.0000711
TA-54-38 (RANT)	0.0005	0.000346	0.0000385	0.000336
TA-55-4 (Plutonium Facility)	0.0005	0.0000287	1.26×10^{-6}	0.000121
TA-55-185 (Storage Shed)	0.0005	0.000143	1.79×10^{-6}	0.000177
TA-54-412 (DVRS)	0.0005	0.0000738	0.0000202	0.000180
TA-54 (Waste Storage Domes)	0.0005	0.0005	0.000277	0.00223
TA-55-355 (SST Facility)	0.0005	0.0000774	1.18×10^{-6}	0.0000882
		Maximum 0.00129	Maximum 0.000277	Total 0.00523

TA = technical area, CMR = Chemistry and Metallurgy Research Building, WETF = Weapons Engineering Tritium Facility, SHEBA = Solution High-Energy Burst Assembly, TSTA = Tritium System Test Assembly, TSFF = Tritium Science and Fabrication Facility, RLWTF = Radioactive Liquid Waste Treatment Facility, WCRR = Waste Characterization, Reduction, and Repackaging Facility, RANT = Radioactive Assay and Nondestructive Test, DVRS = Decontamination and Volume Reduction System, SST = Safe, Secure Transport.

[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-50-1, -69), 343,100 (TA-54-38, DVRS, Domes), 301,900 (TA-55-4, -185, -355).

5.12.3.2 Reduced Operations Alternative

The site-wide Seismic 01 and 02 radiological accident impacts from the Reduced Operations Alternative are similar to those from the No Action Alternative as given in Tables 5–64 through 5–69. 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 01 and 02 – Chemical

The chemicals of concern that could be released in a site-wide Seismic 01 or 02 event are the same for the Reduced Operations Alternative as for the No Action Alternative. None of the chemicals identified for the latter are eliminated in this alternative. The information in Tables 5–70 and 5–71, then, is applicable to the Reduced Operations Alternative.

Table 5–70 Chemical Accident Risks under Seismic 01 Conditions

Chemical	Frequency (per year)	Quantity Released	ERPG-2 [a]		ERPG-3 [b]	
			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 153 yards (140 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 306 yards (280 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 131 yards (120 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 197 yards (180 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 120 yards (110 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] 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 2005c).
[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 2005c).

Table 5–71 Chemical Accident Risks under Seismic 02 Conditions

Chemical	Frequency (per year)	Quantity Released	ERPG-2 [a]		ERPG-3 [b]	
			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 153 yards (140 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 306 yards (280 meters) of facility receiving exposures in excess of limit. Public access is at 900 yards (823 meters).	1	1 chance in 2,000 years of workers within 131 yards (120 meters) of facility receiving exposures in excess of limit. Public access is at 900 yards (823 meters).

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 (Bioscience Facilities)	0.0005	3.7 gallons (14.1 liters)	10	1 chance in 2,000 years of workers or public within 197 yards (180 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 120 yards (110 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. 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. 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 (23,091 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).

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 2005c).

[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 2005c).

5.12.3.3 Expanded Operations Alternative

The Seismic 01 and 02 accident impacts from the Expanded Operations Alternative are similar to those from the No Action Alternative, shown in Tables 5–64 through 5–69. SHEBA operations would cease for the Expanded Operations Alternative. Since its 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 Transuranic Waste Consolidation Facility, located in TA-50 or TA-63. The impacts from this new facility would be less than those of the existing facility because of the new location and because less material would be stored onsite. The entries in Tables 5–64 through 5–69 reflect present DVRS operations because it would be active for most of the time period of interest. Present accident impacts bound the impacts of the replacement facility. Accident impacts for the new facility are described in Appendix H.

Site-Wide Seismic 01 and 02 – Chemical

The chemicals of concern that could be released in a site-wide Seismic 01 or 02 event are the same for the Expanded Operations Alternative as for the No Action Alternative. No additional chemicals were identified in this alternative that would have impacts exceeding those for No Action. The information in Tables 5–70 and 5–71, then, are applicable to the Expanded Operations Alternative.

5.12.4 Wildfire Accident Impacts

A wildfire accident scenario was postulated for evaluation of potential impacts to onsite workers and the offsite population. Details for these scenarios are provided in Appendix D including the LANL buildings that could be affected by the wildfire, inventory of hazardous radiological materials, source term factors and the estimated source terms.

5.12.4.1 Radiological

The estimated consequences for workers and the public as a result of a wildfire are shown in **Tables 5–72** and **5–73** for each listed facility. The values shown assume that a wildfire has occurred and therefore do no reflect any credit for the probability of a wildfire occurrence. The estimated annual risks for each wildfire scenario are shown in **Table 5–74**. These values take credit for the probability of a wildfire's occurrence.

Table 5–72 Radiological Accident Offsite Population Consequences for a Wildfire Accident

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]
TA-03-66/451 (Sigma Complex)	0.00389	2.33×10^{-6}	4.75	0.00285
TA-16-205 (WETF)	0.0605	0.0000363	112	0.0673
TA-48-1 (Radiochemistry Facility)	0.00107	6.42×10^{-7}	0.436	0.000262
TA-54 (Waste Storage Domes)	1,930	1.00 [d]	91,300	54.8
TA-16-411 (Device Assembly)	1.48×10^{-6}	8.88×10^{-10}	0.000174	1.04×10^{-7}
TA-54-412 (DVRS)	4.91	0.00295	1,160	0.696
TA-8-23 (Radiography)	0.000332	1.99×10^{-7}	0.562	0.000337

TA = technical area, WETF = Weapons Engineering Tritium Facility, DVRS = Decontamination and Volume Reduction System.

[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 is approximately 297,030 for TA-03-66/451; 404,913 for TA-16-205 and TA-16-411; 299,508 for TA-48-01; 343,069 for Waste Storage Dome and DVRS; and 349,780 for TA-8-23.

[d] The indicated dose yields a risk greater than 1.00. This means that it is likely than an individual exposed to the indicated dose would contract a fatal latent cancer in their lifetime. For this reason a value of 1.00 is shown.

As shown in Table 5–72, 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 a fatal cancer, during his or her lifetime and for the population, an additional 54.8 LCFs. As shown in Table 5–73, an onsite worker located 109 yards (100 meters) from the facility would be likely to contract a fatal cancer during his or her lifetime as a result of this accident at TA-54.

Table 5–73 Radiological Accident Onsite Worker Consequences for a Wildfire Accident

Accident	*Noninvolved Worker at 109 Yards (100 meters)*	
	Dose (rem)	*Latent Cancer Fatality Risk* [a]
TA-03-66/451 (Sigma Complex)	0.0759	0.0000455
TA-16-205 (WETF)	0.333	0.00020
TA-48-1 (Radiochemistry Facility)	0.0155	9.30×10^{-6}
TA-54 (Waste Storage Domes)	8,730	1.00 [b]
TA-16-411 (Device Assembly)	0.0000173	1.04×10^{-8}
TA-54-412 (DVRS)	16.4	0.00984
TA-8-23 (Radiography)	0.00191	1.15×10^{-6}

TA = technical area, WETF = Weapons Engineering Tritium Facility, DVRS = Decontamination and Volume Reduction System.

[a] Increased risk of an LCF to an individual, assuming the accident occurs.

[b] The indicated dose yields a risk greater than 1.00. This means that it is likely than an individual exposed to the indicated dose would contract a fatal latent cancer in their lifetime. For this reason a value of 1.00 is shown.

Table 5–74 Radiological Accident Offsite Population and Worker Risks for a Wildfire Accident

Accident	*Frequency (per year)*	*Onsite Worker*	*Offsite Population*	
		Risk to Noninvolved Worker at 109 Yards (100 meters) [a]	*Risk to Maximally Exposed Individual* [a]	*Latent Cancer Fatality Risk* [b, c]
TA-03-66/451 (Sigma Complex)	0.05	2.28×10^{-6}	1.17×10^{-7}	0.000143
TA-16-205 (WETF)	0.05	9.99×10^{-6}	1.82×10^{-6}	0.00336
TA-48-1 (Radiochemistry Facility)	0.05	4.65×10^{-7}	3.21×10^{-8}	1.31×10^{-5}
TA-54 (Waste Storage Domes)	0.05	0.05	0.05	2.74
TA-16-411 (Device Assembly)	0.05	5.19×10^{-10}	4.44×10^{-11}	5.22×10^{-9}
TA-54-412 (DVRS)	0.05	0.000492	0.000147	0.0348
TA-8-23 (Radiography)	0.05	5.73×10^{-8}	9.96×10^{-9}	1.69×10^{-5}

TA = technical area, WETF = Weapons Engineering Tritium Facility, DVRS = Decontamination and Volume Reduction System.

[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 is approximately 297,030 for TA-03-66/451; 404,913 for TA-16-205 and TA-16-411; 299,508 for TA-48-01; 343,069 for Waste Storage Dome and DVRS; and 349,780 for TA-8-23.

The risks for this accident, which takes credit for its frequency of occurrence, are estimated to be about a 1 chance in 8.6 (0.116) 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 109 yards (100 meters) from the facility experiences an increased likelihood of an LCF of about 1 chance in 1.9 (0.524) per year of operations. These risks assume that the receptors do not take evasive action in the event of a wildfire. Because the releases from TA-54 domes dominate the consequences and risks from a wildfire, it represents the total impacts on the offsite and worker populations.

5.12.4.2 Chemical

The chemicals of concern at LANL facilities under wildfire conditions are shown in **Table 5–75**. These have been 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, if an accident were to occur, concentrations in excess of these values could result in serious health effects or life-threatening implications for exposed individuals.

Table 5–75 also shows the risk of worker and public exposure in the event of a chemical release. The estimated frequency of each release is shown in the table. The direction traveled by the chemical plume would depend upon meteorological conditions at the time of the accident and would determine what segment of the worker and offsite populations would be at risk of exposure.

Table 5–75 Chemical Accident Impacts under Wildfire Conditions

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. 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 120 yards (110 meters) of facility receiving exposures in excess of limit. 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 2005c).

[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 2005c).

For formaldehyde at TA-43-1, there is an annual risk of 0.05 (once in 20 years) that workers and 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 face the same risk of being exposed to concentrations in excess of ERPG-2 values.

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 120 yards (110 meters) of the release 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 since 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 impacts workers. Since construction activities do not involve radioactive materials, there would be no radiological impacts. The presence of hazardous flammable, explosive and other chemical substances could initiate accident conditions that could impact the health and safety of workers. In addition, in the course of their work, construction personnel and site personnel could receive serious or fatal injuries as a result of incidents that are in the category of industrial accidents. DOE's construction contractors are required to adhere to strict safety standards and procedures in order to provide a working environment that minimizes the possibility of such accidents.

