THE LOS ALAMOS NATIONAL LABORATORY SITE-WIDE ENVIRONMENTAL IMPACT STATEMENT PROCESS

The United States Department of Energy (DOE) has a policy (10 Code of Federal Regulations [CFR] 1021.330) of preparing a Site-Wide Environmental Impact Statement (SWEIS) for certain large, multiple-facility sites, such as the Los Alamos National Laboratory (LANL). The purpose of a SWEIS is to provide DOE and its stakeholders with an analysis of the environmental impacts resulting from ongoing and reasonably foreseeable new operations and facilities and reasonable alternatives at the DOE site. The SWEIS analyzes four alternatives for the continued operation of LANL to identify the potential effects that each alternative could have on the human environment.

The SWEIS Advance Notice of Intent, published in the *Federal Register* (FR) on August 10, 1994 (59 FR 40889), identified possible issues and alternatives to be analyzed. Based on public input received during prescoping, DOE published the Notice of Intent to prepare the SWEIS in the *Federal Register* on May 12, 1995 (60 FR 25697). DOE held a series of public meetings during prescoping and scoping to provide opportunities for stakeholders to identify the issues, environmental concerns, and alternatives that should be analyzed in the SWEIS. An Implementation Plan[1] was published in November 1995 to summarize the results of scoping, describe the scope of the SWEIS based on the scoping process, and present an outline for the draft SWEIS. The Implementation Plan also included a discussion of the issues reflected in public comments during scoping.

In addition to the required meetings and documents described above, the SWEIS process has included a number of other activities intended to enhance public participation in this effort. These activities have included:

- Workshops to develop the Greener Alternative described and analyzed in the SWEIS.
- Meetings with and briefings to representatives of federal, state, tribal, and local governments during prescoping, scoping, and preparation of the draft SWEIS.
- Preparation and submission to the Los Alamos Community Outreach Center of information requested by members of the public related to LANL operations and proposed projects.
- Numerous Open Forum public meetings in the communities around LANL to discuss LANL activities, the status of the SWEIS, and other issues raised by the public.

The draft SWEIS was distributed to interested stakeholders for comment. The comment period extended from May 15, 1998, to July 15, 1998. Public hearings on the draft SWEIS were announced in the *Federal Register*, as well as community newspapers and radio broadcasts. Public hearings were held in Los Alamos, Santa Fe, and Española, New Mexico, on June 9, 1998, June 10, 1998, and June 24, 1998, respectively.

Oral and written comments were accepted during the 60-day comment period for the draft SWEIS. All comments received, whether orally or in writing, were considered in preparation of the final SWEIS. The final SWEIS includes a new volume IV with responses to individual comments and a discussion of general major issues. DOE will prepare a Record of Decision no sooner than 30 days after the final SWEIS Notice of Availability is published in the *Federal Register*. The Record of Decision will describe the rationale used for DOE's selection of an alternative or portions of the alternatives. Following the issuance of the Record of Decision, a Mitigation Action Plan may also be issued to describe any mitigation measures that DOE commits to in concert with its decision.

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1. DOE *National Environmental Policy Act* regulations (10 CFR 1021) previously required that an implementation plan be prepared; a regulation change (61 FR 64604) deleted this requirement. An implementation plan was prepared for this SWEIS.

COVER SHEET

Responsible Agency: U.S. Department of Energy (DOE)

Cooperating Agency: Incorporated County of Los Alamos

Title: Site-Wide Environmental Impact Statement for the Continued Operation of the Los Alamos National Laboratory, Los Alamos, New Mexico (DOE/EIS-0238)

Contact: For further information concerning this Site-Wide Environmental Impact Statement (SWEIS), contact:

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

Carol Borgstrom, Director
Office of NEPA Policy and Assistance (EH–42)
U.S. DOE, 1000 Independence Avenue, SW, Washington, DC 20585
Telephone: 202–586–4600 or leave a message at 1–800–472–2756

Abstract: DOE proposes to continue operating the Los Alamos National Laboratory (LANL) located in Los Alamos County, in north-central New Mexico. DOE has identified and assessed four alternatives for the operation of LANL: (1) No Action, (2) Expanded Operations, (3) Reduced Operations, and (4) Greener. Expanded Operations is DOE's Preferred Alternative, with the exception that DOE would only implement pit manufacturing at a level of 20 pits per year. In the No Action Alternative, DOE would continue the historical mission support activities LANL has conducted at planned operational levels. In the Expanded Operations Alternative, DOE would operate LANL at the highest levels of activity currently foreseeable, including full implementation of the mission assignments from recent programmatic documents. Under the Reduced Operations Alternative, DOE would operate LANL at the minimum levels of activity necessary to maintain the capabilities to support the DOE mission in the near term. Under the Greener Alternative, DOE would operate LANL to maximize operations in support of nonproliferation, basic science, materials science, and other nonweapons areas, while minimizing weapons activities. 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. The primary discriminators are: collective worker risk due to radiation exposure, socioeconomic effects due to LANL employment changes, and electrical power demand.

Public Comment and DOE Decision: The draft SWEIS was released to the public for review and comment on May 15, 1998. The comment period extended until July 15, 1998, although late comments were accepted to the extent practicable. All comments received were considered in preparation of the final SWEIS[1]. DOE will utilize the analysis in this final SWEIS and prepare a Record of Decision on the level of continued operation of LANL. This decision will be no sooner than 30 days after the Notice of Availability of the final SWEIS is published in the *Federal Register*.

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1. Changes made to this SWEIS since publication of the draft SWEIS are marked with a vertical bar to the right or left of the text.

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ABBREVIATIONS AND ACRONYMS

BNM	Bandelier National Monument
CAA	*Clean Air Act*
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMIP	Capability Maintenance and Improvement Project
CMR	Chemistry and Metallurgy Research
CT EIS	Conveyance and Transfer of Certain Land Tracts at Los Alamos National Laboratory Environmental Impact Statement
D&D	decontamination and decommissioning
DARHT	Dual Axis Radiographic Hydrodynamic Test (Facility)
DOE	U.S. Department of Energy
EIS	environmental impact statement
ERPG	Emergency Response Planning Guideline
FR	*Federal Register*
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
LCF	latent cancer fatality
LEDA	Low-Energy Demonstration Accelerator
LLMW	low-level mixed waste
LLW	low-level radioactive waste
MEI	maximally exposed individual
MeV	million electron volts
MSL	Materials Science Laboratory

MW	megawatt
NA	not applicable
NEPA	*National Environmental Policy Act of 1969*, as amended
NMSF	Nuclear Materials Storage Facility
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
PEIS	programmatic environmental impact statement
PHERMEX	Pulsed High-Energy Radiation Machine Emitting X-Rays
PL	public law
PSSC	project-specific siting and construction
RCRA	*Resource Conservation and Recovery Act*
rem	roentgen equivalent man
ROD	Record of Decision
SCC	Strategic Computing Complex
SHPO	State Historic Preservation Office(r)
SNM	special nuclear material
SSM	Stockpile Stewardship and Management
SWEIS	site-wide environmental impact statement
TA	Technical Area
TCP	traditional cultural property
TRU	transuranic (waste)
TSFF	Tritium Science and Fabrication Facility
TSTA	Tritium Systems Test Assembly
UC	University of California
U.S.	United States

U.S.C.	United States Code
WETF	Weapons Engineering Tritium Facility
WM	waste management

SUMMARY
MEASUREMENTS AND CONVERSIONS

The following information is provided to assist the reader in understanding certain concepts in this SWEIS. Definitions of technical terms can be found in volume I, chapter 10, Glossary.

SCIENTIFIC NOTATION

Scientific notation is used in this report to express very large or very small numbers. For example, the number 1 billion could be written as 1,000,000,000 or, using scientific notation, as 1×10^9. Translating from scientific notation to a more traditional number requires moving the decimal point either right (for a positive power of 10) or left (for a negative power of 10). If the value given is 2.0×10^3, move the decimal point three places (insert zeros if no numbers are given) to the right of its current location. The result would be 2,000. If the value given is 2.0×10^{-5}, move the decimal point five places to the left of its present location. The result would be 0.00002. An alternative way of expressing numbers, used primarily in the appendixes of this SWEIS, is exponential notation, which is very similar in use to scientific notation. For example, using the scientific notation for 1×10^9, in exponential notation the 10^9 (10 to the power of 9) would be replaced by E+09. (For positive powers, sometimes the "+" sign is omitted, and so the example here could be expressed as E09.) If the value is given as 2.0×10^{-5} in scientific notation, then the equivalent exponential notation is 2.0E-05.

UNITS OF MEASUREMENT

The primary units of measurement used in this report are English units with metric equivalents enclosed in parentheses.

Many metric measurements presented include prefixes that denote a multiplication factor that is applied to the base standard (e.g., 1 kilometer = 1,000 meters). The following list presents these metric prefixes:

giga	1,000,000,000 (10^9; E+09; one billion)
mega	1,000,000 (10^6; E+06; one million)
kilo	1,000 (10^3; E+03; one thousand)
hecto	100 (10^2; E+02; one hundred)
deka	10 (10^1; E+01; ten)
unit	1 (10^0; E+00; one)
deci	0.1 (10^{-1}; E-01; one tenth)
centi	0.01 (10^{-2}; E-02; one hundredth)
milli	0.001 (10^{-3}; E-03; one thousandth)

micro 0.000001 (10^{-6}; E-06; one millionth)

nano 0.000000001 (10^{-9}; E-09; one billionth)

pico 0.000000000001 (10^{-12}; E-12; one trillionth)

DOE Order 5900.2A, *Use of the Metric System of Measurement*, prescribes the use of this system in DOE documents. Table MC–1 lists the mathematical values or formulas needed for conversion between English and metric units. Table MC–2 summarizes and defines the terms for units of measure and corresponding symbols found throughout this report.

RADIOACTIVITY UNIT

Part of this report deals with levels of radioactivity that might be found in various environmental media. Radioactivity is a property; the amount of a radioactive material is usually expressed as "activity" in curies (Ci) (Table MC–3). The curie is the basic unit used to describe the amount of substance present, and concentrations are generally expressed in terms of curies per unit of mass or volume. One curie is equivalent to 37 billion disintegrations per second or is a quantity of any radionuclide that decays at the rate of 37 billion disintegrations per second. Disintegrations generally include emissions of alpha or beta particles, gamma radiation, or combinations of these.

RADIATION DOSE UNITS

The amount of ionizing radiation energy received by a living organism is expressed in terms of radiation dose. Radiation dose in this report is usually expressed in terms of effective dose equivalent and reported numerically in units of rem (Table MC–4). Rem is a term that relates ionizing radiation and biological effect or risk. A dose of 1 millirem (0.001 rem) has a biological effect similar to the dose received from about a 1-day exposure to natural background radiation. A list of the radionuclides discussed in this document and their half-lives is included in Table MC–5.

CHEMICAL ELEMENTS

A list of selected chemical elements, chemical constituents, and their nomenclature is presented in Table MC–6.

TABLE MC–1.—*Conversion Table*

MULTIPLY	BY	TO OBTAIN	MULTIPLY	BY	TO OBTAIN
ac	0.405	ha	ha	2.47	ac
°F	(°F -32) x 5/9	°C	°C	(°C x 9/5) + 32	°F
ft	0.305	m	m	3.28	ft
ft^2	0.0929	m^2	m^2	10.76	ft^2
ft^3	0.0283	m^3	m^3	35.3	ft^3
gal.	3.785	l	l	0.264	gal.
in.	2.54	cm	cm	0.394	in.
lb	0.454	kg	kg	2.205	lb
mCi/km^2	1.0	nCi/m^2	nCi/m^2	1.0	mCi/km^2
mi	1.61	km	km	0.621	mi
mi^2	2.59	km^2	km^2	0.386	mi^2
mi/h	0.447	m/s	m/s	2.237	mi/h
nCi	0.001	pCi	pCi	1,000	nCi
oz	28.35	g	g	0.0353	oz
pCi/l	10^{-9}	µCi/ml	µCi/ml	10^9	pCi/l
pCi/m^3	10^{-12}	Ci/m^3	Ci/m^3	10^{12}	pCi/m^3
pCi/m^3	10^{-15}	mCi/cm^3	mCi/cm^3	10^{15}	pCi/m^3
ppb	0.001	ppm	ppm	1,000	ppb
ton	0.907	metric ton	metric ton	1.102	ton

TABLE MC–2.—*Names and Symbols for Units of Measure*

LENGTH	
SYMBOL	**NAME**
cm	centimeter (1 x 10^{-2} m)
ft	foot
in.	inch
km	kilometer (1 x 10^{3} m)
m	meter
mi	mile
mm	millimeter (1 x 10^{-3} m)
µm	micrometer (1 x 10^{-6} m)
VOLUME	
SYMBOL	**NAME**
cm^3	cubic centimeter
ft^3	cubic foot
gal.	gallon
$in.^3$	cubic inch
l	liter
m^3	cubic meter
ml	milliliter (1 x 10^{-3} l)
ppb	parts per billion
ppm	parts per million
yd^3	cubic yard
RATE	
SYMBOL	**NAME**
Ci/yr	curies per year
cm^3/s	cubic meters per second
ft^3/s	cubic feet per second
ft^3/min	cubic feet per minute
gpm	gallons per minute
kg/yr	kilograms per year
km/h	kilometers per hour
mg/l	milligrams per liter
MGY	million gallons per year
MLY	million liters per year
m^3/yr	cubic meters per year
mi/h or mph	miles per hour
µCi/l	microcuries per liter
pCi/l	picocuries per liter

TABLE MC–2.—*Names and Symbols for Units of Measure*-Continued

NUMERICAL RELATIONSHIPS	
SYMBOL	**MEANING**
<	less than
≤	less than or equal to
>	greater than
≥	greater than or equal to
2σ	two standard deviations
TIME	
SYMBOL	**NAME**
d	day
h	hour
min	minute
nsec	nanosecond
s	second
yr	year
AREA	
SYMBOL	**NAME**
ac	acre (640 per mi^2)
cm^2	square centimeter
ft^2	square foot
ha	hectare (1 x 10^4 m^2)
$in.^2$	square inch
km^2	square kilometer
mi^2	square mile
MASS	
SYMBOL	**NAME**
g	gram
kg	kilogram (1 x 10^3 g)
mg	milligram (1 x 10^{-3} g)
µg	microgram (1 x 10^{-6} g)
ng	nanogram (1 x 10^{-9} g)
lb	pound
ton	metric ton (1 x 10^6 g)
oz	ounce

TABLE MC–2.—*Names and Symbols for Units of Measure*-Continued

TEMPERATURE	
SYMBOL	**NAME**
°C	degrees Celsius
°F	degrees Fahrenheit
°K	degrees Kelvin
SOUND/NOISE	
SYMBOL	**NAME**
dB	decibel
dBA	A-weighted decibel

TABLE MC–3.—*Names and Symbols for Units of Radioactivity*

RADIOACTIVITY	
SYMBOL	**NAME**
Ci	curie
cpm	counts per minute
mCi	millicurie (1 x 10^{-3} Ci)
µCi	microcurie (1 x 10^{-6} Ci)
nCi	nanocurie (1 x 10^{-9} Ci)
pCi	picocurie (1 x 10^{-12} Ci)

TABLE MC–4.—*Names and Symbols for Units of Radiation Dose*

RADIATION DOSE	
SYMBOL	**NAME**
mrad	millirad (1 x 10^{-3} rad)
mrem	millirem (1 x 10^{-3} rem)
R	roentgen
mR	milliroentgen (1 x 10^{-3} R)
µR	microroentgen (1 x 10^{-6} R)

TABLE MC–5.—*Radionuclide Nomenclature*

SYMBOL	RADIONUCLIDE	HALF-LIFE	SYMBOL	RADIONUCLIDE	HALF-LIFE
Am-241	americium-241	432 yr	Pu-241	plutonium-241	14.4 yr
H-3	tritium	12.26 yr	Pu-242	plutonium-242	3.8×10^5 yr
Mo-99	molybdenum-99	66 hr	Pu-244	plutonium-244	8.2×10^7 yr
Pa-234	protactinium-234	6.7 hr	Th-231	thorium-231	25.5 hr
Pa-234m	protactinium-234m	1.17 min	Th-234	thorium-234	24.1 d
Pu-236	plutonium-236	2.9yr	U-234	uranium-234	2.4×10^5 yr
Pu-238	plutonium-238	87.7 yr	U-235	uranium-234	7×10^8 yr
Pu-239	plutonium-239	2.4×10^4 yr	U-238	uranium-238	4.5×10^9 yr
Pu-240	plutonium-240	6.5×10^3 yr			

TABLE MC–6.—*Elemental and Chemical Constituent Nomenclature*

SYMBOL	CONSTITUENT	SYMBOL	CONSTITUENT
Ag	silver	Pa	protactinium
Al	aluminum	Pb	lead
Ar	argon	Pu	plutonium
B	boron	SF_6	sulfur hexafluoride
Be	beryllium	Si	silicon
CO	carbon monoxide	SO_2	sulfur dioxide
CO_2	carbon dioxide	Ta	tantalum
Cu	copper	Th	thorium
F	fluorine	Ti	titanium
Fe	iron	U	uranium
Kr	krypton	V	vanadium
N	nitrogen	W	tungsten
Ni	nickel	Xe	xenon
NO_2^-	nitrite ion	Zn	zinc
NO_3^-	nitrate ion		

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SUMMARY

S.1 INTRODUCTION

S.1.1 Background Information

In accordance with the *Atomic Energy Act of 1954* (42 United States Code [U.S.C.] §2011), as amended, and the *Energy Reorganization Act of 1974* (42 U.S.C. §5801), the U.S. Department of Energy (DOE) has responsibilities that have been grouped into four principal missions: national security, energy resources, environmental quality, and science. DOE's responsibilities under these missions are fulfilled through program offices established to manage related aspects of DOE missions. Specific elements of these DOE missions are assigned to DOE sites across the country, including DOE's system of national laboratories. Each of these sites houses facilities established and maintained to support DOE responsibilities. The capabilities established at these facilities also may be used to support other federal agencies, government groups, utilities, universities, and private industry.

The Los Alamos National Laboratory (LANL) is one of DOE's national laboratories. LANL is a multidisciplinary, multipurpose institution engaged in theoretical and experimental research and development. DOE has assigned elements of each of its four principal missions to LANL, and has established and maintains several capabilities in support of these mission elements; these capabilities also support other federal agencies and other organizations in accordance with national priorities and policies. Because the mission elements assigned to LANL are managed by multiple DOE program offices, LANL is referred to as a "multi-program site."

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 (Figure S.1.1–1). 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 and the State of New Mexico are divided north to south by the Rio Grande. LANL is located on the Pajarito Plateau, a volcanic shelf on the eastern slope of the Jemez Mountains at an approximate elevation of 7,000 feet (2,135 meters). The Pajarito Plateau is cut by 13 steeply sloped and deeply eroded canyons that have formed isolated finger-like mesas running west to east. The Santa Fe National Forest, which includes the Dome Wilderness Area, lies to the north, west, and south of LANL. The American Indian Pueblo of San Ildefonso and the Rio Grande border the site on the east, and the Bandelier National Monument (BNM) and Wilderness Area lie directly south.

A large variety of natural and cultural resources lie within the LANL region. The Pajarito Plateau is one of the longest continually occupied areas in the U.S. The archaeological and historical resources of the LANL site reflect the length of temporal occupation as well as the diversity in the cultures of its occupants. American Indian and Hispanic communities and the ruins of prehistoric cultures surround LANL.

The ecosystems in the region are diverse due to the 5,000-foot (1,525-meter) gradient that extends between the Rio Grande Valley on the eastern edge of LANL and the top of Pajarito Mountain on its western border. Variations in precipitation and temperature and differences in

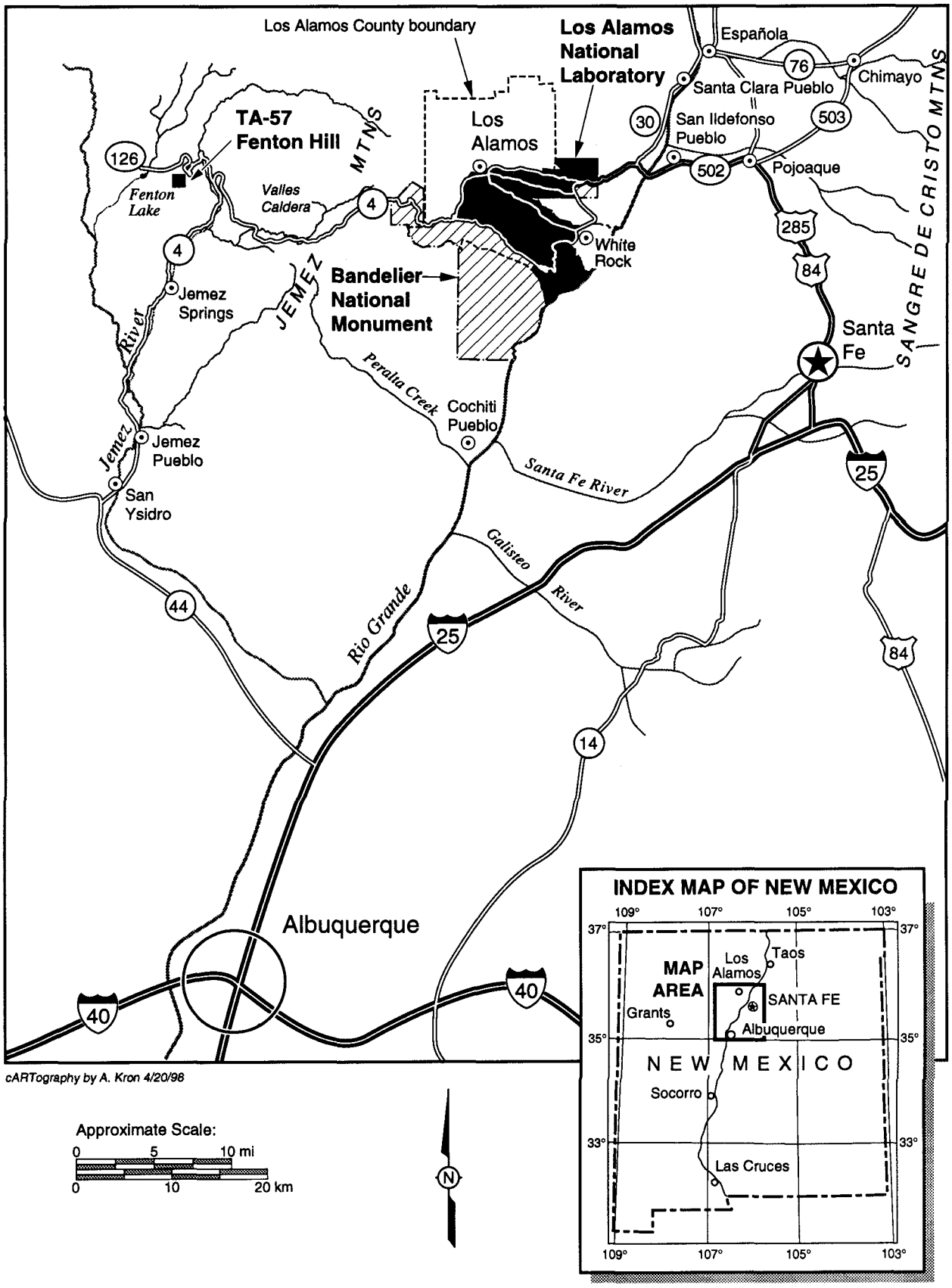


FIGURE S.1.1–1.—***Location of the Los Alamos National Laboratory.***

the amount of sunlight that reach the north-facing and south-facing canyon slopes have resulted in a diversity of plant life, wildlife, and soils.