5.13 Cumulative Impacts

In accordance with the Council on Environmental Quality (CEQ) 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, presented in this chapter; and (3) a review 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 Section 3.3 under the Expanded Operations Alternative. Additional DOE or NNSA actions potentially impacting LANL include the possible siting of a modern pit facility at LANL, consolidation of nuclear operations related to production of radioisotope power systems; and the conveyance and transfer of land at LANL to Los Alamos County and the Department of the Interior to be held in trust for the San Ildefonso Pueblo. Consolidation of DOE Office of Nuclear Energy, Science and Technology plutonium-238 activities at the Idaho National Laboratory 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 2005b) 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 to continue at the LANL Plutonium Facility Complex, as described under the *Consolidation EIS* No Action Alternative, manufacturing of up to approximately 50 pits per year (80 pits per year using multiple shift operations) 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 impact of the 80-pit-per-year production and plutonium-238 processing (at levels far above the level of plutonium-238 processing identified in the *Consolidation EIS*) has already been evaluated in both the LANL *1999 SWEIS* and this new SWEIS. Therefore, there would be no additional cumulative effect from these activities.

An EIS analyzing the potential environmental impacts of operation of a BSL-3 Facility is in the early stages of preparation; therefore, definitive data for inclusion in the cumulative impacts analysis are not available for this draft SWEIS. However, information about the facility and its potential operations can be evaluated at a general level that is adequate to assess potential contributions to cumulative impacts from facility operation.

The BSL-3 Facility in TA-3 is a single-story 3,200-square foot (300-square meter) stucco building. It houses two BSL-3 laboratories, a BSL-2 laboratory, and support facilities including offices, a locker room, and showers. Construction is complete, but no operations of any type have been conducted in the facility. Operation of this facility is anticipated to result in at most, minimal incremental impacts on all resource areas. Utility use would be minimal; much less than most other LANL facilities and it would not affect LANL's overall utility demand or that of the region. Air emissions would be passed through HEPA filters and would not affect the air quality of the region. Liquid and solid wastes from operational areas would be thermally or chemically destroyed prior to discharge or disposal. Liquid waste would be discharged to the LANL sanitary sewage system where it would be commingled and treated prior to discharge and would have minimal impact on local and regional water quality. No radiological materials would be used at the facility, so no radioactive waste would be generated. Relatively small amounts of other regulated wastes would be generated which would be easily managed within the LANL waste management infrastructure and have negligible impact on transportation.

For the conveyance and transfer of land at LANL to Los Alamos County and the Department of the Interior to be held in trust for the San Ildefonso Pueblo, cumulative impacts were identified 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 the Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico*, DOE/EIS-0293 (DOE 1999d). Impacts for this action are also included by resource area in earlier sections of this SWEIS.

Primary sources for information on LANL contributions to cumulative impacts, other than the current and *1999 SWEIS*, are listed below:

- *Draft Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility*, DOE/EIS-236-S2 (DOE 2003b)

- *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 1997b)

- *Environmental Surveillance at Los Alamos during 2004*, LA-14239-ENV (LANL 2005j)
- *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems*, DOE/EIS-0373D (DOE 2005b)
- *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)
- Notice of Intent 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

It is also necessary to consider activities implemented by other Federal, state, and local agencies and individuals outside, but within the region of influence for LANL. This could include 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.

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 U.S. Bureau of Land Management (BLM) and the U.S. Forest Service were contacted for information regarding anticipated 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 and Santa Fe Counties, and the Santa Clara and San Ildefonso Pueblos did not provide information for the cumulative impacts analysis. Activities in the region surrounding LANL that were identified include:

- Los Alamos County identified residential, commercial and industrial development on areas transferred from DOE to the County. Residential development includes 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 in the next 5 years (Jeppson 2006), and
- Taos County identified about 20 subdivisions scheduled for review this year. This would include 150 to 750 new homes on 300 to 1,500 acres (121 to 607 hectares) (Trujillo 2006). Many of these would be located more than 50 miles (80 kilometers) from LANL.

In addition Los Alamos County is considering closure of the Los Alamos County Landfill, replacement of the Bayo Wastewater Treatment Facility, and utilization of the San Juan Chama water allotment. The existing Los Alamos County Landfill will close in 2007. Solid wastes will be shipped out of the County via a new transfer station (LAC 2005c). The Bayo Wastewater Treatment Facility in Santa Fe County would be replaced with an advanced wastewater treatment facility in Pueblo Canyon. Construction is expected to begin in 2006 (LAC 2004a). 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 (LAC 2004b).

A number of projects were identified that would affect the Santa Fe National Forest. These include: invasive plant control; road closure; thinning and prescribed fire; fire salvage; mineral extraction; and grazing allotment projects (USFS 2005a).

The BLM identified continued road maintenance, timber harvesting, and grazing permit renewals. A number of other projects were identified that would affect BLM lands. These include: the Power Project; New Mexico Products Pipeline; Mid-America Pipeline Western Expansion Project; Santa Domingo Pueblo-BLM land exchange; San Pedro Rock Quarry; treatment of saltcedar and other noxious weeds; and the Buckman Water Diversion Project (BLM 2006a).

– The Power Project involves upgrade and enhancement of 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 supplementing an existing petroleum products pipeline by adding two additional segments. 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 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-BLM land exchange would involve an equal-value exchange of approximately 7,376 acres (2,985 hectares) of BLM 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 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; and

– 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 have beneficial effects on groundwater levels. Potential effects on fish and aquatic habitats below the proposed project due to effects on water flow would be minimal (BLM and USFS 2004a).

Another project would upgrade the existing 46 kilovolt transmission loop system the serves central Santa Fe 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, upgrade, widening, and resurfacing projects. Some of the more substantial transportation projects in the region include:

– Interstate 40 reconstruction (2004 to 2008) (NMDOT 2006b);

– U.S. Route 84 reconstruction - Pojoaque to Espanola (2006) (NMDOT 2005a);

– State Route 502 reconstruction from DP Road to the Santa Fe County Line (2006) (NMDOT 2005a);

– State Route 344 four-lane road construction near Interstate 40 (2006 to 2011) (NMDOT 2005a);

– State Route 68 reconstruction and four-lane road construction in Taos County (2006 to 2011) (NMDOT 2005a);

– State Route 14 (Turquoise Trail) reconstruction (2007) (NMDOT 2006b);

– U.S. Route 84 reconstruction in Rio Arriba County (2007 to 2009) (NMDOT 2005a);

– State Route 68 reconstruction north of Espanola (2007 to 2010) (NMDOT 2005a);

– State Route 30 four-lane road construction from NM 502 to Espanola (2008) (NMDOT 2005a);

– State Route 41 reconstruction from Galesteo south to Clark Hill (2008) (NMDOT 2005a); and

– U.S. Route 285 reconstruction and resurfacing north of Ojo Caliente (2008) (NMDOT 2005a).

Although the transportation infrastructure in the region would continued to be maintained, 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 if 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 and therefore, would not contribute to cumulative impacts at LANL (EPA 2005c).

Because of the distance from LANL; the routine nature and relatively small size of most of the other actions considered; and the zoning, permitting, environmental review, and construction requirements that these actions must meet, they are not expected to interact with impacts from LANL activities to produce cumulative impacts. In addition, available documentation was reviewed for cumulative impacts, including the following sources:

U.S. Bureau of Land Management

- Draft Environmental Impact Statement for the Buckman Water Diversion Project (BLM and USFS 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 (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 2005b)

U.S. Bureau of Reclamation

- Upper Rio Grande Basin Water Operations Review (Review) and Draft Environmental Impact Statement (DEIS) (U. S. Army Corps, 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 Streams (NMWQCC 2002c)

Each resource area in this SWEIS was reviewed for potential cumulative impacts and the analyses are summarized in the following paragraphs. The level of detail provided for each resource area is dependent on 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 to these resources.

Land Resources

Land resources include impacts to land use and the visual environment. For land use, LANL actions proposed under this SWEIS would not likely result in any incompatible land uses. Under the Land Conveyance and Transfer EIS, land transferred by LANL to Los Alamos County and the San Ildefonso Pueblo, could be developed. Up to 826 acres (334 hectares) of this land could be developed after the transfer, with the potential introduction of incompatible land uses and the loss of recreational opportunities. Under the Expanded Operations Alternative, the cumulative impacts would include fewer restrictions on future land use on lands remaining part of the site under the MDA Removal Option (as opposed to the MDA Capping Option) because the wastes currently buried in the MDAs would be removed completely and shipped offsite or consolidated in onsite disposal areas allowing some of these MDAs to be used for other purposes. The Expanded Operations Alternative would also include the Security-Driven Transportation Modification Project which would not conflict with the current land use designations with the exception of an option for a bridge over Sandia Canyon. Construction of the Sandia Canyon Bridge would represent a departure from current site development plans. Overall cumulative impacts to land use in the region would be small.

Conveyance of the land to Los Alamos County and the San Ildefonso Pueblo under the Land Conveyance and Transfer EIS could also result in cumulative visual impacts such as diminished viewsheds and increases in 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 develop land for light industry along the Los Alamos Canyon rim across from the airport.

Geology and Soils

Proposed actions under the Expanded Operations Alternative would impact mineral resources at LANL and the surrounding region. The primary impacts are due to proposed closures of the MDAs under the Consent Order through either waste containment in place (MDA Capping Option), or waste removal by excavation and offsite disposal (MDA Removal Option).

If the waste at the MDAs is confined in place, 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 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. If the waste was 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.

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. However, other sources would be required to provide the other materials (such as soil and coarse material for erosion control) needed to complete the MDA remediation. In 2001, there were 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 could also be collected from onsite areas of opportunity, such as facility construction or DD&D areas when excess uncontaminated soils are excavated that meet backfill or capping criteria. The use of excavated soils as fill or cap material would minimize the need for importation of geologic materials from outside the immediate LANL area.

Water Resources

Activities at LANL, in combination with other activities in the vicinity, have the potential to affect regional water resources. For purposes of 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 of those watersheds have headwaters on Santa Fe National Forest or Bandelier National Monument land. The region for consideration of cumulative impacts on groundwater extends further east towards Santa Fe and focuses on impacts on the regional aquifer from the activities of landowners and managers other than LANL.

Past effluent discharges from LANL activities, in some cases at least 50 years ago, have caused contamination of sediments in several canyons and continue to affect the quality of storm water runoff and stream flows (LANL 2005j). However, as described under Section 4.3.1 of this SWEIS, current monitoring documents that 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 NMED (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 source of impairment is from unknown natural sources. While 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 ensuring 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 the activities, such as prescribed burns, mechanical and manual thinning, native plant revegetation, and establishment of fire breaks, have the potential to accelerate erosion and sediment delivery to streams, affecting 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, in which 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 will be 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 five to ten 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 reestablished and offsite erosion and sedimentation are minimized. For this reason, fire management activities in the region, in combination with those planned at LANL, are not anticipated to adversely affect surface water quality or quantity. These actions may be beneficial to the 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 on the Santa Fe National Forest for invasive weeds (USFS 2005b). 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, in combination with those planned for LANL, would not affect surface water resources.