LANL occupies an area of approximately 27,832 acres (11,272 hectares), or approximately 43 square miles (111 square kilometers), of which 86 percent lies within Los Alamos County and 14 percent within Santa Fe County. The Fenton Hill site (Technical Area [TA]–57), a remote site 20 miles (32 kilometers) west of LANL, occupies 15 acres (6 hectares) in Sandoval County on land leased from the U.S. Forest Service.

DOE performs much of its work through its contractors. The contractor for the operation of LANL is the University of California (UC). The LANL-affiliated workforce includes employees of UC and its subcontractors, of which the major employers are Johnson Controls World Services, Inc., and Protection Technology of Los Alamos. LANL employs both technical and nontechnical subcontractors, as well as consultants on a temporary basis. At the end of March 1996, the LANL-affiliated workforce totaled 12,837.

LANL is divided into 49 separate TAs. These TAs (which are not numbered sequentially) compose the basic geographic configuration of LANL (Figure S.1.1–2 and Table S.1.1–1). LANL has 2,043 structures containing 7.9 million square feet (734,700 square meters), of which 1,835 are buildings, totaling 7.3 million square feet (678,900 square meters). The other structures consist of such items as meteorological towers, pumphouses, water towers, manhole covers, and small storage sheds.

S.1.2 Public Involvement

Under DOE's compliance strategy for the *National Environmental Policy Act of 1969* (NEPA) (42 U.S.C. §4321), a site-wide environmental impact statement (SWEIS) is prepared to examine the environmental impacts of operations at a multi-program site (10 Code of Federal Regulations [CFR] 1021.330). A SWEIS was prepared for the operation of LANL in 1979. That document and subsequent NEPA reviews for specific project or program activities have served as the NEPA basis for operations at LANL since 1979. Changes in the world political situation have the potential to alter the role of and the operations at LANL, as well as change reasonably foreseeable actions that may be taken during the next 10 years (e.g., the assignment of new mission elements to LANL as a result of other programmatic NEPA reviews). Thus, DOE is preparing this SWEIS to replace the 1979 SWEIS, and future NEPA documents at LANL will be tiered from or reference this SWEIS. This SWEIS addresses operation of LANL (from 1997 through 2006) across the approximately 43 square miles (111 square kilometers) of government land under the administrative control of DOE. DOE is the lead agency and Los Alamos County is a cooperating agency (due to the interdependence of county and DOE planning) in the preparation of this SWEIS.

The process for the preparation of this SWEIS was designed to enhance the participation of members of the public. The SWEIS Advance Notice of Intent, published in the *Federal Register* (FR) on August 10, 1994 (59 FR 40889), identified possible issues and alternatives to be analyzed. It was followed by a series of public meetings intended to both provide information on LANL and the plans for the SWEIS and to obtain public input regarding the scope of the SWEIS. Based on the input received during this "prescoping" period, DOE prepared and published the Notice of Intent to prepare the SWEIS on May 12, 1995 (60 FR 25697). This publication was also followed by a series of public meetings to provide opportunities for stakeholders to identify the issues, environmental concerns, and alternatives that should be analyzed in the

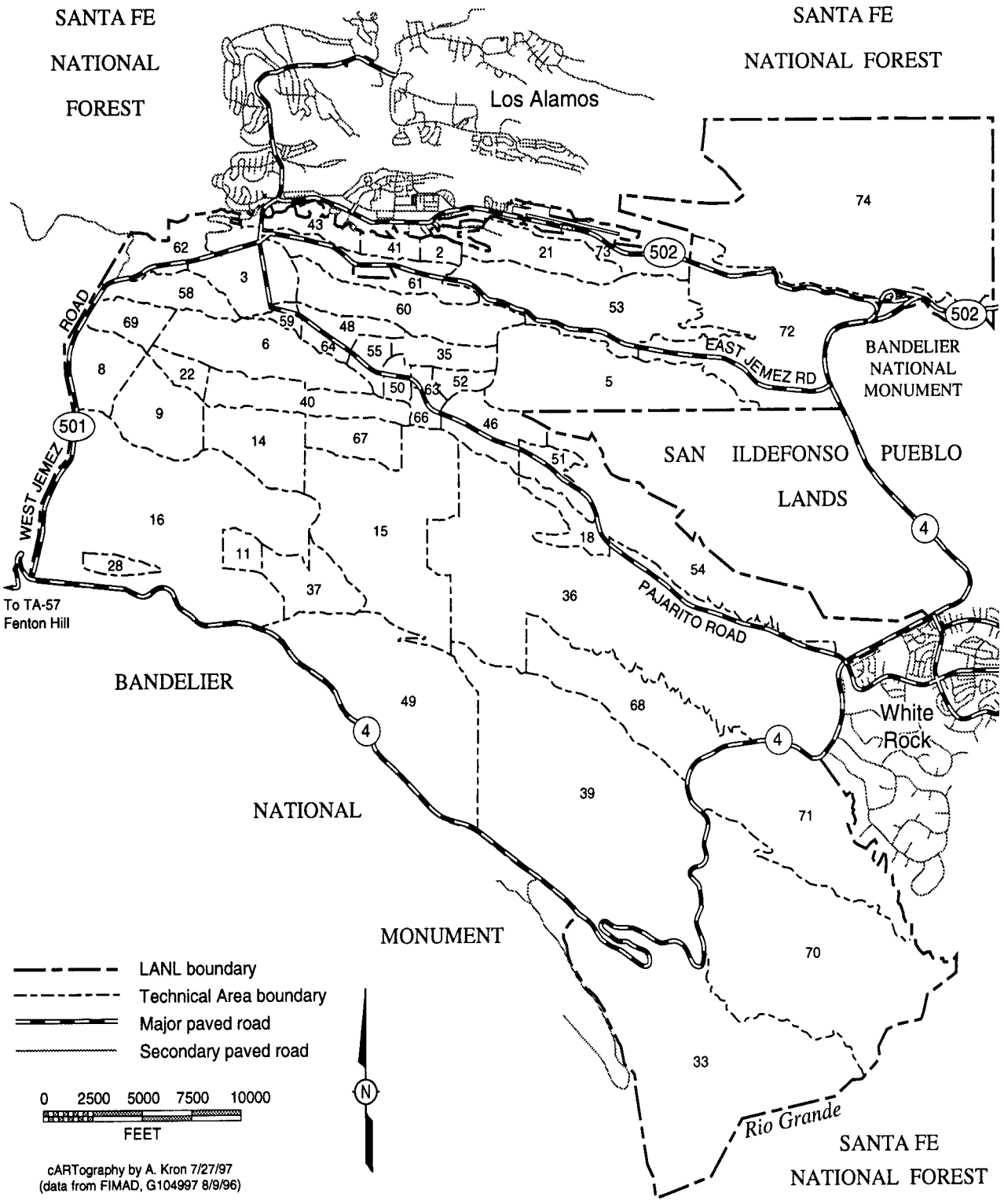


FIGURE S.1.1–2.—*Technical Areas of Los Alamos National Laboratory.*

TABLE S.1.1–1.—*Overview of Technical Areas and Their Associated Activities*

TECHNICAL AREA[a]	ACTIVITIES
TA–0	LANL has about 180,000 square feet (16,722 square meters) of leased space for training, support, architectural engineering design, and unclassified research and development in the Los Alamos townsite and White Rock. The Community Reading Room and the Bradbury Science Museum are also located in the Los Alamos townsite.
TA–2 (Omega Site)	Omega West Reactor, an 8-MW nuclear research reactor, is located here. It was placed in a safe shutdown condition in 1993. It is currently being removed from the nuclear facilities list and will be transferred into the decontamination and decommissioning (D&D) program possibly during 1998. All fuel has been removed from this reactor.
TA–3 (Core Area)	The Administration Complex contains the Director's office, administrative offices, and support facilities. Laboratories for several divisions are in the main TA. TA–3 contains major facilities such as the Chemistry and Metallurgy Research (CMR) Building, the Sigma Complex, the Main Shops, and the Materials Science Laboratory (MSL). Other buildings house central computing facilities, chemistry and materials science laboratories, earth and space science laboratories, physics laboratories, technical shops, cryogenics laboratories, the main cafeteria, and the Study Center. TA–3 contains about 50 percent of LANL's employees and floor space.
TA–5 (Beta Site)	This site contains some physical support facilities such as an electrical substation, test wells, and environmental monitoring and buffer areas.
TA–6 (Two-Mile Mesa Site)	This site is mostly undeveloped and contains gas cylinder staging and vacant buildings pending decommissioning.
TA–8 (GT-Site [or Anchor Site West])	This is a dynamic testing site operated as a service facility for LANL. It maintains capability in all modern nondestructive testing techniques for ensuring quality of material, ranging from test weapons components to high-pressure dies and molds. Principal tools include radiographic techniques (x-ray machines with potentials up to 1 MeV and a 24-MeV betatron), radioisotope techniques, ultrasonic and penetrant testing, and electromagnetic test methods.
TA–9 (Anchor Site East)	At this site, fabrication feasibility and physical properties of explosives are explored. New organic compounds are investigated for possible use as explosives. Storage and stability problems are also studied.
TA–11 (K-Site)	These facilities are used for testing explosives components and systems, including vibration testing and drop testing, under a variety of extreme physical environments. The facilities are arranged so that testing may be controlled and observed remotely and so that devices containing explosives or radioactive materials, as well as those containing nonhazardous materials, may be tested.
TA–14 (Q-Site)	This dynamic testing site is used for running various tests on relatively small explosive charges for fragment impact tests, explosives sensitivities, and thermal responses.
TA–15 (R-Site)	This site houses the Pulsed High-Energy Radiation Machine Emitting X-Rays (PHERMEX) Facility, a multiple-cavity electron accelerator capable of producing a very large flux of x-rays for dynamic experiments and hydrodynamic testing. TA–15 also is the site for the Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility (now under construction), whose major feature will be its intense high-resolution, dual-machine radiographic capability. This site is also used for the investigation of weapons functioning and systems behavior in nonnuclear tests, principally through electronic recordings.
TA–16 (S-Site)	Investigations at this site include development, engineering design, prototype manufacture, and environmental testing of nuclear weapons components and subsystems. It is the site of the Weapons Engineering Tritium Facility (WETF) that focuses on research and applications using tritium. Development and testing of high explosives, plastics, and adhesives, and research on process development for manufacture of items using these and other materials are accomplished in extensive facilities.

TABLE S.1.1–1.—*Overview of Technical Areas and Their Associated Activities*-Continued

TECHNICAL AREA[a]	ACTIVITIES
TA–18 (Pajarito Laboratory Site)	This is a nuclear facility that studies both static and dynamic behavior of multiplying assemblies of special nuclear materials (SNMs). SNMs are used to support a wide variety of activities for stockpile management, stockpile stewardship, emergency response, nonproliferation, safeguards, etc. In addition, this facility provides the capability to perform hands-on training and experiments with SNM in various configurations below critical.
TA–21 (DP-Site)	This site has two primary research areas: DP West and DP East. DP West has been in the D&D Program since 1992, and about half of the facility has been demolished. DP West continues to provide office space for ongoing functions. Some activities conducted at DP West, primarily in inorganic and biochemistry, are being relocated during 1997 and 1998, and the remainder of the site scheduled for D&D in future years. DP East is a tritium research site and includes the Tritium Science and Fabrication Facility (TSFF) and Tritium Systems Test Assembly (TSTA).
TA–22 (TD-Site)	This site is used in the development of special detonators to initiate high-explosives systems. Fundamental and applied research in support of this activity includes investigating phenomena associated with initiating high explosives and research in rapid shock-induced reactions.
TA–28 (Magazine Area A)	This is an explosives storage area.
TA–33 (HP-Site)	The old, High-Pressure Tritium Laboratory Facility is being decommissioned. Tritium operations at this site were suspended in 1990, and the tritium inventory and operations were moved to WETF at TA–16. The National Radio Astronomy Observatory's Very Large Baseline Array Telescope is also located at this site.
TA–35 (Ten Site)	Activities include nuclear safeguards research and development that are concerned with techniques for nondestructive detection, and identification and analysis of fissionable isotopes. Research is also done on reactor safety, laser fusion, optical sciences, pulsed-power systems, high-energy density physics, metallurgy, ceramic technology, and chemical plating.
TA–36 (Kappa-Site)	This TA has four active firing sites that support explosives testing. Nonnuclear ordnance tests are conducted here, including tests of armor and armor-defeating mechanisms, as well as tests of shockwave effects on explosives and propellants. Phenomena of explosives, such as detonation velocity, are investigated at this dynamic testing site.
TA–37 (Magazine Area C)	This is an explosives storage area.
TA–39 (Ancho Canyon Site)	The behavior of nonnuclear weapons is studied here, primarily by photographic techniques. Investigations are also made into various phenomenological aspects of explosives, interactions of explosives, explosions involving other materials, shock wave physics, equation-of-state measurements, and pulsed-power systems design.
TA–40 (DF-Site)	This site is used in the development of special detonators to initiate high-explosives systems. Fundamental and applied research in support of this activity includes investigating phenomena associated with the physics of explosives.
TA–41 (W-Site)	Personnel at this site engage primarily in engineering design and development of nuclear components, including fabrication and evaluation of test materials for weapons.
TA–43 (Health Research Laboratory)	This site is adjacent to the Los Alamos Medical Center. Research performed at this site includes structural, molecular, and cellular radiobiology; biophysics; mammalian radiobiology; mammalian metabolism; biochemistry; and genetics. The DOE Los Alamos Area Office is also located within TA–43.
TA–46 (WA-Site)	Activities include applied photochemistry research such as the development of technology for laser isotope separation and laser enhancement of chemical processes. A new facility completed during 1996 houses research in inorganic and materials chemistry. The Sanitary Wastewater System Consolidation Plant is located at the east end of this site.
TA–48 (Radiochemistry Site)	Research and development activities at this site include a wide range of chemical processes such as nuclear and radiochemistry, geochemistry, biochemistry, actinide chemistry, and separations chemistry. Hot cells are used to produce medical radioisotopes.

TABLE S.1.1–1.—*Overview of Technical Areas and Their Associated Activities*-Continued

TECHNICAL AREA[a]	ACTIVITIES
TA–49 (Frijoles Mesa Site)	This site is currently restricted to carefully selected functions because of its location near BNM and past use in high-explosives and radioactive materials experiments. The Hazardous Devices Team Training Facility and the Antenna Test Range are located here. A helicopter pad used for wildfire response and storage for interagency wildfire response supplies are also located here.
TA–50 (Waste Management Site)	Activities include management of the industrial liquid and radioactive liquid waste received from various TAs. Activities also include development of improved methods for solid waste treatment and containment of radionuclides removed by treatment.
TA–51 (Environmental Research Site)	Research and experimental studies on the long-term impact of radioactive waste on the environment and types of waste storage and coverings are studied at this site.
TA–52 (Reactor Development Site)	A wide variety of theoretical and computational activities related to nuclear reactor performance and safety are done at this site.
TA–53 (Los Alamos Neutron Science Center)	This site includes the Los Alamos Neutron Science Center (LANSCE), the LANSCE linear proton accelerator, the Manuel Lujan Jr. Neutron Scattering Center, and a medical isotope production facility. Also located at TA–53 are the Accelerator Production of Tritium Project Office, including the Low-Energy Demonstration Accelerator (LEDA), and research and development activities in accelerator technology and high-power microwaves.
TA–54 (Waste Disposal Site)	Activities consist of radioactive and hazardous solid waste management, including storage, treatment, and disposal operations.
TA–55 (Plutonium Facility Site)	This facility provides research and applications in chemical and metallurgical processes for recovering, purifying, and converting plutonium and other actinides into many compounds and forms, as well as research into material properties and fabrication of parts for research and stockpile applications. Additional activities include the means to safely and securely ship, receive, handle, and store nuclear materials, as well as manage the wastes and residues produced by TA–55 operations. The Nuclear Materials Storage Facility (NMSF) is located at this TA.
TA–57 (Fenton Hill Site)	This site is located about 20 miles (32 kilometers) west of Los Alamos on the southern edge of the Valles Caldera in the Jemez Mountains, and was the location of LANL's now decommissioned Hot Dry Rock geothermal project. The site is used for the testing and development of downhole well-logging instruments and other technologies of interest to the energy industry. Because of the high elevation and remoteness of Fenton Hill, a gamma ray observatory is located at the site, and other astrophysics experiments are planned.
TA–58 (Two-Mile North Site)	This site is reserved for multi-use experimental sciences requiring close functional ties to activities currently located at TA–3.
TA–59 (Occupational Health Site)	Occupational health and safety and environmental activities are conducted at this site. Environmental, safety and health offices, and emergency management facilities are also located here.
TA–60 (Sigma Mesa)	This area contains physical support and infrastructure facilities, including the Test Fabrication Facility and Rack Assembly and the Alignment Complex.
TA–61 (East Jemez Road)	This site is used for physical support and infrastructure facilities, including the Los Alamos County sanitary landfill.
TA–62 (Northwest Site)	This site is reserved for multi-use experimental science, public and corporate interface, and environmental research and buffer zones.
TA–63 (Pajarito Service Area)	This site is a major growth area with environmental and waste management functions and facilities. This area contains physical support facilities operated by Johnson Controls, Inc.
TA–64 (Central Guard Site)	This is the site of the Central Guard Facility and headquarters for the Hazardous Materials Response Team.
TA–66 (Central Technical Support Site)	This site is used for industrial partnership activities.
TA–67 (Pajarito Mesa Site)	This area is a buffer zone, designated as a TA in 1989. No operations or facilities are currently located here.

TABLE S.1.1–1.—*Overview of Technical Areas and Their Associated Activities*-Continued

TECHNICAL AREA[a]	ACTIVITIES
TA–68 (Water Canyon Site)	This is a dynamic testing area.
TA–69 (Anchor North Site)	This undeveloped TA serves as an environmental buffer for the dynamic testing area.
TA–70 (Rio Grande Site)	This undeveloped TA serves as an environmental buffer for the high-explosives test area.
TA–71 (Southeast Site)	This undeveloped TA serves as an environmental buffer for the high-explosives test area.
TA–72 (East Entry Site)	This is the site of the Protective Forces Training Facility (Live Firing Range).
TA–73 (Airport Site)	This area is the Los Alamos Airport. DOE owns the airport, and the County of Los Alamos manages, operates, and maintains it under a leasing arrangement with DOE. Use of the airport by private individuals is permitted with special restrictions.
TA–74 (Otowi Tract)	This large area, bordering the Pueblo of San Ildefonso on the east, is isolated from most of LANL. This site contains LANL water wells and future well fields.

[a] The concept of technical areas (TAs) was implemented during the first 5 years of LANL's existence; however, the early TA designations did not cover all land within the LANL boundary and, in the early 1980's, LANL's TA numbering system was revamped to provide complete coverage. Because all TAs received new numbers, a correlation between the historic system and the current system does not exist. In addition, in the current system, some numbers were reserved for future TAs. Sites that have been closed or abandoned were incorporated into adjacent TAs.

MW = Megawatt, MeV = million electron volts

SWEIS. Nearly 1,300 comments from 215 commentors were recorded. The most significant requests and concerns raised were:

- A preference for a nonnuclear mission for LANL
- Imposing a moratorium on current or proposed projects until the SWEIS is completed
- Inclusion of "green" and shut-down and clean-up alternatives
- Reservations regarding waste management strategies, treatment, and disposal options, as well as waste transportation issues
- An interest in having environmental restoration activities included in the SWEIS
- Requests that the SWEIS be put on hold until the completion of the *Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (SSM PEIS) (DOE 1996) and the *Waste Management Programmatic Environmental Impact Statement* (WM PEIS) (DOE 1997)

Based on consideration of the input received in this "scoping" period, DOE published an implementation plan[1] to summarize the results of the scoping process, describe the scope of the SWEIS, and present the planned outline for the draft SWEIS. In addition to these activities, there were several other efforts to obtain public input regarding the SWEIS, including: workshops; meetings with and briefings to representatives of federal, state, tribal, and local governments; meetings with various interested groups; open forum sessions in several communities around LANL; and preparation of responses to requests for information (including requests that information be placed in the Los Alamos Community Outreach Center).

SWEIS Terminology

Mission. *In this SWEIS, "missions" refer to the major responsibilities assigned to DOE (described in this section). DOE accomplishes its major responsibilities by assigning groups or types of activities (referred to in this SWEIS as mission elements) to its system of national laboratories, production facilities, and other sites.*

Programs. *DOE is organized into Program Offices, each of which has primary responsibilities within the set of DOE 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 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 (e.g., the capability for advanced/ complex computation and modeling that was established to support DOE's national security mission requirements may also be used to address needs under DOE's science mission).*

Projects. *This 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 (e.g., 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 (including facility modification) activities (e.g., a project to build a new office building or a project to establish and demonstrate a new capability). Construction projects considered reasonably foreseeable at LANL over the next 10 years are discussed and analyzed in this SWEIS.*

1. DOE NEPA regulations (10 CFR 1021) previously required that an implementation plan be prepared; a regulation change (61 FR 64604) deleted this requirement. An implementation plan was prepared for the SWEIS.

DOE released the draft SWEIS in May 1998, for review and comment by the State of New Mexico, Indian tribes, local governments, other federal agencies, and the general public. The formal public comment period lasted 60 days, ending on July 15, 1998. Comments were accepted and considered after close of the comment period to the extent practicable.

DOE considered all comments to evaluate the accuracy and adequacy of the draft SWEIS and to determine when the SWEIS text needed to be corrected, clarified, or otherwise revised. DOE gave equal weight to spoken and written comments, comments received at the public hearings, and comments received in other ways. Comments were reviewed for content and relevance to the environmental analysis contained in the SWEIS. Each comment was addressed individually in volume IV, chapter 3 of the SWEIS.

Commentors raised several common topics during the SWEIS public comment process that the DOE has addressed in the Major Issues section located in chapter 2 of volume IV. In some cases, commentors raised issues that were not within the scope of this SWEIS, such as comments regarding opposition to nuclear weapons. To the extent practicable, DOE addressed these comments in the Major Issues section and in the individual responses.

The key areas of concern that emerged from public comments on the draft SWEIS were as follows:

- Commentors expressed a general opposition to nuclear weapons. Comments were received questioning why the draft SWEIS does not address the impacts that expanding operations at Los Alamos will have on the proliferation of nuclear weapons. Expanded operations at LANL contradict the 1970 Nonproliferation Treaty. Commentors stated that DOE should focus their resources on environmental technologies and not on nuclear weapons.
- DOE's implementation of the NEPA process was unclear to commentors, in particular, how public input is considered in NEPA documents and the factors that DOE considers in its decision-making process. Commentors expressed frustration over the perception that DOE is not addressing their concerns in a serious manner. Commentors also questioned why the draft SWEIS did not consider the cost impacts of each alternative in its analysis.
- Commentors believed that DOE had not considered an adequate range of alternatives. Commentors stated that the alternatives discussed in the draft SWEIS are inadequate because they fail to include any alternative that considers the closure and cleanup of LANL. They questioned how DOE selected levels of operations for each alternative. Commentors also questioned why there is little difference in the impacts among the alternatives.
- Commentors questioned the impacts of LANL operations on the regional aquifer and the safety of the drinking water. They stated that the draft SWEIS did not provide adequate site-wide plans for the monitoring, protection, and remediation of surface water and groundwater. Requests also were made for clarification of the hydrogeologic mechanism for the surface water to groundwater connection at LANL. Commentors stated that LANL's current monitoring program should be upgraded to obtain information about the source of recharge to the main aquifer and the sources of contaminants to the main aquifer. Comments also were received on the analyses of impacts to groundwater.
- Concern was expressed that LANL's pit production activities will have the same kind of safety problems that occurred at the Rocky Flats Plant. Commentors expressed concern that fires releasing radioactive materials would occur at the Plutonium

Facility. Concern was expressed that DOE had not adopted any safety measures as a result of the 1969 Rocky Flats Plant fire. Commentors believe that LANL will become a bomb production factory.