Cerro Grande Fire Structures

Structures installed after Cerro Grande Fire in and around LANL altered surface water flows to retain sediment. The Northern Rio Grande Resource Conservation and Development Council lead an effort to rebuild fences, bridges, culverts, and other structures that were destroyed by the Cerro Grande Fire on private land (NRCS 2004). On Santa Clara and San Ildefonso Pueblos, fifteen 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 (U.S. Army Corps 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 those at LANL and their removal would have the potential to 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 for conveyance and transfer of lands from LANL to either the County of Los Alamos or San Ildefonso Pueblo 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 (U.S. Army Corps, 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 of the alternatives 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 (U.S. Army Corps, 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 impacts 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 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 2004b). The Buckman Well Field currently consists of thirteen wells that draw from the regional aquifer, but well yields have been reduced and groundwater levels declined since its inception, causing depletions of nearby streamflows (BLM and USFS 2004b). The diversion, which will divert up to 5,230 acre-feet per year from the river (BLM and USFS 2004b), is planned to 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 the proposed action, it is projected that 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 2004b). The DEIS for the Buckman Well Field Project predicts that direct diversions with reduced pumping from the Buckman Well Field, if the proposed action were implemented, 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 (by 2007) because pumping and aquifer depletions would be greatly reduced (BLM and USFS 2004b). 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 RLWTF Zero Discharge Option included in the Expanded Operations Alternative, reduction of contaminant contributions from elimination of the outfall from the RLWTF into Mortandad Canyon and improved water quality monitoring would provide beneficial impacts on surface water quality that may benefit Santa Fe's project.

The City of Los Alamos and San Ildefonso Pueblo are considering diverting Rio Grande water, and there 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. 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 2004b).

Groundwater Quality

Additional modeling and monitoring wells are needed to determine the foreseeable future impacts on the regional aquifer from radionuclides and other contaminants derived from former LANL waste disposal 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 be conducting future data collection activities, along with analysis of 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 the development of 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 improvement 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) will also require additional research to determine the source of the contaminant.

Air Quality and Noise

Table 5–76 presents the estimated maximum cumulative air quality concentrations offsite or at the site boundary from operations if the LANL SWEIS Expanded Operations Alternative were adopted and a new modern pit facility were operating at its highest projected level of production. The cumulative concentrations of the all criteria pollutants are expected to remain in compliance with Federal and state ambient air quality standards. Cumulative air quality impacts for the No Action and Reduced Operations Alternatives would be lower still.

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 the 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 occur near the site boundary. The impact on the public would likely be minor.

Table 5–76 Estimated Maximum Cumulative Air Quality Concentrations at the Site Boundary (micrograms per cubic meter)

Criteria Pollutant	*Averaging Period*	*LANL SWEIS (Expanded Operations)* [a]	*MPF EIS (450 Pits Per Year Alternative)* [b]	*Cumulative Concentration*	*Most Stringent Standard or Guideline* [a]
Carbon monoxide	8 Hours 1 Hour	192.4 1,071	12 17	204.4 1,088	7,900 11,900
Nitrogen dioxide	Annual 24 Hours	7.0 40.2	5.7 28.7	12.7 68.9	75 150
Sulfur dioxide	Annual 24 Hours 3 Hours	10.2 83.5 397.3	0.42 2.1 4.8	10.6 85.6 402.1	42 209 1,050
Total suspended particulates	Annual 24 Hours	5.7 135.0	0.46 2.3	6.2 137.3	60 150
PM_{10}	Annual 24 Hours	5.24 101.6	0.17 0.84	5.4 102.4	50 150

MPF = modern pit facility, PM_{10} = particulate matter less than or equal to 10 microns in diameter.

[a] Data from Table 5–8 of this LANL SWEIS. 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 were assumed to be included in the background monitoring concentrations discussed in the current and 1999 SWEIS. The results of the modeling 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. All of the equipment at the TA 3 Co-Generation Complex, including an additional Combustion Turbine Generator that would be constructed in the 2007 to 2013 time frame would all operate within the emission limits specified in the air quality permit.

[b] Data from Table 5.2.3.1–3 of the MPF EIS (DOE 2003b).

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 Site operations at TA-14, TA-15, TA-36, TA-39, and TA-40; and 2) the additive emissions from all of the pollutants from all technical areas 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 EIS* (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 the 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 occurs 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 cumulative impacts of oil and gas development when 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. They also found that 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 area and the San Juan Basin Coalbed Methane Project area, and it is unclear if these 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 EIS (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 EIS (BLM 2003b), the Record of Decision for this study (BLM 2003c) included a number of mitigation measures designed to reduce the 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 their nitrogen oxide emissions to less than 10 grams per horsepower-hour, and each pipeline compressor station shall limit its total nitrogen oxide emissions to 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 an 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 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 *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) would not be major and would not cause or contribute to an exceedance of any ambient air quality standard.

Ecological Resources

The continuing transfer of LANL land under the Land Conveyance and Transfer EIS to the County of Los Alamos and the Department of the Interior to be held in trust for San Ildefonso Pueblo would result in the cumulative impact of the conveyance of 770 acres (312 hectares) of undeveloped habitat which could potentially be developed. A transfer of resource protection responsibility may also result in a less rigorous environmental protection review process. Power grid upgrades would have minimal effects of vegetation and temporary impacts on wildlife. The Wildlife Hazard Reduction Program would have short-term impacts on wildlife, create historic forest conditions and have a positive effect on the Mexican spotted owl due to healthier habitat. The disposition of flood retention structures would have short-term impacts on wildlife and its habitat and potential temporary impacts on downstream wetlands as a result of possible habitat disturbance and changes in the water flow rate. The Trails Management Program would have short-term impacts on wildlife and an increase in 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.

Human Health

Table 5–77 presents the estimated cumulative impacts from radiological emissions at LANL. Cumulative impacts to the public would likely remain within the maximum level of impacts forecasted under the SWEIS Expanded Operations Alternative. No cancer deaths (LCFs) would be expected in terms of the MEI or in the general population. The dose to the maximally exposed offsite individual would be expected to remain within the 10 millirem per year limit required by the Clean Air Act. There would be no increase expected in the number of LCFs among the general public even if a modern pit facility operations were located at LANL.

Collective worker doses would increase substantially if a facility producing 450 pits annually were located at LANL at the same time that the Expanded Operations Alternative MDA Removal Option was being implemented. Collective worker dose would increase from less than 200 person-rem per year to an annual average of 1,080 person-rem per year. Worker dose would decrease by about 110 person-rem annually after the MDA remediation work was complete. Individual worker dose would be maintained ALARA and within applicable regulatory limits.

Table 5–77 Estimated Cumulative Impacts from Radiological Emissions

Activity	General Public				Worker Population	
	Maximally Exposed Individual		Population Within 50 Miles			
	Dose (millirem per year)	*Latent Cancer Fatality Risk per year*	*Collective Dose (person-rem per year)*	*Excess Latent Cancer Fatalities per year*	*Collective Dose (person-rem per year)*	*Excess latent cancer fatalities per year*
LANL SWEIS Alternatives						
No Action	7.8	4.7×10^{-6}	30	0.018	281	0.17
Reduced Operations	0.79	4.7×10^{-7}	6.4	0.0038	258	0.15
Expanded Operations	8.2	4.9×10^{-6}	36	0.022	520	0.31
Other Actions						
Modern Pit Facility [a]	1.2×10^{-7}	7×10^{-14}	1.0×10^{-6}	6×10^{-10}	560	0.34
Total	0.79 to 8.2	4.7×10^{-7} to 4.9×10^{-6}	6.4 to 36	0.0038 to 0.022	818 to 1,080	0.71
Dose Limit [b]	10	NA	NA	NA	NA	NA

NA = not applicable.
[a] *MPF EIS* (DOE 2003b) Tables 5.2.9.1-1 and 5.2.9.1-2; 450 pits per year alternative.
[b] 10 millirem per year limits as required by the Clean Air Act.

Cultural Resources

Actions proposed under the Land Conveyance and Transfer EIS would result in the cumulative impact of the conveyance and transfer of cultural resources out of the responsibility and protection of the DOE. A consequence of this transfer and conveyance would be potential damage to cultural resources on land due to future development and impacts to the protection and accessibility to American Indian sacred sites.

Infrastructure

Table 5–78 presents the estimated cumulative infrastructure requirements at LANL for electricity, natural gas and water. Cumulative infrastructure requirements include usage projections through 2011 for LANL and other Los Alamos County users that rely upon the same utility system. Therefore, the projections provided in Section 5.8.2 and adopted here, already include consideration of the 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 5–78, if a new modern pit facility were located at LANL, the combined electrical demand (peak load site capacity) and water use could exceed current capacity when combined with the Expanded Operations Alternative under this SWEIS. While it is projected that the electric peak load capacity would be exceeded, the projection does not take into account completion of a new transmission line and other power grid upgrades which would help offset the deficit in peak load capacity and would ensure that electrical energy availability would not be problematic 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) of generating capacity beyond 2006.

Table 5–78 Estimated Cumulative Infrastructure Requirements for the LANL Region of Influence

Activity	Electricity (megawatt-hours per year)	Electricity Peak load (megawatts)	Natural Gas (decatherms per year)	Water (millions of gallons per year)
LANL SWEIS Alternatives Projected through 2011 [a]				
No Action	632,000	112	2,213,000	1,682
Reduced Operations	497,000	84.5	2,190,000	1,605
Expanded Operations	814,000	145	2,320,000	1,816
Other Actions				
Modern Pit Facility [b]	178,814	36.5	272,977	133
Total (range)	675,814 to 992,814	121 to **181.5**	2,462,977 to 2,592,977	1,738 to **1,949**
System Capacity [c]	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] *CMRR EIS* (DOE 2003f) Table 4-27, and *MPF EIS* (DOE 2003b) Table 5.2.2.2-2; 450 pits per year alternative.
[c] 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.
Note: Potential exceedances of system capacity are shown in **bold**. A decatherm is equivalent to 1,000 cubic feet.

For water use, 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 that include 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 to date 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 5–79 presents the estimated amount of radioactive and chemical waste that would be generated for the LANL SWEIS Alternatives (through 2016) when combined with potential waste from a new modern pit facility. Cumulative waste generation rates for all waste types are expected to be substantial, largely due to future remediation and DD&D of facilities, and the potential operation of a new modern pit facility. 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.