- Commentors expressed concern about the consequences of potential seismic activities at LANL, specifically at the Chemistry and Metallurgy Research (CMR) Building (TA–3) and Plutonium Facility (TA–55), and the impact of the results of ongoing seismic studies. Questions also were raised about the frequency of seismic events in the LANL region and the potential release of radioactive materials from such an event.
- The need for expansion of the low-level radioactive waste (LLW) disposal capacity at the TA–54/Area G Disposal Facility was questioned. Concern was expressed that impacts both natural and cultural, on San Ildefonso Pueblo lands would be irreversible. Commentors also expressed concern about the importation of low-level waste from other DOE sites. Concerns about further restriction of movement of the elk herd, due to a security fence surrounding Area G, also were expressed. Commentors were concerned about migration of contaminated wastes to the groundwater if leaks were to occur in disposal cells. Commentors stated that the draft SWEIS was deficient because it did not analyze the removal of all waste from TA–54.
- Commentors questioned the lack of specific quantitative risk analyses in the SWEIS on environmental restoration sites and the absence of data about environmental restoration sites in the context of various environmental settings. Commentors believed that more information on specific measures should be provided so that public comment could be provided on this program. Commentors questioned the impacts of not environmentally restoring each contaminated site at LANL. Questions were raised about the use of bounding analysis in describing the overall impacts of environmental restoration activities at LANL.
- Concern was expressed about the management of cultural resources at LANL and the depth of the traditional cultural properties study performed for the SWEIS. Commentors questioned whether DOE seeks and utilizes input on cultural resources from affected Indian tribes. Concern also was expressed that the impacts of the operation of LANL would have an irretrievable impact on cultural resources in the area, including spiritual or unseen resources.
- Commentors questioned the adequacy of the environmental justice analysis in the SWEIS and the steps taken to protect minority or low-income populations. Commentors stated that expansion of Area G at TA–54, which is located adjacent to San Ildefonso Pueblo lands, constitutes a disproportionately high and adverse impact on the minority community of San Ildefonso.
- Commentors stated that DOE should have an integrated approach for the management of natural resources at LANL to provide better protection of resources. Commentors stated that the draft SWEIS is deficient in the quantification of direct, indirect, and cumulative impacts to natural resources. Wildlife habitat fragmentation was another concern of commentors.
- Concern was expressed by commentors that implementation of the Expanded Operations Alternative would strain the electrical power demand in the region. Commentors requested clarification on the steps to be taken by DOE to address the electrical power supply issue. Concern also was expressed that if electrical supply shortages were to occur, equipment monitors or other safety equipment could fail, potentially causing environmental impacts.

- Commentors stated the draft SWEIS does not provide an adequate analysis of the environmental and health impacts of a major forest fire at LANL. Commentors stated that the draft SWEIS only examines the effects of a fire to specific facilities and initiated within those facilities. It was recommended that the environmental consequences of a catastrophic wildfire be addressed in the section on accidents.
- Commentors disagree with the claim in the draft SWEIS that LANL was in compliance with standards of the *Clean Air Act* (CAA), and specifically, that LANL is in full compliance with the radiological emissions under National Emission Standards for Hazardous Air Pollutants. Commentors stated that an independent auditor found that LANL was noncompliant, but these findings were disputed. The final SWEIS should discuss the auditors' findings, justification for the claim of CAA compliance, and steps to be taken by DOE and LANL if the CAA standards are exceeded.
- Commentors stated that the draft SWEIS did not consider the impacts of stormwater runoff events at LANL, noting that storm runoff events can be a significant pathway for the off-site migration of contaminants. Many storms over the years and numerous canyon systems, as noted by the commentors, create a potential for cumulative off-site migration of contaminants.

S.1.3 Changes to the Draft SWEIS

DOE revised the draft SWEIS in response to comments received from other federal agencies; tribal, state, and local governments; nongovernmental organizations; the general public; and DOE reviews. The text was changed to provide additional environmental baseline information, to correct inaccuracies and make editorial corrections, and provide additional discussion of technical considerations to respond to comments and clarify text. In addition, DOE updated information due to events or decisions made in other documents since the draft SWEIS was provided for public comment in May 1998.

S.1.3.1 *Summary of Significant Changes*

Revised Preferred Alternative

In the draft SWEIS, the DOE's Preferred Alternative was the Expanded Operations Alternative. In this final SWEIS, the Expanded Operations Alternative remains the Preferred Alternative with one modification, as noted below. The modification to the Preferred Alternative involves the level at which pit manufacturing will be implemented at LANL. Under the Expanded Operations Alternative, DOE would expand operations at LANL, as the need arises, to increase the level of existing operations to the highest reasonably foreseeable levels, including the full implementation of pit manufacturing up to the capacity of 50 pits per year under single-shift operations (80 pits per year using multiple shifts). However, as a result of delays in the implementation of the Capability Maintenance and Improvement Project (CMIP) and recent additional controls and operational constraints in the CMR Building (instituted to ensure that the risks associated with the CMR Building operations are maintained at an acceptable level), the DOE has determined that additional study of methods for implementing the 50 pits per year production capacity is warranted. In effect, because DOE has postponed any decision to expand pit manufacturing beyond a level of 20 pits per year in the near future, the revised Preferred Alternative would only implement pit manufacturing at this level. This postponement does not modify the long-term goal announced in the Record of Decision (ROD) for the SSM PEIS (up to 80 pits per year using multiple shifts).

Enhanced Pit Manufacturing

As described above, as a result of delays in the implementation of the CMIP and recent additional controls and operational constraints in the CMR Building (chapter 2, section 2.2.2.3), DOE has postponed any decision to implement the pit manufacturing capability beyond a level of 20 pits per year (14 pits is the No Action level). DOE believes it can expand the pit manufacturing capability to 20 pits at TA–55 without significant infrastructure upgrades and still meet its near-term mission requirements. When the additional studies are completed, DOE will provide the appropriate NEPA review, tiered from this SWEIS, to implement the pit manufacturing capability beyond the 20 pits per year capacity. The project-specific siting and construction (PSSC) analysis for the Enhancement of Plutonium Pit Manufacturing (in volume II of this SWEIS) no longer states a "Preferred PSSC Alternative." The Preferred Alternative would only implement pit production at a level of 20 pits per year. However, for completeness and to bound the impacts of implementing pit production at LANL, the "Utilize Existing Unused Space in the CMR Building" Alternative (the Preferred PSSC Alternative in the draft SWEIS) is still included in the Expanded Operations Alternative as the "CMR Building Use" Alternative. The ROD for the SWEIS will only include a decision regarding the operations to implement the pit production mission at LANL for up to 20 pits per year. This change is reflected in volume II, part II.

Wildfire

The scenario that a wildfire could encroach on LANL was analyzed and included in the accident set presented for all the alternatives. The detailed wildfire analysis, referred to as the SITE–04 accident, is presented in appendix G, section G.5.4.4 of volume III of this SWEIS. A summary of the impacts is presented in chapter 5.

Comparison Between the Rocky Flats Plant and LANL

An overview of the 1969 plutonium fire at the Rocky Flats site and a comparison of the design and operational differences between the Rocky Flats Plant and LANL are included in appendix G, section G.4.1.2. A summary is included in chapter 5.

CMR Building Seismic Upgrades

DOE has decided not to implement the seismic upgrades as part of the CMR Building Upgrades Project, Phase II, as a result of (1) new seismic studies (chapter 4, section 4.2.2.2, and appendix I) released after the draft SWEIS was issued indicating the additional hazard of a seismic rupture at the CMR Building and (2) DOE's postponement of any decisions to implement the pit manufacturing capability beyond 20 pits per year in the near future. Although the seismic rupture risk does not have a substantial effect on the overall seismic risk (chapter 2, section 2.2.2.3), it is an aspect of risk that cannot be cost-effectively mitigated through engineered structural upgrades. Given that assessment, the DOE is considering more substantial actions that are not yet ripe for analysis in the SWEIS (e.g., replacement of aging structures). The overall goal of DOE's evaluation is ultimately to reduce the risk associated with a seismic event, should one occur. In the meantime, DOE is taking actions to mitigate seismic risks through means other than seismic upgrades (e.g., minimizing material at risk and putting temporarily inactive material in process into containers). In any event, DOE is presenting the larger and more conservative impacts (no seismic upgrades) for the SITE–01, SITE–02, and SITE–03 accidents. Therefore, SITE–01, SITE–02, and SITE–03 accidents were revised to include new seismic data published after the draft SWEIS was released and to exclude the mitigation of the impacts of implementing the seismic upgrades. The detailed revised analysis is presented in appendix G. A summary of the impacts is presented in chapters 3 and 5.

Strategic Computing Complex

The impacts of constructing and operating the proposed Strategic Computing Complex (SCC) project, primarily electric power demand and water usage, were incorporated into all the alternatives analyzed. Water usage was not increased in these analyses because DOE and LANL committed to no net increase of water as a result of conservation measures and recycling of treated wastewater from the Sanitary Wastewater System Consolidation Plant, TA–46, as cooling water for the SCC project.

Conveyance and Transfer of DOE Land

DOE has begun the preparation of an EIS for the Conveyance and Transfer of Certain Land Tracts at LANL (CT EIS). The CT EIS, scheduled to be released in draft form for public review and comment in early 1999, will analyze the impacts of conveying and transferring certain tracts of land to the County of Los Alamos and the U.S. Department of the Interior in trust for the Pueblo of San Ildefonso. The CT EIS also will present the cumulative impacts of the land being developed by either the County of Los Alamos or the Pueblo of San Ildefonso, as well as the impacts of continuing to operate LANL.

S.1.3.2 *Next Steps*

The SWEIS ROD, to be published no sooner than 30 days after the Notice of Availability of the final SWEIS has been issued, will explain all factors, including environmental impacts, that the DOE considered in reaching its decision. The ROD will also identify the environmentally preferred alternative or alternatives. If mitigation measures, monitoring, or other conditions are adopted as part of DOE's decision, these will summarized in the ROD, as applicable, and will be included in the Mitigation Action Plan that would be prepared following the issuance of the ROD. The Mitigation Action Plan would explain how and when mitigation measures would be implemented and how the DOE would monitor the mitigation measures over time to judge their effectiveness.

S.2 ALTERNATIVES TO MEET THE PURPOSE AND NEED FOR AGENCY ACTION

S.2.1 Purpose and Need for Agency Action

As directed by the President and Congress, DOE has the core mission to provide for stewardship and management of the nuclear weapons stockpile. DOE also has other national security, energy resources, environmental quality, and science missions. These missions are national in scope, and aspects are carried out at various DOE facilities. The purpose of continued operation of LANL is to provide support for DOE missions.

The need to continue to operate LANL is based on the unique facilities and expertise of the staff located there. These facilities and this expertise provide key capabilities within the broad areas of:

- Theoretical research, including parameter estimation, mathematical modeling, and high-performance computing
- Experimental science and engineering ranging from bench-scale to multisite, multitechnology facilities (including accelerators, radiographic facilities, etc.)
- Advanced and nuclear materials research and development, and technological applications, including weapons component testing, fabrication, stockpile assurance, replacement, surveillance, and maintenance (including theoretical and experimental activities)

DOE assignments to LANL use and build upon these capabilities. DOE's need to continue to operate LANL is focused on DOE's obligation to ensure a safe and reliable nuclear stockpile in accordance with national security policy.

S.2.2 Proposed Action and Alternatives

DOE proposes to continue operating LANL in support of DOE's national missions. The decisions that DOE expects to make as a result of the alternatives analyzed in this SWEIS will satisfy the purpose and need presented above. The decisions include the level of operation for LANL, as well as specific decisions regarding construction projects that are ripe for decision on a schedule compatible with the SWEIS. In particular, two of these construction projects involve multiple facilities and operations across LANL: (1) the site-specific implementation of the pit production mission assigned in the ROD regarding SSM (61 FR 68014, December 1996), and (2) the disposition of LLW off the site or the expansion of on-site disposal capacity. DOE also will select from appropriate mitigation measures to reduce or avoid potential impacts associated with the alternative and project-level decisions.

This SWEIS evaluates four broad alternative levels of operation at LANL: No Action, Expanded Operations, Reduced Operations, and "Greener."

The No Action Alternative analyzed in this SWEIS reflects the levels of operation at LANL that are currently planned (that is, the levels of operations that would be undertaken in the absence of a decision to change operational levels). This includes operations that provide for continued support of DOE's four primary missions, but would not include an increase in the existing pit manufacturing capacity (which is 14 pits per year) nor expansion of the LLW disposal facility at TA–54 (the remaining space in the existing Area G footprint would be used, but some LLW would be shipped for off-site disposal). This alternative includes the maintenance of existing capabilities, continued support/infrastructure activities, and facility construction or modification projects throughout LANL that have previous NEPA reviews (projects not previously reviewed under NEPA, as listed in the Expanded Operations Alternative, would not proceed under this alternative).

The Expanded Operations Alternative would expand operations at LANL, as the need arises, to increase the level of existing operations to the highest reasonably foreseeable levels, and to fully implement the mission elements assigned to LANL. This includes the impacts of the full implementation of pit manufacturing (discussed further in section S.2.5.2) up to a capacity of 50 pits per year under single-shift operations (80 pits per year using multiple shifts). This alternative also includes the expansion of the LLW disposal site at TA–54 (discussed further in section S.2.5.1). This alternative also includes the continued maintenance of existing and expanded capabilities, continued support/infrastructure activities, and implementation of several facility construction or modification projects at TA–53 (the long-pulse spallation source, the 5-megawatt target/blanket experimental area, the Dynamic Experiment Laboratory, and the Exotic Isotope Production Facility), which have not previously been reviewed under NEPA (construction projects throughout LANL that have previous NEPA reviews would proceed as planned). The TA–53 projects proposed do not have meaningful siting and construction alternatives at LANL because they are dependent on the delivery of an accelerator beam that is not provided at other LANL facilities. (Construction of a new accelerator solely to provide for these activities is not considered reasonable.)

The Reduced Operations Alternative reflects the minimum levels of operation at LANL considered necessary to maintain the capabilities to support DOE missions over the

near term. While the capabilities are maintained under this alternative, this may not constitute full support of the mission elements currently assigned to LANL. This alternative reflects pit manufacturing at a level below the existing capacity (at 6 to 12 pits per year) and reflects shipment of much of the LLW generated at LANL for off-site disposal (on-site disposal would be limited to those waste types for which LANL has a unique capability at Area G). This alternative includes the maintenance of existing capabilities, continued support/infrastructure activities, and facility construction or modification projects throughout LANL that have previous NEPA reviews; some of the projects previously reviewed under NEPA would be reduced in scope or eliminated (e.g., the Low-Energy Demonstration Accelerator [LEDA] would only be operated at the lower end of its energy range).

The Greener Alternative reflects increased levels of operation at LANL in support of nonproliferation, basic science, and materials recovery/stabilization mission elements, and reduced levels of operation in support of defense and nuclear weapons mission elements. All LANL capabilities are maintained for the short term under this alternative; however, this may not constitute full support of the nuclear weapons mission elements currently assigned to LANL. This alternative reflects pit manufacturing at a level below the existing capacity (at 6 to 12 pits per year) and reflects shipment of much of the LLW generated at LANL for off-site disposal (on-site disposal would be limited to those waste types for which LANL has a unique capability at Area G). This alternative includes the maintenance of existing capabilities, continued support/infrastructure activities, and implementation of several facility construction or modification projects at TA–53 (the long-pulse spallation source, the 5-megawatt target/blanket experimental area, the Dynamic Experiment Laboratory, and the Exotic Isotope Production Facility), which have not previously been reviewed under NEPA (other projects throughout LANL that have previous NEPA reviews would also proceed). As discussed above for the Expanded Operations Alternative, these TA–53 projects do not have meaningful siting and construction alternatives. The name and general description for this alternative were provided by interested public stakeholders as a result of the scoping process.

In the draft SWEIS, the DOE's Preferred Alternative was the Expanded Operations Alternative. In this final SWEIS, the Expanded Operations Alternative remains the Preferred Alternative with one modification, as noted below. The modification to the Preferred Alternative involves the level at which pit manufacturing will be implemented at LANL. Under the Expanded Operations Alternative, DOE would expand operations at LANL, as the need arises, to increase the level of existing operations to the highest reasonably foreseeable levels, including the full implementation of pit manufacturing up to the capacity of 50 pits per year under single-shift operations (80 pits per year using multiple shifts). However, as a result of delays in the implementation of the CMIP and recent additional controls and operational constraints in the CMR Building (instituted to ensure that the risks associated with the CMR Building operations are maintained at an acceptable level), the DOE has determined that additional study of methods for implementing the 50 pits per year production capacity is warranted. In effect, because DOE has postponed any decision to expand pit manufacturing beyond a level of 20 pits per year in the near future, the revised Preferred Alternative would only implement pit manufacturing at this level. This postponement does not modify the long-term goal announced in the ROD for the SSM PEIS (up to 80 pits per year using multiple shifts). The Preferred Alternative, as the Expanded Operations Alternative, also includes the expansion of the LLW disposal site at TA–54 (discussed further in section S.2.5.1). The Preferred Alternative

also includes the continued maintenance of existing and expanded capabilities, continued support/infrastructure activities, and implementation of several facility construction or modification projects at TA–53 (the long-pulse spallation source, the 5-megawatt target/blanket experimental area, the Dynamic Experiment Laboratory, and the Exotic Isotope Production Facility), which have not previously been reviewed under NEPA (construction projects throughout LANL that have previous NEPA reviews would proceed as planned). The TA–53 projects proposed do not have meaningful siting and construction alternatives at LANL because they are dependent on the delivery of an accelerator beam that is not provided at other LANL facilities. (Construction of a new accelerator solely to provide for these activities is not considered reasonable.)

S.2.3 Alternatives Considered But Not Analyzed

Comments received during prescoping and scoping were considered by DOE. Some of the alternatives suggested for future operation of LANL were considered but not analyzed. These alternatives and the reasons they were eliminated from detailed analysis are presented below:

- *Decontamination and Decommissioning of LANL*. Under this alternative, LANL operations would be phased out, and all facilities of LANL would be decontaminated and decommissioned as soon as practicable. This alternative is not analyzed in the SWEIS because it is considered unreasonable in the foreseeable future under the terms of the *National Defense Authorization Act of 1994* (Public Law [PL]103-160), subsequent authorizations, and presidential policy statements on the future of the national laboratories (DOE 1995). Under this act (and subsequent authorizations) and national security policy, the maintenance of a safe and reliable nuclear weapons stockpile will remain a cornerstone of the U.S. nuclear deterrent for the foreseeable future, and the continued vitality of all three DOE weapons laboratories (LANL, Lawrence Livermore National Laboratory, and Sandia National Laboratories) are essential to ensuring national security.
- *Elimination of All Weapons-Related Work from the Continued Operation of LANL*. Under this alternative, operation of LANL would continue, but all weapons work would cease except currently authorized pit disassembly, material stabilization, and material storage. This alternative is not analyzed in the SWEIS because it is considered unreasonable in the foreseeable future under the terms of the *National Defense Authorization Act of 1994* (PL 103-160) and presidential policy statements on the future of the national laboratories (DOE 1995). Additionally, LANL has an integral role within the system of national laboratories to support all DOE missions, including the national security mission. Elimination of the operations that support the national security mission would adversely affect DOE's ability to meet its mission requirements under the terms of the *Atomic Energy Act*, as amended (42 U.S.C. §2011). Even relocation of the capabilities that exist at LANL to another DOE site could not be accomplished within the next 10 years while maintaining continuous support of DOE's national security responsibilities.
- *Operating LANL Exclusively as a National Environmental Research Park*. Under this alternative, DOE would operate LANL exclusively in support of environmental research that would contribute to understanding how people can best live in balance with nature while enjoying the benefits of technology. This alternative is not analyzed in the SWEIS because it is considered unreasonable in the foreseeable

future, given LANL's role in supporting DOE's national security mission (as discussed in the two previous alternative discussions on this matter). LANL was designated as a National Environmental Research Park in 1977, and research activities associated with this designation continue.

- *Privatizing the Operations of LANL*. Under this alternative, the operations of LANL would be privatized. This alternative is not analyzed in the SWEIS because it is not considered reasonable in the foreseeable future, given the terms of the *Atomic Energy Act*, as amended (42 U.S.C. §2015). This act governs the transfer of real property and limits what DOE can do with real properties. The *Atomic Energy Act* also governs what can be done with respect to government responsibilities regarding nuclear materials and access to information classified under this act. Although this alternative is not considered reasonable, it should be noted that the environmental impacts of operations under this alternative would not likely be any different from those presented in this SWEIS; the environmental consequences of operating LANL are primarily functions of the specific activities assigned to LANL and the facilities, equipment, and procedures used to implement them (and these would not be expected to change due to privatization).

S.2.4 Approach Used to Describe the SWEIS Alternatives in Detail

LANL is a multifaceted institution, funded primarily to undertake a broad range of theoretical and experimental research and development as well as undertaking various applications (including some production activities) for DOE and other federal agencies. The research and development activities throughout LANL are dynamic by their very nature, with the norm being continual change within the limits of the facility capabilities, authorizations, and operating procedures. Activities at LANL take place across approximately 43 square miles (111 square kilometers), including over 2,000 structures with about 7.9 million square feet (about 735,000 square meters) of floorspace. The size of the site and the diversity of the activities on the site present a challenge in terms of providing a useful description of alternatives for the operation of LANL (the goal being to provide the public and decision makers with an understanding of the alternatives and their consequences without providing encyclopedic details on every process and range of activities across the entire site).

Knowing that some activities are of more interest than others, the operations, buildings, and physical setting of LANL were all reviewed to determine an approach that would provide meaningful descriptions and analyses. The approach selected was to describe activities at two levels of detail. One level describes the entirety of operations in a summary fashion. Activities were grouped into the broad areas of: (1) theory, modeling, analysis and high-performance computation; (2) experimental science and engineering; and (3) research, development, and applications using advanced and nuclear materials (including both theoretical and experimental elements). The additional operations necessary to support these activities (such as administrative and technical services [e.g., human resources, safeguards and security, facilities, and environment, safety, and health], public/corporate interface [including the Bradbury Science Museum], and physical support and infrastructure [such as warehouses, storage, utilities, and waste handling]) are also described at a summary level. This is a sufficient level of description to support the analysis of environmental impacts for the majority of activities at LANL because these activities have little potential for environmental impacts. Many of these activities were not

projected to change across the alternatives, and their contributions to environmental impacts were carried as a constant factor in the analysis of each of the alternatives.

Activities of interest tend to be concentrated within certain facilities. The more detailed description of activities at LANL were therefore focused on the operations within a limited set of facilities. Criteria were established to determine which of the facilities at LANL (often a facility is composed of multiple buildings) should be the subjects of the more detailed description and analysis. These facilities were designated SWEIS "key" facilities and are the facilities that house activities that are critical to meeting DOE assignments to LANL, and:

- House operations that have the potential to cause significant environmental impacts, or
- Are of most interest or concern to the public (based on scoping comments received), or
- Would be the most subject to change due to recent programmatic decisions.