Table 5–79 Estimated Cumulative Waste Generation at LANL (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	71,000 to 156,000	1,800 to 2,700	197,000	19,000,000 to 37,000,000
Reduced Operations	3,500 to 5,900	71,000 to 137,000	1,800 to 2,700	197,000	19,000,000 to 37,000,000
Expanded Operations	5,400 to 33,000	275,000 to 1,403,000	4,000 to 183,000	656,000 to 736,000	65,000,000 to 129,000,000
Reasonably Foreseeable Future Actions					
Modern Pit Facility [b]	15,000	66,000	55	105,000	81,000
Total (range) [c]	18,000 to 48,000	137,000 to 1,469,000	1,900 to 183,000	302,000 to 841,000	19,000,000 to 129,000,000

[a] Data rounded from Table 5–37.
[b] *MPF EIS* (DOE 2003b) Table 5.2.13.2-1 and 5.2.13.2-2; 450 pits per year alternative operating for 10-years; hazardous waste converted assuming 1,000 pounds per cubic yard.
[c] 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.

The waste estimates included in the Expanded Operations Alternative in this SWEIS includes expanding pit production to 50 pits per year under single-shift operations (80 pits per year using multiple shifts) from 20 pits per year under the No Action Alternative. Wastes associated with pit production are also accounted for in the modern pit facility estimates in Table 5–79. Therefore, Table 5–79 overestimates cumulative waste generation associated with pit production.

Increases in the cumulative waste generation rate may require the construction of additional facilities and assignment of additional staff to manage the wastes. All categories of waste are expected to see increased 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 to satisfy LANL's ongoing requirements for such materials. Most wastes, with the exception of some low-level radioactive waste, are disposed offsite at permitted facilities.

Low-level radioactive waste generation rates will increase under all alternatives, but the most significant increase is seen in the Expanded Operations Alternative. A modern pit facility would also generate significant quantities of low-level radioactive waste. 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. In addition, offsite disposal options for low-level radioactive waste include NNSA's Nevada Test Site and a number of commercial facilities, including facilities in Washington, Utah and South Carolina. For these 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 is also 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 elsewhere) as low-level radioactive waste.[2]

The Record of Decision for the *WIPP SEIS* allows for the 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 1997b). Transuranic waste generated under the Expanded Operations Alternative and the total cumulative transuranic generation shown in Table 5–79 could exceed this amount. Transuranic waste would be 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 1997b).

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 is particularly evident under the Expanded Operations Alternative. Offsite treatment options are available at commercial facilities across the country, including treatment and disposal facilities in Nevada, Colorado, Utah and Texas (U.S. Army Corps 2006).

Significant quantities of non-radioactive solid wastes, including construction and demolition debris, would be generated under all alternatives. The most significant increase would occur under the Expanded Operations Alternative. The planned closure of the Los Alamos County Landfill by the end of 2007 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 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 the LANL and Los Alamos County waste, including the Rio Rancho, Sandoval County, and Torrance County/Bernalillo County Landfills. In 2000, the NMED Solid Waste Bureau estimated that the State had approximately 30 years of landfill capacity remaining. (NMED 2000)

Transportation

The collective dose, cumulative health effects, and traffic fatalities from approximately 100 years of radioactive material and waste transport across the United States are estimated in **Table 5–80**. The total collective worker dose from all types of shipments (general transportation, historical DOE shipments, reasonably foreseeable actions, and the *LANL SWEIS* alternatives) was estimated to be 360,280 to 361,030 person-rem which would result in 216 to 217 LCFs among the affected transportation workers. The total collective dose to the general public was estimated to be 339,900 to 340,130 person-rem which would result in 204 excess LCFs among the affected

[2] 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 onsite at LANL.

general population. The total estimated traffic fatalities associated with accidents involving radioactive material and waste transports would be 100 to 103. 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 (22 fatalities) and reasonably foreseeable actions (74.5 fatalities).

Table 5–80 Cumulative Impacts of Radioactive Material and Waste Transport (1943 to 2047) [a]

Activity	*Worker*		*General Public*		*Traffic Fatalities*
	Collective Dose (person-rem)	*Latent Cancer Fatalities*	*Collective Dose (person-rem)*	*Latent Cancer Fatalities*	
LANL SWEIS Alternatives [b]					
No Action	147	0.088	49	0.030	0.28
Reduced Operations	131	0.079	44	0.027	0.25
Expanded Operations	up to 884	up to 0.53	up to 271	up to 0.16	up to 2.9
Other Past, Present, and Reasonably Foreseeable Future Actions					
General Transportation (1943 to 2047) [c]	330,000	198	290,000	174	22
Historical DOE Shipments [c]	330	0.20	230	0.14	No data
Reasonably Foreseeable Actions [c]	21,000	12.6	48,000	29	74.5
High Level Waste and Spent Nuclear Fuel Disposal at Yucca Mountain (up to 2047) [c, d]	8,800	5.3	1,600	0.96	3.1
Modern Pit Facility [e]	18	0.011	29	0.017	0.028
Total [f]	360,280 to 361,030	216 to 217	339,900 to 340,130	204	100 to 103

[a] Collective dose, health effects, and traffic fatalities associated with transporting radioactive materials and waste.
[b] From Table 5–51.
[c] From Yucca Mountain EIS (DOE 2002b) and Table K–10 of this LANL SWEIS.
[d] From Yucca Mountain EIS (DOE 2002b), Proposed Action, Mostly rail alternative.
[e] MPF EIS (DOE 2003b) Table 5.2.12.2-2 and 5.2.13.2-3; 450 pits per year alternative operating for 10-years.
[f] 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.

Table 5–80 shows that the impacts of 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 3 traffic fatalities (through 2016), and therefore would not contribute substantially 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 Table 4–51). Nationwide, in 2004, there were more than 42,000 traffic fatalities (NCSA 2006).

Local Transportation

The potential impacts to traffic at the main access points to LANL are estimated in **Table 5–81**. The modern pit facility, if located at LANL and operating at a 450 pit production level, combined with this SWEIS's No Action Alternative would result in an 14 percent increase in daily traffic in and around LANL. If the Reduced Operations Alternative were chosen for this SWEIS, combined with a modern pit facility, the resulting increase in traffic would be 10 percent versus 14 percent under the No Action Alternative. The largest estimated daily traffic increase would occur if the SWEIS Expanded Operations Alternative – MDA Removal Option were selected and a modern pit facility was constructed at LANL. Under this scenario, daily traffic could increase by up to 30 percent. Approximately 17 percent of the increase would be associated with increased vehicle trips under this SWEIS's Expanded Operations Alternative and 13 percent would be due to operation of the modern pit facility.

Development of land transferred under the Land Conveyance and Transfer EIS could, after the land was remediated, result in an increase in traffic in the vicinity of the airport and TA-21 based on current Los Alamos County plans to develop light industry on these tracts. This action combined with the increased traffic due to DD&D activities at TA-21 could cause excessive traffic loads on NM 502.

Table 5–81 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 State Road 4*	*East Jemez Road at State Road 4*	*West Jemez Road at State Road 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	+1,500	+3,800	+1,200	+200	+400
Other Past, Present, and Reasonably Foreseeable Future Actions					
Modern Pit Facility	+3,300	+700	+1,300	+300	+200
Total Change in Daily Vehicle Trips	+2,400 to 4,800	+500 to 4,500	+900 to 2,500	+210 to 500	+150 to 600
Percent Change from Baseline	+10 to 20	+10 to 90	+9 to 26	+10 to 25	+12 to 48

Note: Incremental changes for LANL SWEIS Alternatives may not match earlier tables due to rounding.

East Jemez Road, as designated by the State of New Mexico and governed by 49 CFR 397, is the primary route for the transportation of hazardous and radioactive materials. Therefore, hazardous and radioactive material shipments leave or enter LANL from East Jemez Road to NM 4 to NM 502. All shipments would meet the applicable U.S. Department of Transportation, U.S. Nuclear Regulatory Commission, and DOE requirements.

Summary of Cumulative Impacts

Each resource area in this SWEIS was reviewed for potential cumulative impacts and the analyses are summarized in the following paragraphs. The level of detail provided for each resource area is dependent on 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 the decisions to implement the Expanded Operations Alternative in this SWEIS and locate a facility producing 450 pits annually at LANL were made.

Land Use, Visual Resources, Ecological Resources, and Cultural Resources

Cumulative impacts on land use, visual resources, ecological resources and cultural resources are largely due to the conveyance and transfer of land to Los Alamos County and the Department of Interior in trust for the San Ildefonso Pueblo as required under Public Law 105-119. Up to 826 acres (334 hectares) of land could be developed after the transfer. For example, Los Alamos County has indicated there are proposals to develop approximately 1,000 new residences on land adjacent to LANL and develop land for light industry 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.

Geology and Soils

For geology and soils, the primary impacts are due to proposed closures of the MDAs under the Expanded Operations Alternative in compliance with the Consent Order. If the waste at the MDAs is confined in place (MDA Capping Option), the final covers would require up to 2,000,000 cubic yards (1,500,000 cubic meters) of crushed tuff through 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. These fill materials would likely be obtained from both LANL resources and the 24 quarries and mines in the surrounding counties. While the quantity of materials would be large, there are sufficient resources in the region to meet the demand.

Water Resources

For water resources, reasonably foreseeable future activities in the region have the potential to 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. Additional groundwater depletion projected as a result of potential new residential development within Los Alamos County may 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, as well to track the amount of water available for use.

Air Quality

The cumulative concentrations of all criteria pollutants are expected to remain in compliance with Federal and state ambient air quality standards.

The 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 the 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 occur near the site boundary. The impact on the public would likely be minor.

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 were shown to occur very close to the source, with concentrations decreasing rapidly with distance. 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) were found to be generally limited to a few miles downwind from the source. For emissions from the 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 oxides emissions on ozone levels usually occurs several hours after these compounds are emitted and many miles from their sources. 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 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 with the addition of a modern pit facility) could be as much as 36 person-rem per year. The dose to the maximally exposed offsite individual from all anticipated airborne emissions at LANL (Expanded Operations Alternative with the addition of a modern pit facility) could be as much as 8.2 millirem per year. The Clean Air Act limits airborne doses to 10 millirem year to any individual member of the public. No additional LCFs would be expected at these dose levels.

Collective worker doses would increase substantially if a facility producing 450 pits per year were located at LANL at the same time as the Expanded Operations Alternative MDA Removal Option was being implemented. Collective worker dose would increase from 281 person-rem per year under the No Action Alternative to an annual average of 1,080 person-rem per year. Worker dose would decrease by about 110 person-rem annually after the MDA remediation work was complete. At a collective dose of 1,080 person-rem per year, less than one (0.71) LCF would be expected. Individual worker dose would be maintained ALARA and within applicable regulatory limits.