The 15 key facilities identified in Table S.2.4–1 represent the source of over 99 percent of all radiation doses to LANL personnel, over 99 percent of all radiation doses to the public, over 90 percent of all radioactive liquid waste generated, over 90 percent of the radioactive solid waste generated, and about 30 percent of the chemical waste generated (the other 70 percent is generated throughout all other LANL facilities). Operations in these key facilities were projected to change in accordance with the alternatives, and any changes in support or infrastructure activities that derive from the changes in operations were analyzed as part of those operational levels. As noted above, operations in the non-key facilities and their contributions to impacts are included as a constant factor in the analyses of each of the alternatives.

TABLE S.2.4–1.—*Identification of Key Facilities for Analysis of LANL Operations*

KEY FACILITY	TECHNICAL AREA
Plutonium Facility Complex	TA–55
Tritium Facilities	TA–16 & TA–21
Chemistry and Metallurgy Research Building	TA–3
Pajarito Site	TA–18
Sigma Complex	TA–3
Materials Science Laboratory	TA–3
Target Fabrication Facility	TA–35
Machine Shops	TA–3
High Explosive Processing Facilities	TA–8, TA–9, TA–11, TA–16, TA–28 & TA–37
High Explosive Testing Facilities	TA–14, TA–15, TA–36, TA–39, & TA–40
Los Alamos Neutron Science Center	TA–53
Health Research Laboratory	TA–43
Radiochemistry Laboratory	TA–48
Waste Management Operations: Radioactive Liquid Waste Treatment Facility	TA–50 & TA–21
Waste Management Operations: Solid Radioactive and Chemical Waste Facilities	TA–50 & TA–54

S.2.5 Consideration of Future Projects

DOE and researchers at LANL frequently develop new ideas and proposals for which funding and programmatic support are requested. Such proposals vary in terms of size, complexity, and potential environmental impact. Many of these proposals are characterized as projects. These are typically research, development, and applications activities across LANL. Some of these activities also require construction or modification of facilities or equipment. The

discussion in this section focuses on these construction and modification projects.

Potential construction projects and facility modifications were reviewed to determine which were considered reasonably foreseeable; some of those reviewed were considered too speculative to analyze within the SWEIS. However, several construction projects and facility modifications recently proposed are considered reasonably foreseeable and are included in the SWEIS alternatives (identified by alternative in section S.2.2) and impact analyses. It is expected that the ROD for this SWEIS will include decisions on these projects, unless they were previously reviewed under NEPA. (The previous decisions on these activities are not being revisited in this SWEIS, and these are included in all of the SWEIS alternatives.)

Two of these construction projects have reasonable siting and construction alternatives that are being considered: the Expansion of TA–54/Area G Low-Level Waste Disposal Area (included in both the Preferred Alternative and Expanded Operations Alternative) and the Enhancement of Plutonium Pit Manufacturing (included only in the Expanded Operations Alternative). These siting and construction alternatives are examined in detail in volume II of the SWEIS. The PSSC analyses presented in volume II provide an examination of a set of alternatives specific to each of these projects in greater detail than the description and analysis presented in volume I of the SWEIS. The impacts associated with these siting and construction activities are included in the impacts presented for the Expanded Operations Alternative in volume I. These projects and the PSSC alternatives considered are presented below.

S.2.5.1 *Expansion of TA–54/Area G Low-Level Waste Disposal Area*

Under any of the SWEIS alternatives, more LLW would be generated than can be disposed of in the existing footprint of the Area G LLW disposal site. While the other three SWEIS alternatives include (in varying amounts) shipments of LLW for off-site disposal, the Expanded Operations Alternative (and Preferred Alternative) reflects expansion of the LANL LLW disposal capacity and continued on-site disposal of LANL LLW. Five alternatives in two TAs (TA–54 and TA–67) are considered for the expansion of the on-site LLW disposal capacity (Figures S.2.5.1–1 and S.2.5.1–2):

- Develop Zone 4 at TA–54 (a site almost immediately west of the existing disposal site).
- Develop Zone 6 at TA–54 (a site located to the northwest of the existing disposal site and Zone 4).
- Develop the North Site at TA–54 (located north of Zone 6).
- Develop an undeveloped site at another LANL TA (TA–67, an undeveloped site northwest of TA–54, is used as an example).
- Develop both Zones 4 and 6 in a step-wise fashion (expand these areas as demand requires); this is DOE's Preferred Alternative for this PSSC.

The impacts of this action are included in the site-wide impacts presented and are also described separately in section S.3.

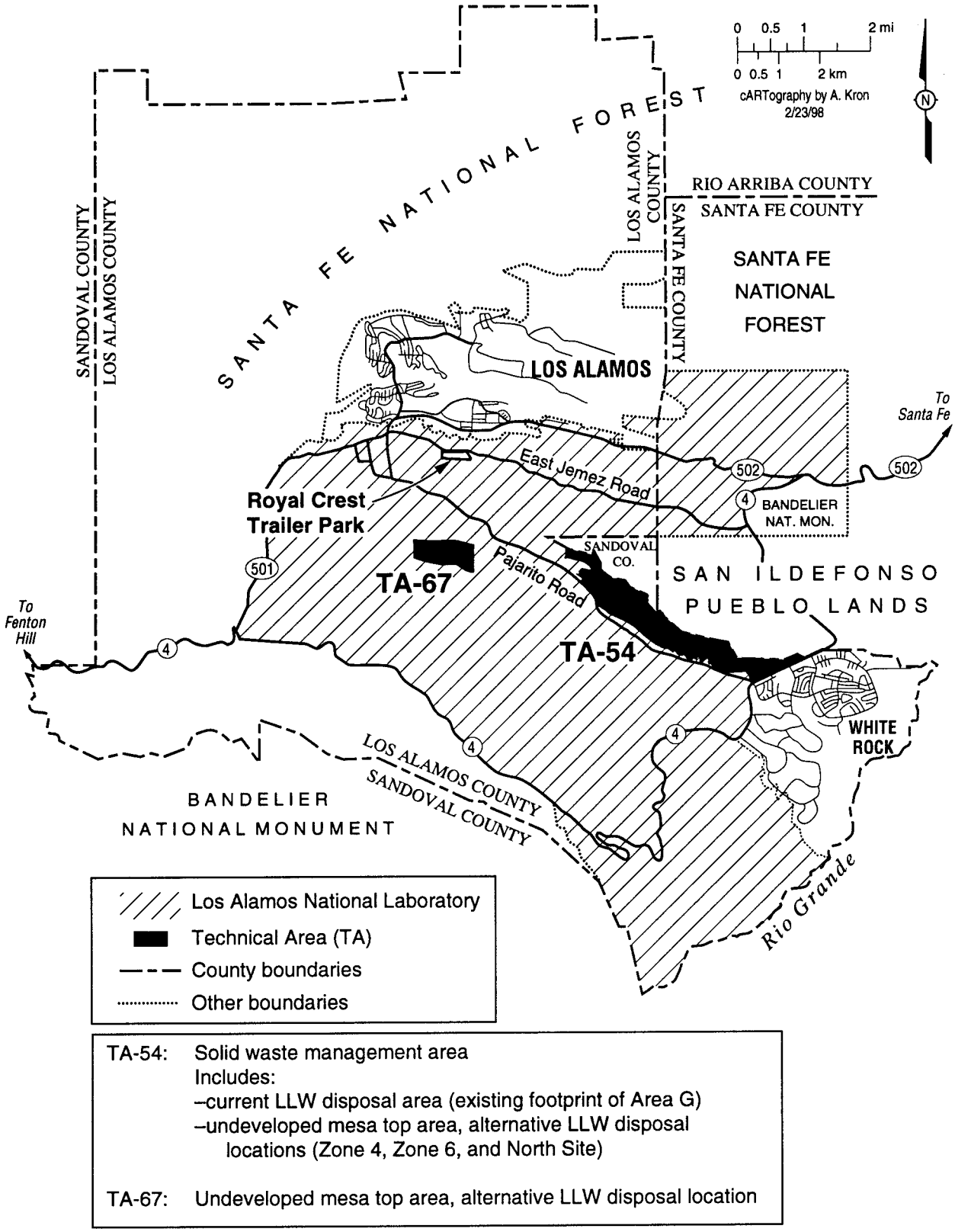


FIGURE S.2.5.1–1.—*Location of LANL, TA–54, and TA–67.*

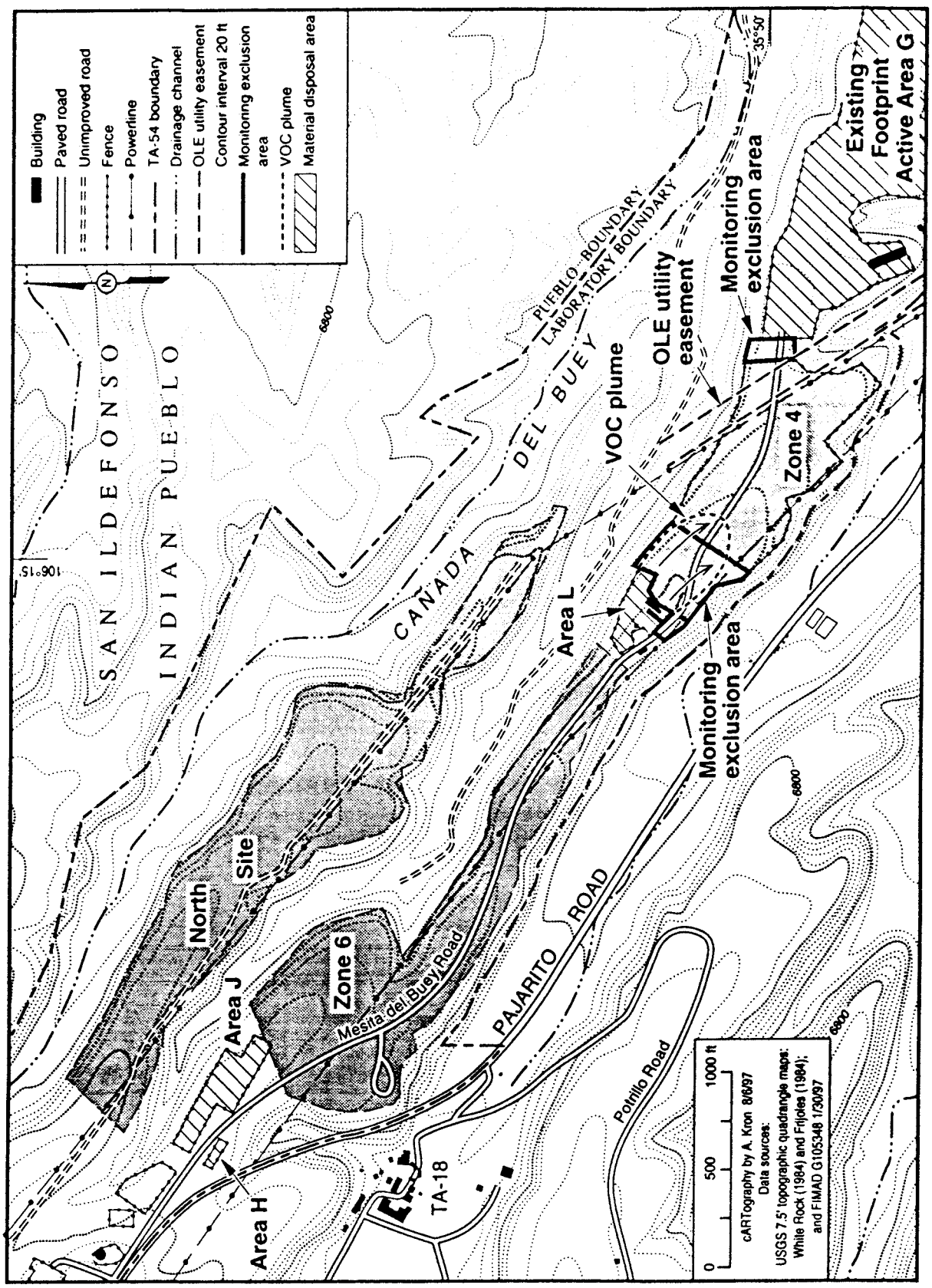


FIGURE S.2.5.1–2.—*Location Within TA–54 of Zones 4 and 6, Areas H, J, and L, and North Site.*

Terminology Related to Pit Production

Pit Fabrication/Manufacturing*—For purposes of the SWEIS, these terms are synonymous. LANL has an existing capability to fabricate or manufacture plutonium parts. That is, the equipment, knowledge, supporting infrastructure, and administrative procedures and controls exist at LANL to create plutonium metallic shapes to precise specifications. This capability is currently used in support of existing missions for research and development and will be used to rebuild some of the pits destroyed in stockpile surveillance activities.*

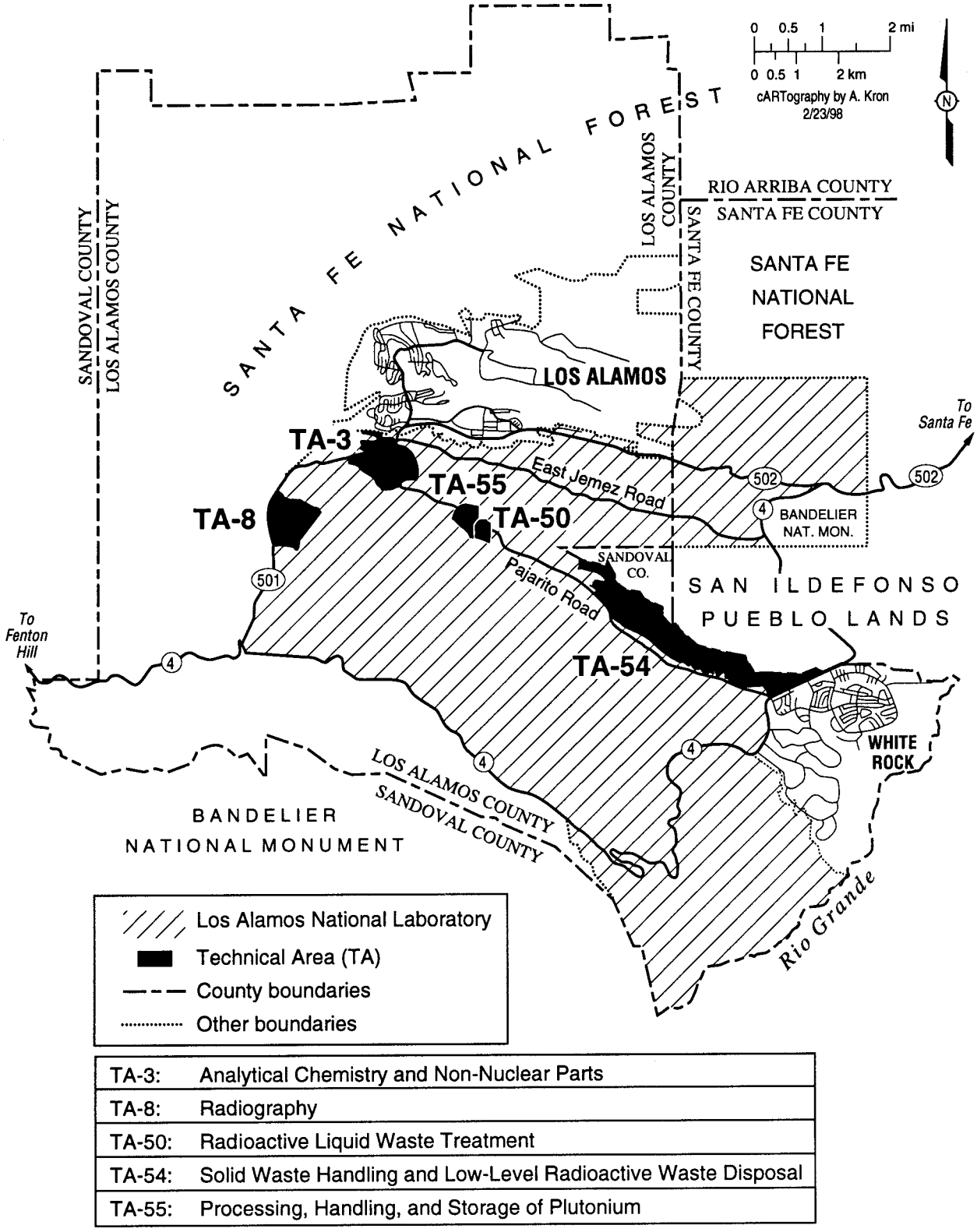
Pit Production*—For the purposes of the SWEIS, this term is used to describe the fabrication/ manufacturing of a relatively large quantity of parts (as compared to the research and development and prototype capability). In the ROD for the SSM PEIS, DOE decided to meet its need for a pit production capability by enhancing its existing fabrication/ manufacturing capability at LANL. This enhancement consists of changes to optimize material flows, remove "choke points" that limit the quantity that can be made, improve efficiency, and replace or upgrade equipment to improve process yield and reliability.*

S.2.5.2 *Enhancement of Plutonium Pit Manufacturing*

The Expanded Operations Alternative reflects implementation of the pit production mission recently assigned to LANL (DOE 1996) by enhancing the existing capability to manufacture pits. The capacity that results from this enhancement would allow for up to 50 pits to be fabricated each year under single-shift operations (80 pits per year under multiple-shift operations).

As a result of delays in the implementation of the CMIP and recent additional controls and operational constraints in the CMR Building (instituted to ensure that the risks associated with CMR Building operations are maintained at an acceptable level), the DOE has determined that additional study of methods for implementing the 50 pits per year production capacity is warranted. In effect, the DOE has postponed the decision to implement the pit manufacturing capability beyond a level of 20 pits per year (14 pits is the No Action level). The DOE believes it can expand the pit manufacturing capability to 20 pits at TA–55 without significant infrastructure upgrades and still meet its near-term mission requirements. This postponement does not modify the long-term goal announced in the ROD for the SSM PEIS (up to 80 pits per year using multiple shifts). The Preferred Alternative would only implement pit manufacturing at a level of 20 pits per year. However, for completeness and to bound the impacts of implementing pit production at LANL, the "CMR Building Use" Alternative is still included in the Expanded Operations Alternative. Pit manufacturing activities at LANL are supported by several TAs at LANL (Figure S.2.5.2–1). Three alternatives are considered for the enhancement of pit manufacturing:

- Utilize existing unused space in the CMR Building at TA–3 (make existing vacant space at this nuclear facility operational and move some operations from the Plutonium Facility at TA–55 to this space to make enough space available in the Plutonium Facility [referred to as building number TA–55–4] for the expanded pit manufacturing operation). This is referred to as the "CMR Building Use" Alternative.
- Brownfield Plutonium Facility (build a new nuclear facility on previously disturbed land at TA–55 and move some operations from TA–55–4 to this facility to make enough space available in TA–55–4 for the expanded pit manufacturing operation).
- Add-on to the TA–55–4 Plutonium Facility (build an addition to the existing Plutonium Facility, TA–55–4, and establish the



TA-3:	Analytical Chemistry and Non-Nuclear Parts
TA-8:	Radiography
TA-50:	Radioactive Liquid Waste Treatment
TA-54:	Solid Waste Handling and Low-Level Radioactive Waste Disposal
TA-55:	Processing, Handling, and Storage of Plutonium

FIGURE S.2.5.2–1.—*Location of LANL Operations that Support Pit Manufacturing.*

expanded pit manufacturing operations within this addition—alternatively, some operations in the existing space could be moved into this addition to make space for the expansion in the existing TA–55–4 space).

These upgrades would be phased to first increase the capacity of existing operations to 20 pits per year, followed by completion of the modifications to achieve the end-point production capacity. Under each of these alternatives, transportation of materials between TA–55 and TA–3 would increase substantially (more so for the "CMR Building Use" Alternative than for the Brownfield and Add-On to TA–55–4 alternatives). Because this increase would result in increased on-site transportation risk and inconvenience to motorists in the area (roads are closed to other motorists while many of these shipments take place), DOE is considering an option to construct a dedicated road between TA–55 and TA–3 that would be closed to the public, but that would decrease the transportation risk and inconvenience to motorists in the area during shipment of materials between these TAs. The construction of this road is part of the bounding PSSC Alternative and is included in the SWEIS Expanded Operations Alternative. However, this road would not be constructed at the 20 pits per year production rate (that is, under the Preferred Alternative), nor would process activities associated with pit manufacturing be moved to the CMR Building.

While the impacts of the actions described in this PSSC are included in the site-wide impacts presented, the impacts specific to these actions are also described separately in chapter 3 of the SWEIS (section 3.6), chapter 5 (section 5.3), and in this summary (section S.3).

S.3 Principal Environmental Issues and Comparison of Environmental Impacts

This section contains three parts. The first, section S.3.1, presents a summary comparison of the potential consequences of the four alternatives for the continued operation of LANL. The second, section S.3.2, is a comparison of the potential consequences (including both construction and operations) of the alternatives for two projects that depend upon or span multiple facilities at LANL: the Expansion of the TA–54/Area G Low-Level Waste Disposal Area, and the Enhancement of Plutonium Pit Manufacturing. (The construction and operations for these two projects are included only in the Expanded Operations Alternative.) The third part, section S.3.3, highlights the Environmental Restoration Project impacts and benefits due to the unique nature of this activity (as compared to other LANL activities) and the level of public interest in these activities.

DOE and LANL conduct all activities in adherence with applicable laws, regulations, and other requirements. Chapter 7 summarizes the requirements governing operations at LANL.

S.3.1 Consequences of SWEIS Alternatives

Site-wide environmental consequences are summarized in two tables. Table S.3.1–1 summarizes the potential consequences of normal operations of LANL under the four alternatives. Table S.3.1–2 addresses the potential consequences of a range of transportation and operational accidents possible at LANL. Accidents evaluated include: natural phenomena, process accidents,

TABLE S.3.1–1.—*Comparison of Potential Consequences of Continued Operations of LANL: Normal Operations*

RESOURCE AREA	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
LAND RESOURCES				
Land Use	No changes projected, except where specific environmental restoration actions change use from waste disposal back to research and development or explosives land uses (none specifically known at this time).	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.
Visual Resources	Temporary and minor changes due to equipment associated with construction and environmental restoration activities.	Same as No Action Alternative, plus effects of lighting for the transportation corridor constructed under this alternative.	Same as No Action Alternative.	Same as No Action Alternative.
Noise	Continued ambient noise at existing levels, temporary and minor noise associated with construction, and explosives noise and vibration at increased frequencies and at the same amplitudes as compared to recent experience.	Individual activities similar to those under No Action Alternative. Additional construction would result in additional temporary and minor noise. Noise and vibration associated with explosives testing is more frequent under this alternative, but the amplitude is the same as compared to No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.
GEOLOGY AND SOILS				
Geology	LANL activities are not expected to change geology in the area, trigger seismic events, or substantively change slope stability.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.
Soils	Minimal deposition of contaminants to soils and continued removal of existing contaminants under the Environmental Restoration Project.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.