Infrastructure

For infrastructure, the cumulative peak load electrical capacity and the water use capacity would be exceeded for the combined LANL Expanded Operations Alternative and a modern pit facility. Planned upgrades to the electrical system should be sufficient to offset the deficit in peak load capacity and ensure that electric energy is available when needed 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 anticipated and LANL demands on infrastructure resources are below projected levels and within site capacities. Potential shortfalls in available capacity will need to be addressed if increased site requirements are realized.

Transportation

The total cumulative worker dose from 100 years of radioactive materials shipments (general transportation, historical DOE shipments, reasonably foreseeable actions, and the LANL SWEIS alternatives) was estimated to be a maximum of 369,230 person-rem, which would result in 222 LCFs. The total cumulative dose to the general public was estimated to be a maximum of 338,530 person-rem which would result in 203 excess LCFs. The total estimated traffic fatalities associated with accidents involving radioactive material and waste transports would be a maximum of 105.

LANL alternatives are expected to result in no more than 3 traffic fatalities and no worker or public cancer deaths (LCFs), and therefore 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 Table 4–51). Nationwide, in 2004, there were more than 42,000 traffic fatalities.

Traffic could increase on Los Alamos County roads from increased development of both housing and light industry as a result of the conveyance and transfer of lands to Los Alamos County and the Department of Interior in trust for the San Ildefonso Pueblo, increased truck shipments under the Expanded Operations Alternative, and projected increases in LANL's workforces under the Expanded Operations Alternative combined with the possibility that a modern pit facility may be located at LANL. Under this scenario, daily traffic could increase by up to 30 percent.

Approximately 17 percent of the increase would be associated with increased vehicle trips under the Expanded Operations Alternative and 13 percent would be due to operation of a modern pit facility.

Development of land transferred under the Land Conveyance and Transfer EIS could result in an increase in traffic in the vicinity of the airport and TA-21 based on current Los Alamos County plans to develop light industry 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.

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, and the potential operation of a modern pit facility. Although this would be the case under all alternatives, the quantities of wastes projected under the Expanded Operations Alternative would be significantly greater than those projected under the other alternatives. Sufficient disposal capacity, both on and off site, for all waste types would be available with the following exception. Under the Expanded Operations Alternative with the MDA Removal Option and the operation of a modern pit facility, the projected low-level radioactive waste volume would exceed the on-site disposal capacity, and the projected transuranic waste volume would significantly exceed the volume that was attributed to LANL in the *Waste Isolation Pilot Plan Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997b). Therefore, additional resources, including new facilities may be required to augment existing waste management capabilities.

5.14 Mitigation Measures

The regulations promulgated by the CEQ 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
- Compensating for the impact by replacing or providing substitute resources or environments (40 CFR 1508.20)

This chapter describes mitigation measures that are built into the alternatives analyzed and those 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 the lack of information regarding resources or mechanisms for impact to resources results in substantial uncertainty in 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 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 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. The laws and regulations applicable to federal facilities are discussed in Chapter 6; many of these requirements are established with the intent of protecting human health and the environment. It is assumed that these or similar regulatory controls will continue to be in place. These regulations, when complied with, mitigate the potential 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, which reduce the potential for catastrophic releases from such facilities in the event of earthquakes, high winds, or other natural phenomena. Similarly, the application of occupational safety and health regulations in 29 CFR 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 that apply to work conducted at LANL that mitigate the potential adverse effects of operations; it is assumed that these or similar policies and procedures will continue. These 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 the stoppage and restart of work where unexpected hazards or resources are identified (for example, the policies regarding recovery of information from archaeological sites uncovered by excavation)

Work controls reduce potential impacts by ensuring that work conducted is 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 with 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 this understanding). Policies for consultations and discussions with other entities mitigate effects by providing an opportunity to avoid or change actions that could cause an adverse impact. For example, consultation with Pueblos could identify the potential to impact traditional cultural properties prior to implementing a construction project or operations and could identify alternative siting or operational approaches that would avoid the impact. 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 this can be accomplished safely) until work plans and authorizations can be modified in consideration of the newly uncovered 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, health of LANL workers, health of the public around LANL, and the effects of LANL operations on these, as well as to avoid or reduce impacts and remediate contamination from previous LANL activities. These programs and projects reduce potential adverse impacts by providing for heightened understanding of the resources that could be impacted; avoidance of some impacts (where mechanisms for impact 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 providing for 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 are:

- The Environmental Surveillance and Compliance Program at LANL monitors LANL for permit and environmental management requirements. This program also includes evaluation of samples from various environmental media for radioactive materials and other hazardous materials locally and regionally (see Section 4.6.1.2). The data generated under this program are collected routinely and publicly reported at least annually, and these data are analyzed to determine regulatory compliance and to determine environmental trends over long periods of time.

- The Threatened and Endangered Species Habitat Management Plan is intended to provide long-range planning information for future LANL projects, and protect habitat at LANL for these species (see Section 4.5.4).

- DOE recently completed a Cultural Heritage Resources Management Plan for LANL (see Section 4.7). This plan has undergone public review and will be fully 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 resulted in a 64 percent reduction in NO_x emissions. These controls and administrative controls applied to the steam plant and other sources are used to comply with the emission source limitations and the facility wide emission limitations specified in the LANL's air permit (see 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 human health in the region and to assess the potential for adverse human health effects due to LANL operations (see 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 Storm Water Permit Program regulates storm water runoff from industrial activities under a Multi-Sector General Permit. Storm water monitoring and erosion controls are required at these sites. An integrated Storm Water Monitoring Program monitors storm water 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 Storm Water Program regulates storm water from construction activities disturbing 1 acre (0.4 hectares) or more (see Section 4.3.1.3).

- LANL has a Groundwater Protection Management Program to assess current groundwater conditions and monitor and protect 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 Section 4.3.2).

- The Safeguards and Security Program restricts unauthorized access to areas of LANL with high potential for impact to human health and the environment. Such access restrictions aid in limiting 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 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 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 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. This program works to reduce the wastes generated and to some extent the effluents and emissions from facilities (see Section 4.11).

- 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 Section 4.8.2).

- The environmental restoration project at LANL (which includes DD&D) assesses and remediates contaminated sites that either were or still are under LANL control (see Section 4.12). The environmental restoration project serves an important role in reducing the potential for future impacts to human health and the environment due to legacy contaminants in the environment. It is assumed that the current mitigation practices used in remediation actions will continue to be used.

While this list is not all-inclusive, it does reflect the importance of these programs in mitigating the potential adverse impacts of operating LANL.

5.14.2 Mitigation Measures Incorporated in SWEIS Alternatives

Several specific mitigation measures are included in the SWEIS alternatives. Unless otherwise noted below, the analyses in this chapter assume that these measures are implemented. These specific measures are:

- Removal of contamination from MDAs and other PRSs, if necessary, would be conducted in a manner that is protective of the environment and public and worker health and safety. Removal of waste from some large MDAs may require use of temporary containment structures to maintain possible releases of contaminated material to the environment to levels within applicable standards and ALARA. The MDAs where use of containment structures or equivalent measures may be required for safe removal operations include MDAs A, B, T, AB, and G (Expanded Operations Alternative – MDA Removal Option).

- Non-radioactive 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 are 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 a utility corridor unpaved 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.

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 which 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 will 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 initiated activities aimed at developing a 40-year water plan to address water service needs, balance the uses of water resources, and make recommendations on a water conservation program tailored to meet the specific needs in Los Alamos, including LANL as a Los Alamos County water supply customer. Only the Expanded Operations Alternative is forecast to have water demands that would approach the available water rights from the regional aquifer. Los Alamos County's plans to make use of 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 demands and current groundwater rights. LANL water use would be mitigated somewhat by the use of recycled water from the Sanitary Effluent Recycle Facility for cooling water.

- Ongoing upgrades to the electrical power transmission and distribution system including construction of a third transmission line would allow the import of additional power into the Los Alamos Power Pool and 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 4.9.2.1, upgrades and installation of one, new combustion turbine generator are scheduled to be complete in 2006. While DOE currently has no timeframe for installation of 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 be used to further reduce emissions under all of the alternatives.

- The increased use of foam and vessels for high explosives testing under all of the alternatives could further reduce air pollutant emissions, such as beryllium and depleted uranium, from these activities. The use of foam has been shown to reduce emissions by 50 to more than 80 percent (LANL 2006). The use of vessels for certain tests could reduce emissions by close to 100 percent.

- Traffic and noise impacts on residents of the Royal Crest Mobile Home Park and Los Alamos Town Center from traffic associated with 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, the possible construction of a bridge or another road off of DP Mesa to allow for alternative routing of traffic. Stockpiling bulk materials on the sites during off-peak hours could also 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 the 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 the maintenance and enhancement of 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 general public. The generation of fission products under any of the three alternatives is unavoidable. Radioactive waste generated during operations would be collected, treated and 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 result in an unavoidable impact 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 would also be unavoidable. These impacts would include the generation of fugitive dust, noise, and 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 could cause short-term commitments of resources and would permanently commit 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 could include the space and materials required to construct new buildings, the commitment of new operations support facilities, transportation, and other 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 from the relocation of materials, including process emissions and the handling of radioactive waste.

Regardless of the location and change in level of activity 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 their 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 the consolidation of new facilities, could result in the further disturbance, use, and commitment of previously undisturbed land. Ultimately, upon the closure of facilities at LANL, NNSA plans to decontaminate and decommission the buildings and equipment and restore them to brown-field sites, which 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 in operating buildings and facilities at LANL. The 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. However, certain materials and equipment used during operations 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.

The disposal of hazardous and radioactive wastes would also 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).

There are a number of Federal environmental laws that 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. Furthermore, State legislatures have adopted 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), is operational, is undergoing decommissioning and decontamination, or is incorporated in whole or in part into an existing facility.

Requirements governing the continuation of LANL operations arise primarily from six sources: 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) to consider compliance prior to specific instances of violations or other events that trigger their provisions. These include the Toxic Substances Control Act (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. State statutes supplement as well as implement Federal laws for protection of air and water quality and for 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 level of protection of the public, often focusing on zoning, utilities, and public health and safety concerns.

Regulatory agreements and compliance orders may also be initiated to establish responsibilities and timeframes for Federal facilities to come into compliance with provisions of applicable Federal and State laws. There are also other agreements, memoranda of understanding, or formalized arrangements that 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 the issuance of permits or licenses for new operations or new emission sources and for amendments to 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 potentially impacting LANL. Consultations with applicable agencies and Federally-recognized American Indian 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, which are potentially addressed by these laws, regulations and permits and Chapter 5 discusses the potential impacts to those resources for each alternative. Consultations with applicable agencies and Federally-recognized American Indian Nations as required by these 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 in the future apply 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 the 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 provide for the preservation of 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 962
"Environmental Radiation Protection Standards for Management of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Materials"	40 CFR 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 800
Worker Safety and Health	
"Occupational Radiation Protection"	10 CFR 835
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 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 71
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.*

Laws, Regulations, Orders, Other Requirements	***Citation***
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 1500 *et seq.*
National Environmental Policy Act of 1969	42 U.S.C. 4321 *et seq.*
"National Environmental Policy Act Implementing Procedures"	10 CFR 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 61
"National Emission Standards for Hazardous Air Pollutants for Source Categories"	40 CFR 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 1022
"EPA-Administered Permit Programs: The National Pollutant Discharge Elimination System"	40 CFR 122
Floodplain Management	Executive Order 11988
"National Primary Drinking Water Regulations"	40 CFR 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 73 (see Appendix C of this SWEIS)
Solid Waste Disposal Act of 1965, 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 for the purpose of furthering 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 the Federal agency having authority over the land on which a resource is located before issuance of a permit; the permit must contain 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—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 the most relevant to radioactive materials and waste management include:

- "Nuclear Safety Management" (10 CFR 830)
- "Occupational Radiation Protection" (10 CFR 835)
- "Byproduct Material" (10 CFR 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 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 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 and radiation standards for the 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 the 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 provides a guarantee that the Federal Government will review the need for compensation beyond that provided (NEI 2005).

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" with regard to 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 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 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 61 and 40 CFR 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 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, requiring that EPA establish regulations for permits for stormwater discharges associated with industrial activities, including construction activities that could disturb five or more acres. 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 such time as 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 the 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 *Federal Register* (FR) 64746 (October 30, 2000). The point source discharges of stormwater regulated by the General Permit include LANL's SWMUs (EPA 2005a).

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).

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.)	February 1, 2001	January 31, 2005 (Permit has been administratively continued.)
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
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.
Source: EPA 2005a, LANL 2004f.

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 and reporting of a release or threat of release of a hazardous substance to the environment; and (2) a statutory framework for the 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 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 the 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 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 having 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 that 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 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 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 the management of hazardous waste. Prior to its passage, mixed waste stored at DOE sites was generally not in compliance 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, and provide 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 or 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 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 171 through 178 and 49 CFR 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 262 apply to off-site 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. On-site 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 830, Subpart B. Off-site 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 71) regulations include detailed packaging design requirements and package certification testing requirements. Complete documentation of design and safety analysis, and the results of the required testing, 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 of its 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 have common migration patterns between the United States and 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 as to 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 1500-1508) can result in a categorical exclusion, an environmental assessment and finding of no significant impact, or an environmental impact statement (EIS). This SWEIS has been prepared in accordance with NEPA requirements, CEQ regulations (40 CFR 1500 *et seq.*), and DOE provisions for implementing the procedural requirements of NEPA (10 CFR 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, 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 with emphasis on 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 having 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 Native American 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 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 provides the Advisory Council on Historic Preservation with a reasonable opportunity to comment with regard to such undertakings, as required by Section 106 of the Act. In promulgating the new regulations, the Council has 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, Native Americans 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: (a) establishing a review committee with monitoring and policymaking responsibilities; (b) developing regulations for repatriation, including procedures for identifying lineal descent or cultural affiliation needed for claims; (c) providing oversight of museum programs designed to meet the inventory requirements and deadlines of this law; and (d) 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 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 in a manner that furthers a national policy of promoting an environment free from noise jeopardizing 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 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. These goals were designed 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 of drinking water. The implementing regulations, administered by EPA unless delegated to 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 that have at least 15 service connections used by year-round residents or regularly serve at least 25 year-round residents. The EPA regulations implementing the Safe Drinking Water Act are found in 40 CFR 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 260 through 283. The New Mexico Environment Department (NMED) 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, and the methods of treatment, storage, and disposal.

Toxic Substances Control Act of 1976 (15 U.S.C. 2601 *et seq.*)—The Toxic Substances Control Act 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 inventory reporting and chemical control provisions of the legislation to protect the public from the 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 purposed 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 defines the characteristics and amount of waste that will be disposed of at the facility. The 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 make a determination that the waste meets all statutory and regulatory requirements for disposal at WIPP.

6.2 Executive Orders

This section identifies environmental-, 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, which are potentially addressed by Executive Orders and Chapter 5 discusses the potential impacts to those resources for each alternative. Consultations with applicable agencies and Federally-recognized American Indian 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 1021) and DOE Order 451.1B for compliance 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 those properties qualify. This process requires

DOE to provide the Advisory Council on Historic Preservation the opportunity to comment on the possible impacts of proposed activities on any potential eligible or listed resources.

Executive Order 11990, *Protection of Wetlands* (May 24, 1977)—This Order (implemented by DOE in 10 CFR 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 opportunity 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 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 be 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, the Toxic Substances Control Act, 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 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 to 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 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 for conservation of 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 constitutes 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, 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 make it a high priority to identify and assess 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 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 for reducing greenhouse gas emissions from facility energy use, reducing energy consumption per gross square foot of facilities, reducing energy consumption per gross square foot or unit of production, expanding use of renewable energy, reducing the use of petroleum within facilities, reducing source energy use, and reducing water consumption and associated energy use.

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, environmental audits, reporting to the public of pollution releases, pollution prevention or reduction at the source, reducing toxic releases and transfers of toxic chemicals reducing use of toxic chemicals and hazardous substances reducing generation of hazardous and radioactive waste types, 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 Native American Tribal Governments" and states that each Executive 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 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 the country's 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 DOE Orders have been 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 151.1, *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 or the workers, the environment, the intended purpose of DOE facilities, or the credibility of DOE.

DOE Order 413.3, *Project Management for the Acquisition of Capital Assets* (October 13, 2000; Change 1, January 3, 2005)—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;

Table 6–3 Applicable DOE Orders and Directives (as of January 11, 2006)

DOE Order/Number	*Subject (date)*
Leadership/Management/Planning	
O 151.1C	Comprehensive Emergency Management System (10/29/03)
Information and Analysis	
O 231.1A	Environment, Safety, and Health Reporting (08/19/03; Change 1, 06/03/04)
Work Process	
O 413.3	Project Management for the Acquisition of Capital Assets (10/13/00; Change 1, 01/03/05)
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 0(9/24/03)
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 440.1A	Worker Protection Management for DOE Federal and Contractor Employees (03/27/98)
O 450.1	Environmental Protection Program (01/15/03; Change 2, 12/07/05))
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)
Environmental Quality and Impact	
O 5400.5	Radiation Protection of the Public and the Environment (02/08/90; Change 2, 01/07/93)
O 5480.4	Environmental, Safety, and Health Protection Standards (05/15/84; Change 4, 01/07/93)
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 5632.1C	Protection and Control of Safeguards and Security Interests (07/15/94)
O 5660.1B	Management of Nuclear Materials (05/26/94)

- 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 the 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 for the 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 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees* (March 27, 1998)—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)—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 are protective of 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)—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 1500-1508), and the DOE NEPA Implementing Procedures (10 CFR Part 1021). The goal of establishing the requirements and responsibilities 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 the proper packaging and transportation 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 be conducted in compliance 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 upon 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 which is designed to enhance the DOE safeguards and security; cyber security; emergency management; and environment, safety, and health programs by providing DOE and contractor managers, 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. The DOE Safeguards and Security Program 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 level 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)—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 for protection of 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 not subject to NRC licensing authority.

DOE Order 5480.4, *Environmental, Safety, and Health Protection Standards* (May 15, 1984; Change 4, January 7, 1993)—This Order requires that DOE and its contractors who are subject to this Order to comply with the Occupational Safety and Health Administration Occupational Safety and Health Standards at 29 CFR 1910. This Order also specifies a number of American National Standards Institute standards applicable to radiation protection that DOE and its contractors must meet.

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 that DOE establish response plans, maintain resources, and provide assistance to 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 5632.1C, *Protection and Control of Safeguards and Security Interests* (July 15, 1994)—This Order establishes policy, responsibilities, and authorities for the protection and control of safeguards and security interests (for example, special nuclear material, vital equipment, classified matter, property, facilities, and unclassified irradiated reactor fuel in transit).

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 and agreements or Orders are provided in **Table 6–4**.

Since the last SWEIS was published, the New Mexico Environmental Department has entered into a Compliance Order on Consent (Consent Order) with DOE and 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 side-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 6-5 lists the State permits that have been issued to LANL.

6.5 Consultations

Certain laws, such as the Endangered Species Act, the U.S. Fish and Wildlife Coordination Act, and the National Historic Preservation Act, require consultation and coordination by DOE with other governmental entities including other Federal agencies, State and local agencies, and Federally-recognized American Indian Governments. In addition, the DOE American Indian and Alaska Native Government Policy requires DOE to consult with any American Indian or Alaska Native Tribal Government with regard to any property to which the Tribe attaches religious or cultural importance that might be affected by a DOE action. Most of these consultations are related to biotic resources, cultural resources, and American Indian rights.

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 December 3, 2001)	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, and 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.
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.

Activity	*Citation*	*Requirements*
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 January 15, 2001)	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 New Mexico Environment Department, 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 1992 Cooperative Agreements with each of four Pueblos (Pueblos of Cochiti, Jemez, Santa Clara, and San Ildefonso)	Sets 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, "Endangered and Threatened Species," 19.33.6.8 (Revised November 30, 2004)	Establishes the list of threatened and endangered species.

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	April 30, 2004	April 29, 2009
Portable Rock Crusher	Construction Permit Number 2195	June 16, 1999	None
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-R3	July 1, 1994 (Revised March 11, 2000)	None
Operational Burning at TA-16	Open Burning TA-16-OB-2003	December 27, 2002	December 31, 2007

Category/Approved Activity	***Permit***	***Date Issued***	***Expiration Date***
Operational Burning at TA-11	Open Burning TA-11-OB-2003	December 27, 2002	December 31, 2007
Operational Burning at TA-14	Open Burning TA-14-OB-2003	December 27, 2002	December 31, 2007
Operational Burning at TA-36	Open Burning TA-36-OB-2003	December 27, 2002	December 31, 2007
Flue Gas Recirculation Installation at the Power Plant	Construction Permit Number 2195-B-R1	September 27, 2000	None
TA-33 Generator	Construction Permit Number 2195-F	October 10, 2002	None
Asphalt Plant	Construction Permit GCP-3-2195G	October 29, 2002	None
Data Disintegrator	Construction Permit Number 2195-H	October 22, 2003	None
Open Burning TA-16 (Flash Pad) and TA-11 (Wood and Fuel Fire Test Sites) (Note: Treatment of non-detonable high explosives-contaminated scrap metal [TA-16-388]/Wood and Fuel Burning [TA-11]) (LANL 2006)	Permit Number 2195J	March 29, 2005	None
Sled Track Dynamic Experimentation (TA-36)	Permit Number 2195K	March 29, 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 2004f.