TABLE S.3.1–1.—*Comparison of Potential Consequences of Continued Operations of LANL: Normal Operations*-Continued

RESOURCE AREA	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
WATER RESOURCES				
Water Use	Effect of water use over the next 10 years (extracted from main aquifer) is an average drop in DOE well fields of up to 13 feet (4.0 meters).	Effect of water use over the next 10 years (extracted from main aquifer) is an average drop in DOE well fields of up to 15 feet (4.6 meters).	Effect of water use over the next 10 years (extracted from main aquifer) is an average drop in DOE well fields of up to 10 feet (3.1 meters).	Effect of water use over the next 10 years (extracted from main aquifer) is an average drop in DOE well fields of up to 14 feet (4.3 meters).
National Pollutant Discharge Elimination System (NPDES) Outfall Volumes	261 million gallons per year (988 million liters per year) discharged from outfalls (an increase of about 28 million gallons per year [106 million liters per year] from recent discharges).	278 million gallons per year (1,052 million liters per year) discharged from outfalls (an increase of about 45 million gallons per year [170 million liters per year] from recent discharges).	218 million gallons per year (825 million liters per year) discharged from outfalls (a decrease of about 15 million gallons per year [57 million liters per year] from recent discharges).	275 million gallons per year (1,041 million liters per year) discharged from outfalls (an increase of about 42 million gallons per year [159 million liters per year] from recent discharges).
Effect of Outfall Flows on Groundwater Quantities	No substantial changes to groundwater quantities are expected, as compared to recent experience, due to outfall flows.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.
Surface Water Quality	Outfall water quality should be similar to or better than in recent experience, so surface water quality on the site is not expected to change substantially as compared to existing quality.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.
Surface Contaminant Transport	Continued outfall flows are not expected to result in substantial contaminant transport off the site.	Similar to No Action Alternative; the small increase in outfall flows (as compared to No Action) are not expected to result in substantial contaminant transport off the site.	Same as No Action Alternative.	Same as Expanded Operations Alternative.

TABLE S.3.1–1.—*Comparison of Potential Consequences of Continued Operations of LANL: Normal Operations*-Continued

RESOURCE AREA	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
Groundwater Quality	Mechanisms for recharge to groundwater are highly uncertain; thus, the potential for LANL operations to contaminate groundwater is highly uncertain. It is possible that increased discharges could increase contaminant transport beneath Los Alamos Canyon and Sandia Canyon and off the site due to increased recharge to intermediate perched groundwater. No other effects can be projected based on existing information.	Same as No Action Alternative.	Although NPDES outfall flows are lower than in the other alternatives, it is still possible that the flows under this alternative could transport contaminants beneath Los Alamos Canyon and Sandia Canyon and off the site.	Same as No Action Alternative.
AIR QUALITY				
Criteria Pollutants	Criteria pollutant emissions are not expected to exceed ambient air quality standards and are not expected to approach levels that could affect human health.	Same as No Action Alternative. Construction activities associated with the Expansion of Area G and the Enhancement of Pit Manufacturing would be transitory and would not be expected to degrade air quality substantially.	Same as No Action Alternative.	Same as No Action Alternative.
Toxic Pollutants	Toxic air pollutants, including carcinogenic pollutants, are not expected to approach levels that could affect human health.	Firing site toxic emissions and the total of carcinogenic pollutant emissions exceeded screening values; but, more detailed analysis does not indicate that these emissions would have a significant effect on ecological resources or human health (see comments under those resource areas). Construction activities associated with the Expansion of Area G and the Enhancement of Pit Manufacturing would be transitory and would not be expected to degrade air quality substantially.	Same as No Action Alternative.	Same as No Action Alternative.

TABLE S.3.1–1.—*Comparison of Potential Consequences of Continued Operations of LANL: Normal Operations*-Continued

RESOURCE AREA	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
Radioactive Emissions Dose to the Public Maximally Exposed Individual (MEI)	3.1 mrem/year to the LANL MEI (see human health effects below).	5.4 mrem/year to the LANL MEI (see human health effects below).	1.9 mrem/year to the LANL MEI (see human health effects below).	4.5 mrem/year to the LANL MEI (see human health effects below).
Radioactive Emissions Population Dose	About 14 person-rem/year to the population within 50 miles (80 kilometers) of LANL (see human health effects below).	About 33 person-rem/year to the population within 50 miles (80 kilometers) of LANL (see human health effects below).	About 11 person-rem/year to the population within 50 miles (80 kilometers) of LANL (see human health effects below).	About 14 person-rem/year to the population within 50 miles (80 kilometers) of LANL (see human health effects below).
ECOLOGICAL AND BIOLOGICAL RESOURCES				
Biological Resources, Ecological Processes, and Biodiversity	No significant adverse impacts projected for biological resources, ecological processes, or biodiversity, including threatened and endangered species.	Same as the No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.
Habitat Reduction	No reduction in habitat projected.	Removal of about 7 acres (2.8 hectares) of habitat for small mammals and birds, plus fencing that could alter large mammal movement, are associated with the proposed dedicated road between TA–55 and TA–3. Gradual removal of up to approximately 41 acres (17 hectares) of pinyon-juniper woodland associated with the Area G expansion; corresponds to small wildlife habitat loss and disturbance.	Same as No Action Alternative.	Same as No Action Alternative.
Ecological Risk	No significant risk to biotic communities due to LANL legacy contamination or contamination due to ongoing operations.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.

TABLE S.3.1–1.—*Comparison of Potential Consequences of Continued Operations of LANL: Normal Operations*-Continued

RESOURCE AREA	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
		HUMAN HEALTH		
Public Health —Radiological (inhalation, ingestion, and external radiation pathways)[a]	Average total ingestion dose to: • Los Alamos County resident: 3.9 mrem/year of operation (2.0 x 10^{-6} excess latent cancer facilities (LCFs)/year of operation). • Non-Los Alamos County resident: 7.5 mrem/year of operation (3.8 x 10^{-6} excess LCFs/year of operation). • Nonresident recreational user: 0.2 mrem/year of operation (1.0 x 10^{-7} excess LCFs/year of operation). • Resident recreational user: 0.6 mrem/year of operation (2.8 x 10^{-7} excess LCFs/year of operation). Air pathway dose to: • LANL MEI: 3.11 mrem/year of operation (1.6 x 10^{-6} excess LCFs/year of operation). • Total population: 14 person-rem/year of operation (0.007 excess LCF/year of operation).	Average total ingestion doses are the same as under the No Action Alternative. Air pathway dose to: • LANL MEI: 5.44 mrem/year of operation (2.7 x 10^{-6} excess LCFs/year of operation). • Total population: 33 person-rem/year of operation (0.017 excess LCF/year of operation).	Average total ingestion doses are the same as under the No Action Alternative Air pathway dose to: • LANL MEI: 1.88 mrem/year of operation (9.4 x 10^{-7} excess LCFs/year of operation). • Total population: 11 person-rem/year of operation (0.005 excess LCF/year of operation).	Average total ingestion doses are the same as under the No Action Alternative. Air pathway dose to: • LANL MEI: 4.52 mrem/year of operation (2.3 x 10^{-6} excess LCFs/year of operation). • Total population: 14 person-rem/year of operation (0.007 excess LCF/year of operation).
Public Health —Chemical	No significant effect to off-site residents or to the recreational user.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.
Special Pathways[b]	No significant effect through special pathways (< 1 x 10^{-6} excess LCFs/year of operation).	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.

TABLE S.3.1–1.—*Comparison of Potential Consequences of Continued Operations of LANL: Normal Operations*-Continued

RESOURCE AREA	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
Worker Health—Radiological[a]	• Collective worker dose: 446 person-rem/year of operation (0.18 excess LCF/year of operation). • Average (non-zero) worker dose: 0.14 rem/year of operation (0.00005 excess LCF/year of operation).	• Collective worker dose: 833 person-rem/year of operation (0.33 excess LCF/year of operation). • Average (non-zero) worker dose: 0.24 rem/year of operation (0.000096 excess LCF/year of operation).	• Collective worker dose: 170 person-rem/year of operation (0.07 excess LCF/year of operation). • Average (non-zero) worker dose: 0.08 rem/year of operation (0.00003 excess LCF/year of operation).	• Collective worker dose: 472 person-rem/year of operation (0.19 excess LCF/year of operation). • Average (non-zero) worker dose: 0.14 rem/year of operation (0.00005 excess LCF/year of operation).
Worker Health—Chemical	1 to 3 reportable chemical exposures per year (none expected to result in serious injury or in fatalities).	2 to 5 reportable chemical exposures per year (none expected to result in serious injury or in fatalities).	Same as No Action Alternative.	Same as No Action Alternative.
Worker Health—Physical Safety Hazards	About 460 reportable cases per year.	About 507 reportable cases per year.	About 417 reportable cases per year.	Same as No Action Alternative.
ENVIRONMENTAL JUSTICE				
Environmental Justice Impacts	No disproportionately high or adverse impacts to minority or low-income populations identified.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.
CULTURAL RESOURCES				
Prehistoric Resources	Negligible to minor potential for effects to some prehistoric resources due to shrapnel or vibrations from explosives testing. However, inspection of resources does not indicate that past operations have caused such effects. Other effects of ongoing operations are negligible or small compared to legacy contamination and natural effects.	Similar to the impacts under No Action, except that Expanded Operations would mean increased frequency of explosives testing (potentially accelerating any damage due to shrapnel and ground vibration). In addition, the Expansion of Area G could affect 15 sites potentially eligible for the National Register of Historic Places; it is anticipated that a determination of no adverse effect would be achieved based on a data recovery plan.	Same as No Action Alternative.	Same as No Action Alternative.

TABLE S.3.1–1.—*Comparison of Potential Consequences of Continued Operations of LANL: Normal Operations*-Continued

RESOURCE AREA	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
Historic Resources	Negligible potential for future operations to add contaminants that may limit preservation options. Other effects of ongoing operations are negligible or small compared to legacy contamination and natural effects.	Similar to the impacts under No Action, except that Expanded Operations would mean increased frequency of explosives testing (potentially accelerating damage due to shrapnel and ground vibration).	Same as No Action Alternative.	Same as No Action Alternative.
Traditional Cultural Properties	Unknown due to a lack of information on specific traditional cultural properties. Potential for effects to all types of traditional cultural properties due to changes in water quality and quantity, erosion, explosives testing shrapnel, noise and vibrations from explosives testing, and contamination from ongoing operations. Security at LANL can prevent access by traditional communities to some traditional cultural properties.	Unknown due to a lack of information on specific traditional cultural properties. Similar to the impacts under No Action, except that Expanded Operations would mean increased frequency of explosives testing (potentially accelerating damage due to shrapnel, ground vibration, and noise). Additionally, traditional cultural properties could be affected by the Expansion of Area G; coordination with the four Accord Pueblos would be pursued to identify and mitigate any potential adverse effects.	Same as No Action Alternative.	Same as No Action Alternative.
SOCIOECONOMICS, INFRASTRUCTURE, AND WASTE MANAGEMENT				
LANL Employment	9,977 full-time equivalents	11,351 full-time equivalents	9,347 full-time equivalents	9,968 full-time equivalents
Tri-County Employment	Increase of 691 full-time equivalents, as compared to the 1995 regional employment, about 85,720.	Increase of 2,186 full-time equivalents, as compared to 1995 regional employment.	Decrease of 33 full-time equivalents, as compared to 1995 regional employment.	Increase of 680 full-time equivalents, as compared to 1995 regional employment.
Tri-County Population	Increase of 1,377 people, as compared to the estimated 1996 Tri-County population of 165,938.	Increase of 4,230 people, as compared to the 1996 estimated population.	Decrease of 64 people, as compared to the 1996 estimated population.	Increase of 1,316 people, as compared to the 1996 estimated population.
Tri-County Personal Income	Increase of about $53 million, as compared to the 1994 estimate of $3.5 billion.	Increase of $172 million, as compared to the 1994 estimate.	Decrease of $6 million, as compared to the 1994 estimate.	Increase of $55 million, as compared to the 1994 estimate.
Maximum Annual Electrical Demand	717 gigawatt-hours	782 gigawatt-hours	508 gigawatt-hours	782 gigawatt-hours

TABLE S.3.1–1.—*Comparison of Potential Consequences of Continued Operations of LANL: Normal Operations*-Continued

RESOURCE AREA	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
Peak Electrical Demand	108 megawatts (exceeds supply during winter and summer months). May result in area brownouts.	113 megawatts (exceeds supply during winter and summer months). May result in area brownouts.	88 megawatts (exceeds supply during winter months and within the existing supply the rest of the year). May result in brownouts.	113 megawatts (exceeds supply during winter and summer months). May result in area brownouts.
Maximum Annual Natural Gas Demand	1,840,000 decatherms (well within existing supply capacity).	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.
Maximum Annual Water Demand	712 million gallons per year (2,695 million liters per year) (DOE rights to water from main aquifer are adequate to meet this demand and other demands that draw from this right to water.)	759 million gallons per year (2,873 million liters per year) (DOE rights to water from main aquifer are adequate to meet this demand and other demands that draw from this right to water.)	602 million gallons per year (2,279 million liters per year) (DOE rights to water from main aquifer are adequate to meet this demand and other demands that draw from this right to water.)	759 million gallons per year (2,873 million liters per year) (DOE rights to water from main aquifer are adequate to meet this demand and other demands that draw from this right to water.)
Annual Chemical Waste Generation	6,264,953 pounds (2,886,000 kilograms)	7,164,045 pounds (3,249,000 kilograms)	6,345,990 pounds (2,878,000 kilograms)	6,372,450 pounds (2,890,000 kilograms)
Annual LLW Generation (includes low-level mixed waste [LLMW])	344,246 cubic feet (9,752 cubic meters)	454,417 cubic feet (12,873 cubic meters)	338,209 cubic feet (9,581 cubic meters)	382,123 cubic feet (10,825 cubic meters)
Annual Transuranic (TRU) Waste Generation (includes Mixed TRU Waste)	18,956 cubic feet (537 cubic meters)	19,274 cubic feet (546 cubic meters)	6,707 cubic feet (190 cubic meters)	8,825 cubic feet (250 cubic meters)
Increase in Contaminated Space	Increase of 63,000 square feet (5,853 square meters), as compared to the index.	Increase of 73,000 square feet (6,782 square meters), as compared to the index.	Same as No Action Alternative.	Same as No Action Alternative.

TABLE S.3.1–1.—*Comparison of Potential Consequences of Continued Operations of LANL: Normal Operations*-Continued

RESOURCE AREA	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
TRANSPORTATION (INCIDENT FREE)				
Public Radiation Exposure (Off-Site Shipments)[a]	• Along route: 3.3 person-rem/year of operation (0.0017 excess LCF/ year of operation). • Sharing route: 30 person-rem/year of operation (0.015 excess LCF/ year of operation). • At rest stops: 210 person-rem/year of operation (0.11 excess LCF/year of operation). • MEI: 0.0003 rem/year of operation (1.5×10^{-7} excess LCFs/year of operation).	• Along route: 4.2 person-rem/year of operation (0.0021 excess LCF/ year of operation). • Sharing route: 37 person-rem/year of operation (0.019 excess LCF/ year of operation). • At rest stops: 270 person-rem/year of operation (0.14 excess LCF/year of operation). • MEI: 0.0004 rem/year of operation (1.9×10^{-7} excess LCFs/year of operation).	• Along route: 3.5 person-rem/year of operation (0.0017 excess LCF/ year of operation). • Sharing route: 31 person-rem/year of operation (0.015 excess LCF/ year of operation). • At rest stops: 230 person-rem/year of operation (0.12 excess LCF/year of operation). • MEI: 0.0003 rem/year of operation (1.6×10^{-7} excess LCFs/year of operation).	• Along route: 3.6 person-rem/year of operation (0.0018 excess LCF/ year of operation). • Sharing route: 33 person-rem/year of operation (0.015 excess LCF/ year of operation). • At rest stops: 250 person-rem/year of operation (0.12 excess LCF/year of operation). • MEI: 0.0003 rem/year of operation (1.7×10^{-7} excess LCFs/year of operation).
Worker (Drivers) Radiation Exposure[a]	• Off-site: 470 person-rem/year of operation (0.19 excess LCF/year of operation). • On-site: 4.2 person-rem/year of operation (0.0018 excess LCF/year of operation).	• Off-site: 580 person-rem/year of operation (0.23 excess LCF/year of operation). • On-site: 10.3 person-rem/year of operation (0.0041 excess LCF/year of operation).	• Off-site: 510 person-rem/year of operation (0.21 excess LCF/year of operation). • On-site: 4.3 person-rem/year of operation (0.0017 excess LCF/year of operation).	• Off-site: 530 person-rem/year of operation (0.21 excess LCF/year of operation). • On-site: 4.5 person-rem/year of operation (0.0018 excess LCF/year of operation).

MEI = Maximally exposed individual (a hypothetical individual who takes no protective actions and receives the maximum potential dose). An MEI may be defined for a particular event or location or for the entire site. The LANL MEI is the MEI at LANL in the location that receives the highest possible dose out of all potential locations (used in this SWEIS for inhalation pathway analyses).

mrem = millirem

Note: The impacts of implementing the proposed actions in the Surplus Plutonium Disposition EIS, Lead Test Assembly (section 1.5.8); Siting, Construction, and Operation of the Spallation Neutron Source (section 1.5.9); and CT EIS (section 1.5.10) are summarized in chapter 5, section 5.6.

[a] Impacts, in terms of excess LCFs per year of operation, are used to quantify the risks of exposure to radiation. When the impact is applied to an individual (e.g., an MEI), the risk is a lifetime incremental probability of a fatal cancer per year of operation. When applied to a population of individuals, the risk is the incremental number of fatal cancers anticipated in the exposed population for each year of operation.

[b] Special pathways refers to the analyses performed regarding potential exposures to radioactive or other hazardous contaminants through pathways or practices associated with the traditional activities of communities in the area (e.g., smoking or drinking [as teas] locally grown herbs, increased ingestion of local fishes, or uses of soils or clays in arts and crafts).

TABLE S.3.1–2.—*Comparison of Potential Consequences of Continued Operations of LANL: Accidents*

ACCIDENT	MEASURE	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
TRANSPORTATION ACCIDENTS[c,f]					
Vehicle Accidents (No Cargo Release)	Accidents per year	4.5	9.0	4.9	5.2
	Resulting injuries per year	3.8	7.6	3.3	3.8
	Resulting fatalities per year	0.38	0.78	0.33	0.44
Release of Radioactive Cargo (Bounding Off-Site Accidents)	Radiation dose (person-rem/year)	2.8	3.0	2.8	3.0
	Resulting in excess LCF per year of operation (total along entire route)	0.0014	0.0016	0.0014	0.0016
Release of Radioactive Cargo (Bounding On-Site Accidents)	Plutonium-238: • Accidents per year • MEI dose (rem) • Resulting MEI risk	 8.8×10^{-8} 8.7 7.7×10^{-7} rem/year (3.1×10^{-10} excess LCFs/year)	 1.7×10^{-7} 8.7 1.4×10^{-6} rem/year (5.8×10^{-10} excess LCFs/year)	 8.8×10^{-8} 8.7 7.7×10^{-7} rem/year (3.1×10^{-10} excess LCFs/year)	 8.8×10^{-8} 8.7 7.7×10^{-7} rem/year (3.1×10^{-10} excess LCFs/year)
	Irradiated targets: • Accident frequency • MEI consequence • Resulting MEI risk	 3.1×10^{-6} Acute fatality 3.1×10^{-6} fatalities/year	 3.2×10^{-6} Acute fatality 3.2×10^{-6} fatalities/year	 2.9×10^{-6} Acute fatality 2.9×10^{-6} fatalities/year	 3.2×10^{-6} Acute fatality 3.2×10^{-6} fatalities/year
Release of Chemical Cargo	Chlorine: Injuries per year (total)	0.006	0.013	0.0056	0.006
	Chlorine: Fatalities per year (total)	0.0016	0.0036	0.0015	0.0016
	Propane: Injuries per year (total)	0.0014	0.0031	0.0014	0.0014
	Propane: Fatalities per year (total)	0.00035	0.00076	0.00032	0.00035

TABLE S.3.1–2.—*Comparison of Potential Consequences of Continued Operations of LANL: Accidents*-Continued

ACCIDENT	MEASURE	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
ACCIDENTS (OTHER THAN TRANSPORTATION ACCIDENTS AND WORKER PHYSICAL SAFETY INCIDENTS/ACCIDENTS)[c]					
SITE–01: Site-Wide Earthquake with Severe Damage to Multiple Low-Capacity Facilities[a]	Event frequency (per year)	0.0029	0.0029	0.0029	0.0029
	MEI dose (rem)	20	20	20	20
	Public exposure (person-rem) excess LCF	27,726 16	27,726 16	27,726 16	27,726 16
SITE–02: Site-Wide Earthquake with Severe Damage to Multiple Moderate-Capacity Facilities[a]	Event frequency (per year)	0.00044	0.00044	0.00044	0.00044
	MEI dose (rem)	34	34	34	34
	Public exposure (person-rem) excess LCF	41,340 24	41,340 24	41,340 24	41,340 24
SITE–03: Site-Wide Earthquake with Severe Damage to Essentially All Facilities[a,d]	Event frequency (per year)	0.000071	0.000071	0.000071	0.000071
	MEI dose (rem)	247	247	247	247
	Public exposure (person-rem) excess LCF	210,758 134	210,758 134	210,758 134	210,758 134
SITE–04: Site-Wide Wildfire Consuming Combustible Structures and Vegetation	Event frequency (per year)	0.1	0.1	0.1	0.1
	MEI dose (rem)	< 25	< 25	< 25	< 25
	Public exposure (person-rem) excess LCF	675 0.34	675 0.34	669 0.33	675 0.34
RAD–12: Plutonium Release from a Seismically Initiated Event	Event frequency (per year)	Approximately 1.5×10^{-6}	Approximately 1.5×10^{-6}	Approximately 1.5×10^{-6}	Approximately 1.5×10^{-6}
	MEI dose (rem)	138	138	138	138
	Public exposure (person-rem) excess LCF	Approximately 35,800 18	Approximately 35,800 18	Approximately 35,800 18	Approximately 35,800 18
	Worker consequences	Any in the facility would be killed by explosion or falling debris.	Any in the facility would be killed by explosion or falling debris.	Any in the facility would be killed by explosion or falling debris.	Any in the facility would be killed by explosion or falling debris.

TABLE S.3.1–2.—*Comparison of Potential Consequences of Continued Operations of LANL: Accidents*-Continued

ACCIDENT	MEASURE	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
CHEM–01: Single Cylinder Chlorine Release from Potable Water Treatment Station (TA–0)	Event frequency (per year)	0.0012	0.0013	0.0011	0.0012
	MEI	NA	NA	NA	NA
	Public exposed to: > ERPG–3 > ERPG–2[b]	 12 43	 12 43	 12 43	 12 43
	Worker consequences	If workers are present, there is potential for worker injury or fatality.	If workers are present, there is potential for worker injury or fatality.	If workers are present, there is potential for worker injury or fatality.	If workers are present, there is potential for worker injury or fatality.
CHEM–02: Multiple Cylinder Chlorine Release from Toxic Gas Storage Facility (TA–3)	Event frequency (per year)	0.00013	0.00015	0.00012	0.00013
	MEI	NA	NA	NA	NA
	Public exposed to > ERPG–3 or > ERPG–2	292	292	292	292
	Worker consequences	Possible injuries or fatalities to workers present at time of accident or responding to accident.	Possible injuries or fatalities to workers present at time of accident or responding to accident.	Possible injuries or fatalities to workers present at time of accident or responding to accident.	Possible injuries or fatalities to workers present at time of accident or responding to accident.
CHEM–03: Single Cylinder Chlorine Release from Toxic Gas Storage Facility (TA–3)	Event frequency (per year)	0.00012	0.00012	0.00012	0.00012
	MEI	NA	NA	NA	NA
	Public exposed to: > ERPG–3 > ERPG–2	 239 263	 239 263	 239 263	 239 263
	Worker consequences	Unlikely that workers are present; but if present, there is potential for worker injury or fatality.	Unlikely that workers are present; but if present, there is potential for worker injury or fatality.	Unlikely that workers are present; but if present, there is potential for worker injury or fatality.	Unlikely that workers are present; but if present, there is potential for worker injury or fatality.