Biotic resource consultations generally pertain to the potential for activities to disturb sensitive species or habitats. Cultural resource consultations relate to the potential for disruption of important cultural resources and archaeological sites. American Indian consultations are concerned with the potential for impacts on any rights and interests, including disturbance of ancestral American Indian sites, and sacred sites, traditional and religious practices of American Indians, and natural resources of importance to American Indians.

DOE consults with the appropriate State Historic Preservation Officers, as required by NEPA and Section 106 of the National Historic Preservation Act; the U.S. Fish and Wildlife Services, as required by the Endangered Species Act of 1973, the Bald and Golden Eagle Protection Act, and the Migratory Bird Treaty Act; and the appropriate State regulators, as required by State of New Mexico laws or regulations. Consultations in support of this SWEIS are in progress.

The Government is committed to meeting its responsibilities in government-to-government relationships between Federally-recognized American Indian Tribes and DOE. **Table 6–6** lists Executive Memoranda and DOE direction regarding government-to-government relations with American Indian Tribal Governments. DOE undertook an extensive effort to consult with American Indian Tribal Governments during the 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 American Indian Tribal Governments, as required by Executive Memoranda and DOE Order 1230.2, *American Indian Tribal Government Policy* (see Section 6.3) to complement that earlier effort.

Table 6–6 Government-to-Government Relationships with Tribal Governments

Date	***Title***
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 American Indian Tribal Governments (References American Indian and Alaska Native Tribal Government Policy)
April 29, 1994	Memorandum for the Heads of Executive Departments and Agencies, Government-to-Government Relations with Native American Tribal Governments

CHAPTER 7
REFERENCES

7. REFERENCES

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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 (alluvial)—Unconsolidated, poorly sorted detrital sediments, ranging from clay-to-gravel sizes, deposited by streams.

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.)

Alluvium—Sediment deposited by flowing water, as in a riverbed, flood plain, or delta.

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.

ambient air—The surrounding atmosphere as it exists around people, plants, and structures.

ambient—Surrounding.

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.

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 amended 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. For this *Consolidation EIS*, 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 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.

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, and which is designed to meet the containment requirements of 10 CFR 60.

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 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 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 standards—Legally enforceable limits on the quantities and/or kinds of air contaminants that can be emitted into the atmosphere.

emission—A material discharged into the atmosphere from a source operation or activity.

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 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 1500-1508 and DOE NEPA regulations in 10 CFR 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 isotopeAlthough 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—a summation of the hazard quotients for all chemicals now being used at a site, and those proposed to be added, to yield cumulative levels for a site. a hazard index value of 1.0 or less means that no adverse human health effects (noncancer) are expected to occur.

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 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.

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.

high-efficiency particulate air 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 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).

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).

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—Formerly known as Idaho National Engineering and Environmental Laboratory, 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 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).

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—An atom that has too many or too few electrons, causing it to be electrically charged.

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.

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 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 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 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—An element, mostly manmade, 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 flux—The product of neutron number density and velocity (energy), giving an apparent number of neutrons flowing through a unit area per unit time.

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.

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.)

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—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.

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 Section 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 Section 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 and/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—A power source that converts the heat from the radioactive decay of plutonium (in a ceramic form of plutonium dioxide consisting mostly of plutonium-238, a non-weapons grade isotope) into usable electrical energy.An electrical generator that derives its electric power from heat produced by the decay of radioactive plutonium-238 dioxide or other suitable isotopes. This energy conversion is accomplished viae heat generated is directly converted into electricity, in a passive process, by an array of thermocouples to power electricalspacecraft components.

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 is 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, 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 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.

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.

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 contractor facilities, property, and equipment.

sediment—Soil, sand, and minerals washed from land into water that deposit on the bottom of a water body.

seismicity—The frequency and distribution of earthquakes.

seismic—Pertaining to any Earth vibration, especially an earthquake.

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 "beyond-design-basis reactor accidents" in this *Consolidation EIS*.

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).

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—any discernible unit at which solid waste has been placed at any time, and from which the Department of Energy 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 at which solid wastes have been routinely and systematically released; they do not include one-time spills.

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 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 that is not classified as high-level radioactive waste and that contains more than 100 nanocuries (3700 becquerels) per gram of alpha-emitting transuranic isotopes with half-lives greater than 20 years.

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

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, LOS ALAMOS SITE OFFICE)
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-three 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-five years. Radioactive waste management, regulatory, and environmental compliance and assessment, radiological assessment.

STEPHEN R. ALCORN, ALCORN ENVIRONMENTAL ASSOCIATES
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-six 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:
Fifteen 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:
Fourteen 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-seven 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: PhD., Geology, Texas A&M University
M.S., Geology, Texas A&M University
B.S. Geology, University of Delaware

Experience/Technical Specialty:
Sixteen 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-three 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 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:
Twenty-nine 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-two 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-five 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:
Three 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 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:
Sixteen years. Public affairs, public involvement, and risk communication.
Fourteen years. Emergency management.

DEBBIE J. FINFROCK, FINFROCK ENGINEERING
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-three 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:
Sixteen 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:
Fifteen 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:
Fifteen 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:
Nineteen years. Applied health physics, occupational and environmental radiological hazards assessment and dose modeling, regulatory compliance, emergency management.

CHADI D. GROOME, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: CHAPTER 3 MANAGER

Education: M.S., Environmental Engineering Sciences, University of Florida
B.S., Zoology, Clemson University

Experience/Technical Specialty:
Twenty-five 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-four 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:
Nineteen years. NEPA compliance, regulatory review, land use planning.

JOHN ISAACSON, LOS ALAMOS NATIONAL LABORATORY
EIS RESPONSIBILITIES: LANL EIS PROJECT LEADER

Education: Ph.D., Anthropology/Archaeology, University of Illinois
B.A., Anthropology, San Francisco State University

Experience/Technical Specialty:
Twenty years. Federal heritage resources management, environmental management.

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-five 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-one 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

Experience/Technical Specialty:
Eight 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-eight 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:
Five 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:
Thirteen 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-one 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-three 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:
Twelve 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:
Twenty-nine 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:
Seventeen 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:
Five 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-six 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:
Fifteen years. Public information, Tribal relations, technical writing and editing.

MARGARET POWERS, LOS ALAMOS NATIONAL LABORATORY
EIS RESPONSIBILITIES: PROJECT-SPECIFIC ANALYSES

Education: M.A., Anthropology, State University of New York
B.A., Anthropology, Cornell University

Experience/Technical Specialty:
Thirty-five years. NEPA, cultural resources management.

SUSAN D. RADZINSKI, LOS ALAMOS NATIONAL LABORATORY
EIS RESPONSIBILITIES: LANL EIS PROJECT LIAISON; PROJECT-SPECIFIC ANALYSES

Education: B.A., Chemistry, Emmanuel College

Experience/Technical Specialty:
Twenty years. Electrochemistry, analytical chemistry, radiochemistry.
Five years. NEPA compliance.

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:
Eighteen 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 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:
Eight 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-seven 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-two 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-five 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-two 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:
One year. 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-two years. Regulatory analysis and compliance, waste management, NEPA compliance.

ELLEN TAYLOR, PACIFIC WESTERN TECHNOLOGIES, LTD.
EIS RESPONSIBILITIES: PROJECT-SPECIFIC ANALYSES

Education: Ph.D., Biology, University of Pennsylvania
B.A., Zoology, University of Vermont

Experience/Technical Specialty:
Twenty-three 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-four years. Contaminant transport through air, groundwater, and surface water, accident risk analysis.

DONNA VIGIL, U.S. DEPARTMENT OF ENERGY, NATIONAL NUCLEAR SECURITY ADMINISTRATION (COMMUNITY AFFAIRS SPECIALIST, LOS ALAMOS SITE OFFICE)
EIS RESPONSIBILITIES: PUBLIC PARTICIPATION PROCESS

Education: Undergraduate Studies, University of New Mexico

Experience/Technical Specialty:
Seven years. Public affairs, public involvement, Tribal liaison.

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-five 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:
Twenty-nine 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:
Eight 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 *Draft 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 and public interest groups; and other organizations and individuals listed in this chapter. Approximately 300 copies of the Draft SWEIS and 200 copies of the Summary of the Draft SWEIS were sent to interested parties. Copies will be provided to others upon 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

Judy Biggert, Committee on Science, Subcommittee on Energy
Joe Barton, Committee on Energy and Commerce
Rick Boucher, Committee on Energy and Commerce, Subcommittee on Energy and Air Quality
Michael Bilirakis, Committee on Energy and Commerce
Sherwood L. Boehlert, Committee on Science
John D. Dingell, Committee on Energy and Commerce
Vernon J. Ehlers, Committee on Science, Subcommittee on Environment, Technology and Standards
Paul E. Gillmor, Committee on Energy and Commerce, Subcommittee on Environment and Hazardous Materials
Bart Gordon, Committee on Science
Ralph M. Hall, Committee on Energy and Commerce, Subcommittee on Energy and Air Quality
David L. Hobson, Committee on Appropriations, Subcommittee on Energy and Water Development, and Related Agencies
Michael M. Honda, Committee on Science, Subcommittee on Energy
Jerry Lewis, Committee on Appropriations
David Obey, Committee on Appropriations
Hilda Solis, Committee on Energy and Commerce, Subcommittee on Environment and Hazardous Materials
Peter J. Visclosky, Committee on Appropriations, Subcommittee on Energy and Water Development, and Related Agencies
David Wu, Committee on Science, Subcommittee on Environment, Technology and Standards

U.S. Senate

Jeff Bingaman, D-New Mexico
Pete V. Domenici, R-New Mexico
John Ensign, R-Nevada
Harry Reid, D-Nevada

U.S. Senate Committees

Lamar Alexander, Committee on Energy and Natural Resources, Subcommittee on Energy
Max Baucus, Committee on Environment and Public Works, Subcommittee on Transportation and Infrastructure
Jeff Bingaman, Committee on Energy and Natural Resources
Christopher S. Bond, Committee on Environment and Public Works, Subcommittee on Transportation and Infrastructure
Robert C. Byrd, Committee on Appropriations
Thomas R. Carper, Committee on Environment and Public Works, Subcommittee on Clean Air, Climate Change, and Nuclear Safety
Thad Cochran, Committee on Appropriations
Lincoln Chafee, Committee on Environment and Public Works, Subcommittee on Fisheries, Wildlife, and Water
Hillary Rodham Clinton, Committee on Environment and Public Works, Subcommittee on Fisheries, Wildlife, and Water
Pete V. Domenici, Committee on Energy and Natural Resources
Pete V. Domenici, Committee on Appropriations, Subcommittee on Energy and Water, and Related Agencies
Bryon L. Dorgan, Committee on Energy and Natural Resources, Subcommittee on Energy
Kay Bailey Hutchinson, Committee on Commerce, Science and Transportation, Subcommittee on Science and Space
James M. Inhofe, Committee on Environment and Public Works
Daniel K. Inouye, Committee on Commerce, Science and Transportation
James M. Jeffords, Committee on Environment and Public Works
Tim Johnson, Committee on Energy and Natural Resources, Subcommittee on Water and Power
Barbara Mikulski, Committee on Appropriations, Subcommittee on Commerce, Justice, Science, And Related Agencies
Lisa Murkowski, Committee on Energy and Natural Resources, Subcommittee on Water and Power
Bill Nelson, Committee on Commerce, Science and Transportation, Subcommittee on Science and Space
Harry Reid, Committee on Appropriations, Subcommittee on Energy and Water, and Related Agencies
Richard Shelby, Committee on Appropriations, Subcommittee on Commerce, Justice, Science, And Related Agencies
Ted Stevens, Committee on Commerce, Science and Transportation
George V. Voinovich, Committee on Environment and Public Works, Subcommittee on Clean Air, Climate Change, and Nuclear Safety