TABLE S.3.1–2.—*Comparison of Potential Consequences of Continued Operations of LANL: Accidents*-Continued

ACCIDENT	MEASURE	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
CHEM–04: Bounding Single Container Release of Toxic Gas (Selenium Hexaflouride) from Toxic Gas Cylinder Storage (TA–54)	Event frequency (per year)	0.004	0.004	0.004	0.004
	MEI	NA	NA	NA	NA
	Public exposed to: > ERPG–3 > ERPG–2	 0 0	 0 0	 0 0	 0 0
	Worker consequences	Possible injuries or fatalities to up to 5 workers present at time of accident.	Possible injuries or fatalities to up to 5 workers present at time of accident.	Possible injuries or fatalities to up to 5 workers present at time of accident.	Possible injuries or fatalities to up to 5 workers present at time of accident.
CHEM–05: Bounding Multiple Cylinder Release of Toxic Gas (Sulfur Dioxide) from Toxic Gas Cylinder Storage (TA–54)	Event frequency (per year)	0.00051	0.00051	0.00051	0.00051
	MEI	NA	NA	NA	NA
	Public exposed to: > ERPG–3 > ERPG–2	 0 0	 0 0	 0 0	 0 0
	Worker consequences	Possible injuries or fatalities to up to 5 workers present at time of accident.	Possible injuries or fatalities to up to 5 workers present at time of accident.	Possible injuries or fatalities to up to 5 workers present at time of accident.	Possible injuries or fatalities to up to 5 workers present at time of accident.
CHEM–06: Chlorine Gas Release from Plutonium Facility (TA–55) Process Line	Event frequency (per year)	0.063	0.063	0.063	0.063
	MEI	NA	NA	NA	NA
	Public exposed to: > ERPG–3 > ERPG–2	 7 102	 7 102	 7 102	 7 102
	Worker consequences	Unlikely that workers are present; but if present, there is potential for worker injury.	Unlikely that workers are present; but if present, there is potential for worker injury.	Unlikely that workers are present; but if present, there is potential for worker injury.	Unlikely that workers are present; but if present, there is potential for worker injury.

TABLE S.3.1–2.—*Comparison of Potential Consequences of Continued Operations of LANL: Accidents*-Continued

ACCIDENT	MEASURE	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
RAD–01: Plutonium Release from Container Storage Area Fire Involving TRU Waste Drums (TA–54)	Event frequency (per year)	0.0016	0.0016	0.0016	0.0016
	MEI dose (rem)	46	46	46	46
	Public exposure (person-rem) excess LCF	72 0.04	72 0.04	72 0.04	72 0.04
	Worker consequences	Potential for plutonium inhalation, but no fatalities would be expected.	Potential for plutonium inhalation, but no fatalities would be expected.	Potential for plutonium inhalation, but no fatalities would be expected.	Potential for plutonium inhalation, but no fatalities would be expected.
RAD–03: Reactivity Excursion at Pajarito Site (TA–18) Kiva #3, Vaporizing Some Enriched Uranium Fuel and Melting the Remainder	Event frequency (per year)	3.4×10^{-6}	3.4×10^{-6}	3.4×10^{-6}	3.4×10^{-6}
	MEI dose rem[e]	150	150	150	150
	Public exposure (person-rem) excess LCF	110 0.06	110 0.06	110 0.06	110 0.06
	Worker consequences	No acute fatalities would be expected.	No acute fatalities would be expected.	No acute fatalities would be expected.	No acute fatalities would be expected.
RAD–05: Aircraft Crash with Explosion and/or Fire at TA–21 Resulting in Tritium Oxide Release	Event frequency (per year)	5.3×10^{-6}	5.3×10^{-6}	5.3×10^{-6}	5.3×10^{-6}
	MEI dose (rem)	0.01	0.01	0.01	0.01
	Public exposure (person-rem) excess LCF	24 0.01	24 0.01	24 0.01	24 0.01
	Worker consequences	Aircraft crash could cause injuries and accidents to workers present; workers not affected by crash could be exposed to tritium oxide released by crash.	Aircraft crash could cause injuries and accidents to workers present; workers not affected by crash could be exposed to tritium oxide released by crash.	Aircraft crash could cause injuries and accidents to workers present; workers not affected by crash could be exposed to tritium oxide released by crash.	Aircraft crash could cause injuries and accidents to workers present; workers not affected by crash could be exposed to tritium oxide released by crash.

TABLE S.3.1–2.—*Comparison of Potential Consequences of Continued Operations of LANL: Accidents*-Continued

ACCIDENT	MEASURE	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
RAD–07: Plutonium Release due to Container Storage Area Fire Involving TRU Waste Drums (TA–50)	Event frequency (per year)	0.00015	0.0003	0.00011	0.00015
	MEI dose (rem)	74	74	74	74
	Public exposure (person-rem) excess LCF	1,300 0.69	1,300 0.69	1,300 0.69	1,300 0.69
	Worker consequences	No acute fatalities would be expected.	No acute fatalities would be expected.	No acute fatalities would be expected.	No acute fatalities would be expected.
RAD–08: Aircraft Crash with Explosion and/or Fire at the TRU Waste Area at TA–54	Event frequency (per year)	4.3×10^{-6}	4.3×10^{-6}	4.3×10^{-6}	4.3×10^{-6}
	MEI dose (rem)	22	22	22	22
	Public exposure (person-rem) excess LCF	400 0.2	400 0.2	400 0.2	400 0.2
	Worker consequences	Aircraft crash could cause injuries and fatalities to workers present; workers not affected by crash could be exposed to plutonium released by crash.	Aircraft crash could cause injuries and fatalities to workers present; workers not affected by crash could be exposed to plutonium released by crash.	Aircraft crash could cause injuries and fatalities to workers present; workers not affected by crash could be exposed to plutonium released by crash.	Aircraft crash could cause injuries and fatalities to workers present; workers not affected by crash could be exposed to plutonium released by crash.
RAD–09: TRU Waste Drum Failure or Puncture at TA–54, Area G (results are for typical drum)	Event frequency (per year)	0.4	0.49	0.4	0.4
	MEI dose (rem)	0.41	0.41	0.41	0.41
	Public exposure (person-rem) excess LCF	4.3 0.002	4.3 0.002	4.3 0.002	4.3 0.002
	Worker consequences	Some workers could inhale plutonium (dose would depend on protective measures taken), but no acute fatalities would be expected.	Some workers could inhale plutonium (dose would depend on protective measures taken), but no acute fatalities would be expected.	Some workers could inhale plutonium (dose would depend on protective measures taken), but no acute fatalities would be expected.	Some workers could inhale plutonium (dose would depend on protective measures taken), but no acute fatalities would be expected.

TABLE S.3.1–2.—*Comparison of Potential Consequences of Continued Operations of LANL: Accidents*-Continued

ACCIDENT	MEASURE	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
RAD–13: Plutonium Melting and Release Accident at Pajarito Site (TA–18) Kiva #3	Event frequency (per year)	0.000016	0.000016	0.000016	0.000016
	MEI dose (rem)	120	120	120	120
	Public exposure (person-rem) excess LCF	160 0.08	160 0.08	160 0.08	160 0.08
	Worker consequences	No acute fatalities would be expected.	No acute fatalities would be expected.	No acute fatalities would be expected.	No acute fatalities would be expected.
RAD–15: Plutonium Release from a Wing Fire at the CMR Building (in TA–3)	Event frequency (per year)	0.000032	0.000032	0.000032	0.000032
	MEI dose (rem)	40	91	40	40
	Public exposure (person-rem) excess LCF	1,700 0.85	3,400 1.7	1,700 0.85	1,700 0.85
	Worker consequences	1 to 3 workers present in accident location could be injured or killed due to fire; if not killed, could inhale plutonium. Other workers in the area could be affected by smoke inhalation.	1 to 3 workers present in accident location could be injured or killed due to fire; if not killed, could inhale plutonium. Other workers in the area could be affected by smoke inhalation.	1 to 3 workers present in accident location could be injured or killed due to fire; if not killed, could inhale plutonium. Other workers in the area could be affected by smoke inhalation.	1 to 3 workers present in accident location could be injured or killed due to fire; if not killed, could inhale plutonium. Other workers in the area could be affected by smoke inhalation.
RAD–16: Aircraft Crash with Explosion and/or Fire at the CMR Building (in TA–3) Resulting in a Plutonium Release	Event frequency (per year)	3.5×10^{-6}	3.5×10^{-6}	3.5×10^{-6}	3.5×10^{-6}
	MEI dose (rem)	3	3	3	3
	Public exposure (person-rem) excess LCF	56 0.03	56 0.03	56 0.03	56 0.03
	Worker consequences	Aircraft crash could cause injuries and accidents to nearly all workers in the building; workers not affected by crash could be exposed to plutonium released by crash.	Aircraft crash could cause injuries and accidents to nearly all workers in the building; workers not affected by crash could be exposed to plutonium released by crash.	Aircraft crash could cause injuries and accidents to nearly all workers in the building; workers not affected by crash could be exposed to plutonium released by crash.	Aircraft crash could cause injuries and accidents to nearly all workers in the building; workers not affected by crash could be exposed to plutonium released by crash.

TABLE S.3.1–2.—*Comparison of Potential Consequences of Continued Operations of LANL: Accidents*-Continued

ACCIDENT	MEASURE	NO ACTION	EXPANDED OPERATIONS	REDUCED OPERATIONS	GREENER
WORK–01: Worker Fatality Due to Inadvertent High Explosives Detonation	Event frequency (per year)	0.001 to 0.01	0.0015 to 0.015	0.0008 to 0.008	0.0006 to 0.006
	Worker injuries or fatalities	1 to 10 injuries or fatalities.	1 to 10 injuries or fatalities.	1 to 10 injuries or fatalities.	1 to 10 injuries or fatalities.
WORK–02: Worker Illness or Fatality Due to Inadvertent Biohazard Contamination	Event frequency (per year)	0.01 to 0.1	0.01 to 0.1	0.01 to 0.1	0.01 to 0.1
	Worker injuries or fatalities	1 injury or fatality.	1 injury or fatality.	1 injury or fatality.	1 injury or fatality.
WORK–03: Multiple Worker Fatality Due to Inadvertent Nuclear Criticality Event	Event frequency (per year)	< 0.00001	< 0.00001	< 0.00001	< 0.00001
	Worker exposures or fatalities	Substantial doses and possible fatalities.	Substantial doses and possible fatalities.	Substantial doses and possible fatalities.	Substantial doses and possible fatalities.
WORK–04: Worker Injury or Fatality Due to Inadvertent Nonionizing Radiation Exposure	Event frequency (per year)	0.01 to 0.1	0.01 to 0.1	0.01 to 0.1	0.01 to 0.1
	Worker injuries or fatalities	Typically 1, rarely several, injuries or fatalities.	Typically 1, rarely several, injuries or fatalities.	Typically 1, rarely several, injuries or fatalities.	Typically 1, rarely several, injuries or fatalities.
WORK–05: Worker Exposure to Plutonium Released from a Degraded Storage Container at TA–55	Event frequency (per year)	0.23	0.23	0.23	0.23
	Worker injuries or fatalities	1 or 2 workers potentially exposed to plutonium inhalation.	1 or 2 workers potentially exposed to plutonium inhalation.	1 or 2 workers potentially exposed to plutonium inhalation.	1 or 2 workers potentially exposed to plutonium inhalation.

MEI = Maximally exposed individual (a hypothetical individual who takes no protective actions and receives the maximum potential dose). An MEI may be defined for a particular event or location or for the entire site. The LANL MEI is the MEI at LANL in the location that receives the highest possible dose out of all potential locations (used in this SWEIS for inhalation pathway analyses).

ERPG = Emergency Planning Response Guideline

NA = Not Applicable

[a] Workers in buildings that are structurally damaged or collapse could be injured or killed, but the number of workers injured or killed cannot be predicted a priori. Worker excess latent cancer fatalities due to radiological releases in an earthquake and worker injuries or fatalities due to chemical releases in an earthquake are expected to be small or modest increments to the impacts directly attributable to the earthquake (e.g., the collapse of structures). The estimates of event frequencies and impacts are conservative.

[b] ERPG–2 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without irreversible or serious health effects or symptoms that could impair their abilities to take protective action. ERPG–3 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without life-threatening health effects.

[c] Impacts, in terms of excess LCFs per year of operation, are used to quantify the risks of exposure to radiation. When the impact is applied to an individual (e.g., an MEI), the risk is a lifetime incremental probability of a fatal cancer per year of operation. When applied to a population of individuals, the LCFs per year expresses is incremental number of fatal cancers anticipated in the exposed population for each year of operation.

[d] There is a potential for fault rupturing to occur at the CMR Building (TA–3–29) at a somewhat lower frequency than the SITE–03 earthquake (estimated at 1 to 3 x 10^{-5} per year). Should this occur in association with the SITE–03 earthquake, a conservative estimate results in an additional 133,833 person-rem population exposure (increasing excess LCFs by 99), and an increase to the MEI of 134 rem.

[e] The MEI dose is provided, under this accident scenario, for an individual located on Pajarito Road at a distance of 164 feet (50 meters) from the facility, even though Pajarito Road would be closed to the public during outdoor operations.

TABLE S.3.1–2.—*Comparison of Potential Consequences of Continued Operations of LANL: Accidents*-Continued

[f] Transportation accidents are typically calculated using computer codes, considering varying accident rates for route types, varying populations along the routes, and other factors. The calculated risks are presented as the product of the accident frequency and the accident consequence; for such calculations, the frequency and consequence terms are not readily accessible from the calculational results. As such, this table reflects the risks associated with transportation accidents, but generally does not separately present the consequence and frequency terms. The on-site radioactive transportation analyses were done by hand calculations, and for these accidents, frequency, consequence, and risk are all presented separately in the table.

Note: Often, there are no differences between accident impacts among the alternatives, largely as a result of conservative approaches used in accident frequency and public consequence. The inventories used in the analyses are typically those of permitted or administrative limits (i.e., controls on the maximum amounts of material that can be processed at one time and/or in storage), rather than operational values (i.e., the actual amount of material needed to perform the task). The operational values would be more likely to change among the alternatives. The administrative limits or inventories are selected so that the analyses are sufficiently conservative and bounding to cover maximum possible operational values. The accident frequencies depend upon the accident initiators, such as an aircraft crash, earthquake, or wildfire. These particular initiators are independent of the operations and of inventory; therefore, the frequency or likelihood of such an event remains constant among the alternatives. In the few cases of accidents in which the frequency depends upon operations, the variation in frequency among the alternatives does not necessarily translate into a significant change in the risk of an environmental release to the public because the value of a release is very small. Likewise, the risk to workers is affected by the change in frequency of the operations; but, the consequence of a single accident remains the same.

and accidents resulting from external human activities (such as airplane crashes and transportation accidents).

The major contributors to environmental impacts of operating LANL are wastewater discharges and radioactive air emissions.

- Historic discharges to Mortandad Canyon from the Radioactive Liquid Waste Treatment Facility have resulted in above background residual radionuclide (americium, plutonium, strontium-90, and cesium-137) concentrations, as well as nitrates in alluvial groundwater and sediments.
- Plutonium deposits have been detected along the Rio Grande between Otowi and Cochiti Lake.
- The principal contributors to radioactive air emissions have been and continue to be the Los Alamos Neutron Science Center and high explosives testing activities.

In addition, trace amounts of tritium have been detected in some samples from the main aquifer. (Isolated results have indicated the presence of other radionuclides. However, results have not been duplicated in previous or subsequent samples, making these results suspect.)

The analysis in the SWEIS indicates that there would be very little difference in the environmental impacts among the SWEIS alternatives analyzed. The major discriminators among alternatives would be: collective worker risk due to radiation exposure, socioeconomic effects due to LANL employment changes, and electrical power demand. The separate analyses of impacts to air and water resources constitute some of the source information for analysis of impacts to human health and the environment. As can be seen from those presentations, the variation across the alternatives is not of a sufficient magnitude to cause large differences in effects.

Often, there are no differences between accident impacts among the alternatives, largely as a result of conservative approaches used in accident frequency and public consequence. The inventories used in the analyses are typically those of permitted or administrative limits (i.e., controls on the maximum amounts of material that can be processed at one time and/or in storage), rather than operational values (i.e., the actual amount of material needed to perform the task). The operational values would be more likely to change among the alternatives. The administrative limits or inventories are selected so that the analyses are sufficiently conservative and bounding to cover maximum possible operational values. The accident frequencies depend upon the accident initiators, such as an aircraft crash, earthquake, or wildfire. These particular initiators are independent of the operations and of inventory; therefore, the frequency or likelihood of such an event remains constant among the alternatives. In the few cases of accidents in which the frequency depends upon operations, the variation in frequency among the alternatives does not necessarily translate into a significant change in the risk of an environmental release to the public because the value of a release is very small. Likewise, the risk to workers is affected by the change in frequency of the operations; but, the consequence of a single accident remains the same. The following information highlights the similarities and differences between the consequences of alternatives.

S.3.1.1 *Land Resources*

There is little difference in the impacts to land resources between the No Action, Reduced Operations, and the Greener Alternatives. Differences among the alternatives are primarily associated with operations in existing facilities, and very little new development is planned. Therefore, these impacts are essentially the same as currently experienced. The Expanded Operations Alternative has very similar land resources impacts to those of the

other three alternatives, with the principal differences being attributable to the visual impacts of lighting along the proposed transportation corridor and the noise and vibration associated with increased frequency of high explosives testing (as compared to the other three alternatives).

S.3.1.2 *Geology, Geological Conditions, and Soils*

There is little difference in the impacts to these resources across the alternatives. Wastewater discharge volumes with associated contaminants do change across the alternatives, but not to a degree noticeable in terms of impacts (such as causing soil erosion, for example). Under all of the alternatives, small quantities (as compared to existing conditions) of contaminants would be deposited in soils due to continued LANL operations and the Environmental Restoration Project (discussed further in section S.3.3) would continue to remove existing contaminants at sites to be remediated.

Geological mapping and fault trenching studies at LANL are currently underway or recently completed to better define the rates of fault movements, specifically for the Pajarito Fault, and the location and possible southern termination of the Rendija Canyon Fault. Appendix I of the SWEIS presents a detailed status of the ongoing and recently completed seismic hazard studies, as well as the implications of these studies for LANL and DOE. That report indicates that slip rates (recurrence intervals for earthquakes) are within the parameters assumed in the 1995 seismic hazards study at LANL (chapter 4, section 4.2.2.2).

S.3.1.3 *Water Resources*

Water demand under all alternatives (section S.3.1.9, below) is within existing DOE Rights to Water, and would result in average drops of 10 to 15 feet (3.1 to 4.6 meters) in the water levels in DOE well fields over the next 10 years. Except for cooling water used for the TA–53 accelerator facilities, there are not predominant industrial water users at LANL. Usage, therefore, will remain within a fairly tight range among the alternatives. The related aspect of wastewater discharges is also within a narrow range for that reason. Outfall flows range from 218 to 278 million gallons (825 to 1,052 million liters) per year across the alternatives, and these flows are not expected to result in substantial changes to existing surface or groundwater quantities. Outfall flows are not expected to result in substantial surface contaminant transport under any of the alternatives. Although mechanisms for recharge to groundwater are highly uncertain, it is possible that discharges under any of the alternatives could result in contaminant transport in groundwater and off the site, particularly beneath Los Alamos Canyon and Sandia Canyon, which have increased outfall flows. (The outfall flows associated with the Expanded Operations and Greener Alternatives would reflect the largest potential for such contaminant transport, and the flows associated with the Reduced Operations Alternative would have the least potential for such transport.)

S.3.1.4 *Air Quality*

Nonradioactive hazardous air pollutants would not be expected to degrade air quality or affect human health under any of the alternatives. The differences across the alternatives do not result in large changes in chemical usage. The activities at LANL are such that large amounts are not typically used in any industrial process (as may be found in manufacturing facilities); but research and development activities

involving many users dispersed throughout the site are the norm. Air emissions are therefore not expected to change by a magnitude that would, for example, trigger more stringent regulatory requirements or warrant continuous monitoring. Radioactive air emissions change slightly, but are within a narrow range due to the controls placed on these types of emissions and the need to assure compliance with regulatory standards. The collective population radiation doses from these emissions range from about 11 person-rem per year to 33 person-rem per year across the alternatives (primarily from TA–53 and high explosives testing activities), and the radiation dose to the LANL maximally exposed individual ranges from 1.9 millirem per year to 5.4 millirem per year across the alternatives (primarily from the operations at TA–53). These doses are considered in the human health impact analysis.

S.3.1.5 *Ecological and Biological Resources*

No significant adverse impact to these resources is projected under any of the alternatives. The separate analyses of impacts to air and water resources constitute some of the source information for analysis of impacts in this area; as can be seen from those presentations, the variation across the alternatives are not of a sufficient magnitude to cause large differences in effects. The impacts of the Expanded Operations Alternative differs from those of the other alternatives in that there is some projected loss of habitat; however, this habitat loss is small (due to limited new construction) compared to available similar habitat in the immediate vicinity, and no significant adverse effects to ecological or biological resources is expected.

S.3.1.6 *Human Health*

The total radiological doses over the next 10 years to the public under any of the SWEIS alternatives are relatively small, as compared to doses due to background radiation in the area (about 0.3 rem per year) and would not be expected to result in any excess latent cancer fatalities (LCFs) to members of the public. Additionally, exposure to chemicals due to LANL operations under any of the SWEIS alternatives are not expected to result in significant effects to either workers or the public. Exposure pathways associated with the traditional practices of communities in the LANL area (special pathways) would not be expected to result in human health effects under any of the alternatives. The annual collective radiation dose to workers at LANL ranges from 170 person-rem per year to 833 person-rem per year across the SWEIS alternatives. (The difference is primarily attributable to the differences in Los Alamos Neutron Science Center (LANSCE) accelerator operations and TA–55–4 actinide processing and pit fabrication activities.) These dose levels would be expected to result in from 0.07 to 0.33 excess LCFs per year of operation, respectively, among the exposed workforce.

These impacts, in terms of excess LCFs per year of operation, reflect the numbers of excess fatal cancers estimated to occur among the exposed members of the work force over their lifetimes per year of LANL operations. The reader should recognize these estimates are intended to provide a conservative measure of the potential impacts to be used in the decision-making process and do not necessarily portray an accurate representation of actual anticipated fatalities. In other words, one could expect that the stated impacts form an upper bound and that actual consequences could be less, but probably would not be worse. Worker exposures to physical safety hazards are expected to result in a range of 417 (Reduced Operations) to 507 (Expanded Operations) reportable cases each year; typically, such cases would result in minor or short-term effects to workers, but some of these incidents could result in long-term health effects or even death.

S.3.1.7 *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 action and alternatives would have disproportionately high and adverse impacts on minority or low-income populations. Based on the analysis of other impact 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 impact to affect all populations in the area equally. DOE also analyzed human health impacts from exposure through special pathways, including ingestion of game animals, fish, native vegetation, surface waters, sediments, and local produce; absorption of contaminants in sediments through the skin; and inhalation of plant materials. 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, human health impacts associated with these special pathways also would not present disproportionately high and adverse impacts to minority or low-income populations.

S.3.1.8 *Cultural Resources*

Under all of the SWEIS alternatives there is a negligible to low potential for impacts to archaeological and historic resources due to shrapnel and vibration caused by explosives testing and contamination from emissions. Logically, potential impacts would vary in intensity in accordance with the frequency of explosives tests and the operational levels that generate emissions (e.g., Reduced Operations would reflect the lowest potential, and Expanded Operations would reflect the highest potential). Recent assessments of prehistoric resources indicate a low potential compared to the effects of natural conditions (wind, rain, etc.). In addition to these potential impacts, the Expanded Operations Alternative includes the expansion of the LLW disposal site at TA–54, which contains several National Register of Historic Places (NRHP) sites; it is anticipated that a determination of no adverse effect to these resources would be achieved based on a data recovery plan.

The potential impacts to specific traditional cultural properties (TCPs) would depend on their number, characteristics, and location. Such resources could be adversely affected by changes in water quality and quantity, erosion, shrapnel from explosives testing, noise and vibration from explosives testing, and contamination from ongoing operations. Such impacts would vary in intensity in accordance with the frequency of explosives tests and the operational levels that generate emissions. The current practice of consultation would continue to be used to provide opportunities to avoid or minimize adverse impacts to any TCPs located at LANL.

S.3.1.9 *Socioeconomics, Infrastructure, and Waste Management*

LANL employment (including UC employees and those of the two subcontractors with the largest employment among the LANL subcontractors) ranges from 9,347 (Reduced Operations) to 11,351 (Expanded Operations) full-time equivalents across the alternatives, as compared to 9,375 LANL full-time equivalents in 1996. These changes in employment would result in changes in regional population, employment, personal income, and other socioeconomic measures. These secondary effects would change existing conditions in the region by less than 5 percent.

Peak electrical demand under the Reduced Operations Alternative exceeds supply during the winter months and may result in periodic

brownouts. Peak electrical demand under the No Action, Expanded Operations, and Greener Alternatives exceeds the power supply in winter and summer; this may result in periodic brownouts. (Power supply to the Los Alamos area has been a concern for a number of years, and DOE continues to work with other users in the area and power suppliers to increase this supply.) Natural gas demand is not projected to change across the alternatives, and this demand is within the existing supply of natural gas to the area; however, the age and condition of the existing supply and distribution system will continue to be a reliability issue for LANL and for residents and other businesses in the area. Water demand for LANL ranges from 602 million gallons (2,279 million liters) per year to 759 million gallons (2,873 million liters) per year across the alternatives; the total water demand (including LANL and the residences and other businesses and agencies in the area) is within the existing DOE rights to water.

LANL chemical waste generation ranges from 3,173 to 3,582 tons (2,878,000 to 3,249,300 kilograms) per year across the alternatives. LANL LLW generation, including low-level mixed waste (LLMW), ranges from 338,210 to 456,530 cubic feet (9,581 to 12,837 cubic meters) per year across the alternatives. LANL transuranic (TRU) waste generation, including mixed TRU waste, ranges from 6,710 to 19,270 cubic feet (190 to 547 cubic meters) across the alternatives. Disposal of these wastes at on-site or off-site locations is projected to constitute a relatively small portion of the existing capacity for disposal sites; disposal of all LANL LLW on the site would require expansion of the LLW disposal capacity beyond the existing footprint of TA–54 Area G under all alternatives (although this is only included in the analysis of the Expanded Operations Alternative).

Radioactively contaminated space in LANL facilities would increase by about 63,000 square feet (5,853 square meters) under the No Action, Reduced Operations, and Greener Alternatives (due primarily to actions previously reviewed under NEPA but not fully implemented at the time the existing contaminated space estimate was established [May 1996]). The Expanded Operations Alternative would increase contaminated space in LANL facilities by about 73,000 square feet (6,782 square meters). The creation of new contaminated space implies a clean-up burden in the future, including the generation of radioactive waste for treatment and disposal; the actual impacts of such clean-up actions are highly uncertain because they are dependent on the actual characteristics of the facility technologies available and the applicable requirements at the time of the cleanup.

S.3.1.10 *Transportation*

Incident-free transportation associated with LANL activities over the next 10 years would be conservatively expected to cause radiation doses that would result in about one excess LCF to a member of the public and two excess LCFs to members of the LANL workforce over their lifetimes under each of the SWEIS alternatives. (Refer to the discussion of the limitations on quantitative estimates of excess LCF risks in section S.3.1.6.) There is little variation in impacts because effects are small, and the increased transport of radioactive materials is not enough to make a significant change in those small effects.

Transportation accidents without an associated cargo release over the next 10 years of LANL operations are conservatively projected to result in from 33 to 76 injuries and 3 to 8 fatalities (including workers and the public) across the alternatives. The bounding off-site and on-site transportation accidents over the next 10 years involving a release of cargo would not be expected to result in any injuries or fatalities to

members of the public for any of the alternatives. Accidents were analyzed by type of material, and the maximum quantities were selected for analysis. These parameters do not change across the alternatives. Total risk also does not change appreciably across the alternatives because the frequency of shipments does not vary enough to substantially influence the result.

S.3.1.11 *Accidents (Other than Transportation Accidents and Worker Physical Safety Incidents/Accidents)*

The SWEIS accident analyses considered a variety of initiators (including natural and manmade phenomena), the range of activities at LANL, and the range of radioactive and other hazardous materials at LANL. Transportation accidents and the relatively frequent worker physical safety incidents/accidents were considered separately (sections S.3.1.10 and S.3.1.6, respectively). The accidents discussed in this section are those that bound the accident risks at LANL (other than transportation and physical safety incidents/accidents).

The operational accident analysis included four scenarios that would result in multiple source releases of hazardous materials: three due to a site-wide earthquake and one due to a wildfire. (Three different earthquake magnitudes were analyzed [labeled SITE–01, SITE–02, and SITE–03], resulting in three different degrees of damage and consequences and one wildfire scenario [labeled SITE–04].) These four scenarios dominate the radiological risk due to accidents at LANL because they involve radiological releases at multiple facilities and are considered credible (that is, they would be expected to occur more often than once in a million years), with the wildfire considered likely. Another earthquake-initiated accident, labelled RAD–12, is facility-specific (to Building TA–16–411) and is dominated by the site-wide earthquake accidents due to its very low frequency (about 1.5×10^{-6} per year). It is noteworthy that the consequences of such earthquakes are dependent on the frequency of the earthquake event, the facility design, and the amount of material that could be released due to the earthquake; such features do not change across the SWEIS alternatives, so the impacts of these accidents are the same for all four alternatives. The risks were estimated conservatively in terms of both the frequency of the events and the consequences of such events. (In particular, it is noteworthy that the analysis assumes that any building that would sustain structural or systems damage in an earthquake scenario does so in a manner that creates a path for release of material outside of the building.) The total societal risk of an accident is the product of the accident frequency and the consequences to the total population within 50 miles (80 kilometers). This risk, as presented in chapter 5 and in appendix G, ranges from 0.046 (SITE–01) and 0.034 (SITE–04) excess LCFs per year of operation, to extremely small numbers for most of the radiological accidents[2]. The societal risk for release of chemicals, such as chlorine, is calculated similarly as the product of the frequency and numbers of people exposed to greater than the selected guideline concentration, Emergency Response Planning Guideline (ERPG)–2[3]. The risks for chemical releases range from 6.4

2. As an example, for SITE–01 the societal risk of 0.046 excess LCFs per year was calculated by multiplying the event frequency of 0.0029 per year by the consequence to the population of 16 excess LCFs (Table S.3.1–2). The excess LCFs resulting from public exposure are calculated by an approved model, such as the MACCS code, or alternatively multiplying the public exposure of 27,726 person-rem (from accident analysis) by the conversion factor of 5×10^{-4} excess LCFs per person-rem (ICRP 1991).

3. ERPG–2 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without irreversible or serious health effects or symptoms that could impair their abilities to take protective action.

(SITE–01) people exposed per year of operation to vanishingly small numbers for some chemical releases. In general, such earthquakes would be expected to cause fatalities due to falling structures or equipment; this also would be true for LANL facilities. Thus, worker fatalities due to the direct effects of the earthquakes would be expected. Worker injuries or fatalities due to the release of radioactive or other hazardous materials would be expected to be small or modest increments to the injuries and fatalities due to the direct effects of the earthquakes.

Often, there are no differences between accident impacts among the alternatives, largely as a result of conservative approaches used in accident frequency and public consequence. The inventories used in the analyses are typically those of permitted or administrative limits (i.e., controls on the maximum amounts of material that can be processed at one time and/or in storage), rather than operational values (i.e., the actual amount of material needed to perform the task). The operational values would be more likely to change among the alternatives. The administrative limits or inventories are selected so that the analyses are sufficiently conservative and bounding to cover maximum possible operational values. The accident frequencies depend upon the accident initiators, such as an aircraft crash, earthquake, or wildfire. These particular initiators are independent of the operations and of inventory; therefore, the frequency or likelihood of such an event remains constant among the alternatives. In the few cases of accidents in which the frequency depends upon operations, the variation in frequency among the alternatives does not necessarily translate into a significant change in the risk of an environmental release to the public because the value of a release is very small. Likewise, the risk to workers is affected by the change in frequency of the operations; but, the consequence of a single accident remains the same.

Plutonium accident risks to the public (other than those associated with the site-wide earthquake scenarios) are dominated by the puncture of a "typical" TRU waste drum (typical refers to the radioactivity of the drum contents), which is the highest frequency plutonium accident analyzed, and the release of plutonium from a fire in a TRU waste container storage area, which had one of the highest population doses from a plutonium accident. These accidents, labeled as RAD–09 and RAD–07, have societal risks of 0.0008 and 0.00011 excess LCFs per year, respectively, under the No Action Alternative. While other accident scenarios were considered and analyzed (including process risks in TA–55 and the CMR Building), their risks to the public are at least an order of magnitude lower because either they are associated with relatively infrequent initiating events (e.g., aircraft crashes), or because the event occurs within facilities that are designed with multiple features (referred to as defense in depth) that prevent or minimize releases to the public. The risks associated with plutonium accidents change slightly (less than an order of magnitude) across the SWEIS alternatives. Frequency or consequence increases (up to double that of No Action) for some accidents under the Expanded Operations Alternative, and frequency decreases (by up to 25 percent) from some accidents under the Reduced Operations Alternative. RAD–07 and RAD–09 remain the dominant plutonium accidents for public exposure under all alternatives.

An overview of the 1969 plutonium pit fire at the Rocky Flats site and a comparison of the design and operational differences between the Rocky Flats Plant and TA–55–4 are presented in appendix G, section G.4.1.2. Substantial differences exist between the nuclear facility and operations being conducted in TA–55–4 today and those that were present at the Rocky Flats Plant in 1969. TA–55–4 was designed to correct the deficiencies detected in older facilities such as the Rock Flats Plant and is

being upgraded to meet the even more stringent requirements of the 1990's, including enhanced seismic resistance and fire containment.

Worker risk due to plutonium accidents is highly dependent on the number of workers present at the time of the event, on the type of protective measures taken at the time of the accident, on the speed with which these measures are taken, and on the effectiveness of medical treatment after exposure; as such, worker risks cannot be predicted quantitatively or reliably. In general, worker risks due to plutonium released in an accident would be limited to those workers in the immediate vicinity of the accident, and the consequences would be an increased risk of excess LCFs due to inhalation of plutonium; any acute fatalities would only be expected due to the initiating event (e.g., an aircraft crash), not due to the plutonium release. Risks to workers change across alternatives only to the extent that frequencies of the events change (as discussed above for public risk from plutonium accidents).

The risks to the public associated with highly enriched uranium (labeled as RAD–03) and tritium (RAD–05) releases due to accidents, other than the site-wide earthquakes, are several orders of magnitude lower than those for the earthquake or for the plutonium accidents. Similarly, worker risks in such accidents are also substantially lower for these types of accidents (as compared to the worker risks for site-wide earthquakes or plutonium accident events). The risks to the public and to the workers associated with highly enriched uranium and tritium releases do not change across the alternatives because the frequencies of the initiating events and the amounts of material involved in the accident do not change across the alternatives.

The risk to the public from accidents that result in chemical releases (due to events other than the site-wide earthquakes and wildfire) at LANL dominate all other accident risks. In particular, the release of chlorine gas from TA–55 (labeled as CHEM–06) has a relatively high frequency and substantial consequences. The societal risk for this accident (again, the product of the frequency and consequence) is about six people per year who would be exposed to greater than ERPG–2 concentrations of chlorine. The site-wide wildfire also can release some chemicals that would be released by earthquakes. Because the frequency of the wildfire is much greater than that of earthquakes, SITE–04 has a societal risk of 1.1 people per year exposed to greater than ERPG–2 concentrations of formaldehyde. Three other accidents that result in chemical releases (CHEM–01, CHEM–02, and CHEM–03) have societal risks that are very similar to the risks associated with hazardous chemical releases from the site-wide earthquakes (up to 0.066 people per year exposed to greater than ERPG–2 concentrations of chlorine gas for CHEM–01). It is noteworthy that the scenario for CHEM–01 is associated with potable water treatment activities; such activities are typical of municipal water supply operations throughout the U.S. It is also noteworthy that the LANL potable water treatment process is being changed to a process that does not require that quantities of chlorine gas be stored for use. The risk associated with CHEM–06 would not be expected to change across the SWEIS alternatives; CHEM–01 and CHEM–02 have slight changes in risk across the alternatives (up to a 14 percent increase and an 8 percent decrease for CHEM–02) due to the operational changes (which change the frequencies of these accidents) associated with the Expanded Operations Alternative and the Reduced Operations Alternative.

As with other worker accidents discussed above, the risk of worker injury or fatality due to these chemical release accidents is highly dependent on whether workers are present at the time of the accident, the protective measures taken, how quickly protective measures are taken, and the effectiveness of medical

treatment after the event. For CHEM–01, CHEM–03, and CHEM–06, it is unlikely that workers would be in the area at the time of the event (if workers were present, there is potential for worker injury or fatality). For CHEM–02, the fire and the chlorine release would be visible, and escape is likely for any workers present; if workers present do not escape, injury or fatality is possible. For CHEM–04 and CHEM–05, four or five workers are typically in the area during working hours; workers present could be injured or killed by missiles from the cylinder rupture or from exposure to the toxic gas. Risks to workers change across alternatives only to the extent that frequencies of the events change (as discussed above for public risk from chemical release accidents).

In addition to the discussions of worker risks for the accidents discussed above, four other accidents were analyzed specifically for potential risk to workers (these would not be expected to result in substantial risks to the public). Of the worker accidents analyzed (recalling that transportation and physical safety hazards are discussed separately, in sections S.3.1.10 and S.3.1.6, respectively), the highest frequency worker accidents would be associated with a biohazard contamination (WORK–02) or with an inadvertent exposure to nonionizing radiation (WORK–04); these would be expected to result in injury or fatality to one worker. Multiple worker injuries or fatalities are possible from either an inadvertent high-explosives detonation (WORK–01) or from an inadvertent nuclear criticality event (WORK–03). Risks to workers under any of these scenarios would not be expected to change across the SWEIS alternatives.

S.3.2 Project-Specific Consequences

This section summarizes the impacts of the proposed expansion of LLW disposal in Area G and the proposed enhancement of plutonium pit manufacturing operations, including siting and construction, as well as operational impacts, once construction is completed. The impacts reflected here are a subset of the impacts associated with the Expanded Operations Alternative (DOE's Preferred Alternative, with the exception that pit manufacturing would not be implemented at a 50 pits per year level, single shift, but only at a level of 20 pits per year in the near term).

S.3.2.1 *Expansion of TA–54/Area G Low-Level Waste Disposal Area*

The disposal of LLW in excavated disposal cells at LANL has been ongoing at Area G for a number of years. At this time, it appears that the disposal space remaining in the existing footprint at Area G will be exhausted within the next 10 years. The SWEIS examines the potential solutions to disposal of LLW through shipment off the site to the extent possible, use of the existing space to maximum capacity and shipment of the remaining waste to off-site locations, and expansion of LLW disposal space at LANL to accommodate on-site disposal for the foreseeable future.

As presented in section S.2.5.1 and discussed in detail in volume II, part I, expansion could be achieved by expansion of the existing disposal site at TA–54 (different TA–54 expansion options are considered), or by expansion into a new disposal site (TA–67 is examined as representative of such sites because it is the best characterized "new" site for such purposes). Expansion into Zones 4 and 6 at TA–54 is DOE's PSSC Preferred Alternative.

Land Resources

Alternatives for the development of additional disposal capacity on the site involve approximately 40 to 72 acres (16 to 29 hectares) depending on location. Locations at TA–54 involve areas that have historically been designated for waste management activities,

while use of the TA–67 site would be a new land use designation. All sites present physical constraints on development of some type, such as required set backs from canyon rims and location of power lines, although the sites closest to existing disposal areas must also avoid monitoring exclusion zones established for investigations under the Environmental Restoration Project. Sites in the Zones 4 and 6 locations are closest to existing waste disposal activities. There would be no changes in visibility of any new site from current operations for any location other than TA–67. In that case, there would be increased visibility from Pajarito Road. As is currently the case, disposal cell excavation activities could slightly exceed background noise levels at the nearest residential area (White Rock) for all sites except the one at TA–67.

Geology and Soils

All new sites involve the same types of surface soils and the same underlying Bandelier Tuff as the current disposal site. There is evidence that TA–67 may have a geologic fault. Disposal activities would not be expected to cause seismic activity or change soil erosion or geology in the area; this is due in part to the practice of revegetating the land after a disposal cell is filled and closed. These activities are not expected to contribute substantially to soil contamination in the area; this is due in part to the geology in the area and disposal and closure practices intended to isolate the buried waste from interacting with the environment.

Water Resources

There are no differences among on-site disposal alternatives in this resource area. Activities are not expected to use large quantities of water. Additionally, current and planned disposal practices (e.g., isolation of the closed disposal cells) minimize the potential for water to run across the site and to transport contaminants. The geology in the area is also expected to contribute to the minimal transport of contaminants to either the surface or groundwater bodies in the area.

Air Quality

Short duration dust from excavation and diffuse emissions (mostly from open disposal cells) will be similar to recent historical experiences (which have not had any substantive effect on air quality), although road development for the TA–67 site would cause additional short-term dust and vehicle exhaust emissions. Additionally, if cleared trees are burned, the smoke would have a temporary effect on air quality. Finally, it is possible that excavation in Zone 4 could disturb a volatile organic compound plume from Area L, resulting in low concentration releases; it is expected that this plume would be avoided during excavation.

Ecological Resources

Total acreage disturbed is greatest for the TA–67 alternative because of the need for new road and infrastructure development, while the Zone 4 and 6 alternatives involve the least disturbance. Because the habitat is similar for all the on-site development alternatives, the extent of habitat loss is also greatest at the TA–67 site, and least at the Zone 4 and 6 locations within TA–54. The habitat change is expected to be relatively small under any of the PSSC alternatives, and similar habitat is available in the immediate area at both TA–54 and TA–67. This loss of habitat is not likely to affect species in the area. Loss of foraging habitat for peregrine falcons is less than 0.1 percent of the area's potential for all alternatives, except for the TA–67 alternative (where it would be about 1.3 percent). The loss of TA–67 habitat may have an adverse effect on the desirability of nesting habitat in the area for the Mexican spotted owl.

Human Health

There are no significant differences in this area among the PSSC alternatives, but effects on human health do potentially arise from operating the expanded waste disposal area. Worker health risks associated with LLW disposal range from radiation exposure (much less for individuals than the DOE radiation exposure standard) to occupational safety and health incidents and accidents related to excavation of disposal cells and equipment operations. These are similar in nature to existing worker health risks; however, the projected waste generation across LANL is higher under the Expanded Operations Alternative, so these worker impacts are slightly greater than have been experienced in recent history and greater than would be expected under the SWEIS No Action Alternative.

In general, public health impacts in the near term would be similar to those experienced in recent years due to effects on soil, water, and air quality; as discussed above, these are minimal (LANL 1998). The Area G Performance Assessment indicates that over the next 1,000 years the maximum health impacts to the public would be minimal (e.g., exposure from all pathways in White Rock and Pajarito Canyon is less than 0.1 millirem per year; exposure from all pathways in Cañada del Buey is less than 6 millirem per year).

Environmental Justice

Expansion of LLW disposal is not likely to result in disproportionately high or adverse impacts to minority and low-income populations.

Cultural Resources

Up to 15 known archeological sites could be affected by excavation activities at the Zone 4 and 6 locations, with the fewest known sites (4) potentially affected at the North Site location. Data recovery plans and consultations would be needed under all PSSC alternatives. (These have been completed for Zone 4.) It is expected that existing policies and procedures at LANL would minimize impacts by avoiding these sites, where possible. Where sites cannot be avoided, existing procedures call for data recovery in consultation with the New Mexico State Historic Preservation Office(r) (SHPO) and others, where appropriate. If TCPs are present in areas of excavation, they would either be destroyed by construction or diminished in value.

Socioeconomics, Infrastructure, and Waste Management

All alternatives for developing additional waste disposal areas require minimal additional workers (30 more, or about a 15 percent increase above the No Action Alternative levels for solid waste management operations). Additionally, these activities do not demand substantial amounts of water, electricity, or gas. Finally, the generation of secondary waste is attributed primarily to treatment, storage, and repackaging operations, not to waste disposal; thus, secondary waste generation would not be expected to change substantially.

Transportation

The SWEIS Expanded Operations Alternative (with on-site disposal) would increase on-site shipments substantially—to almost double the approximately 1,300 shipments per year under the No Action Alternative (due to greater waste generation under the Expanded Operations Alternative and the shipment of LLW off the site under the No Action Alternative). However, due to the low radionuclide concentrations in LLW, the relatively short distances travelled on site, and the low rate of accidents experienced for on-site shipments, this large difference in shipments does not equate to large differences in on-site transportation impacts (on-site transportation impacts under either the Expanded Operations or No Action Alternatives result in far less than one fatality or injury over the next 10 years due

to traffic accidents and radiation doses related to such shipments), and waste shipments do not influence the bounding cargo accident risks.

In contrast, development and use of additional disposal capacity on site would reduce the off-site shipments of waste, as compared to the No Action Alternative (410 off-site LLW shipments per year under No Action Alternative, as compared to 33 under Expanded Operations). Again, the low concentrations of radionuclides in LLW would mean that these shipments contribute very little to incident-free radiation doses, and they do not bound the off-site cargo accident risk. While the longer off-site transportation mileage results in greater risks of vehicle accidents, injuries, and deaths, these are similar to the risks of increasing any vehicular traffic and are not unique to the fact that these are radioactive waste shipments. The off-site LLW shipments are a relatively small percentage of the total off-site shipment mileage under either the SWEIS No Action Alternative or the Expanded Operations Alternative.

Accidents

Accident risk associated with waste disposal operations for all alternatives are essentially the same. This is because the accident frequencies are relatively insensitive to the differences in waste volumes across the alternatives and because the consequences of an accident are dependent on the amount of material involved in the accident (which changes very little across the alternatives), not the total amount of generated or disposed waste. An additional factor is that waste disposal requires comparable packaging, handling, and certification in accordance with waste acceptance criteria whether it is disposed of on or off the site.

S.3.2.2 *Enhancement of Plutonium Pit Manufacturing*

The implementation of the plutonium pit production mission is examined in the SWEIS at varying levels. The No Action Alternative for operations includes the manufacturing of pits at a maximum rate of about 14 pits per year. Under the Expanded Operations Alternative, and as discussed in volume II, part II, DOE is considering the enhancement of the existing capability to optimize processes and remove process "choke" points to allow for production of up to 50 pits per year under single-shift operations (80 pits per year under multiple-shift operations). However, the DOE does not propose to implement pit manufacturing capability beyond a level of 20 pits per year in the timeframe of analyses for the SWEIS. The Preferred Alternative would only implement pit manufacturing at the 20 pits per year level in the near term. Nevertheless, the impacts of full implementation of the Enhancement of Plutonium Pit Manufacturing PSSC are included in the Expanded Operations Alternative. The DOE used the "CMR Building Use" Alternative to bound the impact analysis. Because other activities in TA–55 cannot be discontinued to make space available for the enhancement and operation, TA–55 does not have enough plutonium laboratory space available to undertake this and all other TA–55 activities described under the Expanded Operations Alternative. Options (alternatives) for providing the additional space required to accommodate Expanded Operations, including pit production, are discussed in detail in volume II, part II. Under the PSSC "CMR Building Use" Alternative for providing this additional space, some existing activities at TA–55–4 would be moved over to available space in the CMR Building, thus freeing space in TA–55–4 to accommodate pit production. This would take place in a phased manner: first, the existing capability would be increased to capacity of 20 pits per year; after that, the additional

modifications would be made to achieve the 80 pits per year capacity (using multiple shifts).