Federal Agencies

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 Chavez, Albuquerque
Richard Lucero, Española
Larry Delgado, Santa Fe

County Officials Max Baker, Los Alamos County Administrator
Anthony Mortillaro, Los Alamos County Assistant Administrator
Rick Bohn, Director, Los Alamos County, Community Development
Lorenzo Valdez, Rio Arriba County Manager

NEPA State Point of Contact

Ron Curry, New Mexico

State Government

New Mexico Governor
Bill Richardson

New Mexico Senators
Richard C. Martinez
John Pinto
James G. Taylor
Leonard Tsosie

New Mexico Representatives
Ted Hobbs
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
Gedi Cibas
Ron Curry
William Moats
John Parker
John Volkerding
Steve Yanicak

Citizen Advisory Boards

J. D. Campbell, Northern New Mexico Citizens' Advisory Board
Menice Santistevan, Northern New Mexico Citizens' Advisory Board
Ted Taylor, Northern New Mexico Citizens' Advisory Board

Native American Representatives

New Mexico

Amadeo Shije, Chairman, All Indian Pueblos Council
Gilbert Vigil, Vice Chairman, All Indian Pueblos Council
Roger Madalena, Executive Director, Five Sandoval Indian Pueblos
Terry Aguilar, Executive Director, Eight Northern Indian Pueblos Council
Levi Pesata, President, Jicarilla Apache Nation
Tyron Vicenti, Vice President, Jicarilla Apache Nation
Mark Chino, President, Mescalero Apache Tribe
Thora Padilla, Tribal Historic Preservation Officer, Mescalero Apache Tribe
Ferris Palmer, Sr., Vice President, Mescalero Apache Tribe
David Conrad, National Tribal Environmental Council
Jerry Pardilla, National Tribal Environmental Council
Frank Dayish, Jr., 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
B. Gregory Hista, 1st Lieutenant Governor, Pueblo of Acoma
Jason Johnson, Governor, Pueblo of Acoma
Randall Vincente, 2nd Lieutenant Governor, Pueblo of Acoma
J. Leroy Arquero, Lieutenant Governor, Pueblo of Cochiti
Cippy Crazyhorse, Governor, Pueblo of Cochiti
Robert Benevidez, Governor, Pueblo of Isleta
Michael Jojola, 2nd Lieutenant Governor, Pueblo of Isleta
Max Zuni, 1st Lieutenant Governor, Pueblo of Isleta
Michael Loretto, 1st Lieutenant Governor, Pueblo of Jemez
Roger Madalena, Governor, Pueblo of Jemez
Joseph Alfred Toya, 2nd Lieutenant Governor, Pueblo of Jemez
Roland Johnson, Governor, Pueblo of Laguna
Charles Poncho, 2nd Lieutenant Governor, Pueblo of Laguna
Virgil Siow, 1st Lieutenant Governor, Pueblo of Laguna
Phillip Perez, 1st Lieutenant Governor, Pueblo of Nambe
Dennis Vigil, Governor, Pueblo of Nambe
Manual Archuleta, Lieutenant Governor, Pueblo of Picuris
Richard Mermejo, Governor, Pueblo of Picuris
Linda Diaz, 1st Lieutenant Governor, Pueblo of Pojoaque
George Rivera, Governor, Pueblo of Pojoaque
Lawrence R. Gutierrez, Governor, Pueblo of Sandia
Scott Paisano, 1st Lieutenant Governor, Pueblo of Sandia
Martin Wayne Aguilar, 1st Lieutenant Governor, Pueblo of San Ildefonso
Erik Fender, 2nd Lieutenant Governor, Pueblo of San Ildefonso
James Mountain, Governor, Pueblo of San Ildefonso
Neil Weber, Director, Environmental and Cultural Preservation, Pueblo of San Ildefonso
Peter Cata, 1st Lieutenant Governor, Ohkay Owingeh
Joseph Garcia, Governor, Ohkay Owingeh
Sam Candelaria, Governor, Pueblo of San Felipe
Earl Patrick Sandoval, Lieutenant Governor, Pueblo of San Felipe
Leonard Armijo, Governor, Pueblo of Santa Ana
Bruce Sanchez, Lieutenant Governor, Pueblo of Santa Ana
Michael Chavarria, Governor, Pueblo of Santa Clara

Alvin Warren, 1st Lieutenant Governor, Pueblo of Santa Clara
Julian Coriz, Governor, Pueblo Santo Domingo
Sammy Garcia, Lieutenant Governor, Pueblo Santo Domingo
James Lujan, Sr., Governor, Pueblo of Taos
Clyde M. Romero, Sr., 1st Lieutenant Governor, Pueblo of Taos
Anthony Dorame, 1st Lieutenant Governor, Pueblo of Tesuque
Gil Vigil, Governor, Pueblo of Tesuque
David Pino, 1st Lieutenant Governor, Pueblo of Zia
Rudy Shije, Governor, Pueblo of Zia
Arlen P. Quetawki, Sr., Governor, Pueblo of Zuni
Carmelita Sanchez, 1st Lieutenant Governor, Pueblo of Zuni

Public Interest Groups

Dorelen Bunting, Albuquerque Center for Peace and Justice
Jim Bridgman, Alliance for Nuclear Accountability
Susan Gordon, Alliance for Nuclear Accountability
Laura Harris, Americans for Indian Opportunity
Sue Dayton, Citizens, Action for New Mexico
Janet Greenwald, Citizens for Alternatives to Radioactive Dumping
Joni Arends, Concerned Citizens for Nuclear Safety
Sheri Kotowski, Embudo Valley Environmental Monitoring Group
Tom Carpenter, Government Accountability Project
Tom Clements, Greenpeace International
Lois Chalmers, Institute for Energy and Environmental Research
Arjun Makhijani, Institute for Energy and Environmental Research
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
Doug Melklejohn, New Mexico Environmental Law Center
Paul Leventhal, Nuclear Control Institute
Jay Coghlan, Nuclear Watch of New Mexico
Colin King, Nuclear Watch of New Mexico
Scott Kovac, Nuclear Watch of New Mexico
Geoff Petrie, Nuclear Watch of New Mexico
Peggy Prince, Peace Action New Mexico
Virginia Miller, People for Peace
Robert Musil, Physicians for Social Responsibility
Juan Montes, Rural Alliance for Military Accountability
Alice Roos, Sanctuary Foundation
Penelope McMullen, Sisters of Loretto
Michael Guerrero, Southwest Organizing Project
William Paul Robinson, Southwest Research and Information Center
Don Hancock, Southwest Research and Information Center
Kathy Sanchez, TEWA Women United
Jay Gilbert Sanchez, Tribal Environmental Watch Alliance
Alden Meyer, Union of Concerned Scientists

Public Reading Rooms and Libraries

A complete copy of the Draft SWEIS 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) 586-3142

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) 662-8250

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
314-A Oñate NW
Española, NM 87532
(505) 747-6087

Government Information Department
Zimmerman Library
University of New Mexico
Albuquerque, NM 87131-1466
(505) 277-5441

Individuals

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Rick Alexander
Navroze D. Amaria
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Shama Beach
Julie Bechko
Michael Bechko
Kathryn S. Becker
Leslie Behn
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Shirley A. Belz
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Mark Bentley
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Keri Boynt
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Mark W. Bundy
Amy Bunting
Janet Burstein
Cleo C. Byers
Clark Case
Phil Clark
Sarah Cobb
Karen Cohen
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Barbara Ford
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Lisa Fox
Bernard Foy
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Graciela Garcia
Jade Garcia
Myra Garcia
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Linda Hobbs
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Sue Holmes
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Norma Jetté
Marge Johnson
Terry Johnson
Myron M. Kaczmarsky
Greg Kaufman
Kate Keely
C.F. Keller
Diane Kenny
Joy Kincaid
Kim A. Kirkpatrick
Andrew Koehler
Sheri Kotowski

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Leslie LaKind
Shaphan Laos
Jack Larson
Rick Lass
Lisa Law
Patricia A. Leahan
Andy Lilley
Susannah H. Lippman
Ashana Lobody
Ross Lockridge & Ann Murray
Lorrie Bonds Lopez
Jane Lumsden
Sue Shen Lyons
Sue Malec
Jon R. Marin
Tor Matson
Dominique Mazeaud
Chris Mechels
M. Rachel McCarthy
Doug McClellen
Anne McConnell
Beverly A. McCrary
Rita McElmury
Amy McFall
Sarah Meyer
Lesley A. Michaels
Celeste Miller
Larry Miller
Ian Mion
W. David Moss
Ignacio Montano
Carlos Mora
Luis Morales
Amanda Murchison
Frank E. Murchison
Ann Murray
Linda Naranjo-Huebl
Margaret Nes
David Nesbit
Renze Nesbit
Shel Neymark
Jean Nichols
Francesca Oldeni-Neff
James Oliver
Cheryl Olson
Mark Oswald
Dennis Overman
Eileen Overman
Michael T. Pacheco
Claudia Parker
Kathleen Parker

Ruth Parrish
Robert E. Pearson
Chuck Pergler
Giselle Piburn
Dave Pierce
Steve Piersol
Jean Porteus
Donivan Porterfield
Peter Prandoni
Giuseppe Quinn
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Adam Read
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Joe Ritchey
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Veronica Rodriquez
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Wendy Singer
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Patrick L. Travers
Robin Urton
Sue Vorenburg
Jason P. Walsh
Sally J. Warnick
Deanna M. Watson
Mark L. Watson
Kimberly Webber
Michael Wiese
Michel Wiggs-West
Amy Williams
Holly Ann Williams
Dean Williamson
Natasha Williamson
Ray Wood
Keith R. Wuertz
Cecile J. Zeigler
Nina Zelenunsky
Tiffin Zellers
Alice Zorthian