The increased pit production will require additional transportation of materials between TA–55 and the CMR Building (at least an increase in transportation of samples, but potentially, the additional transportation of plutonium for CMR activities transferred from TA–55–4); DOE is proposing to construct a dedicated road to minimize impacts (road closures and accidents) to the public. Under the Preferred Alternative, these processes would not be moved to the CMR Building nor would the transportation corridor be built.

Land Resources

All project alternatives other than the No Action Alternative require the use of additional land, including land that would be used for an optional dedicated transportation corridor between TA–55 and TA–3. While the land disturbed under the "CMR Building Use" Alternative would be limited to that associated with the transportation corridor, the Brownfield and TA–55–4 Add-On Alternatives would each require about one additional acre, both of which are in developed areas of TA–55. The 7 acres (2.8 hectares) required for the optional transportation corridor have been disturbed previously but not developed. Fencing and security lighting along the road could result in visual impacts. There would be some short-duration increase in noise during construction of the road; once the road is constructed, traffic noise would not be substantially different from the existing traffic noise in the area. (Note that the road would not be constructed to establish the 20 pits per year capability under the Preferred Alternative, and the impacts associated with construction of that road would not be incurred.) Increased noise levels due to construction activity at TA–55 would occur under any of the PSSC alternatives. In addition, the "CMR Building Use" Alternative would result in increased construction noise at TA–3.

Geology and Soils

No changes in geology or soils are anticipated for either construction or operations under any PSSC alternative.

Water Resources

Minimal increase in water use is anticipated for either construction or operations under any of the PSSC alternatives. Some increases in radioactive liquid waste generation (associated with all activities under this alternative; pit production activities are not substantial contributors to this waste stream) would also be anticipated (a maximum increase of 2.6 million gallons [10 million liters] per year above the No Action Alternative level of about 6.6 million gallons [25 million liters] per year) under any of the PSSC alternatives. The location for wastewater discharge does not change from that under the SWEIS No Action Alternative.

Air Quality

The only potential construction air quality impacts are related to the emissions from construction equipment; these emissions would not exceed regulatory standards for criteria pollutants and would not be expected to affect air quality beyond the immediate vicinity of the construction work.

Operations under the "CMR Building Use" PSSC alternative in TA–55–4 and the CMR Building directly related to the implementation of pit production at LANL would result in minor increases in radioactive air emissions. For the CMR Building, an increase of 38 microcuries per year is attributable to pit production activities (the total difference between the No Action and Expanded Operations radioactive air emissions at the CMR Building is about 340 microcuries per year). For TA–55, a net increase (considering pit manufacturing increases and decreases due to activities moved to the CMR Building) of about 9 microcuries per year is attributable to pit production activities (the total difference between the No

Action and Expanded Operations radioactive air emissions at TA–55 is about 11 microcuries per year). Under the other PSSC alternatives, the radioactive air emissions would not increase as much at the CMR Building, but most of the total 47 microcuries in increased annual air emissions attributed to pit production in both facilities would occur at TA–55. At the 20 pits per year production rate (Preferred Alternative), radioactive air emissions for TA–55 and the CMR Building together would result in about a 20 microcuries per year increase due to pit production activities; the radioactive air emissions impacts under the Expanded Operations Alternative at this rate would be essentially the same as those presented under the "CMR Building Use" Alternative. No substantive changes in nonradioactive air emissions are expected due to these activities under any of the PSSC alternatives.

Ecological Resources

Construction of the dedicated access road under any of the PSSC alternatives would disturb about 7 acres (2.8 hectares) and would reduce peregrine falcon foraging and meadow jumping mouse habitats by this amount. Other potential effects include:

- Large mammals (bear, elk, deer, mountain lion, coyotes) could be restricted from accessing the land in the transportation corridor and transversing to lands beyond the corridor; this access restriction could also alter predator-prey associations, food use, and habitat use in the project area.
- Potential for increases in automobile/animal collisions could result from elk and deer movement into areas these animals do not usually inhabit.

Only minimal changes in potential habitat would be associated with alternatives requiring construction at TA–55 or TA–3. The total loss of 7 (for the "CMR Building Use" Alternative) to 8 (for the other two alternatives) acres (2.8 to 3.2 hectares) of habitat is small compared to that available on the entire LANL site. (Under the Preferred Alternative, at the 20 pits per year rate, these impacts would not be incurred because the road would not be constructed.) No other ecological impacts from operations are anticipated.

Human Health

Occupational exposure to radioactive material during the construction and modification of existing nuclear facility space for the "CMR Building Use" PSSC alternative is expected to result in up to 45 person-rem (0.018 excess LCFs) to the involved workers. The other alternatives would have lower doses due to the reduced need for modification of existing nuclear facility spaces to accomplish the construction. Radiation doses to workers during operations that are directly related to pit production would constitute an increase of about 150 person-rem per year (the total difference in collective dose associated with all activities at LANL between No Action and Expanded Operations is about 387 person-rem per year). These occupational doses would not be expected to vary between the PSSC alternatives because the total work load would be the same, and the design criteria of the facilities would be the same regardless of implementation. This change in collective worker dose constitutes an incremental increase of about 0.06 excess LCF per year to the worker population involved in these activities. At the 20 pits per year rate (Preferred Alternative), worker exposures associated with pit production would be lower (about 130 person-rem per year lower than presented at the 80 pits per year rate). Thus, the worker population exposure and the estimated excess LCF risk associated with that exposure would be about 15 percent less than reflected for the Expanded Operations Alternative at the 80 pits per year rate.

Impacts to public health would not be expected to change substantially due to routine pit manufacturing operations. Except for transportation impacts (discussed below) and

the contribution to public health impacts due to radiological air emissions, the remaining contributors to public health impacts do not change across the alternatives. As reflected in appendix B, (Table B.1.2.3–1), the radiological air emissions from TA–55 and CMR Building operations together contribute 1.005 person-rem per year and 1.853 person-rem per year under the No Action and Expanded Operations Alteratives, respectively. (The total collective public doses under these alteratives are about 14 and about 33 person-rem per year, respectively.) Of the total TA–55 and CMR Building air emissions, which lead to these collective public doses, about 1 percent of the curies emitted (under either the No Action or Expanded Operations Alternatives) are attributable to pit manufacturing, analytical chemistry support for pit manufacturing, actinide processing, and pit surveillance and disassembly activities (the activities that would be involved in the implementation of pit production at LANL under the Expanded Operations Alternative). Any variation to public health impacts between the PSSC alternatives would only be due to the differences in physical location of the air emission release points with relation to the publicly occupied areas, as discussed above in the air quality section.

Environmental Justice

Expansion of pit manufacturing is not likely to result in disproportionately high or adverse impacts to minority and low-income populations.

Cultural Resources

No impacts are anticipated under any of the PSSC alternatives due to construction or operations (prehistoric and historic sites are avoidable, and there are no known TCPs in the area).

Socioeconomics, Infrastructure, and Waste Management

Building modifications under the "CMR Building Use" PSSC alternative would employ about 221 construction workers over about a 3- or 4-year period (with peak employment for construction at 140 workers). The number of construction workers and project duration would be somewhat greater, but not substantially different for the other PSSC alternatives. Operations would increase employment by about 170 workers (the total difference between employment under No Action and Expanded Operations is about 1,374 workers). At the 20 pits per year rate (Preferred Alternative), construction and operations employment would be somewhat lower than reflected for the "CMR Building Use" Alternative. The employment differences are small compared to the total employment changes under the Expanded Operations Alternative. Thus, the impacts presented for the Expanded Operations Alternative are relatively insensitive to the PSSC alternatives and to the 20 pits per year phasing of pit production at LANL.

Utility use and contaminated space would not change substantially under the "CMR Building Use" PSSC alternative. The other two PSSC alternatives would require slightly more electrical power and would create about 15,000 square feet (1,400 square meters) of nuclear facility space that would be presumed as contaminated space.

Construction for the "CMR Building Use" PSSC alternative would generate about 15,100 cubic feet (426 cubic meters) of TRU waste, 10,200 cubic feet (288 cubic meters) of TRU mixed waste, 46,200 cubic feet (1,306 cubic meters) of LLW, and 1,100 cubic feet (31 cubic meters) of LLMW. The other PSSC alternatives would be expected to generate little, if any, radioactive waste (it could only be generated in equipment transfer to the new space). Pit manufacturing operations under

the SWEIS Expanded Operations Alternative are not expected to generate substantial quantities of waste (as presented in the final SSM PEIS, this activity is expected to result in waste generation increases of less than 5 percent over current levels), except for TRU waste generation, which will increase from this activity by about 3,535 cubic feet (100 cubic meters) per year. (The total difference between No Action and Expanded Operations TRU waste generation is about 10,600 cubic feet [300 cubic meters] per year.) At the 20 pits per year level (Preferred Alternative), TRU waste generation would be about 530 cubic feet (15 cubic meters) per year.

Transportation

The Expanded Operations Alternative activities related to pit production would be expected to increase on-site shipments between TA–55 and the CMR Building by about 500 shipments per year (of plutonium sample solutions and plutonium metal, including components). Additionally, off-site shipments to and from Oak Ridge and Pantex are expected to increase by a total of about 50 shipments per year due to implementation of pit manufacturing at LANL. Even though the total risk is small (see chapter 3, Tables 3.6.2–1 and 3.6.2–2, Transportation Risks), these types of plutonium shipments are among those that bound both on-site and off-site transportation risk; additionally, such shipments are the main contributors to driver and public incident-free radiation doses. Because the portion of these shipments attributable to pit production operations is a small percentage of the total on-site (about 5 percent) and off-site (about 1 percent) shipments, transportation risks from pit production operations under the Expanded Operations Alternative are very small. Differences in shipment quantities are important contributors to the differences in transportation risk between the No Action and Expanded Operations Alternatives, although the absolute risk presented by these shipments is small. The construction of a dedicated transportation corridor between TA–55 and the CMR Building at TA–3 would further reduce risk associated with on-site shipments. At the 20 pits per year rate (Preferred Alternative), there would be somewhat fewer on- and off-site shipments in support of pit production; thus, the transportation impacts at that production rate would be slightly lower than presented for the Expanded Operations Alternative at 80 pits per year. Under the Preferred Alternative, the dedicated transportation route would not be constructed for implementation of the 20 pits per year rate.

Accidents

Accident risk associated with pit manufacturing operations (and those operations moved to the CMR Building to make space in TA–55 for pit production) are essentially the same under the No Action and Expanded Operations Alternatives. The reasons that there are such minor differences, given the differences in the number of pits manufactured, are that: accidents involving pit manufacturing activities themselves do not bound the risks associated with plutonium operations (chapter 3, section 3.6.2.11), although some of the support operations (e.g., waste handling and plutonium processing and recovery) are included in the set of bounding accidents analyzed; the frequencies of the bounding accidents are relatively insensitive to the number of pits manufactured (pit manufacturing activities are relatively small contributors to support operations throughputs); and, the consequences of accidents are dependent on the amount of material involved in the accident, which is relatively insensitive to the quantities of pits manufactured over a year. (That is, the difference in the number of pits produced over a year is dependent on process or room and does not change limits for the amount of material allowed to be in process at one time.) Any variation to accident risk between the PSSC alternatives would only be due to the differences in physical location of the release points with relation to the publicly occupied areas, similar to the discussion above in the air quality section.

S.3.3 Consequences of Environmental Restoration Activities

Environmental restoration activities, which include decontamination and decommissioning activities, are undertaken with the intent of reducing the long-term public and worker health and safety risks associated with contaminated sites or with surplus facilities and to reduce risk posed to ecosystems. Decisions regarding whether and how to undertake an environmental restoration action are made after a detailed assessment of the short-term and long-term risks and benefits for options specific to the site in question, and, at LANL, they are made primarily within the framework of the *Resource Conservation and Recovery Act* (RCRA).

Because there are no individual or specific environmental restoration actions proposed within the scope of the SWEIS (such actions are proposed and undertaken on a time scale that is not compatible with the preparation of this SWEIS), the impact analyses regarding such actions are presented in general terms based on the experiences of the program, to date. As noted in the ecological resources and human health impact analyses in chapter 5, LANL's influence on ecological and human health risk arises primarily from the legacy of past operations in the form of contaminants that were historically deposited on land and in water. An improvement in the risk posed by the LANL site is therefore expected from the removal of some of this legacy contamination. A principal impact from restoration actions is related to the generation of waste during the cleanup or decontamination and decommissioning. The waste generated must be stored, treated, or disposed. Waste generation from the totality of future environmental restoration actions is estimated in the SWEIS, and the risks associated with the transport, treatment, storage, and disposal of this waste are included in the analyses.

The short-term risks and controls associated with the environmental restoration activities include:

- *Fugitive Dust*. This is the suspension of soil, including contaminated soil, in the air, resulting in the potential for exposure or dispersal of this material. At LANL, this potential risk is typically controlled by frequently wetting the ground at the clean-up site; this reduces the amounts of material suspended in air, and thus, the risk to human health and the environment (LANL 1996).
- *Surface Runoff*. This is the transport of contaminants from the clean-up site by surface water flow across the site. At LANL, surface runoff is controlled by flow barriers, collection of surface water, or contouring the ground such that flow off the site is precluded (LANL 1995).
- *Soil and Sediment Erosion*. This is the transport of soil and sediment due to the force of wind and the intensity and frequency of precipitation. This potential risk is mitigated by covering clean-up sites with tarps during storm events to minimize the infiltration of water (LANL 1995).
- *Worker Health and Safety Risks.* Environmental restoration actions have similar risks to those discussed in the human health impact analyses in chapter 5. Activities can involve heavy equipment, uneven ground (e.g., trenches), solvents and other chemicals, and other hazards of this nature. Worker health and safety risks are mitigated with work plans, safety programs, protective equipment, and similar administrative, education, and physical protection measures.

S.4 MITIGATION MEASURES

The regulations promulgated by the Council on Environmental Quality (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 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 section 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 in the SWEIS. These measures address the range of potential impacts of continuing to operate LANL. The mitigation measures built into the alternatives analyzed (section S.4.1) are of two types: (1) existing programs and controls and (2) specific measures built into the alternatives that serve to minimize the effects of activities under the alternatives.

Additional mitigation measures that could further reduce the adverse impacts are discussed in section S.4.2. Commitments to mitigation measures would be reflected in the ROD following this SWEIS, with a more detailed description and implementation plan presented in a Mitigation Action Plan following the ROD.

S.4.1 Mitigation Measures Included in the SWEIS Alternatives

S.4.1.1 *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. These requirements help to mitigate the potential adverse impacts of operations to the public, the worker, and the environment. For example, the application of DOE design standards results in more robust facility designs for modern nuclear facilities, which reduces the potential for catastrophic releases from such facilities in the event of earthquakes, high winds, or other natural phenomena.

DOE and LANL also have instituted policies and procedures that apply to work conducted at LANL that help to mitigate the potential adverse effects of operations. Examples include:

- Procedures that control work conducted at LANL
- Policies regarding the knowledge, skills, and abilities of personnel assigned to perform hazardous work
- Policies reflected in agreements with other entities 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

DOE also has established programs and projects at LANL to increase the level of knowledge regarding the surrounding environment, health of workers, health of the public around LANL, and the effects of LANL operations, as well as to avoid or reduce impacts and remediate

contamination from previous LANL activities. These programs and projects help to reduce potential adverse impacts by providing for heightened understanding of the resources that could be impacted. Examples include:

- The Environmental Surveillance and Compliance Program
- The Threatened and Endangered Species Habitat Management Plan
- The Natural Resource Management Plan (in various stages of development)
- Studies of public and worker health in and around LANL
- Implementation of the Groundwater Protection Management Program Plan and the RCRA Hydrogeologic Workplan
- The Safeguards and Security Program
- Emergency management and response capabilities
- LANL's Fire Protection Program
- Pollution Prevention and Waste Minimization Programs
- Water and Energy Conservation Programs
- The Environmental Restoration Project
- Work to remedy foreseeable power supply and reliability issues

S.4.1.2 *Specific Mitigation Measures Incorporated in the SWEIS Alternatives*

Several specific mitigation measures are included in the SWEIS alternatives. Unless otherwise noted below, the analyses assume that these measures are implemented. These specific measures are:

- Development and use of a dedicated transportation corridor between TA–55 and TA–3 (TA–55 and TA–3, Expanded Operations Alternative) (This measure would not be implemented under the Preferred Alternative.)
- DOE's contribution to the Santa Fe Relief Route (all LANL facilities, all alternatives)[4]
- CMR Building Upgrades (CMR Building at TA–3, all alternatives)[5]
- Planned maintenance and refurbishment activities (e.g., Plutonium Facility at TA–55 and Sigma at TA–3, all alternatives)
- Radioactive Liquid Waste Treatment Facility upgrades (TA–50, all alternatives)
- Effluent reduction activities (all LANL facilities, all alternatives)
- Phased containment for Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility tests (one of the high explosives firing sites, all alternatives)
- Design of the long-pulse spallation source (TA–53, Expanded Operations and Greener Alternatives)[6]

S.4.2 Other Mitigation Measures Considered

In addition to those mitigation measures described in section S.4.1, other possible measures include:

- *Eliminate Public Access to Part or All of LANL*. At various times DOE has considered the possibility of closing public access to part or all of the LANL site. While this is typically suggested for security reasons, such an action would also tend to reduce public health risk by removing access to on-site locations that contribute most to public health risk.
- *Land Transfers and Financial Assistance*. Transfers of portions of LANL land are being examined. Such action would

4. Use of this route is addressed in the transportation impact analyses.

5. These upgrades are to maintain existing capabilities and to improve safety features.

6. The proposed design limits the emissions from this operation so that it contributes, at most, 1 millirem per year to the facility and site-wide MEI.

provide land resources that could be used to reduce economic dependence on LANL and/or provide the means for growth in housing, parks, and recreational space. On May 6, 1998, DOE published a Notice of Intent to prepare an EIS for the Proposed Conveyance and Transfer of Certain Land Tracts in the Federal Register (63 FR 25022).

- *Extensive Ethnographic Study.* An extensive ethnographic study regarding the traditional and cultural practices and resources in the LANL area could increase knowledge of specific TCPs at LANL and could provide opportunities for mitigation of impacts to specific TCPs. Attempts to identify specific TCPs at LANL have encountered concerns from traditional groups because of the potential for increased risk to these resources if they are identified.
- *Develop a Cultural Resources Management Plan*. Such a plan would include studies to increase the level of knowledge regarding potential shrapnel and vibration damage to resources near firing sites, existing levels of contamination for resources and plans to avoid levels that would limit data recovery, plans for management of former nuclear weapons complex properties, and implementation of programmatic agreements with the SHPO.
- *Develop a Wildfire Management Plan for the LANL Site*. Such a plan would reduce the fuel loading surrounding the site and around individual facilities that have moderate or higher vulnerability to burning as a result of wildfire. The probability of an approaching wildfire encroaching upon the site can be reduced by removing and thinning vegetation on the site boundary and within the site. Ongoing efforts to reduce the vegetation at the site boundary exist that would be accelerated. The vulnerability of individual facilities depends upon the amount and height of the exterior fuel loading and its proximity to the facility (see Evaluation of Building Fires in appendix G, section G.5.4.4). Consideration is being given to reducing the vulnerability of individual facilities that contribute potential public exposure. Long-term actions would be taken to reduce the fuel loads in the forested areas surrounding LANL, and a forest and land management program would be undertaken to prevent or mitigate the potential for large wildfires to occur. In the near term, mitigation actions, such as for TA–54, will be taken to ensure that the wildfire risk to this facility is reduced to low or extremely low prior to the start of the 1999 fire season.
- *Limited Power Supply.* DOE and other regional electric power users continue to work with suppliers to remedy foreseeable power supply and reliability issues. The impact analyses in this SWEIS emphasize the severity of these issues and the consequences if they are not resolved. Solutions to power supply issues are essential to mitigate the effects of power demand under all alternatives. DOE is committed to measures that will conserve energy and avoid, or at least minimize, periods of brownouts. Some of the measures being contemplated by DOE include: (1) limiting operation of large users of electricity to periods of low demand, (2) reduced operation of LEDA (not implement all phases of this project), and (3) contractual mechanisms to bring additional electric power to the region.

S.5 CLASSIFIED SUPPLEMENT

The discussions in this SWEIS are augmented by a classified supplement to the SWEIS. This supplement contains certain classified information and data related to the activities at LANL that, though important to support understanding of certain details underlying the SWEIS and its analyses, must be protected in accordance with the *Atomic Energy Act of 1954* (42 U.S.C. §2011). This information includes

details associated with some operations, experiments, processes, or source terms. DOE presents as much information as possible in this unclassified document. Furthermore, the environmental impacts are fully contained in the results presented to the public in this unclassified document.

DOE invited the U.S. Environmental Protection Agency, the U.S. Department of Defense, the Accord Pueblos, and the State of New Mexico to review the classified supplement. Only those individuals with appropriate clearances and a need to know were given access to the classified information.

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ABOUT THE *NATIONAL ENVIRONMENTAL POLICY ACT*

The *National Environmental Policy Act* (NEPA) (42 United States Code [U.S.C.] §4321 *et seq.*) was enacted to ensure that federal decision makers consider the effects of proposed actions on the human environment and to lay their decisionmaking process open for public scrutiny. NEPA also created the President's Council on Environmental Quality (CEQ). The U.S. Department of Energy's (DOE's) NEPA regulations (10 Code of Federal Regulations [CFR] 1021) augment the CEQ regulations (40 CFR 1500 through 1508).

Under NEPA, an environmental impact statement (EIS) documents a federal agency's analysis of the environmental consequences that might be caused by major federal actions, defined as those proposed actions that may result in a significant impact to the environment. An EIS also:

- Explains the purpose and need for the agency to take action.
- Describes the proposed action and the reasonable alternative courses of action that the agency could take to meet the need.
- Describes what would happen if the proposed action were not implemented—the "No Action" (or status quo) Alternative.
- Describes what aspects of the human environment would be affected if the proposed action or any alternative were implemented.
- Analyzes the changes, or impacts, to the environment that would be expected to take place if the proposed action or an alternative were implemented, compared to the expected condition of the environment if no action were taken.

The DOE EIS process follows these steps:

- The Notice of Intent, published in the *Federal Register*, identifies potential EIS issues and alternatives and asks for public comment on the scope of the analysis.
- The public scoping period, with at least one public meeting, during which public comments on the scope of the document are collected and considered.
- The issuance of a draft EIS for public review and comment (for a minimum of 45 days), with at least one public hearing.
- The preparation and issuance of the final EIS, which incorporates the results of the public comment period on the draft EIS.
- Preparation and issuance of a Record of Decision, which states:
  - — The decision.
  - — The alternatives that were considered in the EIS and the environmentally preferable alternative.
  - — All decision factors, such as cost and technical considerations, that were considered by the agency along with environmental consequences.
  - — Mitigation measures designed to reduce adverse environmental impacts.
- Preparation of a Mitigation Action Plan, as appropriate, which explains how the mitigation measures will be implemented and monitored.